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Resilience Evaluation, Analysis and Learning

RESILIENCE MEASUREMENT PRACTICAL GUIDANCE NOTE SERIES | 2

Measuring Shocks and Stresses

About the Resilience Evaluation, Analysis and Learning (REAL) Associate Award:

REAL is a consortium-led effort funded by the USAID Center for Resilience. It was established to respond to growing demand among USAID Missions, host governments, implementing organizations, and other key stakeholders for rigorous, yet practical, monitoring, evaluation, strategic analysis, and capacity building support. Led by Save the Children, REAL draws on the expertise of its partners: Food for the Hungry, Mercy Corps, and TANGO International.

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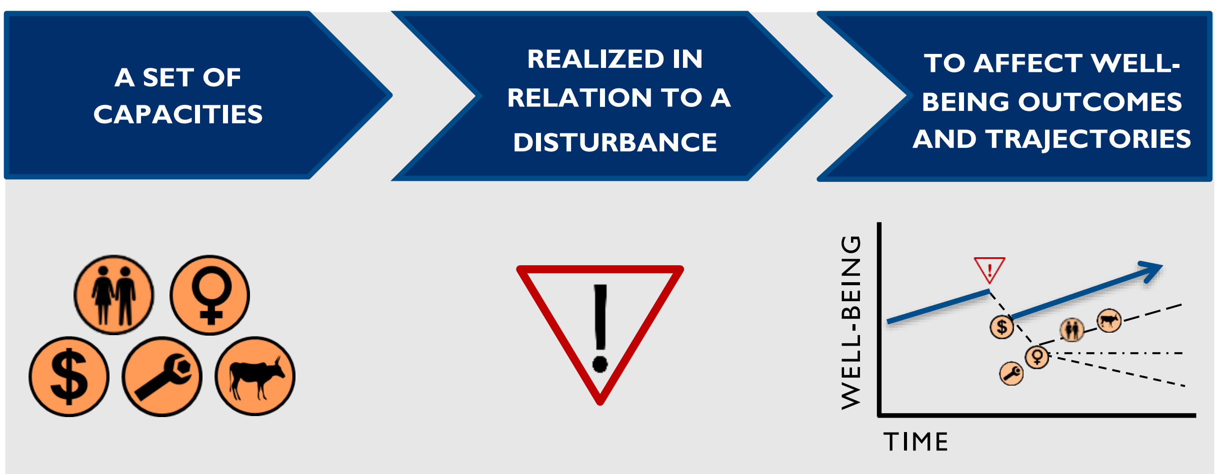
1. Introduction

The first guidance note from USAID's *Resilience Measurement Practical Guidance Note Series* introduced resilience assessments and when, why and how to conduct them. The second guidance note in this series builds on the first by describing how to measure and analyze shocks and stresses.

Investing resources in resilience building requires earnest efforts in resilience measurement and analysis, and an indispensable component of resilience measurement is shock measurement. Incorporating shock measurement into monitoring and evaluation frameworks serves two purposes. The first is to gain conceptual understanding of the complex relationships between disturbances, critical capacities and wellbeing to better design and evaluate initiatives focused on building resilience. The second is related to the fact that shocks and stresses pose significant operational threats to development gains.

Figure 1 below presents the simplified resilience measurement framework introduced in the first guidance note. Central to this framework is the measurement of a disturbance, or shock/stress. This guidance note adopts the definitions for shocks and stresses outlined in Choularton et. al. 2015.[1] ***Shocks*** are "external short-term deviations from long term trends that have substantial negative effects on people's current state of well-being, level of assets, livelihoods, safety or their ability to withstand future shocks". Shocks can be slow-onset like drought, or relatively rapid onset like flooding, disease outbreak, or market fluctuations. ***Stresses*** are "long-term trends or pressures that undermine the stability of a system and increase vulnerability within it". Stresses could include factors such as population pressure, climate variability, chronic poverty, persistent discrimination, and protracted crises like intergroup conflict.

Figure 1: Simplified Resilience Measurement Framework.



[1] Refer to *Practical Guidance Note Series Key Terminology Companion Guide* for full definitions of key terms

Figure I, adapted from Mercy Corps' resilience framework, illustrates how resilience capacities, when measured in connection with a shock or stress, can help us understand programs' impacts upon development and well-being outcomes.[2]

Understanding the impacts of shocks and stresses on individuals, households, communities and the systems they live in provides some direction on what data to collect and when. In general, we would like to understand how household and community response evolves over time, whether household or community resilience has been eroded by repeated events and whether the negative effects are compounded by multiple, intersecting shocks/stresses. These data are useful throughout the project cycle, including informing a resilience assessment for project design, targeting emergency and/or development interventions, monitoring and evaluating projects, and testing key assumptions about resilience.

1.1. Learning Objectives

This guidance note will enable users to:

- Define and describe key characteristics of the shocks and stresses affecting their program context, like scale, severity, frequency, etc.
- Identify and understand key indicators, data sources, and when and how to collect these data to suit various needs and constraints
- Have a basic understanding of analytical approaches to shock measurement, describe their purposes and how they may be incorporated into broader resilience analyses and project management.

