FSIN-AUC Technical Consultation
Food and Nutrition Security and Resilience Analysis

Are we effectively using the right data?

November 2015

PANEL 2
Background Discussion Paper

A Proposed Framework for Harmonized Resilience Metrics: A Structurally Integrated Matrix of Indicators for Resilience[1]

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[1] This paper was prepared under the auspices of the Food Security Information Network's Resilience Measurement Technical Working Group.

1. Introduction

Among individuals whose work is concerned with low income countries, it is now widely recognized that climate change, agro-ecological fragility, economic instability, and related socio-political instability have produced a more varied, less predictable configuration of risks for the world's poor. Against the backdrop of a more complex risk landscape, the concept of resilience has captured the interest of varied groups of stakeholders concerned with how to ensure the welfare of vulnerable populations living in high poverty. A commitment to using the concept of resilience as a reference point for policy and programming is particularly strong when the welfare of those who live in shock-prone contexts is considered. As interest in resilience has increased and funding has grown, so too has the need for clear technical guidance on how to measure resilience. In recognition of this need, the Food Security Information Network established the Resilience Measurement Technical Working Group (RM-TWG).[2] The present paper draws on the guidance of the RM-TWG to explore how a project on harmonized metrics might be focused and structured.

When the enthusiasm associated with the uptake of an idea grows, as it has for resilience, it is natural for questions about payoff to arise. How much has been invested under the name of resilience? In what particular areas, both geographically and programmatically, have investments in resilience been made? What results can be attributed to the range of policies, programmes and interventions associated with resilience? And over what time period can one reasonably expect results to appear? Measurement provides a set of technical practices that enable one to draw empirically based conclusions about questions of this kind. Although measurement serves many purposes and the task of developing resilience measures can be approached from different disciplinary perspectives (e.g., psychometrics, econometrics, ecology, engineering), decisions about how to specify measures can be largely represented by a four part question: *What data need to collected (or extracted), from what entities or locations, with what instruments, to enable what types of inferences?* The task of developing answers to these measurement questions, for a given resilience intervention, in a selected setting, for a particular outcome, is not simple. Answering these measurement questions as part of the larger task of assembling national data sets or cross-national data sets introduces additional challenges. Yet, the fact that funding for resilience has been allocated at national, regional and global levels highlights the need to think about data structures beyond individual studies. From a scientific perspective, an interest in generating empirically testable hypotheses about heterogeneous well-being outcomes in the face of shocks would be supported by data structures that permit aggregation across programmes, within and across regions and over time. It is for these reasons that the value of creating harmonized metrics for resilience becomes clear.

The ambition of creating harmonized metrics for resilience is based on two premises. First, viewing resilience as an innovative approach to supporting welfare outcomes in the face of shocks introduces a special set of demands for measurement[3] (see Constas, Frankenberger, Hoddinott, 2014). While some have questioned the merits of attempting to measure resilience (see Levine, 2014), the allocation of funds and the implementation of interventions that are uniquely focused

[2] The Resilience Measurement Working Group, is jointly coordinated co-sponsored by the European Union and United States Agency for International Development, is comprised of 20 individuals from government and non-government organizations. The full list of members is available at http://www.fsincop.net/topics/resilience-measurement/technical-working-group/en/

[3] M. Constas, T. Frankenberger & J. Hoddinott, 2014. Resilience measurement principle: Toward an agenda for measurement design, Resilience Measurement Technical Working Group. Technical Series No.1. Rome. Food Security and Information Network

on resilience requires a refocused measurement agenda. Second, acknowledging the importance of context does not mean that some subset of indicators and/or some features of that subset cannot be measured and catalogued across all settings. An initial step in the direction of developing frameworks for harmonized resilience measurement can be taken if one accepts these premises. The outputs[4] of the Resilience Measurement Technical Working Group (RM-TWG), a group that was formed to help focus and advance the task of developing rigorous measures of resilience, provide useful guidance to help conceptualize work associated with creating harmonized metrics.

The goal of advancing resilience as a portfolio of scientific work and the goal of evaluating the extent to which the portfolio of resilience investments helps those who are exposed to shocks would be well served by the availability of harmonized resilience metrics. With these two broad goals as reference points, the purpose of the present paper is to describe a framework that will support the mission to promote harmonized metrics for resilience measurement. This paper aims to answer the question "what are the features of a platform or data structure for harmonized metrics that could underwrite resilience analysis where such analysis would yield aggregable, broadly comparable results?" Working at a fairly high level of abstraction, the objective of creating harmonized metrics is to specify categories in which clusters of semantically similar and empirically comparable groups of indicators may be organized. This high level of abstraction facilitates interoperability and supports the effort to harmonize data elements across studies, over locations and across time. As Hammond (2005 p. 1205) notes in his discussion of the importance of interoperability for the health care field, "to share and use data from multiple institutions, data must be built upon common words (data elements and terminology), structures and organization."

The paper is organized into three main sections followed by a conclusion. The first section of the paper specifies the features of a model to consider as we explore how to construct an information platform for harmonized resilience metrics. From the perspective of information science, such platforms serve as *abstract data types* on which more *concrete data structures* may be based[5]. As an example of an abstract data type for resilience measurement, a three dimensional model is presented. The *Structurally Integrated Matrix of Indicators* for Resilience (SIMI-R) is offered as a provisional model to support harmonized metrics. To explain how the contents of SIMI-R are defined and organized, the first section also describes the composition of each of the dimensions and the metrics that constitute the model. The third section summarizes recommendations of the two primary papers of the RM-TWG. In the conclusions section, some of the conceptual and operational challenges of developing harmonized metrics for resilience are discussed.

2. Structurally Integrated Matrix of Indicators for Resilience

The task of establishing harmonized metrics for resilience measurement begins with proposing an abstract data type in which categories of indicators and their properties can be organized. The structure needs to be general enough to allow for adaptation across different interventions, settings and populations. To facilitate empirical aggregation and comparability, however, the framework must be focused enough to specify a standard set of metrics that can be used across different settings.

