



# **Quantitative Analysis of Resilience Factors Associated with Food Insecurity and Poverty in the Context of HIV/Aids in Southern Africa**

## ***Quantitative Data Analysis - Dimension Descriptions***

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### **EXECUTIVE SUMMARY**

The SARILab undertook a household survey to assess various resilience dimensions of households in targeted communities in Malawi, South Africa and Zimbabwe

(n=1,948 households). In particular, this study sought to collect dimension-specific data to inform the development of a valid and reliable measure of resilience to food security and sustainable livelihood within the context of high burden of HIV infection and climate variability. Furthermore, we determined the resilience factors associated with food security so as to inform the design and point of entry for specific innovative resilience-based interventions. This report, which follows on a previous qualitative study, presents the main findings of quantitative assessments and analyses done on data collected in the targeted communities in Chikwawa District, Southern Malawi; Pyramid community, north of Pretoria in South Africa; Molepo and Dikgale Traditional Authorities in the Limpopo province of South Africa; and Beitbridge District in Zimbabwe.

In the study, resilience was conceived as a latent multi-dimensional construct defined according to a number of resilience dimensions informed by the literature and findings from a prior qualitative study in the same target communities. The effective total sample was 1948. This was constituted by 568 respondents from Dikgale and Molepo in Limpopo in South Africa; 455 from Pyramid, Pretoria in South Africa; 484 from Chikwawa, Malawi; and 423 from Beitbridge, Zimbabwe. The categories or dimensions of resilience explored in this study included, Environment, Infrastructure, Human capital, Health, Psychosocial, Wealth, Basic services, Social capital, Social support and Security/protection.

A number of indicator items were used to explore these dimensions, which by themselves were considered latent constructs. Items were subjected to factor analysis using principal component analysis and a standardized score for best fitting items were computed for each resilience dimension. Data analysis included descriptive statistics supported by graphical display of resilience dimensions by location, vulnerability such as Household HIV status and livelihood changes over the last five years. We also presented dimensions by resilience outcome of interest, namely food security. Using Structural Equation Model (SEM), a measurement model for resilience was constructed following a confirmatory factor analysis (CFA) to obtain the best fitting model starting with all ten hypothesised resilience dimensions. Reliability of component dimensions and the resilience construct were tested using internal consistency as measured by Cronbach's alpha ( $\alpha$ ).

Using the final model's standardized coefficients of each of the component dimensions as weighting factors, a resilience index score was computed. The resilience construct was then structurally validated using a general model in SEM

with food consumption status as an outcome. The possible moderating role of household HIV status was explored using multi-group SEM. Finally, a binary logistic regression model was constructed to determine factors independently associated with food security, including the role of resilience as the mediator of the effect of a resilient livelihood on food security.

There were distinct characteristics across the study sites with females being the heads of households in most participating households in Malawi and Zimbabwe, while males were the majority heads of households in the two participating communities in South Africa. About one in every 10 household reported having an HIV positive member, with significantly higher prevalence in Malawi (16.5%) and Zimbabwe (14.7%) than in the studied South African (4.8%) communities. HIV prevalence was highest among those who had no formal education, had lost a spouse, had experienced reduced livelihood in the last five years and had poor or borderline food security. Although as many as 25% of the sampled household heads indicated they were unemployed, less than 10% indicated that they have no income, with salaries, social grants, and sales of farm products being the three most common sources of income.

Issues related to livelihood were considered the most important stressor by a majority of households, but this was closely followed by environmental challenges such as drought, floods and land degradation. Of the respondents, 43% reported having experienced reduced livelihood in the last 5 years, the majority of whom were those whose main source of income was from sales of farm products. Just over half of the population (54.5%) was considered as having adequate food consumption, and thus food secured. Overall, most households reported coping with food insecurity by spending their savings, borrowing money or reducing non-food expenses such as expenses on health or education. Our assessment for more nuanced vulnerability/ resilience dimensions shows that respondents from study sites in the Pyramid and Limpopo are generally better off than the other targeted communities when considering various resilience factors such as wealth, food security, environmental stability, infrastructure and human capital. Study sites in Malawi and Zimbabwe are much less resilient in this regard. This is also generally consistent with our findings on wealth and food security assessments across all the study sites.

Only six dimensions fitted the data as a reliable measure of a latent construct resilience ( $\alpha = 0.71$ ). These included environment, infrastructure, psychosocial,

health, human capital and wealth. Both health and human capital were single-item measures. The four sub-constructs or dimensions of resilience developed as subscales were considered reliable with Cronbach alpha ranging between 0.68 and 0.87. Resilience was significantly higher among males, those with the highest level of education, those without HIV positive household members and those food secured. Although, there were significant differences in the pathway to resilience to food security between households with HIV-positive member and those without, in the final structural models, human capital and wealth remained central to the pathway to food security for all households.

The SEM also showed that social capital and social support could only be considered enabling short-term coping strategies rather than adaptive capacities represented by the six dimensions of resilience. In the regression model for food security, it was interesting to note that those with the highest household size were more likely to have adequate food consumption than others. Other factors independently associated with food security included being a male-headed household, in full-time employment, and a member of a 'burial society', which is a voluntary saving scheme used to support its members in the event of a death in the family.

This study was able to demonstrate the validity and reliability of a multi-dimensional resilience construct with human capital (skills training) and wealth (income generation) being the potential entry points for promoting resilience to food security and sustainable livelihood, even in the presence of HIV burden. It would be important, particularly for those households with HIV-positive individuals that the income generating intervention should be non-agricultural or if agricultural, it should not be dependent on environmental resilience. There is need for further studies to understand innovations within large households that promote food security, such that they take advantage of economies of scale for food production.

## 1. INTRODUCTION

Despite the implementation of many research and development interventions intended to address human vulnerability, the resilience of households and communities in several parts of Southern Africa remain weak and inadequate. The Resilience Africa Network (RAN) has been implementing a number of project interventions with the major aim of building a solid evidence-base for addressing the major dimensions of vulnerability and resilience at local levels in various parts of the African continent. RAN's establishment of various research labs in different regions of the continent has enabled the conceptualization and implementation of programmes and projects that are relevant to each sub-region's socio-economic circumstances. It is within this context that the Southern Africa Resilience Innovation lab (SARILab) has carried out research study that enables the disaggregation and articulation of the resilience factors relating to food insecurity and poverty in the context of HIV/Aids for selected study sites in Malawi, South Africa, and Zimbabwe. The study was conducted between September 2015 and January 2016.

While, many scholars have written extensively on the subject of *resilience*, most definitions tend to emphasize the capacity for successful community or household adaptation in the face of disturbances, stress, or adversity that affect the social, economic and environmental dimensions of their livelihoods. In this project, we define resilience as the capacity of people and systems to mitigate, adapt to, recover, and learn from shocks and stresses in a manner that reduces vulnerability and increases wellbeing (see Bene et al., 2012; Norris, et al. 2008; Folke et al. 2010). Such disturbances may include acute ecological and social stresses or shocks such as floods, chronic poverty or persistent drought or even diseases such as HIV infection. Indeed, many communities in Malawi, South Africa, Zimbabwe and other Southern African countries have suffered many stresses in recent years, which have exposed them to various vulnerabilities.

In the SARILab, we are convinced that targeted innovative interventions can contribute to the building of community and household resilience in the face of

multiple socio-economic and environmental stressors. Our understanding of resilience building converges with Rockstrom (2003)'s concept of *resilience parachutes*, which are defined as specific interventions designed to enable communities and ecosystems to move significantly (if not rapidly) from situations of vulnerability towards resilience. It is also crucial to be able to prove that working and building capacity with some of the most vulnerable communities in our region to withstand, mitigate, adapt and thrive in the face of increasing frequencies of shocks and stresses on their socio-economic systems, can result in measurable and transformative development outcomes.

For us in the SARILab, a good understanding of community needs and adaptive capacity or resilience in the target communities of Malawi, South Africa and Zimbabwe is absolutely important to the construction of appropriate 'parachutes' and promoting the well-being of people living in poverty. Such an understanding is being gained through detailed research that enables us to establish the community and household poverty and vulnerability baseline conditions as well as the needs that communities and households articulate. This report, which follows on a previous qualitative study, presents the main findings of quantitative assessments and analyses done on data collected in the targeted communities in Chikwawa District, Southern Malawi; Pyramid community, north of Pretoria in South Africa; Molepo and Dikgale Traditional Authorities in the Limpopo province of South Africa; and Beitbridge District in Zimbabwe.

## **2. GOALS AND OBJECTIVES OF THE STUDY**

The main goal of this study was to explore the resilience factors which are mitigating the effects of chronic poverty and/or low income generation on food security in Southern African communities that have a relatively high burden of HIV. This would serve as a basis for informing the development of resilience dimensions and metrics in the community that can be used to monitor the impact of social development interventions on strengthening the resilience of the communities.

### **2.1 Specific objectives**

- (i) To further develop and define dimensions of resilience informed by findings from a qualitative study in the same targeted communities.
- (ii) To gather dimension-specific data to inform the development of a valid and reliable resilience metrics.
- (iii) To assess the resilience factors independently associated with food security, so as to inform the design and identification of point of entry of specific innovative resilience-based interventions.

### **3. RESEARCH METHODS**

While both qualitative and quantitative methods were used to gather data for this assessment, the results presented in this report are only those from the quantitative survey. A structured questionnaire was developed based on the variables derived from the qualitative survey as well as quantitative measures for resilience as per the RAN framework. After the design of the structured questionnaire, it was translated into the local languages and pre-tested in a pilot survey with households in one of the neighbouring communities. During the pre-testing, the enumerators checked for the length of time it takes to conduct the interviews, the ease with which questions are understood by the respondents, the extent to which questions have been properly translated without losing meaning, and the sufficiency of the codes where responses are coded. Through the pre-testing we also assessed whether or not respondents were able and willing to provide the needed information.