2. Characteristics of Shocks and Stresses

Before discussing how to measure shocks and stresses, it is helpful to review commonly used terms that describe these events that are critical to define and distinguish the phenomenon.[3]

2.1. Types of Shocks and Stresses

Shocks and stresses are commonly thought of in terms of their source or types, such as natural or "man-made". This section provides some common shocks, and how they might be categorized. However, it is important to remember that these events usually do not occur in isolation and are often combined with and compounded by other shocks (see Section 2.3 below). While it is important to be able to understand the type of shock or stress, it is equally important to understand the complex relationships between shocks and stresses that may occur (see Karamoja

[2] Adapted Mercy Corps' Resilience Framework presented in: *Our Resilience Approach to relief, recovery and development.* Mercy Corps. (2016).

[3] There is a wide variety of terminology and definitions of shocks, stresses and their respective characteristics, the nuances of which are beyond the scope of this document. Commonly used definitions are identified in this section, and where available, additional references for further review are provided.

Development Vision from Guidance Note 1[4]). The table below provides some examples of common types of shocks and stresses experienced.[5]

Table 1: Common shocks and stresses

Geophysical/Meteorological	Human induced
• Typhoons/hurricanes/cyclones • Tornadoes • Severe thunderstorms • Flooding • Earthquakes • Tsunamis • Landslides • Volcanoes • Heat/cold waves • Drought • Wildfires (naturally occurring) • Climate variability • Land degradation	• Terrorism • Conflict • Gender-based violence • Coups • Crime/ violence • Fire • Social exclusion/ discrimination • Market failures • Population pressure • Extreme poverty • Irregular migration • Land/soil degradation
Biological	**Technological**
• HIV/AIDS • Vector borne diseases (dengue, influenza, malaria, etc.) • Hepatitis • Cholera • Avian Influenza • Ebola • SARS	• Toxic spills • Dam failure • Nuclear disaster • Grid failure

Fragility as a stress

While disagreement persists on a precise definition of fragility, most include some reference to functionality of institutions and presence of conflict (Ferreira 2015). Regardless of the definition, fragile states characterized by weak institutions, extreme poverty, political instability, poor infrastructure, and limited service provision perpetuate a persistently risky environment. Fragile states simultaneously expose populations to various shocks (e.g. violence) and compound the effects of other shocks. While the current famine in Somalia is a complex confluence of factors, an admittedly over simplified analysis reveals how chronic fragility exacerbated the effects of drought to create a dire humanitarian emergency. In contexts like this, it is not sufficient to respond to humanitarian crises without investing in longer term development that enhances resilience and mitigates the risk posed by conflict and other shocks that are particularly devastating in fragile states.

[4] Vaughan, E. and Henly-Shepard, S. (2018)
[5] Adapted from Shimizu and Clark (2015)

2.2. Scale and Duration

Often shocks and stresses are described as covariate or idiosyncratic – these terms refer to the amount or extent of people affected as one measure of scale. ***Covariate*** events directly affect large numbers of people in a given geographic area, while ***idiosyncratic*** events affect specific individuals or households within a community. It is important to note that covariate shocks, even though experienced by most people within a community, may still be highly localized. Drought, for example, may leave neighboring communities relatively unaffected, even if they are located relatively close to each other.

Shocks are usually (but not always) ***acute*** (rapid onset, typically short duration) events, while stresses usually (but not always) described as ***chronic*** (slow onset, typically protracted duration), which refers to the onset and duration of the event. Acute shocks and stresses occur rapidly at one point in time, whereas chronic shocks and stresses occur over relatively longer periods of time – note that this definition is limited to the event itself and not the effects, which usually persist long after the shock or stress.

The distinctions within both of these characteristics regarding scale and duration of shocks and stresses are subjective and, conceptually, significant gray areas exist. For example, at what point does an idiosyncratic shock become covariate? Or acute shocks become a protracted stress? In practice the differences will vary by event and context, and are generally easily distinguished. These characteristics may or may not be constant for a given shock/stress. For example, drought tends to be covariate, but wildfire may be idiosyncratic or covariate. Similarly, earthquakes will always be acute, while conflict may be either acute or chronic. The figure below provides common shocks/stresses arranged on these two axes – note that if an event can assume either characteristic, it is included in both.

Figure 2: Examples of covariate/idiosyncratic and acute/chronic shocks and stresses

	Idiosyncratic	**Covariate**
Acute	• Death of a family member • Pest infestation • Illness • Loss of job • Gender based violence • Social exclusion/ discrimination • Crime/ violence • Theft	• Flood • Earthquake • Cyclone/typhoon/hurricane • Tsunami • Dry spells/erratic rain • Market shock (price volatility) • Pest outbreak • Disease outbreak • Irregular migration

	Idiosyncratic	Covariate
Chronic	• Gender based violence • Social exclusion/ discrimination • Crime/ violence • Theft • Illnesses such as HIV/AIDS	• Drought • Inter-group conflict • Population pressure • Climate change/variability • Extreme poverty • Land degradation • Irregular migration

2.3. Complex Interactions

When these systems are affected by a shock or stress, which are themselves complex, it is difficult to anticipate the multitude of effects an event is likely to have and in many cases these are only recognized in hindsight (Shimizu and Clark 2015). Nevertheless any program or investment focused on building resilience should identify possible scenarios and measurement options, ideally through a comprehensive resilience assessment as described in the first guidance note of this series.

Describing the nuances of the complex interactions of the multitude of shocks and stresses that affect households and communities at any given time quickly becomes complicated. For our purposes it is useful to think about events as *coinciding* or *successive.*[6] *Coinciding* events occur at the same time, while *successive* events occur consecutively – in either case, the combined impact of the adverse events will almost certainly be compounded. In addition, events may be categorized as ***independent*** or ***inter-dependent***. ***Independent*** events are completely unrelated while ***interdependent*** events occur when a series of events is triggered as the result of a single event or confluence of events. Drought for example can trigger widespread and varied events; reduced crop and livestock production can result in agricultural market volatility, increased migration and potentially conflict over natural resources, deteriorated soil quality, and wildfires.

