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Mali Resilience Research Report

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Prepared for:

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Acronyms

2sls	Two-stage least square
FANTA	Food and Nutrition Technical Assistance III Project
FFP	USAID Office of Food for Peace
HARANDE	Human Capital, Accountability and Resilience Advancing Nutrition Security, Diversified Livelihoods and Empowerment
HDDS	Household dietary diversity score
HH	Household
HHS	Household Hunger Score
IPM	Integrated Pest Management
IV probit	Instrumental variable probit
MIT	Micro-irrigation technology
NRM	Natural resource management
OLS	Ordinary least squares
TOPS	Technical and Operational Performance Support
USAID	United States Agency for International Development
USD	United States dollar
WASH	Water, sanitation, and hygiene
ZAI	Pot-holing

Executive Summary

The objective of this research is to provide implementing partners, the Office of Food for Peace (FFP), the Food and Nutrition Technical Assistance (FANTA) Project, and the United States Agency for International Development / Center for Resilience (C4R) with insights into factors that strengthen household and community resilience in Mali. This report complements the Baseline Study implemented by ICF International in Fiscal Year 2016. The research examines factors, in the context of resilience and mitigation of the negative effects of shocks and stresses on well-being, which can serve as the foundation for an evidence base for improving resilience programming in the Human Capital, Accountability and Resilience Advancing Nutrition Security, Diversified Livelihoods and Empowerment (HARANDE) Project areas.

Across the sampled households, the most common shock experienced in the previous 12 months was drought. Nearly half of all households indicated as such, and between 20 and 25 percent of the households also cited epizootic disease, flooding, food price increases, and pests. A cluster analysis revealed households tended to fall into one of three categories: drought, flooding, and "no fish in the river" with little to no overlap. Additionally, households in each cluster had relatively low exposure to any of the remaining eight shock types.

At the time of the FFP Baseline Study household survey from May to June of 2016, well-being as measured by food security and dietary diversity indicate that many households were recovering from any negative food security impacts of shocks experienced in the past year. The prevalence of severe to moderate hunger ranged between 4.9 and 12.2 percent (across climate-sensitive livelihood and remittance categories), and household diets were relatively diversified, ranging from 6.2 to 6.9 on the household dietary diversity scale.

While poverty appears to be a persistent problem across all program area households (61.1 percent), households engaged in both climate- and non-climate-sensitive livelihoods experience a significantly lower rate of poverty (55.1 percent) compared to those who rely solely on climate-sensitive-only sources of food and income (63.4 percent), suggesting livelihood diversification across risk categories reduces the likelihood of poverty.

At the time of the survey, 19.1 percent of households indicated having recovered from shocks. Households that do not rely on climate-sensitive livelihoods had a recovery rate of 29.2 percent, despite having the highest rate of hunger (12.2 percent) and lowest dietary diversity (6.2) compared to those who rely on sources of food and income that are sensitive to climate or rely on remittances.

Levels of household resilience capacity, namely adaptive capacity, differ significantly across climate-sensitive livelihood and remittance categories. In particular, households who rely on both climate- and non-climate-sensitive livelihoods have higher levels of adaptive capacity (43.3 out of 100) compared to those who rely only on climate-sensitive livelihoods (35.5 out of 100). Adaptive

capacity scores are also significantly higher among households relying on remittances (42.7 out of 100) compared to climate-sensitive only households. Those who rely only on non-climate-sensitive livelihoods have the lowest adaptive capacity score of 30.8 compared to 35.5 for those who are engaged in climate-sensitive livelihood activities. Higher levels of adaptive capacity seen in both remittance and climate- and non-climate-sensitive livelihood households are driven by differential rates of accumulation of household assets, which represents a proxy for wealth. Compared to climate-sensitive-only households, both climate- and non-climate-sensitive households and remittance households own more assets (3.8 and 3.4 versus 3.1) and are more likely to have more educated adults (30.2 and 32.0 percent versus 19.4 percent). They are also more likely to be engaged in more livelihoods as evidenced by significantly higher diversity scores (3.3 and 3.0 versus 2.0). Households who rely on remittances are also more likely to have stronger bridging social capital compared to climate-sensitive-only households (4.6 versus 3.9). On the other hand, lower adaptive capacity scores among non-climate-sensitive-only households is likely a function of less access to financial services (0.6 versus 0.7), fewer livelihoods (1.3 versus 2.0), even though they have the highest percentage of educated adults across all climate-sensitive-livelihood and remittance categories.

Across all the sampled HARANDE Project households, those who rely on both climate- and non-climate-sensitive livelihoods also have significantly higher absorptive capacity index values than climate-sensitive-only households (50.1 compared to 46.5). Access to informal safety nets, savings, wealth (assets), and shock preparedness explain this differential across the two groups. Significantly more households who rely on climate-and non-climate-sensitive livelihoods have access to informal safety nets (54.4 percent) compared to climate-sensitive-only households (44.8 percent). They are also more likely to have savings (27.1 percent versus 20.7 percent), own more assets (3.8 versus 3.1) and are slightly better prepared for shocks base on higher mitigation scores (0.6 versus 0.5).

Transformative capacity levels are similar across all the climate-sensitive livelihood and remittance categories (29.3 out of 100). Average levels of transformative capacity of households range from 24.5 among non-climate-sensitive only livelihood households to 28.7 among households engaged in both climate- and non-climate sensitive livelihoods. Households relying on remittances have the highest transformative capacity compared to climate-sensitive only households (31.5 versus 28.6, respectively), driven primarily by higher bridging social capital scores.

KEY FINDINGS

Households with higher adaptive and/or transformative capacity are less likely to be poor, are more likely to earn higher incomes, have diets that are more diverse, are less likely to be hungry, and more able to recover. This is true (controlling) for any level of shock. However, of the two resilience capacities, transformative capacity has the greatest impact on reducing poverty, increasing incomes, improving dietary diversity, decreasing household hunger and increasing ability to recover. Households with higher levels of transformative capacity are also less likely to reduce costs associated with child care or change food consumption patterns as a means to cope with shocks.

Absorptive capacity, as measured in this study, does not have as strong of an influence on improvements in well-being. In particular, absorptive capacity is weakly, but negatively associated with lower poverty, increased expenditures, and likelihood of recovery. Contrary to expectations, households with higher levels of absorptive capacity are less likely to have diverse diets and experience more hunger compared with households having lower levels of absorptive capacity. The weak relationships between absorptive capacity and outcomes is likely due to the low values of salient dimensions of absorptive capacity that are captured in the data, such as shock preparedness and mitigation scores and access to remittances.

Several underlying components of resilience capacity directly support improvements in poverty and hunger. Increases in household assets, access to cash savings and formal safety nets, and bridging social capital, consistently and directly, are associated with better economic and food security outcomes. Households with more diverse livelihoods in the same risk environment (climate-sensitive) are marginally more likely to be poor, indicating more vulnerable households have a higher need to find sources of food and/or income. In addition, greater access to finances and higher levels of shock preparedness are also directly and positively associated with hunger, suggesting households receiving early warning information may also be experiencing greater likelihood of shock, and a greater propensity to take out loans to cope with shocks.

1. Introduction

1.1. Objectives

The objective of this research is to provide the United States Agency for International Development (USAID) Office of Food for Peace (FFP), the Food and Nutrition Technical Assistance (FANTA) Project, the Center for Resilience (C4R), and implementing partners of the Human Capital, Accountability and Resilience Advancing Nutrition Security, Diversified Livelihoods and Empowerment (HARANDE) Project with insights into factors that strengthen household and community resilience in the Mopti region of Mali. This report complements the baseline study conducted by ICF International in 2016. In particular, the research examines factors that can serve as the foundation for an evidence base for improving resilience programming in the HARANDE Project area. The research aims to address the following three questions:

1. Which resilience capacities are associated with positive well-being outcomes, including poverty, expenditures, dietary diversity, hunger, and recovery from shocks and stresses?
2. Do resilience capacities mitigate the negative impact of shocks and stresses on well-being outcomes?
3. Are there coping strategies that households use to deal with shocks and stresses that lead to better – or, conversely, act as barriers to – well-being outcomes?
4. How do planned HARANDE programming activities enhance resilience and lead to better well-being outcomes?

1.2. Organization of the Report

The report is organized to provide both context and understanding of the HARANDE Project in relation to how the resilience capacities and well-being indicators are measured and analyzed. To begin, Section 2 describes the methodology used to conduct this research. Section 3 provides a brief description of the HARANDE Project. Sections 4 and 5 describe the types of shocks households experienced in the past 12 months and the extent to which households utilized coping strategies to recover from shocks. Section 6 assesses the types of livelihoods households are engaged in and categorized into climate- and non-climate sensitive categories to be used as disaggregates in the remaining analyses. Section 7 provides baseline estimates for select well-being outcome indicators used in this study. These include: prevalence of poverty, per capita daily expenditures, household dietary diversity scores (HDDS), moderate or severe hunger, and recovery from shocks. Section 8 presents the absorptive, adaptive, and transformative resilience capacity index scores, as well as scores for each of their respective components. Section 9 demonstrates the effects of each resilience capacity on well-being outcomes, their ability to mitigate the negative impacts of shocks on well-being outcomes, and the effects of each of their respective components on key well-being outcomes. Section 10 looks at the association of shock coping strategies and well-being outcomes. Section 11 analyzes the utilization of program-promoted practices, and Section 12 investigates the extent to which these practices (adoption of improved agricultural practices, better WASH behaviors, and improved sanitation) influence recovery from shocks first directly and then indirectly when mediated by resilience capacity. Finally, Section 13 gives a summary of the report findings. Additionally, at the end of each section, are blue Takeaway boxes that summarize the major findings throughout the report.

2. Methodology

This section briefly outlines the methodology, in particular the multivariate analysis methods employed to address the objectives of this research.

2.1. Quantitative Analysis

Quantitative data collection took place from May-June 2016 as part of a baseline study of the HARANDE development food assistance project. The study, implemented by ICF International, utilized a population-based household survey to collect information needed to report project indicators, including those measuring resilience capacities of households in the HARANDE Project area. The original sample size was 2,220 households, consisting of 74 enumeration areas drawn from the HARANDE Project area. For further details concerning the baseline study sample design, see the ICF Baseline Study Report (ICF International, 2017). The quantitative data analysis was conducted with Stata SE version 13.1. Both descriptive and multivariate results incorporate sample weights and techniques necessary (i.e., complex sample corrected standard errors) to account for the clustering used as part of the sample design.

Descriptive Data Analysis

Results are initially presented descriptively (e.g., means and percentages) in Sections 4-8 and Section 11. First, household exposure to shocks and stresses (Section 4) and utilization of coping strategies to respond to shocks and stresses (Section 5) are disaggregated by shock-predominant clusters (e.g., flooding, drought, etc.). Sources of food and income are presented according to their ethnicity-associated livelihood groups in Section 6. Key well-being outcomes (Section 7), resilience capacities (Section 8), and selected program indicators related to adoption of improved agricultural practices and WASH behaviors (Section 11), disaggregated by climate-sensitive livelihood and remittance categories, are presented as part of the descriptive analysis.

Resilience capacity indexes were generated using (exploratory) factor analysis methods and are consistent with the methods employed by ICF International as part of their baseline analysis of HARANDE Project (ICF International, 2017). The calculation of the resilience capacities and resilience capacity indexes are described in detail in Annex A.

Multivariate Analysis

Key results from multivariate regression analyses in Sections 9, 10, and 12 are presented in tabular and graphic forms. Comprehensive results generated as part of the multivariate analysis are available in Annex B, and a detailed description of all multivariate specifications used in this study is available in Annex C. The multivariate analysis utilizes appropriately chosen estimators, depending on the particular specification and distribution of the dependent variable (i.e., outcomes). Dichotomous dependent variables are estimated with a probit estimator and continuous outcomes with an

ordinary least squares (OLS) estimator. Estimators used are noted in the respective regression output tables in Annex B.

In general, the multivariate specifications treat resilience capacity, in the face of shocks and stressors, as a key determinant of well-being outcomes. Other determinants, used as controls, include shock exposure, demographic household characteristics, and livelihood type.

The presentation of multivariate results begins in Section 9. Section 9.1 summarizes results exploring the direct relationship between resilience capacity indexes and well-being outcomes. Section 9.2 explores the ability of resilience capacities to mitigate the negative impact on well-being by estimating the interaction between shock exposure and resilience capacity indexes. Finally, in Section 9.3, the relationships between the underlying components of the resilience capacity indexes and well-being outcomes are presented.

Section 10 is a summary of the relationship between key coping strategies (i.e., household response to shocks and stresses) and well-being outcomes. Section 11 presents baseline estimates of adoption of improved agricultural practices and WASH behaviors. Finally, Section 12 looks at the extent to which resilience capacity mediates the relationship between recovery and improved agricultural practices and WASH behaviors.

Predicted Values of Outcomes

In Sections 9, 10, and 12 of this report, the relationships between resilience capacities, coping strategies and well-being outcomes are presented in the graphical form of predicted values or probabilities of outcomes. The predicted values of the outcomes are presented as "Percent change" the full regression result tables located in Annex B. They are computed using the estimated results from the respective regression specifications at varying values of resilience capacities (i.e., at the 25th and 75th percentiles for continuous variables; 0 and 1 for binary variables), while holding all values of other explanatory variables constant at their means.

2.2. Limitations

Cross-sectional analysis: Resilience is operationalized as the mitigation of negative effects of shocks and stresses on well-being outcomes. This relationship is best understood in the context of changes in well-being outcomes over time and achieved using a panel design. However, this study utilizes data from just one period, or cross-section of time, which limits the ability to capture the dynamic nature of resilience capacities and how people cope with shocks and stresses over time.

***Shock exposure*:** The list of shocks in the resilience module of the questionnaire was limited to climate, conflict, and economic types. Including idiosyncratic shocks that are typically part of shock exposure, such as illness or death of a household member, would be useful for future analysis as they can provide a more extensive picture of the impact on households and how they cope.

Timing of the survey: Household survey data were collected in May, toward the end of the harvest period for rice, a staple food source (FAO, 2016); thus, the estimate for the prevalence of hunger, which is based on self-perception, may be lower than if the survey had been administered during the lean season, which typically occurs from July to September. To maintain consistency and be able to approximate best estimates of change over time, it is recommended that future surveys to complement this baseline study occur in the same timeframe.

Qualitative data: A qualitative component was not included as part of this study, which reduces the ability to contextualize quantitative indicators and triangulate data for a better interpretation and a more complete understanding of beneficiary resilience capacities. Adding a qualitative component in future data collection efforts, if affordable, would help to substantiate findings.

Gender: Variables related to women's decision making were considered and explored as potential contributing indicators for this study. However, as seen in Annex B: Table 19, the lack of significant differences among any of the livelihood categories rendered inclusion of these variables moot - suggesting a level of gender neutrality across all livelihood categories.

3. Description of Project

In fiscal year 2015, FFP awarded funding for a five-year development food assistance project in Mali, the HARANDE Project. The HARANDE Project is implemented by CARE and its partners, including Save the Children, Helen Keller International, YA-G-TU (Organization for Women's Promotion), Sahel-Eco, and GREAT (Research and Technical Applications Group).

The goal of the HARANDE Project is to provide access to sustainable food, nutrition, and income security for 310,855 vulnerable household members in four districts (Bandiagara, Douentza, Tenenkou, and Youwarou) of the Mopti Region in Mali by 2020.

4. Household Exposure to Shocks and Stresses

This section describes the types of climate, conflict, and economic shocks and stresses households report experiencing in the 12 months prior to the baseline survey (idiosyncratic, or household-level shocks and stresses, were not included in the shocks module used in the questionnaire for this study). Shocks/stresses rarely occur as isolated events; rather, one shock often contributes to another, resulting in households experiencing several shocks/stresses sequentially and/or simultaneously.[1] For example, high food prices can lead to social unrest, which can itself be experienced as a shock. The potential for multiple shocks – as well as possible interactions among shocks – suggests that shocks should not be considered in isolation from each other.[2]

Table 1 shows that drought was the most commonly cited shock. Other shocks/stresses that were fairly salient among households include epizootic (animal) disease, flood, food price increases, and pests.

Table 1: Households experiencing shocks/stresses over the 12 months prior to the survey

Shock/stress	% Households
Climate shocks	
Drought	49.1
Epizootic disease	23.7
Flood	22.7
Pests	20.9
Lack of fish in the river	12.4
Cholera	1.0
Conflict shocks/stresses	
Armed conflict	15.4
Conflict over land	5.6
Conflict over water	1.7
Economic shocks/stresses	
Food price increase	21.9
Unavailability of agriculture/livestock inputs	12.3
n	*1519*

FINDING 1: Drought is the most common shock experienced by households in the past year, followed by animal disease, flood, food price increases, and pests.

[1] Choularton et al. 2015.
[2] TANGO 2016

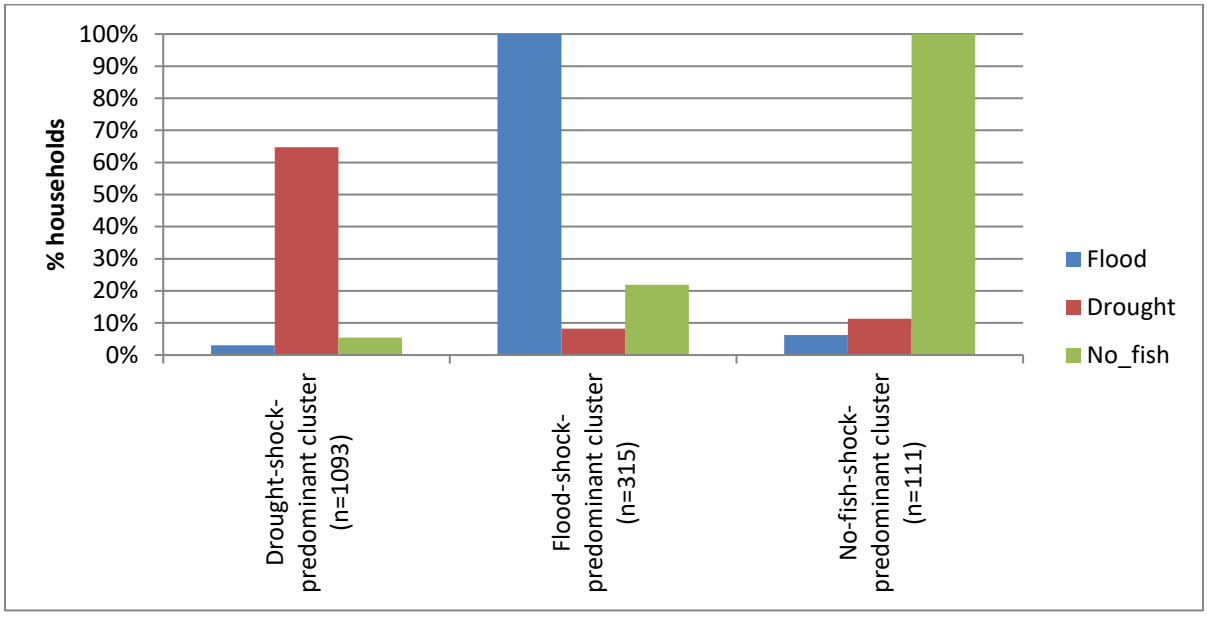
Due to the often complex and compounding nature of shocks, cluster analysis was used to identify patterns of combinations of shocks experienced by sample households in the past 12 months. The analysis yielded three sets, or clusters, of shocks: one for which drought shocks predominated, one for which flood shocks predominated, and one for which the shock of "no fish in the river" predominated.

Cluster analysis also allows us to identify the degree to which shocks overlap by comparing their respective prevalence within a given cluster. These results are shown in Figure 1. By definition, the predominant shock has the highest frequency within each cluster (e.g., drought is the most common shock experienced in the drought-predominant cluster, flood in the flood-predominant cluster, etc.). A somewhat unexpected finding, however, was that households in each cluster did not experience much overlap of these three shocks: outside of the defining shock for any given cluster, only 2 to 11 percent of households in each cluster experienced either of the other two cluster types. For example, while 100 percent of households in the flood-predominant group reported experiencing flood in the past year, only about eight percent of these same households said they experienced drought, and only two percent reported "no fish in the river". Similarly, while all households in the no-fish cluster experienced "no fish in the river," only 11 percent experienced drought and six percent experienced flood.

Some caution is merited in interpreting these findings because they are based on what households perceive as shocks. For example, because a household did not report a drought shock does not necessarily imply that a shock did not occur in the community. It only suggests that the household did not experience the event as a shock, or associate it with a shock that they perceived more readily.[3] Similarly, a drought may contribute to a reduction in the fish population due to low water level and flow volume, related effects on water contamination, rising water temperature, die-off of species the fish depend on for food, and so on. However, a fisher's conceptualization and first description of what shocks affected his livelihood may be "no fish in the river," rather than lack of rainfall or drought. The reduction in fish in this case is a downstream effect of the drought (and possibly other factors), and the fisher may not perceive this causal chain.

[3] In another example: if we were to ask a shopkeeper what shocks he experienced, he may not mention drought or "no fish in the river" because he does not sense the impact on his livelihood or daily life. In fact, these shocks may have occurred but had downstream effects that are more difficult to causally discern, e.g., reduced income of drought-affected farmers means these farmers may not be able to make purchases at his shop.

Figure 1: Prevalence of drought, flood, and no fish in the river shocks, by shock-predominant cluster



FINDING 2: Households tend to cluster into three shock-predominant categories, drought, flood, and 'no fish in the river', and there is very little overlap as far as experiencing either of the other two shocks.

Table 2 shows the prevalence of the remaining reported shocks (i.e., all shocks surveyed in addition to drought, flood and no fish in the river) among the three shock-predominant clusters described above. With the exception of armed conflict (46.1 percent) and increase in food prices (34.1 percent) in the no-fish cluster, the exposure to other shocks was relatively low within each of the three shock-predominant clusters; the lowest exposure to other co-occurring shocks is seen in the flood cluster. Looking across the clusters, using drought as the reference group, we see that significantly more households in the drought cluster experienced more animal disease and pests (27.2 percent, 22.6 percent) compared to both the flood (animal disease: 15.5 percent; pest: 18.7 percent) and no-fish (animal disease: 12.3 percent; pest: 10.6 percent) clusters. Roughly half of the households in the flood cluster compared to the drought cluster reported increases in food prices (12.3 percent and 23.3 percent, respectively), unavailability of agriculture inputs (9.2 percent and 13.9 percent, respectively), and conflict over land (3.1 percent and 6.4 percent, respectively). While all three clusters experienced armed conflict and conflict over water (significantly greater in the no-fish group), this is unlikely to be closely related to the presence of drought, flood or fish supply. The ICF baseline report (p.66) notes the following context, which may be reflected in survey responses to questions about experiencing armed conflict: "The crisis in neighboring Libya and Ivory Coast, the rising prices of food on international markets, the invasion of North Mali in 2012 by insurgent groups, the military coup against the president, and the activity of Al Qaeda and Boko Haram, to

name a few, have increased the vulnerability of the population to shocks in the recent years." Finally, livestock diseases (epizootic shock) are more likely for the drought cluster and increases in food prices and unavailability of agriculture inputs are also higher for the drought cluster compared to the flood cluster.

Table 2: Prevalence of other shocks/stresses, by shock-predominant cluster

Shock/stress	Shock-predominant cluster					
	Drought	Flood		No fish		
Epizootic disease	27.2	15.5	***	12.3	***	
Sharp increase in food prices	23.3	12.3	***	34.1		
Pests	22.6	18.7		10.6	*	
Unavailability of agriculture inputs	13.9	8.0	**	9.2		
Armed conflict	12.1	14.8		46.1	***	
Conflict over land	6.4	3.1	**	4.8		
Cholera	1.2	0.5		0.0	***	
Conflict over water	0.6	1.3		12.6	*	
n	*1093*	*315*		*111*		

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

FINDING 3: With a few exceptions, the three types of shock-predominant clusters had relatively low exposure to any other types of shocks in the past year.

Takeaway 1: Shock Exposure

- Drought was the most common shock experienced by sample households in the past year, followed by animal disease, flood, food price increases, and pests.
- Households tend to fall into three types of shock clusters, drought, flood, and lack of fish in the river, and there was very little overlap.
- In general, the three types of shock-predominant clusters had relatively low exposure to other types of shocks (e.g., pests, animal disease, food price shocks). The flood-predominant group had the lowest general prevalence of other shock types compared to the other clusters.

5. Coping Strategies to Recover from Shocks

Survey respondents were read a list of 23 coping strategies and asked which ones they used to recover from all shocks/stresses in the past year. The 23 individual strategies were collapsed into 11 strategy categories in order to simplify the analysis. Annex E shows the details of this categorization, i.e., which coping strategies correspond to each coping strategy category. For ease of reading, in the text and tables we refer to the 11 categories as "coping strategies," though it must be kept in mind that each may include more than one specific strategy.