[4] See http://www.fsincop.net/topics/resilience-measurement/outupts/en/

[5] In the field of information sciences, an abstract *data type* illustrates the semantic content and organization of a range of admissible data elements. A *data structure* represents the practical application or actual implementation of an abstract data type to actual data.

Using the guidance provided by the RM-TWG as a foundation for specifying harmonized metrics, two substantive dimensions of resilience measurement may be derived: 1. *A well-being dimension*-focused on common welfare outcomes and 2. *A resilience dynamics dimension*-focused on indicators that are more specifically connected to understanding resilience. In addition to these two substantive dimensions, the RM-TWG's recommendations also suggest that the measurement of resilience requires one to consider properties of indicators, some of which are motivated by specific features of resilience and others by the general need for precision and accuracy. Properties of indicators, which express a *methodological dimension* of resilience measurement, ask questions about what characteristic of indicators (e.g., spatial properties, frequency) one should include as part of resilience measurement. For each dimension, categories of metrics may be introduced to specify how a platform of harmonized metrics might be structured.

As a first approximation of how to define a structure of this kind, the three dimensions of resilience measurement (well-being dimension, resilience-specific dimension and methodological dimension) are combined. Using food security as an example of a well-being outcome, Figure 1 provides an illustration of this integration in the form of a Structurally Integrated Matrix of Indicators for Resilience.

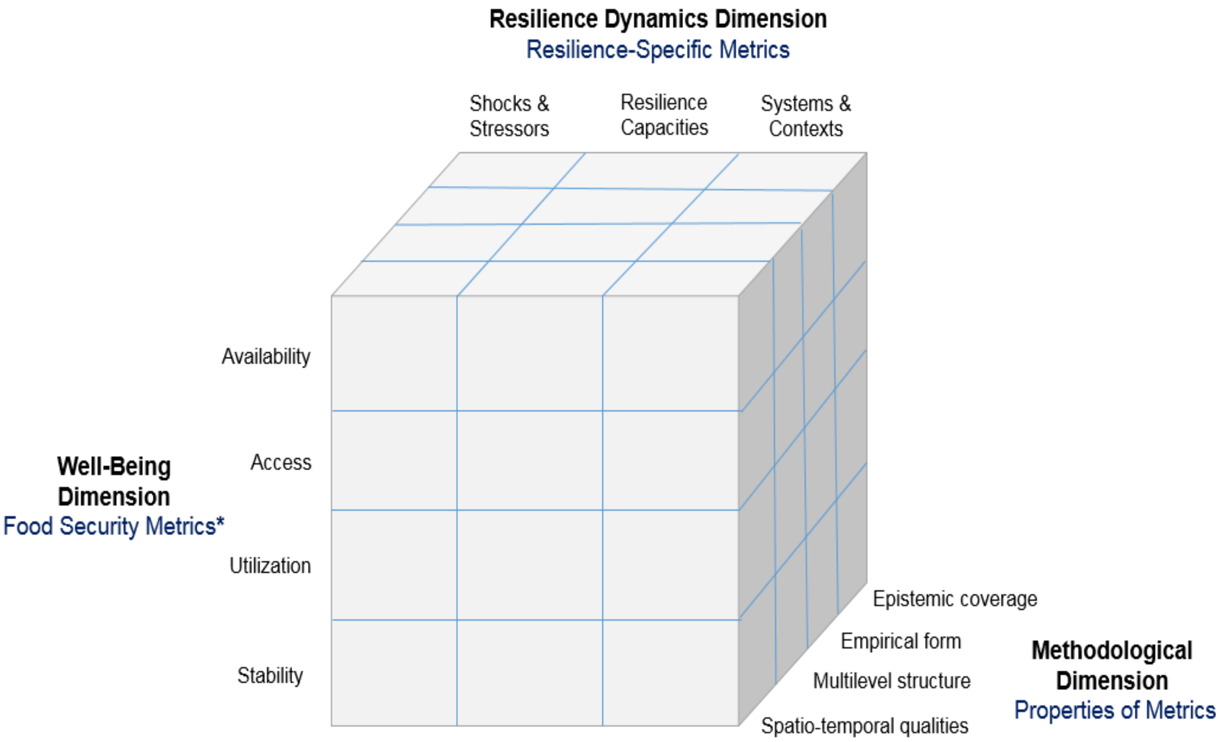

Figure 1: Structurally Integrated Matrix of Indicators for Resilience – Food Security (SIMI-RFS)

*Nutritional status observed over time is used as an illustrative well-being measure, with the understanding that the four pillars of basic food security represent a set of interrelated, first order well-being outcomes.

A simple rendering of this integration of the three dimension yields a matrix with 48 cells (4 well-being metrics X 3 resilience dynamics dimensions X 4 methodological metrics). A more complex treatment of metrics that includes categories of indicators would, of course, produce many more cells. Differentiating the shocks metrics into different types of covariate shocks (e.g., drought or flood, geological shocks, price shocks, political conflicts) produces a more complex matrix. A further differential of idiosyncratic shocks (e.g., family illness or death, crop loss, job loss) and/or capacities (e.g., risk diversified livelihood strategies, /social networks, agro-ecological resource access and use) increases the complexity of the matrix. The task of expanding metrics within dimensions and/or specifying additional metrics (sub-metrics–and so forth) will further differentiate the matrix in a way that adds complexity. Further differentiation if organized according to a transparent and theoretically defensible hierarchy will not undermine the objective of creating harmonized metrics. As an information management problem, increasing complexity is solved by expanding data fields within cells and by specifying intersections within and between metrics that make sense for measurement.