Understanding this complexity is critical for analyzing whether household/community resilience has been eroded by repeated independent/inter-dependent events and whether the negative effects are compounded by multiple, intersecting shocks/stresses. In order to answer these types of questions, it is important to know the sequence/coincidence of events and whether they are cascading – i.e. are there knock-on, compounding effects that are affecting households within and beyond the area affected by the triggering event.

[6] See Gamper, C. (2014) and Shimizu, M. & Clark, A. L. (2015) for in-depth discussion of concepts and terminology

3. Measuring shocks

The process of measuring shocks can be categorized into three adaptable steps, summarized below and described in detail in the sections that follow:

- **Step 1**: Document the basics about the population of interest (demographics, livelihood strategies, capacities, wellbeing, etc.), context, and relevant shocks and stresses
- **Step 2**: Plan for data collection by identifying what, when/how frequently and how to measure shocks
- **Step 3**: Analyze data to either gain a descriptive understanding of the context or to make inferences about the resilience dynamics in the population of interest

3.1. Step 1: Documenting the Basics

The first step in measuring shocks and stresses is to understand the context. This means defining and describing:

- the overall purpose of measuring shocks/stresses, i.e. assessment, emergency response, research, or evaluation
- the population(s) of interest and their political, social, and economic context
- the relevant shocks/stresses for this context in more detail (including interactions, underlying causes, etc.), using the concepts and terms introduced in section two above

These definitions and descriptions will directly translate into which data you collect, when/how frequently, and how these data will be collected. If a risk and resilience assessment has been conducted, like the kind described in the first guidance note in this series, this step is likely already completed. If no assessment has been conducted, it is strongly recommended to first consider conducting one – even the least resource intensive assessment will provide valuable insight into what shocks and stresses to measure.

If it is truly impossible to conduct a resilience assessment, the next best option is to rely on secondary data and expert opinion. Typically there is a government ministry tasked with producing a national risk assessments that will provide insight into major shocks and stresses (hazards, risks, etc.) affecting the country, often disaggregated at a sub-national level. Once these shocks/stresses have been identified, in depth descriptions of their characteristics and how they affect communities can be developed in partnership with government, donor, NGO, or community stakeholders. At this point in the process, the list of shocks and stresses may be long. The following steps will help define whether, when, and how frequently to collect data, providing considerations for low, medium, and high resource settings.

3.1.1. Key Outputs

The key outputs of this step include:

- A well-defined context and population of interest, including the ecological, social, political and economic context
- A descriptive list of commonly experienced shocks and stresses, any interactions that may exist and key drivers/impacts

3.2. Step 2: Plan for Data Collection

This section outlines key considerations for what, when and how to collect shock data. A key takeaway is that there are many ways of measuring shocks, none of which are unambiguously "correct" – they each reveal a different aspect of the complex nature of a given shock/stress, or combination thereof.

These rules of thumb are explored in depth in the following section. When reading this section, it is helpful to refer to Annex I which provides a table of various possible indicators and data sources and serves as a resource for future shock measurement efforts. Note that it is not exhaustive however, and should be contextualized.

Rules of thumb when measuring shocks

- Have a clear vision of what shocks to focus on, population (and constituent sub-populations) of interest, and ecological, social, political, and economic context
- As much as possible, use multiple, diverse measures of the same phenomenon and triangulating the results, will provide a more accurate picture of the reality on the ground
- As demonstrated in the previous section, shocks and people's responses evolve over time. Having multiple rounds of data collection captures this dynamic
- It is not enough to know whether or not a shock has been experienced – there needs to be some measure of the severity of the shock, which usually involves comparison to the "norm"

3.2.1. Primary and Secondary Data

In many cases, resilience analyses integrate both primary and secondary data to incorporate multiple dimensions and scales. Secondary data is often (but not always) objective in nature while primary data tends to be more subjective, features which are discussed in the next section.

Primary data is usually based on household or community questionnaires (quantitative and qualitative) asking about shocks experienced, degree of severity, coping, recovery, etc. The major benefits of primary data include:

- flexibility to include a wide variety of relevant indicators
- control of the timing and frequency of the data collection such that data are gathered at the right time after a shock/stress and at the right frequency if using recurrent monitoring (discussed further in section 3.2.3 below)

- greater control over the sampling strategy, such that data can be representative at the desired administrative level (e.g. project catchment area, district or state level) or for desired sub-groups (e.g. female headed households, ethnic groups, etc.)

Secondary data, or data collected by governments, donors, academics, and multi-lateral organizations, has become increasingly publically available and in some cases include relevant shock/stress, wellbeing and/or capacity data. The major benefits of secondary data include:

- significantly reduced data collection costs
- enables access to data that is otherwise difficult to collect (e.g. remote sensing data)
- often provides both a historical record of trends
- relatively high frequency data that can be used for real time monitoring (data dependent)

Secondary data was critical for shock measurement in Nepal post-earthquake in 2015 and in the Philippines post-typhoon in 2013. Mercy Corps leveraged the Nepal Earthquake Severity Index, a composite indicator that measures earthquake intensity, population, and vulnerability, as a measure of shock exposure to analyze how households coped and recovered from the earthquake (Petryniak, Kurtz and Frischknecht 2015). Similarly, Mercy Corps used typhoon severity measures based on storm surge, proximity, population and vulnerability to evaluate the importance of financial services for disaster resilience (Hudner and Kurtz 2015). These secondary measures provided relevant and meaningful data that complemented primary data well. Choosing the appropriate secondary measure can be challenging and is explored in the following text box.

