MEASURING SUBJECTIVE HOUSEHOLD RESILIENCE

INSIGHTS FROM TANZANIA

Lindsey Jones and Emma Samman

BRACED KNOWLEDGE MANAGER

Working paper

CONTACT THE AUTHORS

Lindsey Jones is a Research Fellow at ODI, working on issues of climate change, adaptation and development. He leads BRACED Rapid Response Research which seeks to explore issues of subjective resilience and the use of mobile phone surveys in a range of BRACED countries.

Dr Emma Samman is a Research Associate in the Growth, Poverty and Inequality Programme at Overseas Development Institute. Her research interests include the analysis of poverty and inequality, gender and empowerment, the human development approach, survey design and the use of subjective data to inform development policy.

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Executive summary

In this paper, we explore the feasibility and utility of a subjective approach to measuring household resilience. Subjective measures comprise of a person's self-evaluation of their household's capability and capacity to respond to climate extremes or other related hazards. To date, most quantitative approaches to resilience measurement rely on objective indicators and frameworks of assessment. More recently, subjective methods of resilience measurement have been advocated in helping to overcome some of the limitations of traditional approaches. While subjective measures may hold significant promise as an alternative and complementary approach to traditional, few standardised quantifiable tools have been tested at scale. With this in mind we carried out a nationally representative survey in Tanzania to explore perceived levels of household resilience to climate extremes and assess the utility of standardised subjective methods for its assessment. The focus of the study is primarily on flood risk, examining a range of self-assessed resilience-related capacities and patterns of resilience across socio-demographic groups.

Results of the survey show that most of the population perceive their household to be ill prepared to respond to (66%), recover from (75%) and adapt to (61%) extreme flooding. Factors that are most associated with resilience-related capacities are advance knowledge of a previous flood and, to a lesser extent, believing flooding to be a serious community problem. This suggests further investment in early warning and awareness-raising regarding extreme flooding could be warranted. Somewhat surprisingly, although most socio-demographic variables – such as levels of education, livelihood type and rural/urban locality – show weak associations with perceived resilience-related capacities, few exhibit statistically significant differences between groups,

with the exception of a household's wealth. If corroborated in future work, these findings may pose a challenge to a number of traditional assumptions about the factors that underlie household resilience to climate variability and change. Most notably it calls into question the suitability of many objective and observable socio-demographic factors as proxies for household resilience.

We argue the insights offered by the subjective questions, and the lack of correlation with the objective measures, require better understanding of the relationships between a household's perceived resilience and objective approaches to resilience measurement. Above all, efforts to evaluate and quantify resilience should take into account subjective aspects of household resilience in order to ensure a more holistic understanding of resilience to climate extremes.

Introduction

Resilience measurement has soared to the top of the development agenda (Frankenberger et al., 2014). As a result, researchers have proposed a large number of frameworks and methods to quantify the resilience of different social systems – whether at a household, community or national level (Constas and Barrett, 2013; Elasha et al., 2005; D'Errico and Di Giuseppe, 2014; Nguyen and James, 2013; Twigg, 2009; USAID, 2009). To date, the vast majority of these methods have focused on objective indicators and approaches, often centred on observing key socioeconomic variables and other types of capital that support people's livelihoods (Bahadur et al., 2015). More recently, the advantages of subjective approaches to measuring social systems have been advocated (Jones and Tanner, 2015; Lockwood et al., 2015; Marshall, 2010; Maxwell et al., 2015). These methods may offer opportunities to address many of the weakness that beset traditional objective approaches, such as lack of attention to context specificity, difficulties with indicator selection and an inability to take people's own knowledge of their resilience into account. However, few quantitative assessments of subjective resilience have taken place to date (Marshall, 2010). As such, little is known about the feasibility of subjective approaches as a resilience measurement tool and how they compare with traditional objective methods.

In this paper, we present results from a nationally representative survey focused on the subjective resilience of households to flood risk in Tanzania. We explore a range of resilience-related capacities and examine patterns of resilience across socio-demographic groups. On the basis of this exercise, we outline some preliminary insights into the feasibility and suitability of subjective approaches to measuring resilience at the household level, as well as future avenues for methodological refinement.

1. BACKGROUND

IMAGE: BBCLIMATE CHAMPIONS

The concept of resilience is used across a wide range of disciplines and programmatic sectors (Alexander, 2013). While such diversity demonstrates the utility of the term, it also contributes to ambiguities in how it is understood and defined (Aldunce et al., 2015). Indeed, even within single disciplines – such as resilience to climate extremes – no apparent consensus exists (Olsson et al., 2015). Despite this, frameworks for conceptualising resilient social systems tend to identify a range of common capacities needed to respond to change and uncertainty (though not all agree on which ones are relevant). These often include, but are by no means limited to, the ability to prepare and anticipate; absorb and recover; and adapt and transform (Bahadur et al., 2015). For the most part, efforts to evaluate and measure such resilience-related capacities have

revolved around objective approaches: observations of things and activities that are (externally) considered to support a household or community's ability to deal with risk. For example, the widely used Resilience Index Measurement and Analysis (RIMA) model combines socioeconomic variables from six dimensions: income and food access; access to basic services; assets; adaptive capacity; social safety nets; and sensitivity to shock. Table 1 shows the objective variables used to describe two dimensions of this index.

> "Social networks and community cohesion, power and marginalisation, and risk tolerance each play a key role in determining a household's resilience"

Identifying a common set of observable indicators that relate to a household's capacity to recover from a flood, or its ability to adapt to ever-increasing flood risk, has so far proven difficult (Cutter et al., 2008), not least because many factors that contribute to resilience-related capacities are process-driven and relatively intangible (Jones et al., 2010). For example, social networks and community cohesion, power and marginalisation, and risk tolerance each play a key role in determining a household's resilience (Adger et al., 2013). At the same time, identifying a common set of observable assets or activities that can serve as proxies for each quickly proves challenging.

Table 1: Examples of variables used to construct RIMA's resilience index

RESILIENCE DIMENSION	VARIABLES USED TO COMPUTE RESILIENCE DIMENSION
Access to basic services	Percentage of households reporting they have access to water
	Percentage of households reporting they have access to electricity
	Percentage of households reporting they have access to toilets
	Percentage of households reporting they have access to waste disposal
	Distance to a primary school
	Distance to a bus stop/means of transport
	Distance to a market
	Distance to a health centre
	Infrastructural index built through factor analysis of various indicators of infrastructure wealth
Adaptive capacity	Number of different sources of income available to household
	The coping strategies index is derived from the severity and frequency of consumption coping strategies households apply in times of acute food shortages. It is a relative measure to compare trends in food insecurity over time, as well as cross-sectional differences in food insecurity among sub-groups
	Ratio between employed people and labour force in household
	Household head's years of education
	Share of literate people in household

Source: Adapted from UNICEF (2014).

Though yet to be fully explored in both conceptual and practical terms, subjective approaches may offer an alternative and complementary approach to resilience assessment (Marshall, 2010; Maxwell et al., 2015; Nguyen and James, 2013; Seara et al., 2016). At its simplest, subjective household resilience

relates to an individual's cognitive and affective self-evaluation of the capabilities and capacities of their household, community or any other social system in responding to risk (Jones and Tanner, 2015). Borrowing on insights and research from related fields, such as subjective well-being and psychological resilience, it is apparent that subjective forms of evaluation may offer complementary or alternative ways of capturing many of the 'softer' elements of resilience-related capacities, allow comparison across different contexts over time and permit individuals' knowledge of the factors that contribute to their own resilience to be taken into account. In this paper, we undertake an exercise that aims to measure people's evaluations of their own resilience in the face of a common extreme event. The next section describes our approach.

2. CONCEPTUAL APPROACH

IMAGE:
CECILIA SCHUBERT

Subjective household resilience can be measured in many ways. Perhaps the most evident and practical way of collecting standardised data is through the use of large household surveys. While open-ended questions might provide rich qualitative detail, closed-ended questions are more likely to enable the aggregation of scorings of resilience capacities and to facilitate comparison across social groups or time (OECD, 2013). In order to examine the suitability of a subjective approach to measuring resilience-related capacities, and to explore differences among different social groups, we took advantage of the opportunity to add a small module of close-ended questions to a nationally representative longitudinal telephone survey in Tanzania. To narrow the focus, we concentrated our survey questions

on household-level disaster resilience – more specifically, household resilience to flood risk.[1]

Our survey is not able to provide an all-inclusive framing or evaluation of subjective resilience. Rather, we sought to test a simple and replicable mechanism for delivering subjective questions related to widely recognised core components of resilience. On this basis, we aimed to assess patterns and obtain insights into the validity and viability of the approach borrowing on that outlined by Jones and Tanner (2015). Thus, while we recognise the diversity of definitions and frameworks for resilience, we base our survey on a commonly used framing of disaster resilience (Aldunce et al., 2015; DFID, 2014; Linkov et al., 2014), as comprising three core capacities.

The first capacity relates to a household's ability to *prepare* – more specifically, to anticipate and reduce the impact of climate variability and extremes through preparedness and planning, often by making use of relevant information and early warning (Bahadur et al., 2015). The second capacity relates to a household's ability to *recover*. This is associated primarily with its ability to absorb and cope with the impacts of climate variability and extremes, often through maintaining core functions or livelihood activities (Folke et al., 2010; TFQCDM and WADEM, 2002). The third capacity relates to a household's ability to *adapt* – more specifically, to adjust, modify or change its characteristics or actions to moderate potential damage or take advantage of new opportunities that arise (Jones et al., 2010).