3. Description of the Three Dimensions of Resilience Measurement for Harmonized Metrics

To provide further details related to the contents and structure of a proposed abstract data type for resilience measurement, brief descriptions of each of the three dimension follows.

Well-being Dimension: Food Security Metrics

The first, perhaps most fundamental, feature of a protocol for harmonized metrics for resilience is that it must include well-being indicators as the key outcome variable. Although one may predict resilience as a measurable end-state (see Alinovi, et al., 2009, 2010), an interest in resilience is grounded in the belief that it can help improve well-being outcomes in the face of shocks. Empirical demonstrations of the connections between well-being as capacity and well-being outcomes have begun to emerge (see Food and Agriculture Organization, 2015; Smith et al., 2014).

What counts as a well-being indicator for development is commonly described in terms of capabilities and functioning (see Sen, 1999). It is, however, important for the contents of a data structure to be readily recognized as vital. It makes sense to define well-being in terms of indicators that are important for basic well-being and survival. From this perspective, well-being indicators such as food security, health, physical safety and freedom from threat of violence, and economic status serve as compelling well-being indicators.

The measurement of well-being, like many development outcomes, requires a multi-dimensional measure (see Alkire and Foster, 2011). Focusing on food security, for example, the dimensions of food availability, access, utilization and stability are well established. More recently, discussions of food security have also focused on food and nutrient content, highlighting the importance of the nutritional dimension.

Resilience Dynamics Dimension: Focus on Resilience Specific Metrics

The empirical question examined in connection with resilience concerns the ability to accurately describe and explain causes of heterogeneous well-being outcomes (and pathways) observed over time in the face of shocks. Consistent with the resilience causal framework presented earlier, the opportunity to generate needed descriptions and to model such heterogeneity requires metrics focused on:

- *Shocks and stressors* - What kinds of issues need to be considered to accurately measure the effects of risk exposure?
- *Capacities* – What kinds of issues need to be considered to accurately measure the characteristics and abilities of households, communities and possibly larger units to absorb, adapt and transform in the face of shocks and stressors?

- *Systems and contexts* – What kind of issues need to be considered to measure the way in which systems and contexts affect the ability to respond to shocks and stressors?

Drawing on outputs of the RM-TWG, each of these three categories of metrics are briefly elaborated upon in the sections that follow.

Shocks and Stressors. A commitment to collecting more detailed, more accurate data on shocks is one of the defining features of the resilience measurement agenda. Although resilience is commonly understood in terms of "resilience to" some shock or stressors, measures of resilience do not pay adequate attention to shocks (see Choularton, et al., 2015).

As noted in paper No. 2 (Constas et al., 2014, p. 8), "Data on shocks may include widely experienced shocks (covariate shocks), local or individualized shocks (idiosyncratic shocks), and low-intensity stressors that can have multivariate negative effect on development. Specific types of shock that contribute to resilience measurement include the effects of climate change, distinct weather events, conflict shocks, economic shocks, geological shocks, pests and disease.

In a briefing focused on shocks and stressors for resilience measurement, the RM-TWG's Technical Series No. 5 (Chourlarton et al., 2015, pgs. 7-12) outlined six principles that inform thinking about how to sharpen resilience measurement.

Comprehensive risk analysis - a comprehensive analysis of the larger risk landscape – including potential risks over time should be part of resilience measurement.

Multi-scale measurement - measure the effects of shocks and stressors at varying levels – from households, to communities, to regions and possibly to higher levels –and measure the effects over appropriate (often more frequent) intervals.

Shock-stressor connection - it is important to collect data that allows one to measure the relationship between less frequent catastrophic events and everyday stressors that may have a less dramatic effect. Measure the connections and interrelationships between shocks and stressors.

Objective and subjective effects of shocks - measure both the objective and the subjective aspects of shocks.

Varying magnitude of shocks and stressors - it is important to measure both smaller shocks and stressors that appear to pose limited threats to well-being and larger shocks that typically have an impact on larger numbers of households and communities.

Political instability - shock and stressor measurement should include indicators of political instability and conflict.

In contrast to the discussion of resilience capacities, this discussion of shocks and stressors offers both *substantive* guidance on the composition of data elements and *methodological* guidance on the properties of measurement. Substantive guidance emphasizes the need for comprehensive risk analysis, the need to measure shock-stressor connections, the importance of measuring shocks of varying magnitude, and the importance of political stability as a core element of resilience measurement. Methodological guidance emphasizes the need to consider multi-scale, high-frequency measurement, with attention to objective-subjective effects.

Resilience Capacities. Building on the definition of resilience presented in paper No. 1 of the RM-TWG Technical Series, the measurement of resilience requires one to identify indicators that represent resilience capacities. The importance of such indicators was further emphasized and elaborated upon on in Paper No. 2, which also notes that (Constas et al., 2014, p. 5), "resilience is a dynamic relationship that explains how a given set of capacities can reduce the vulnerability of a household (or other unit) and help it *absorb, adapt* and *transform* in the face of shocks and stressors." To help focus the resilience capacities concept for the purpose of measurement, paper No. 2 listed several characteristics of resilience capacities:

Resilience capacity a positive influence - it is meant to improve well-being outcomes in the face of shocks and stressors. While there are negative factors that are important for predicting well-being outcomes, these factors should not be counted as part of the resilience capacity construct. To the contrary, negative factors are – by definition – incapacities. As such, they may be vital for modelling but are distinct from resilience capacity.

Resilience capacity is defined as a multi-dimensional human-centric construct - It is therefore seen as residing in human attributes and in the processes and structures created by humans. Structures and processes include institutions, systems of governance, policies and programmes.

Resilience capacity depends on the characteristics of the environments on which the well-being of shock-prone populations depend - Environments include the set of ecological resources or services and the agro-ecological conditions that are important for food security, livelihoods and other development outcomes. Environmental conditions also influence the severity of a shock. For example, the impacts of flooding and droughts are magnified by degraded lands that cause higher run-off rates and the depletion of essential soil nutrients.

