Can flood resilience be measured?

An innovative collaborative approach may do just that

Introduction

Increased severe flooding globally has focused attention on finding practical ways to improve flood risk management. As part of this effort, Zurich Insurance Group (Zurich) launched a global flood resilience program in 2013. The program aims to advance knowledge, develop robust expertise, and design strategies that help communities strengthen their resilience to flood.

To implement the program, Zurich has formed a multi-year, interdisciplinary alliance with the International Federation of Red Cross and Red Crescent Societies (IFRC), the non-governmental organization Practical Action, the International Institute for Applied Systems Analysis (IIASA), and the Wharton Business School's Risk Management and Decision Processes Center (Wharton) in the United States. This alliance of risk experts seeks to improve the public dialogue around flood resilience while demonstrating the benefits of pre-event risk reduction, as opposed to post-event disaster relief.

Flooding along the Usamacinta river, Tabasco, Mexico

> *"no general measurement framework for disaster resilience has been empirically verified yet."*
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> *Thomas Winderl, "Disaster Resilience Measurements: Stocktaking of Ongoing Efforts in Developing Systems for Measuring Resilience," United Nations Development Programme, February 2014, http://www.preventionweb.net/files/37916_disasterresiliencemeasurementsundpt.pdf.*

The measurement challenge

The program's impact will be seen in communities' enhanced resilience to flooding. But demonstrating this impact presents a particular challenge: measuring resilience is not as easy as it sounds.

There are many approaches to measuring resilience that have grown up over the last 10 years, any of which could potentially be applied to our efforts. However, a recent survey conducted for the United Nations Development Programme concluded that "no general measurement framework for disaster resilience has been empirically verified yet."

This finding highlights a key challenge for any resilience-building efforts: if resilience cannot be empirically verified, how do you empirically measure whether a community is more resilient as a result of your work? By combining the expertise of all our partners, this challenge is what we have set out to address.

Breaking down the challenge

It is a truism that what gets measured, gets done. Thus if we can find a way to measure enhanced community resilience to flooding, we are likely to be able to design interventions that contribute to such an enhancement. In order to measure something, though, we must first define it.

Measuring "resilience" per se is too complicated and we have concluded that we should look at **resilience in the face of a specific event** (e.g. flooding). We have also concluded that "resilience" is an outcome that ensures that a community can continue to thrive and develop. In other words, a community will be able to continue to function and grow if it has resilience. However resilience can come from many sources. It is important to look holistically at these sources of resilience if we hope to know in advance of a flood whether a community will be resilient. This has allowed us to concentrate on appropriate measurement factors – the sources of resilience.

Potentially, a "community" could be defined geographically (perhaps in rural contexts) or by administrative boundaries (which may work in more urban situations). However, no single community will "feel" like another and there may be cultural aspects to consider, too. As a result we have concluded that when it comes to ground reality, a community largely defines itself.

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Alliance contributions

Each of the alliance institutions has a different expertise that makes a distinct contribution to the measurement model.

The insurance partner

Zurich has extensive experience and expertise in managing risk. Our aim is to help customers understand and protect themselves from risk, so we not only provide insurance but also look at how risk can be mitigated. Our risk engineering teams use our **Technical Risk Grading Standard (TRGS)** to offer an objective view of the impact of hazards and make recommendations about actions that can be taken to reduce risks.

The TRGS provides a consistent benchmark against which to quantify risk. For each of around 30 different perils, it offers a separate tool that takes into account the different factors that make up the risk associated with that peril. Each tool includes 5 to 10 **risk categories;** each of the categories is made up of **risk factors;** and for each of the risk factors, we define the evidence needed to earn that factor a grade of A, B, C, or D. Grades are assigned as follows:

- A: Best practice for managing the risk
- B: Good industry standard, no immediate need for improvement
- C: Deficiencies, room for visible improvement
- D: Significantly below good standard, potential for imminent loss

Gathering data exercises, Tabasco, Mexico

Each factor's grade carries a numerical value, and when all the values of the factors making up the categories are added together, they produce a meaningful number (between 0 and 100) that is the level of risk.

Engineers compare data gathered from their site visit with the definitions in the TRGS to allow them to make a judgment and conduct conversations with the customer about how to manage the risks they are facing. When customers manage risks effectively, they reduce overall losses, which in turn allows them to cope with any residual losses more easily - that is, to rebuild more quickly after a catastrophe with less business interruption. Effective risk management should also mean that the cost of insurance is lower, and in some cases that the losses Zurich incurs from claims are lower.

This measurement methodology can be adapted in the context of communities' enhanced resilience to flooding. The approach brings together quantitative and qualitative data about the factors that contribute to resilience, allowing us not only to "grade" these factors (using the TRGS approach) but also to identify actions for enhancing resilience.