After the pre-test, the questionnaire was revised based on feedback from the enumerators. The translation was also revisited for accuracy using back translations. The pilot survey also provided the research team with a chance to test the sampling strategy and logistical arrangements. Prior to the pilot survey and pre-testing of the questionnaires, a team of enumerators was recruited and trained in a one-day workshop facilitated by the researchers. The training of enumerators included going through the questionnaire in English and local languages, discussion of the purpose of the survey, the sampling approach and logistical arrangements. Ethical issues were also discussed in the workshop. After the workshop, and revision of the questionnaire, and arrangement of survey logistics such as photocopying of the

instrument, transport arrangements, the survey was commenced. Direct observation of livelihood activities, natural resources and infrastructure in each of the study sites also helped the researchers in verifying some of the information provided by participants during questionnaire administration.

### **3.1 The study sites and population**

#### *3.1.1 Chikwawa District in southern Malawi*

Chikwawa District is located in the Southern Region of Malawi and borders Blantyre (to the north east), Mwanza (to the north), Thyolo (to the east), Nsanje (to the south) and Mozambique (to the west). The topography of the district includes a flat basin of the Shire River (as it takes water from Lake Malawi towards the Indian Ocean) and Thyolo-Chikwawa escarpment. On a yearly-basis Chikwawa District experiences the flooding of the Shire River, as rains from the Shire Highlands and the Thyolo Escarpments move down the Shire River, displacing communities that reside close to this river, which is an important source of livelihood. Apart from floods, Chikwawa also experiences prolonged dry spells every year. The persistent floods and dry spells have made the households in the district to also suffer from chronic food insecurity. It is also a district with a high prevalence of HIV and AIDS in Malawi.

#### *3.1.2 The Pyramid Community - Northern Pretoria, South Africa*

The Pyramid community is in Tshwane district, north of Gauteng province. Pyramid is predominantly a farming area situated along the Old Warm Baths Road, also known as R101. It is approximately 22km north of Pretoria. Most of the land is used for commercial farming and light industrial activity on plots. It has a population of 31 150 people with 9372 households (StatsSa projections in 2013 based on 2011 census). The community is comprised mostly of makeshift houses known as shacks, and single rooms with poor ventilation and sanitation. Most of these make-shift houses are occupied by people working on the farms and plots. It is a community with a relatively high prevalence of HIV and AIDS and high rate of prostitution. The level of education in the area is quite poor, with most of the adult population not having a high school qualification. Many residents do not have identity documents which makes accessing government grants difficult. There are a number

of foreigners living in the area who are prepared to work for very low wages. There is also a high level of unemployment. All these contribute to a high level of poverty and vulnerability in the community.

### *3.1.3 Molepo and Dikgale communities, Limpopo Province, South Africa*

The survey was conducted in two communities namely Molepo and Dikgale Traditional Authorities. The Molepo Traditional Authority comprises seven villages, whilst the Dikgale Traditional Authority comprises twenty three villages. Both communities are part of Polokwane Local Municipality in the Capricorn District. Covering an area of 3 775km<sup>2</sup>, Polokwane Local Municipality has a population of about 629 000, with 178 000 households according to 2011 statistics. The geographical area of the municipality is predominantly rural, falling under the jurisdiction of different Traditional Authorities. The majority of the population lives in rural or peri-urban settlements, which are mostly poorly serviced.

### *3.1.4 Beitbridge District, Zimbabwe*

Beitbridge district has a total population of 122 553 people. The quantitative study was focusing on ward 15, which is also the ward where the qualitative study was conducted. The ward has 4 villages, namely, Mapai, Dumba, Shabwe, and Old Nuli. It has a total population of 4,248 and is broken down as follows: 1971 males and 2,277 females. It has a total of 982 households and the average household size is 4.3. The survey covered all the 4 villages.

## **3.2 Study design**

This was a population-based cross-sectional study that targeted all private households in the SARILab sites. Thus, the survey does not cover other collective living quarters such as student hostels, old-age homes, hospitals, prisons and military barracks, and is therefore, only representative of non-institutionalized and non-military persons or households in SARILab sites.

## **3.3 Sample size**

This study was carried out with a sample of respondents from research sites in Malawi, South Africa and Zimbabwe. The effective total sample was 1948. This was constituted by 568 respondents from Dikgale and Molepo in Limpopo in South Africa; 455 from Pyramid, Pretoria in South Africa; 484 from Chikwawa, Malawi; and 423 from Beitbridge, Zimbabwe.

### **3.4 Sampling procedures**

A stratified sampling technique was used, which is based on a stratified design with probabilities proportional to the size of selected households in the strata and subsequently simple random sampling of individual households at the second stage. Villages or census enumeration areas in Beitbridge, Chikwawa, Dikgale and Pyramid made up the different strata. The number of households selected for the sample from each stratum is proportionate to the number of households in the population. A sample size of 402 was calculated to be adequate to provide a power of 80% and 5% error in detecting a 15% group differences with regards to resilient and non-resilient households, based on an assumption of prevalence of food insecurity of 20% in the studied population.

### **3.5 Variables and measurements**

#### *3.5.1 Main dependent variables*

Food security was measured using household dietary diversity scores (HDDS) and household hunger scales. We use these two measures of food security mainly because they capture different domains of household food security such as food availability and nutritional value of the food consumed. However, because the results were similar, the final analysis reported here focused on the food consumption scores derived from the HDDS.

#### *3.5.2 Household dietary diversity score (HDDS)*

It has been shown that there is a positive relationship between the HDDS and food security (Nyikahadzoi et al. 2012). The HDDS is an important proxy indicator of food security, as documented by studies in various countries (see Hatløy et al., 1998; Ogle et al., 2001; Hoddinott & Yohannes, 2002; Mirmiran et al., 2006; and Ekesa et al.,

2008). In our study, the respondents were asked about the number of food groups and items that their households consumed the day before the survey. There were 12 food groups and each group had response options of (1) Yes or (2) No (see attached questionnaire), which was recoded as 1 (Yes) or 0 (No). The respondents also answered how many days of the week was the particular food item consumed (1-7 days). To compute a food consumption score (FCS), food items were summed following grouping into seven categories with different assigned weights, namely Starch (e.g. maize, Potatoes) with a weighting of 2, Pulses (beans) with a weighting of 3, Fruits and Vegetables with a weighting of 1 each, Meat (e.g. pork, beef, chicken) and Dairy (milk) with a weighting of 4 each, sugar and fats with a weighting of 0.5 each. Using the FCS, respondents were then categorized into three namely, poor food consumption (FCS below 21), borderline food consumption (FCS 21-35) and adequate food consumption (FCS above 35).

### *3.5.3 Household Hunger Scale*

The Household Hunger Scale developed by USAID's Food and Nutrition Technical Assistance (FANTA) project was also used to measure food security in each household. The scale consists of 3 items with 3 frequency response options namely, Rarely (1-2 times), Sometimes (3-10 times), and Often (more than 10 times) and 3 items with "Yes" or "No" options. This index scores ranged from 0 to 9.

## **3.6 Main independent variable**

### *3.6.1 Household wealth/income*

Household wealth and income was measured using different indices:

- (i) Employment status: The respondents were asked about their current employment status by requesting them to pick one of several options (see attached questionnaire). For the purpose of analysis, the options were collapsed into four categories, namely, Employed full-time, employed part-time, Unemployed, and not economically active i.e. Permanently sick/Student/Pensioner/Housewife not looking for a job.

- (ii) Sources of household main income: Respondents were asked to choose the top 4 most important sources of income in their households during the past 6 months preceding the survey.
- (iii) Household income for the last calendar month: Respondents were asked about the estimated total amount of income in cash and equivalent amount in kind earned by their households from each of the activities that are listed during the year preceding the survey (see attached questionnaire).
- (iv) Wealth or Asset index: Consistent with the literature that suggests using multiple measures to capture indicators of socio-economic position along a person's life course an asset index was measured using the question: "Does your household have.....?" (see Galobardes, 2006). A list of assets was subsequently itemized in the questionnaire. This theoretical construct of dimension of wealth was explored using principal component analysis of the list of asset item responses. The z-scores derived from adding up the response options "No" (coded 0) or "Yes" (coded 1) of the best fitting set of asset items were ranked to classify the study participants into three main categories, namely, the lowest, middle and highest material wealth index tertiles.
- (v) Other resilience dimensions as obtained from the qualitative report were measured using questionnaire items from existing household surveys in the various countries and/or using questionnaire items from the existing literature. The resilience dimensions explored included those related to environment, infrastructure, basic services, Health, Psychosocial, human capital, social capital, social support/social safety net and security.
- (vi) Livelihood changes: In order to determine resilience to global economic disturbance that occurred in 2009, respondents were asked to indicate if the last five years their main source of livelihood reduced, did not change or increased. Those who claimed their livelihood did not change or increased were said to have experienced a resilient livelihood.

### 3.7 Data management and analysis

The primary data gathered was first entered into Excel and thereafter, it was exported into SPSS for detailed analysis. Group differences were tested using chi-square statistics and t-tests for categorical and continuous variables, respectively. Multi-variable adjusted logistic regression was carried out using the backward deletion approach. All tests were two-tailed and statistical significance was set at  $p < 0.05$ .

Exploratory factor analysis was conducted using the principal component analysis to explore potential items that could be reliably grouped satisfactorily to constitute the various resilience dimension scales, otherwise items were used as index measure of a specific resilience dimension, such as self-rating of health and level of education that were used as indices of health and human capital dimensions respectively.