1 Flood risk was chosen specifically given that it is a rapid-onset shock that is easily communicable and defined in a survey context. In addition, flooding is a hazard that affects large areas of Tanzania, with recovery typically occurring immediately after the cessation of a flood. It is worth noting that extensive flooding had occurred two weeks prior to the survey (May 2015), affecting areas of Dar es Salaam, Arusha, Kilimanjaro, Tanga and Kagera.

Using the above three capacities to infer relevant information about household resilience, and building on similar approaches used to evaluate subjective capacities in related fields, we administered a single question to address each of the three resilience-related capacities (Table 2). Each capacity question uses a standardised unipolar Likert scale with four response items.

Table 2: Resilience-related questions administered through the national survey

CORE CAPACITY OR PROCESS	SURVEY QUESTION	RESPONSE ITEMS
Enumerator introduction: 'First we would like to ask you about what would happen if an extreme flood affected your community in the near future. By extreme flood, I mean one that is likely to affect your household, or harm your dwelling, fields or resources.'		
Capacity to prepare	If an extreme flood occurred, how likely is it that your household would be well prepared in advance?	4-point scale: (1) Extremely likely; (2) Very likely; (3) Not very likely; (4) Not at all likely.
Capacity to recover	If an extreme flood occurred, how likely is it that your household could recover fully within six months?	4-point scale: (1) Extremely likely; (2) Very likely; (3) Not very likely; (4) Not at all likely.
Capacity to adapt	If extreme flooding were to become more frequent, how likely is it that your household could change its source of income and/or livelihood, if needed?	4-point scale: (1) Extremely likely; (2) Very likely; (3) Not very likely; (4) Not at all likely.
Enumerator introduction: 'Finally, I'm going to ask you about your household's experience of flooding over the past two years.'		
Severity	In the past two years, how serious a problem has flooding been to your household?	4-point scale: (1) The most serious problem; (2) One of the serious problems of many; (3) A minor problem; (4) Not at all a problem.
	In the past two years, how serious a problem has flooding been to your community?	4-point scale: (1) The most serious problem; (2) One of the serious problems of many; (3) A minor problem; (4) Not at all a problem.
Early warning	Please think about the last extreme flood that affected your household. Did you know about it in advance?	3-point scale: (1) No; (2) Yes; (3) Household not affected by a flood in the past two years.

3. DATA AND METHOD

IMAGE:
DAVID DENNIS

The questions were administered via a nationally representative survey in Tanzania, namely the Sauti za Wananchi longitudinal survey managed by the Tanzanian non-governmental organisation, Twaweza, and surveying company Ipsos Synovate. The survey comprises two phases. First, a baseline survey is carried out through traditional face-to-face interviews using a multi-stage stratified sampling approach (Twaweza, 2013). A sample of 2,000 households in 200 enumeration areas were surveyed in October 2012, using a sampling frame designed to be representative of the Tanzanian population aged 18 years and older – based on the 2012 Tanzania Population and Housing Census (NBS, 2013). At this point, all households were given a mobile phone and a solar charger. The second phase consists of a series of mobile telephone surveys with the same sampled households as in the baseline.

Follow-up mobile surveys have been conducted every three to six months covering a range different themes from health, water and sanitation to education and political polling.[2]

In the round associated with this paper's results, the survey focused on assessments of political leadership. Resilience-related questions were included in an add-on module.[3] Respondents were contacted in July 2015 to take part in the survey through a Computer Aided Telephonic Interview (CATI) operated via an Ipsos Synovate-managed call centre in Dar es Salaam. A total of 1,335 respondents completed the survey.[4] Questions were administered in Ki-Swahili and English, with a small financial incentive provided to respondents for their participation ($0.50 mobile airtime credit).[5] For 1,334 of the respondents, a wide array of socio-demographic data from the 2012 baseline are available, as well as responses to the resilience questions listed above.[6] We removed an additional 40 of these respondents from the dataset because it was not certain that the same person replied as in the baseline, leaving 1,294 matched observations.[7]

2 Details of surveys to date and the datasets are available at www.twaweza.org/go/sauti-za-wananchi-english

3 The Global Resilience Partnership provided financial support for this.

4 The individuals and households participating in this round were assigned 'weights' to adjust for non-response and design error (Twaweza, n.d.). The resulting data are intended to be representative of the adult population of mainland Tanzania not including Zanzibar (Twaweza, 2013).

5 For full details of the sampling procedure, weighting and data collection, see Twaweza (n.d.).

6 For one respondent, baseline information was not available and so the corresponding data were removed.

7 Because the Sauti za Wanachi survey is administered by phone, each time it is conducted the respondent is asked to give their name. In this round, eight respondents gave a different name than in the baseline and 32 respondents did not provide a name.

In the analysis, we describe the characteristics of our sample and then present descriptive statistics on their reported resilience-related capacities, followed by multivariate analysis. Because the ordinal variables measuring resilience-related capacities are not normally distributed, we test the equality of proportions rather than the means.[8] In the multivariate analysis, we used ordinal logistic models in which we regressed indicators of perceived resilience on a range of objective controls to test whether these individual variables were independently able to predict outcomes. Given the regressors are the same across these models, we use a seemingly unrelated estimation technique to account for the correlation in the error terms (Statacorp, 2013; Weesie, 2009). Independent variables included the age, gender, education and household size of respondents, whether they were occupied in farming and whether they lived in an urban or a rural area;[9] the 'wealth' quintile of the household (using an asset index); and whether the household had previous experience of a flood, whether they believed flooding to be a serious problem for their community and whether they had known about the last flood that affected them (within the previous two years) in advance.[10]

8 The Wilcoxon-Mann Whitney statistic (for two groups) and the Kruskal-Wallis test (for more than two groups) were selected as the non-parametric test best suited to ordinal responses (following Marusteri and Bacarea, 2010), although it does not permit incorporating the complex stratified survey design. Non-parametric tests do not make assumptions about the underlying distribution of a variable but are less powerful than parametric tests.

9 The sample size is not large enough to permit analysis by sub-region apart from by urban/rural zone (personal communication, Sana Jaffers).

10 Beliefs that flooding posed a problem to the community and to the household were highly correlated; we chose to include the former because the bivariate analysis revealed stronger relationships with the resilience-related capacities. We restricted the focus to flooding occurring in the previous two years in order to ensure a relatively recent and consistent frame of reference.

Our sample of respondents to the survey comprised predominantly of household heads (98%), the majority of whom were male (57%).[11] They were primarily rural (65%) and occupied in farming (also 65%). We define household wealth status according to an asset index that places households into relative wealth quintiles.[12] Some 93% of households in the poorest asset quintile were in rural areas, compared with about 16% of households in the richest asset quintile. The majority of respondents had completed primary education (61%); around 13% had some or a complete secondary education, 3% had higher education and just under 10% had no formal education. The mean age of respondents in our sample was 40 years – 37 for females and 42 for men – with a range between 18 and 89 years old. The mean household size was 5.8.

11 Because almost all respondents were household heads, we focused our analysis on the gender of the respondent rather than female versus male headship.

12 The wealth index was generated by principal components analysis using the following household assets: radio, mobile phone, fridge, TV, sofa set, electric/gas cooker, motor vehicle, livestock and water pump (Twaweza, personal communication).

4. DESCRIPTIVE STATISTICS

IMAGE: BIOVERSITY INTERNATIONAL/ E. HERMANOWICZ

Overall, around one-third of the sample lived in households that had experienced a severe flooding event in the two years prior to the survey (Appendix Table A.1).[13] The reports were similar among male and female respondents, those occupied in farming and in non-farming activities, households in rural and urban areas and respondents across wealth quintiles.[14] Reports of flood experience were positively associated with education –

13 The statistics presented here are for the population – i.e., they incorporate the complex sampling design – while Appendix A presents the unweighted data and test statistics for these data. In practice, the differences between the averages derived from weighted and unweighted data are very slight.

14 None of the differences among these groups was statistically significant in the unweighted data (see Table A.1).

with the exception that about 15% of the population with some higher education reported experiencing a recent extreme flood, compared with one third of those with less education.[15]

Within this subset of respondents with recent experience of flooding, about one quarter (26%) reported receiving information about the flood in advance. In general, higher shares of more educated respondents reported advance knowledge of a flood (excluding again those with a tertiary education) – for example, about 16% of the population with less than a complete primary education reported having advance knowledge of the flood, compared with just under 30% of those with at least some secondary education. Differences in having advance knowledge between men and women, farmers and non-farmers, residents of urban and rural areas and wealth quintiles were also slight.[16]

Respondents were also asked how serious a problem flooding was, independently of whether they had recently experienced a flood. For most, it was not a serious concern either for their household (86%) or for their community (71%) (Figure 1, Appendix Tables A2a and A2b). However, three findings stand out. First, respondents from households that had experienced a flood in the previous two years were far more likely to perceive flooding as problematic – close to 40% of the population that had been exposed to flood reported flooding as a serious problem or the most serious problem for their household and over half (54%) reported it as serious or most serious for their community, compared with 2% and 17% of those that had not been exposed to a recent flood, respectively. There were no

15 Differences among education levels are statistically significant in the unweighted sample but only when higher education is included.

