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Resilience capacities and implications for food security in Zimbabwe

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Abstract

There is an emerging body of studies assessing the influence of resilience on household food security in developing countries. Yet no study has systematically analysed this theme in Zimbabwe, an area that we address. Data was collected from 331 randomly selected farm households in four districts of Zimbabwe. Factor analysis was used to compute resilience capacities. Poisson regression was used for model estimations. Assets, market diversity and social capital increased dietary diversity by 7.5%, 3.6% and 2.9% respectively. Interventions that enhance asset accumulation, for example income-generating activities, should be promoted. Promoting farmer groups and collective actions are important to strengthen social capital. Adaptive and absorptive capacity increases dietary diversity by 5.9% and 5.4% respectively. Household resilience is positively associated with dietary diversity. The public and private sectors and civil society need to promote interventions that build adaptive, absorptive, and overall resilience capacity of farming households to enhance food security.

Key words: resilience capacities, dietary diversity, farmers, Poisson, Zimbabwe

1. Introduction

Economic, natural, social and political shocks are on the increase globally. Shocks such as inflation, drought, fall armyworm outbreaks, COVID-19, livestock diseases, food price spikes, election violence and the death of a family member are dominant in Zimbabwe (Hoddinott 2006; Kahinda *et al*. 2007; Stoeffler *et al*. 2016) and other developing countries (Smith & Frankenberger 2018). These shocks can have far-reaching negative consequences for the wellbeing of individuals, households and communities, affecting their income, nutrition and health, and may drive households deeper into poverty (Béné *et al*. 2016b).

Resilience is the ability of people, households and systems to mitigate, adapt to and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth (Sharifi 2016; Béné *et al*. 2017). Building resilience involves interventions that promote adaptive, absorptive and transformative capacities at multiple levels, namely those of individuals, households, the community and the region (d'Errico & Di Giuseppe 2018; Smith & Frankenberger 2018). In this era of diverse climate, economic, political and social shocks and stresses, households' resilience capacities need to be strengthened to enable smallholder farmers to better withstand impacts from shocks (Asmamaw *et al*. 2019). According to Smith and Frankenberger (2018), a resilient household can maintain its wellbeing even in the face of shocks and stressors, and resilience capacities are a set of conditions that enable households to achieve resilience in the face of shocks. Given this, there is an emerging interest in the study of resilience and efforts to promote resilience capacities.

Studies have recently started to explore the linkages between resilience and household welfare in the face of shocks (Sharifi 2016; Béné *et al*. 2017; d'Errico & Pietrelli 2017; Douxchamps *et al*. 2017; d'Errico *et al*. 2018; Smith & Frankenberger 2018). For example, d'Errico *et al*. (2018) demonstrated that household resilience was significantly and positively related to household food security status, and that those with a higher resilience capacity index were better equipped to absorb and adapt to shocks in Tanzania and Uganda. d'Errico and Pietrelli (2017) and Smith and Frankenberger (2018) found positive effects of resilience on nutrition in Mali and Bangladesh respectively.

As shown above, there is an emerging body of studies assessing the influence of resilience on individual and household food security in developing countries. Yet there is a general lack of sufficient empirical evidence about the effects of resilience on food security in these countries, or in sub-Saharan Africa (SSA). Insights from this study would be relevant for similar contexts in SSA. We contribute to this literature gap by analysing how resilience capacities influence household food security in Zimbabwe.

Zimbabwe is an interesting case study for several reasons. First, Zimbabwe is highly dependent on agriculture and there is widespread poverty and undernutrition in the country (Stoeffler *et al*. 2016). More than 70% of Zimbabweans are engaged in smallholder subsistence farming, which is the most important sector of the economy (Kahinda *et al*. 2007). Maize is the main staple for 90% of the population of Zimbabwe, and almost all agricultural production is rainfed. This situation is worsened by erratic rainfall and frequent dry spells, as well as limitations to the expansion of irrigation (Kahinda *et al*. 2007). Second, Zimbabwe experiences recurring droughts, macroeconomic instability, high unemployment, declining soil fertility and poor agricultural policies, which reduce agricultural productivity and subsequently reduce food and nutrition security (Kahinda *et al*. 2007; Stoeffler *et al*. 2016; Witter *et al*. 2017). Third, development agencies have started implementing rural and urban resilience-building interventions in the country (ZRBF 2019; World Vision 2020).

Given the discussion above, this study was designed to explore the influence of resilience on household food security in four districts implementing the Enhancing Nutrition, Stepping Up

Resilience and Enterprise (ENSURE) programme in Zimbabwe. Therefore, research questions were formulated to address the desired objective. These were: (i) which resilience indicators contribute to dietary diversity? (ii) what is the influence of adaptive, absorptive and transformative capacities on household dietary diversity? and (iii) what is the influence of resilience capacity on household dietary diversity? The findings of the study will provide important policy guidance on the strategies to build resilience and improve food security.