Different resilience capacities support different structural outcomes - consistent with perspectives developed in the field of ecology (see Folke et al., 2002) and applied to development studies (see Béné et al., 2012; Frankenberger et al., 2014), the resilience construct is seen as representing *three types of capacities* in response to shocks and stressors: i) the capacity to *absorb* shocks and stressors, ii) the capacity to *adapt* to shocks and stressors and iii) the capacity to *transform* in the face of shocks and stressors.

Consistent with Alkire and Foster's multidimensional arguments of poverty measures, the measurement of "resilience capacity must encompass a range of indicators including economic (assets, markets, supply chains), social (social capital, social networks), human capital, technological practices (agricultural practices), environmental (resources, natural resource management practices), infrastructure-related (roads), safety (conflict mitigation practices) and institutional (government) resources and capabilities" (Constas et al., 2014, p. 8).

Paper No. 2 suggested that the different dimensions of resilience capacity might be explored in terms of their connections to different resilient functions - to absorb, to adapt, or to transform in the face of shocks. This connection, along with a sample of indicators, are presented in Table 1 (adapted from the original presentation in RM TWG paper No. 1).

Contexts and systems. The phrase "it depends on the context" is commonly invoked to describe our inability to arrive at generalizable explanations that hold across settings. It is, however, not so frequently theorized. Consequently the indicators one might use to investigate the effect of context are either unspecified or selected on an ad hoc basis. The importance of context for resilience measurement was noted in both papers No. 1 and No. 2 (Constas et al., 2014 a, b). Building on ideas provided by a systems theory perspective, paper No. 6 (Mock et al., p. 5, 2015), described how an array of factors broadly, but theoretically, categorized under the heading of *context* might be more coherently organized and measured: "Systems approaches look at the causes and outcomes of shocks and stresses from a variety of perspectives and scales (e.g. individual, household, community and socio-ecological system), taking into account the larger system of determinants."

Resilience Capacities Data Structure: Data Elements, Resilience Functions and Measurement Tactics					
Data Elements for Resilience Capacity		**Resilience Functions**	**Measurement Tactics to Increase Validity of Resilience Measures**		
Resilience Capacity Categories	**Sample Indicators**	**Response to Shocks**	**Perspectives and Methods**	**Levels Measured**	**Time Periods and Trigger Events**
Social capital* RC-SC	• Bonding • Bridging • Linking				
Human Capital RC–HC	• Education • Skills & abilities • Health and wellness**				
Economic resources RC-ER	• Assets -financial & productive • Market access/mechanisms • Supply chain efficiency				
Service infrastructure RC-SI	• Roads & transportation • Water & sanitation • Medical				
Livelihood strategies RC-LS	• Food security & financial • Diversity • Adaptive	• Absorb • Adapt • Transform	• Objective • Subjective • Quantitative • Qualitative	• Individual • Household • Community • Higher levels	• Short term • Medium term • Long term • Event sensitive
Inst. & governance RC-IG	• Coverage • Structural integrity • Effectiveness				
Risk strategies RC-RS	• Risk exp. history/perception • Risk landscape assessment • Problem definition • Decision making & planning				
Tech. & innovation RC-TI	• Agriculture • Food handling/production • Business				
Social protection RC-SP	• Focus & type • Strategic aim • Integration & duration				
Agro-ecological RC-AE	• Soils & water resources • Cropping/grazing practices • Natural resource management				

* Aldrich, 2013
**Includes both physical and mental wellness

Table 1: Resilience capacities data structure, adapted from RM-TWG Technical Series No. 2 (p.17)

A key point concerns the importance of natural resources and ecosystems as contextual variables for resilience measurement. For example "poor and food-insecure populations – especially in rural environments – depend heavily on natural resources" and "the role of the biophysical environment in constructing an understanding of the vulnerability of households and communities and their potential resilience capacities."

Element	Implications for Resilience Measurement
Level and scale of system components	• Vulnerable households and communities are embedded in nested dynamics and processes that operate at different levels of spatial, institutional, ecological, social and temporal scales. • A systems approach requires that causes of resilience vulnerability and well-being be analysed from a multi-level and multi-scale perspective.
Cross-level and cross-scale interactions	• Cross-level and cross-scale interactions reflect changes in capacities and outcomes related to the unique effects of one level of measure on another level (e.g. national governance on community governance) or one scale on another scale (e.g., ecological on social or jurisdictional).
Feedback loops	• Feedback occurs when outputs of a system are "fed back" as inputs in a chain of cause-and-effect that forms a circuit or loop in a system. • Complex interactions among system components should be part of resilience measurement.
Threshold and tipping points	• Systems feedback can give rise to non-linear relationships among the determinants of resilience, vulnerability and well-being. • Ecological/environmental variables need to reach certain threshold values before they generate specific desired (or undesired) consequences.
Networks	• Community capacity for collective action – particularly the use of social networks – is considered essential for resilience.
Varying rates of change	System components may change at different rates (temporal scale). The rate of change is often correlated with the level of scale, where lower levels change more quickly than higher levels of scale.
Self-organization and unanticipated change	• The complex nature of relationships among the various scales and levels of the determinants and dynamics of systems can make it very difficult to predict resilience trajectories. Large-scale change can occur from a seemingly innocuous local event.

Table 1: Elements of a Systems Perspective: Implications for Resilience Measurement, adapted from RM-TWG Technical Series No. 6 (p. 7)

Methodological Dimension: Properties of Metrics

Whereas the discussion of the first two dimensions on which a platform for resilience metrics might be based focused on types of indicators, the methodological dimension draws attention to properties of indicators. Here the questions are focused on features of indicators that can increase the accuracy, rigor and completeness of resilience metrics. Consistent with guidance provided in a number of the RM -TWG papers, four properties of metrics can be considered as key features of resilience measurement. In an operational sense, the methodological dimension specifies an additional way in which resilience indicators may be classified, either for the purpose of selecting/constructing indicators or for the purpose of classifying indicators. To organize these properties under the methodological dimension, they are summarized below.