In conducting the principal component analysis, all items conceptually or theoretically considered related to the particular resilience dimension or as previously used in the literature were used as variables for principal component analysis. Items with extraction coefficient  $< 0.50$  were excluded from further principal component analysis. The variables were factor-analyzed using the eigenvalue cut-off of  $> 1$  and *a priori* set criteria that the items retained will explain at least 60% of variance with Varimax rotation applied to display factor solutions for ease of interpretations (ref). In order to give equal weighting, to component items, only the standardised or z-scores were used in computing the dimension of resilience scales or indices. Furthermore, for the purpose of computing the resilience measures in cases with multiple components, we used only the z-scores derived from an unrotated model (ref). Finally, the items so derived from the final model were then subjected to a test of internal consistency as a measure of scale reliability as depicted by Cronbach alpha value, using the benchmark of 0.60 – 0.69 as satisfactory, 0.70 -0.79 as good and 0.80 and above as excellent

In order to develop the latent construct of resilience, the resilience dimensions were subjected to a confirmatory factor analysis (CFA) using SEM measurement model

(Amos version 23) and starting with all hypothesised sub-constructs or dimensions of resilience. In the analysis, we used modification indices to progressively refine pathways until the best fitting model was derived. Variables with large residual covariances were also progressively removed to improve model fit. The indices used to examine the fitness of the model are (1) absolute fit [Root mean square error of approximation (RMSEA) and Goodness of fit index (GFI)]; (2) incremental fit [Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI)]; and (3) parsimonious fit [chi square/degree of freedom (chisq/df)]. As a norm, at least four of a number of fit indices was used to test the adequacy of model fit. The acceptable results with a significant fit for continuous data are values – Chi-square/degree of freedom < 5; GFI > 0.95; TLI > 0.95; CFI > 0.95; RMSEA < 0.06 (Hu and Bentler, 1999).

Given the complexity of resilience dimensions as both cause and effect of each other, and in order to validate the hypothesised conceptual or theoretical pathway for resilience derived from the qualitative study, we structurally modelled various resilience dimensions to test how well our quantitative data fits with the hypothesized pathways. The multi-group structural equation modelling (MSEM) was then used to test household HIV status as a moderator of the structural pathways of resilience by comparing the pathways to resilience outcomes of interest, starting with the same theoretical model. All SEM analysis were carried out using AMOS version 23.0 with maximum likelihood estimation since normality could be assumed for all variables.

In order to inform further understanding of resilience as an explanatory variable for resilience outcomes of interest, namely adequate food consumption or food security, we constructed a binary logistic regression model using the backward deletion method. We started with a full model that contained resilience-related dimensions in addition to those factor analysed as converging as the latent construct of resilience. We explored resilience as an explanatory or independent predictor of food security, controlling for demographic characteristics of the household respondent such as age, marital status, household size, employment status, membership of volunteer organisation(s) and gender of the household head.

Furthermore, we explored the association between having experienced a stable or improved livelihood (i.e. resilient livelihood) and current food security status. In particular, using mediation analysis as described by Baron & Kenny (1986), we explored if resilience capacity as measured by our resilience index, mediates the association between resilient livelihood and food security by first building a model without a resilience index (Model A) and then another adding the resilience index (Model B). If resilience capacity completely mediates the effect of resilient livelihood on food security, we expect the association between the two to become attenuated and non-significant (Baron & Kenny, 1986). Finally, we explored interactions between resilience and HIV status of the households as a test of the moderating effect of household HIV status on the correlates of food security.

## 4. STUDY FINDINGS AND DISCUSSION

### 4.1 Main characteristics of the study sample

The effective total sample for all the study sites was 1948. This was constituted by 568 respondents from Limpopo; 455 from Pretoria; 484 from Malawi; and 423 from Zimbabwe. Table 1 presents the main demographic characteristics of the respondents disaggregated by study site, gender, age, and several other variables.

**Table 1: Participants' characteristics by study site**

Characteristics	category	% (n)				% (n)
		DikgaleLimpopo	Pyramid, Pretoria	Chikwawa, Malawi	Beitbridge, Zimbabwe	
Gender	Male	64.3 (377)	58.2 (265)	37.0 (179)	28.4 (120)	48.3 (941)
	Female	35.7 (209)	41.8 (190)	63.0 (305)	71.6 (303)	51.7 (1007)
Age category	18-24 yrs	12.3 (72)	9.0 (40)	15.7 (72)	12.5 (48)	12.4 (232)
	25-34 yrs	21.6 (126)	28.5 (127)	32.8 (151)	13.0 (50)	24.2 (454)
	35-44 yrs	19.7 (115)	20.6 (92)	21.3 (98)	17.9 (69)	20.0 (374)
	45-54 yrs	15.6 (91)	20.4 (91)	13.7 (63)	13.5 (52)	15.8 (297)
	55-64 yrs	13.4 (78)	12.8 (57)	7.8 (36)	23.9 (92)	14.0 (263)
	65plus yrs	17.3 (101)	8.7 (39)	8.7 (40)	19.2 (74)	13.6 (254)
Education level	No school	5.5 (32)	7.5 (34)	30.4 (147)	27.4 (116)	16.9 (329)
	<High Sch	58.4 (342)	56.9 (259)	68.0 (329)	65.5 (277)	62.0 (1207)
	High Sch	25.4 (149)	20.9 (95)	1.7 (8)	0.7 (3)	13.1 (255)
	>High Sch	10.8 (63)	14.7 (67)	0 (0)	6.4 (27)	8.1 (157)
Employment	Unemployed	42.3 (248)	16.5 (75)	1.2 (6)	38.3 (162)	25.2 (491)

	Pensioner/ill/ House wife/student	29.7 (174)	11.4 (52)	1.2 (6)	42.3 (179)	21.1 (411)
	Part-timer employed <sup>†</sup>	13.5 (79)	16.5 (75)	25.0 (121)	17.5 (74)	17.9 (349)
		14.5 (85)	55.6 (253)	72.5 (351)	1.9 (8)	35.8 (697)
Marital status	Never	48.4 (282)	42.3 (185)	2.1 (10)	14.2 (60)	27.9 (537)
	Previously married	9.4 (55)	9.4 (41)	19.0 (92)	31.7 (134)	16.7. (322)
	Married	42.2 (246)	48.3 (211)	78.9 (382)	54.1 (229)	55.4 (1068)
Wealth tertile	Lowest third	64.3 (377)	4.4 (20)	38.6 (187)	15.9 (64)	33.6 (648)
	Middle	4.3 (25)	22.4 (102)	57.4 (278)	57.7 (232)	33.1 (637)
	Highest	31.4 (184)	73.2 (333)	3.9 (19)	26.4 (106)	33.3 (642)
Food security	Poor	17.7 (104)	5.5 (25)	13.5 (65)	55.3 (234)	22.0 (428)
	Borderline	16.4 (96)	9.2 (42)	35.5 (172)	35.2 (149)	23.5 (459)
	Adequate	65.9 (386)	85.3 (388)	51.0 (247)	9.5 (40)	54.5 (1061)
HIV Household	Yes	4.8 (28)	4.6 (21)	16.5 (80)	14.7 (62)	9.8 (191)
Had a reduced livelihood over last 5yrs	Yes	26.5 (153)	23.3 (102)	63.6 (306)	63.5 (264)	43.1 (825)
Main Stressor categories	Chronic diseases	21.0 (123)	16.5 (75)	24.8 (120)	21 (89)	20.9 (407)
	Infrastructure*	25.8 (151)	33.4 (152)	4.5 (22)	6.4 (27)	18.1 (352)
	Environment	6.3 (37)	1.3 (6)	31.7 (192)	29.1 (123)	18.4 (358)
	Livelihood**	45.6 (267)	33.4 (152)	30 (145)	31.2 (132)	35.7 (696)
Group Membership	Religious groups	62.6 (361)	51.8 (227)	41.2 (198)	41.3 (163)	50.2 (949)
	Stokvel/savings	42.8 (247)	20.5 (90)	15.8 (76)	14.7 (58)	24.9 (471)
	Burial society	84.6 (488)	37.4 (164)	4.2 (20)	4.3 (17)	36.4 (689)
	Sports group	15.4 (89)	13.5 (59)	3.5 (17)	5.6 (22)	9.9 (187)

<sup>†</sup>Those categorised as employed includes those with own business and farmers (mostly in Malawi)

\*Includes challenges such as those related to poor sanitation, roads, & housing

\*\*Includes challenges such as unemployment, fluctuating price of food and/or agricultural products or inputs.

### **a. Gender and age**

In Limpopo, 64.3% of the participants were male while 35.7% were female. In Pretoria, 58.2% of the respondents were male while 41.8% were female. In Malawi, 37% of the respondents were male and 63% were female. In Zimbabwe, 28.4% of the respondents were male while 71.6% were female. These differences in the gender of respondents suggest differences in gender of household heads in the various target communities.

Across all the study sites, the 25-34 years age group was the most represented with 24.2% of the total number of respondents. It is followed by the 35-44 years and 45-54 years age groups which respectively constituted 20% and 15.8% of the total

number of respondents. It is pertinent to note that target communities in Limpopo (30.7%) and Zimbabwe (43.1%) had populations of older-adults age 55 years and older than the average for the study sample. However, the distribution of the participants across age group categories in the aggregated study sample was not significantly different.

### ***b. Education levels***

In terms of educational levels, it is important to note that 16.9% of the respondents had no formal education at all while another 62% had educational levels below high school. This suggests that at least 78.9% of the respondents experience higher levels of vulnerability since educational levels often determine the levels of individual vulnerability/ resilience. The Pretoria study site had the highest proportion of people with education levels above high school (14.7%), followed by Limpopo with 10.8% and then Zimbabwe with 6.4%. The study site in Malawi had no participants with a level of education above high school. This suggests that Malawi may be worse-off than all the other study sites in terms of the resilience possibilities that educational qualifications raise. However, overall, all the study sites are not very strong in terms of the education 'resilience parachute' given that in all of them, the proportion of people with high school qualifications is less than 26% while those with qualifications higher than high school are not more than 15% in any of the study sites, with an average of only 8.1% for all the sites.