2. Enhancing Nutrition, Stepping Up Resilience and Enterprise programme

Enhancing Nutrition, Stepping Up Resilience and Enterprise (ENSURE) is a seven-year USAID-funded programme that was implemented in six districts of Zimbabwe and benefits more than 215 000 households (Figure 1). World Vision Zimbabwe implemented ENSURE in partnership with Care, SNV and Safire. The programme is organized around three interrelated objectives and its goal is to contribute to the long-term food security of rural people (World Vision 2020). The three strategic objectives are a) to increase household resilience to shocks, b) to improve household food security and nutrition among pregnant and lactating women, women of reproductive age and children under the age of five years, and c) to increase household and micro-enterprise income and productivity through market-oriented approaches. The second strategic objective aims at addressing underlying causes of chronic food insecurity by enhancing the knowledge, capacity, access to markets for income generation, asset building and savings of farm households (World Vision 2020).

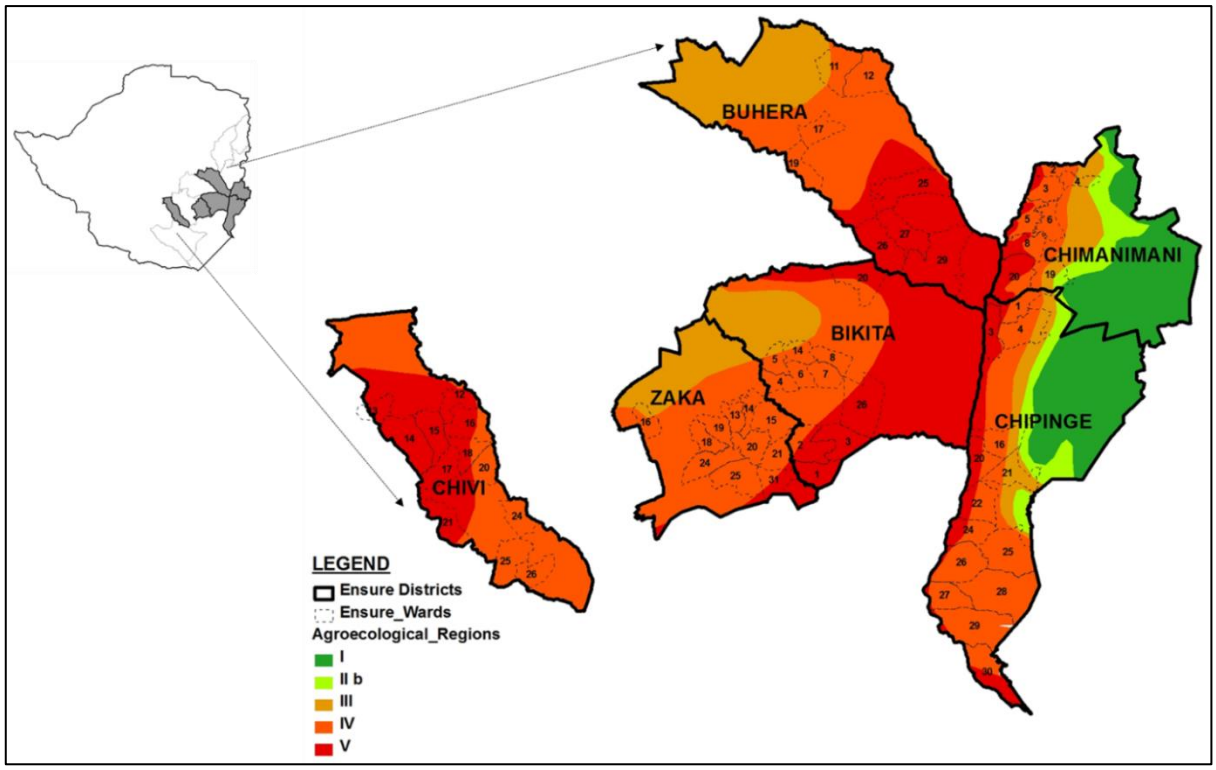

Figure 1: Distribution of ENSURE wards by district in Zimbabwe

3. Conceptual framework

The conceptual framework in Figure 2 shows the link between household resilience and food security. In this article, dietary diversity is used as a measure of food security. Resilience is defined as the ability of individuals, households and communities to withstand these shocks (Sharifi 2016; Béné *et al*. 2017; d'Errico & Pietrelli 2017; d'Errico *et al*. 2018; Smith & Frankenberger 2018). d'Errico and Pietrelli (2017) and Smith and Frankenberger (2018) found that household resilience capacity was

positively associated with nutritional outcomes in Mali and Bangladesh respectively. d'Errico and Di Giuseppe (2018) found that households in Uganda with higher resilience capacities in an initial period were less likely to suffer a reduction in per capita calorie intake in a future period, even when shocks hit them. Household resilience is a function of adaptive, absorptive and transformative capacities (Béné *et al*. 2016a).