Using secondary data to measure drought[7]

Drought is a complex phenomenon and there exist numerous measures and indices, each measuring different types and aspects of drought. For example, there is the:

- Standardized precipitation index (SPI)
- % of normal precipitation
- Soil moisture index
- Palmer drought severity index (PDSI)
- Normalized difference vegetation index (NDVI)

To name just a few - so how does one select the "right" measure? The first step is to be clear about what the indicator is measuring, and at what time scale. For agricultural drought for example, NDVI or soil moisture may be more appropriate, while for hydrological drought, percent of normal precipitation is more appropriate. Often these measures are highly correlated with one another, so exploratory analyses of the data may show that the differences are moot. Finally, it is possible to use different measures in multiple models to capture a fuller picture or determine the most appropriate measure.

[7] For an example, see Smith et. al. (2014) and Frankenberger, Smith and Griffin (2017)

However, secondary data does not always have the right information, at the right time or at the right location/level. Where secondary data does not meet these criteria, primary data may need to be collected as a substitute.

Linking primary household data to secondary remote sensing data

There is little literature on combining household survey data with secondary shock data, but there are examples from other disciplines to draw on, including ecology, agricultural economics and public health. Key considerations include:

- In order to link primary with secondary data, both need to have GPS coordinates (i.e. latitude and longitude) for the specific household
- Multiple "coordinate systems" exist – i.e. there are different approaches to measuring latitude and longitude. In order to integrate the data sets, both must use the same coordinate system, a process that is easy to ensure in any mapping software
- Remote sensing data must be at the right spatial and temporal scale. Spatially the data should be high enough resolution to be meaningful at the community level. Temporally, the data must be frequent enough to be useful for real time monitoring (see Section 3.2.3 below), and cover a long enough time period (generally 30 years) to establish norms.
- Collecting location data of respondents introduces confidentiality issues that must be addressed through appropriate encryption and data management protocols, and may involve randomly off-setting the household location data within a 2-5 km radius.

3.2.2. Objective versus Subjective Measures

Measuring resilience often relies on both ***objective*** and ***subjective*** measures. ***Objective measures*** are directly observable measurements of a shock including for example rainfall data, wind speed, seismic activity, national and community early warning system data (in some cases), food price shocks, infrastructure/assets destroyed etc. These measures tend to be standardized and are widely applicable – for example – rainfall deviation from norm is a consistently meaningful measure across all contexts.

Individuals, households and communities experience shocks and stresses differently - ***subjective measures*** capture these unique perceptions and experiences of the respondents and are therefore highly context-specific and may not be relevant in other locations. These measures generally rely on self-reported quantitative and qualitative survey data and are less standardized, but tend to focus on events experienced, perceived severity, ability to recover, coping strategies, etc.

Subjective measures can be used as substitutes for objective measures when no objective measures exist for a specified shock or they can be used as complements to objective measures to provide an alternative perspective. Regardless of whether subjective measures are used in combination with or instead of objective measures, subjective measures are fundamentally different in that they capture the unique personal experience and perception and provide insight into subsequent behavior.

For example a given shock may be minor according to objective measures, but it might be the worst a household has experienced – either because they have limited experience with the shock or were particularly vulnerable to the effects of the shock for any number of reasons. Neither measure is wrong and both need to be taken into consideration during analysis.

Subjective measurements for capturing gender dimensions

A substantial evidence base has been amassed that indicates that men and women respond to and are affected by shocks differently.[8] Coping strategies are beyond the scope of this guidance note, but understanding the gender dimensions of shocks is important. Fundamentally men and women face different risks; women face health and nutrition risks associated with menstruation, pregnancy, and lactation and other risks associated with early marriage and risky sexual behavior in their adolescence[9]. Not only do women face different risks – they are also affected differently by the same risks. For example, women were significantly less likely to survive the 2004 tsunami, and natural disasters in general were found to lower women's life expectancies more than men according to a review of 141 countries from 1981-2002[10].

Capturing these gender dynamics is essential for shock measurement and requires not only comparing male and female-headed households, but also capturing intra-household dynamics of what/how shocks are experienced and responded to. The gender dimension provides a clear example of a broader concept - having a nuanced understanding of what shocks affect individuals and in what way allows for a more sophisticated resilience analysis. This requires:

- Capturing a variety of relevant idiosyncratic shocks
- Employing subjective measures
- Collecting individual level data, e.g. asking which household members were affected by a given shock and how, to capture intra-household dynamics[11]

3.2.3. Defining Level, Timing, and Frequency of Data Collection

It is important to measure shocks and stresses at different levels including ***macro*** (regional or national) or ***micro*** (individual, households and communities) levels. This is important for at least three reasons:

1. Shocks and stresses can affect individuals, households, communities, countries and regions differently
2. Certain shocks and stresses are best measured at a specific level – e.g. remote sensing data is particularly useful for covariate climatic shocks while individual and household level is uniquely suited to capture idiosyncratic shocks

[8] For a brief review of the literature, refer to Kumar and Quisumbing (2014)

[9] Kumar and Quisumbing (2014)

[10] Frankenberg et. al. (2011), Neumayer and Plumper (2007)

[11] Heltberg, Oviedo and Talukdar (2015)

3. Data from different levels may have different uses – e.g. national level data may be better for targeting response, while household data may be more useful for research and evaluation

For each level of analysis (micro or macro) an appropriate data source should be selected. The table below provides some examples of different types of data sources and the respective levels of analysis. This list is not exhaustive and should be refined for specific contexts.