### ***c. Employment***

The research findings show that unemployment is highest in the Limpopo study site where it affects 42.3% of the respondents. This is closely followed by the study site in Zimbabwe where it sits at 38.3%. In the Malawi study site, unemployment is almost insignificant at 1.2% of the study participants. Conversely, Malawi has the highest number of employed participants at 72.5%, which were predominantly farmers or those who indicated they were self-employed. This is followed by Pretoria at 55.6%. The study site in Zimbabwe has the lowest number of people employed either full-time (1.9%) or part-time (17.5%), but also has the largest numbers of economically inactive participants (42.3%). Similarly, Limpopo had only 14.5% in full-

time employment and 13.5% in part-time employment, and as high as 29% that were economically inactive. This suggests that vulnerability levels arising from economic inactivity and unemployment is higher in Limpopo and Zimbabwe than in any of the other sites. Innovations that generate employment in these sites are therefore, likely to have greater significant impact.

#### ***d. Marital status***

Our findings on marital status in the study sites revealed that Limpopo has the highest proportion of people who have never married (at 48.4% of the total sample) while Malawi has the smallest number of respondents who have never married (at 2.1%). In terms of those respondents who are currently married, Malawi has the highest proportion at 78.9%, followed by Zimbabwe at 54.1%. It is pertinent to note that Malawi (19%) and Zimbabwe (31.7%) with higher than average female-headed households also had the highest number of respondents who indicated they were previously married, which suggests that a high proportion have either experienced the death of their male partner or divorced, which could make these households more vulnerable especially if the male partners were the breadwinners and the spouses were not economically active.

#### ***e. Wealth***

Regarding wealth categories, Limpopo, at 64.3%, has the highest proportion of people in the lowest tertile while those in Pyramid - a peri-urban community on the outskirts of the South African capital city of Pretoria, understandably has the lowest proportion of people in the lowest wealth tertile at 4.4%. In the middle tertile, target communities in Malawi and Zimbabwe have the highest proportions of respondents at 57.4% and 57.7% respectively. Under the highest tertile, the community close to Pretoria has the largest proportion of respondents (73.2%) while Malawi has the lowest proportion (3.9%). This suggests that there may be more vulnerable households in Malawi than in all the other study sites while there may be more resilient households in Pretoria when compared to the other study sites.

### ***f. Food security***

Our assessment for food security suggests that there are more households with poor food security in Zimbabwe (at 55.3%) than in all the other sites, while Pretoria had the lowest proportion of households with poor food security (at only 5.5%). Zimbabwe and Malawi also have a substantial number of households who are just *borderline* food secure. Such households can very easily move into the *poor food security* category if sudden shocks are experienced by their socio-economic system. Any interventions to improve resilience of the communities in question would have to take this into account as well.

At 85.3%, Pretoria has the highest number of households with *adequate* food security. This is followed by Limpopo at 65.9%. Zimbabwe emerged as the study site with the lowest number of people who have adequate food security (at only 9.5%). This suggests that when considering food security, there are more vulnerable people in Zimbabwe than in the other sites. In Malawi, 51% of the households have adequate food security. However, this still falls below the average of 54.5% that we obtained across all the study sites in this survey and, therefore, food security is a key issue in the Malawi study site in as much as it is a key challenge elsewhere.

### ***g. HIV Household***

The average proportion of people in HIV households across all the study sites is 9.8%. At 16.5% and 14.7% respectively, Malawi and Zimbabwe have proportions that are above the average while Limpopo and Pretoria are below the average (at 4.8% and 4.6% respectively). The statistics for the study site in Zimbabwe roughly approximates the national average of HIV prevalence in the country which is at 14.7% (WHO, 2012). The statistic for the study site in Malawi is significantly above the national average of 10.8%. This suggests that in Malawi, Chikwawa is one of the areas most affected when compared to other regions in the country. The figures for the study sites in South Africa are relatively low when compared to the national average of HIV prevalence 12.2% as of December 2012 (Shisana et al., 2014). However, the figures also suggest that the HIV/Aids pandemic is more severe in the Malawi and Zimbabwe study sites than it is in the South African study sites.

#### ***h. Livelihood changes in the last 5 years***

Our findings suggest that in the last 5 years, people in study sites in Malawi and Zimbabwe had the most substantial reduction in livelihoods at 63.6% and 63.5% respectively. Study sites in Limpopo (26.5%) and Pretoria (23.3%) experienced reductions in livelihoods that are well below the average of 43.1%, which consistent with findings of proportion of households with food security, suggest that these two communities in South Africa were more economically resilient than those in Malawi and Zimbabwe .

#### ***i. Group membership***

Group membership including reporting belonging to a religious group (50.2%), a stokvel or similar group savings (24.9%), a 'burial society' (36.4%) and sports group (9.9%). Belonging to any of these groups was associated with better food security and lower likelihood of reporting reduced livelihood in the last 5 years.

#### ***j. Main stressor categories***

When assessing for the main stressor categories in each study site, we found out that on average(at 35.7% of the total), issues related *livelihood*(e.g. increasing food prices, cost of agricultural inputs or lower output prices) are the main stressor in almost all the study sites except in Malawi (30%) where it is overtaken by *environment*(drought or floods), which is at 31.7% of the respondents. The figures for all the other stressors, namely, chronic diseases, infrastructure, and environment, seem to be much less significant across all the study sites when compared to livelihoods.

### **4.2 Study participants' characteristics by vulnerability and resilience outcome**

We set out to measure the respondents' levels of vulnerability and resilience. A number of our findings stand out more significantly than others. Table 2 summarizes our findings in this regard.

### **a. Gender**

In our findings, *drought/ flood* appear to significantly increase vulnerability and this was more often reported by both male (62.3%) and female (75.4%) headed households than the other stressors. The category for reduced livelihood comes second with 38% for male respondents and 48.1% for female respondents. Vulnerability arising from HIV household membership is relatively low at 9.2% for male participants and 10.3% for female participants. This suggests that interventions should be more targeted at mitigating the impacts of vulnerability to drought/ flood and reduced livelihoods.

### **b. Age**

Vulnerability to specific stressors seems relatively uniform across all age categories with most of the age categories not deviating much from the mean. Those in the 35-44 years age range seem to be the most vulnerable to HIV (14.2%). They are followed closely by those in 55-64 years age category, at 13.7%. In terms of adequate food consumption, only those in the 55-64 years category reflected levels below 50% (i.e. at 48.3%). Those participants in the 25-34 years category reflected the highest level of adequate food consumption (at 62.1%).

### **c. Education level**

Education level emerged as a relatively important factor in vulnerability/ resilience outcome measurements. Our cross-tabulations reveal that those with 'no school' are the more likely to be associated with HIV household membership (at 16.1% of the population). Those with high school or higher qualifications are less likely to be associated with HIV household membership, respectively at 4.3% and 4.5%. Respondents in the 'no school' category are also more likely to be affected by all the other stressors when compared to other categories. For instance, they are the highest affected by drought/ flood (88.1%); they are the highest affected by reduced livelihood (56.8%); they also have the lowest levels of *adequate food consumption* (35.6%), particularly when compared to 75.8% adequate food consumption for those with education levels above high school.

#### d. Employment

The data obtained shows that there is limited association between unemployment and HIV household membership. In other words, whether or not you are employed, you can still belong to an HIV household. As a result, almost all the employment categories converge around 10% when cross-tabulated with household HIV status. At 75.1%, part-time workers emerge as the most vulnerable to drought/ flood even though all the other employment categories are also almost within the same range of vulnerability. At 51%, the part-timer is more likely to be vulnerable to reduced livelihood than all the other categories that are converging around 41%. Among all the employment categories, the Pensioner/ill has the lowest level of adequate food consumption (at 43.6%).

**Table 2: Participants' characteristics by vulnerability and resilience score and outcome**

Characteristics	category	Resilience Mean (SD)	% (n)			
			HIV household member	Drought/flood	Reduced livelihood	Adequate food consumption
Gender	Male	0.56 (1.96)	9.2 (87)	62.3 (586)	38 (358)	
	Female	-0.50 (2.06)	10.3 (104)	75.4 (759)	48.1 (471)	
		<i>P</i> <0.001	<i>P</i> =0.42	<i>P</i> <0.001	<i>P</i> <0.001	
Age category	18-24 yrs	0.04 (1.92)	1.7 (4)	71.1 (165)	40.6 (91)	51.3 (119)
	25-34 yrs	0.08 (2.15)	10.1 (146)	69.2 (314)	38.9 (175)	62.1 (282)
	35-44 yrs	0.09 (2.16)	<b>14.2</b> (53)	67.1 (251)	42 (154)	55.1 (206)
	45-54 yrs	0.22 (2.18)	10.4 (31)	64.6 (192)	44.4 (130)	59.9 (178)
	55-64 yrs	-0.05 (1.91)	13.7 (36)	69.2 (182)	51.0 (132)	<b>48.3</b> (127)
	65 plus yrs	-0.00 (2.07)	6.3 (16)	68.9 (175)	42.1 (104)	50.8 (129)
		<i>P</i> =0.762	<i>P</i> <0.001	<i>P</i> =0.666	<i>P</i> =0.057	<i>P</i> <0.001
Education level	No school	-1.89 <sup>a</sup> (1.33)	<b>16.1</b> (53)	<b>88.1</b> (290)	<b>56.8</b> (184)	<b>35.6</b> (117)
	<High Sch	-0.26 <sup>b</sup> (1.72)	9.9 (120)	70.2 (847)	45.0 (532)	52.7 (636)
	High Sch	2.00 <sup>c</sup> (1.35)	4.3 (11)	47.5 (121)	22.2 (56)	74.1 (189)
	>High Sch	2.75 <sup>d</sup> (1.49)	4.5 (7)	55.4 (87)	34.6 (53)	<b>75.8</b> (11)
		<i>P</i> <0.001	<i>p</i> <0.001	<i>P</i> <0.001	<i>P</i> <0.001	<i>P</i> <0.001
Employment	Unemployed	0.52 <sup>a</sup> (1.83)	10.6 (52)	64.8 (318)	41.3 (198)	47.9 (235)
	Pensioner/ill	0.30 <sup>a</sup> (1.86)	6.3 (26)	66.9 (275)	41.4 (167)	<b>43.6</b> (179)
	Part-timer	-0.28 <sup>ab</sup> (2.28)	10.9 (38)	<b>75.1</b> (6172)	<b>51.0</b> (173)	49.9 (174)
	employed	-0.33 <sup>ab</sup> (2.18)	10.8 (75)	70.3 (490)	41.5 (287)	67.9(473)
		<i>P</i> <0.001	<i>P</i> =0.067	<i>P</i> =0.009	<i>P</i> <0.015	<i>P</i> <0.001
Marital status	Never	1.21 <sup>a</sup> (1.57)	5.4 (29)	51 (274)	25.3 (131)	63.3 (340)
	Past married	-0.95 <sup>b</sup> (1.87)	<b>19.3</b> (62)	<b>78.6</b> (253)	<b>57.7</b> (189)	<b>35.7</b> (115)
	Married	-0.30 <sup>c</sup> (2.11)	9.3 (99)	75.5 (806)	48.2 (509)	55.2 (590)
		<i>P</i> <0.001	<i>P</i> <0.001	<i>P</i> <0.001	<i>P</i> <0.001	<i>P</i> <0.001
Wealth tertile	Lowest third	-0.05 <sup>a</sup> (2.00)	9.3 (60)	70.8 (459)	40.7 (259)	54.0 (350)