Table 3 compares the extent to which households in each of the three shock-predominant clusters utilized different strategies to recover from shocks/stresses they experienced in the past year. Across all shock clusters, offtake of livestock was the most common coping strategy, which was used twice as often as changing food consumption patterns and taking loans. In general, utilization of coping strategies was similar for households in the drought and flood affected clusters. Those in the no-fish cluster, however, were significantly more likely to take out loans, seek wage labor, and engage in some sort of conflict management. Given that nearly half of the households in no-fish cluster experienced armed conflict relative to the other clusters, relying on conflict management is not surprising. Neither is the fact that they cited offtake of livestock less than half as often as drought-cluster households based on their reliance on fishing rather than livestock.

Table 3: Coping strategies used in the past 12 months, by shock-predominant cluster

Coping strategies used	All	Drought	Flood		No fish	
			(% HHs)			
Offtake of livestock	62.3	65.5	62.3		34.4	***
Changing food consumption patterns	37.1	36.1	37.7		43.9	
Loan	31.5	30.2	25.2		58.6	***
Social capital	24.4	23.4	27.7		25.0	
Wage labor	21.9	19.5	20.0		48.2	***
Formal assistance	21.2	20.5	19.3		31.4	
Child cost reduction strategies	18.3	17.9	18.7		20.8	
Remittances	17.8	17.3	22.0		11.7	
Conflict management	15.9	14.9	8.1	***	43.5	***
Own savings	14.5	15.8	10.5	**	12.4	
Other asset sales	4.9	4.7	7.0		1.2	**
n	*1519*	*1093*	*315*		*111*	

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level. The drought cluster is the reference group.

Takeaway 2: Coping Strategies

- Nearly two-thirds of households in the overall sample utilized offtake of livestock as a coping strategy to recover from shocks/stresses. The next most common coping strategies were changing food consumption patterns and taking loans.
- The greatest differences in coping strategies are seen in the cluster of households characterized by the predominant shock of "no fish in the river," relative to the drought cluster. The no-fish cluster employed livestock offtake and other asset sales less often than the drought group, but took loans, engaged in wage labor, and managed conflict as a shock coping strategy significantly more often than the drought group.
- The flood-shock-predominant cluster used savings and managed conflict as a coping strategy less often than the drought group.

6. Livelihoods

Ethnic groups in Mali culturally identify with specific livelihoods. For example, traditionally, the Peulh and Touareg are known as agro-pastoralists who raise and trade livestock. Other groups are historically associated with crop farming and others with fishing. The HARANDE project area has at least seven main ethnic groups and an assortment of smaller groups.

Table 18 in Annex B shows the weighted distribution of ethnic groups in the baseline sample. About one-third (31.3 percent) are Dogon, one-third (31.1 percent) are Peulh, and 14.4 percent are Bozo. Other groups each comprise less than 10 percent of the sample. Given that several ethnic groups represent only small proportions of the sample, and to simplify comparison across traditional livelihood groups, this analysis collapses ethnic groups with the same primary traditional livelihood into four categories:

- Agropastoralists: primarily crop farming (Bambara, Dogon, Sarakole, Sonrai)
- Agropastoralists: primarily livestock (Peulh, Touareg)
- Fishers (Bozo)
- Other livelihoods (other ethnic groups, unspecified)

The subsequent tables and text refer to these groups as "ethnicity-associated livelihood" groups or categories.

Table 4 shows the number and percentage of each ethnic group in the ethnicity-associated livelihood categories, which will be used in the subsequent analysis.

Table 4: Distribution of ethnic groups in ethnicity-associated livelihood categories

Ethnic group	Ag-past: crops	Ag-past: livestock	Fishers	Other
Dogon	66.6	--	--	--
Sonrai	15.4	--	--	--
Bambara	9.7	--	--	--
Sarakole	8.2	--	--	--
Peulh	--	99.1	--	--
Touareg	--	0.9	--	--
Bozo	--	--	100.0	--
Other	--	--	--	100.0
n	1037	669	282	167

Table 5 shows the specific sources of food and income households reported in the 12 months prior to the survey, categorized by ethnicity-associated livelihood category. For the most part, how respondents identified their particular livelihood(s) matched the ethnicity-associated livelihood category – sale of livestock was dominated by ag-pastoralist/livestock category households, sale of fish products was largely only done by fishers, sale of vegetable crops by ag-pastoralist/crop households, etc. Besides agriculturally-derived food/income, about one-third of the sample relied on remittances, although much less so among the Fishers and Other households, and being engaged in technical professions or having a small business was more common among Other households, though it is difficult to analyze these meaningfully given that the "Other" group represents a range of tribes whose traditional livelihoods are uncategorized in this analysis.

Table 5: Sources of food and income, past 12 months, by ethnicity-associated livelihood (multiple response)

Livelihood	All	Ag-past: crops	Ag-past: livestock		Fishers		Other	
			(% HH)					
Production and sale of livestock	69.3	68.9	83.2	***	45.0	***	63.1	
Production and sale of agricultural products	63.7	71.4	63.9		47.2	**	47.1	***
Small shop (shopkeeper, sale of non-agricultural products)	35.4	30.9	33.7		43.4	***	57.9	***
Remittances	29.0	33.9	31.1		14.0	***	19.1	***
Sale of fishing products	16.4	2.8	4.1		82.5	***	11.1	*
Technical and professional activities[1]	15.5	15.5	12.7		16.1		30.0	***
Production and sale of vegetable crops	12.8	21.2	5.0	***	5.6	***	8.5	***
Production and sale of firewood, charcoal, poles, timber	7.1	9.9	1.6	***	9.3		9.2	
Other -agriculture	4.9	7.8	1.4	**	3.4		4.8	
Agricultural worker	3.0	3.0	2.5		1.9		8.1	
Non-agricultural service delivery agent	2.8	1.4	3.5	*	3.7		6.7	**
Sale of wild products	2.1	2.7	1.1		2.3		2.5	
Other non-agriculture	1.9	1.1	2.8	*	1.9		4.0	
Production and sale of seedlings, seeds, animal feed	1.2	1.6	0.9		0.5		1.8	
Private agricultural service providers[2]	0.6	1.0	0.0		0.0		1.5	
n	*1515*	*717*	*475*		*223*		*100*	

NOTE: Asterisks represent statistical significance between agropastoralist/crops and other livelihood groups at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

[1] Examples of technical and professional activities include carpenter, mason, bike or motorcycle repairman, tire repairman, mechanic, cellular phone repairman, motor pump repairman, and tailor.

[2] Examples of private agricultural service providers include veterinary paraprofessionals, and agricultural service delivery agents.

The following analysis seeks to categorize the ethnicity-associated livelihood groups in terms of their sensitivity to changes in climate and to their receipt of remittances. Doing so allows for a more straight-forward comparison across groups of households engaging in a similar combination of livelihood activities.

Table 6 shows how the resulting four categories are defined. For example, households in the "climate-sensitive-only" category engaged in one or more types of agricultural livelihood activities, but none of the non-agricultural ones, and did not receive remittances. Conversely, households in the "non-climate-sensitive-only" category engaged in at least one non-agricultural activity, but not in agriculture, and did not receive remittances. Households in the "both" category engaged in at least one agricultural and one non-agricultural livelihood activity, and did not receive remittances; this group is constructed to be able to observe what differentiates households whose livelihoods are more diverse in terms of climate sensitivity (presumably spreading risk exposure so that they are less vulnerable to shocks) from households engaged in livelihoods equally vulnerable to certain shocks. Finally, "remittances" households reported having emigrated as a livelihood strategy, and may have engaged in one or more agricultural and/or non-agricultural activities in any combination. Households relying solely on remittances are also in this category, but in practice, this is rare; households typically engage in at least a small variety of activities to obtain food and income. The four categories are mutually exclusive, i.e., each household is categorized into one and only one climate-sensitive livelihood and remittance category.

Table 6: Definition of climate-sensitive livelihood and remittance categories

Livelihood Activity		Climate-sensitive livelihood and remittance category			
		Climate-sensitive-only	Non-climate-sensitive- only	Both climate-sensitive and non-climate-sensitive	Remittances
Agricultural sources	Production and sale of agricultural products	At least one	None	At least one	Any combination of livelihood activities OR no other livelihood activities
	Production and sale of livestock				
	Agricultural worker				
	Production and sale of seedlings, seeds, animal feed				
	Production and sale of firewood, charcoal, poles, timber				
	Sale of wild products				
	Sale of fishing products				
	Production and sale of vegetable crops				
	Private agricultural service providers (veterinary paraprofessionals, agricultural service delivery agent, etc.)				
	Agricultural sources – other				
Non-agricultural sources	Small shop (shopkeeper, sale of non-agricultural products, etc.)	None	At least one	At least one	
	Non-agricultural service delivery agent				
	Technical and professional activities (carpenter, mason, bike or motorcycle repairman, tire repairman, mechanic, cellular phone repairman, motor pump repairman, tailor, etc.)				
	Non-agricultural sources - other				
Rem.	Remittances	None	None	None	Required

Table 7 maps the different combinations of climate-sensitive livelihoods and remittances against the ethnicity-associated livelihood categories. The data show no significant differences between the two types of agro-pastoralists in term of their participation in climate-sensitive livelihood activities or receipt of remittances. In contrast, ethnic groups traditionally associated with fishing are more diversified than traditional crop farmers in terms of engaging in livelihoods with different levels of exposure to climate risk. Fishers are, however, less reliant on remittances than crop farmers. The "other" category appears to be the most diversified of any of the ethnicity-associated livelihoods, based on statistical significance down the line, and on the magnitude of the differences (e.g., twice as many households in the "other" group engage in both climate- and non-climate-sensitive livelihood activities compared to those in the agropastoralist/crop group).

Table 7: Climate-sensitive livelihood and remittance categories, by ethnicity-associated livelihood

Climate-sensitive livelihood and remittance category	Ethnicity-associated livelihood					
	Ag-past: crops	Ag-past: livestock	Fishers		Other	
	% HH					
Both climate- and non-climate sensitive	25.0	32.4	45.7	***	50.9	***
Only climate-sensitive	35.5	32.9	38.7		16.1	***
Only non-climate sensitive	5.5	3.6	1.7	***	13.8	**
Remittances	34.0	31.2	14.0	***	19.1	***
n	*715*	*474*	*223*		*100*	

NOTE: Asterisks represent statistical significance between agropastoralist/crops and other livelihood groups at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

FINDING 4: Ethnic groups traditionally associated with fishing are less reliant on remittances and engage in a broader array of both climate- and non-climate-sensitive livelihood activities compared to agropastoralist/crop group.

Takeaway 3: Livelihoods

- Agricultural activities – both crop farming and livestock – dominate as sources of food and income across the sampled households, even when disaggregated by the four ethnicity-associated livelihood categories (agropastoralists who engage primarily in crop farming, agropastoralists who engage primarily in livestock, fishers, and other).
- The fishers group had higher engagement in small shop-keeping and sale of fishing products compared to agropastoral/crops, and lower percentages in terms of remittances and production and sale of vegetable crops.
- Very few households overall engaged in some of the more extreme coping strategies such as producing/selling firewood or sale of wild products.
- The data show no significant differences between crop farmers and livestock pastoralists in terms of their participation in climate-sensitive livelihood activities or receipt of remittances. Ethnic groups traditionally associated with fishing are more diversified than traditional crop farmers in terms of engaging in livelihoods with different levels of exposure to climate risk. Fishers are, however, less reliant on remittances than crop farmers.

7. Household Well-being Outcomes

Table 8 shows the values for selected outcome indicators for household well-being in terms of poverty, food security, and recovery from shock, disaggregated by climate-sensitive livelihood and remittance category. Tests of statistical significance were conducted relative to the "climate-sensitive-only" category. All well-being indicators, with the exclusion of recovery from shocks, are included in the HARANDE Project's M&E results framework.

Average daily expenditures across the sample is US$1.83 and is highest among households that engaged only in non-climate-sensitive livelihood activities (US$1.90). Two-thirds (61.1 percent) of the sample households live under the poverty line (US$1.90 per day). Significantly fewer households engaged in both climate-sensitive and non-climate-sensitive livelihoods live in poverty compared to the climate-sensitive-only group (55.1 percent and 63.4 percent, respectively). This finding supports the notion that households that diversify between climate-sensitive and non-climate-sensitive livelihoods are better off.

Table 8: Food security, poverty, and recovery outcomes, by climate-sensitive livelihood and remittance category

Outcome indicator	All	n	Climate-sensitive only	Both climate- and non-climate-sensitive	Non-climate-sensitive only	Remittances
Income proxy						
Per capita daily expenditures (mean; US$)	$1.83	*1516*	$1.80	$1.85	$1.90 *	$1.82
Prevalence of poverty (% people living on less than $1.90/day	61.1	*1516*	63.4	55.1 *	60.5	65.1
Food security						
HDDS (past 24 hours) (mean; range 1-12)	6.7	*1463*	6.7	6.9 **	6.2	6.6
% HH with moderate or severe hunger (past month)	7.1	*1516*	7.4	8.1	12.2	4.9
Recovery	19.1	*1516*	20.5	17.7	29.2 **	17.3

NOTE: Asterisks represent statistical significance between climate-sensitive-only and other livelihood categories at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

The other two outcome indicators measure different aspects of food security. The Household Dietary Diversity Score (HDDS) is used as a proxy measure of household food access, defined as the ability to acquire a sufficient quality and quantity of food to meet all household members' nutritional requirements for productive lives.[4] (It is important to note that the HDDS does not indicate nutrition levels.) The HDDS is computed by summing the number of different food

[4] FANTA III Food and Nutrition Technical Assistance Web site. http://www.fantaproject.org/monitoring-and-evaluation/household-dietary-diversity-score Accessed February 1, 2017.

categories reported eaten by the household in the 24 hours prior to the interview. The HDDS was measured as recommended by FANTA, using the following 12 food groups: cereals, tubers, vegetables, fruits, meat, eggs, fish, legumes, dairy, oils, sugar, and other.[5] A higher HDDS represents a more diverse diet, which is empirically highly correlated with a household's income level and access to food.[6] The average HDDS values in this sample indicate moderate to high dietary diversity, with households consuming six to seven food groups in the 24 hours prior to the survey. Households that engaged in both climate-sensitive and non-climate-sensitive livelihood activities fared slightly better compared to those that only engaged in climate-sensitive activities (6.9 versus 6.7, respectively).

Data collected for the HHS indicator are based on a 30-day recall period and tabulated into three categories of hunger: little to no hunger in the household (HHS 0-1), moderate hunger in the household (HHS 2-3), and severe hunger in the household (HHS 4-6).[7] It is important to note that the HHS focuses on food quantity, not dietary diversity. Also, because it is a household-level indicator, it does not capture data on food availability or utilization, elements of food security typically measured at the national level (availability) and individual level (consumption/utilization). The data in Table 8 show hunger is low (7.2 percent) in the overall sample, and no significant differences between livelihood categories. The baseline report suggests the low values for the hunger indicator may not be representative of year-round hunger levels: "HHS is based on perceptions of hunger in the past four weeks, and thus, is sensitive to the season in which the survey is conducted. One of the limitations of the study is that the household survey data were collected in May, at the tail end of the harvest period for rice—a staple food (FAO, 2016); thus, the estimate for the prevalence of hunger may be lower than if the survey had been administered during the lean season, which typically occurs from July to September. The baseline measure of hunger should be interpreted with caution in light of the baseline estimates of other food security and nutrition indicators discussed below that underscore moderate access to food."[8] The report also notes that because rice is a filling food, and that participants in the qualitative study reported eating 2-4 times a day – customarily, three times – they are less likely to report being hungry, which could also result in a downward bias for the hunger indicator.[9]

Recovery from shock is computed based on how households responded to questions about their abilities to meet their food needs after a shock (of any type) in the past year – *better than, the same as,* or *worse than* before the shock. A recovered status includes households who reported recovering to the same or better levels as before the shock. Approximately one in four households

[5] Other may include such items as condiments, spices, coffee or tea

[6] Swindale, Anne, and Paula Bilinsky. Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (v.2). Washington, D.C.: Food and Nutrition Technical Assistance Project, Academy for Educational Development, 2006.

[7] Ballard, Terri; Coates, Jennifer; Swindale, Anne; and Deitchler, Megan. Household Hunger Scale: Indicator Definition and Measurement Guide. Washington, DC: FANTA-2 Bridge, FHI 360.

[8] ICF International. 2017. Baseline Study of the Food for Peace Development Food Assistance Project in Mali. Report prepared for USAID. Draft. March 15. Page 22.

[9] ICF International. 2017. Pp ix, 23.

(19.1 percent) indicated having recovered and households relying on non-climate-sensitive livelihoods had the highest rate of recovery. This finding is attributable, in part, to the observation that they also experienced the least number of shocks relative to the other livelihood categories.

Takeaway 4: Household Well-being Outcomes

- Average per capita expenditures across the sample is US$1.83/day. The non-climate-sensitive-only livelihood group had slightly higher expenditures than the climate-sensitive-only group. The percentage of households engaging in both climate-sensitive and non-climate-sensitive livelihoods that was living on less than US$1.90/day was smaller than the climate-sensitive-only group (55.1 percent versus 63.4 percent). This finding suggests that households that diversify between climate-sensitive and non-climate-sensitive livelihoods are better off.
- Household dietary diversity, as measured by HDDS, is an average of 6.7, out of a maximum of 12, for the whole sample. Households that engaged in both climate-sensitive and non-climate-sensitive livelihood activities had slightly better dietary diversity than those that only engaged in climate-sensitive activities alone, consuming from (on average) 6.9 food groups versus 6.7, respectively.
- Hunger is low (7.2 percent) in the overall sample. This may be due to challenges with measurement (survey timing, recall) and thus not represent hunger levels year-round; other studies indicate that the region experiences chronic hunger. No significant differences in hunger level exist between the climate-sensitive and other livelihood categories.
- Approximately one in four households indicated having recovered to the same or better condition than before the shock, and households relying on non-climate-sensitive livelihoods had the highest rate of recovery; this finding is most likely due to the observation that they experienced the least amount of shocks.

8. Household Resilience Capacities

This section presents and analyzes the absorptive, adaptive, and transformative resilience capacity index scores, disaggregated by climate-sensitive livelihood and remittance category, along with the indicators that comprise each index. Annex A details how each indicator is computed and cross-references survey questions used to gather data for the indicator. Note that some indicators are components of more than one index (e.g., asset score is a component of both the absorptive capacity index and the adaptive capacity index). All resilience capacity components included in this section are presented in their original scales to facilitate understanding of the disparate factors – and their differing measurement – contributing to resilience capacities. Annex D includes tables with all resilience capacity components and resilience capacity indexes scaled to 0-100 indexes to facilitate comparison to the same measures reported in the ICF Baseline Study.

Please note that the adaptive capacity index differs slightly with respect to composition, compared to the same index calculated and reported in the ICF Baseline Study. For purposes of the current analysis, the decision was made to exclude *adoption of sustainable agricultural practices* from the adaptive capacity index. This decision was made for two reasons – first, in order to facilitate comparison across similar studies, which generally do not include this measure as part of adaptive capacity, and second, to enable multivariate analysis using *adoption of improved agricultural practices* as an exogenous determinant of household resilience capacity (e.g., absorptive and adaptive capacity). The adaptive capacity index reported in Annex F is recalculated to include adoption of sustainable agricultural practices in order to maintain consistency with the original specifications reported in the Baseline Study.

The methodology in this section employs exploratory factor analysis, a statistical technique that computes a composite index from several component variables. The composite index variable (factor) is computed in such a way as to maximize the correlations between this variable and all the associated variables that make up the index. The *factor loading* is an output from the factor analysis that allows us to measure the strength of the contribution of each of the individual index components to the overall indicator value. The factor loading value, shown in the right-most column of each table, ranges from 0-1. The higher the factor loading value, the stronger the influence, or contribution, of the component indicator to the index, i.e., the more it "drives" the index. Conversely, the lower the factor loading value, the less the indicator contributes to the index. The tables are structured so that the component indicators are listed in descending order according to their factor loadings (i.e., highest factor loading listed first).

8.1. Absorptive Capacity

Table 9 shows the overall absorptive capacity index values for the four climate-sensitive livelihood and remittance categories, and the component indicators. Tests of statistical significance were conducted relative to the climate-sensitive-only group (reference group). Based on the factor loading values, the indicators that most strongly contribute to absorptive capacity are bonding

social capital and shock preparedness and mitigation (factor loading values 0.77 and 0.63, respectively). Interestingly, remittances play a nearly negligible role in absorptive capacity (factor loading -0.09).

The sample overall has an average absorptive capacity index score of 47.4 on a scale of 0-100. The group that engages in both climate-sensitive and not-climate-sensitive livelihood activities has a higher index score than the climate-sensitive-only group (46.5 and 50.1 respectively). The higher index score for climate- and non-climate-sensitive livelihood households is explained by significantly higher values on all of the absorptive capacity components with the exception of remittance.

The four livelihood groups have similar characteristics in terms of some of the individual indicators that make up the absorptive capacity index. The bonding social capital score ranges from between 4.3 and 5.0 (out of a possible maximum of 8.0). Bonding social capital is seen in the bonds between community members. It involves principles and norms such as trust, reciprocity, and cooperation, and is often drawn on in the disaster context, where community members work closely to help each other to cope and recover (Frankenberger et al., 2013). (See Annex A1 for full definition.)

Between 20 and 30 percent of households in each group livelihood has savings, and about half have access to informal safety nets (52.5 percent). Asset scores are low across the sample: on average, households own assets in 3.4 out of a possible 14 categories.

Differences in absorptive capacity components between the livelihood groups are small, with two exceptions. As noted, households engaging in both climate-sensitive and non-climate-sensitive activities have higher shock preparedness than those who only work in climate-sensitive livelihoods (0.6 versus 0.5, respectively). This is consistent with the hypothesis that more diversified households are more resilient in the face of a shock than less-diversified households. By construction, the percentage of households receiving remittances in the "remittances" group is dramatically higher than any other group, because receipt of remittances defines this category. As noted above, the factor loading analysis suggests remittances have only a very small influence on absorptive capacity.

Table 9: Absorptive capacity index and components, by climate-sensitive livelihood and remittance category

Indicator		All	Climate-sensitive only	Both climate- and non-climate-sensitive		Non-climate-sensitive-only	Remittances	
Absorptive capacity index (mean; range 0-100)		47.4	46.5	50.1	**	45.6	45.8	
Index components:	*Factor Loading*							
Bonding social capital score (mean; range 0-8)	0.77	4.7	4.7	5.0		4.3	4.6	
Shock preparedness and mitigation score (mean; range 0-3)	0.63	0.6	0.5	0.6	***	0.6	0.5	
% HH with access to informal safety nets	0.59	52.5	44.8	54.3	***	38.6	61.7	***
% HH with any cash savings	0.26	24.4	20.7	27.1	*	29.5	25.0	
Asset score (mean; range 0-14)	-0.09	3.4	3.1	3.8	***	3.1	3.4	**
% HH receiving remittances	-0.09	29.0	5.7	7.6		3.2	84.6	***
	n	*1514*	*493*	*491*		*80*	*450*	

NOTE: Asterisks represent statistical significance between climate-sensitive-only and other livelihood categories at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Takeaway 5: Absorptive Capacity

- Households engaged in both climate- and non-climate-sensitive livelihoods achieved significantly higher average scores compared to climate-sensitive-only households (50.1 versus 46.5).

What is driving differences?

- The significantly higher absorptive capacity index scores for the climate- and non-climate-sensitive livelihood group are driven primarily by higher access to informal safety nets compared to those in the climate-sensitive only group (54.4 percent versus 44.8 percent, respectively). In addition, they have higher access to savings compared to those in the climate-sensitive only group (27.1 percent and 20.7 percent, respectively), own an average of nearly 1 more asset (3.8 versus 3.1) and are slightly better prepared for shocks based on their higher mitigation scores (0.6 versus 0.5).

What is working?

- Bonding social capital is relatively high across the climate-sensitive livelihood and remittance categories; out of a maximum potential score of 8, the average is roughly 5. Access to informal safety nets is, on average, more common than not (52.5 percent), particularly among households in the remittance category (61.7 percent).

What could be improved?

- Household shock preparedness and mitigation activities is low (average scores range from 0.5 to 0.6 on a scale of 0-3), indicating information and/or training is either lacking in the community or households are simply not engaging with it. Less than 10 percent of all categories except remittances receive remittances (the high percent among remittance households is simply a measurement artifact and would be troubling if the value was any smaller).

8.2. Adaptive Capacity

Table 10 presents the findings on adaptive capacity. As in the previous table, tests of statistical significance were run relative to the climate-sensitive-only group. With the exception of education level, the component indicators for the adaptive capacity index exert similar levels of influence on the index, with factor loadings ranging from 0.18 for household assets to 0.71 for bridging social capital.