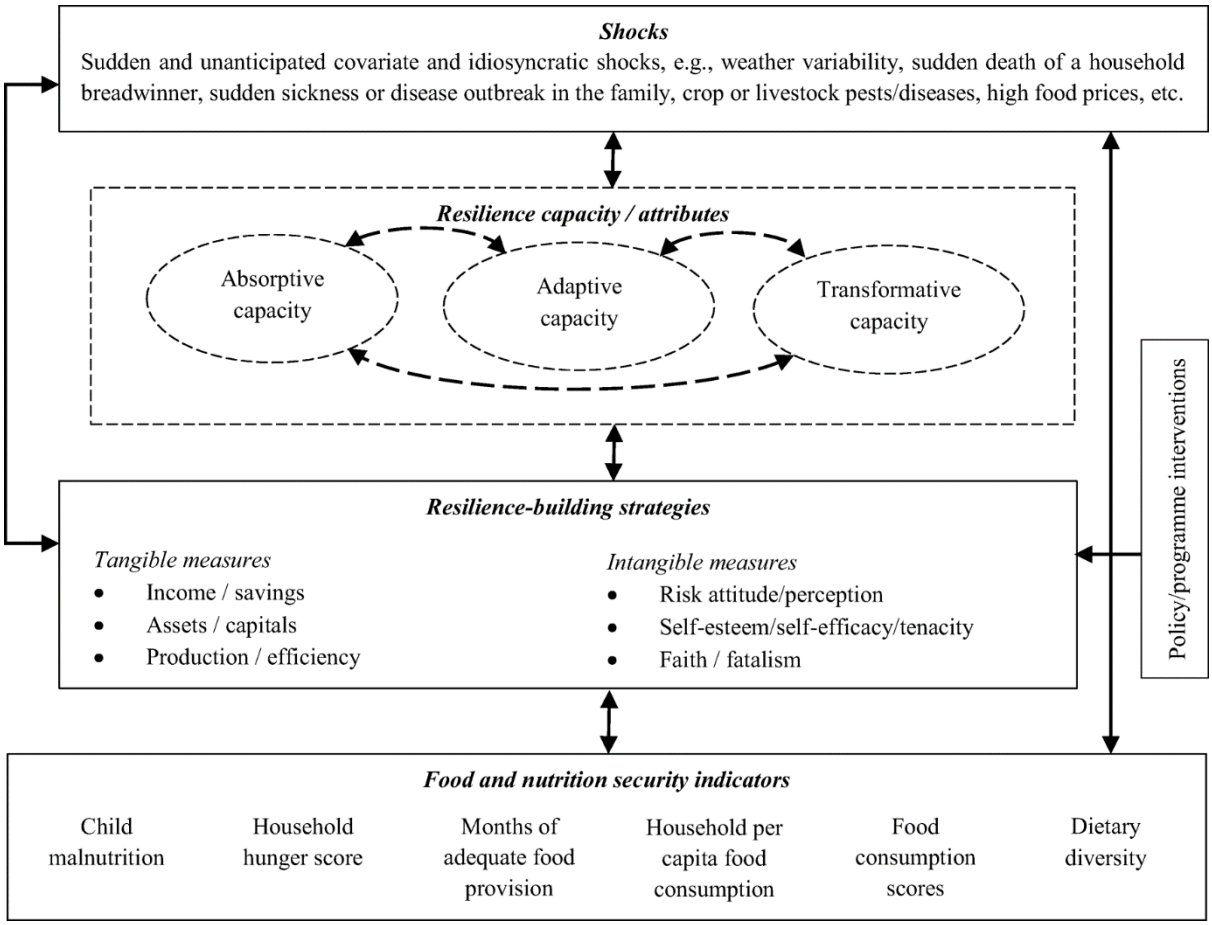

Figure 2: Conceptual framework of resilience and food security
Source: Adapted from Béné *et al.* (2017)

3.1 Adaptive capacity

Adaptive capacity refers to an individual, household or system's ability to adapt to the changing environment in which it operates (Smith & Frankenberger 2018). Some of the adaptive capacity indicators include livelihood diversity, assets, human capital and access to information. A diversity of livelihood sources is important for resilience, since they allow flexibility, thereby reducing households' vulnerability in the face of shocks. Households with greater levels of livelihood diversity achieve greater levels of resilience than those that have less diversification, ceteris paribus (Béné *et al*. 2017). Livelihood diversity includes all livelihood activities a household is engaged in, which entail a list of activities along with the percentage of households engaged in those activities. Crop diversity is the number of crop activities carried out by a household, while livestock diversity is the total number of livestock activities undertaken by a household. Asset availability is an important coping mechanism during periods of hardship, as assets form part of the household's capital. Productive and non-productive assets are important components of households' resilience, since they can be used by households to increase income and buffer themselves against shocks (Hoddinott 2006; Heltberg *et al*. 2013). These assets include land, smartphones, scotch carts, televisions, radios, solar

panels, ploughs and wheelbarrows. A household with more assets is likely to be more resilient to shocks that threaten food security through consumption smoothing.

Human capital endows people with the ability to use information and other resources to cope with shocks and stressors (Smith & Frankenberger 2018). Human capital also enhances household resilience, since skilled and educated household members can engage in other non-farm or off-farm activities to earn extra income. Exposure to information is important in building resilience, as households make informed decisions, such as on the types of crops to grow and the time of the season to plant. Households exposed to information can prepare in a timely manner to absorb and adapt to a shock when it occurs (Smith & Frankenberger 2018). Therefore, for improved adaptive capacity, investments should be made to enable people and systems to adapt proactively to changing conditions by giving them better access to information, diversifying livelihoods into different risk profiles, accumulating assets, having access to financial services and investing in human capital (Béné *et al*. 2017; d'Errico *et al*. 2018; Smith & Frankenberger 2018).