	Middle	-1.36 <sup>b</sup> (1.25)	<b>13.5</b> (86)	<b>84.3</b> (537)	<b>55.2</b> (346)	<b>42.2</b> (270)
	Highest	1.46 <sup>c</sup> (1.86)	6.9 (44)	51.4 (330)	32.8 (206)	68.5 (440)
		<i>P</i> <0.001	<i>P</i> <0.001	<i>P</i> <0.001	<i>P</i> <0.001	<i>P</i> <0.001
Food security	Poor	-0.62 <sup>a</sup> (1.82)	<b>12.9</b> (55)	79.2 (339)	48.7 (202)	N/A
(food consumption)	Borderline	-0.92 <sup>a</sup> (1.87)	12.6 (58)	<b>82.1</b> (377)	<b>59.1</b> (270)	
	Adequate	0.67 <sup>ab</sup> (2.04)	7.4 (78)	59.3 (629)	33.9 (353)	
		<i>P</i> <0.001	<i>P</i> <0.01	<i>P</i> <0.001	<i>p</i> <0.001	
HIV Household	No	0.15 (2.09)	N/A	67.2 (1181)	42.3 (728)	55.9 (983)
	Yes	-1.16 (1.65)		<b>85.9</b> (164)	<b>51.3</b> (97)	<b>40.8</b> (78)
		<i>P</i> <0.001		<i>P</i> <0.001	<i>P</i> =0.017	<i>p</i> <0.001
Decreased livelihood in last 5 years	No	0.60 (1.98)	8.5 (92)	63.4 (689)	N/A	63.2 (667)
	Yes	-0.78 (1.95)	<b>11.8</b> (97)	<b>77.0</b> (635)		<b>42.8</b> (353)
		<i>P</i> <0.001	<i>P</i> =0.011	<i>P</i> <0.001		<i>P</i> <0.001

NB: Resilience scores are as computed from Fig 8. Superscripts that differs shows significant differences on pairwise comparison and those that are the same shows differences are not statistically significant at  $P < 0.05$ .

#### ***e. Marital status***

From the data presented, it appears as if those in the 'past married' are more likely to belong to an HIV household (19.3%) compared to those in the 'never married' category (5.4%). The 'past married' category also seems to be strongly associated with all the other stressors/ vulnerability factors, namely, 78.6% reporting experiencing drought/ flood; 57.7% reporting having experienced reduced livelihood; and only 35.7%, (the lowest levels) reporting adequate food consumption.

#### ***f. Wealth tertile***

Assessments for wealth revealed that the middle wealth tertile was more strongly associated with the vulnerability factors than the lowest and highest wealth tertile. For instance, at 84.3% and 55.2%, the middle wealth tertile is respectively strongly associated with reporting experiencing drought/flood and reduced livelihood. The middle wealth tertile is also quite conspicuous for having the lowest levels of adequate food consumption (42.2%) when compared to 54% for the lowest wealth tertile and 68.5% for the highest wealth tertile.

#### ***g. Food security***

In terms of food security assessments, our findings suggest that those with poor or borderline levels of food security are more likely to belong to HIV households than those with adequate food security. At 82.1%, those with borderline food security are

likely to be the hardest hit by drought/ flood. This is closely followed by those with poor food security at 79.2%. In terms of reduced livelihoods, those with poor and those with borderline food security are significantly affected, respectively pitching at 48.7% and 59.1%.

#### ***h. HIV household***

When HIV household is cross-tabulated with other vulnerability and resilience factors, the results show that participants from HIV households are more likely to report experiencing drought/flood (85.9%) and reduced livelihood at 51.3%. These households also experience lower levels of adequate food consumption, at 40.8% compared to 55.9% for non-HIV households.

#### ***i. Decreased livelihood in last 5 years***

From the data available, one can discern that the prevalence of having a HIV-positive household member was higher among those participants who experienced decreased livelihoods(11.8%) than among those did not (8.5%). When these findings are considered together with the findings of cross-tabulations done on HIV household and other vulnerability factors described above, they suggest that interventions that take household HIV status into account are likely to realize more impact on the resilience of such households.

### **4.3 Main sources of income**

To obtain a more comprehensive picture of the vulnerability and resilience factors at the local level, we also explored issues about the respondents' sources of income. Table 3 presents results of the main sources of income cross-tabulated with some of the core vulnerability/ resilience factors that we look out for in this program.

***Table 3: Main sources of income***

	% (n)				
Income source	Non-HIV household	HIV Household		Livelihood reduced in last 5 years	Resilient livelihood(no change or increased)

Salaries/wages	40.9 (718)	29.3 (56)*		31.3 (258)	45.7 (497)*
Own Business/trading	13.7 (240)	16.2 (31)		17.9 (148)	10.8 (117)*
Remittances/gifts	10.4 (183)	19.9 (38)*		15.0 (124)	8.4 (91)*
Pension grant	9.8 (172)	3.1 (6)*		7.8 (63)	10.6 (115)*
Social grant	22.3 (392)	15.7 (30)*		15.2 (125)	26.8 (291)*
Farm products/services	28.3 (498)	49.7 (95)*		44.2 (365)	20.6 (224)*

\*Statistically significantly different at  $p < 0.05$

The study findings show that for Non-HIV households, the main source of income is salaries and wages (40.9%). For HIV households, the main source of income is farm products/ services (49.7%). Those respondents whose livelihood reduced in the last 5 years also derive most of their income from farm products/ services (44.2%). Overall, and at 45.7%, salaries i.e. protected wages seem to have a greater positive impact on resilient livelihoods across most of the households than all the other sources of income and this was statistically significant at  $p < 0.05$ . In this regard, social grants come second at 26.8%, and at 8.4%, remittances seem to be the least effective in improving household resilience.

#### 4.4 Coping strategies for food and/or livelihood challenges

We also sought to establish how the communities and households in our study sites cope with various food-related stressors and livelihood challenges. Table 4 summarizes our findings in this regard.

**Table 4: Coping strategies for food and/or livelihood challenges**

Strategies	% (n)			
	Non-HIV household	HIV household	Livelihood reduced in last 5 years	Resilient livelihood (no change or increased)
<i>Sold household assets</i>	5.2 (92)	1.7 (9)	5.8 (48)	4.8 (52)
<i>Reduced non-food expenses such as on health and education</i>	10.1 (177)	8.4 (16)	13.6 (112)	7.0 (76)*
<i>Sold Productive assets</i>	6.9 (122)	4.7 (9)	10.4 (86)	3.8 (41)*

<i>Spent savings</i>	18.8 (331)	15.7 (30)	17.1 (141)	19.3 (210)
<i>Borrowed money</i>	11.1 (195)	11.5 (22)	9.8 (81)	11.8 (128)
<i>Sold house or land</i>	3.2 (57)	6.8 (13)*	4.4 (36)	3.0 (33)
<i>Withdrew child from school</i>	2.6 (45)	2.1 (4)	2.8 (23)	2.2 (24)
<i>Sold female breeding livestock</i>	2.6 (45)	1.6 (3)	3.5 (28)	1.7 (18)*
<i>Begging</i>	3.1 (56)	4.7 (9)	3.9 (32)	2.8 (30)
<i>Sold more animals than usual</i>	3.8 (67)	4.7 (9)	6.4 (53)	2.0 (22)*

\*Statistically significantly different at  $p < 0.05$

The results of the livelihood coping strategies assessment revealed that non-HIV households mainly cope with their challenges by spending their savings (18.8%). Other significant coping options for non-HIV households include borrowing money and reducing non-food expenses. For HIV households, the main coping strategy is also spending their savings (15.7%). Their next significant strategy is borrowing money (11.5%). Those respondents whose livelihood reduced in the last 5 years mainly cope through spending their savings (17.1%) and reducing non-food expenses (13.6%). It is pertinent to note that HIV affected households were significantly more likely to report having sold a house or land as a coping strategy than households without HIV member. Similarly, compared those who had not experienced a reduced livelihood, those who reported reduced livelihood were significantly more likely to report reducing spending on non-food items such as health or education and were also significantly more likely to report having sold a productive asset, including a female breeding livestock or more animals than usual. Overall, it seems all the households rely mostly on spending their savings or selling productive assets and borrowing money to increase their coping capacity. However, both coping strategies are generally not sustainable because spending your savings means reducing the resources available to you in future while borrowing has the same effect since you will be essentially spending money that you do not have in your coffers. This suggests that interventions intended to increase the resilience of households in our study sites should take into account some of the critical sustainability dimensions.