The mean adaptive capacity index score for the sample is 39.9, with significant differences between climate-sensitive and climate- and non-climate sensitive livelihood categories, as well as climate-sensitive and remittance livelihood categories. *Exposure to information* is the strongest driver of the index (factor loading is 0.68). *Exposure to information* is constructed from responses to questions about information households received that potentially improves livelihood outcomes, quality of life, and human and animal health.[10] The scores for this indicator are low, though the "both" group scores slightly higher than the climate-sensitive-only group on this measure. The low values suggest that communities have very poor access to information that would help them to make positive livelihood and other adaptations.

Asset scores are low for all livelihood groups, ranging from 3.1 to 3.8. Not surprisingly, households engaged in both climate-sensitive and non-climate-sensitive activities have a higher asset score than those engaged in climate-sensitive activities alone. Still, asset ownership overall is very low, averaging 3.4 (out of a possible 14 inquired about in the survey), [11] and ranging from 3.1 (non-climate-sensitive only) to 3.8 (both climate- and non-climate-sensitive).

[10] The survey asked whether households had received information on any of the following five topics: 1 rainfall prospects / weather prospects for coming season; 2 water availability and prices of local boreholes, shallow wells etc.; 3 information on livestock disease threats or epidemics; 4 cultural innovations (techniques of cultures); 5 child nutrition and health information.
[11] The survey asked what were the household's sources of food/income in the past 12 months, vis a vis the following 14 categories: 1 production and sale of agricultural products; 2 production and sale of livestock; 3 agricultural worker; 4 production and sale of seedlings, seeds, animal feed; 5 production and sale of firewood, charcoal, poles, timber; 6 sale of wild products; 7 sale of fishing products; 8 production and sale of vegetable crops; 9 private agricultural service providers (veterinary paraprofessionals, agricultural service delivery agent, etc.); 10 small shop (shopkeeper, sale of non-agricultural products, etc.), 11 non-agricultural service delivery agent; 12 technical and professional activities (carpenter, mason, bike or motorcycle repairman, tire repairman, mechanic, cellular phone repairman, motor pump repairman, tailor, etc.); 13 emigration; 14 other.

Some statistically significant differences exist with respect to the adaptive capacity component indicators. The most marked difference is that all groups had higher levels of education compared to the climate-sensitive-only group, with the greatest contrast with non-climate-sensitive-only (38.6 percent of these households had one or more adults with a primary education or higher) compared to climate-sensitive-only (19.4 percent). This is consistent with the notion that some level of education is a prerequisite to entering non-agricultural livelihoods. The remittance group also had a relatively high percentage here – 30.2 percent – suggesting that those who seek opportunities outside the country also tend to have more education. However, as noted above, education level drives adaptive capacity to a lesser extent than the other index components, so while some comparisons of education level across livelihood groups are significant, these findings must be taken in the context of the relatively small influence of education on adaptive capacity – less important than information exposure, asset score, bridging social capital, access to financial services, and livelihood diversity.

The other significant inter-group differences are small. One of the statistically significant differences is the bridging social capital index: bridging social capital connects members of one community or group to other communities/groups; it often crosses ethnic/racial lines, geographic boundaries and language groups, and can facilitate links to external assets and broader social and economic identities. The remittance group scores higher on bridging social capital than the climate-sensitive-only group (4.6 versus 3.9, respectively, out of a possible 8), which is logical in that emigration involves some level of intra-community connections, which facilitate (and are, in turn, likely to be expanded by) the emigration.

The *access to financial services* indicator values indicate the presence of an institution that provides savings and/or credit support. A score of zero indicates the household has no access to any such institution in its community whereas a (maximum) score of two indicates institutions exist that provide both savings and credit services. On average, sample households scored 0.7 on this indicator, suggesting that access to financial services is limited.

Table 10: Adaptive capacity index and components, by climate-sensitive livelihood and remittance category

Indicator		All	Climate-sensitive only	Both climate- and non-climate-sensitive		Non-climate-sensitive only		Remittances	
Adaptive capacity index (mean; range 0-100)		39.9	35.5	43.3	***	30.8	**	42.7	***
Index components:	*Factor Loading*								
Exposure to information (mean; range 0-5)	0.68	1.8	1.5	2.1	***	1.9		1.6	
Asset score (mean; range 0-14)	0.19	3.4	3.1	3.8	***	3.1		3.4	**
Bridging social capital score (mean; range 0-8)	0.71	4.2	3.9	4.2		3.8		4.6	***
Access to financial services (mean; range 0-2)	0.51	0.7	0.7	0.8		0.6	**	0.6	***
Livelihood diversity score (mean; range 0-14)	0.53	2.7	2.0	3.0	***	1.3	***	3.3	***
% HH w/ one or more adults in HH w/primary education or higher	-0.07	27.5	19.4	32.0	***	38.6	***	30.2	***
	n	*1515*	*489*	*490*		*63*		*441*	

NOTE: Asterisks represent statistical significance between climate-sensitive-only and other livelihood categories at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Takeaway 6: Adaptive Capacity

- Average values of the adaptive capacity index range from a low of 30.8 in non-sensitive-climate-only livelihood households to 43.3 in households that engage in both climate- and non-climate-sensitive livelihoods. Climate-sensitive-only households are closer to the lower end of the range with an average score of 35.5 and households that rely primarily on remittances (42.7) have levels, on average, closer to those engaged in climate- and non-climate-sensitive (43.3).

What is driving differences?

- Differences in adaptive capacity scores can be explained by disparities in exposure to information, asset holdings, education, and livelihood diversity. Households engaged in both climate- and non-climate-sensitive livelihoods have significantly more exposure to information compared to climate-sensitive-only households (2.1 versus 1.5, respectively), but this could due to the fact that household with more diversified sources of income seek more types of information. Not surprisingly, livelihood diversity is higher among households engaged in both climate- and non-climate-sensitive activities (3.0) and relying on remittances (3.3) as compared to those in the more restricted category of just

climate-sensitive-only livelihoods (2.0). Roughly twice as many adults are educated in households that are engaged in non-climate-sensitive livelihoods (38.6 percent) compared to climate-sensitive-only livelihoods (19.4 percent) while those relying on remittances have about 10 percent more educated adults (30.2 percent). Households with more diversified livelihoods have, on average, nearly one more asset holding compared to those relying primarily on climate-sensitive-only livelihoods (3.8 versus 3.1, respectively). Households relying on remittances also tend to have significantly more assets (3.4) than climate-sensitive-only households (3.1).

What is working?

- Average bridging social capital levels are similar across the three climate-sensitive livelihood categories and range from 3.8 to 4.6 (out of 8), and are significantly higher among the remittance category households (4.6). The greater diversity of livelihoods among households engaged in both climate- and non-climate-sensitive livelihoods (average of 3.0) is somewhat expected given that the group is defined by their diversification between climate-sensitive and non-climate-sensitive activities. The other high-diversity group (remittances, mean of 3.3 livelihoods) may also include activities from other categories.

What could be improved?

- Access to financial services is somewhat low (0.7 out of a possible score of 2). Exposure to information scores for this indicator are similar and generally low for all livelihood categories. Out of a possible five topics, households engaged in both climate- and non-climate-sensitive livelihood activities report receiving an average of 2.1, which may simply be a function of their higher livelihood diversity. Asset scores are also fairly low for all groups; on average, sample households own assets in just 3.4 out of a possible 14 categories.

8.3. Transformative Capacity

The values for the transformative capacity index and its component indicators are shown in Table 11. The index score for the sample overall is 29.3. The index is comprised of only three component indicators, unlike more extensive transformative capacity measurement indices which have about eight components, but all three are strong drivers of the index ranging from 0.62 to 0.76.

The remittances group has a significantly but only slightly higher transformative capacity index score than the climate-sensitive-only group (31.5 versus 28.6, respectively). This difference is driven by the significantly higher values in bridging social capital (remittance households = 4.6 versus 3.9 for the climate-sensitive-only group, on a scale of 0-8).

Table 11: Transformative capacity index and components, by climate-sensitive livelihood and remittance category

Indicator		All	Climate-sensitive only	Both climate- and non-climate-sensitive		Non-climate-sensitive only	Remittances	
Transformative capacity index (mean; range 0-100)		29.3	28.6	28.7		24.5	31.5	*
Index components:	*Factor Loading*							
Access to basic services (mean; range 0-28)	0.76	3.6	3.9	3.4		2.5	* 3.7	
% HH with access to formal safety nets	0.70	31.7	29.9	31.0		27.4	35.3	
Bridging social capital score (mean; range 0-8)	0.62	4.2	3.9	4.2		3.8	4.6	***
	n	*1516*	*494*	*492*		*80*	*450*	

NOTE: Asterisks represent statistical significance between climate-sensitive-only and other livelihood categories at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Takeaway 7: Transformative Capacity

- The transformative index scores range from a low of 24.5 (on a scale of 0-100) in the non-climate-sensitive-only group to a high of 31.5 in the remittances group. The difference between the remittances group and the climate-sensitive-only group (31.5 and 28.6, respectively), is small but statistically significant.

What is driving differences?

- The only observed difference in transformative capacity is between climate-sensitive only and remittances livelihood groups and is accounted for by variations in their respective bridging social capital scores.

What is working?

- Roughly one-third (31.7 percent) of all households have access to formal safety nets at the community level and there are no differences across the four livelihood categories. On a scale from 0 to 8, a mean score of 4.2 overall would indicate a fairly strong degree of bridging social capital, particularly among households that rely primarily on remittances; their average score of 4.6 is significantly higher compared to the climate-sensitive only reference group average score of 3.9.

What could be improved?

- Access to services is low for households in the project areas, with an average score of 3.6 out of a possible 28, and households in the non-climate-sensitive-only category have significantly fewer services relative to the climate-sensitive only reference group.

9. Resilience Capacities and Outcomes

The first part of this section (9.1) presents figures that map the three resilience capacity index scores against of the well-being outcome measures for this study, including poverty, expenditures, food security, and recovery from shocks. The aim of this analysis is to determine which resilience capacities are associated with better outcomes while controlling for shock exposure. The findings inform our understanding of the kinds of outcomes we can expect given investments in a particular resilience capacity, and give some idea of the direction and degree of this influence. The figures in Section 9.1 show findings only for relationships that are statistically significant *and* in the expected direction (full results from all regressions are available in Annex B). The specifications are described in further detail in Annex C.

While Section 9.1 looks at the associations between resilience capacities and well-being outcomes, Section 9.2 extends the analysis by assessing the ability of resilience capacities to mitigate the negative impact of shocks by including an interaction term in the regression models.

Section 9.3 presents a series of graphs that demonstrate the predicted effects of resilience capacity variables – indexes as well as index components – that have the strongest positive relationship with key outcomes.

Each figure in this section shows the change in a given outcome indicator corresponding to a movement in each of the respective resilience capacity indexes, each of which has a minimum value of 0 and a maximum value of 1. As a general rule, results indicating improvements in outcomes affected by increases in resilience capacity will be reported in terms of a movement from the bottom quarter of the sample (25th percentile) to the top quarter (75th percentile). Reporting the change in outcome indicators using the same percentiles, i.e., showing the movement between two fixed reference points, facilitates comparability across indicators and lends consistency to the analysis. The 25th and 75th percentile values for the sample are shown in Table 12.

Table 12: Resilience indicator values at 25th and 75th percentiles of sample

Indicator	Value at 25th percentile	Value at 75th percentile
Absorptive capacity index	33.5	59.4
Adaptive capacity index	26.1	50.8
Transformative capacity index	13.5	41.9

9.1. Resilience Capacities and Well-being Outcomes

Probability of Poverty

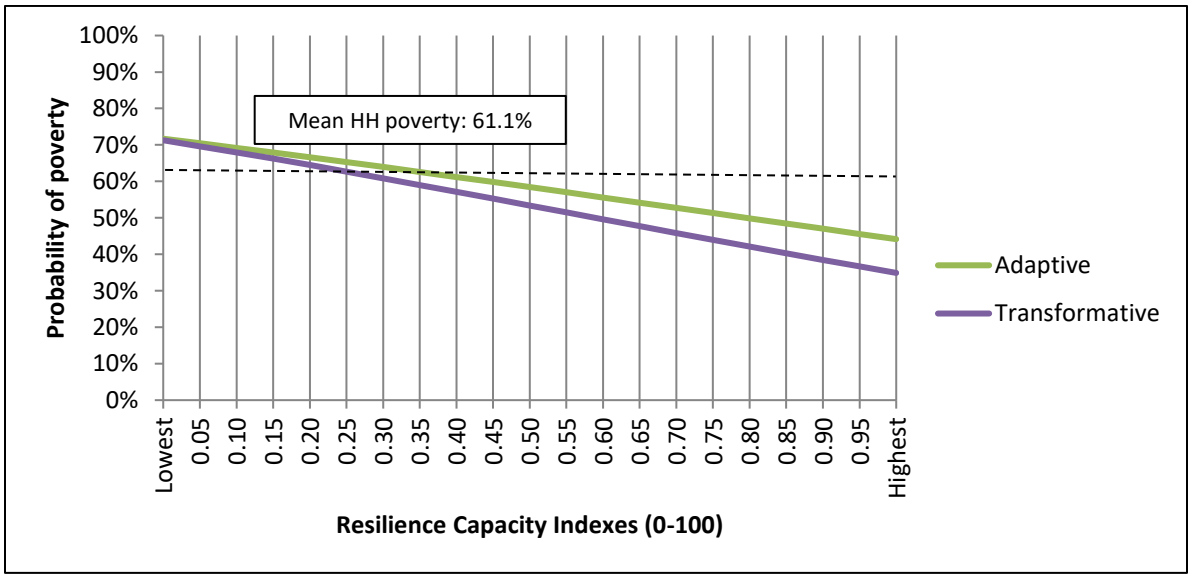
In this report, daily per capita expenditures are a proxy indicator for income. Daily per capita expenditures are directly related to poverty prevalence because a household is considered poor if daily per capita expenditures are less than $US1.90 per day. Figure 2 maps the relationship of the

probability of poverty against varying levels of the adaptive and transformative resilience capacity indexes. The full regression results that serve as the foundation of these predicted outcomes are provided in Annex B: Table 20**.** Note that absorptive capacity was not found to be statistically related to probability of poverty and is therefore not presented in Figure 2.

The slope of a curve shows the predicted magnitude of a given capacity's impact on poverty level: a steeper line indicates more impact; a flatter line indicates less impact. The lines in Figure 2 tell us that both absorptive and transformative resilience capacities are predicted to have an inverse relationship with poverty, i.e., as these capacity levels increase (left to right along the x-axis), poverty levels decrease (from high to low along the y-axis).

Another way to describe the findings in Figure 2 is that it tells us how poverty is predicted to change as resilience levels change, and the relationship between specific resilience index score values and poverty level. With respect to the two resilience indexes that are statistically significant, a movement in adaptive capacity from the 25th percentile (26.1) to the 75th percentile (50.8) predicts a roughly seven percent decrease in prevalence of poverty from approximately 65 to 58 percent. A similar movement in transformative resilience capacity (from 25th percentile [13.5] to 75th percentile [41.9] [12]) predicts a decrease in poverty prevalence of about 10 percent, from approximately 67 to 57 percent.

Figure 2: Probability of poverty predicted by adaptive and transformative capacity resilience levels



NOTE: Adaptive capacity significant at 0.05 (**) and transformative capacity significant at the 0.01 (***) level.

[12] Percentile values are from Table 12.

FINDING 5: Households with higher adaptive and transformative capacity are less likely to be poor. A movement from the bottom quarter to the top quarter of adaptive and transformative capacity predicts a (minimum) 5 to 10 percent absolute reduction in the level of poverty.

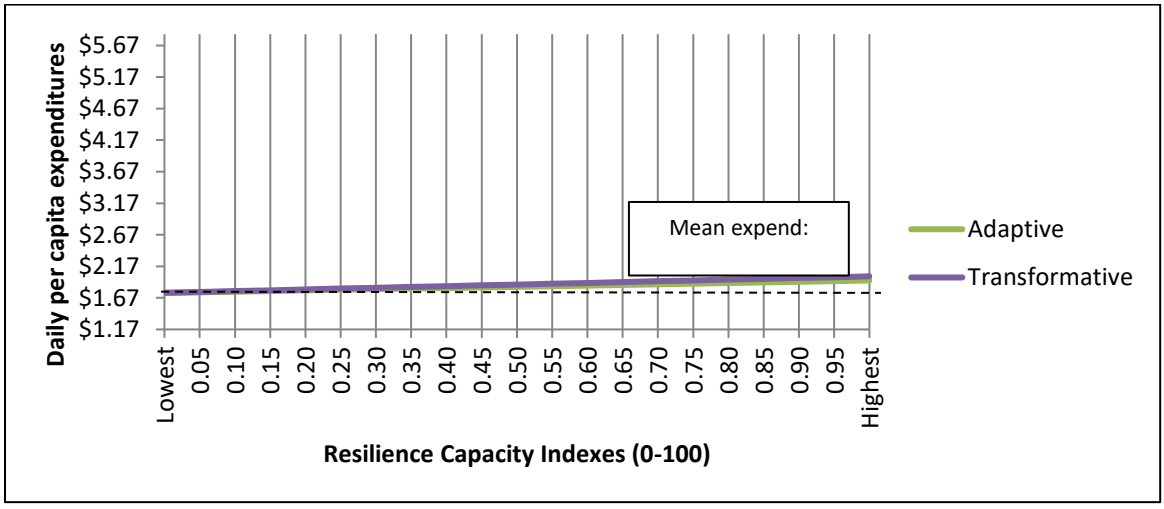
Expenditures

The same two resilience indexes that were statistically significant for predicted poverty are also significant for expenditures – though in the opposite direction. Figure 3 shows that a movement in adaptive capacity from the 25th percentile to the 75th percentile raises daily expenditures above the sample mean ($1.83), from about $1.80 to $1.85, a five-cent difference. A similar movement in transformative capacity predicts a larger increase in daily expenditures from $1.79 to $1.86, a seven-cent difference.

Figure 3 shows the relationship between adaptive capacity, transformative capacity, and actual daily per capita expenditures (absorptive capacity is not a significant predictor and therefore not shown) (please see Annex B for full regression results). Mean expenditures for the whole sample ($1.83/day) are shown as a dotted horizontal line. As noted earlier, daily per capita expenditures are a proxy for income and used to measure poverty levels; hence, an increase in daily per capita expenditures suggests that poverty is decreasing.

The same two resilience indexes that were statistically significant for predicted poverty are also significant for expenditures – though in the opposite direction. Figure 3 shows that a movement in adaptive capacity from the 25th percentile to the 75th percentile raises daily expenditures above the sample mean ($1.83), from about $1.80 to $1.85, a five-cent difference. A similar movement in transformative capacity predicts a larger increase in daily expenditures from $1.79 to $1.86, a seven-cent difference.

Figure 3: Daily per capita expenditures predicted by adaptive and transformative capacity resilience levels



NOTE: Adaptive and transformative resilience capacities are statistically significant at the 0.01 (***) levels.

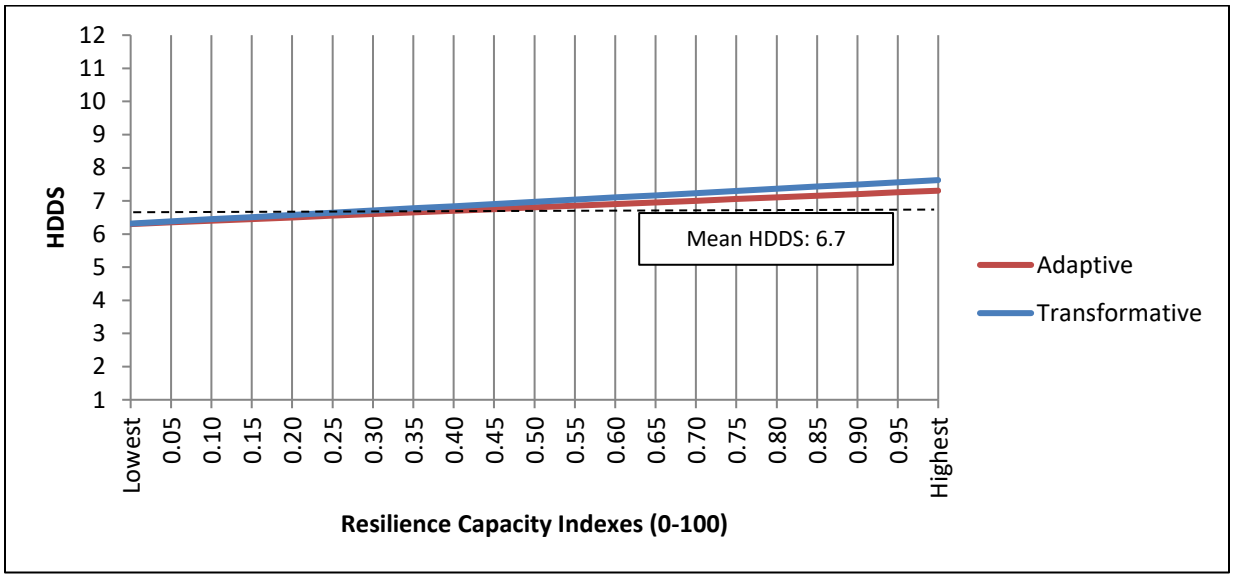
FINDING 6: Households with higher adaptive and transformative resilience capacities are more likely to earn higher income. A movement from the bottom quarter to the top quarter of the adaptive capacity is associated with about a five-cent increase in daily per capita expenditures and a seven-cent increase associated with transformative capacity scores.

Household Dietary Diversity

Figure 4 shows a significant positive relationship between household dietary diversity (as measured by HDDS) and adaptive and transformative resilience capacities (absorptive capacity is not significantly related to HDDS) (please refer to Annex B, Table 22 for full regression results). The mean HDDS for the sample, 6.7 out of a maximum possible score of 12, is shown as a dotted horizontal line.

Movement from the bottom quarter (25th percentile, 26.1) to the top quarter of adaptive capacity (75th percentile, 50.8) results in a 0.2 increase in the number of food groups consumed (6.6 to 6.8). An increase in transformative capacity (25th percentile, 13.1 to 75th percentile, 41.9) is also associated with a slightly larger increase in food groups consumed, from 6.5 to 6.9.

Figure 4: HDDS predicted by adaptive and transformative capacity resilience levels



NOTE: Adaptive capacity statistically significant at the 0.05 (**) level. Transformative capacity statistically significant at the 0.01 (***) level.

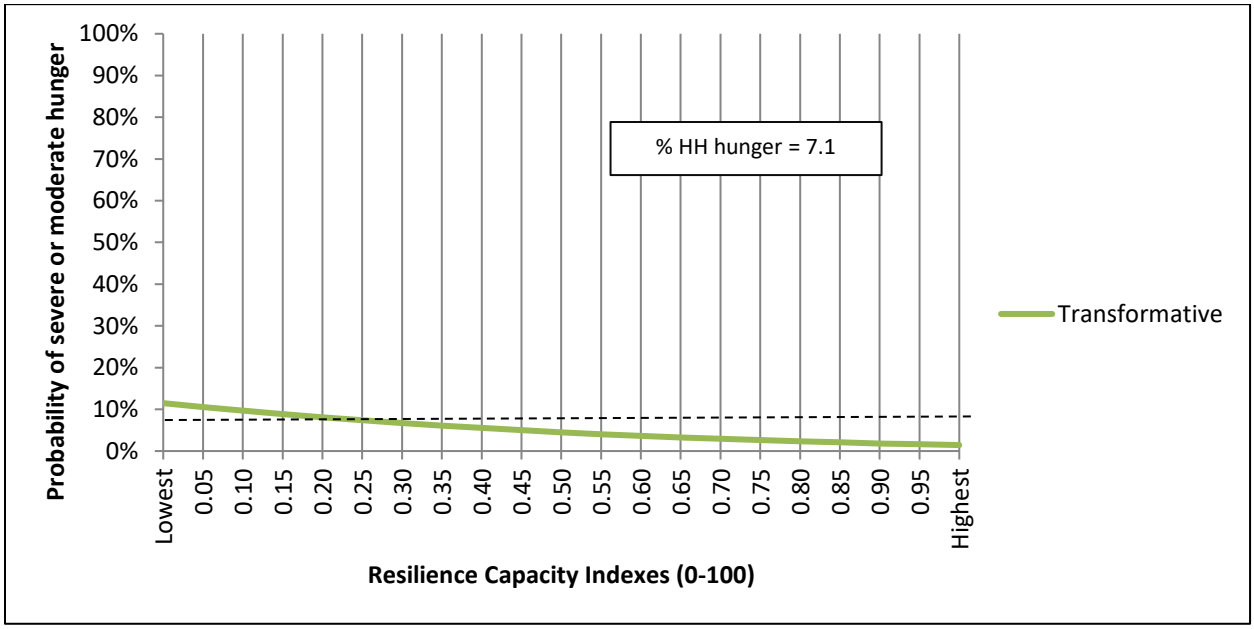
FINDING 7: Households with higher levels of adaptive and transformative resilience capacity are more likely to have more diverse diets. However, the predicted increases in dietary diversity associated with movements from the bottom quarter to the top quarter of the sample for these two capacities are fairly small: from 0.2 more food groups (adaptive capacity) to 0.4 food groups (transformative capacity).