Spatio-temporal- This focuses on questions about where and when resilience data were collected. Such questions highlight the need to collect data and classify metrics based on location and timing parameters. Spatial/locational information calls attention to the value of classification according to geo-referenced coordinates that provide locational information that is related to, for example, agro-ecological zones, livelihood zones or shock exposure events. Temporal features highlight the need to collect and classify metrics according to frequency of occurrence.

Multi-level structure - This focuses on questions about levels at which resilience measurement data are collected and classified. This property calls attention to the need to collect and classify metrics at multiple levels –from the household level (and possibly individual to examine intra-household variation), to the community level and possibly to higher levels.

Empirical form - This focuses on questions about the type of data that are collected as part of resilience measurement. It draws attention to the need to collect and classify resilience metrics using both quantitative and qualitative data. Although the idea of "qualitative data" is not usually part of the discussions of harmonized metrics, it is important to recognize that not all aspects of resilience are represented in the form of quantitative expressions, some may be best represented in the form of qualitative descriptions. Acceptance of this idea does not, however, require one to abandon the idea of developing harmonized protocols and standards for collecting and reporting on qualitative data.

Epistemic coverage - This focuses on asking questions about the kind of knowledge that is collected and classified as part of resilience measurement. This emphasizes the need to collect and accurately classify indicators with reference to an objective-subjective category. When collecting data on shocks, for example, paying attention to the epistemic property of resilience measurement suggests that it is important to recognize that both factual records of loss (objective) and perceptions of the consequences of loss, including aspirations, can be represented.

As is the case with the indicators described for *well-being dimension* and the predictor *variable dimension*, these properties of the methodological dimension are multidimensional and can therefore assume one of several values.

4. Foundational Background for Harmonized Resilience Metrics[6]

Since its establishment in June 2013, the RM-TWG has prepared two comprehensive papers and produced an associated set of technical briefings on resilience measurement. The aim of the first paper was to "set an agenda for resilience measurement" (Constas et al., 2014). This was done by describing the empirical challenges associated with the effort to conceptualize and measure resilience. The second paper, 'A Common Analytical Model for Resilience Measurement', outlined a strategy that provides the operational vehicle needed to move in the concept of resilience from an abstract set of ideas to a measurable set of outcomes (Constas et al., 2014). Using the common analytical model as a point of reference, this section provides a condensed summary of the work of the RMTWG.

RM-TWG Paper No. 1: Principles for Resilience Measurement
While there has been a good deal of activity associated with the concept of resilience, questions about its exact meaning have occupied the attention of many – particularly as the concept was just being embraced by the development community. Recognizing that a clear conceptualization of

[6]This section of the paper draws heavily on the publications of RM-TWG.

resilience was the foundation for sound measurement guidance, the first paper of the RM-TWG defined resilience "*as the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences*" (Constas et al., 2014, p. 3)[7]. This definition suggests that resilience should be measured according to the instrumental effects it exerts on targeted development outcomes that may be affected by stressors and shocks. Defining resilience as a capacity means that it involves a set of characteristics of a particular entity (e.g., household, community or at higher levels) that should help it absorb, adapt, or transform in the face of shocks and stressors.

As resilience continues to attract attention, one question to pose concerns the distinctiveness of resilience. Does resilience offer a new perspective or does it simply offer a different vocabulary to describe vulnerability? While closely related to the concept of vulnerability, it is important to note that resilience is not merely its inverse. Vulnerability describes a set of conditions that prevents people from managing adverse events, while resilience is comprised of a set of responses[8] that may counter the structural and stochastic factors that may make a household or other unit vulnerable when exposed to a set of shocks and stressors. In this sense, vulnerability refers to the set of characteristics that increases the probability of descent when exposed to risks. Expanding on the initial definition provided above, resilience capacity includes the array of characteristics, actions and strategies taken to prevent and/or counter the effect of such risks. Whereas vulnerability has the effect of enabling the causal connections between shocks and negative outcomes, resilience has the effect of disabling or transforming those causal connections.

In addition to providing a definition that suggests that resilience offers a distinct perspective, the first paper in the RM-TWG series outlined ten measurement design principles. The purpose of these principles was to describe, in brief form, an agenda that might help focus work on resilience measurement.

Measurement Design Principle #1 - Resilience as a Normatively Indexed Capacity
Resilience is a capacity that should be indexed to a given development outcome (e.g., food security, poverty, health) with a normative threshold. Measures of resilience should be developed in relation to the instrumental value that such capacity has for a particular outcome. The outcome of interest should include a normative boundary that defines a threshold condition below which the well-being of an individual, household, or community is unacceptable.

Measurement Principle #2 - Subjective States and Qualitative Data
The role played by subjective states in resilience, such as perceptions of shocks, perceived utility of actions taken or not taken, and general expectations of future states, should be included as key components of resilience measurement. The potential value of qualitative indicators should be explored as an element of resilience measurement.

Measurement Principle #3 - Systems and Complex Causality
A vital first step in the development of resilience measures requires the modeling of an outcome of interest as the result of a series of interactions among the conditions, attributes and processes, and disturbances that affect well-being. The attempt to

[7] See Barrett and Constas (2014) for a theoretical discussion of how resilience for development can be conceptualized and modelled.

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model and measure the complex cause and effect relationships produced by such interactions is supported by systems-oriented analysis.