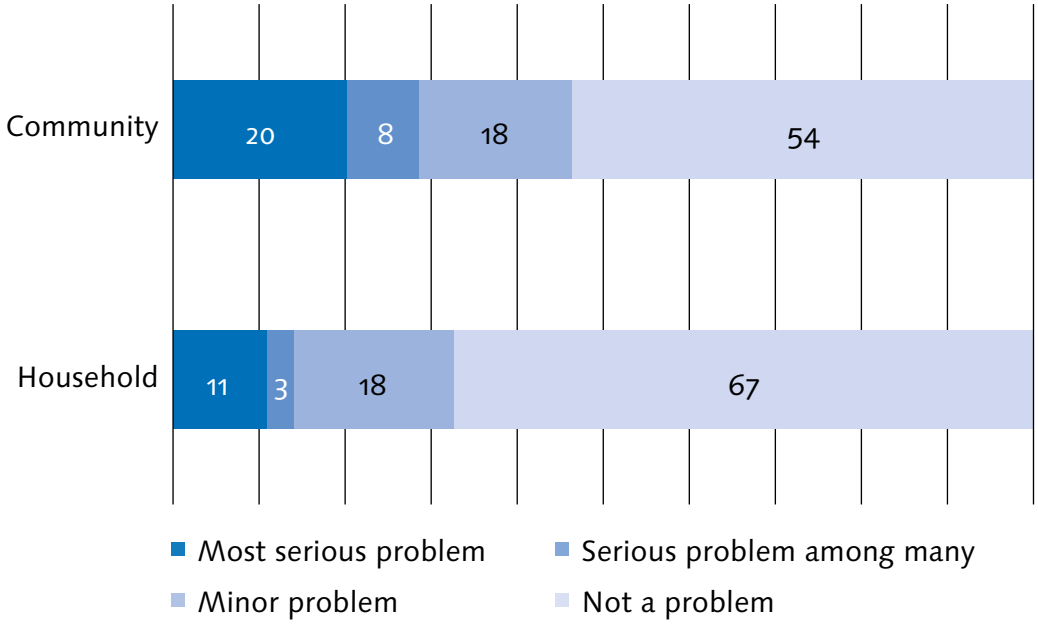
16 None of these differences were statistically significant in the unweighted sample.

other socio-demographic cleavages, except that respondents from more asset-poor households were more likely to believe flooding was serious for their community (but not their household).

"Among those respondents who had been exposed to a recent flood, those who had early warning of that flood were more likely than those who had not to perceive it as a serious problem"

Second, among those respondents who had been exposed to a recent flood, those who had early warning of that flood were more likely than those who had not to perceive it as a serious problem – both for their households and for their communities (Figure 2). Some 57% and 67% of the population that had received advance warning of a previous flood perceived flooding to be a serious threat to their household and community, respectively, compared with 33% and 49% of those that did not have an early warning. This association could be a function of the severity of the previous flood – more efforts are likely to be taken to warn people of more extreme events – but, given that the survey stipulated prior to these questions that the concern was with extreme flooding, it could also suggest that people who believe flooding is serious are more likely to seek out advance warning.

Figure 1: Share of people who perceived flooding to be a serious problem to their household or community



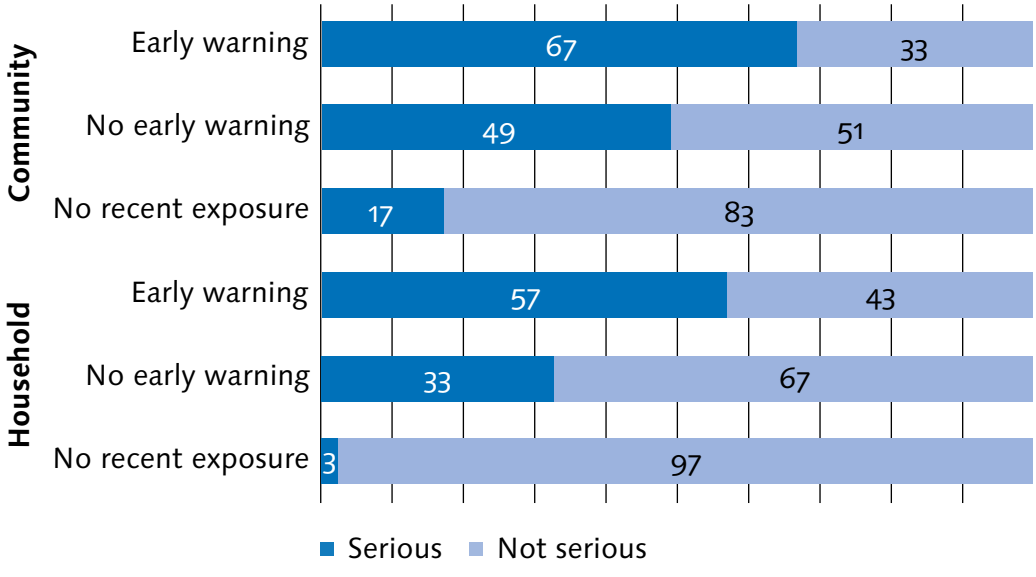
Note: Values may not equal 100 owing to rounding error.

Third, it is notable that, while some 14% of the population believed flooding was a serious problem for their household, twice that share felt it was a serious problem for their community. There are few socio-demographic differences in the characteristics of respondents who held the view that flooding was a serious problem for their community but not for their household and the rest of the population; however, paradoxically, the former category contains a slightly higher share of respondents among the relatively poorly educated and the bottom two wealth quintiles.[17] It is difficult to know how to interpret this finding.

17 For a completed primary education or more, 14% of people were in this category compared with 18% of those with less than a primary education (chi2(1) = 2.3, p = 0.1334). Similarly, 13% of respondents in the bottom two wealth quintiles held this view compared with 18% in the top three quintiles (chi2(1) = 3.2, p = 0.074).

We speculate that it could result from the relative vulnerability of community infrastructure and assets (such as road networks, schools and community building, etc.) owing to poor resourcing; poor confidence in community and local government governance; or unwillingness among respondents to portray their household as vulnerable.

Figure 2: Share of population reporting flooding to be a serious problem based on whether they had advance knowledge of recent flood

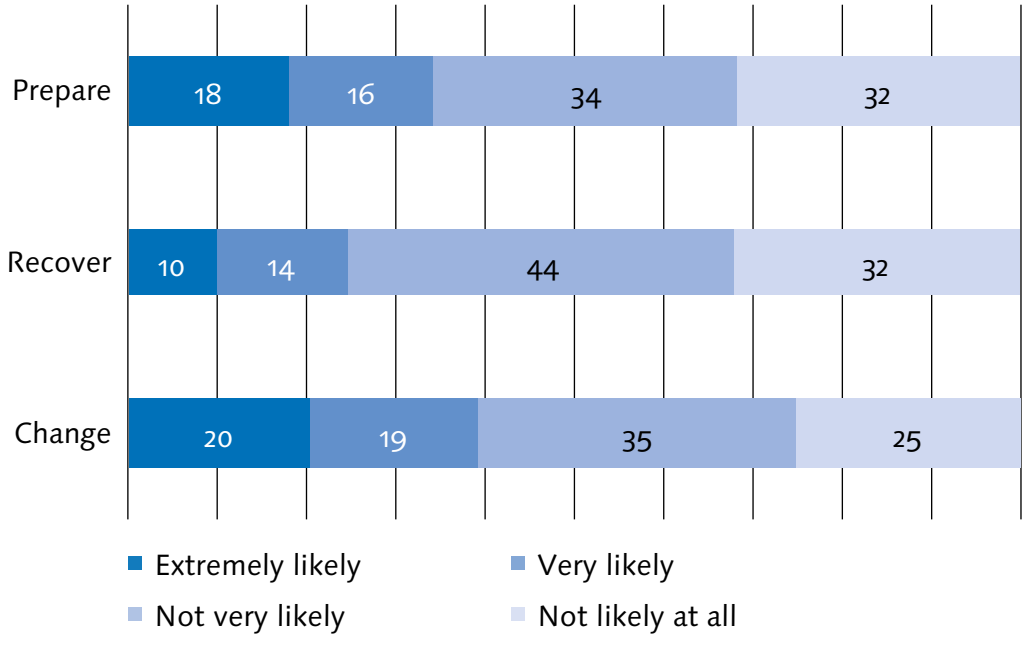


Note: Values may not equal 100 owing to rounding error.

Respondents were then asked to assess their perceived capacities to prepare for, recover from and change their livelihood strategy, respectively, in response to an extreme flood event. Most respondents felt their household was ill equipped to respond to extreme flooding. Just one third of the population reported that their household would be prepared in the event of a flood, a quarter felt their household was capable of recovering fully within a six-month period and

four in 10 people felt their household could change source of income/livelihood, if needed (Figure 3).

Figure 3: Perceptions of the capacity to respond to extreme flooding in Tanzania



Note: Values may not equal 100 owing to rounding error.

It is perhaps unsurprising that a higher share of respondents felt they would be prepared for a flood than able to recover fully and promptly from it. However, it is striking that a high share (39%) of respondents felt their income or source of livelihood could be changed in order to adapt to increasing future flood risk. This share is somewhat lower among people with less education and fewer assets (though only the wealth differences are statistically significant). However, fully 30% of respondents without education and one third of those from households in the poorest asset quintile felt they would be able to adapt. In future work, it would be advisable to probe further understandings of the 'adaptation' question and the types of new livelihood strategies people felt they could adopt, and how.

The rank order correlations among these three types of capacity were positive, as expected, but fairly low – all less than .5 (Table 3). The highest correlation (.45) is between reporting being able to prepare for a flood and to recover from it; the lowest (.25) is between being able to recover from a flood and to change one's way of life in response to it. As noted above, these questions have four response options ranging from very likely to very unlikely; we also constructed binary variables (likely/unlikely) and found very similar correlations.

Table 3: Spearman correlations between key measures of subjective resilience

	PREPARE	RECOVER	CHANGE
Prepare	1		
Recover	0.4519*	1	
Change	0.3173*	0.2514*	1

Note: *Statistically significant at .05 level.