Hunger

Figure 5 plots the relationship between severe and moderate hunger outcomes and different levels of the transformative capacity index values (adaptive and absorptive resilience capacities are not statistically significantly correlated with hunger as shown in Annex B: Table 23). A low probability is the desired outcome for this indicator: we would hope to see fewer than 7.1 percent of households – the sample mean – experiencing hunger. The analysis indicates that higher levels of transformative capacity reduce the likelihood of hunger in the face of shocks.

Movement from the bottom quarter (25th percentile, 13.1) to the top quarter of transformative capacity (75th percentile, 41.9) results in about a four percent reduction in prevalence of moderate and severe household hunger, from nine percent to five percent; this brings the percent of households experiencing hunger a little below the sample mean. It bears noting again that baseline hunger prevalence in this sample is fairly low (see earlier discussion in Section 7 and data in Table 8).

Figure 5: Probability of severe or moderate hunger predicted by transformative capacity levels



NOTE: Transformative capacity statistically significant at the 0.01 (***) level.

FINDING 8: Households with higher transformative capacity are less likely to experience moderate or severe hunger.

Recovery from Shock

Recovery from shock is computed based on how households responded to questions about their abilities to meet their food needs after a shock (of any type) in the past year – *better than, the same as,* or *worse than* before the shock; the reported measurement includes households who reported

recovering to the same or better levels as before the shock. Across the sample, 19.1 percent indicated having recovered from shock. Analysis of the data indicate that transformative capacity is significantly related to recovery, but not in the expected positive direction (please refer to Annex B: Table 24 for full regression results). In other words, households with higher levels of transformative capacity are less likely to recovery. The unexpected negative slope of transformative capacity may be driven largely by access to formal safety nets. A likely explanation might be that households receiving assistance were identified by formal agencies (NGOs and Governmental) as less able to recover. Although counter-intuitive at first glance, this result may reflect effective targeting of formal safety nets to the most vulnerable households, who in turn are less likely to recover from shocks. It may be that without access to formal safety nets, these households would have been even less likely to recover from the shocks they were exposed to.

FINDING 9: Transformative capacity is significantly and negatively associated with recovery from all shocks experienced in the past 12 months. Access to formal safety nets is the primary driver behind this finding. A possible explanation for this unexpected finding may be indicating that agencies are appropriately targeting safety nets toward households that are less able to recover.

Takeaway 9: Resilience Capacity and Outcomes

- Households with higher adaptive or transformative resilience capacity are less likely to be poor. A movement from the bottom quarter to the top quarter of adaptive and transformative capacity predicts a (minimum) 5 to 10 percent absolute reduction in the level of poverty. Absorptive capacity does not have a statistically significant relationship with poverty.
- Households with higher adaptive or transformative capacity are more likely to earn higher income. A movement from the bottom quarter to the top quarter of adaptive and transformative capacity predicts a (minimum) five- to seven-cent increase in daily income.
- Households with higher adaptive or transformative capacity are more likely to have diets that are more diverse. A movement from the bottom quarter to the top quarter of adaptive and transformative capacity results in a 0.2 - 0.4 increase in the number of food groups consumed.
- Households with higher transformative capacity are less likely to have moderate or severe hunger. A movement from the bottom quarter to the top quarter of transformative capacity predicts a roughly four percent decrease in household hunger.
- Only transformative capacity is significantly and negatively associated with recovery. The unexpected direction is likely influenced largely by access to formal safety nets, which reflects appropriate targeting of more vulnerable households.

9.2. Mitigating the Negative Impact of Shock on Well-being: Resilience Capacity by Shock Interactions

The regressions in this section build on the previous analysis by exploring whether and to what extent resilience capacity mitigates the negative impacts of shock on well-being outcomes. The model being tested here is that households exposed to more shocks are expected to be less able to recover, and have worse food security and economic outcomes, all else being equal, but higher levels of resilience capacities are anticipated to mitigate these negative effects of shock exposure. To test this anticipated effect, an interaction term of resilience capacity by shock exposure is included in the model. The inclusion of the interaction term tests the hypothesis that not only do higher levels of resilience capacities mitigate the negative effects of shocks, but that these mitigating effects are even stronger for greater levels of shock exposure.

The results presented in Table 13 indicate that these expected patterns do not hold, rendering the results difficult to interpret meaningfully. For example, the regression results for the poverty outcome variable indicate that higher levels of adaptive capacity are associated with lower poverty as expected, yet counterintuitively, increased exposure to shock also lowers the likelihood of poverty. Similarly, for HDDS, households exposed to more shocks are likely to have a less diverse diet, but having more absorptive capacity is also associated with lower dietary diversity. Based on these results, we can conclude that resilience capacity has a direct effect on well-being outcomes taking into account the level of shock exposure as seen in Section 9.1., but not strong enough to mitigate the negative impact of shock.

Table 13: Interactions between resilience capacity and shock exposure

Indicator	Outcome				
	Per capita expenditures	Poverty	HDDS	Hunger	Recovery
Absorptive capacity	0.002*	-0.00411	-0.0236***	0.0135**	-0.00155
Shock exposure	0.0357	-0.146	-0.657***	0.266	-0.535***
Absorptive * Shock	-0.000482	0.000925	0.0123***	-0.00405	-0.000661
Adaptive capacity	0.0037***	-0.0134***	-0.00507	-0.000691	-0.00749
Shock exposure	0.0428**	-0.197**	-0.382***	0.0792	-0.684***
Adaptive * Shock	-0.00077**	0.0025*	0.00684***	-0.000393	0.00298
Transformative capacity	0.00336***	-0.00695*	0.00408	-0.0086**	-0.00644
Shock exposure	0.0206	-0.0168	-0.186***	0.102	-0.591***
Transformative * Shock	-0.000398	-0.00177	0.00472***	-0.000739	0.000954

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

FINDING 10: Interacting resilience capacity with shock exposure does not yield a consistent pattern across the well-being outcomes. The expected direction of resilience capacity and shock exposure are often incongruent.

Takeaway 10: Resilience Capacity, Shock Exposure, and Outcomes

- The analysis of the shock-mitigating impacts of resilience capacities does not indicate that the resilience capacities have progressively stronger effects on mitigating the negative impacts for higher levels of exposure to shocks.

9.3. Decomposing Absorptive, Adaptive, and Transformative Capacities: The Strongest Relationships

The graphs presented in this section focus on how changes in components of the resilience capacity indexes are predicted to affect three outcomes, poverty, hunger, and recovery from shock. It highlights the particular components that have the strongest effects, both in terms of statistical significance and direction, based on the principal regression specification described in Annex C. This analysis differs from the previous discussions because it focuses only on the statistically significant component variables that go into the resilience capacity indexes. The effects of the individual capacity components can be interpreted as the direct influence these characteristics have on a given outcome indicator.

The resilience component indicators are plotted on the x-axis, using two points of reference: the values of the indicator at the 25th and 75th percentile of the sample, or what we refer to as "low" and "high" range values. Table 14 presents the mean values at the 25th and 75th percentile values, respectively, of indicators measured as continuous variables. This permits comparability across variables that use different scales. In other words, the red bars in the following figures indicate the value for the variable at the 25th percentile and the adjacent blue bars reference the value at the 75th percentile. For binary variables, i.e., variables whose values is either 0 (absence of) or 1 (presence of), the change noted is not connected to percentiles; the change is defined as the difference between *absence of* and *presence of* (e.g., not having versus having access to remittances). The y-axis represents the probability of a particular outcome (poverty, hunger, recovery – Figure 6 to Figure 8, respectively).

Table 14: Resilience indicator values at 25th and 75th percentiles of sample[a]

Indicator	"Low" (value at 25th percentile)	"High" (value at 75th percentile)
Bonding social capital	3	7
Asset index	2	5
Bridging social capital	2	6
Livelihood diversity	2	3
Exposure to information	0	3
Access to services	0	6

[a]The values presented in this table are for continuous variables; binary variables have values of 0 and 1, and are not presented in this table.

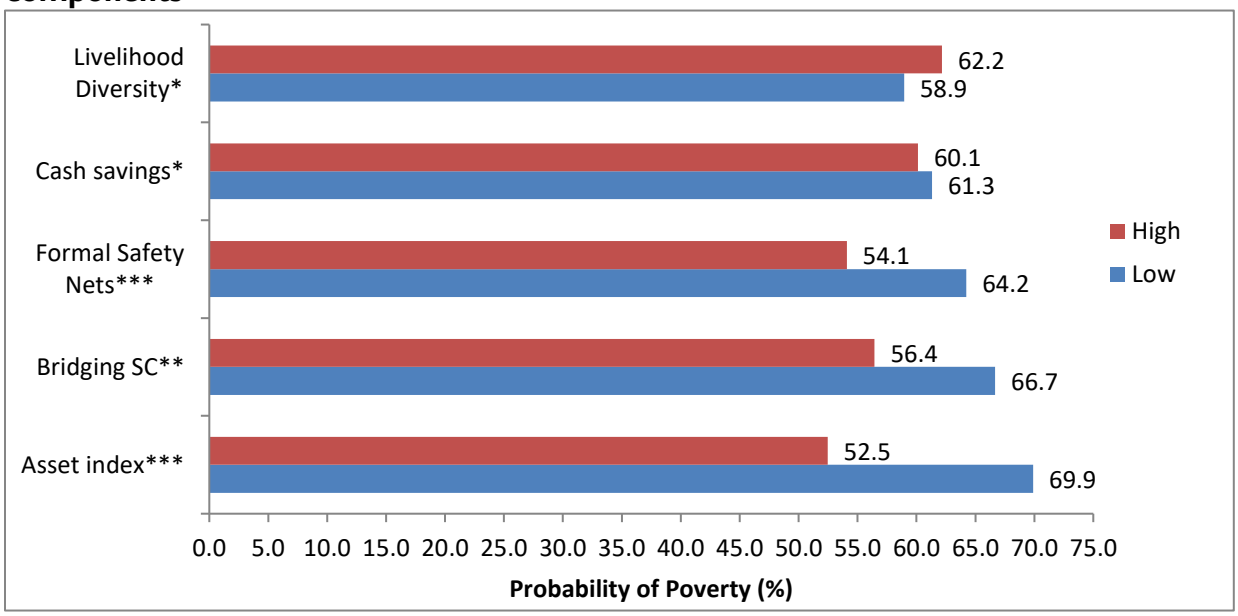
Probability of Poverty

Figure 6 plots the probability of poverty (as measured by per capita expenditures) against five component variables with statistically significant relationships. The data show that four of the five indicators are predicted to decrease the likelihood of a household living in poverty: higher values for any of these indicators are associated with lower levels of poverty (the blue bars).

The asset index is most strongly associated with reduction in the likelihood of poverty: moving from the 25th to the 75th percentile values corresponds to a 17 percent decrease in the probability of poverty from about 70 percent to 53 percent, a dramatic improvement. In other words, owning assets from three more categories (five categories at the 75th percentile versus two at the 25th percentile) corresponds to a 17 percent decrease in the chance that the household will be poor.

The next-strongest indicators, bridging social capital and formal safety nets, have effects of nearly identical magnitude; each reduces the probability a household lives in poverty by 10 percent. The 25th percentiles for bridging social capital correspond to 67 percent poverty rate and drops to 56 percent at the 75th percentile. The presence of formal safety nets also has a strong influence. Moving from the 25th to the 75th percentile decreases the probability of poverty by about 10 percent.

Figure 6: Likelihood of poverty by high and low levels of resilience capacity components



NOTE: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

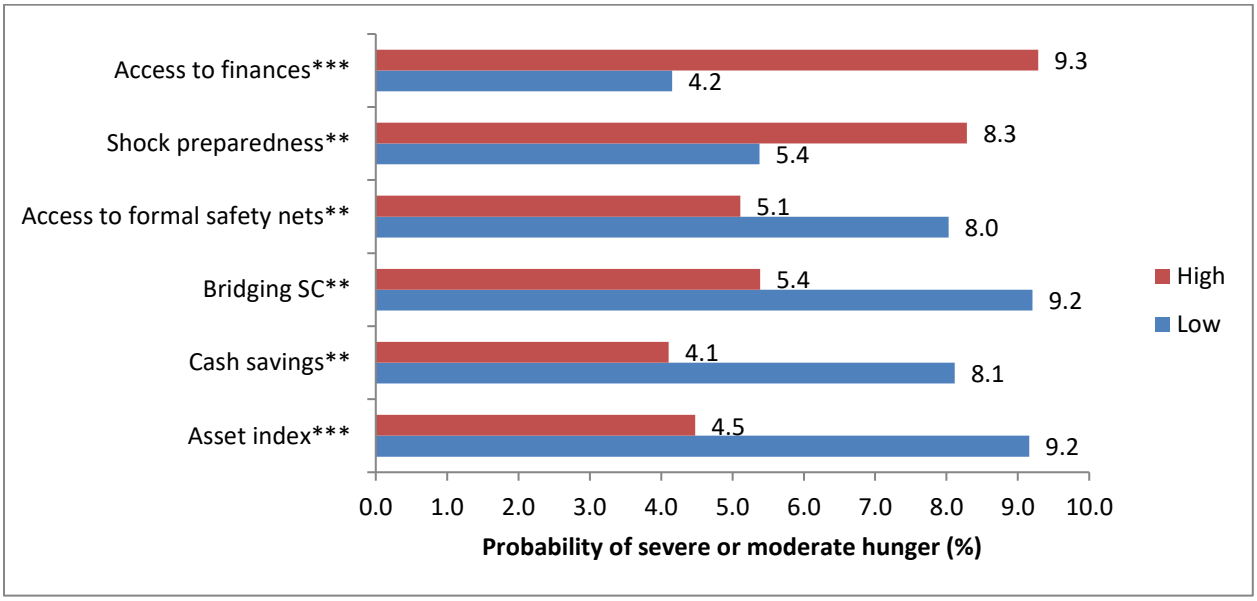
FINDING 11: Reductions in poverty are predicted most strongly by higher asset ownership, bridging social capital, and access to formal safety nets. Movements from the bottom quarter to the top quarter reduces the likelihood a household will be poor by 10 to 17 percent. Asset ownership is a particularly powerful predictor of poverty level – owning assets in five categories corresponds to a 17 percent lower incidence of poverty than owning assets in just two categories. It is worth nothing that households who have more diverse livelihood activities are marginally more likely to be poor (by three percent), an indication that these households are more vulnerable.

Hunger

Figure 7 plots the probability of hunger against six variables with statistically significant relationships with this outcome. Similar to the finding for probability of poverty, a component variable (household assets) is the strongest predictor of hunger. Moving from the 25th to 75th percentile values for assets is predicted to lower the chance of household hunger from about 9.2 percent to under 4.5 percent.

The other three indicators that are also significantly associated with lower prevalence of hunger are cash savings, bridging social capital, and access to formal safety nets. Having cash savings and higher bridging social capital corresponds to a four percent reduction in hunger, and a two percent reduction is associated with access to formal safety nets. As noted in Sections 6, the level of poverty in the sample is low to begin with, and these data must be interpreted cautiously given the measurement challenges described earlier. Nevertheless, these data suggest that controlling for other resilience capacities, achieving higher values for asset index, cash savings, bridging social capital, and access to formal safety nets reduce household hunger by a small, but significant, degree.

Figure 7: Likelihood of hunger by high and low levels of resilience capacity components



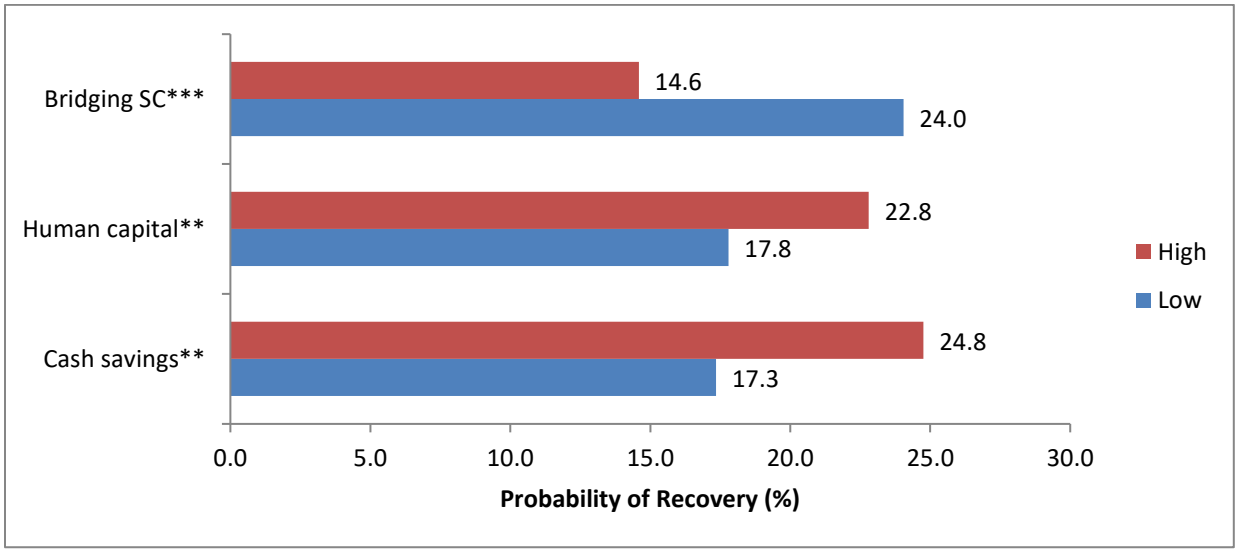
NOTE: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels.

FINDING 12: Asset ownership, bridging social capital, cash savings, and access to formal safety nets have a direct but small influence on reducing hunger, although asset ownership reduces hunger more than any of these other measures. Overall, the influence of resilience capacity in reducing hunger for this sample is low, likely a reflection of the low prevalence of hunger in this particular sample population. The findings suggest that investments in these areas will positively influence hunger levels more than the other possible indicators measured in this survey. On the other hand, households are three to five percent more likely to be hungry if they receive early warning information relating to shocks and stressors or if they have access to financial resources. Those who are receiving early warning information may also be experiencing more shocks and stressors which has a direct negative influence on hunger levels. Likewise, households who are more food insecure may also be more likely to take out loans or borrow money.

Recovery

Recovery is significantly associated with cash savings, human capital, and bridging social capital (Figure 8). Households with cash savings are more likely to recover; moving from the 25th to 75th percentile value is predicted to increase recovery by roughly seven percent. Households with educated adults are five percent more likely to recover. Relying on or assisting others outside the community (bridging social capital) appears to hinder recovery; households with higher levels of bridging social capital are ten percent less likely to recover. Even though bonding social capital is not a significant predictor of recovery, the coefficient is in the expected direction (please refer to Annex B: Table 26), suggesting that recovery is more likely by relying on or helping others within the community.

Figure 8: Likelihood of recovery by high and low levels of resilience capacity components



NOTE: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels.

FINDING 13: Households with cash savings and educated adults are five to seven percent more likely to recover. The counterintuitive finding that lower levels of bridging social capital results in a ten percent greater likelihood of recovery might be a reflection that relying on or helping others outside the community may be a strategy of last resort for households that have been severely affected by the shock, and have exhausted all other types of support, and thus are less likely to recover. While bonding social capital is not a significant predictor of recovery, the positive direction suggests that relying on others within the community promotes recovery.

Takeaway 10: Resilience Capacity Components and Outcomes

- Greater asset ownership, more bridging social capital, and greater access to formal safety nets are associated with a 10 to 17 percent reduction in households experiencing poverty.
- Households are less likely to be hungry if they have more assets, cash savings, more bridging social capital, and access to formal safety nets. Collectively, the account for an average of four percent reduction in the likelihood of experiencing moderate to severe hunger.
- Recovery is roughly six percent more likely among households that have cash savings and educated adults. Relying on others outside the community is associated with lower levels of recovery.

10. Shock Coping Strategies and Outcomes

The results presented in this section demonstrate the relationships between well-being outcomes and coping strategies, and the likelihood of using coping strategy by level of household resilience capacity. Results in section 10.1 were generated using multivariate regression analysis in which strategies used to cope with shock are treated as key determinants of poverty, hunger, and recovery from shock, controlling for shock exposure, household characteristics, and livelihood type. Results presented in 10.2 were generated using the same analytical technique to determine the utility of coping strategies as a function of household resilience capacities. Descriptions of the specifications are described in Annex C. Full results from all regressions are available in Annex B: Table 32 to Table 34.

It should be noted that the shock coping strategies presented below, although seemingly similar, are distinct from resilience capacities. All of the shock coping strategies are sourced from questions asking respondents about their actual use of each of the respective response strategies in reference to shocks experienced (see list of coping strategies in Annex E). In contrast, similar characteristics that are defined as resilience capacities (e.g., social capital, access to remittances, access to savings, etc.) are measured as sustained household stocks of these characteristics independent of their exposure to shocks or their use of these strategies.

In addition, we are largely interested in the use of two negative coping strategies, changing food consumption and reducing childcare expenses. These negative coping strategies are generally considered extreme or last-resort behaviors, suggestive of a high level of food insecurity and vulnerability. Likewise, we are interested in the use of positive coping strategies associated with higher levels of resilience capacities such as offtake of livestock, participation in conflict management, seeking wage labor, and social capital.

10.1. Coping Strategies and Outcomes

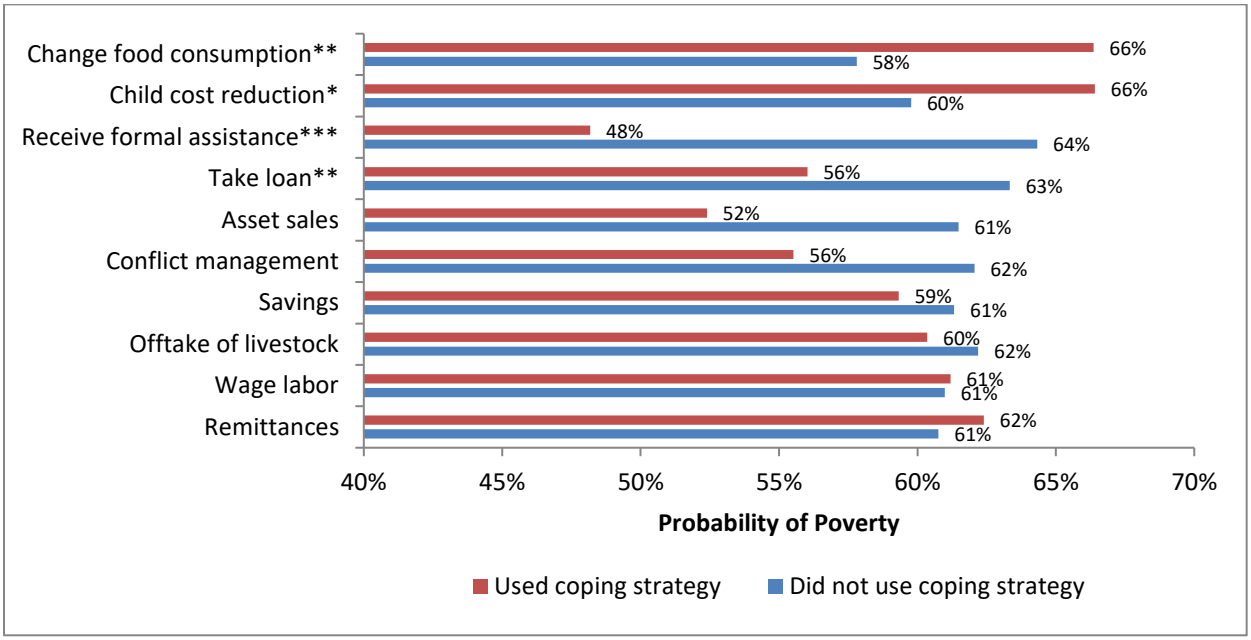
Probability of poverty

Figure 9 shows the effect of use versus non-use of shock coping strategies on the probability of poverty. The data show that households that respond to shock by relying on negative coping strategies (e.g., changing household food consumption patterns or reducing expenses related to taking care of children) are, on average, eight percent more likely to be poor than those who do not.