Measurement Design Principle #4 - Shock and Stressor Specificity
Resilience measures should be sensitive to the specific types of shocks and/or stressors that are seen as threatening [food and nutrition security]. The necessity of highly detailed, technically sound shock modules is central to resilience measurement

Measurement Design Principle #5 - Desirable and Undesirable Equilibria
Resilience measures should contain indicators that help one identify those instances when the return to a prior state is and when it is not desirable.

Measurement Design Principle #6 - Inherent Volatility and Instability
Resilience measures should be sensitive to the fact that conditions before and after a shock may be best characterized by systemic volatility or by patterns that can only be described as chaotic. Resilience measures, and associated analytical methods, should be structured to detect, measure, and model such volatility and chaotic behavior.

Measurement Design Principle #7 - Multiple Scales and Multi-Level Interactions
Resilience is a capacity that can be observed at different levels, ranging from individuals, to households, communities, and nations. One of the challenges of developing measures of resilience involves identification of the mechanisms that explain how resilience capacity functions within and between levels to exert positive effects on [food security].

Measurement Design Principle #8 - Rates of Change and Timing of Measurement
The time points at which data on resilience capacity, and shocks and stressors are collected should be informed by knowledge of expected rates of change/growth associated with a particular unit or scale of measurement for resilience capacity.

Measurement Design Principle #9 - Resilience-Vulnerability Connections
Resilience measures should build on the knowledge gained from studies of vulnerability and the contents of existing vulnerability measures and coping measures should be used as key points of reference for constructing resilience measures.

Measurement Design Principle #10 - Tool for Interpreting Heterogeneity
The ability to explain heterogeneous effects of vulnerability conditions that lead to food insecurity represents one of the key challenges of measurement and analysis. The ability to measure resilience should facilitate efforts to explain heterogeneous responses to shocks and stresses observed in households and communities with different and similar levels of vulnerability. Measures of resilience should assess the way in which resilience capacities mediate the consequences of shocks.

Although these ten design principles were developed to guide measurement, a number of the principles have implications for how to conceptualize a data structure than can be populated by indicators from secondary data sets (see Carletto, Banerjee, Zezza 2015). Principles one through four and principles seven and eight have a direct bearing on the types of indicators around which a data structure for harmonized metrics might be structured.

RM-TWG Paper No. 2: A Common Analytical Model for Resilience Measurement
This paper provides a common analytical model and a causal framework, both of which were designed to inform resilience measurement. The common analytical model describes the range of analytical issues that one must consider whilst developing or selecting resilience measurement tools. The causal framework illustrates how resilience is located within a network of cause and effect relationships.

Common Analytical Model for Resilience. Because the list of analytical actions associated with measurement is typically long and often complex, it is useful to describe a discrete series of steps around which the process of developing measures may be structured. Based on the deliberations of the RM-TWG, six analytical elements are described. These elements specify core tasks that should be pursued in order to develop resilience measurements. Figure 2 provides a schematic of how the six elements are organised and sequenced. While the analytical elements are the core feature of the figure, it is important to recognise that resilience measurement is based on a foundation of technical considerations as noted in the left hand side of the figure. Further description of each of these technical considerations is provided in the full paper on which this article is based.

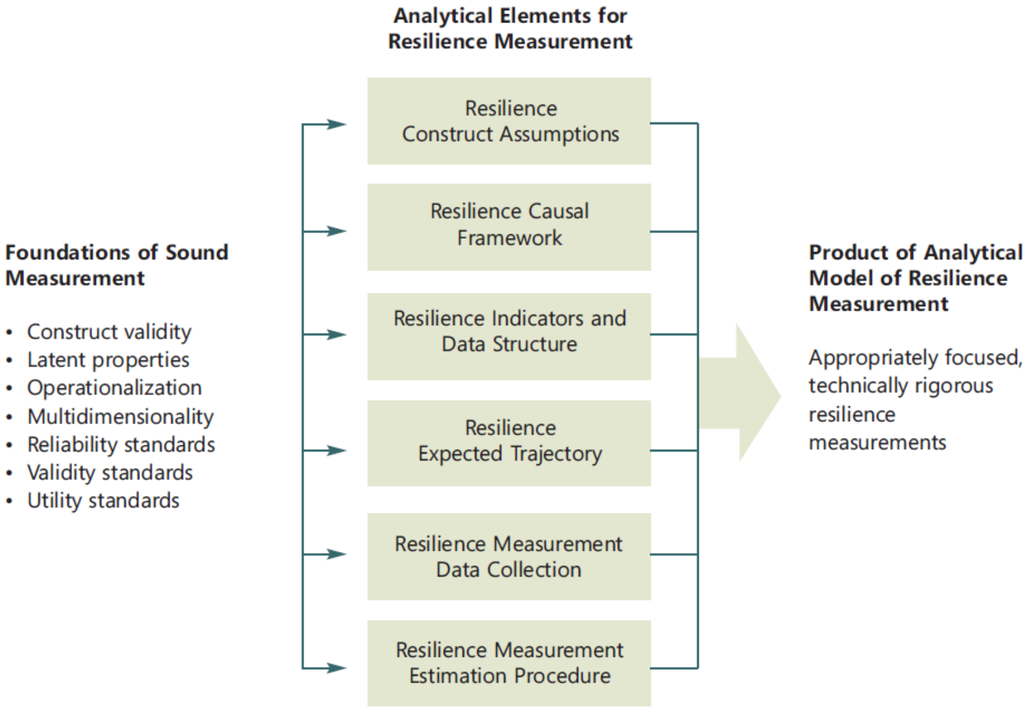

Figure 2: Components of the common analytical model for resilience measurement taken from RM-TWG Technical Series No. 2 (p. 14)

To add detail to the common analytical model, the analytical elements are introduced through a series of questions that can inform the process of developing resilient measurement tools. The analytical elements and related focal questions are summarized briefly here.

Resilience measurement assumptions – How is resilience defined? A decision must be made to establish whether resilience will be treated as an input or as an output. Additionally, the recognition of the different types of resilience (e.g., ability to absorb, adapt or transform) should be built into the definition. For either case, the kinds of inputs or outputs associated with the definition should also be stated.