Table 2: Data sources for various levels of analysis

Regional/National	Household/Community	Individual
• Integrated Phase Classification (IPC) • Famine Early Warning Systems Network (FEWSNET) • Armed Conflict Location and Event Data Project (ACLED) • FAO's Global Information and Early Warning System (GIEWS) • WFP's Global Food Security Update • Agricultural Market Information System • African Flood and Drought Monitor (AFDM) • National Early Warning Systems • National disease surveillance systems • WHO disease outbreak news • International Crime and Victimization Survey (ICVS) • Demographic and Health Surveys (DHS) • UN Survey on Crime Trends (UN CTS)	• Emergency Market Mapping and Analysis • Community early warning systems • Community health surveillance systems • Household quantitative surveys • Community quantitative surveys • Key informant interviews • Focus group discussions	• Household quantitative surveys • Key informant interviews • Focus group discussions

Infectious disease surveillance

There are limited examples to draw on that use human or animal disease surveillance as a major shock measure in resilience analysis. Disease however, both idiosyncratic cases and covariate epidemics, is often found in conjunction with other shocks and stresses. Most recently the Ebola outbreak in West Africa highlighted the risk posed by infectious diseases as well as the need to strengthen and integrate national and regional disease surveillance systems.

The WHO maintains a "network of networks" linking local, regional, national and international laboratories and medical centers, drawing on government resources, universities, the US Centers for Disease Control and Prevention, the UK Public Health Laboratory Service, as well as informal sources (WHO n.d.). Once an outbreak has been confirmed the WHO aggregates the data and releases Disease Outbreak News (http://www.who.int/csr/don/en/) periodically. Other data sources should exist locally and will vary by context.

In addition to defining the level of data collection, defining the ***timing** and **frequency*** is also important. For secondary data, the timing of data collection may or may not limit its utility, depending on the data. Remote sensing data, for example, is often collected on a very frequent basis, while other data may be collected on an annual or semi-annual basis – these limitations need to be assessed to determine whether or not secondary data is suitable for shock measurement.

Ideally "real-time" monitoring (also called recurrent monitoring) of shocks is conducted either through regular monitoring of secondary data and or primary data from surveys conducted at regular intervals that are triggered by an event.[12] Recurrent monitoring provides insight into the effects of multiple successive shocks, how the cascading effects evolve over time, and in the case of primary data collection, reduces recall bias.

Recurrent Monitoring Surveys for Shock Measurement

Recurrent monitoring surveys (RMS) have the following main features:

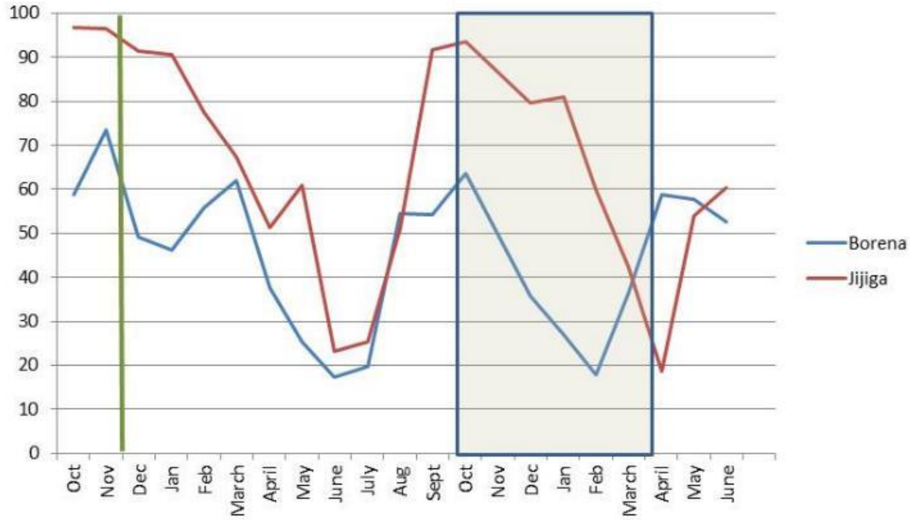
- real-time data collection following a pre-determined trigger indicator for a specified shock
- high-frequency, panel data, and
- relatively small sample sizes

This requires defining a specific threshold – depending on the metric, thresholds may already exist – for example the standardized precipitation index for drought, or other thresholds defined by government ministries. In other cases the threshold may need to be defined, based on what constitutes a shock – i.e. a meaningful deviation from the norm that is affecting lives and livelihoods. After defining this threshold, data (typically, but not necessarily, secondary objective data) for this metric is monitored regularly (e.g. monthly). After the RMS is triggered, household and community quantitative and qualitative data (including subjective shock measures) is collected from a panel of households, repeated on a monthly or bi-monthly basis for a pre-defined amount of time (e.g. six months). The instruments used in these surveys are typically very short, with the average interview taking 15-20 minutes. Determining how frequently to collect this primary data depends on the shock or stress (i.e. whether data collection is feasible, how quickly the situation is evolving), how time sensitive the indicators are, what is appropriate for the communities, and resource limitations.