The other two coping strategies significantly related to poverty have the opposite impact. Receiving formal food assistance is predicted to decrease the probability of a household living in poverty following a shock by 16 percent, from about 64 percent to about 48 percent, a dramatic reduction. Taking loans is also predicted to have a powerful effect, decreasing the percentage of households living in poverty from about 63 percent to 56 percent. The analysis indicates that changing food consumption practices in one or more of the listed ways is correlated with a predicted increase in poverty, from about 58 percent to 66 percent of households. Efforts to reduce expenditures

associated with raising children also has a negative association with poverty; withdrawing children from school, sending them to live with other adults or relatives or away to work do not alleviate the household from poverty, but in fact, is predicted to increase it by roughly six percent.

Figure 9: Effect of use of shock coping strategies on the probability of poverty



NOTE: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels.

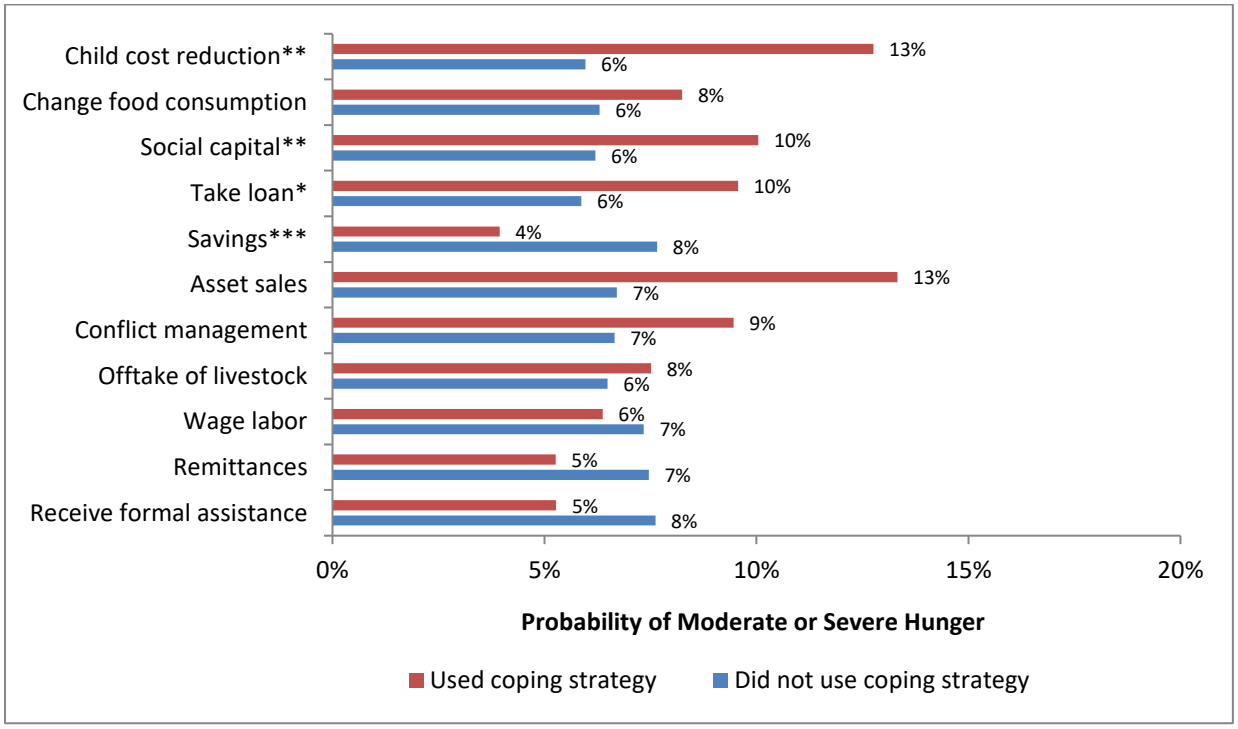
FINDING 14: Households that changed food consumption practices in certain ways or sought to reduce costs associated with raising children are more likely to live in poverty. Contrarily, households that rely on formal food assistance and taking loans as shock coping strategies experience less poverty.

Hunger

Figure 10 shows how the use of coping strategies affects severe or moderate household hunger. Reducing childcare expenses as a response to shock is associated with a seven percent increase in hunger, from roughly 6 to 13 percent. While the other significant strategies are not considered negative (taking loans and relying on others/social capital), they are also associated with about a four percent increase in likelihood of having moderate to severe household hunger.

The only coping strategy that is significantly associated with a reduction in household hunger is using money from household savings. This result is not surprising, as drawing down on household savings may be used to purchase food or otherwise provide for food needs. The indicator is predicted to reduce severe or moderate hunger by a significant but small amount, from eight to four percent of sample households. (Again, as noted in previous sections, baseline hunger levels in the sample are low and there are methodological caveats to the reliability of this finding; hunger at other times of year is likely higher.)

Figure 10: Effect of use of shock coping strategies on the probability of severe or moderate hunger



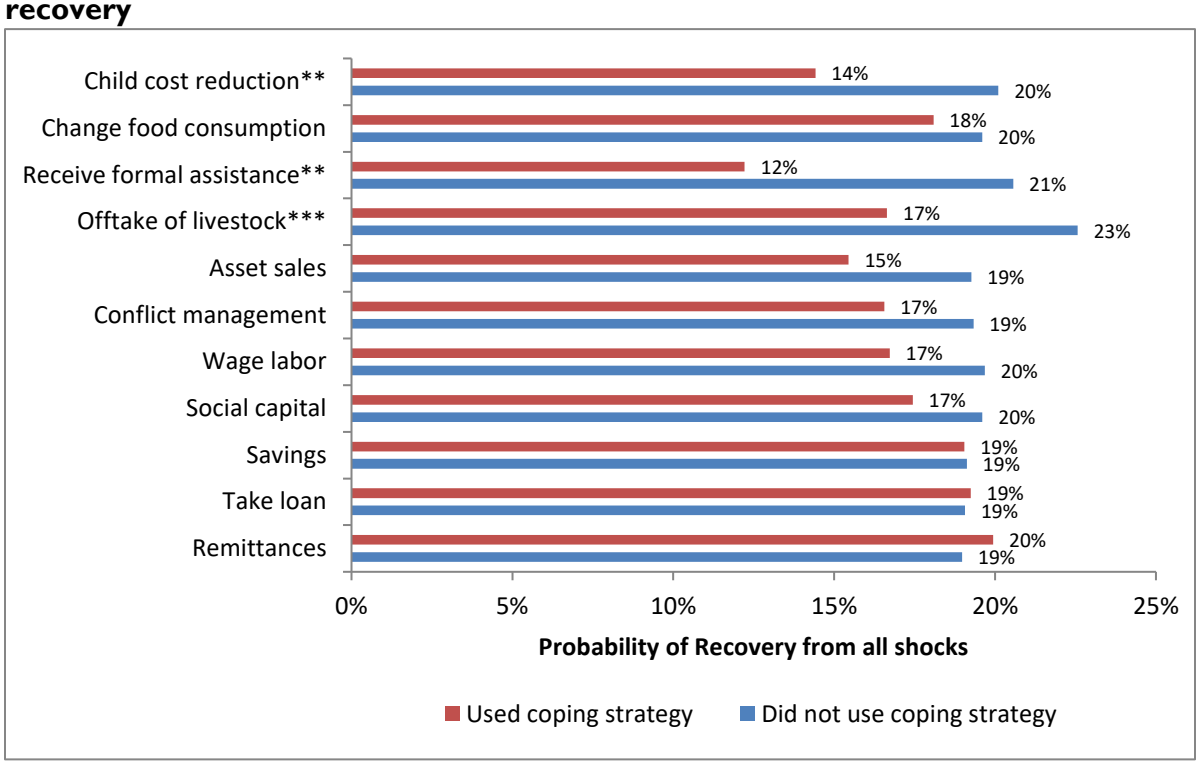
NOTE: Asterisks represent statistical significance at the 0.01(***) and 0.05 (**) levels and marginal significance at the 0.10 (*) level.

FINDING 15: Households that use savings as a coping mechanism to recover from shocks are predicted to have lower levels of severe or moderate hunger than those that did not. Several coping strategies are associated with more hunger (reducing child care costs, social capital, and taking loans), although given the limitations of the model and a need for further contextualization. These negative correlations may be due to the fact that the associated coping strategies are only undertaken when households face severe food insecurity.

Shock Recovery

Figure 11 illustrates that households who reduce child care costs as a means to cope with shock are about six percent less likely to recover than those who do not. Receiving formal assistance also is associated with lower likelihood of recovery as is offtake of livestock. This may reflect extreme levels of vulnerability: in particular, selling or slaughtering livestock and finding ways to reduce the cost of feeding and caring for children are coping methods of last resort.

Figure 11: Effect of use of shock coping strategies on the probability of shock recovery



NOTE: Asterisks represent statistical significance at the 0.01(***) and 0.05 (**) levels.

FINDING 16: Reducing child care costs, receiving formal assistance, and offtake of livestock predict a lower likelihood of recovery from shock. This may reflect extreme levels of vulnerability, either predating the shock and/or exacerbated by a series of shocks.

Reflecting on the findings reported in the last three figures as a group, it is interesting to note that households receiving food assistance are less likely to be poor or suffer from severe or moderate hunger – both desirable outcomes – yet also less likely to recover to the same or better level as before the shock. The significance of this finding is open to interpretation and likely further contextualization and study are needed for a reliable interpretation. Ideas to explore include "Does this suggest that extremely vulnerable households are being served well by food assistance in that they have positive poverty and hunger outcomes – yet their baseline level of vulnerability, and/or the extent of the shock impact, is so great that a more intensive approach and strategy is needed to enable them to recover?" and "What obstacles to recovery do these households face?"

Takeaway 11: Effect of Coping Strategies on Poverty, Hunger, and Shock Recovery

- Households that use loans and food assistance to recover from shocks are less likely to be poor than households that do not. Households that changed food consumption practices in certain ways, reduced child care costs and took a loan are more likely to be poor.
- Households that use savings are predicted to have lower levels of hunger than those that did not. Several coping strategies are predicted to increase hunger, though there are limitations on the interpretation of this particular result.
- Livestock offtake, child cost reduction strategies, and receiving formal food assistance are predicted to decrease the chance of recovering from a shock(s). This may reflect extreme levels of vulnerability, either predating the shock and/or exacerbated by a series of shocks.

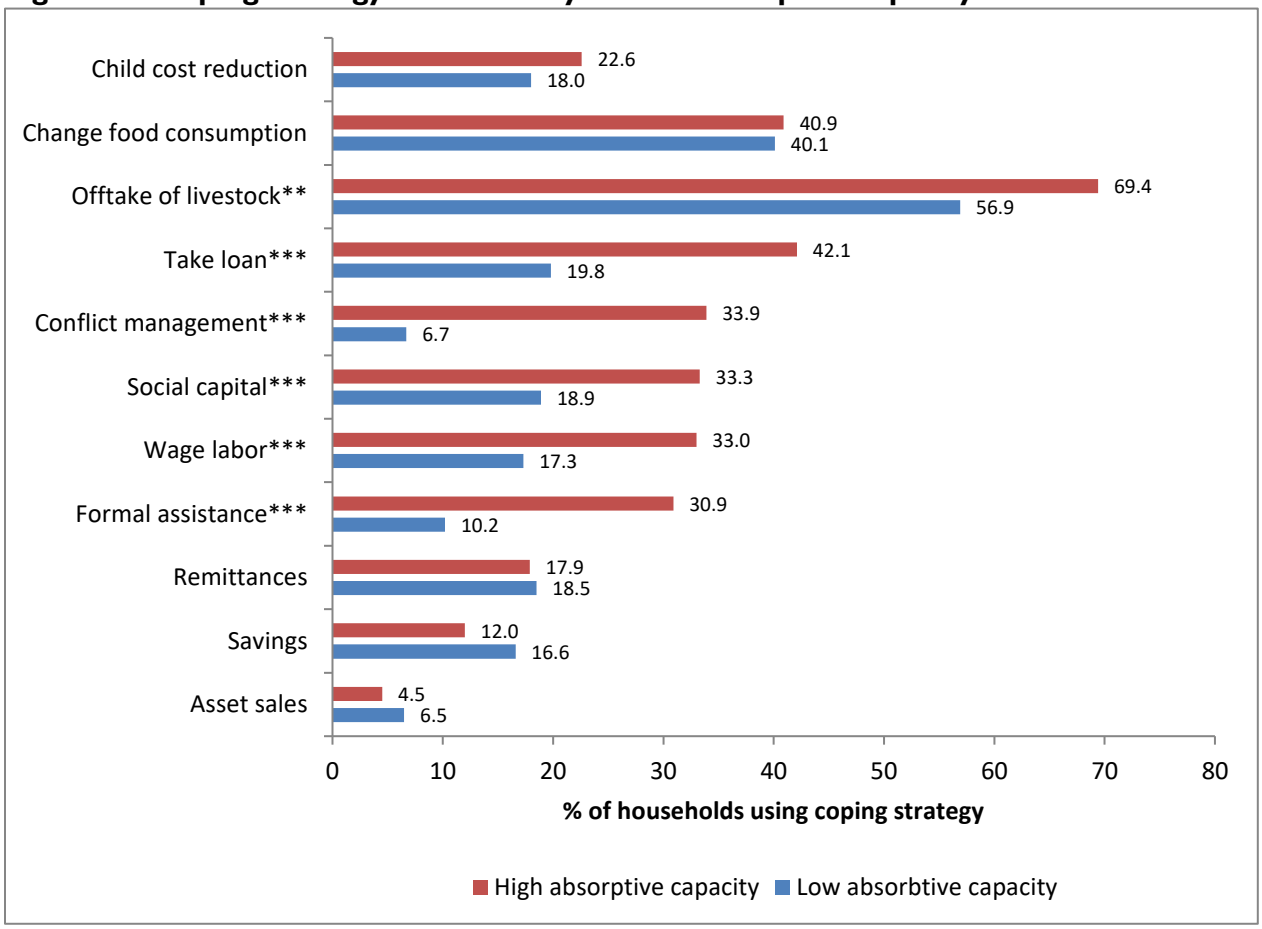
10.2. Resilience Capacities and Coping Strategy Utilization

The results in this section illustrate the likelihood of a coping strategy being used as a function of whether a household has "low" or "high" resilience capacity, where "low" indicates households in the 25th percentile or below and "high" indicates households in the 75th percentile or higher. The expectation is that households with "high" resilience rely on fewer coping strategies, and in particular, negative coping strategies (changing food consumption patterns and reducing child care costs).

Absorptive Capacity

Figure 12 presents the likelihood that household will adopted particular coping strategies depending on their level of absorptive capacity. Households with high absorptive capacity are more likely to offtake livestock, take out loans, seek wage labor, rely on social capital, receive formal food assistance, and engage with conflict management. While households tend to change their food consumption at a higher rate than reducing childcare costs, there is no significant difference between high and low levels of absorptive capacity and use of either of the two negative coping strategies.

Figure 12: Coping strategy utilization by level of absorptive capacity

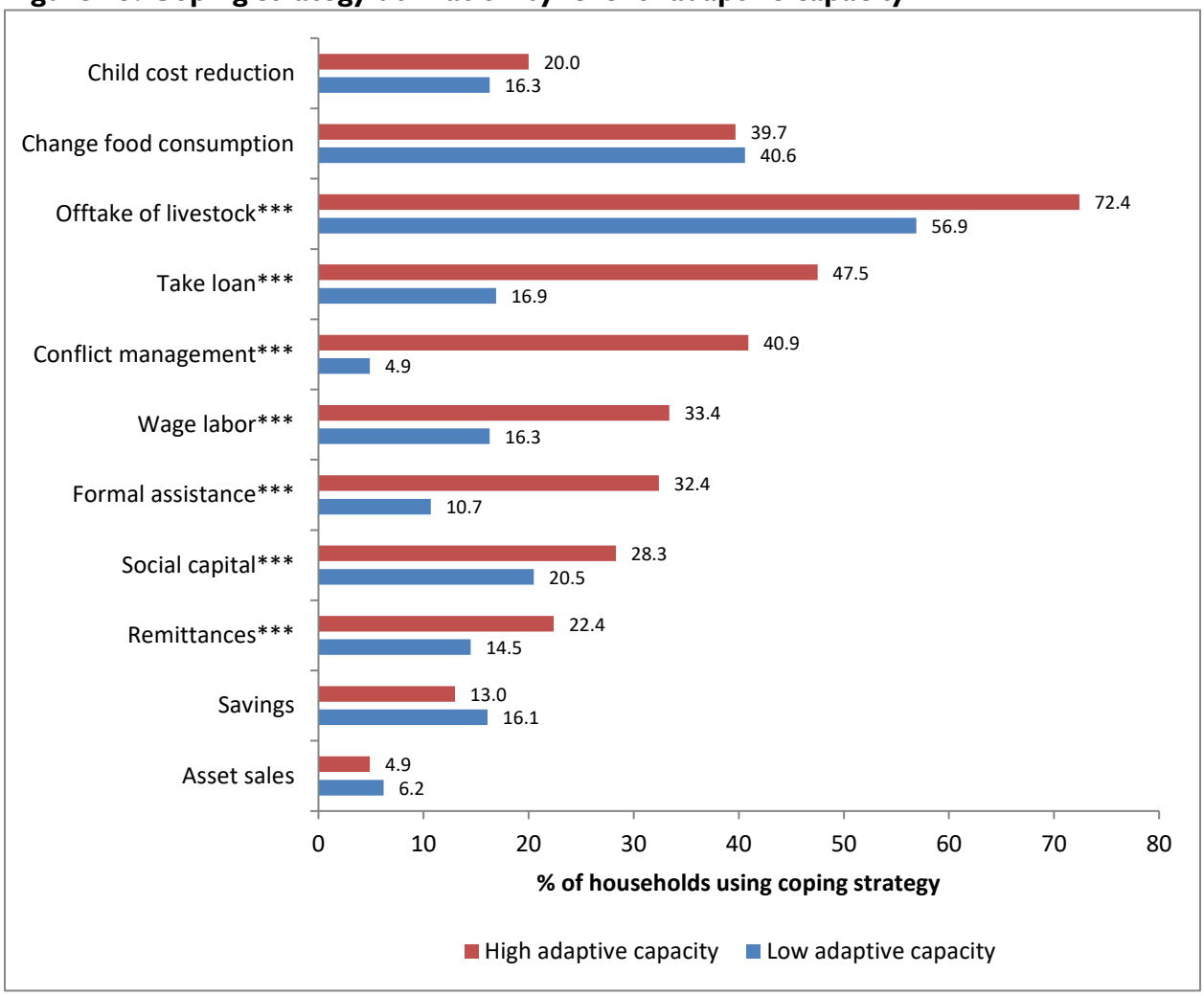


NOTE: Asterisks represent statistical significance at the 0.01(***) and 0.05 (**) levels.

Adaptive Capacity

The patterns of coping strategy use for at different levels of adaptive capacity are similar to those for absorptive capacity (Figure 13). That is, households with high levels of adaptive capacity are just as likely to change their food consumption behavior as those with low levels of adaptive capacity, and this strategy is engaged with more often than reducing childcare costs. Households with higher levels of adaptive capacity are more likely to adopt offtake of livestock, take loans, engage in conflict management, engage in wage labor, draw on social capital, formal assistance, and remittances compared with households with low levels of adaptive capacity.

Figure 13: Coping strategy utilization by level of adaptive capacity

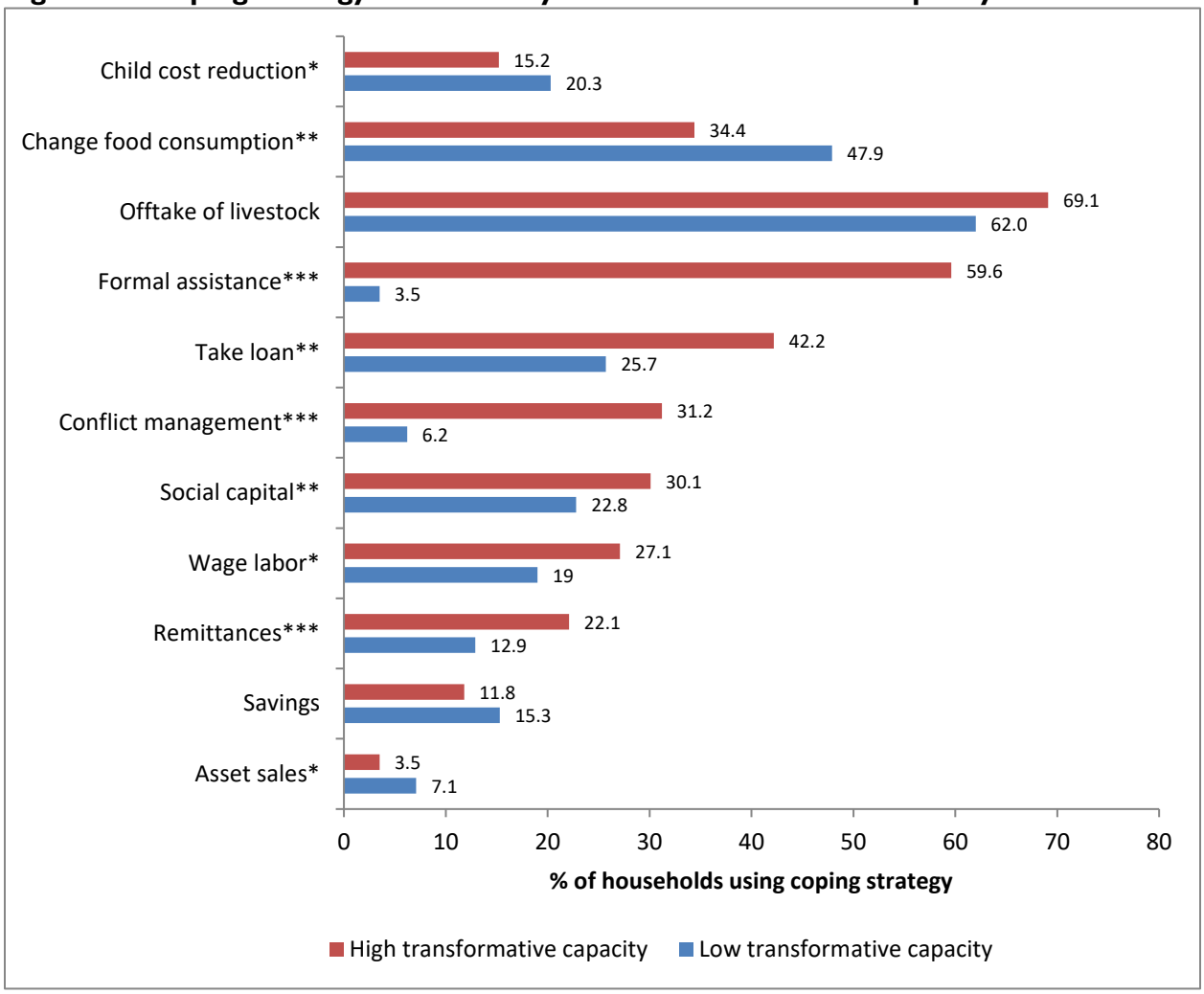


NOTE: Asterisks represent statistical significance at the 0.01(***) and 0.05 (**) levels.

Transformative Capacity

In the case of transformative capacity, differences in reliance two negative coping strategies are observed (Figure 14). Households with low levels of transformative capacity are more likely to resort to reducing childcare costs and changing food consumption. Those with high transformative capacity rely more on formal assistance, conflict management, taking loans, engaging with conflict management, rely on family/friends (social capital), seek wage labor, and use remittances to offset the negative impacts of shocks. Higher levels of transformative capacity reflect greater access to formal assistance and financial services, which are likely explanations for utilization of formal assistance and loans. Better access to these options may explain why households with greater transformative capacities do not need to rely so much on reducing childcare expenses or altering household food consumption.

Figure 14: Coping strategy utilization by level of transformative capacity



NOTE: Asterisks represent statistical significance at the 0.01(***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Takeaway 12: Use of coping strategies as a function of resilience capacity

- Two negative coping strategies that suggest greater vulnerability and last-resort approaches to dealing with the negative impact of shock are reducing childcare costs and changing household food consumption. Households with more transformative capacity tend not to rely on these strategies.
- Households with higher resilience capacities tend to rely more on a particular set of coping strategies compared to households with lower levels of these capacities. Coping strategies associated with higher levels of resilience capacities are: offtake of livestock, participation in conflict management, seeking wage labor, taking loans, relying on formal assistance and social capital.

11. Utilization of Anticipated Project-promoted Practices

This section compares households with different climate-sensitive livelihood and remittance categories in terms of their utilization – at baseline – of household practices related to agriculture and WASH. The analysis focuses on specific practices that the HARANDE Project plans to promote or influence, based on the inclusion of these required-if-applicable indicators in the project's M&E results framework.