3.2 Absorptive capacity

Absorptive capacity is defined as the ability of the system to minimise its exposure to shocks, but also having the mechanisms to recover quickly when shocks actualise (Ansah *et al*. 2019). To improve absorptive capacity, interventions should focus on the ability of households, communities and systems to manage shocks and stresses in the short term through cash savings and informal safety nets, the disposal of liquid assets that are accumulated in non-shock years, disaster risk-reduction strategies and reliance on bonding social capital.

Social capital is the quantity and quality of social resources (networks, membership in groups, social relations, and access to wider institutions in society) upon which people draw in pursuit of livelihoods and that allow them to work closely with each other to prevent, cope with and respond to shocks and stressors (Maertens & Barrett 2013). It comprises informal support, mainly in the form of loans, gifts and remittances from relative, neighbours or friends, far more often than formal sources of support such as food aid, cash transfers and capacity-building support (d'Errico *et al.* 2018).

Social safety nets are an important element of resilience building, as they help in mitigating risks. They include assistance from friends, relatives, charities, international agencies and non-governmental organisations (Smith & Frankenberger 2018; Sseguya *et al*. 2018). The most highly available formal safety net is food assistance through in-kind distributions and cash transfers. Cash savings are important, as they enable rural households to purchase food and non-food items. Disaster preparedness and mitigation benefit households' resilience to shocks. Household resilience depends on the preparedness of the household to anticipate and absorb shocks (d'Errico & Di Giuseppe 2018).

3.3 Transformative capacity

Transformative capacity refers to the system-level conditions that are necessary for changing the basic configuration of the system to create long-term resilience (Smith & Frankenberger 2018; Ansah *et al*. 2019). To improve transformative capacity, investments should be geared towards access to basic services and markets, as well as empowering women. Access to basic services enables households to maintain their human capital and meet several other needs, such as conflict mitigation services and access to infrastructure. Basic services include access to healthcare services, family planning services, a primary school, a preschool and a local government council. The availability of these services plays a big role in resilience building, as it helps households in times of crisis (Béné *et al*. 2016b; Shively 2017).

Regarding women's empowerment, women have less power to make decisions and less control over resources than men do, yet they engage in productive and income-generating activities and make major contributions to household physical wellbeing through their caring practices (Béné *et al*. 2016a; Bikketi *et al*. 2016). Women's empowerment through internal savings and lending schemes (ISALs) (Lønborg & Rasmussen 2014), farmer groups and nutrition groups are important in explaining household resilience, because most rural households are female headed. Households become resilient when women are empowered. Access to diverse markets enables vulnerable households to reduce their risk by providing access to input and output markets and financial services, thus promoting the diversification of assets and income-generation activities The variety of input and output markets affects input provision and source of food (Sibhatu *et al*. 2015), thus influencing the household's resilience capacity. Overall, in the farm household setting, an important pathway for building resilience capacity to food security is through building adaptive, absorptive and transformative capacities (Béné *et al*. 2016a, 2017; Smith & Frankenberger 2018; Ansah *et al*. 2019).

4. Sampling and data collection

The data used in this analysis was drawn from four districts of the ENSURE programme: Chimanimani, Bikita, Buhera and Zaka. The household survey was carried out during the month of September, which is about four months after the harvest of the staple crop in a normal season. A multi-stage sampling technique was used. The first stage of sampling involved purposive sampling of the four districts in which the programme was implemented. Wards, and villages thereafter, were chosen randomly. Households were randomly selected from each village list obtained from the agricultural extension officers. Cochran's formula was used to determine the sample size:

$$\eta_0 = \frac{Z^2 .p.q}{e^2},$$

where n = sample size, Z = values for the confidence interval, p = level of variability in the level of attributes being measured, and $q = (1 - p)$ is the level of precision (margin of error). Using a 95% confidence interval, $p = 0.5$, the margin of error is 5%, and a sample size of 385 was sufficient for the study. A total of 331 households were sampled, which represented 86% of the targeted sample. The number of households sampled in each district was 77 in Bikita, 80 in Buhera, 96 in Chimanimani and 78 in Zaka.

5. Measurement and estimation strategy

5.1 Household dietary diversity score

Food security was measured using household dietary diversity (HDDS) (Swindale & Bilinsky 2006). Food items were categorised into 12 different food groups, namely cereals, roots and tubers, vegetables, fruits, meat, eggs, fish and seafood, pulses and nuts, milk and milk products, oils and fats, sugar, and condiments (Swindale & Ohri-Vachaspati 2004; Swindale & Bilinsky 2006). A food item consumed in the previous 24 hours by anyone in a household counts towards the household score. It is a count variable from 0 to 12. The shorter recall period improves the accuracy of estimates compared with longer recall periods (Swindale & Bilinsky 2006).

5.1.1 Resilience capacity

Following Smith and Frankenberger (2018), resilience capacity was measured using multiple indicators of the three capacities: adaptive capacity (AC), absorptive capacity (ABC) and transformative capacity (TC). Factor analysis was used for the computation of the three capacity

indices as well as the resilience capacity. Factor analysis determines and assigns weights mathematically to capture the relative importance of multiple indicators and maximise the variance explained by the linear composites (Field 2013).

5.1.2 Adaptive capacity

Adaptive capacity is the ability of a system to adjust impacts to moderate potential damage and to take advantage of opportunity so that it continues functioning without significant change in system structures.

$$AC_i = f(LIVD_{i,}ASS_i, HUMK_i, ACINFOR_i), \quad (1)$$

where AC = adaptive capacity, $LIVD$ = livelihood diversity, ASS = asset index, $HUMK$ = human capital, and $ACINFOR$ = access to information.