We examined whether these items could be combined to form an index of a latent construct of resilience. The three items did not meet the established threshold for internal consistency (Cronbach's alpha is .62, below the commonly accepted threshold of .7), but item selection was also tested by principal components analysis, which showed that the three items loaded strongly onto one variable with an eigenvalue higher than 1 (the threshold recommended by Kaiser's rule) (Table 4). This gives some support for constructing an index of perceptions of resilience; however, in this paper we focus on analysis of the three components individually to obtain more insights into factors that are associated (or not) with each, and defer discussion of the value of a composite index as a question for future work.

Table 4: Results of principal components analysis

1. Factor analysis

FACTOR	EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
Factor 1	1.72461	0.95787	0.5749	0.5749
Factor 2	0.76674	0.25808	0.2556	0.8304
Factor 3	0.50865		0.1696	1

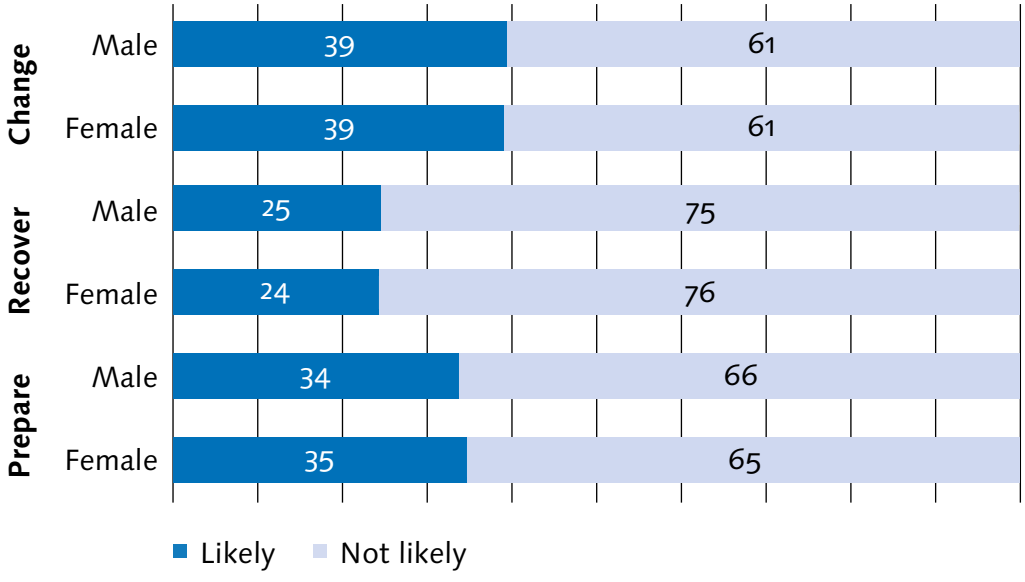
Note: LR test – independent vs. saturated: chi2(3) = 512.47
Prob>chi2 = 0.0000.

2. Factor loadings and unique variances (unrotated)

VARIABLE	FACTOR 1	UNIQUENESS
Prepare	0.8198	0.328
Recover	0.7914	0.3738
Change	0.653	0.5736

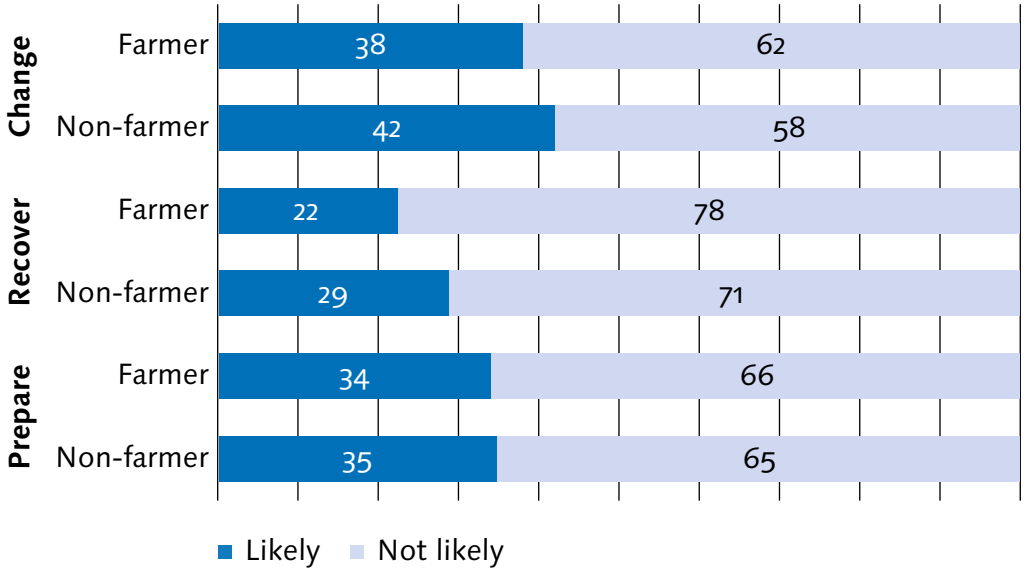
Some interesting differences emerge in examining the socioeconomic correlates of the three capacities (Appendix Tables A3 through A5). Male and female respondents provided very similar responses across the board (Figure 4) – although this may not be too surprising, given that the survey deliberately asked respondents to rate household-level capacities, not individual ones. Fewer farmers than non-farmers (and people in rural versus urban areas) reported that it was likely that they could recover fully from an extreme flood event within six months. Responses were very similar across occupations, and rural and urban zones, with respect to the perceived capacity to prepare for and adapt, although a lower share of farmers and rural residents reported that it was 'extremely likely' they would adapt to an extreme flood (Figures 5 and 6).

Figure 4: Gender of respondent and resilience-related capacities



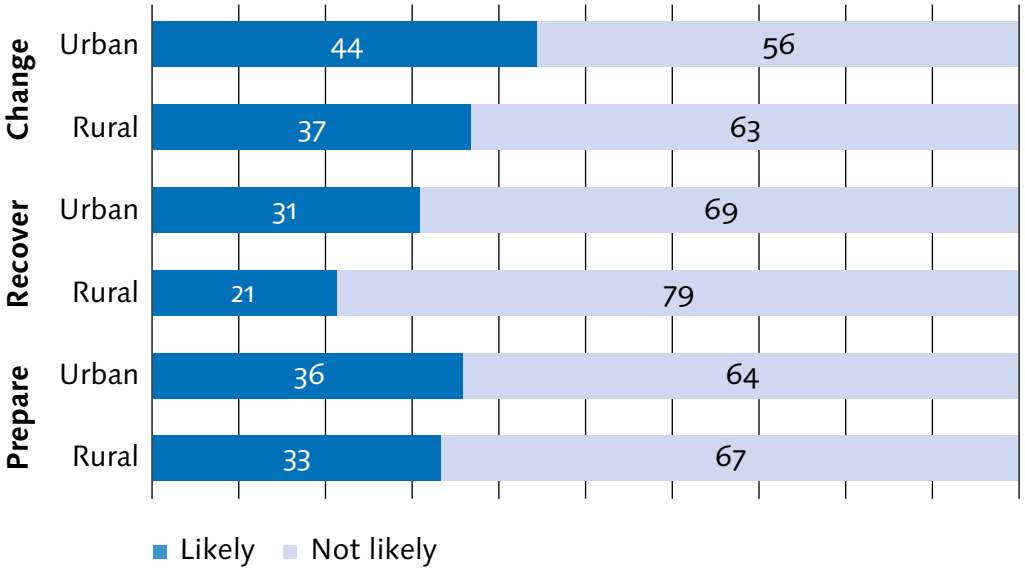
Note: Values may not equal 100 owing to rounding error.

Figure 5: Occupation in farming and resilience-related capacities



Note: Values may not equal 100 owing to rounding error.

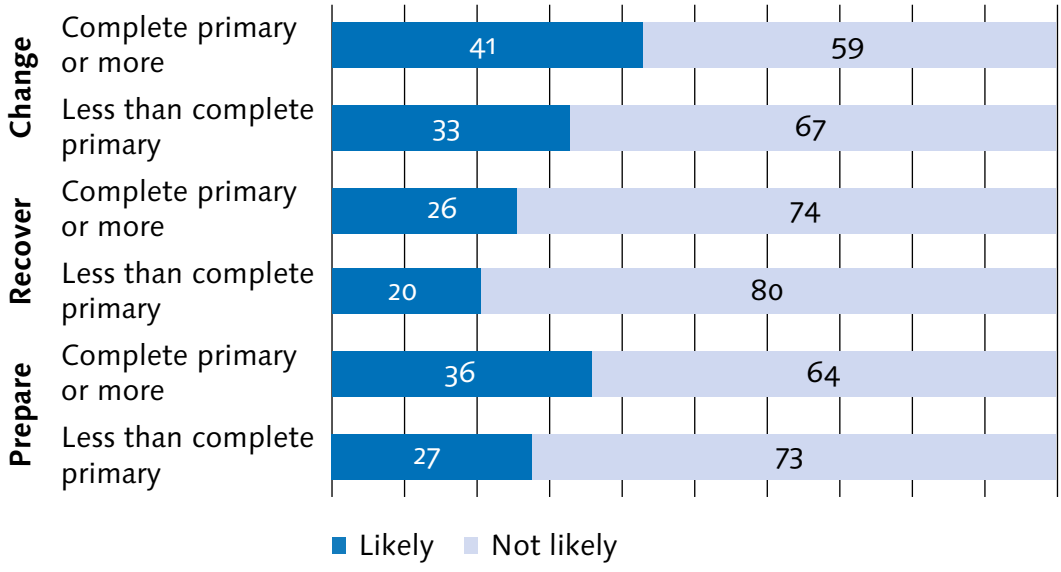
Figure 6: Rural/urban classification and resilience-related capacities



Note: Values may not equal 100 owing to rounding error.