#### **4.5 Resilience dimensions**

We deepened our analysis of the vulnerability and resilience dimensions confronting the targeted communities. The results of that analysis are presented in the following sections. In figure 1, the resilience dimensions are analysed by target community i.e.

from a comparative perspective. The assessment shows that respondents from study sites in the Pyramid and Limpopo are better off than the other targeted communities when considering the various resilience factors under consideration such as wealth, food security, environmental stability, infrastructure and human capital. Study sites in Malawi and Zimbabwe are much less resilient in this regard. This is also generally consistent with our findings on wealth and food security assessments across all the study sites.

**Table 5: Table of scales and Indices used**

<b>Social Capital</b> (alpha=0.67)	<b>Basic services</b> (alpha =0.64)	<b>Infrastructure</b> (alpha = 0.75)	<b>Psychosocial</b> (alpha=0.68)
- Name neighbour  -Trust neighbour to watch house -Trust neighbour to watch child	-School services quality  - Water services quality - Health services quality -Police services quality	- Water source -Electricity connection	-Don't feel defeated -Self-reported recovery
<b>Food security index</b>	<b>Health index</b>	<b>Human Capital index</b>	
Food Consumption	Self-rated health on scale 1-5	Level of Education 0 (no school)- 4 (tertiary education)	
<b>Wealth</b> (alpha = 0.87)	<b>Environment</b> (alpha=0.69)	<b>Security</b> (apha=0.86)	<b>Social support</b> (alpha =0.59)
Microwave House Helper Vacuum cleaner Laptop Wash machine Car Cable/Mnet DVD cellphone Electric stove TV Bed Table Chairs Cook utensil Bicycle Plough Oxcart	Land degradation Drought Flood	Fear of public transport Fear walking to shop Fear walking to work  Fear of open spaces Fear child playing Fear child walk to school Fear livestock in kraal Fear invest home business	Family assists Neighbours assists Government assists  Religious grp assist Chief/headman assists

Goats			
Cattle			

**Fig 1: Resilience dimension by target community/site**

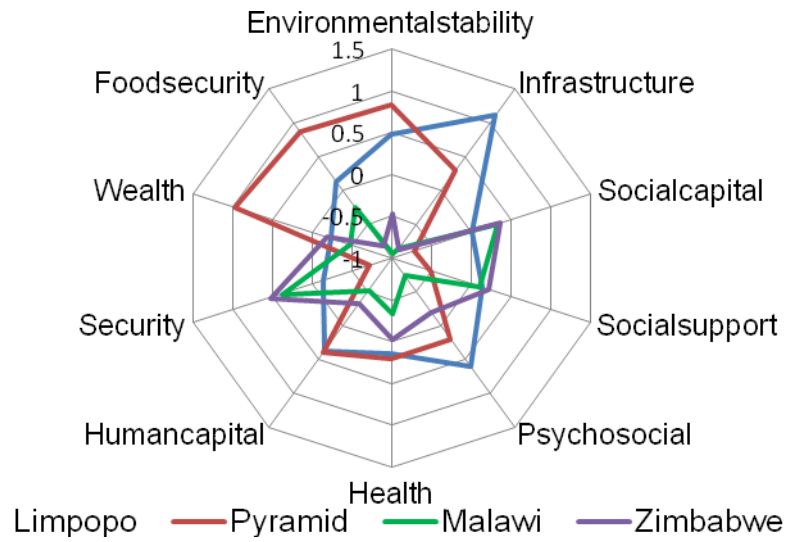


Figure 2 presents the results of our analysis of resilience dimensions by change in livelihood in the last 5 years, across all the study sites. The analysis shows that most of the respondents in our study experienced either no change or increased their resilience in the last 5 years. Those who experienced some reduced livelihood in the last 5 years did so mainly in the dimensions related to social capital, social support and security.

**Fig.2: Resilience dimensions by change in livelihood in the last 5 years**

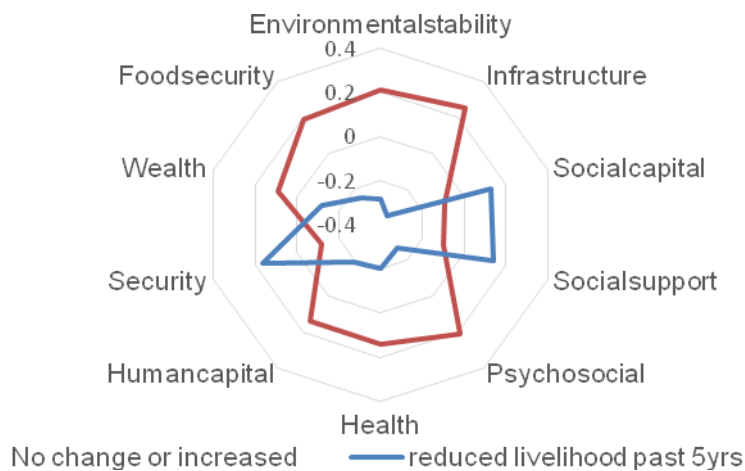


Figure 3 presents results of our assessments of resilience dimensions by self-reported household HIV status. Results of the analysis show that non-HIV households are generally more resilient than HIV households. This is reflected in the measurements for almost all the household resilience factors considered. HIV households seem only resilient to some extent on dimensions associated with social capital, security, and social support.

**Fig.3: Resilience dimensions by self-reported household HIV status**

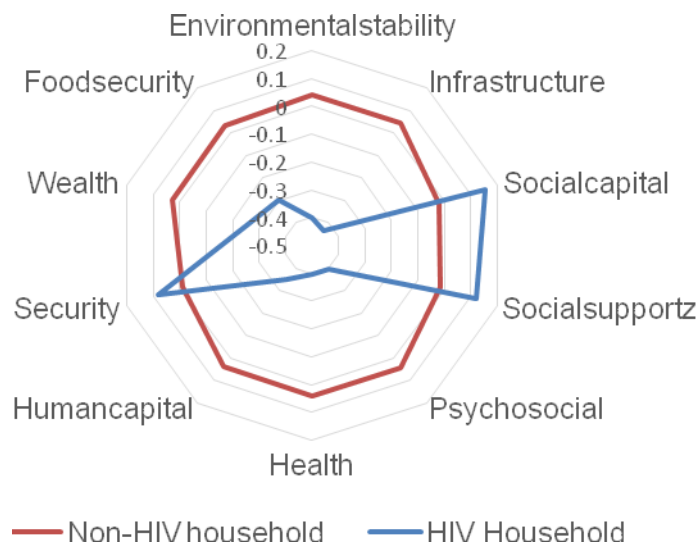
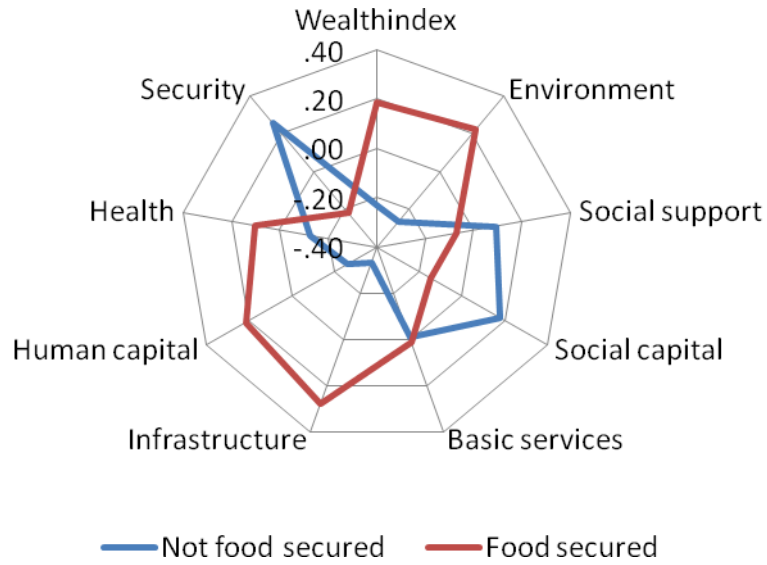


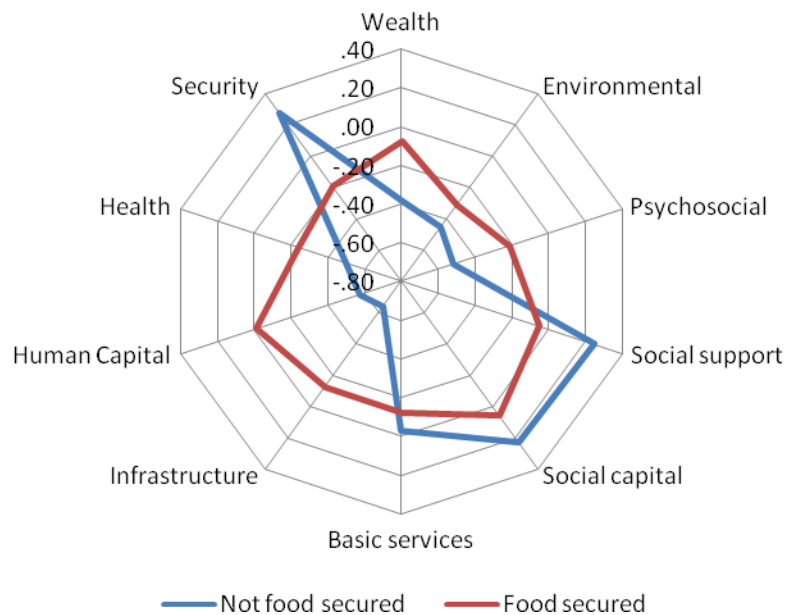
Figure 4 shows results of our analysis of resilience dimensions by food security in the general population.