"Where does the water level come to?" Tabasco, Mexico

The academic partners

Through a comprehensive review of current techniques and thinking on resilience, our academic partners **Wharton** (in the United States) and **IIASA** (in Austria) have drawn up a framework around which we can build a measurement tool. The framework combines thinking developed at the Multidisciplinary Center for Earthquake Engineering Research (MCEER) at the University of Buffalo, New York, and the Sustainable Livelihoods Framework of the Department for International Development (DFID). This "systems analysis" approach takes into account the quality of life, interactions, and interconnections at the community level, and provides consistency in identifying and testing potential sources of resilience.

The framework is based on four separate properties related to community resilience (the "Four Rs" defined by MCEER) and five types of community capital (the "Five Cs" from DFID's Sustainable Livelihoods Framework). The "Four R-Five C" framework can be applied to virtually any community.

For MCCER, see "MCEER's Resilience Framework," October 2006, http://mceer.buffalo.edu/research/resilience/Resilience_10-24-06.pdf.
For DFID, see "Sustainable Livelihoods Guidance Sheets," April 1999, http://eldis.org/vfile/upload/1/document/0901/section2.pdf.

The Four Rs (resilience properties) are

- Robustness (ability to withstand a shock)
- Redundancy (functional diversity)
- Resourcefulness (ability to mobilize when threatened)
- Rapidity (ability to contain losses and recover in a timely manner)

The Five Cs that characterize communities are complementary forms of capital that can help to improve inhabitants' well-being. Judicious use of these resources can increase personal and collective wealth, provide a sense of security, and enhance environmental stewardship. From an analytical perspective, the Five Cs provide greater richness of data about a community's sources of resilience than any single metric (e.g., average income). Thus they provide a more holistic picture of a community's resilience.

The Five Cs are

- Physical (things produced by economic activity from other capital, such as infrastructure, equipment, improvements in crops, livestock, etc.)
- Financial (level, variability, and diversity of income sources and access to other financial resources that contribute to wealth)
- Human (education, skills, health)
- Social (social relationships and networks, bonds aiding cooperative action, links facilitating exchange of and access to ideas and resources)
- Natural (natural resource base, including land productivity and actions to sustain it, as well as water and other resources that sustain livelihoods)

This framework provides a system and a type of matrix to measure the sources of community flood resilience. It allows comparisons within and across communities to empirically validate resilience and to measure in clear, concise terms how resilient a community is to floods. The framework also makes it possible to test how a change in one of the Five Cs affects a community's overall resilience level.

"Tell me about the impact of floods for your family", Tabasco, Mexico

The community partners

Having a methodology for building a measurement tool (the TRGS) and a framework to determine the potential indicators (Four R-Five C) can help us build a theoretical model for resilience measurement. But to ensure that our model is not merely theoretical but also has relevance to real communities, the role of **Practical Action** and the **Red Cross** is key. These partners have on-the-ground experience that forms the basis for specific indicators that are highly relevant to communities. Both partners make use of data-gathering tools to help them understand the communities they are working with, and these have been adapted for use in our model to ensure that all the data needed to measure resilience are available.

The future

Over the course of 2014, the Zurich flood resilience alliance team has built an initial iteration of a measurement tool and through programming work in Mexico has gathered data to test it. The data will be analyzed using the tool, and the results will help us to evaluate how well it works. Further iterations of the tool will continue into 2015, with the aim of having a comprehensive documented model available for use in the alliance's community projects.

We believe that we are on the way to producing a model that empirically measures community resilience to flooding, and that this model could eventually be the basis for a comprehensive resilience measurement approach.

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Further Resources

For more details on the work of the Zurich flood resilience alliance, please visit

Zurich: http://www.zurich.com/en/corporate-responsibility/flood-resilience
IFRC: http://www.ifrc.org
Practical Action: http://practicalaction.org/
IIASA: http://www.iiasa.ac.at
Wharton: http://www.wharton.upenn.edu/riskcenter/

Flooding in Germany, Summer 2013

About the Zurich flood resilience alliance

An increase in severe flooding around the world has focused greater attention on finding practical ways to address flood risk management. In response, Zurich Insurance Group launched a global flood resilience program in 2013. The program aims to advance knowledge, develop robust expertise and design strategies that can be implemented to help communities in developed and developing countries strengthen their resilience to flood risk.

To achieve these objectives, Zurich has entered into a multi-year alliance with the International Federation of Red Cross and Red Crescent Societies, the International Institute for Applied Systems Analysis (IIASA) in Austria, the Wharton Business School's Risk Management and Decision Processes Center (Wharton) in the U.S. and the international development non-governmental organization Practical Action. The alliance builds on the complementary strengths of these institutions. It brings an interdisciplinary approach to flood research, community-based programs and risk expertise with the aim of creating a comprehensive that will help to promote community flood resilience. It seeks to improve the public dialogue around flood resilience, while measuring the success of our efforts and demonstrating the .benefits of pre-event risk reduction, as opposed to post-event disaster relief.