11.1. Agricultural Practices

As shown in Table 15, substantial and statistically significant differences exist between the non-climate-sensitive and remittance groups, as compared to the climate-sensitive group. The first indicator (1) relates to financial services that may be used to support agricultural livelihoods. These include credit services (agro-vet [cash or in-kind], contract farming, village savings/credit groups, farmers associations, microfinance institutions, farmer-to-farmer exchange, input from buyers, bank, cooperative, village money lender, and other); savings services (village savings/credit groups, microfinance institutions, co-ops, banks, mobile banking, other); and crop insurance. Overall, 38.3 percent of households in the sample utilized some type of these financial services. Utilization was much higher in climate-sensitive livelihood households (41.6 percent) than in non-climate sensitive livelihood households (19.6 percent). The difference between the groups is logical: climate-sensitive livelihoods tend to be agricultural, and as expected, this group and the both-climate-and-non-climate-sensitive clusters have the highest utilization of financial services, and the difference in utilization compared to the non-climate-sensitive and remittance groups is statistically significant.

Table 15: Utilization of agricultural financial services and agricultural practices in the past 12 months, by climate-sensitive livelihood and remittance category

	Indicator	All	Climate-sensitive livelihoods	Climate and non-climate sensitive livelihoods		Non-climate sensitive livelihood		Remittances	
1	% of farmers who used financial services	38.3	41.6	41.6		19.6	***	33.3	**
2	% of farmers who practiced value chain activities promoted by the project	63.5	70.1	62.8		21.4	***	61.9	**
3	% of farmers who used at least 2 sustainable crop practices and/or technologies	59.5	60.7	54.9		55.8		63.9	
4	% of farmers who used at least 2 sustainable livestock practices and/or technologies	57.2	57.2	53.3		57.7		61.6	
5	% of farmers who used at least 2 sustainable NRM practices and/or technologies	20.2	22.7	20.0		5.8	***	19.1	
6	% of farmers who used at least 3 sustainable agricultural practices and/or technologies	76.5	77.7	72.3		64.2	*	81.4	
7	% of farmers who used improved storage practices	64.6	66.7	57.4	**	51.1	*	71.8	*
	n	*1484*	*489*	*491*		*63*		*441*	

NOTE: Asterisks represent statistical significance between climate-sensitive-only and other livelihood categories at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Value chain promotion (2) is an important anticipated component of the HARANDE Project. The survey measured utilization of the following project-promoted value chain activities: purchasing inputs through agro-dealers or community associations; use of mobile finance; use of financial services (not mobile); use of training and extension services; use of contract farming; use of feed lots or pen feeding; drying, processing and packaging for selling/storage; trading/marketing produce through agro-vets/community associations/co-ops; and use of formal marketing systems for livestock/fruits/spices/honey/organic coffee. A little more than one-third of the sample (63.5 percent of households) reported engaging at least one of these practices in the past year, and the climate-sensitive-only group is the most likely to have engaged in value chain activities: 70.1 percent versus 61.9 percent for the remittance group and 21.4 percent for non-climate-sensitive-only. The large difference between the climate-sensitive and non-climate-sensitive groups is expected if we make the reasonable assumption that the former are primarily engaged in agriculture, to which the listed value chain practices are mainly directed; conversely, the non-climate-sensitive group is less engaged in agriculture and therefore less likely to participate in the project-promoted value chain activities.

The other indicators in this table refer to agricultural practices promoted by the HARANDE Project; these indicators measure the range of sustainable crop, livestock, natural resource management (NRM), agricultural, and storage practices used in the past year. See Annex F for the list of specific practices in each category.

Another significant difference is use of NRM practices: just 5.8 percent of non-climate-sensitive only group used at least two NRM practices in the past year, compared to 22.7 of the climate-sensitive-only group. As with value chains, this is to be expected given the dominance of agricultural livelihoods in the latter group. There is a small but significant difference in use of improved storage practices (71.8 percent of remittance group versus 66.7 percent of the climate-sensitive only group).

Finally, there is a moderate significant difference for the 6th listed indicator – 64.2 percent of non-climate-sensitive-only households versus 77.7 percent of climate-sensitive ones used at least three of the target agricultural practices.

11.2. WASH Practices

Table 16 shows the values for the WASH indicators, disaggregated by climate-sensitive livelihood and remittance category. High values are considered positive: increased values for these indicators over project life will indicate improvements (except for the indicator that measures open defecation, where we would wish to see lower values). The data show that about a third (35.2 percent) of sampled households have access to an improved water source.[13] Significant differences are seen relative to the reference group (climate-sensitive-only): 49.5 percent of the non-climate-sensitive-only group, and 42.8 percent of the both climate-sensitive and non-climate-sensitive-only group, can access an improved water source, compared to just 28.7 percent of the climate-sensitive-only group.

Only 16.7 percent of the sample uses the project's recommended water treatment technologies.[14] The proportion was extremely and significantly low in the non-climate-sensitive-only group: 4.4 percent vs 14.7 percent in the climate-sensitive-only group.

The majority (72.1 percent) of sample households have access to a water source within 30 minutes' walking (this also includes cases where water is available at the dwelling or plot). Households that engage in both climate-sensitive and non-climate-sensitive livelihoods fare slightly better than those who engage in climate-sensitive activities alone: 77.3 percent versus 68.7 percent of households, respectively.

Only a small proportion of sample households (14.2 percent overall) have improved sanitation facilities.[15] However, there is some diversity here across climate-sensitive livelihood and remittance categories. The non-climate-sensitive only group has the highest percentage of households with improved sanitation – nearly one-third (29.4 percent). This is significantly higher than the climate-

[13] Improved water sources include water piped into the dwelling, yard/plot, or standpipe; tube well or borehole; protected well, protected spring, rainwater or bottled water. The source must be available year round, with no interruption in the two weeks prior to the survey.
[14] Recommended water treatment technologies include chlorination, filtration, solar disinfection, and boiling.
[15] Improved sanitation must be non-shared and includes flush to piped sewer system, flush to septic tank, flush to pit latrine, ventilated pit latrine, pit latrine w/slab, and/or composting toilet.

sensitive only group (7.8 percent). The remittance and the "both" group also have significantly higher access to improved sanitation than the climate-sensitive only group (17.2 percent and 16.0 percent, respectively). This is consistent with the higher levels of open defecation in all groups: 40.9 percent of the overall sample openly defecates. The non-climate-sensitive-only group has the lowest rate of open defecation (31.2 percent), which aligns with its having the highest percentage of households with access to improved sanitation (29.4 percent).

Handwashing facilities[16] were observed only rarely (1.8 percent of overall sample – fewer than 30 households), though they are more prevalent in the non-climate-sensitive only group.

Table 16: Utilization of WASH practices, by climate-sensitive livelihood and remittance category

	Indicator	All	Climate-sensitive livelihoods	Climate and non-climate sensitive livelihoods		Non-climate sensitive livelihood		Remittances	
1	% of households using an improved drinking water source	35.2	28.7	42.8	***	49.5	**	32.0	
2	% of households in target areas practicing correct use of recommend household water treatment technologies	16.7	14.7	21.0	*	4.4	***	16.4	
3	% of households that can obtain drinking water in less than 30 minutes (round trip)	72.1	68.7	77.3	**	60.8		72.2	
4	% of households using improved sanitation facilities	14.2	7.8	16.0	***	29.4	**	17.2	***
5	% of households in target areas practicing open defecation	40.9	49.8	33.4	***	31.2	**	40.3	**
6	% of households with soap and water at a handwashing station commonly used by family members	1.8	0.7	1.6		7.0	**	2.5	*
	n	*1484*	*489*	*492*		*80*		*450*	

NOTE: Asterisks represent statistical significance between climate-sensitive-only and other livelihood categories at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

[16] The handwashing indicator refers to the presence of a commonly used handwashing station, including water and soap or a locally available cleansing agent, readily observed by the interviewer during the household visit and where participants indicate that family members generally wash their hands.

Takeaway 13: Utilization of Agricultural and WASH Practices

- The analysis compared use of agricultural and WASH practices across climate-sensitive livelihood and remittance categories, and tested for statistical significance using the climate-sensitive group as the reference group.
- Unsurprisingly, large and significant differences in use of financial services exist between the climate-sensitive only group and the non-climate-sensitive and remittance groups. This difference is somewhat expected because many financial services are oriented to smallholder agriculture, and agriculture is a central activity of the climate-sensitive group. The climate-sensitive-only group is the most likely to have engaged in value chain activities, which is also logical given that the listed value chain practices are mainly directed toward the agricultural sector. This relative pattern repeats for NRM practices with statistically significant comparisons across groups: a much higher percentage of the climate-sensitive-only group practiced at least two NRM practices in the past year, compared to the non-climate-sensitive-only group.
- Approximately one-third of sampled households have access to an improved water source. The climate-sensitive-only group has significantly reduced access to improved water sources than the non-climate-sensitive-only and both climate-sensitive and non-climate-sensitive-only groups. Less than one-fifth of the sample uses recommended water treatment technologies, which were dramatically less common in the non-climate-sensitive-only group (4.4 percent vs 14.7 percent in the climate-sensitive-only group.) Almost three-quarters of the sample have access to a water source within 30 minutes' walking with some significant but small differences across livelihood groups.
- Availability of improved sanitation facilities varied across climate-sensitive livelihood and remittance categories. The non-climate-sensitive only group was most likely to have improved sanitation –29.4 percent, compared to just 7.8 percent of the climate-sensitive only group. The remittance and the "both" group also have significantly higher access to improved sanitation. These findings are consistent with the higher levels of open defecation in all groups: 40.9 percent of sample households. The presence of handwashing facilities was rare.

12. Factoring in Anticipated Program Variables: Regression Analysis of Effects on Recovery and Resilience Capacity Outcomes

The regression analyses described in this section seek to determine the influence adoption of improved agricultural practices, better WASH behaviors, and improved sanitation has on household recovery from shocks. The hypothesis tested is that anticipated program activities improve household recovery from shocks when mediated by resilience capacity. For purposes of this analysis and following discussion, "anticipated program variables" refers to indicators that are tracking activities anticipated to be promoted by the HARANDE Project (e.g., adoption of improved agricultural practices, WASH behaviors), as well as indicators the project is measuring that are related to expected program implementation (e.g., improved sanitation). In all, there are 13 anticipated program variables sourced from the Baseline study. All are binary variables, i.e., each one tells us whether a specific condition or set of related conditions is met or not met, whether a certain characteristic or set of related characteristics is present or not present. For example, "*% of farmers that practiced at least one value chain activity in the past 12 months*" can have a value of 0 or 1, "present" or "not present." The household either practices one or more of the value chain activities expressed in the survey (value = 1), or it does not (value = 0).

Direct Impact of Program Variables on Recovery, Absorptive Capacity, and Adaptive Capacity

The first set of analyses employed to test our hypothesis investigates whether anticipated program variables have a *direct*, positive effect on household recovery from shock. There is no reason to believe that adoption of agricultural practices or WASH behaviors should directly improve recovery; however, we do believe that the anticipated program variables should improve some intermediate outcomes – in particular, resilience capacity. In turn, these increases in resilience capacity should support, positively and directly, improved recovery. Although evidence in section 8.1 (see Table 24 in Annex B) does not indicate that household resilience capacity directly supports recovery, we sought to determine whether the anticipated program variables lead to higher household resilience capacity, and in turn, recovery from shocks.

Results from analysis exploring the relationship between adoption of agricultural practices and WASH behaviors suggest they are weakly related to recovery from shock (Table 17). Of 13 possible behaviors and practices, only one, use of sustainable crop practices and/or techniques, is positively and significantly related to recovery, controlling for other household variables (Annex B: Table 35 and Table 36.).

Table 17: Effects of adoption of agricultural practices and WASH behaviors on recovery, absorptive capacity, and adaptive capacity

Agricultural practices and WASH behaviors	Recovery	Absorptive Capacity	Adaptive Capacity
% of farmers who used financial services in past 12 months		+++	+++
% of farmers who practiced at least 1 value chain activity in past 12 months			+
% of farmers who used at least 2 sustainable crop practices and/or technologies	+++		
% of farmers who used at least 2 sustainable livestock practices and/or technologies			
% of farmers who used at least 2 sustainable NRM practices and/or technologies		++	++
% of farmers who used at least 3 sustainable agricultural practices and/or technologies		+	
% of farmers who used at least improved storage practice			
% of HH with improved water source		++	++
% of HH within 30 minutes walking of water			
% of HH following correct water treatment practices			
% of HH with improved sanitation			
% of HH practicing open defecation			---
% of HH practicing proper handwashing practices			
Total effect of WASH and improved agricultural practice	**N/A**	**Moderate (11.5 of 100)**	**Strong (30.8 of 100)**

(+) represents a positive relationship between practice with more (+) representing stronger statistical significance; (-) represents a negative relationship with more (-) representing stronger statistical significance.

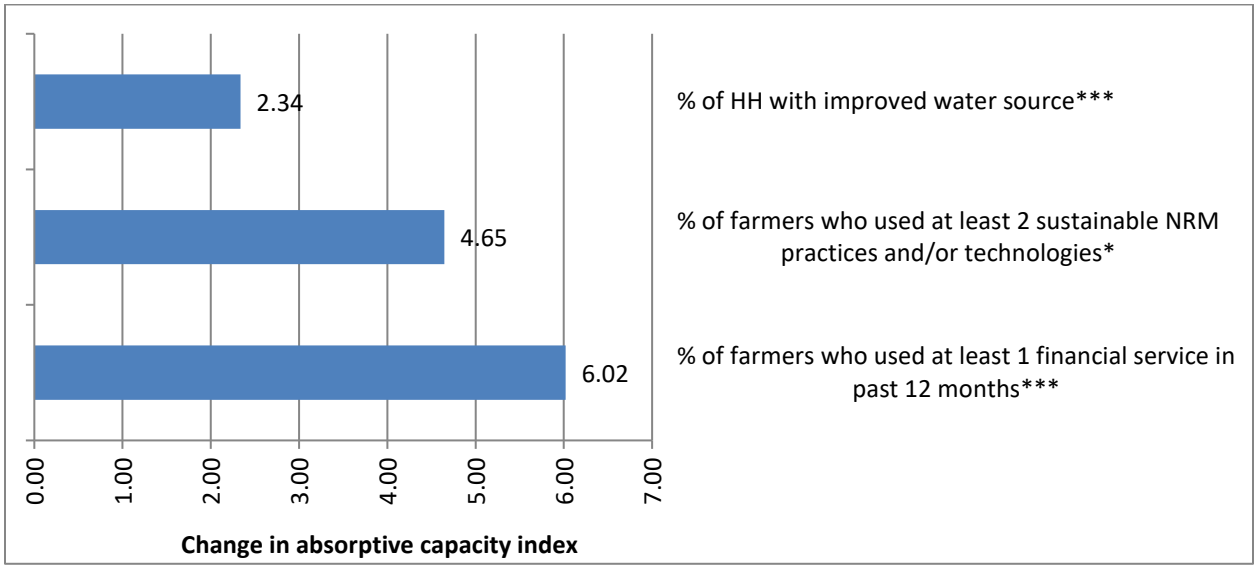
Contrary to the aforementioned results in which only one WASH/agricultural practice is related to recovery, more are related to higher absorptive and adaptive capacity (Table 17; full results in Annex B: Table 35 and Table 36). Of the 13 WASH and agricultural practices, three have moderate to strong associations with absorptive capacity and four have similar relationships with adaptive capacity. Overall, the 13 indicators explain 11.5 percent and 30.7 percent of the variation in absorptive capacity and adaptive capacity across sampled households in the program area, respectively. These are fairly robust results and lend support to our hypothesis that these characteristics and behaviors ultimately are supportive of improved recovery, indirectly through household-level absorptive and adaptive resilience capacity. Results presented later in this section provide the final piece of evidence necessary to determine the validity of the hypothesis – namely, that higher absorptive and adaptive capacities predicted by adoption of these WASH and improved agricultural practices, behaviors and characteristics lead to improved recovery outcomes.

FINDING 17: Adoption of improved agricultural practices and improved WASH behaviors do not have a strong, direct influence on household recovery from shocks. However, adoption of some improved WASH and agricultural practices are associated with higher absorptive and adaptive capacities.

Changes in Absorptive Capacity

Prior to presenting the final link between agricultural practices, WASH behaviors, resilience capacity, and recovery, the following set of figures demonstrate the *magnitude* of effect that each of the practices have on absorptive and adaptive capacities. Figure 15 maps the degree of effect of the three anticipated program variables indicated in Table 17 with moderate to strong relationships with absorptive capacity index values. The ten indicators that are weakly or not statistically significant are excluded from the figure (again, full results in Annex B: Table 35 and Table 36).

Figure 15: Magnitude of effects of WASH behaviors and characteristics and adoption of improved agricultural practices on absorptive capacity



FINDING 18: Access to financial services, adoption of sustainable NRM practices, and access to an improved water source are the strongest determinants of improved absorptive capacity.

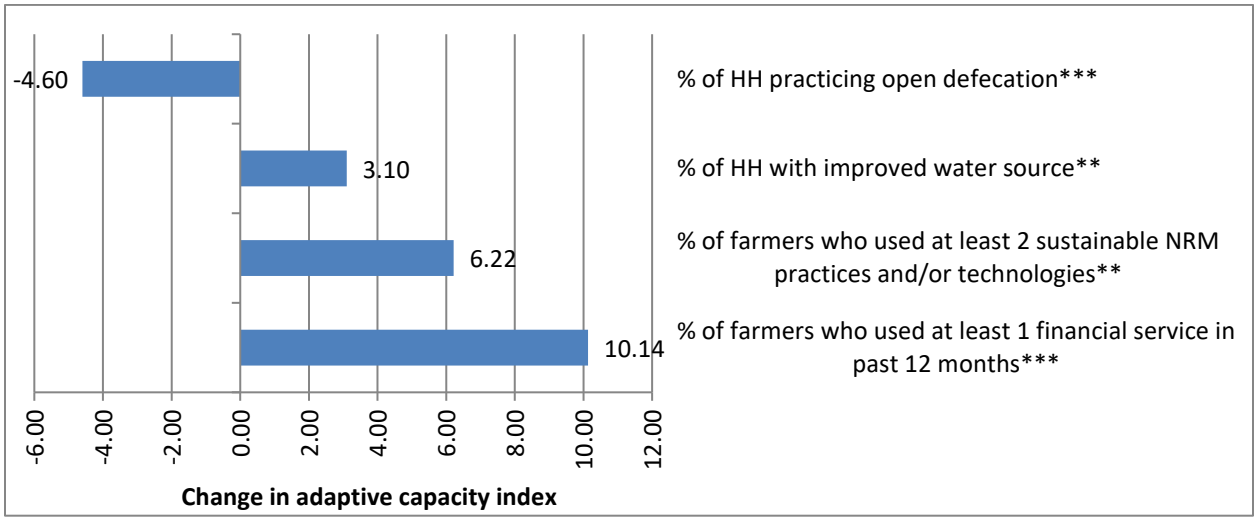
Of the 13 indicators measured, access to financial services has the strongest positive (desired) effect on absorptive capacity: it increases the absorptive capacity index score by six points. The adoption of sustainable NRM practices is also an important indicator as it raises the absorptive capacity index value by roughly five points. Having access to an improved water source raises it by two points.

Changes in Adaptive Capacity

WASH practices and adoption of agricultural practices also prove to be moderate to strong determinants of adaptive capacity (Figure 16; full results in Annex B: Table 36). Of the 13 indicators, four are found to be related to higher adaptive capacity, and taken together explain 30.7 percent of the total model variation (versus 11.5 percent for absorptive).

Figure 16 shows the effect of the four moderate-to-strong statistically significant variables on the adaptive capacity index. The top two anticipated program variables with the strongest effects on adaptive capacity are the same as those for absorptive: use of financial services (which increases the adaptive index score by 10 points compared to six for absorptive) and use of NRM practices (six point increase in the adaptive score, one point higher than for absorptive capacity). Access to an improved water source increases adaptive capacity by three points, roughly the same amount as seen for absorptive capacity. Open defecation decreases adaptive capacity by about five points. In sum, the findings in Figure 15 and Figure 16 tell us that essentially the same WASH practices, improved sanitation, and adoption of agricultural practice measures are significant determinants of both absorptive and adaptive capacity, and have mostly the same order of relative importance.

Figure 16: Magnitude of effects of WASH behaviors and characteristics and adoption of improved agricultural practices on adaptive capacity



FINDING 19: Access to financial services, adoption of NRM practices, access to improved water sources, and reduced open defecation are positively associated with improved adaptive capacity.

Takeaway 14: WASH/ Sanitation/Agricultural Practices, Resilience Capacity, and Recovery

- Adoption of improved WASH and agricultural practices exhibit little or no direct relationship with recovery from shocks, but they are positively associated with adaptive and absorptive capacities, as was expected.
- Households that utilize an agricultural financial service, adopt sustainable NRM practices, have access to an improved water source, and do not openly defecate have notably higher levels of expected absorptive and adaptive capacity.

Conclusions

Using data from the 2016 Baseline Study of HARANDE development food assistance project, this study provides a glimpse into household well-being and recovery from shocks experienced in the 12 months prior to the study. The study identifies various factors that strengthen household and community resilience in Mali. Following are summary conclusions that address the research questions posed for this study.

***Research question 1*:** Which resilience capacities are associated with positive well-being outcomes, including recovery from shock?

- **Improvements in adaptive capacity are associated with less poverty, higher incomes, and diets that are more diverse.** Movement from levels of adaptive capacity seen in the sample population from the bottom quarter to the top quarter decrease the likelihood of poverty by approximately seven percent. Similar increases in adaptive capacity lead to an estimated 5-cent USD increase in income and a 0.2 increase in the average number of food groups consumed.
- **Transformative capacity significantly predicts poverty, dietary diversity, and household hunger.** More transformative capacity is associated with a 10 percent decrease in a household experiencing poverty, a 7-cent USD increase in expenditures, marginal increase in dietary diversity of 0.04 food groups, and a four percent reduction in hunger.
- **Absorptive capacity, as measured in this study, is not associated with outcomes.** This lack of predictive ability may be a reflection of weak measurement properties of the index as evidenced by the low or negative factor loadings, particularly for important dimensions such as asset holdings, shock preparedness, and remittances.
- **In the context of resilience capacity, there is evidence of opportunities available for improving well-being outcomes, both indirectly through improved adaptive or transformative capacities, and directly through increases in household assets, savings, and stronger bonding social capital.** Having cash savings, more household assets, and stronger bonding social capital are most often, and directly, associated with better outcomes, including reduced poverty and less hunger. In addition to these three common components, reduced poverty is associated with greater access to formal safety nets and more access to services, which directly reduces likelihood of hunger. Although neither absorptive, adaptive, nor transformative capacities significantly predict enhanced recovery, two absorptive resilience components do directly support a greater likelihood of recovery, including higher education levels and cash savings.
- As previously discussed, evidence suggests that adaptive and transformative capacities contribute to improved well-being outcomes, keeping shock exposure constant. Underlying drivers of adaptive capacity that are strong and contribute to improved well-being outcomes include bridging social capital (average score of 4.2 of a maximum potential 8) and access to financial services (a score of 0.7 on a scale of 0-2). Those supporting better transformative capacity include better access to formal safety nets (31.1 percent of households) and bridging social capital, previously cited for adaptive capacity.

- **There are notable areas of potential improvement that might increase households' abilities to effectively respond to shocks given deficiencies in resilience capacities.** Limited cash savings and household shock preparedness contribute to lower levels of sustained absorptive capacity. Access to shock preparedness and mitigation activities is low, averaging only 0.6 on a scale of 3 potential activities. Exposure to information corresponds to low levels of preparedness; households receive, on average 1.8 pieces of information out a potential five. Both of these findings could reflect a structural deficiency in community and social service infrastructure that support shock preparedness.
- Overall, access to broader social networks (bonding and bridging social capital) is not necessarily low, but the average value of 4.7/4.8 out of 8, respectively, suggests room for improvement by encouraging stronger social ties across communities and between households and formal institutions. Improvements that would help build informal networks to link households across communities and with public and private organizations could support higher sustained outcomes, including recovery from shock.

Research question 2: Does resilience mitigate the negative impact of shock on well-being outcomes?

- **In this study, there is no evidence that resilience capacities mitigate the negative impact of shocks on well-being outcomes.** Models that were specified to test whether and to what extent resilience capacity mitigates the negative impact of shock on well-being outcomes revealed that shock exposure was associated in the unexpected direction with well-being outcomes (e.g., higher shock exposure is associated with less poverty and less hunger), rendering results from further analysis to isolate the effect of resilience capacity on shock exposure (i.e., interacting shock exposure with resilience capacity) difficult. Specifications interacting shock exposure with resilience capacity (indexes) were tested, and in no cases were the results statistically significant with the correct sign (i.e., direction of influence of effect). This is likely a measurement artifact wherein resilience capacity indexes are a conglomeration of individual variables. Future work will explore individual resilience capacity components to determine which ones have a significant mitigating effect on improving outcomes.