Resilience causal framework – How is resilience located in the chain of cause-effect relationships? The factors that affect the status of resilience, defined as an input or output, should be identified and the way in which those factors may potentially interact with each other should be stated.

Resilience indicators and data structure – What set of indicators will be used as measures of resilience? Indicators which are used to represent a set of abstract concepts associated with resilience should be clearly identified and defined.

Resilience expected trajectory – What is the expected rate of change and time scale on which measurement data should be collected? The timing of measurements for resilience should not be arbitrary and should rather reflect an understanding of the length of time it takes for expected effects to appear.

Resilience measurement data collection – What selection of quantitative and qualitative data collection tools are required for resilience measurement and what procedures will be put in place to ensure that standardised procedures are employed? The complexity of resilience requires a balanced measurement approach, one that draws on the strengths of both quantitative and qualitative measurement tools.

Resilience estimation procedures – Once resilience data have been collected, how should these data be analysed to draw inferences and formulate warranted conclusions? The procedures that are used to extract meaning from measurement data should have the capacity to both illustrate simple relationships and reveal non-linear, complex relationships of resilience dynamics.

The way in which each of these questions is answered depends strongly on the purpose of measurement and the context in which resilience measurement data will be collected and applied. At a general level, however, each of the design principles has implications for how to structure a data platform on which a protocol for harmonized resilience metrics may be based.

Resilience causal framework. Of the six listed analytical elements, the task of locating resilience within a framework of cause and effect relationships is perhaps the task that is at the heart of resilience measurement. Whilst not a required part of all measurement work, the need to map cause-effect relationships is important in those situations where one intends to measure the effect of a particular intervention, programme, strategy or policy on an outcome of interest.

To be useful for evaluation, a platform for organizing harmonized resilience metrics should be constructed with an eye toward testing causal models. The *resilience causal framework* developed for paper No. 2 of the RM-TWG is presented in Figure 3.

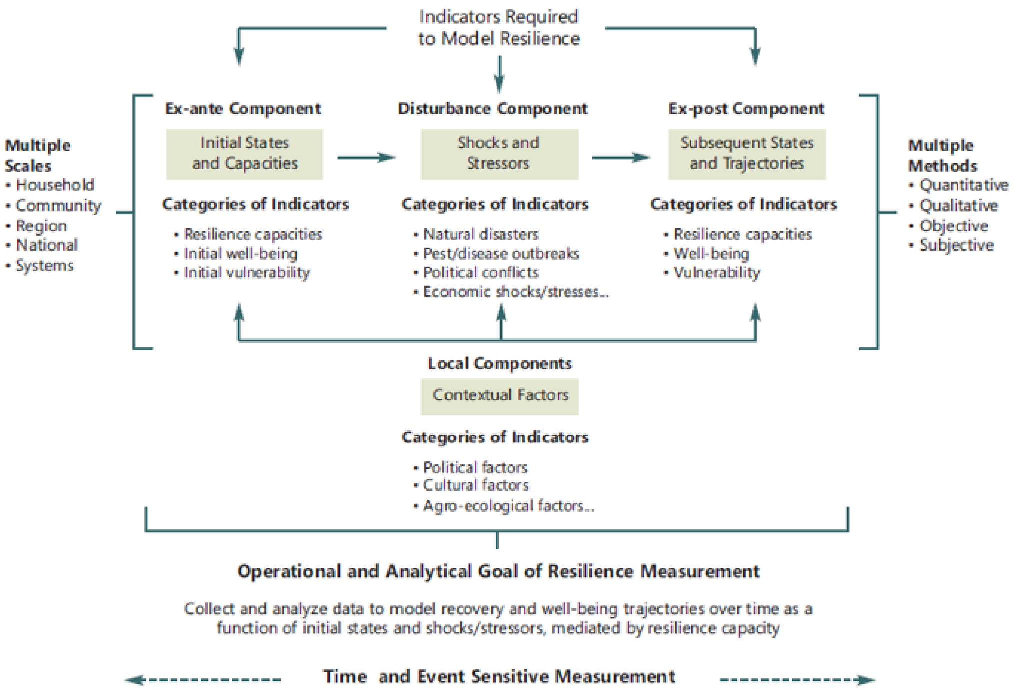

Figure 3: Resilience Causal Framework: Components of resilience modelling, taken from RM-TWG Technical Series No. 2

The centre part of the model portrays resilience as comprised of three components that offer opportunities for measurement. Arranged as a simplified chronological sequence, the resilience causal framework points out that resilience measurement is comprised of three components. The *ex-ante component* requires identifying indicators to measure initial states of well-being and measures of the capacities that may or may not be in place to protect against shocks. The *disturbance component* requires measurement of the shock or stressors that threaten the well-being or condition measured at the initial state. The *ex-post component* looks at ways of measuring subsequent states and provides a point at which a measurement of well-being should be administered.

Whenever possible it is important to take measures at multiple levels. Within this causal framework, resilience is defined as the ability of a particular entity (e.g., person, household, community, organisation) to maintain and/or improve on its well-being in the face of shocks and stressors. In simple quantitative terms, an individual, household or community may be called resilient if it is able to return to, or improve upon, its initial state following exposure to a shock.

Two additional points should be made. First, as highlighted on the far left of the causal framework, resilience measures may require data to be collected at multiple scales. While one may be interested in measuring resilience at a particular level (e.g., an individual level or an organisation level), it important to recognise cross-level interactions. Second, as highlighted on the right-hand side of the framework, resilience measurement requires a selection of methods. Although measurement is often viewed as an objective enterprise driven by quantitative data; it is important to take advantage of the full range of measurement tools, including the judicious use of subjective measures and qualitative methods.