5.1.3 Absorptive capacity

Absorptive capacity is the ability of a socio-ecological system to prepare for, mitigate or prevent negative impacts through coping strategies in order to preserve and restore basic structures and functions (Smith & Frankenberger 2018). Absorptive capacity is computed as:

$$ABC_i = f(SC_i, SSN_i, DP\&R_i, CAS_i), \quad (2)$$

where ABC = absorptive capacity, SC = social capital, $DP\&R$ = disaster preparedness and mitigation, and CAS = cash savings.

5.1.4 Transformative capacity

Transformative capacity is the ability to create an enabling new system in times of crisis. The transformative capacity index is calculated as:

$$TC_i = f(ABS_i, MDIV_i, WEMP_i), \quad (3)$$

where TC = transformative capacity, ABS = access to basic services, $MDIV$ = market diversity, and $WEMP$ = women's empowerment.

5.1.5 Resilience capacity

The Resilience Capacity Index (RCI) was computed as a function of the three resilience capacities, namely adaptive, absorptive and transformative capacities, using factor analysis (Smith & Frankenberger 2018). According to d'Errico and Pietrelli (2017), using an index to represent a complex multidimensional construct has the advantage that it is easily incorporated into other modelling procedures and allows for a more concise description of the overall resilience capacity. It also is useful for the analysis of interventions and policy components. Equation 4 shows the computation of RCI.

$$RCI_i = f(AC_i, ABS_i, TC_i), \quad (4)$$

where RCI = resilience capacity index, AC = adaptive capacity index, ABS = absorptive capacity index, and TC = transformative capacity index

5.2 Influence of resilience capacity on dietary diversity

To find the relationship between household resilience and dietary diversity, the following model was estimated:

$$DDS = \beta_0 + \beta_1 RCI + \beta_2 I + \beta_3 H + \varepsilon, \quad (5)$$

where DDS = dietary diversity score, RCI = the resilience capacity index, H and I are vectors of household and individual characteristics, respectively, β_0 are the parameters to be estimated, and ε is the error term. β_1 captures how resilience capacity influences dietary diversity, and β_2 and β_3 capture the effect of household and individual characteristics on dietary diversity. If these parameters have a positive coefficient, it implies that the independent variables are positively correlated with the dietary diversity score.

The dietary diversity score, which is the dependent variable, is a count variable that can take values between 1 and 12 and is not normally distributed. Therefore, we relied on a count data regression model for estimation (Wooldridge 2010). To determine whether the Poisson model was the appropriate model for the analysis, deviance statistics and the Pearson statistic were calculated. The p-value of both tests was 1.00, which is greater than 0.05 and means that the Poisson regression model was appropriate (Wooldridge 2010).

The results only show associations and should be interpreted with caution, given the presence of unobserved heterogeneity as well as reverse causality. As shown in the conceptual framework, resilience capacity can influence nutrition, and households with better nutritional status might also become more resilient. This is because of their better cognitive ability, and hence human capital, which might motivate them to actively search for and use information. The data used came from the ENSURE project, which unfortunately did not account for shocks and stressors. The influence of resilience capacity on household food security is better explained with the inclusion of shock variables. Despite this limitation, the study provides a useful formative study of the ENSURE project. Accounting for the presence of shocks in the analysis would be a fruitful area for further research.

6. Results and discussions

6.1 Descriptive results

Table 1 shows the descriptive statistics of the dependent variable, resilience capacities, and the demographics. At the household level, the mean HDDS is 5.48; that is, the average household consumed 5.48 food groups in the course of the reference day. This points to relatively moderate levels of dietary diversity among rural households in the study area during the dry season, when the data was collected. The average farm household produces five different crop and livestock enterprises. Our sample was dominated by male-headed households (73%), with a mean age of 55 years. The household size varied from one to 22 members, with a mean size of 5.9.

Table 1: Descriptive statistics (a priori expectations in parenthesis)

Variable	Description	Min	Max	Mean	SD
Dependent variable					
HDDS	Household dietary diversity score	0	1	5.48	1.52
RCI pillars/capacities					
AC (+)	Adaptive capacity index	0	1	0	1
ABC (+)	Absorptive capacity index	0	1	0	1
TC (+)	Absorptive capacity index	0	1	0	1
RCI	Resilience capacity index	0	1	0	1
Resilience indicators					
Livelihood diversity (+)	Number of livelihood activities in which a HH is engaged	0	16	5.09	4.49
Access to basic services (-)	Availability of schools, healthcare service, local government council (index)			0	1
Assets (+)	Productive and non-productive assets (index)	0	1	0	1
Social safety nets (+)	Cash and in-kind assistance received, quality of assistance (index)	0	1	0	1
Disaster preparedness and mitigation (+)	Volunteers trained for disasters, awareness of coping mechanisms and livestock feeding practices	1	2	0.91	0.28
Social capital (+)	Formal and non-formal organisations in which the household is involved (index)	0	1	0	1
Cash savings (+)	Dummy = 0 if HH has had cash savings in the past five years, 0 otherwise	0	1	0.79	0.41
Human capital (+)	Number of years of formal education of HH head	0	19	8.24	3.23
Access to information (+)	Type of information received and household perceptions of the information (index)	0	1	0	1
Market diversity (+)	Number of input and output markets in which a HH participates	0	3	0.80	0.79
Women's empowerment (+)	Participation of women in internal savings and lending clubs (ISALs), nutrition groups and farmer groups (index)	0	1	0	1
Demographics					
Age (+)	Age in years of HH head	22	110	55.34	14.93
Gender (+)	Dummy = 1 if HH head is male, 0 otherwise	0	1	0.77	0.42
Marital status (-)	Dummy = 1 if HH is married, 0 otherwise	0	1	0.74	0.44
Family size (-)	Total number of family members	1	22	5.93	2.51