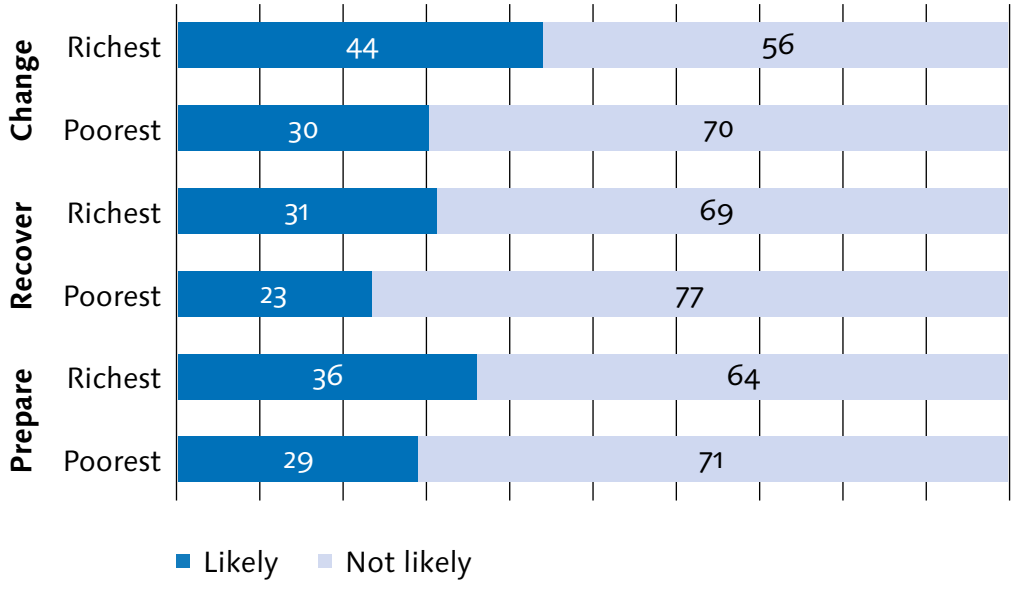
Education, too, is positively associated with the perceived capacity to recover from a flood but not with the capacity to be prepared or to adapt – on average (Figure 7). However, far fewer respondents with a higher education believed it was 'not at all likely' they would be prepared for or able to adapt to an extreme flood, relative to those with less education. Wealth quintile is not linked with perceived preparedness, but a higher share of respondents in wealthier quintiles reported that they could recover and change their livelihoods in response to an extreme flood event (Figure 8).

Figure 7: Level of education and resilience-related capacities



Note: Values may not equal 100 owing to rounding error.

Figure 8: Wealth quintile of respondents' households and resilience-related capacities

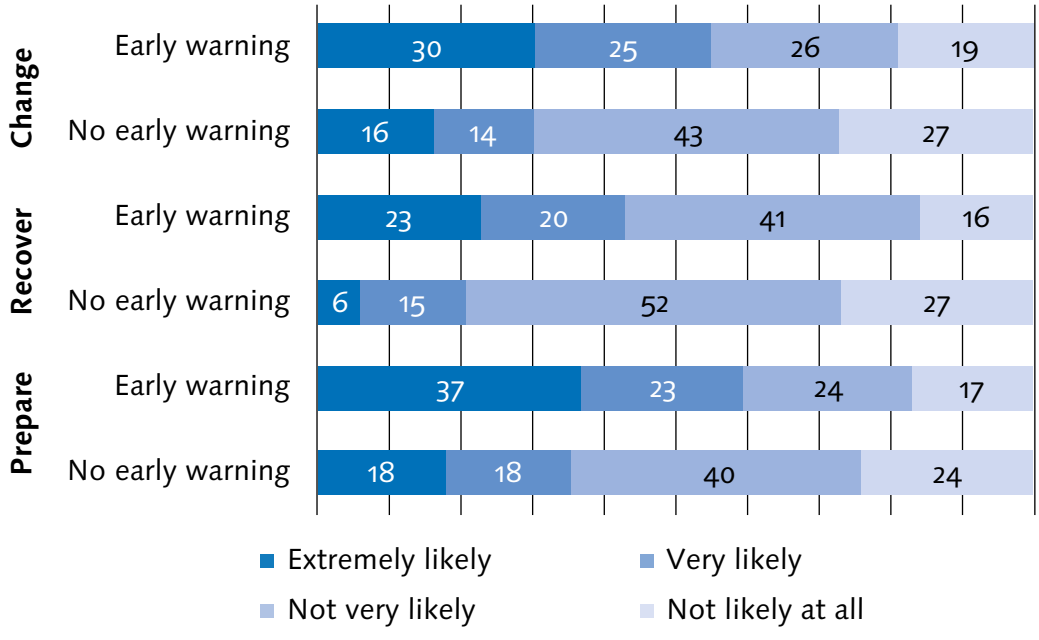


Note: Values may not equal 100 owing to rounding error.

Self-reported capacities differ more markedly in line with recent experience of flooding. Indeed, a higher share of those who had had an experience of extreme flooding in the two years prior to the survey reported that they would be likely or very likely to prepare and to recover (but not to change their livelihood). For example, one quarter of the population with recent flood exposure reported that it was 'not at all likely' they would be prepared for or recover fully from extreme flooding within a six-month period, compared with over a third (35–36%) of those who had not experienced a flood. This suggests either that perceptions may be more extreme than the reality or that floods have been experienced in areas where households have higher resilience-related capacities.

Having had early warning is consistently and strongly associated with all three capacities (Figure 9). For example, 45% of those with early warning of a previous flood reported that it was unlikely that they would be prepared for extreme flooding, compared with 70% of those who had not had such a warning. On capacity to recover, the figures were 57% and 79%, respectively, whereas on capacity to adapt they were 40% and 64%. In other words, the differences associated with early warning ranged between 22 and 25 points. It could be that respondents in more resilient households are more likely to obtain information regarding upcoming extreme weather events, or, conversely, that the receipt of such information improves household resilience (indeed, both mechanisms could be in play, or an unobserved trait could influence both aspects). But, given that the provision of early warning information is such an important policy lever, greater exploration of the hypothesis that making information about flooding available improves resilience-related capacities is warranted.

Figure 9: Relationship between early warning of an extreme flood in the previous two years and perceived capacity to prepare, recover and change



Note: Values may not equal 100 owing to rounding error.

Whether people perceive flooding as a serious problem or not is also positively related to perceptions of the capacity to prepare and to adapt – but this is more evident among those respondents who believe flooding poses a serious problem to their community (rather than household). For example, some 26% of the population who perceived flooding as a serious problem for their community reported it was 'extremely likely' they could adapt, compared with 17% of those who did not perceive it as a serious problem. This finding suggests policy efforts geared at raising awareness of the potential severity of flooding may be useful – though, again, the direction(s) of causality is unclear.

In addition, people may be undervaluing the potential severity of flooding to their household relative to their community – another finding that would merit further qualitative study.

5. MULTIVARIATE ANALYSIS

IMAGE:
CECILIA SCHUBERT

To understand better the factors associated with perceived capacity to be prepared for, recover from and adapt to extreme flooding, and how they relate to one another, we conducted a seemingly unrelated regression analysis using ordinal logistic models with the three capacities as the dependent variables. Across all the models, it is immediately apparent that the regressors have negligible explanatory power – explaining at most 2% of variation in these capacities.[18] Very few variables display a statistically significant association with any of the

18 It is not feasible to compute a measure of goodness of fit for the ordinal logit that takes into account complex sampling design in STATA. To give an indication of the fit, we compute the Pseudo R2 for unweighted specifications of these regressions, which yields values of about 2%.