5. Conclusions: From an Abstract Data Type to an Operational Plan

Integrating harmonized data from different populations allows achieving sample sizes that could not be obtained with individual studies, improves the generalizability of results, helps ensure the validity of comparative research, encourages more efficient secondary usage of existing data, and provides opportunities for collaborative and multi-centre research (see Doiron, 2013, p. 2).

There is a substantial literature that considers how best to organize the task of creating harmonized metrics. The goal of harmonized metrics is a theoretical problem examined within information sciences and a practical problem that is part of protocols for reporting standards (e.g., International Standards Organization, World Reporting Initiative). Of more immediate relevance to the task of developing harmonized metrics for resilience measurement, a number of efforts can be cited. At a regional level, Cadre Harmonisé (within *Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel, CILSS*) in West Africa serves as a useful point of reference. Both the Integrated Food Security Phase Classification (IPC), and The Famine Early Warning System (FEWSNET) have dedicated a good deal of attention to the topic of harmonized metrics. As a programmatic example, USAID's Feed the Future Results Framework demonstrates a commitment to encouraging harmonized metrics. The task of creating a platform for harmonized metrics for resilience is therefore not a blank-slate that has no points of reference. There is much to build on as we move forward and many opportunities to find synergies.

The aim of the present paper was to put the idea of harmonized metrics for resilience into circulation as a topic of potential interest. To this end, a three dimensional model, SIMI-R, was presented as a proposal for an abstract data type. SIMI-R, as a first approximation of an abstract data type is meant to stimulate thinking about the critical features of resilience-oriented data structures. Using guidance provided by RM-TWG and other sources, the structure and content of the model were described. To provide further background information and to stimulate thinking about how best to focus a project that aims to promote harmonized metrics, guidance from the primary papers of the RM-TWG was summarized.

Possible Next Steps

As we contemplate some of the steps that need to be taken to advance the idea of harmonized metrics for resilience measurement, a number of recommendations can be offered and questions posed:

Further develop/specify resilience data types and create/test data structures – Presenting SIMI-R as a pre-cursor to a data structure that would promote harmonized metrics was intended to stimulate thinking. Refinement, revision and a more precise definition of a data type needs to be explored.

- Do the dimensions and associate metrics (and sub-metrics) noted in SIMI-R provide adequate coverage and an abstract data type on which harmonized metrics might be based?

Leverage and catalog existing large-scale data sets- A sensible first step is to use SIMI-R (or other data types) to examine the structure and contents of platforms that are already operational. To assess the potential for resilience analysis, the contents and methodological features of indicators in various data sets may be examined.

- Can a simple tool for reviewing data sets for resilience-related indicators be developed?

- Might it be possible to automate the review procedure by using codes derived from an abstract data type such as SIMI-R?

Learn from existing efforts – It is useful to consider the technical challenges encountered in projects that have used harmonized metrics (e.g., Global information and Early Warning System, Famine Early Warning System and the Integrated Food Security Phase Classification). These efforts and others, offer important insights of how to address challenges associated with the task of specifying and implementing harmonized metrics.

- What lessons can be learned from past and current efforts to harmonize metrics?
- Why have some efforts been more successful than others?

Engage key stakeholders and build a coalition – Determine the levels of interest and particular empirical needs of a group of stakeholders from governments, agencies, non-governmental organizations and the donor community who might benefit from a harmonized metrics initiative.

- In what ways can existing coalitions be used as models or as actual resources for developing a platform and forming a coalition to support harmonized resilience metrics?

Draft a plan and estimate costs – Develop a plan that considers the time, labour, capacities and costs needed to launch and sustain a harmonized resilience metrics initiative.

- What is required to launch a harmonized resilience metrics plan?
- What intermediary steps can be taken to make progress?

In addition to the above ideas for possible next steps, work on harmonized metrics for resilience measurement should include careful thinking about intended users. At an operational level, individuals responsible for data management constitute the first obvious group to consider. A second critical group are analysts, who are responsible for formulating and testing estimation models on which inferences about resilience will be based. Monitoring and evaluation specialists constitute a third group that has direct interests in the composition of metrics. In addition to these three data-focused user groups, the way in which a harmonized data structure for resilience is operationalized should support the possibility of developing interactive user interfaces (now popularly referred to as dashboards) to serve the interests of application. Users concerned with application would include, but not be limited to: project designers, implementers, and policy makers. The point here is that it important to conceptualize and implement the task of specifying harmonized metrics for resilience as a demand side problem.

Conclusion

The task of finding broadly generalizable solutions to the challenges of development is difficult because the conditions that drive food insecurity and poverty are multidimensional, time-sensitive, contextually bound and often highly volatile. Consequently, many solutions proposed by policy makers, implementers and researchers who work on development lack a unifying theme. At certain points, however, the various strands of work undertaken in a given field converge on a particular idea. In the past few years, resilience has emerged as one such idea. High profile policy statements from major agencies and the donor community have been made. Numerous programmes have been launched to support a new generation of work that will help the world's poor more effectively cope with and adapt to the range of recurrent shocks and stressors that threaten their well-being. Observations that such shocks and stressors exert their effects with increasing frequency and decreasing predictability have intensified interest in resilience and deepened the resolve to identify solutions that can be applied across settings within, and possibly across, countries. The sustained levels of interest in resilience, across programs and countries, provides a compelling case for harmonized resilience metrics. The opportunity to share metrics and aggregate findings across studies will allow us to determine the extent to which the programmes and policies based on resilience have, on the whole, been successful. As noted above, a programme of harmonized metrics will also allow us to engage more coherently in questions about the scientific merit of our work. In closing, one final question about timing and readiness can be introduced. Is this the right time to initiate work on harmonized metrics for resilience? While a negative answer to this question may be justified, I would contend that committing to the task of developing harmonized metrics would have a net positive effect on the future of resilience measurement.

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