***Research question 3*:** Are there coping strategies that households use to manage shocks that lead to better – or, conversely, act as barriers to – well-being outcomes?

- Households that received formal assistance and took out loans to cope with shocks were less likely to experience poverty. Alternatively, households that changed food consumption patterns or reduced childcare costs were more likely to be poor. Decreases of 16 percent in the likelihood of poverty were associated with receiving formal assistance to cope with shock. Taking out loans, when controlling for other factors, also alleviated poverty by roughly seven percent. Households that changed their food consumption patterns or spent less on child care costs were 6 to 8 percent more likely to be poor.
- Using household savings results in less hunger. This is the only coping strategy that promotes less hunger and does so by a marginal, but significant, four percent. Hunger is not

alleviated, but rather increases by 4 to 7 percent when households rely on taking out loans, reducing child care costs and receiving money or food from family members (social capital).

- Households that relied on offtake of livestock, reducing child care costs, and receiving formal assistance, when used to cope with shocks and stresses, were less likely to recover from shock. Households utilizing any of these four coping strategies were 6 to 8 percent less likely to recover from shock, when controlling for other factors.
- Levels of resilience capacities are associated with reliance on a suite of coping strategies. The most common strategies that households with higher levels of resilience capacity use in response to shock are offtake of livestock, participation in conflict management, seeking wage labor, taking loans, relying on formal assistance, and social capital.

Research question 4: How do planned HARANDE programming activities enhance resilience and lead to better well-being outcomes?

- At this point, improved WASH, sanitation, and project-promoted agricultural practices do not have a strong enough collective influence on absorptive or adaptive capacity to influence recovery from shocks. While WASH and agricultural practices are not directly related to recovery from shock, some of these behaviors and practices do support adaptive and absorptive capacity. There is moderate-to-strong evidence that improved WASH and agricultural practices lead to increases in adaptive and absorptive capacity. However, subsequent analysis of their ability to predict better recovery outcomes were not statistically significant.
- The four most influential drivers of absorptive and adaptive capacity of the WASH, sanitation, and agricultural adoption practices measured are utilization of an agricultural financial service, adoption of at least two NRM practices and/or techniques, access to an improved water source and reductions in the practice of open defecation.

Programming implications

- The results from the analysis of resilience and household well-being outcomes point to some important conclusions regarding programming to enhance resilience. First, traditional economic development interventions, namely those that enhance or improve households' income and wealth through, e.g. increasing agricultural/livestock productivity, investment in human capital (education/training), value chains, and infrastructure are also avenues to enhance household and community resilience capacities.
- Access to savings is importantly associated with improved household economic status and reduced hunger, suggesting the importance of supporting savings and loans groups and mechanisms to promote savings by individuals and other organizations. Households would also benefit by programming elements that encourage stronger social capital and greater access to formal safety nets.
- Finally, investments to support savings and education/training foster an environment for the ability of households to recover from shocks.

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Annex A. Calculation of Resilience Indicators for Mali

1. Absorptive Capacity Index

The absorptive capacity index is constructed from seven indicators, some of which are themselves indices. The indicators and calculation explanations are as follows.

1. Access to informal safety nets. Binary variable with a value of 1 if the household reports receiving any assistance from relatives, neighbors, or friends in the last 12 months.

Survey question: r1304a.

2. Bonding social capital index. The bonding social capital index is based on responses to questions on whether the household could RECEIVE any assistance from relatives and/or non-relatives within their community if they need it, and whether the household would be able to PROVIDE assistance to people in need living inside their community, including relatives or non-relatives. The bonding social capital index is computed by adding up all the *yes* responses and ranges between 0 and 7.

Survey questions: r1305a, r1305c, r1306b, r1308a, r1308c, r1309a, r1309c

3. Whether any household member holds savings. This indicator is a binary (dummy) variable equal to 1 if the respondent reported that a household member regularly saves cash.

Survey question: r1001

4. Access to remittances. This indicator is a binary (dummy) variable equal to 1 if the respondent reported that the household receives remittances in either of the two circumstances:

- Household coped with shocks by receiving money from a family member who migrated
- Any family member who migrated in the past 12 months sent money back to the household

Survey questions: r306, r1211

5. Asset ownership index. Asset ownership is an additive index based on the number of consumer durables owned out of a possible 14.

Survey questions: BL H7.02

6. Shock preparedness and mitigation. This variable measures the information that the household receives relating to shocks/stressors, and whether the household has received training on early warning systems.

The information component has a value of 1 if the household received any of the following types of information:

- Rainfall prospects / weather prospects for coming season (r1101_2)
- Water availability and prices of local boreholes, shallow wells, etc. (r1101_3)
- Livestock disease threats or epidemics (r1101_4)

The training on early warning systems component has a value of 1 if the response to question r1312 is *yes*.

The overall index value of shock preparedness and mitigation is 0 if the household received no information or training, 1 if it received either information or training but not both, and 3 if the household received both information and training.

Survey questions: r1101, r1312

Combine the six indicators described above into an absorptive capacity index using polychoric factor analysis.

2. Adaptive Capacity Index

The adaptive capacity index is constructed from seven indicators, some of which are indices themselves. The indicators and calculation explanations are as follows.

1. Bridging social capital. The bridging social capital index is based on responses to questions about being able to receive assistance when needed from people (relatives or non-relatives) living outside of the household's community or being able to provide assistance to people (relatives or non-relatives) living outside of the community. An additive index ranging from 0 to 8 is calculated based on responses to the eight questions.

Survey questions: r1305b, r1305d, r1306a, r1306c, r1308b, r1308d, r1309b, r1309d

2. Human capital. This binary (dummy) variable equal to 1 if any household adult has a primary or higher education. This is computed using the information about age and level of education attained for each household member in Module B, (B05A and B21a). If any household member age 16 or older (B05A > 15) has value of B21a between 1 and 4, the value of this variable is set to 1.

Survey questions: B05A, B21a

3. Livelihood diversification. Total number of livelihood activities engaged in during the last year. The question asked to identify these livelihoods is question r1201: "What were the sources of your household's food/income over the last 12 months?" The possible 14 options are:

- Production and sale of agricultural products
- Production and sale of livestock
- Agricultural worker
- Production and sale of seedlings, seeds, animal feed
- Production and sale of firewood, charcoal, poles, timber
- Sale of wild products
- Sale of fishing products
- Production and sale of vegetable crops
- Private agricultural service providers (veterinary paraprofessionals, agricultural service delivery agent, etc.)
- Small shop (shopkeeper, sale of non-agricultural products, etc.)
- Non-agricultural service delivery agent
- Technical and professional activities (carpenter, mason, machinery repair, etc.)
- Emigration
- Other

Survey question: r1201

4. Exposure to information. Number of topics the respondent has received information on in the last year, out of five information categories. Range: 0-5.

Survey question: r1101

5. Asset ownership index. Defined above in *Absorptive capacity index* section.

6. Access to financial resources. This variable has the following values:

- 0 if the household did not take out a loan or have savings (r901 = no and r1001 = no)
- 1 if the household either borrowed (r901 = yes or r1001 = yes)
- 2 if the household both borrowed and had savings (r901 = yes and r1001 = yes)

Survey questions: r901, r1001

Combine the indicators into an index using polychoric factor analysis.

3. Transformative Capacity Index

The transformative capacity index is constructed from three indicators, some of which are indexes themselves. The indicators and calculation explanations are as follows.

1. Access to formal safety nets. This community-level variable is based on a binary (dummy) variable equal to 1 if the household response to question r1301 *(Has your household received any type of social assistance from government services, NGOs, or religious organizations during the last year?)* is *yes*.

Survey questions: r1301

2. Access to services. This variable is based on information about household access to and level of satisfaction with six food security services (L6A to L11B), four health and nutrition services (L12A to L14B), and four income security services (L16A to L19B). For each type of service, the access indicator is computed as:

- 0 if the household reports that they did not receive the service;
- 1 if they received the service but were not satisfied with the service; and
- 2 if they received the service and were satisfied with the service.

The overall indicator of *access to services* is computed by adding up the access indicator values for each type of service, over all 14 service types. The indicator ranges from 0 to a maximum possible value of 28 (if households accessed all types of services and were satisfied with all the services).

Survey questions: L6A to L19B

3. Bridging social capital. Defined above in *Adaptive capacity index* section.

Combine these three indicators into an index using polychoric factor analysis.

4. Other Indicators

1. Household has agricultural hazard insurance. Binary (dummy) variable equal to 1 if the respondent reported it has agricultural hazard insurance.

Survey question: BL G09

2. Adoption of improved practices. This binary (dummy) variable equal to 1 if respondents report:

- adopting three or more improved practices for crop production (incl. vegetables) OR
- adopting three or more improved practices for livestock production OR
- following one natural resource management practice or technique not related directly to on-farm production OR
- using any improved storage method.

Survey questions: G13b, G16, G18, G21

Annex B. Supplemental Tables and Figures

Table 18: Distribution of ethnic groups in baseline sample

Ethnic group		Count	% of sample
Dogon		674	31.3%
Peulh		671	31.1%
Bozo		311	14.4%
Sonrai		157	7.3%
Other		156	7.2%
Bambara		99	4.6%
Sarakole		83	3.8%
Touareg		6	0.3%
	n	2157	100.0%

Table 19: Gender indicators, by livelihood profile category

Indicator	All	n	Climate-sensi-tive only	n	Both climate and non-climate-sensitive	n	Non-climate-sensitive-only	n	Remit-tances	n
Men in a union that make sole decision on how to use self-earned income	92.8	1422	92.2	436	93.9	548	95.2	107	90.9	328
Women in a union that make sole decision on how to use self-earned income	68.6	1265	65.1	360	72.1	490	68.8	83	67.2	326
Men in a union that make joint decision on how to use self-earned income	1.0	1422	1.3	436	0.3	548	1.7	107	1.6	328
Women in a union that make joint decision on how to use self-earned income	6.4	1265	5.8	360	5.2	490	7.6	83	8.9	326
Men in a union that make sole decision on maternal health and nutrition	70.8	753	68.9	273	73.3	264	64.7	48	71.3	166
Women in a union that make sole decision on maternal health and nutrition	13.6	920	11.7	303	13.3	312	19.2	61	14.9	242
Men in a union that make joint decision on maternal health and nutrition	9.5	753	8.9	273	9.2	264	10.8	48	11.1	166
Women in a union that make joint decision on maternal health and nutrition	11.3	920	9.4	303	12.0	312	11.1	61	13.2	242
Men in a union that make sole decision on child health and nutrition	63.8	752	60.6	272	66.2	264	73.2	48	62.8	166
Women in a union that make sole decision on child health and nutrition	13.4	921	12.9	303	13.5	312	15.3	61	13.1	243
Men in a union that make joint decision on child health and nutrition	12.6	752	11.9	272	11.8	264	19.0	48	13.7	166
Women in a union that make joint decision on child health and nutrition	15.0	921	12.7	303	16.9	312	17.1	61	15.0	243

NOTE: Asterisks represent statistical significance between climate-sensitive-only and other livelihood categories at the 0.01 (***), and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 20: Relationship between resilience capacity indexes and poverty

Resilience Capacities	Poverty (Probit estimator)					
	Absorptive		Adaptive		Transformative	
	Coef.	Percent change[a/]	Coef.	Percent change[a/]	Coef.	Percent change[a/]
Absorptive capacity	-0.230	-0.0354				
Adaptive capacity			-0.777**	-0.1026		
Transformative capacity					-1.028***	-0.1537
Shock exposure	-0.0951**		-0.0690*		-0.0808*	
Household demographics (/Percent female 0-16)						
Percent female 16-30	-0.0856		-0.0948		-0.0969	
Percent female 30+	-0.0845		-0.0825		-0.0658	
Percent male 0-16	0.145		0.146		0.158	
Percent male 16-30	-0.0473		-0.0578		-0.0757	
Percent male 30+	-0.164		-0.160		-0.186	
Female headed HH	-0.195		-0.222		-0.264*	
Household size	0.113***		0.114***		0.112***	
Livelihood diversification (/Both climate and non-climate sensitive)						
Only climate sensitive	0.221*		0.175		0.233**	
Only non-climate sensitive	0.0136		-0.0535		-0.00515	
Remittances	0.281**		0.292**		0.330***	
Constant	-0.0909		0.104		0.155	
Observations	1514		1515		1516	
r2	N/A		N/A		N/A	

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.
a/ This represents the percent change from the lowest to highest quartile (25th to 75th percentile) of the sample for indicators measured as continuous variables. For binary variables, the change is defined as the difference between 0 and 1.

Table 21: Relationship between resilience capacity indexes and per capita expenditures

Resilience Capacities	Per capita expenditures (OLS estimator)					
	Absorptive		Adaptive		Transformative	
	Coef.	Percent change[a/]	Coef.	Percent change[a/]	Coef.	Percent change[a/]
Absorptive capacity	0.110	0.0164				
Adaptive capacity			0.199**	0.0265		
Transformative capacity					0.260***	0.0412
Shock exposure	0.00930		0.00325		0.00607	
Household demographics (/Percent female 0-16)						
Percent female 16-30	-0.0157		-0.0151		-0.0133	
Percent female 30+	-0.0912**		-0.0912**		-0.0930**	
Percent male 0-16	-0.0942***		-0.0957***		-0.0954***	
Percent male 16-30	-0.0359		-0.0341		-0.0285	
Percent male 30+	-0.0876***		-0.0921***		-0.0832***	
Female headed HH	0.0241		0.0283		0.0377	
Livelihood diversification (/Both climate and non-climate sensitive)						
Only climate sensitive	-0.0346		-0.0235		-0.0382	
Only non-climate sensitive	0.0511		0.0668		0.0542	
Remittances	-0.0181		-0.0216		-0.0303	
Constant	2.002***		1.982***		1.968***	
Observations	1514		1515		1516	
r2	0.0319		0.0357		0.0470	

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.
a/ This represents the percent change from the lowest to highest quartile (25th to 75th percentile) of the sample for indicators measured as continuous variables. For binary variables, the change is defined as the difference between 0 and 1.

Table 22: Relationship between resilience capacity indexes and household dietary diversity

Resilience capacities	HDDS (OLS estimator)					
	Absorptive		Adaptive		Transformative	
	Coef.	Percent change[a/]	Coef.	Percent change[a/]	Coef.	Percent change[a/]
Absorptive capacity	-0.0113	-0.0004				
Adaptive capacity			1.007**	0.0379		
Transformative capacity					1.312***	0.0613
Shock exposure	0.0210		-0.0273		-0.0107	
Household demographics (/Percent female 0-16)						
Percent female 16-30	0.127		0.132		0.145	
Percent female 30+	-0.0769		-0.0560		-0.0781	
Percent male 0-16	0.172		0.121		0.133	
Percent male 16-30	-0.0247		-0.0275		0.00402	
Percent male 30+	0.178		0.158		0.214	
Female headed HH	0.195		0.265		0.296*	
Household size	0.0304		0.0301		0.0337	
Livelihood diversification (/Both climate and non-climate sensitive)						
Only climate sensitive	-0.246**		-0.180		-0.242**	
Only non-climate sensitive	-0.774**		-0.694**		-0.757**	
Remittances	-0.390***		-0.398***		-0.429***	
Constant	6.176***		5.800***		5.697***	
Observations	1461		1462		1463	
r2	0.0238		0.0320		0.0471	

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.
a/ This represents the percent change from the lowest to highest quartile (25th to 75th percentile) of the sample for indicators measured as continuous variables. For binary variables, the change is defined as the difference between 0 and 1.

Table 23: Relationship between resilience capacity indexes and household hunger

Resilience capacities	Moderate to severe hunger (Probit estimator)					
	Absorptive		Adaptive		Transformative	
	Coef.	Percent change[a/]	Coef.	Percent change[a/]	Coef.	Percent change[a/]
Absorptive capacity	0.531	0.30142				
Adaptive capacity			-0.159	-0.0706		
Transformative capacity					-1.01***	-0.4383
Shock exposure	0.0415		0.0590		0.0778*	
Household demographics (/Percent female 0-16)						
Percent female 16-30	-0.182		-0.187		-0.183	
Percent female 30+	-0.0480		-0.0510		-0.0389	
Percent male 0-16	0.163		0.174		0.189	
Percent male 16-30	-0.0495		-0.0477		-0.0750	
Percent male 30+	-0.265		-0.291		-0.321	
Female headed HH	-0.108		-0.160		-0.234	
Household size	0.0151		0.0141		0.0114	
Livelihood diversification (/Both climate and non-climate sensitive)						
Only climate sensitive	-0.0322		-0.0647		-0.0611	
Only non-climate sensitive	0.285*		0.254		0.258	
Remittances	-0.235		-0.254*		-0.223	
Constant	-1.489***		-1.098***		-0.825**	
Observations	1514		1515		1516	
r2	N/A		N/A		N/A	

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.
a/ This represents the percent change from the lowest to highest quartile (25th to 75th percentile) of the sample for indicators measured as continuous variables. For binary variables, the change is defined as the difference between 0 and 1.

Table 24: Relationship between resilience capacity indexes and recovery from shock

Resilience capacities	Recovery (Probit estimator)					
	Absorptive		Adaptive		Transformative	
	Coef.	Percent change[a/]	Coef.	Percent change[a/]	Coef.	Percent change[a/]
Absorptive capacity	-0.247	-0.0797				
Adaptive capacity			-0.303	-0.0906		
Transformative capacity					-0.511**	-0.1797
Shock exposure	-0.566***		-0.557***		-0.564***	
Household demographics (/Percent female 0-16)						
Percent female 16-30	-0.171		-0.174		-0.175	
Percent female 30+	-0.424***		-0.428***		-0.424***	
Percent male 0-16	0.182		0.180		0.188	
Percent male 16-30	-0.0368		-0.0390		-0.0482	
Percent male 30+	0.0731		0.0774		0.0762	
Female headed HH	-0.00693		-0.00499		-0.0231	
Household size	0.0446***		0.0459***		0.0444***	
Livelihood diversification (/Both climate and non-climate sensitive)						
Only climate sensitive	0.100		0.0859		0.107	
Only non-climate sensitive	0.188		0.165		0.190	
Remittances	0.0581		0.0688		0.0871	
Constant	-0.0395		-0.0578		-0.01000	
Observations	1514		1515		1516	
r2	N/A		N/A		N/A	

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.
a/ This represents the percent change from the lowest to highest quartile (25th to 75th percentile) of the sample for indicators measured as continuous variables. For binary variables, the change is defined as the difference between 0 and 1.

Table 25: Relationship between resilience capacity components and income proxy outcomes

Capacity components	Expenditure		Poverty	
	Coef.	Percent change [a/]	Coef.	Percent change [a/]
Absorptive capacity components				
Access to cash savings (0-1)	-0.101***	-0.001	0.251*	0.074
Availability of informal safety nets (0-1)	0.0303	0.033	0.0393	0.041
Bonding social capital (0-8)	-0.00716	-0.016	0.033	-0.014
Access to remittances (0-1)	-0.00619	0.006	0.123	0.007
Asset index (0-14)	0.0327***	0.055	-0.175***	0.130
Shock prep and mitigation (0-3)	0.0346	0.019	-0.0112	-0.012
Adaptive capacity components				
Bridging social capital (0-8)	0.0169**	0.038	-0.0775***	0.009
Human capital (0-1)	0.0221	0.025	-0.136	0.046
Livelihood diversification (0-14)	-0.0153	-0.008	0.0983*	0.004
Exposure to information (0-5)	-0.00875	-0.014	-0.0311	-0.019
Access to financial institutions (0-2)	0.0588**	0.033	-0.0529	0.046
Transformative capacity components				
Availability of formal safety nets (0-1)	0.0784***	0.051	-0.304***	0.060
Access to basic services (0-28)	0.00118	0.004	-0.0098	0.037
Household characteristics				
Shock exposure	-0.0004		-0.0597	
Household size			0.146***	
Female headed HH	0.0328		-0.235	
Household demographics (/Percent female 0-16)				
Percent female 16-30	-0.0263		-0.0513	
Percent female 30+	-0.102***		-0.0922	
Percent male 0-16	-0.103***		0.118	
Percent male 16-30	-0.0378		-0.0505	
Percent male 30+	-0.094***		-0.146	
Livelihood diversification (/Both climate and non-climate sensitive)				
Only climate sensitive	-0.0281		0.209*	
Only non-climate sensitive	0.0684		0.0335	
Remittances	-0.0044		0.146	
Constant	1.904***		0.253	
Observations	1513		1513	
R2	0.0884		N/A	

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.
a/ This represents the percent change from the lowest to highest quartile (25th to 75th percentile) of the sample for indicators measured as continuous variables. For binary variables, the change is defined as the difference between 0 and 1.

Table 26: Relationship between resilience capacity components, food security, and recovery outcomes

Capacity components	HDDS		Hunger		Recovery	
	Coef.	Percent change [a/]	Coef.	Percent change [a/]	Coef.	Percent change [a/]
Absorptive capacity components						
Access to cash savings (0-1)	-0.025	0.074	-0.611**	-0.494	0.416**	0.427
Availability of informal safety nets (0-1)	0.161	0.041	0.181	0.520	-0.0750	-0.162
Bonding social capital (0-8)	-0.023	-0.014	0.00645	0.045	0.0522	0.285
Access to remittances (0-1)	-0.111	0.007	-0.0124	-0.247	-0.178	-0.252
Asset index (0-14)	0.273***	0.130	-0.133***	-0.511	0.0209	0.080
Shock prep and mitigation (0-3)	-0.081	-0.012	0.246**	0.540	-0.114	-0.130
Adaptive capacity components						
Bridging social capital (0-8)	0.0149	0.009	-0.0774**	-0.415	-0.101***	-0.393
Human capital (0-1)	0.0517	0.046	-0.0236	-0.246	0.206**	0.300
Livelihood diversification (0-14)	0.0267	0.004	-0.0583	-0.095	0.0575	0.073
Exposure to information (0-5)	-0.0419	-0.019	0.0493	0.294	0.0658	0.273
Access to financial institutions (0-2)	0.299***	0.046	0.462***	1.235	-0.102	-0.116
Transformative capacity components						
Availability of formal safety nets (0-1)	0.209*	0.060	-0.257**	-0.363	-0.0544	-0.128
Access to basic services (0-28)	0.0408***	0.037	-0.0227	-0.209	-0.00229	-0.017
Household characteristics						
Shock exposure	-0.061		0.0849*		-0.580***	
Household size	0.0119		0.0210		0.0390**	
Female headed HH	0.292*		-0.129		0.00383	
Household demographics (/Percent female 0-16)						
Percent female 16-30	0.0614		-0.145		-0.209*	
Percent female 30+	-0.0500		-0.0388		-0.422***	
Percent male 0-16	0.0420		0.158		0.171	
Percent male 16-30	-0.0607		-0.0772		-0.134*	
Percent male 30+	0.0859		-0.241		0.00671	
Livelihood diversification (/Both climate and non-climate sensitive)						
Only climate sensitive	-0.0725		-0.152		0.214	
Only non-climate sensitive	-0.481		0.217		0.246	
Remittances	-0.229		-0.148		0.281	
Constant	5.117***		-0.924		-0.196	
Observations	1460		1513		1513	
r2	0.167					

Table 27: Relationship between interaction of shock exposure with resilience capacity indexes and per capita expenditure

Resilience capacities	Per-capita expenditures (OLS estimator)		
Absorptive capacity	0.204*		
Adaptive capacity		0.371***	
Transformative capacity			0.336***
Shock exposure	0.0357	0.0428**	0.0206
Absorptive capacity * shock exposure	-0.0482		
Adaptive capacity * shock exposure		-0.0770**	
Transformative capacity * shock exposure			-0.0398
Household demographics (/Percent female 0-16)			
Percent female 16-30	-0.0161	-0.0168	-0.0142
Percent female 30+	-0.0916**	-0.0930**	-0.0941***
Percent male 0-16	-0.0939***	-0.0960***	-0.0958***
Percent male 16-30	-0.0358	-0.0336	-0.0286
Percent male 30+	-0.0876***	-0.0921***	-0.0844***
Female headed HH	0.0237	0.0289	0.0359
Livelihood diversification (/Both climate and non-climate sensitive)			
Only climate sensitive	-0.0353	-0.0244	-0.0392
Only non-climate sensitive	0.0505	0.0707	0.0542
Remittances	-0.0188	-0.0255	-0.0311
Constant	1.954***	1.905***	1.948***
Observations	1514	1515	1516
r2	0.0327	0.0384	0.0477