**Fig. 4: Resilience dimensions by food security in the general population**



Results of the analysis show that there are more food-secure people amongst the general population in our study sites than those who are non-food secure. Those who are food-secure are also quite strong on resilience dimensions such as infrastructure, human capital, wealth and environment. Conversely, those who are not food secure are quite weak on resilience dimensions such as infrastructure, health, human capital, wealth and environment. They are a little bit strong on resilience dimensions such as social capital, and security. In Figure 5, we present our findings regarding resilience dimensions by food security in the HIV population.

**Fig. 5: Resilience dimensions by food security in the HIV population**



Results of the analysis show that those people among the HIV population who are food secure are also more resilient across all the resilience dimensions considered in this assessment when compared to those who are not food secure. However, the people who are not food secure have better access to social support, social capital, security and basic services than those who are food secure.

In figure 6, we present results of the analysis done to demonstrate the state of resilience dimensions by livelihood resilience in the general population. The analysis shows that the general population that enjoys a resilient livelihood are strongly associated with dimensions such as health, human capital, infrastructure psychosocial support and environment. On the other hand, those who do not enjoy a resilient livelihood are more associated with dimensions such as social capital, security and social support. Their association with dimensions such as environment, wealth and infrastructure is very weak.

**Fig.6: Resilience dimensions by livelihood resilience in general population**

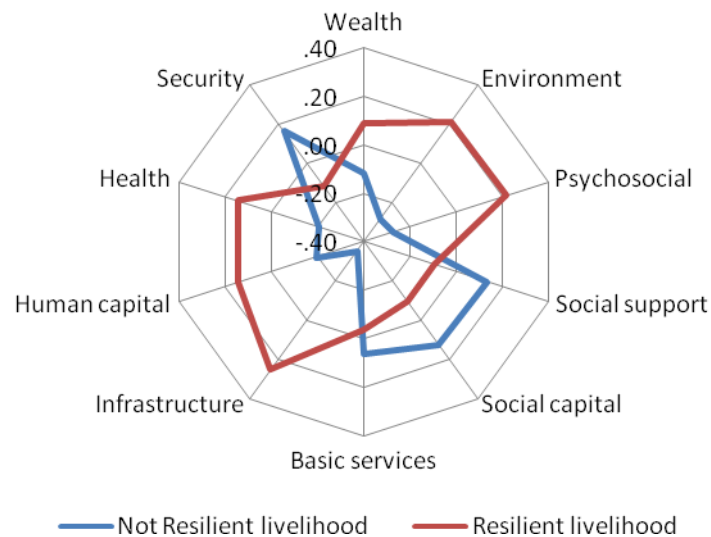
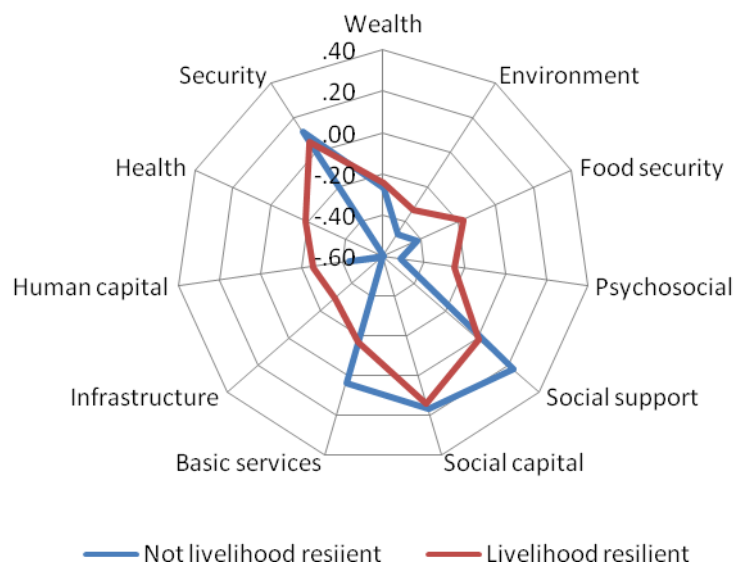


Fig 7 presents the results of the analysis of resilience dimensions by livelihood resilience in HIV population.

**Fig.7: Resilience dimensions by livelihood resilience in HIV population**



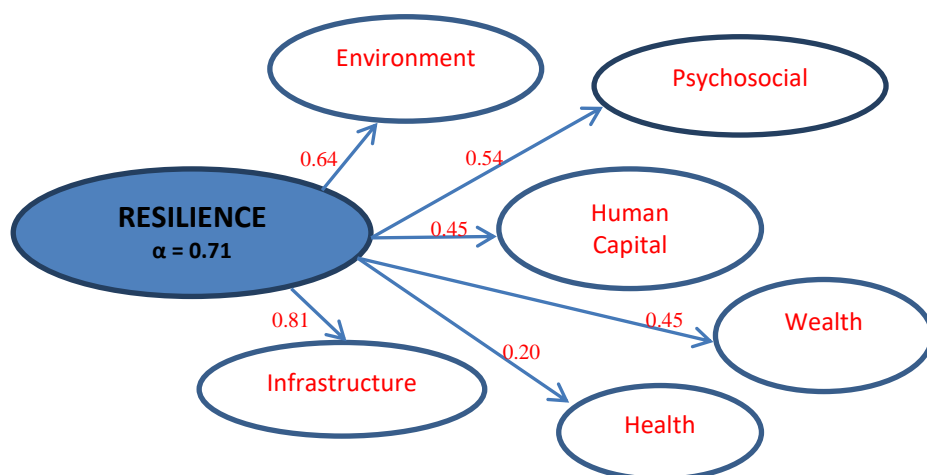
The analysis reveals that the HIV population that is livelihood resilient is slightly better off than the population that is not livelihood resilient. While both groups are relatively the same on most of the resilience dimensions under consideration, the group that is livelihood resilient is much stronger on dimensions associated with food security, human capital, health and infrastructure.

#### 4.6 Resilience measurement SEM model using confirmatory factor analysis (CFA)

The best fitting model retained only six dimensions of resilience as the best measure of the latent construct of resilience with good reliability as depicted by Cronbach alpha of 0.71. The standardized coefficients from the CFA SEM is as depicted in the resilience equation below:

$$Resilience\ index\ score = 0.45 * Wealth + 0.64 * Environment + 0.54 * Psychosocial + 0.81 * Infrastructure + 0.45 * Human\ capital + 0.20 * Health$$

Fig 8: SEM measurement model for Resilience construct



Model fit indices:

Chisq/df = 1.478

GFI=0.999

RMSEA = 0.016

TLI = 0.996

CFI = 1.000

**Table 6: Logistic regression model of predictors of food security (n=1870)**

Explanatory variables		Odds Ratio (95% Confidence interval)	
		Model A	Model B
Gender of household head			
	Male	1	1
	Female	0.69 (0.55 – 0.86)*	0.71 (0.56 – 0.88)*
Household size rank (range 1-13)			
	Lowest quartile	1	1
	2 <sup>nd</sup> quartile	1.29 (0.90 -1.85)	1.21 (0.85 – 1.74)
	3 <sup>r</sup> quartile	1.48 (1.01 – 2.15)*	1.40 (0.96 – 2.04)
	Highest quartile	1.71 (1.15-2.54)*	1.59 (1.07 - 2.37)*
Employment status			
	Unemployed	1	1
	Pensioner/House wife	1.27 (0.90 – 1.79)	1.25 (0.89 – 1.77)
	Part-time employed	1.15 (0.79 – 1.66)	1.10 (0.76 – 1.59)
	Full-time employed	1.60 (1.11 – 2.31)*	1.51 (1.05 – 2.19)*
Household location			
	Limpopo (Dikgale/Molepo)	1	1
	Pyramid (Pretoria)	4.15 (2.71 – 6.36)*	4.30 (2.79 – 6.63)*
	Chikwawa (Malawi)	0.69 (0.44 – 1.08)	1.60 (0.87 – 2.95)
	Beitbridge (Zimbabwe)	0.09 (0.05 – 0.14)*	0.16 (0.09 – 0.27)*
Member Burial society			
	No	1	1
	Yes	1.42 (1.02 – 1.98)*	1.46 (1.05 – 2.04)*
Livelihood stable/improved			
	No	1	1
	Yes	1.27 (1.00 – 1.60)*	1.24 (0.98 – 1.57)
	Resilience capacity	-	1.23 (1.11 – 1.37)*