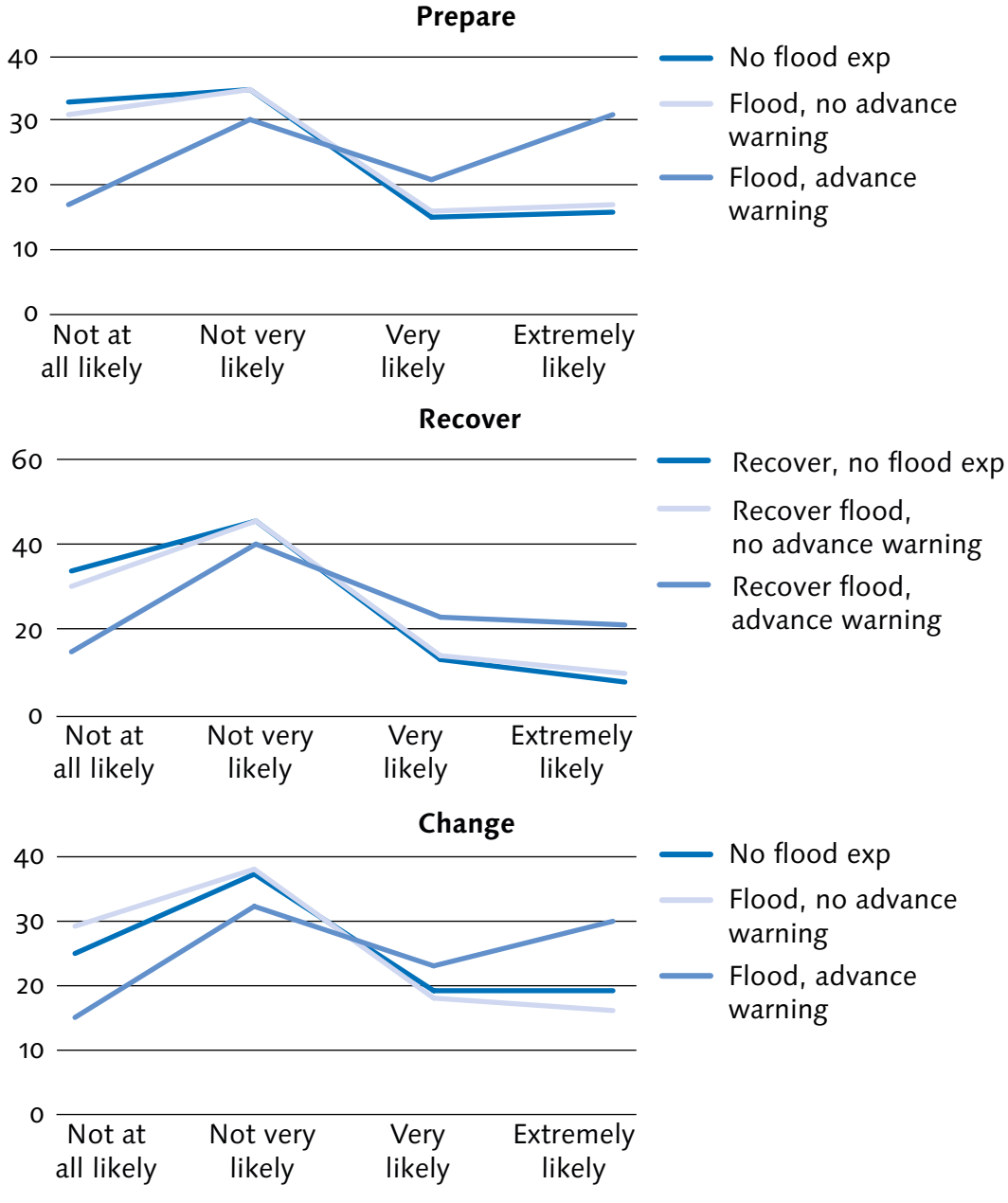
capacities – results should be interpreted accordingly and are reported simply for the sake of completeness (Table A.6).

Across all the regressions, the only consistent explanator is having had advance warning of a previous flood (occurring within the prior two years). In all the models, this was associated with lower reported capacities and the coefficients were strongly statistically significant. Examination of the marginal effects reveals the extent of these gaps (Figure 10). In all cases, predicted probabilities for respondents who had not experienced a flood or who had experienced a flood but did not know about it in advance were very similar (the differences were not statistically significant). Meanwhile, respondents who had had advance knowledge of a previous flood were more likely to report preparedness and the capacities to recover and adapt.

> "Across all the regressions, the only consistent explanator is having had advance warning of a previous flood"

Other positive (and statistically significant) relationships were found between having a higher education and both preparedness and capacity to recover; between household size and capacity to recover; and between wealth quintile and capacity to adapt. The effect of age is negatively associated with reporting preparedness until the age of 35 and positive thereafter. None of the covariates variables had an equivalent effect to having known about a previous flood, with the sole exception of being in the top wealth quintile on the perceived capacity to adapt.

Figure 10: Predicted probability of capacity to prepare, recover and adapt to an extreme flood event, based on early warning of that event



Note: Marginal effects computed on the basis of the separate ordinal logistic regressions.

6. DISCUSSION AND CONCLUSIONS

IMAGE:
DAVID DENNIS

In this paper, we have sought to contribute to a nascent body of literature on the measurement of resilience-related capacities. On the basis of a nationally representative survey of Tanzania, we have attempted to elicit some preliminary insights into the feasibility and suitability of subjective approaches to measuring resilience at the household level, and to point to future avenues for methodological development.

We initially speculated that subjective approaches might offer alternative or complementary approaches to capturing a more holistic understanding of resilience, enable cross-cultural comparison, and permit greater understanding of what factors people believe enhances their resilience. The instrument we used contained three key questions, one to capture each of

the core capacities that have emerged as widely accepted in previous work – the ability to prepare, to recover and to adapt to an extreme event. The focus was confined to extreme flooding because of its undoubted relevance (our results suggest one third of the population had experienced an extreme flood in the two years prior to the survey); in order to enable greater comparability across responses; and because respondents may be better able to assess their responses to sudden-onset shocks rather than more gradual events, such as drought. Moreover, to facilitate administration in the context of a household survey, we opted for close-ended questions and a simple four-item Likert response structure. The instrument has the advantage of simplicity – both in a focus on three core questions and in the response structures – rather than aspiring to a comprehensive treatment of a large number of potential facets of subjective resilience. It follows that the results can give only partial – albeit suggestive – insights into the value of this approach.

The chief finding is that low resilience-related capacities appear to be a concern in Tanzania, where most households reported limited capacities to be prepared for, respond to or change their livelihood strategies in response to an extreme flood. The scores across the three capacities were fairly similar – around one third of respondents felt they were likely to be prepared in the event of a flood, one quarter felt they could recover fully within six months and four in 10 felt they could change their livelihood if needed. It is surprising that more respondents felt able to change their livelihood strategies than to prepare for (and recover from) a flood. Further qualitative exploration would be useful to understand better why people feel relatively able to transform their income sources.

The correlations among responses to the three questions were positive but lower than expected (less than .5), reflecting

considerable diversity among households with respect to the three capacities. These moderate correlations (and the relatively low Cronbach's alpha of .6) also point to a lack of internal consistency – although principal components analysis showed that the three capacity variables loaded strongly onto a single factor. To better understand these three components, we treat them separately and defer the question of whether an index of resilience-related capacities could be useful. This is in line with much of the theoretical literature characterising household resilience to climate extremes (Cutter et al., 2009; O'Brien et al., 2004). What is interesting is that the subjective measures assessed through the survey, by and large, do not correlate well with the objective socioeconomic characteristics of respondents and their households that are typically assumed to indicate a lack of resilience – for example their age, education, occupation, wealth status and place of residence (e.g., see D'Errico and Di Giuseppe, 2014).

There are a number of areas worth considering. On the one hand, this could indicate that traditional objective characteristics do not have a strong influence on individuals' perceptions of their household's ability to prepare, recover from and adapt to climate risk. If shown to replicate in other areas and through different means, this could in turn cast doubt on the suitability of objective characteristics as effective measures of household resilience overall (Levine, 2014). On the other, a subjective approach to assessing household resilience may be a poor reflection of overall resilience: those with low resilience may perceive themselves to be more resilient than they are, and vice versa. Part of the difficulty in establishing which of these two positions is applicable is that there is no present means of validating one or the other. Given that there is no exact measure of household resilience, both objective and subjective measures are approximations

of a somewhat intangible, contextual and evolving concept. This is similar in many ways to difficulties faced in defining and measuring concepts such as well-being and happiness (Deeming, 2013). Additional considerations relate to the validity of the survey questions themselves and response structures, as well as the means of administering the survey by telephone (see Leo et al., 2015). Each may have affected the results of the survey and may explain a number of the counterintuitive findings. Further research will be needed to investigate in more detail and in other contexts, including cognitive testing of the questions themselves and of the response scales.

> "The results provide some confidence to the considerable investments that have gone into early warning systems as a means of supporting disaster risk reduction and resilience globally"

It is encouraging, nonetheless, that, where there are correlations between objective indicators and perceptions, these are of the expected sign and magnitude. In the multivariate analysis, again very few significant relationships are apparent and the goodness of fit of the models is negligible. Having advance knowledge (presumably through some form of early warning system) is strongly and consistently associated with the ability to prepare for, recover from and change one's livelihood in response to an extreme flood event, whereas believing flooding to be a problem is associated with the capacity to change one's livelihood if needed. The mechanisms are unclear and will warrant further exploration, but these variables suggest a potentially valuable policy lever to enhance resilience could be the widespread

provision of early warning and, to a lesser extent, raising awareness about the potential severity of extreme flooding. Most importantly, the results provide some confidence to the considerable investments that have gone into early warning systems as a means of supporting disaster risk reduction and resilience globally (Basher, 2006; Sorensen, 2000).

This research also draws attention to a more acute issue facing the study of resilience and resilience-related capacities – namely, the lack of a gold standard of what constitutes resilience against which attempts at its measurement could be triangulated. The concept is inherently an elusive one – given that it refers to complex interactions between individuals, households and their environments – so attempts at its measurement, be they objective or subjective, may necessarily offer only partial and imperfect insights. At the same time, we believe the potential insights offered by the subjective questions and the lack of correlation with the objective measures give a motivation for continuing to study both perspectives and to seek better understandings of how they relate to one another.

In this respect, the research suggests several promising avenues for future research:

1. Further testing of this instrument and of other efforts to measure perceptions of resilience, alongside objective indicators, is warranted. Ideally, the aim would be to test a battery of resilience-related questions, which could be reduced using statistical methods into a short scale of resilience-related capacities. Further qualitative work and surveys will be needed to reach this aim. In addition, research is needed to investigate the extent to which this and other instruments could provide cross-nationally comparable measures. Many of the ideas and principles

generated through this research will be further tested under research supported by the Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED) initiative. BRACED will adopt a similar approach of using mobile surveys conducted in post-disaster contexts to examine recovery and adaptation of households over time through a longitudinal study in Myanmar and other BRACED countries. It is hoped that this, along with other research related areas, can help us better understand the validity or subjective approaches to research measurement and compare (and potentially blend) them with traditional objective methods.