Notes: HH is household and SD is standard deviation; number of observations = 331.

Only indicators with an eigen value greater than one were retained in constructing the household resilience capacity index, and all three capacities are shown (Field 2013). The adaptive, absorptive and transformative capacities load highly onto the resilience capacity index, with factor loadings of 0.61, 0.79 and -0.65 respectively. The Kaiser-Meyer-Olkin measure of sampling adequacy was greater than the recommended minimum of 0.5 in all the indices, and thus unbiased inferences can be drawn from the indices constructed (Field 2013). Bartlett's test of sphericity was also significant in all the indices, implying that factor analysis is useful with the data. The first factor with the largest eigen value (Field 2013) was assumed to be the one reflecting household resilience, and adaptive, absorptive and transformative capacities.

Categorising households into levels helps to understand the distribution of household dietary diversity (Swindale & Bilinsky 2006). Swindale and Ohri-Vachaspati (2004) propose cut-offs for categorising households according to their HDDS. The sample distribution was divided into HDDS tertiles, which were characterised as low (0 to 5), moderate (6 to 7) and high (8 to 12) dietary diversity. The Chimanimani and Buhera districts had a larger proportion of households with low dietary diversity, with 61.3% and 62.3% respectively (Figure 3). In Zaka district, 55.13% of the households were categorised as having moderate dietary diversity. A total of 15.6% of the households in Bikita were categorised as having high dietary diversity. Bikita and Zaka districts seemed to have a higher dietary diversity than the other districts. This could be related to the fact that these two districts receive

relatively high rainfall compared to the others, and they have more irrigation schemes, which are conducive to better agricultural production.

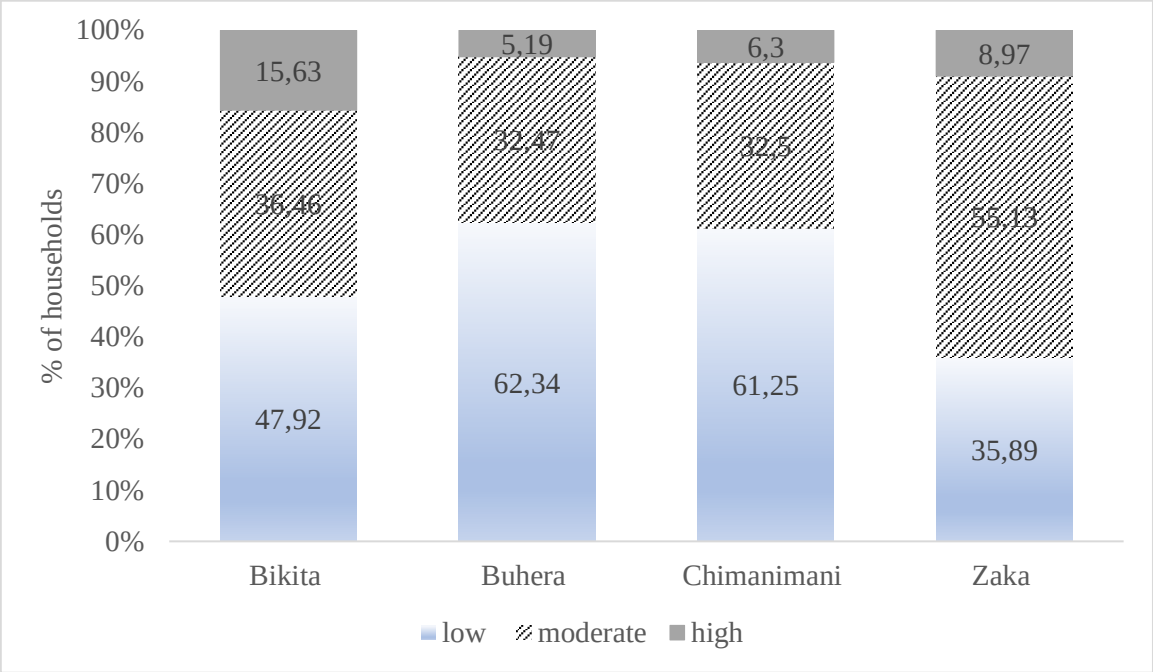

Figure 3: Proportion of households by dietary diversity tertiles

6.2 Econometric results

6.2.1 Influence of individual resilience indicators on dietary diversity

Table 2 shows the role played by different individual resilience indicators in dietary diversity. Assets were positively correlated with dietary diversity. An additional unit increase in asset index increased dietary diversity by 7.5%. The finding that assets are an important indicator in this study corroborates the findings of other studies focusing on household resilience and food security (d'Errico & Di Giuseppe 2018, d'Errico *et al*. 2018; Smith & Frankenberger 2018). For example, Smith and Frankenberger (2018) found that assets reduce the negative impact of shocks on food security in Bangladesh. Liquid assets are easily convertible into cash, which can be used by most rural households to buy food and are used to smooth food consumption. Activities and interventions that enhance asset accumulation among smallholder farmers should be promoted, for example income-generating activities, micro-credit schemes that increase access to capital and boost investments in assets, and small-scale business development that allows households to increase the return to assets (Winters *et al*. 2009; Roodman & Morduch 2014).