It is also possible to collect retrospective data at a single point in time post-shock. While attractive from a resource perspective, this will only provide a single snapshot in time and does little to capture how shocks and stresses and their impacts evolve. The figure below plotting soil moisture percentage over time in two districts of Ethiopia illustrates why frequent panel data is required to capture shock and resilience dynamics. The trend shows two major droughts since the baseline (represented by the vertical green line). High frequency data illustrated not only how the drought evolved on a monthly basis, but also how household and community responses evolved. Initially communities were bolstered through social capital, but as the drought wore on and households' stocks were depleted, households and communities were increasingly forced to turn to more severe coping strategies, look outside the community for external assistance, or migrate.[13]

[12] For more details refer to Frankenberger, Smith and Griffin (2017)
[13] Smith and Frankenberger (2015)

Figure 3: Soil Moisture Percentage of Norm in Borena and Jigjiga, October 2013-2015[14]



3.2.4. Measuring Complex Interactions

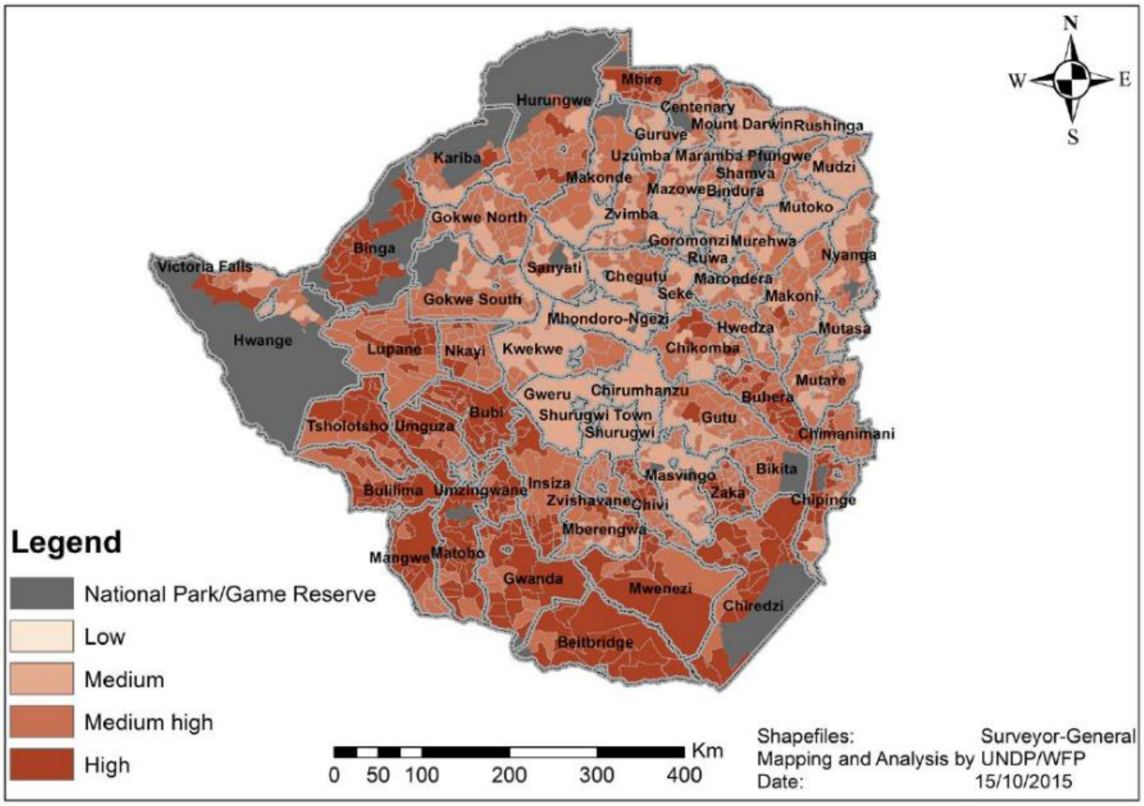
Recall that shocks are likely to be complex and compounding. Getting a sense for how these may be interacting is important. Objectively measuring complex interactions is difficult, and it is not likely that a perfect objective measure will ever be developed – for example, we will not be able to empirically demonstrate that a mild drought of a given magnitude combined with major price increases of a certain percentage is somehow better or worse for household welfare than a severe drought combined with minor price increases. Instead, we rely largely on subjective measures, or objective measures combined with subjective measures.

The UNDP and WFP in Zimbabwe approached this by combining objective data for nine priority hazards with a subjective assessment from experts on the ranking (1-9) of the impact of the hazard in each of the 25 livelihood zones in Zimbabwe[15]. This data was ultimately used to create a hazard convergence map which identified the areas at low, medium, medium-high, and high risk of being affected by some combination of hazards (see figure below). This approach involved working with various ministries to get access to secondary data, intensive data cleaning and processing, normalizing the hazards into a single scale, undertaking the ranking process with ministry experts, and finally mapping the results.

[14] The green vertical line represents the timing of baseline data collection. The shaded box represents the timing for the RMS. Source: Smith and Frankenberger (2015)

[15] See UNDP (2016) and UNDP & WFP (2016)

Figure 4: Zimbabwe Mean Hazard Index Map for Nine Major Hazards[16]



Not all programs will have the resources to undertake such an analysis, but not all efforts to measure complex interactions need to be resource intensive. For example, the Pastoralist Areas Resilience Improvement and Market Expansion (PRIME) evaluation in Ethiopia used a shock exposure index that measured the number and severity of shocks experienced by a household into a single subjective composite measure (Smith et al. 2014, as quoted in Choularton et. al. 2015).