2. Big data offers another potentially important information source and may offer insights that will enable a better understanding of the nexus between environmental circumstances, and changes in those circumstances, and individual and household responses (Dumas and Letouze, 2015). This may provide a tangible third aspect against which to situate measures of resilience-related capacities that are grounded in individual and household measures, and against which to situate people's perceptions and their objective characteristics.

3. Investigating further how the mode of administration of household surveys, particularly those focused on capturing information about resilience, affects results. In this exercise, we opted for a call centre-based approach, for two reasons. Our first motivation was pragmatic: it was a cost-effective means of reaching a large number of respondents, and, as mentioned, we had the opportunity to append questions to a survey that was being fielded in the immediate aftermath of flooding across a number of regions in the country (Floodlist, 2015). Our second motivation was that the

mode appears suited to the need to collect information and respond rapidly to extreme weather events such as flooding with the aim of supporting people's resilience. Phone-based surveys, we suggest, have particular promise to measure aspects of resilience because they can be deployed very quickly and used to collect information frequently. However, to confirm that the approach is robust, we need to test such surveys more rigorously alongside traditional household surveys to evaluate whether and how responses are biased by the method of administration as well as more practical questions. For example: can we be sure the respondent to a longitudinal phone survey is always the same person? What are valid ways of constructing a representative sample using phone-based methods? To what extent does low coverage in some areas affect representativeness? In related work, we are also evaluating the potential use of SMS-based surveys to elicit valid responses, but this will represent yet another step that needs more rigorous evaluation.

In short, the research presented in this paper represents one of the first efforts to collect nationally representative data on subjective aspects of resilience – namely, perceptions of the capacity to prepare for, recover from and adapt to extreme flooding events. While the work we have presented suggests the approach we adopt is a potentially useful one, it is necessarily far from indicative or comprehensive at this stage. We have outlined a number of areas in which we aim to take this agenda forward.

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Appendix

Table A.1: Respondents' experience of flood in previous two years and whether they knew of it in advance

	N	NO FLOOD IN PREVIOUS 2 YEARS	FLOOD IN PREVIOUS 2 YEARS	N	OF WHICH, NO EARLY WARNING	OF WHICH, EARLY WARNING
Total	1,294	67.1	32.9	426	76.1	23.9
Gender of respondent						
Female	513	67.1	32.9	161	76.9	23.1
Male	781	67.1	32.9	257	75.5	24.5
Wilcoxon-Mann Whitney		*n.s.*			*n.s.*	
Occupation						
Not farming	442	65.4	34.6	153	72.5	27.5
Farming	852	68.0	32.0	273	78.0	22.0
Wilcoxon-Mann Whitney		*n.s.*			*n.s.*	
Place of residence						
Rural	868	67.4	32.6	283	77.7	22.3
Urban	426	66.4	33.6	43	72.7	27.3
Wilcoxon-Mann Whitney		*n.s.*			*n.s.*	
Education level						
No school	98	72.5	27.5	27	92.6	7.4
Some primary	152	67.8	32.2	49	79.6	20.4
Complete primary	822	65.6	34.4	283	76.3	23.7
Some secondary	35	57.1	42.9	15	40.0	60.0
Complete secondary	129	68.2	31.8	41	68.3	31.7
Higher/technical	51	82.5	17.5	9	88.9	11.1
Kruskal-Wallis H test		*x2(5)= 6.1, p= 0.102*			*x2(5)= 17.2, p= 0.004*	

Asset quintile						
Poorest	209	65.5	34.5	72	79.2	20.8
2	239	69.0	31.0	74	79.7	20.3
3	275	68.4	31.6	87	73.6	26.4
4	296	69.3	30.7	91	79.1	20.9
Richest	275	62.9	37.1	102	70.6	29.4
Kruskal-Wallis H test		*n.s.*			*n.s.*	
Perceived household severity						
Serious	1103	76.5	23.5	259	82.2	17.8
Not serious	177	12.4	87.6	155	69.9	30.0
Wilcoxon-Mann Whitney		*z=-16.9, p=.000*			*z=-3.9, p=.0001*	
Perceived community severity						
Serious	930	78.3	21.7	202	82.2	17.8
Not serious	348	38.8	61.2	213	69.9	30.0
Wilcoxon-Mann Whitney		*z=-13.4, p=.000*			*z=-2.9, p=.004*	

Table A.2a: Respondents' perceptions of flood severity among their households

HOUSEHOLD	N	MOST SERIOUS PROBLEM	SERIOUS PROBLEM AMONG MANY	MINOR PROBLEM	NOT A PROBLEM
Total	1,280	10.8	3.0	17.9	68.3
Gender of respondent					
Female	512	11.1	3.1	16.6	69.1
Male	768	10.5	3.0	18.7	67.7
Wilcoxon-Mann Whitney			*n.s.*		
Occupation					
Not farming	440	10.7	2.5	18.9	67.9
Farming	840	10.8	3.3	17.4	68.4
Wilcoxon-Mann Whitney			*n.s.*		
Place of residence					
Rural	859	10.9	2.9	17.1	69.0
Urban	421	10.4	3.3	19.5	66.7
Wilcoxon-Mann Whitney			*n.s.*		
Education level					
No school	98	13.3	1.0	20.4	65.3
Some primary	149	12.7	1.3	14.1	71.8
Complete primary	811	10.1	3.9	17.8	68.2
Some secondary	35	11.4	0	25.7	62.9
Complete secondary	129	12.4	2.3	20.2	65.1
Higher/technical	51	5.9	2.0	15.7	76.5
Kruskal-Wallis H test			*n.s.*		

Asset quintile					
Poorest	207	14.5	2.4	17.8	65.2
2	235	10.2	4.3	18.3	67.2
3	271	10.0	4.1	18.8	67.2
4	292	8.2	1.4	16.1	74.3
Richest	275	12.0	3.3	18.5	66.2
Kruskal-Wallis H test				*n.s.*	
Flood experience					
No flood in past 2 years	866	1.8	.69	12.0	85.4
Flood in past 2 years	414	29.5	8.0	30.2	32.4
Wilcoxon-Mann Whitney				*z=20.1, p=.000*	
Early warning of flood (among flood-exposed)					
No early warning	314	25.2	7.0	30.2	37.6
Early warning	100	43.0	11.0	30.0	16.0
Wilcoxon-Mann Whitney				*z=4.5, p=.000*	

Table A.2b: Respondents' perceptions of flood severity for their communities

COMMUNITY	N	MOST SERIOUS PROBLEM	SERIOUS PROBLEM AMONG MANY	MINOR PROBLEM	NOT A PROBLEM
Total	1,278	19.9	7.4	16.9	55.9
Gender of respondent					
Female	511	20.5	8.4	16.4	54.6
Male	767	19.4	6.6	17.2	56.7
Wilcoxon-Mann Whitney			*n.s.*		
Occupation					
Not farming	439	20.3	7.5	17.5	54.7
Farming	839	19.7	7.3	16.6	56.5
Wilcoxon-Mann Whitney			*n.s.*		
Place of residence					
Rural	857	19.4	7.0	17.0	56.6
Urban	421	20.9	8.1	16.6	54.4
Wilcoxon-Mann Whitney			*n.s.*		
Education level					
No school	98	22.4	13.3	14.3	50.0
Some primary	147	22.4	4.1	17.7	55.8
Complete primary	812	20.1	7.3	16.6	56.0
Some secondary	35	17.1	5.7	22.9	54.3
Complete secondary	129	19.4	5.4	21.7	53.5
Higher/technical	50	8.0	10.0	10.0	72.0
Kruskal-Wallis H test			*n.s.*		

Asset quintile					
Poorest	206	24.3	8.2	19.9	47.6
2	235	23.0	8.5	14.0	54.5
3	271	19.9	6.6	16.6	56.8
4	292	14.7	4.1	17.5	63.7
Richest	274	19.3	9.3	16.8	54.0
Kruskal-Wallis H test			*x2(4)= 15.6, p= 0.004*		
Flood experience					
No flood in past 2 years	863	10.9	4.7	11.4	73.0
Flood in past 2 years	415	38.5	12.8	28.4	20.2
Wilcoxon-Mann Whitney			*z=17.5, p=.000*		
Early warning of flood (among flood-exposed)					
No early warning	315	33.3	14.0	28.2	24.4
Early warning	100	55.0	9.0	29.0	7.0
Wilcoxon-Mann Whitney			*z=4.2, p=.000*		

Table A.3: Perceived capacity to be prepared for an extreme flood by respondent characteristics

	N	EXTREMELY LIKELY	VERY LIKELY	NOT VERY LIKELY	NOT AT ALL LIKELY
Total	1,294	17.0	16.2	34.7	32.2
Gender of respondent					
Female	513	16.4	16.8	35.5	31.4
Male	781	17.4	15.8	34.2	32.7
Wilcoxon-Mann Whitney			*n.s.*		
Occupation					
Not farming	442	16.1	18.6	34.8	30.5
Farming	852	17.5	14.9	34.6	33.0
Wilcoxon-Mann Whitney			*n.s.*		
Place of residence					
Rural	868	16.8	15.3	36.8	31.1
Urban	426	17.4	17.8	30.5	34.3
Wilcoxon-Mann Whitney			*n.s.*		
Education level					
No school	98	14.3	10.2	41.8	33.7
Some primary	152	14.5	15.1	36.8	33.6
Complete primary	822	17.5	17.3	32.9	32.4
Some secondary	35	8.6	22.9	31.4	37.1
Complete secondary school	129	17.8	15.5	34.1	32.6
Higher/technical	51	25.5	11.8	47.1	15.7
Kruskal-Wallis H test			*n.s.*		