\*Statistically significant at p&lt;0.05; †n&lt;1948 because of missing data

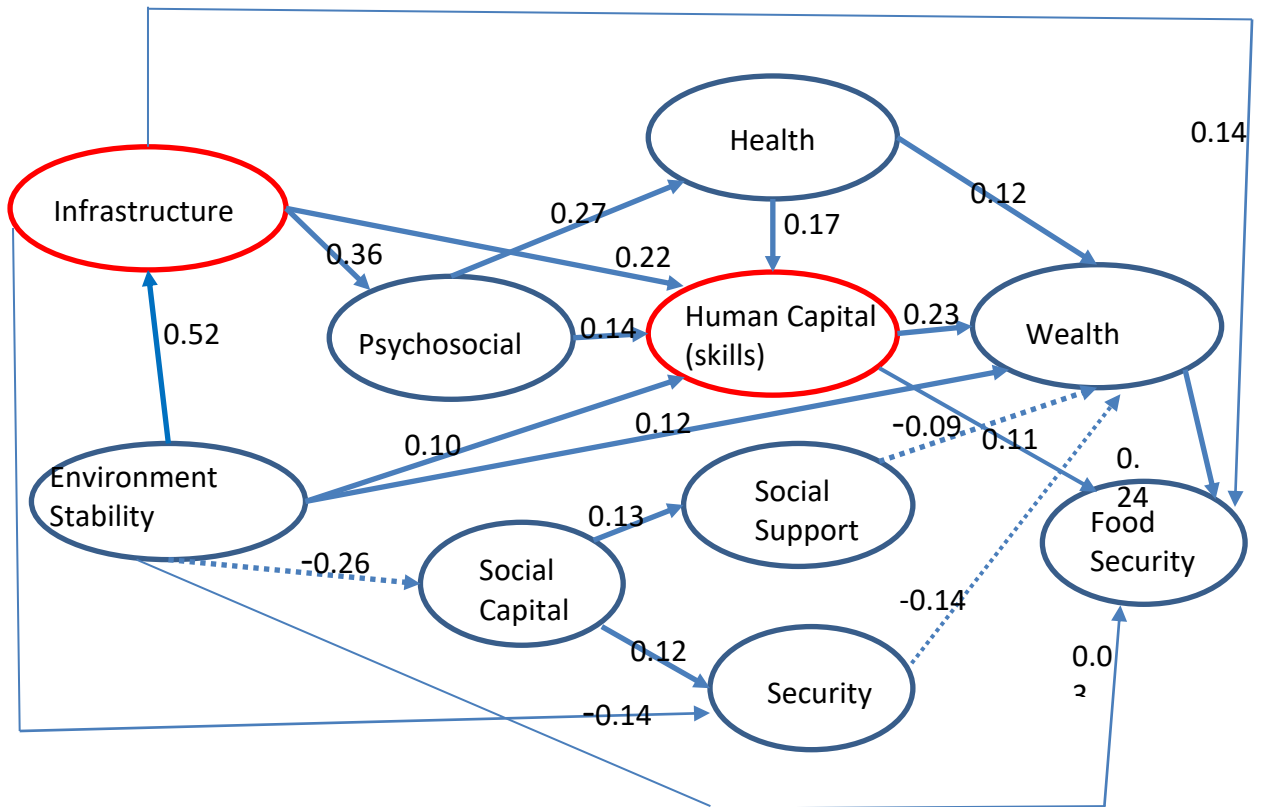
In further validation of the construct of resilience measurement derived in this analysis, a higher resilience was positively associated with greater odds of reporting adequate food consumption or being food secured, independent of the location of the household respondent (Table 6). It is pertinent to note that compared to male headed households, our analysis suggest that female-headed households were less likely to be food secured. This finding corroborates findings in the literature (Deaton & Paxson, 1998). However, contrary to the literature, those who had the highest household size were more likely to be more food secured than others. This apparently paradoxical finding might be due to such households taking advantage of economies of scale in food production and thus reducing expenditure per capita as previously described in the literature (Ibid).

In addition, as expected, those who are in full-time employment, as opposed to being unemployed or in part-time employment, were more likely to be food secured. The regression model also showed that after controlling for gender differences and regional differences in employment status, compared to households in the Limpopo region, food security is not significantly different in Chikwawa, but significantly higher in peri-urban the Pyramid area which is close to the South African capital city of Pretoria and significantly lower in Beitbridge, Zimbabwe.

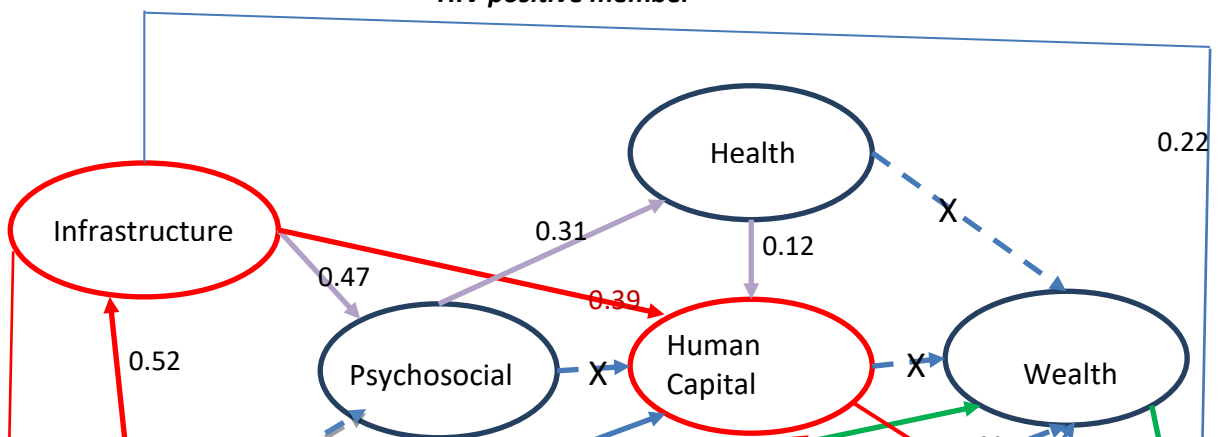
It was interesting to note that those who belonged to a burial society were more likely to report food security. These societies or organisations might provide both social capital and social support, which have been associated with better coping, in the event of adversity. Finally, resilient livelihood was shown to be completely mediated by the resilience capacity of households as this variable was no longer associated with food security after controlling for resilience capacity as measured by the resilience index. This further confirms the validity of our resilience measure in this population. It is also pertinent to note that the association between household size and food security was partly mediated by household resilience capacity as the size of the effect of this association became attenuated (see Table 6; Model B), but remain significant particularly for those in the highest quartile of household size

(with average household size = 5.9) as compared to those in lowest quartile (average household size = 1.6).

**Fig. 9: A resilience pathway for improved income and food security for the general population of the four communities**



**Fig. 10: A resilience pathway for improved income and food security for Households with HIV positive member**



In order to structurally validate the resilience construct and thus provide a deeper understanding of how resilience contributes to food security, the six resilience sub-constructs/dimensions were structurally modelled along with other related constructs such as social capital, social support, security and access to good basic services. In the general population, similar to that of the non-HIV household population, environmental stability has a direct positive effect on infrastructure and the level of human capital in a household. Human capital then has a direct positive effect on food security and on wealth creation, which in turn had a direct positive effect on food security. However, in the households with an HIV-positive member, there was no direct effect of human capital on wealth. Other pathways to wealth and food security are as depicted in Figures 9 and 10. It is pertinent to note that human capital, which can be broadly defined as having skills, was central to a number of pathways to food security and to wealth, particularly in the general or non-HIV households.

Interestingly, an environmentally stable state tended to be negatively associated with social capital. Conversely, by implication, a disruption in the environment would seem to trigger stronger social capital, which in turn triggers stronger social support and perceived security. However, this stronger social support or security was associated with households in poverty as there was negative effect on wealth, which in turn would result in negative effect on food security. It is indeed conceivable that in the event of environmental variability, greater social capital would be associated with having to distribute the little amount of income and/or food available to a

particular household among neighbours who might not have any food and thus resulting in the households generally all having less than adequate wealth and food security in the longer-term. Social capital and social support or safety nets in this instance could thus be considered a 'coping' (short-term) strategy rather than an 'adaptive' (long-term) resilience strategy.

However, the SEM model in the households with an HIV-positive member did not show any negative association between social support and wealth or food security. Instead, unlike in the non-HIV population, social support was associated with direct positive effect on human capital development, which in turn was directly associated with improved food security. Also distinctly different from the SEM model for the general or non HIV households, was the fact that the only path to wealth for HIV positive households was a stable environment and, by implication, any income generation by these households must not be dependent on the climate.

## **5. STUDY LIMITATIONS**

The major limitation of this study was the fact that it was a cross-sectional study which precluded causal inferences considering that we do not have the information of the temporal order of events. However, to address the limitation to some extent, the question on changes in livelihood in the preceding five years was meant to provide information on household responses to a somewhat covariate shock related to the global financial crises in 2009 and the outcome of food security status collected over the past week would naturally follow on the event of change or not in livelihood. The use of the structural equation model (SEM) also provides further understanding of possible causal pathways.

A further limitation is the use of self-reporting which is subject to possible biases. For instance, it is likely that not all households would have voluntarily provided the HIV status of their members, but it may also well be that the household head might not be aware of the HIV status of his/her household members. There is therefore, a potential for misclassification of households based on HIV status. Such a misclassification, however, is more likely to bias the association between HIV status

and resilience outcomes towards the null than to inflate such association. It is therefore, likely that we have only presented conservative estimates of the effect of household HIV status on resilience outcomes.

We also just used exploratory factor analysis that is dependent on shared variances statistically explained but may not necessarily capture all the underlying constructs for a particular dimension of resilience. Furthermore, some of the indices used such as that used as a proxy measure of human capital, might also not capture the underlying construct of this dimension. For example, those without formal education might well still have other skills that can support livelihoods and these might not have been captured by the measure of formal education alone. In addition, some of these resilience dimensions may not have reached the desirable benchmark levels of 0.70 for reliability of scales, but all final six sub-constructs or dimensions of resilience were at levels generally considered satisfactory. It is pertinent to note that the more the items considered, the higher the chances of obtaining higher Cronbach alpha coefficients. The reliability of our scales were therefore, further considered satisfactory given that most dimensions with Cronbach alpha lower than 0.70 contained five or fewer items, which provides the added advantage of being able to be fielded in national surveys with little burden on the survey respondents when measuring resilience at a national population level.

Finally, the study findings might not be generalizable given that the sample was not nationally representative. However, considering that this quantitative study followed on a qualitative study in the same target communities and would be followed on by interventions, it provides for the first time an opportunity for an in-depth understanding of the construct of resilience in vulnerable Southern African communities. The study can therefore, be replicated in future studies on larger populations.

## **6. CONCLUSION**

Despite the limitations identified above, we were still able to confidently reach some definite conclusions. Consistent with the findings from the qualitative study, findings

from this quantitative study support the hypothesised structure of resilience in the target communities. This study was also able to demonstrate the validity and reliability of a multi-dimensional resilience construct with human capital (skills training) and wealth (income generation) being the potential entry points for promoting resilience to food security and sustainable livelihood, even in the presence of the HIV burden. It would be important, particularly for those households with HIV-positive individuals, that the income generating interventions should be non-agricultural or food or cash crop-related. If they are agriculture-related, they should not be dependent on environmental resilience e.g. growing drought-resistant crops. There is need for further studies to understand innovations within large households that promote food security, such that they take advantage of economies of scale for food production.

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