This was accomplished by asking households whether or not they experienced any shocks from a list of 18 different shocks, and if they had, how severe the impact of the shock was on a scale from 1 (No impact) to 5 (Worst ever experienced) (see Smith et al 2014 for details). The composite index was created by multiplying whether or not the household had experienced a shock (where the household gets a 1 if they had and a 0 if not) and the severity weight for that shock. The weighted scores were then summed across all 18 shocks. So the shock exposure index has a maximum range of 0-90, where 0 means the household experienced no shocks in the specified time period, and 90 means the household experienced all 18 shocks, and for each one it was the worst they have ever experienced.

In addition to composite indices of shock exposure to measure complex interactions, additional analyses can be conducted to determine whether households are more or less likely to experience other shocks based on exposure to a major shock. A recent example from Nepal compared

[16] UNDP (2016)

earthquake affected households to non-affected households and found that those affected by the earthquake were more likely to experience market-based shocks (price fluctuation), floods, landslides, and illness.[17]

3.2.5. Key Outputs

The key output of this step should be a table similar to the one presented in Annex II which details which specific shock(s) are of interest, a basic description, and details of the data required. In this example, the shocks most commonly experienced are drought, associated price shocks, conflict, livestock disease and pests. Note for each shock, multiple indicators and sources are defined that have various characteristics (primary/secondary, objective/subjective, national/sub-national, real-time, etc.)

3.3. Step 3: Data Analysis

Detailed guidance on analyzing shock data for resilience analysis is addressed in depth in the fourth guidance note of this series. Rather than provide guidance on how to analyze shock data here, descriptions of the types of analysis that are possible and when and how they might be used are instead provided.

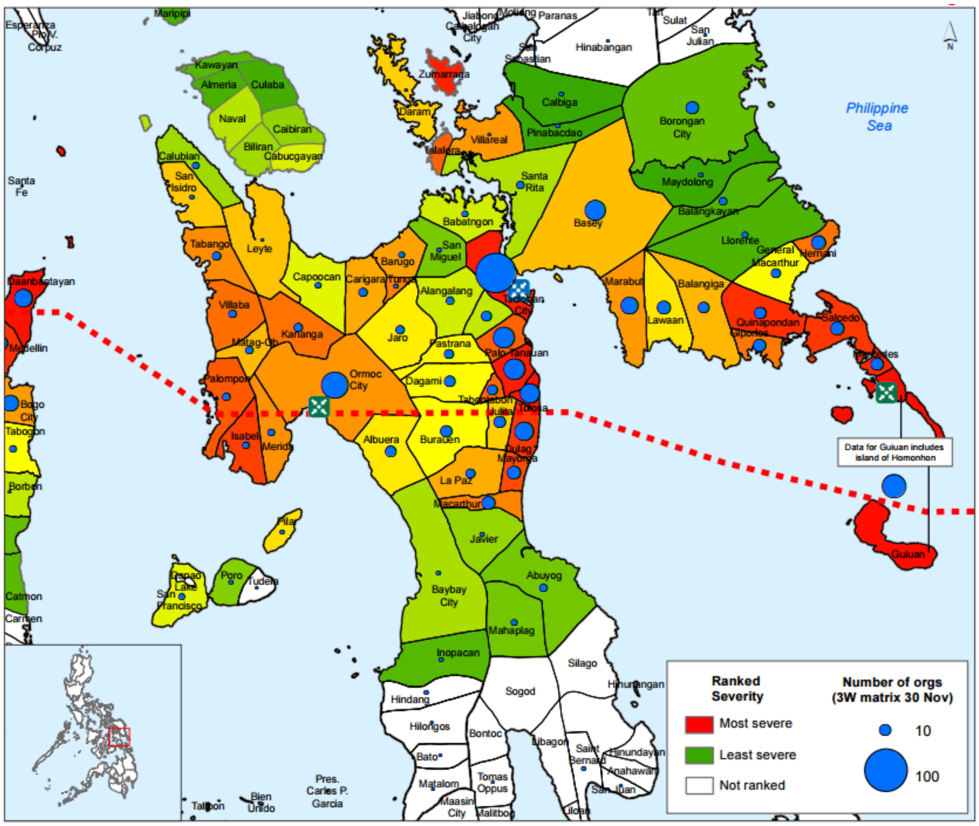
Shock measurement data may be used ***descriptively*** to illustrate overall shock exposure which can be further disaggregated by administrative divisions and other populations of interest (sex, ethnicity, socio-economic status, etc.). One example is a shock intensity map (e.g. shake map for earthquake, drought index map, wind speed map, conflict, etc.) that illustrates the spatial distribution of the shock. For example, the map below illustrates Typhoon Yolanda's severity in the Philippines.

Descriptive shock analyses serve two primary objectives from a project management perspective:

- Assessment purposes to understand which shocks are most important for a given context and to understand the spatial and temporal distribution of these shocks
- Routine project monitoring that can trigger and target humanitarian response (e.g. crisis modifiers) when a shock occurs

[17] Forthcoming from TANGO International

Figure 5: Example of Descriptive Presentation of Shock Data from the Philippines[18]



It is worth reiterating here the differences between objective secondary data and subjective primary data – while the sample map above illustrates typhoon severity, it does not capture the community perception of the event. It could be in mildly affected areas households perceive the shock to be much more severe than it may seem from the objective measurement. Simultaneously, households in severely affected areas may not experience the typhoon as seriously or in the same ways if their lives and livelihoods are more or less unaffected in their daily lives. This highlights the value of using multiple data sources to better understand the dynamics on the ground.