Human capital has a positive effect on household dietary diversity. An additional unit increase in education increases dietary diversity by 0.7%. Educated households can diversify their income sources and properly manage them, thereby increasing their income earnings, which can then be used to acquire food from the market. The influence of human capital accords with a recent study in Bangladesh (Smith & Frankenberger 2018). Access to information is negatively correlated with dietary diversity. Although this is contrary to expectation, it could possibly be because, although households are receiving information about new technologies, they are not yet implementing them due to resource and other constraints to utilising the information received (Smith & Frankenberger 2018). In addition, it might be that the information received is not relevant and timely for promoting the production and consumption of diverse food groups. We therefore recommend that the public and private sectors disseminate relevant and timely information on agricultural production and nutrition.

Social capital is positively correlated with dietary diversity. A unit increase in social capital increases dietary diversity by 2.9%. Households with higher levels of social capital are more food secure because they have access to networks through which they get food and social assistance. Market diversity has a positive effect on dietary diversity. An additional unit increase in market diversity increases dietary diversity by 3.6%. Market diversity affects dietary diversity mainly because it allows for alternative sources of agricultural productivity-enhancing inputs. In addition, it offers alternative sources from which farmers can purchase their foodstuffs. The effect of social capital and access to markets on dietary diversity resonates with numerous past studies (Sibhatu *et al*. 2015; Smith & Frankenberger 2018; Sseguya *et al*. 2018; Murendo *et al*. 2019). Interventions that promote social capital, for example the formation and strengthening of farmers' groups and associations, are crucial for enhanced agricultural productivity. Linking farmers to diverse input and output markets is important for promoting diversity sources of inputs and destinations for selling marketable surplus.

Table 2: Influence of individual resilience indicators on dietary diversity – Poisson regression

HDDS	Coef.	Std err	t-value	p-value	95% confidence interval	Sig.
Adaptive capacity						
Livelihood diversity	-0.004	0.003	-1.18	0.239	[-0.010, 0.003]	
Assets	0.075	0.016	4.79	0.000	[0.044, 0.105]	***
Human capital	0.007	0.004	1.83	0.067	[-0.001, 0.015]	*
Access to information	-0.022	0.012	-1.77	0.076	[-0.045, 0.002]	*
Absorptive capacity						
Social safety index	0.014	0.013	1.03	0.302	[-0.012, 0.040]	
Preparedness for disaster mitigation	-0.038	0.049	-0.77	0.443	[-0.134, 0.059]	
Cash savings	0.041	0.044	0.94	0.350	[-0.045, 0.126]	
Social capital	0.029	0.016	1.76	0.079	[-0.003, 0.061]	*
Transformative capacity						
Women's empowerment	-0.013	0.013	-1.03	0.305	[-0.038, 0.012]	
Access to basic services	-0.024	0.014	-1.70	0.089	[-0.051, 0.004]	*
Market diversity	0.036	0.019	1.90	0.057	[-0.001, 0.073]	*
Constant	1.626	0.067	24.15	0.000	[1.494, 1.758]	***

Mean dependent variable	5.477	SD dependent variable	1.516
Pseudo r-squared	0.019	Observations	331
Chi-square	95.002	Prob > chi^2	0.000
Akaike criterion (AIC)	1 308.728	Bayesian criterion (BIC)	1 354.354

*, ** and *** indicate statistical significance at the 10%, 5% and 1% level, respectively
Notes: Sig. is significance; SD is standard deviation

6.2.2 Influence of resilience capacities on dietary diversity

In Table 3, we analyse the influence of the three resilience capacities on dietary diversity. The results show that adaptive and absorptive capacities are positively associated with dietary diversity, whereas a negative association was found for transformative capacities. A unit increase in adaptive capacity increases dietary diversity by 5.9%. Higher adaptive capacity means households are able to recuperate from various shocks without a significant reduction in food security status, and this corresponds with the findings of other studies (d'Errico & Pietrelli 2017; Smith & Frankenberger 2018). As a result, there is scope to enhance household adaptive capacities. Based on our earlier findings, as illustrated in Table 2, interventions that enhance asset accumulation and human capital development will go a long way in building household adaptive capacities.