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 28: Relationship between interaction of shock exposure with resilience capacity indexes and poverty

Resilience capacities	Poverty (Probit estimator)		
Absorptive capacity	-0.411		
Adaptive capacity		-1.342***	
Transformative capacity			-0.695*
Shock exposure	-0.146	-0.197**	-0.0168
Absorptive capacity * shock exposure	0.0925		
Adaptive capacity * shock exposure		0.250*	
Transformative capacity * shock exposure			-0.177
Household demographics (/Percent female 0-16)			
Percent female 16-30	-0.0845	-0.0910	-0.100
Percent female 30+	-0.0836	-0.0811	-0.0689
Percent male 0-16	0.144	0.144	0.158
Percent male 16-30	-0.0476	-0.0623	-0.0753
Percent male 30+	-0.165	-0.164	-0.190
Female headed HH	-0.194	-0.224	-0.272*
Household size	0.113***	0.116***	0.112***
Livelihood diversification (/Both climate and non-climate sensitive)			
Only climate sensitive	0.222*	0.177	0.229**
Only non-climate sensitive	0.0137	-0.0700	-0.00355
Remittances	0.282**	0.305**	0.328***
Constant	0.00112	0.355	0.0633
Observations	1514	1515	1516
r2	N/A	N/A	N/A

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 29: Relationship between interaction of shock exposure with resilience capacity indexes and household dietary diversity

Resilience capacities	HDDS (OLS estimator)		
Absorptive capacity	-2.365***		
Adaptive capacity		-0.507	
Transformative capacity			0.408
Shock exposure	-0.657***	-0.382***	-0.186***
Absorptive capacity * shock exposure	1.234***		
Adaptive capacity * shock exposure		0.684***	
Transformative capacity * shock exposure			0.472***
Household demographics (/Percent female 0-16)			
Percent female 16-30	0.154*	0.152	0.158
Percent female 30+	-0.0579	-0.0431	-0.0658
Percent male 0-16	0.168	0.117	0.133
Percent male 16-30	-0.0236	-0.0306	0.00244
Percent male 30+	0.171	0.151	0.225
Female headed HH	0.188	0.252	0.309**
Household size	0.0318	0.0337	0.0347*
Livelihood diversification (/Both climate and non-climate sensitive)			
Only climate sensitive	-0.235*	-0.173	-0.229*
Only non-climate sensitive	-0.769**	-0.738**	-0.753**
Remittances	-0.392***	-0.374***	-0.424***
Constant	7.397***	6.476***	5.959***
Observations	1461	1462	1463
r2	0.0485	0.0429	0.0522

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 30: Relationship between interaction of shock exposure with resilience capacity indexes and household hunger

Resilience capacities	Severe or moderate hunger (Probit estimator)		
Absorptive capacity	1.350**		
Adaptive capacity		-0.0691	
Transformative capacity			-0.856**
Shock exposure	0.266	0.0792	0.102
Absorptive capacity * shock exposure	-0.405		
Adaptive capacity * shock exposure		-0.0393	
Transformative capacity * shock exposure			-0.0739
Household demographics (/Percent female 0-16)			
Percent female 16-30	-0.186	-0.187	-0.185
Percent female 30+	-0.0461	-0.0507	-0.0393
Percent male 0-16	0.163	0.174	0.190
Percent male 16-30	-0.0532	-0.0483	-0.0749
Percent male 30+	-0.267	-0.292	-0.323
Female headed HH	-0.108	-0.160	-0.237
Household size	0.0161	0.0139	0.0112
Livelihood diversification (/Both climate and non-climate sensitive)			
Only climate sensitive	-0.0269	-0.0648	-0.0620
Only non-climate sensitive	0.294*	0.257	0.259
Remittances	-0.228	-0.255*	-0.225
Constant	-1.937***	-1.138***	-0.864**
Observations	1514	1515	1516
r2	N/A	N/A	N/A

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 31: Relationship between interaction of shock exposure with resilience capacity indexes and recovery from shock

Resilience capacities	Recovery (Probit estimator)		
Absorptive capacity	-0.155		
Adaptive capacity		-0.749	
Transformative capacity			-0.644
Shock exposure	-0.535***	-0.684***	-0.591***
Absorptive capacity * shock exposure	-0.0661		
Adaptive capacity * shock exposure		0.298	
Transformative capacity * shock exposure			0.0954
Household demographics (/Percent female 0-16)			
Percent female 16-30	-0.171	-0.171	-0.175
Percent female 30+	-0.424***	-0.427***	-0.424***
Percent male 0-16	0.181	0.181	0.188
Percent male 16-30	-0.0376	-0.0349	-0.0478
Percent male 30+	0.0730	0.0787	0.0779
Female headed HH	-0.00733	-0.00558	-0.0209
Household size	0.0445***	0.0463***	0.0444***
Livelihood diversification (/Both climate and non-climate sensitive)			
Only climate sensitive	0.0997	0.0882	0.109
Only non-climate sensitive	0.188	0.157	0.191
Remittances	0.0578	0.0726	0.0879
Constant	-0.0808	0.115	0.0220
Observations	1514	1515	1516
r2	N/A	N/A	N/A

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 32: Relationship between coping strategies and poverty

Coping strategies for shock	Poverty (Probit estimator)	
	Individual strategies	Total strategies used
Total coping strategies		-0.0285
Offtake of livestock	-0.0538	
Other asset sales	-0.260	
Changing food consumption patterns	0.251**	
Child cost reduction strategies	0.196*	
Conflict management	-0.187	
Wage labor	0.00629	
Loan	-0.210**	
Social capital	0.0770	
Formal assistance	-0.452***	
Savings	-0.0582	
Remittances	0.0480	
Shock exposure	-0.0557	-0.0858**
Household demographics (/Percent female 0-16)		
Percent female 16-30	-0.0890	-0.0847
Percent female 30+	-0.0640	-0.0711
Percent male 0-16	0.148	0.143
Percent male 16-30	-0.0892	-0.0447
Percent male 30+	-0.196*	-0.162
Female headed HH	-0.273*	-0.188
Household size	0.111***	0.113***
Livelihood diversification (/Both climate and non-climate sensitive)		
Only climate sensitive	0.249**	0.221*
Only non-climate sensitive	0.00603	0.00395
Remittances	0.228*	0.305**
Constant	-0.0491	-0.163
Observations	1516	1516
r2	N/A	N/A

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 33: Relationship between coping strategies and hunger

Coping strategies for shock	Moderate or severe hunger (Probit estimator)	
	Individual strategies	Total strategies used
Total coping strategies		0.116***
Offtake of livestock	0.0822	
Other asset sales	0.413	
Changing food consumption patterns	0.152	
Child cost reduction strategies	0.448***	
Conflict management	0.204	
Wage labor	-0.0793	
Loan	0.277*	
Social capital	0.278*	
Formal assistance	-0.202	
Savings	-0.355*	
Remittances	-0.192	
Shock exposure	-0.00243	-0.0142
Household demographics (/Percent female 0-16)		
Percent female 16-30	-0.165	-0.186
Percent female 30+	-0.0753	-0.0886
Percent male 0-16	0.100	0.141
Percent male 16-30	-0.0589	-0.0579
Percent male 30+	-0.255	-0.277
Female headed HH	-0.144	-0.139
Household size	0.0118	0.0174
Livelihood diversification (/Both climate and non-climate sensitive)		
Only climate sensitive	-0.0555	0.000498
Only non-climate sensitive	0.444**	0.354**
Remittances	-0.301*	-0.310*
Constant	-1.346***	-1.370***
Observations	1516	1516
r2	N/A	N/A

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 34: Relationship between coping strategies and recovery

Coping strategies for shock	Recovery (Probit estimator)	
	Individual strategies	Total strategies used
Total coping strategies used		-0.116***
Offtake of livestock	-0.244***	
Other asset sales	-0.170	
Changing food consumption patterns	-0.0640	
Child cost reduction strategies	-0.254**	
Conflict management	-0.121	
Wage labor	-0.128	
Loan	0.00746	
Social capital	-0.0926	
Formal assistance	-0.385**	
Savings	-0.00306	
Remittances	0.0402	
Shock exposure	-0.496***	-0.499***
Household demographics		
Percent female 16-30	-0.180*	-0.179*
Percent female 30+	-0.394***	-0.399***
Percent male 0-16	0.203	0.209
Percent male 16-30	-0.0159	-0.0296
Percent male 30+	0.0999	0.0854
Female headed HH	-0.0161	0.00384
Household size	0.0428***	0.0424***
Livelihood diversification (/Both climate and non-climate sensitive)		
Only climate sensitive	0.0787	0.0716
Only non-climate sensitive	0.134	0.136
Remittances	0.136	0.117
Constant	0.0102	-0.0280
Observations	1516	1516
r2	N/A	N/A

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 35: Relationship between agricultural practice and WASH variables, recovery from shock and absorptive capacity index

Indicator	Dependent Variable		
	Recovery	Recovery	Absorptive Index
% of farmers who used at least 1 financial service in past 12 months	0.0617	0.0737	0.0538***
% of farmers who practiced at least 1 value chain activity in past 12 months	-0.196	-0.193	0.00819
% of farmers who used at least 2 sustainable crop practices and/or technologies	0.357***	0.355***	-0.00589
% of farmers who used at least 2 sustainable livestock practices and/or technologies	0.0555	0.0595	0.00714
% of farmers who used at least 2 sustainable NRM practices and/or technologies	-0.235*	-0.225	0.0415**
% of farmers who used at least 3 sustainable agricultural practices and/or technologies	0.232	0.238	0.0262*
% of farmers who used at least 1 improved storage practice	0.0973	0.0924	-0.0309**
% of HH with improved water source	-0.163	-0.159	0.0280**
% of HH within 30 minutes walking of water	-0.00207	-0.00138	-0.00304
% of HH following correct water treatment practices	-0.0591	-0.0556	0.00750
% of HH with improved sanitation	-0.00850	-0.0213	-0.0476***
% of HH practicing open defecation	0.0301	0.0292	-0.0155
% of HH practicing proper handwashing practices	-0.0440	-0.0501	-0.0418
Absorptive capacity index		-0.271	
Shock exposure	-0.599***	-0.598***	0.0177***
Household demographics (/Percent female 0-16)			
Percent female 16-30	-0.181*	-0.181*	-0.00937
Percent female 30+	-0.478***	-0.474***	0.00328
Percent male 0-16	0.171	0.175	0.0166
Percent male 16-30	-0.0550	-0.0581	-0.00336
Percent male 30+	-0.0320	-0.0447	-0.0373**
Female headed HH	-0.0420	-0.0558	-0.0564***
Household size	0.0441**	0.0436**	-0.00201
Livelihood diversification (/Both climate and non-climate sensitive)			
Only climate sensitive	0.0370	0.0281	-0.0334**
Only non-climate sensitive	0.135	0.140	0.0115
Remittances	-0.0114	-0.0189	-0.0269*
Constant	-0.172	-0.0275	0.533***
Observations	1484	1482	1482
r2	N/A	N/A	0.115

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 36: Relationship between agricultural practice and WASH variables, recovery from shock and adaptive capacity index

Indicator	Dependent Variable		
	Recovery	Recovery	Adaptive Index
% of farmers who used at least 1 financial service in past 12 months	0.0617	0.0933	0.0861***
% of farmers who practiced at least 1 value chain activity in past 12 months	-0.196	-0.186	0.0264*
% of farmers who used at least 2 sustainable crop practices and/or technologies	0.357***	0.364***	0.0157
% of farmers who used at least 2 sustainable livestock practices and/or technologies	0.0555	0.0619	0.0104
% of farmers who used at least 2 sustainable NRM practices and/or technologies	-0.235*	-0.214	0.0381**
% of farmers who used at least 3 sustainable agricultural practices and/or technologies	0.232	0.240	0.0160
% of farmers who used at least 1 improved storage practice	0.0973	0.104	-0.00702
% of HH with improved water source	-0.163	-0.151	0.0291**
% of HH within 30 minutes walking of water	-0.00207	0.00437	0.00852
% of HH following correct water treatment practices	-0.0591	-0.0638	-0.00209
% of HH with improved sanitation	-0.00850	-0.00905	-0.00934
% of HH practicing open defecation	0.0301	0.0224	-0.0332***
% of HH practicing proper handwashing practices	-0.0440	-0.0478	-0.0464
Adaptive capacity index		-0.482	
Shock exposure	-0.599***	-0.587***	0.0370***
Household demographics (/Percent female 0-16)			
Percent female 16-30	-0.181*	-0.187*	-0.0136
Percent female 30+	-0.478***	-0.481***	-0.00906
Percent male 0-16	0.171	0.173	0.0159
Percent male 16-30	-0.0550	-0.0616	-0.00851
Percent male 30+	-0.0320	-0.0430	-0.00748
Female headed HH	-0.0420	-0.0542	-0.0439***
Household size	0.0441**	0.0452***	0.00112
Livelihood diversification (/Both climate and non-climate sensitive)			
Only climate sensitive	0.0370	0.00144	-0.0679***
Only non-climate sensitive	0.135	0.104	-0.0550***
Remittances	-0.0114	-0.00648	0.0110
Constant	-0.172	-0.0157	0.327***
Observations	1484	1483	1483
r2	N/A	N/A	0.307

Note: Asterisks represent statistical significance at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Annex C. Multivariate Specifications

The principal specification treats resilience capacity, in the face of shocks and stressors, as a key determinant of well-being outcomes. Other determinants, used as controls, include shock exposure, and household characteristics (female-headed households, household size, etc.), and livelihood type:

$$\textbf{Outcomes} = f\left[\begin{array}{c} \textbf{Shock exposure} \\ \\ \textbf{Household resilience capacities} \\ (assets, human\ capital, bonding\ and\ bridging\ social\ capital, \\ exposure\ to\ information, number\ of\ livelihoods) \\ \\ \textbf{Community resilience capacities} \\ (access\ to\ formal\ safety\ nets\ and\ basic\ services) \\ \\ \textbf{Household characteristics} \\ (size\ of\ household, \\ household\ demographics, etc.) \\ \\ \textbf{Livelihood type} \end{array}\right]$$

Household and community resilience are included in regression equations as the primary explanatory variables of interest both in their index form (i.e., absorptive, adaptive and transformative capacity index) and decomposed into components (i.e., bonding social capital, human capital, access to basic services, etc.).

The relationships between response to shock, outcomes, and resilience capacities are also explored. First, shock coping strategies are treated as determinants of outcomes:

$$\textbf{Outcomes} = f\left[\begin{array}{c} \textbf{Shock exposure} \\ \\ \textbf{Shock coping strategies} \\ (use\ of\ savings, social\ capital, \\ formal\ assistance) \\ \\ \textbf{Household characteristics} \\ (size\ of\ household, \\ household\ demographics, etc.) \\ \\ \textbf{Livelihood type} \end{array}\right]$$

The specification above helps us determine which shock coping strategies are "positive", in that they lead to better recovery and improved well-being outcomes, and alternatively, which are "negative" in that they lead to worse recovery and poor well-being outcomes.

Next, resilience capacities are treated as determinants of shock coping strategies. A general hypothesis is that absorptive, adaptive, and transformative capacities influence households to adopt "positive" coping strategies that promote better recovery and other well-being outcomes and conversely avoid "negative" coping strategies that inhibit recovery and lead to worse well-being outcomes.

$$\textbf{\textit{Shock coping strategies}} = f\begin{bmatrix} \textbf{\textit{Shock exposure}} \\ \\ \textbf{\textit{Household resilience capacities}} \\ (absorptive, adaptive) \\ \\ \textbf{\textit{Community resilience capacities}} \\ (transformative) \\ \\ \textbf{\textit{Household characteristics}} \\ (size\ of\ household, \\ household\ demographics, etc.) \\ \\ \textbf{\textit{Livelihood type}} \end{bmatrix}$$

An important, additional specification treats certain indicators related to sanitation, WASH, and adoption of agricultural practices, collected as part of the program's M&E system, ("anticipated program variables") as key determinants of recovery from shock. It is important to note that the data used in this study is sourced from a baseline survey, thus the WASH and sanitation behaviors and agricultural practice adoption measures are only a proxy for what will ultimately be program interventions in the coming years. Again, other determinants, used as controls, include shock exposure, structural household characteristics and livelihood type, and in this specification, household resilience capacity is now included as a control:

$$\boldsymbol{Recovery} = f\left[\begin{array}{c} \boldsymbol{Shock\ exposure} \\ \\ \boldsymbol{Anticipated\ program\ variables} \\ (agricultural\ practices, WASH\ practices\ and\ characteristics) \\ \\ \boldsymbol{Household\ resilience\ capacities} \\ (social\ capital, human\ capital, etc.) \\ \\ \boldsymbol{Household\ characteristics} \\ (size\ of\ household, \\ household\ demographics, etc.) \\ \\ \boldsymbol{Livelihood\ type} \end{array}\right]$$

As the lone resilience outcome available for this analysis, the above specification tests the hypothesized positive relationship between anticipated programming activities and resilience as an outcome.

The final specification explores the hypothesis that (household) resilience capacity acts as a mediator between anticipated program variables and recovery from shock – or, stated differently – potential programming activities (represented by "anticipated program variables") serve to improve household resilience capacity (i.e., absorptive and adaptive capacity) which in turn improves recovery from shock. This regression model is specified as a simultaneous equation:

$$\boldsymbol{Recovery} = f\left[\begin{array}{c} \boldsymbol{Shock\ exposure} \\ \\ \boldsymbol{Anticipated\ program\ variables} \\ (agricultural\ practices, WASH\ practices\ and\ characteristics) \\ \\ \boldsymbol{Household\ resilience\ capacities} \\ f[\boldsymbol{Anticipated\ program\ variables}(ag\ practices, WASH)] \\ \\ \boldsymbol{Household\ characteristics} \\ (size\ of\ household, \\ household\ demographics) \\ \\ \boldsymbol{Livelihood\ type} \end{array}\right]$$

The simultaneous equation model is estimated using a two-stage least square (2sls) and instrumental variable probit (IV probit) estimator.[17] These instrumental techniques have the advantage of eliminating any endogeneity bias that may result from the inherent interdependence between recovery from shock and resilience capacity (i.e., better recovery promotes greater resilience and alternatively higher resilience promotes increased recovery).[18]

[17] A binary version of recovery is tested with the appropriate IV probit estimator.
[18] An excellent description, and example in practice, of using instrumental variable techniques to establish the existence of a mediating variable is available in Acemoglu, Johnson and Robinson's seminal article: Reversal of Fortune (Acemoglu 2002).

Annex D. Resilience Capacity Tables (scaled 0-100)

Table 37: Absorptive capacity index and components (scaled 0-100), by livelihood categories

Indicator	Climate-sensitive only	Both climate and non-climate sensitive		Non-climate sensitive only		Remit-tances		All
Absorptive capacity index (mean; range 0-100)	46.5	50.1	***	45.6		45.8		47.4
Index components:								
Bonding social capital score (mean; range 0-100)	66.7	71.3	*	61.1		65.7		67.6
% HH with any cash savings	20.7	27.1	*	29.5	*	25.0		24.4
% HH receiving remittances	5.7	7.6		3.2		84.6	***	29.0
Asset score (mean; range 0-100)	28.1	34.2	***	27.7		30.5	**	30.7
Shock preparedness and mitigation score (mean; range 0-100)	17.3	21.7	***	20.0		18.3		19.1
% HHs access to informal safety nets	44.8	54.3		38.6		61.7		52.4
n	*493*	*491*		*80*		*450*		*1514*

NOTE: Asterisks represent statistical significance between climate-sensitive-only and other livelihood categories at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 38: Adaptive capacity index and components (scaled 0-100), by livelihood categories

Indicator	Climate-sensitive only	Both climate and non-climate sensitive		Non-climate sensitive only		Remit-tances		All
Absorptive capacity index (mean; range 0-100)	46.5	50.1	***	45.6		45.8		47.4
Index components:								
Bridging social capital score (mean; range 0-100)	48.5	52.2		47.6		57.0	'**	52.1
% HHs w/one or more adults in HH w/primary education or higher	19.4	32.0	***	38.6	***	30.2	'**	27.5
% HHs adopted improved (project promoted) agriculture practice	84.5	78.8		67.3	**	87.4		83.0
Asset score (mean; range 0-100)	28.1	34.2	***	27.7		30.5	**	30.7
Livelihood diversity score (mean; range 0-100)	28.8	42.9	***	18.7	***	46.6	'**	38.0
Use of financial services (0-100)	36.6	38.9		27.7	**	31.4	'*	35.4
Exposure to information (mean; range 0-100)	30.6	41.5	***	37.6		32.8		35.1
n	*494*	*492*		*80*		*450*		*1516*

NOTE: Asterisks represent statistical significance between climate-sensitive-only and other livelihood categories at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Table 39: Transformative capacity index and components (scaled 0-100), by livelihood categories

Indicator	Climate-sensitive only	Both climate and non-climate sensitive		Non-climate sensitive only		Remit-tances		All
Transformative capacity index (mean; range 0-100)	29.5	29.6		26.0		32.9	*	30.3
Index components:								
Bridging social capital score (mean; range 0-8)	48.5	52.2		47.6		57.0	***	52.1
% HHs access to formal safety nets	29.9	31.0		27.4		35.3		31.7
Access to basic services (mean; range 0-100)	15.7	13.9		11.0		15.2		14.8
n	*494*	*492*		*80*		*450*		*1516*

NOTE: Asterisks represent statistical significance between climate-sensitive-only and other livelihood categories at the 0.01 (***) and 0.05 (**) levels, and marginal significance at the 0.10 (*) level.

Annex E. Coping Strategies

	Coping strategy category	Coping strategy (from survey question)
1	Offtake of livestock	Selling livestock
		Slaughtering cattle
		Sell small animals (sheep, goats)
2	Other asset sales	Lease out land
		Sell household items (e.g., radio, bed)
		Sell productive assets (e.g., plow, water pump)
3	Changing food consumption patterns	Consume the reserves of food kept for the next season
		Consume seed
		Limit portion size at mealtimes or reduce the number of meals
		Eating of lean season food (leaf and wild fruits, insects, etc.)
4	Loan	Take out a loan
5	Social capital	Receive money or food from family members
6	Wage labor	Take up new wage labor
7	Formal assistance	Receive food aid from the government / NGO
8	Child cost reduction strategies	Withdraw children of the school
		Send the children or an adult to relatives
		Exodus of the young people (boys and girls)
		Send children to work for money (e.g., domestic service)
9	Remittances	Get money from a relative that migrated (remittances)
10	Conflict management	Committees to facilitate the dialogue between the groups in conflict
		Local conventions
		Law enforcement
11	Own savings	Use money from savings

Annex F. Agricultural Practices and Technologies Promoted by the Project

This annex lists the agricultural practices and technologies promoted by the HARANDE project, by category.

Value chain activities

1. Purchase of inputs through agro-dealers and/or community associations
2. Use of mobile financial services
3. Use of financial services other than mobile (excluding insurance)
4. Use of training and extension services
5. Contract farming
6. Use of feed lots or pen feeding
7. Drying, processing and packaging for selling/storage
8. Trading or marketing produce through agro-vets, community associations and/or cooperatives
9. Training or marketing systems
10. Use of formal market information services

Sustainable crop practices and/or technologies

1. Micro dosing
2. Manure
3. Compost
4. Planting basins
5. Mulching
6. Weed control
7. Dry planting
8. Ripping into residues
9. Clean ripping
10. Tied ridges
11. Pot-holing (ZAI)
12. Crop rotations
13. Intercropping
14. Integrated Pest Management (IPM)
15. Early planting
16. Use of improved seed and/or crop varieties
17. Contour planting
18. Terracing
19. Land leveling
20. Micro-irrigation technology (MIT)

21. Soaking seeds
22. Transplanting
23. Half-moon (Demi-lune)
24. Chemical fertilizer

Sustainable livestock practices and/or technologies

1. Improved animal shelters
2. Vaccinations
3. Deworming
4. Castration
5. Dehorning
6. Homemade animal feed made of locally available products
7. Animal feed supplied by stock feed manufacturer
8. Artificial insemination
9. Pen feeding
10. Fodder production and/or veld reinforcement with legumes
11. Used the services of community animal health workers/paravets
12. Improved breed selection

Sustainable natural resource management practices and/or technologies

1. Management or protection of watersheds or water catchments
2. Agro-forestry
3. Management of forest plantation
4. Regeneration of natural landscapes
5. Sustainable harvesting of forest products
6. Rotational grazing or trans-humane system of livestock feeding
7. Hedge-row planting
8. Trench
9. Small dikes
10. Stone rows to control erosion
11. Gabion

Sustainable storage practices and/or technologies

1. Hermetic storage
2. Improved granary
3. Warehousing
4. Grain bag with bio-pesticides
5. Triple bag
6. Hang and smoke