While descriptive analyses are useful to understand the distribution of the shock at the national level, often we want to use this data ***inferentially*** with sample data to test hypotheses and draw conclusions about relationships in the broader population. Some examples of potential research questions include:

1. What is the impact of various shocks on household wellbeing? Is there any evidence of complex interactions?

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[18] Source: MapAction and OCHA. (2013). *Philippines: Typhoon Yolanda - Severity and Operational Presence, Eastern Visayas (as at 30 Nov 2013).* Retrieved from: http://maps.mapaction.org/dataset/f2b82f8a-0e06-419a-bfcf-f56b0f0cd9b7/resource/b2bbbe45-fef0-4323-863f-8d609f958b21/download/ma1003severity3wevisayas-300dpi.pdf

2. How are households responding to the shock, and how is this evolving over time as the shock (or its associated effects) persist?
3. What capacities make households more or less resilient to the major shocks? Do these vary over time?
4. What community characteristics are associated with resilience – e.g. presence of basic services, access to electricity, markets, infrastructure, urban/rural composition, etc.

Answering inferential questions like these enable donors and project managers to:

1. Invest in and design interventions that are more likely to enhance household and community resilience by providing a clear picture of the shock dynamics in the operating environment and identifying what capacities should be supported and how
2. Evaluate whether a project has been effective at building resilience

Inferential analysis is usually accomplished through regression analysis which is designed to model the relationship between shocks, wellbeing and capacities of interest to give insight into the severity of impact on wellbeing as well as what characteristics are related to maintaining or improving wellbeing at various intensities of shock. The relationships of interest should be defined by research questions relevant to the context.

Dependent variables are typically related to important welfare outcomes like food security, economic status, child malnutrition, etc. There are many potential independent variables, but typically these include a measure of shock exposure like the ones discussed in this guidance note, and important household (e.g. resilience capacities, demographic composition, livelihood, etc.) and community (e.g. population, infrastructure, services, etc.) characteristics.

Inferential analysis: PRIME RMS case study

Smith and Frankenberger (2015) use regression analysis to explore the relationship between drought exposure and household food security status. This was evaluated through the following model:

$$\begin{aligned} &Change\ in\ food\ security \\ &= f(shock\ exposure, baseline\ food\ security, household\ \&\ community\ characteristics) \end{aligned}$$

Which models food security trends (as measured by changes in the household food insecurity access scale) as a function of shock exposure (as measured by SPI, soil moisture, and household perceptions), food security status at baseline (assumed to be negatively associated with changes in food security), and various household and community characteristics related to food security (household composition, educational attainment, livelihood, sex of household head, assets, etc.). This analysis found that the more a household was exposed to the drought, the less likely it was to recover from it (i.e. they were less resilient), a finding consistent across both districts studied. Moreover, this study found that households that were reached by USAID's comprehensive resilience programs were better able to maintain their food security in the face of the historic drought relative to households in communities not targeted by these programs (USAID 2017).

4. Conclusion

This guidance note introduced key terms and concepts to describe, measure, and understand major shocks and stresses. The subtle differences between the terms are less important than understanding the general concept and the measurement implications in terms of scale, timing, and frequency of data collection.

The next section detailed the three main steps in shock measurement, including documenting the basics, planning for data collection, and analyzing the data. The main takeaways from this section are:

- Have a well-defined vision of the context, the population, shocks, and various systems
- Collect varied indicators at different temporal and spatial scales
- Use objective/subjective and primary/secondary measures

Not every project will have sufficient capacity and resources to undertake sophisticated shock measurement efforts. Nevertheless, any project with a resilience focus should attempt to measure shocks to be able to understand the dynamics in their program areas at a minimum.

The table below provides some indication of what a shock measurement plan might look like under various resource levels.

Table 3: Shock Measurement Level of Effort Matrix

Low	Medium	High
• Baseline and end-line • Limited primary data on various shocks, integrated with secondary data if technical capacity is available	• Baseline, mid-term, and end-line • Primary data on various shocks, integrated with secondary data	• Multi-hazard convergence maps leveraging secondary data • Baseline, mid-term, and end-line • Recurrent monitoring surveys • Extensive primary data on various shocks, integrated with secondary data

Measuring shocks is integral to resilience analysis, having reliable shock measures enables practitioners to answer key questions for resilience programming, for examples:

- What the impact of the shock(s) is on wellbeing,
- What characteristics matter for resilience, and
- Ideally, whether the interventions are effective at building resilience to the specified shock

These analyses are explored in further depth in the fourth guidance note of this series. In the next guidance note resilience capacities measurement is explored, the next key component from the resilience measurement framework outlined in Figure 1 above.

Helpful Resources

The following lists select resources that provide background on measuring shocks and stresses. This list illustrates the diversity of thought leadership in this field, including academics, research institutes, donors, implementing agencies and consortia partners. These resources also provide some indication of how the field has evolved over time.

Technical Notes and Working Papers:

USAID. (forthcoming). *Resilience Measurement Practical Guidance Note Series: Key Terminology Companion Guide.*

Vaughan, E. and Henly-Shepard, S. (2018). *Resilience Measurement Practical Guidance Note Series 1: Risk and Resilience Assessments*. Produced by Mercy Corps as part of the Resilience Evaluation, Analysis and Learning (REAL) Associate Award.

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