Absorptive capacity increases dietary diversity by 5.4%, which indicates that absorptive capacity is relevant to household food security status. Social capital is one of the indicators of absorptive capacity that positively enhance dietary diversity. Therefore, efforts to build and strengthen household absorptive capacities should consider strengthening collective action. Overall, the results demonstrate

the need to build and strengthen households' adaptive and absorptive capacities in Zimbabwe. Transformative capacities are usually found at the system or community level, such as governance, compared to the other two capacities, which focus mainly on the individual and household levels. The finding that transformative capacity plays a negative role could be due to the fact that the effects of system-level activities take time to manifest in tangible food security benefits

Table 3: Influence of resilience capacities on dietary diversity – Poisson regression

HDDS	Coef.	Std err	t-value	p-value	95% confidence interval	Sig
Adaptive	0.059	0.013	4.62	0.000	[0.034, 0.085]	***
Absorptive	0.054	0.027	1.97	0.049	[0.000, 0.107]	**
Transformative	-0.110	0.054	-2.02	0.043	[-0.216, -0.003]	**
Constant	1.697	0.015	115.07	0.000	[1.668, 1.726]	***
Mean dependent variable	5.477		SD dependent variable		1.516	
Pseudo r-squared	0.010		Observations		331	
Chi-square	35.518		Prob > chi^2		0.000	
Akaike criterion (AIC)	1 304.303		Bayesian criterion (BIC)		1 319.511	

*, ** and *** indicate statistical significance at the 10%, 5% and 1% level, respectively
Notes: Sig. is significance; SD is standard deviation

6.2.3 Influence of resilience capacity on dietary diversity

The results show that the household resilience index is positively associated with dietary diversity after controlling for other individual and household variables (Table 4). An increase in the resilience capacity index by one unit leads to an 8.6% increase in dietary diversity. The positive influence of household resilience on food security in Sub-Saharan Africa is well documented in previous studies (Béné *et al*. 2017; d'Errico & Di Giuseppe 2018; Smith & Frankenberger 2018). As expected, household size is negatively correlated with household dietary diversity. An additional member in the family is associated with a 2.2% decrease in dietary diversity, indicating that, on average, the larger the household the less food there is for each household member. As found in previous studies (d'Errico *et al*. 2018; Smith & Frankenberger 2018), household size has a negative effect on food security. This is mainly because the marginal productivity of labour is zero in developing countries, thus making a small household better off.

Table 4: Influence of resilience capacity on dietary diversity – Poisson regression

HDDS	Coef.	Std err	t-value	p-value	95% confidence interval	Sig.
Resilience capacity index	0.086	0.016	5.28	0.000	[0.054, 0.118]	***
Gender	0.010	0.052	0.19	0.848	[-0.092, 0.112]	
Age	0.001	0.001	1.35	0.177	[-0.001, 0.003]	
Marital status	-0.011	0.028	-0.38	0.708	[-0.066, 0.044]	
Farming experience	0.000	0.000	-2.44	0.015	[0.000, 0.000]	**
Household size	-0.022	0.013	-1.67	0.096	[-0.048, 0.004]	*
Household income	-0.007	0.007	-1.01	0.312	[-0.019, 0.006]	
Constant	1.869	0.112	16.66	0.000	[1.649, 2.088]	***
Mean dependent variable	5.477		SD dependent variable		1.516	
Pseudo r-squared	0.011		Observations		331	
Chi-square	34.589		Prob > chi^2		0.000	
Akaike criterion (AIC)	1 310.240		Bayesian criterion (BIC)		1 340.657	

*, ** and *** indicate statistical significance at the 10%, 5% and 1% level, respectively
Notes: Sig. is significance; SD is standard deviation

7. Conclusion and policy implications

This paper has investigated the influence of households' resilience capacity on household food security in Zimbabwe. World Vision's ENSURE programme was being implemented at the time of

the study in the four selected study districts of the country. The paper draws on the data collected as part of the programme's thematic survey to determine which resilience indicators contribute to dietary diversity, and the influence of adaptive, absorptive and transformative capacities, as well as resilience capacity, on household dietary diversity.

The results show that assets are an important indicator and positively correlated with dietary diversity. Activities and interventions that enhance asset accumulation among smallholder farmers should be promoted, for example income-generating activities, micro-credit schemes that increase access to capital and boost investments in assets, and small-scale business development. Investments in human capital are also important for household food security. Social capital and market diversity have positive effects on dietary diversity. From a policy perspective, interventions that promote social capital, for example collective actions and farmer groups, are important for enhanced agricultural productivity and subsequent food security. Linking farmers to both input and output markets promotes diverse sources of inputs and outlets for selling marketable surplus. Market diversity allows for additional and alternative food purchases and sales, which will help households to smoothen consumption and increase income.

With regard to the three resilience capacities, the study's findings highlight that adaptive and absorptive capacities are positively associated with household dietary diversity. Interventions that build and strengthen households' adaptive and absorptive capacities should be promoted. In particular, activities that enhance productive and non-productive asset accumulation and human capital development are important for building household adaptive capacities, while strengthening activities for collective action enhances absorptive capacity. Overall, the results demonstrate that resilience capacity improves household dietary diversity. The public and private sectors and civil society need to promote interventions that build the resilience capacity of smallholder farming households in order to enhance food security.

Study limitations

The limitation of this study is that both the dependent and independent variables are self-reported and are likely to entail reporting bias and recall lapse. The data used is cross-sectional and was subject to Poisson regression for analysis. It is possible that there are endogeneity issues that were not fully addressed, and the results should be interpreted as associations and not causality. In addition, we did not account for shocks, as these were not captured in the survey. Despite these limitations, this study is important in that it provides an understanding of the association between resilience and food security.

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