Asset quintile					
Poorest	209	13.4	13.4	35.9	37.3
2.0	239	21.3	12.6	33.5	32.6
3.0	275	15.6	19.3	32.7	32.4
4.0	296	16.2	16.6	37.5	29.7
Richest	275	18.2	17.8	33.8	30.2
Kruskal-Wallis H test			*n.s.*		
Flood experience					
No flood in past 2 years	868	16.9	15.7	32.1	35.3
Flood in past 2 years	426	17.1	17.1	39.9	25.8
Wilcoxon-Mann Whitney			*z=2.2, p=.027*		
Early warning of flood (among flood-exposed)					
No early warning	324	15.4	14.8	42.6	27.2
Early warning	102	22.6	24.5	31.4	21.6
Wilcoxon-Mann Whitney			*z=-2.5, p=.012*		
Perceived severity of flooding to household					
Not serious	1103	16.4	16.0	35.2	32.5
Serious	177	19.8	16.4	34.5	29.4
Wilcoxon-Mann Whitney			*n.s.*		
Perceived severity of flooding to community					
Not serious	930	14.4	17.1	35.6	32.9
Serious	348	23.6	12.6	33.6	30.2
Wilcoxon-Mann Whitney			*z=2.1, p=.037*		

Table A.4: Perceived capacity to be recover fully from an extreme flood by respondent characteristics

	N	EXTREMELY LIKELY	VERY LIKELY	NOT VERY LIKELY	NOT AT ALL LIKELY
Total	1,294	9.7	14.0	43.1	33.2
Gender of respondent					
Female	513	9.2	13.7	43.5	33.7
Male	781	10.0	14.2	42.9	32.9
Wilcoxon-Mann Whitney			*n.s.*		
Occupation					
Not farming	442	14.0	14.0	43.2	28.7
Farming	852	7.4	14.0	43.1	35.6
Wilcoxon-Mann Whitney			*z=-3.3, p=.001*		
Place of residence					
Rural	868	7.3	13.0	44.9	34.8
Urban	426	14.6	16.0	39.4	30.1
Wilcoxon-Mann Whitney			*z=3.5, p=.000*		
Education level					
No school	98	4.1	12.2	50.0	33.7
Some primary	152	11.2	13.2	50.0	25.7
Complete primary	822	9.1	13.9	39.9	37.1
Some secondary	35	5.7	17.1	37.1	40.0
Complete secondary	129	15.5	12.4	48.1	24.0
Higher/technical	51	11.8	21.6	54.9	11.8
Kruskal-Wallis H test			*x2(5)= 18.6, p= 0.001*		

Asset quintile					
Poorest	209	6.7	14.8	45.0	33.5
2	239	8.0	12.6	46.4	33.1
3	275	5.8	13.8	42.9	37.5
4	296	11.2	13.9	41.2	33.8
Richest	275	15.6	14.9	41.1	28.4
Kruskal-Wallis H test			*x2(4)= 12.3, p= 0.015*		
Flood experience					
No flood in past 2 years	868	10.0	13.6	39.5	36.9
Flood in past 2 years	426	8.9	14.8	50.5	25.8
Wilcoxon-Mann Whitney			*z=2.6, p=.010*		
Early warning of flood (among flood-exposed)					
No early warning	324	6.8	13.6	51.5	28.1
Early warning	102	15.7	18.6	47.1	18.6
Wilcoxon-Mann Whitney			*z=3.0, p=.002*		
Perceived severity of flooding to household					
Not serious	1103	9.5	13.9	42.1	34.5
Serious	177	9.6	13.6	50.9	26.0
Wilcoxon-Mann Whitney			*n.s.*		
Perceived severity of flooding to community					
Not serious	930	10.1	12.9	41.7	35.3
Serious	348	7.8	16.1	47.7	28.5
Wilcoxon-Mann Whitney			*n.s.*		

Table A.5: Perceived capacity to change livelihood strategy by respondent characteristic

	N	EXTREMELY LIKELY	VERY LIKELY	NOT VERY LIKELY	NOT AT ALL LIKELY
Total	1,294	9.7	14.0	43.1	33.2
Gender of respondent					
Female	513	9.2	13.7	43.5	33.7
Male	781	10.0	14.2	42.9	32.9
Wilcoxon-Mann Whitney			*n.s.*		
Occupation					
Not farming	442	14.0	14.0	43.2	28.7
Farming	852	7.4	14.0	43.1	35.6
Wilcoxon-Mann Whitney			*n.s.*		
Place of residence					
Rural	868	7.3	13.0	44.9	34.8
Urban	426	14.6	16.0	39.4	30.1
Wilcoxon-Mann Whitney			*n.s.*		
Education level					
No school	98	4.1	12.2	50.0	33.7
Some primary	152	11.2	13.2	50.0	25.7
Complete primary	822	9.1	13.9	39.9	37.1
Some secondary	35	5.7	17.1	37.1	40.0
Complete secondary	129	15.5	12.4	48.1	24.0
Higher/technical	51	11.8	21.6	54.9	11.8
Kruskal-Wallis H test			*n.s.*		

Asset quintile					
Poorest	209	6.7	14.8	45.0	33.5
2	239	8.0	12.6	46.4	33.1
3	275	5.8	13.8	42.9	37.5
4	296	11.2	13.9	41.2	33.8
Richest	275	15.6	14.9	41.1	28.4
Kruskal-Wallis H test			*x2(4)= 14.3, p= 0.006*		
Flood experience					
No flood in past 2 years	868	10.0	13.6	39.5	36.9
Flood in past 2 years	426	8.9	14.8	50.5	25.8
Wilcoxon-Mann Whitney			*z=2.0, p=.041*		
Early warning of flood (among flood-exposed)					
No early warning	324	6.8	13.6	51.5	28.1
Early warning	102	15.7	18.6	47.1	18.6
Wilcoxon-Mann Whitney			*z=3.7, p=.000*		
Perceived severity of flooding to household					
Not serious	1103	9.5	13.9	42.1	34.5
Serious	177	9.6	13.6	50.9	26.0
Wilcoxon-Mann Whitney			*z=1.9, p=.054*		
Perceived severity of flooding to community					
Not serious	930	10.1	12.9	41.7	35.3
Serious	348	7.8	16.1	47.7	28.5
Wilcoxon-Mann Whitney			*z=4.9, p=.000*		

Table A.6: Seemingly unrelated ordinal logit regressions on resilience-related capacities

	PREPARE			RECOVER			CHANGE		
	coeff.	s.e.		coeff.	s.e.		coeff.	s.e.	
Age	-0.04178	0.022877	*	0.008188	0.029356		0.023346	0.023275	
Age*age	0.000591	0.000251	**	-5.7E-05	0.000332		-0.00025	0.000262	
HH size	-0.02154	0.029596		0.057243	0.030101	*	-0.01139	0.025702	
Gender of respondent (0=Female)									
Male	-0.21288	0.136759		-0.08906	0.138948		0.031399	0.117012	
Education (0=No schooling)									
Some primary	-0.10105	0.254595		0.325443	0.251784		-0.01077	0.268081	
Complete primary	0.283689	0.208586		0.068452	0.22027		0.172616	0.222544	
Some secondary	-0.2171	0.365452		-0.20937	0.435185		-0.28874	0.399968	
Complete secondary	0.18981	0.297669		0.446112	0.310883		0.312827	0.294242	
Higher/technical	0.618664	0.32281	*	0.790097	0.330437	**	-0.22091	0.385306	
Occupation (0=Not farmer)									
Farmer	0.015496	0.159584		-0.19584	0.158581		0.023046	0.163823	
Residence (0=Rural)									
Urban	-0.14879	0.177868		0.233246	0.193552		-0.01206	0.15358	
Asset quintile (0=Poorest)									
2	0.274711	0.197128		-0.00812	0.19168		0.318369	0.170953	*
3	0.294673	0.194847		-0.23765	0.205879		0.386612	0.185554	**
4	0.259757	0.199634		-0.0027	0.216596		0.471904	0.203927	**
5	0.236234	0.273183		-0.14113	0.280719		0.622743	0.237072	***

Early warning of last flood (0=No flood experience)									
No	0.089287	0.141337		0.175426	0.127271		-0.17358	0.131181	
Yes	0.878122	0.255168	***	1.098366	0.251372	***	0.610098	0.219203	***
Believes flooding serious problem for community (0=Not problematic)									
Serious	0.069486	0.161157		-0.04985	0.143167		0.508353	0.14222	***
N	1,271								
Prob>F	0.030			0.001			0.000		

BRACED aims to build the resilience of more than 5 million vulnerable people against climate extremes and disasters. It does so through a three year, UK Government funded programme, which supports 108 organisations, working in 15 consortiums, across 13 countries in East Africa, the Sahel and Southeast Asia. Uniquely, BRACED also has a Knowledge Manager consortium.

The Knowledge Manager consortium is led by the Overseas Development Institute and includes the Red Cross Red Crescent Climate Centre, the Asian Disaster Preparedness Centre, ENDA Energie, ITAD, Thompson Reuters Foundation and the University of Nairobi.

The BRACED Knowledge Manager generates evidence and learning on resilience and adaptation in partnership with the BRACED projects and the wider resilience community. It gathers robust evidence of what works to strengthen resilience to climate extremes and disasters, and initiates and supports processes to ensure that evidence is put into use in policy and programmes. The Knowledge Manager also fosters partnerships to amplify the impact of new evidence and learning, in order to significantly improve levels of resilience in poor and vulnerable countries and communities around the world.

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