

# Risk Nexus

## Enhancing community flood resilience: a way forward

“To reduce flood losses and help communities improve flood resilience, it is imperative that we focus more on mitigating risks and preparing for floods, rather than simply dealing with the consequences after a flood occurs.”

May 2014

### Introduction

Floods cause more damage worldwide to human life and property than any other type of natural disaster. This trend shows no sign of abating. Many of the efforts to address flooding so far have been focused on recovery. To reduce flood losses and help communities in both developed and developing countries improve flood resilience, it is imperative that we focus more on mitigating risks and preparing for floods, rather than simply dealing with the consequences after a flood occurs. This publication is based on a more detailed white paper developed by the International Institute for Applied Systems Analysis (IIASA) and the Wharton Risk Management and Decision Processes Center (Wharton) as part of the Zurich flood resilience alliance. It provides insights into ways this might be done.

Empirical evidence suggests that flood risk prevention is highly cost-effective. Even so, more resources are put into helping communities to recover after a flood, as opposed to enhancing flood resilience. This is true in developed countries where most spending is done through government relief and insurance payment after a disaster. It is also true in less-developed countries where disaster aid is heavily dominated by emergency response. Over the past two decades, nearly 87 percent of spending on aid went into emergency response, reconstruction and rehabilitation, and only 13 percent toward reducing and managing the risks before they became disasters. For every USD 100 spent on development aid, just 40 cents has been invested in defending that aid from the impact of disaster.<sup>1</sup>

<sup>1</sup> Kellett, J. & Caravani, A. 2013, 'Financing disaster risk reduction: A 20-year story of international aid,' ODI and the Global Facility for Disaster Reduction and Recovery at the World Bank, London/Washington.

This publication is based on a more detailed white paper produced by the Zurich flood resilience alliance available at: <http://www.iiasa.ac.at/web/home/research/researchPrograms/RiskPolicyandVulnerability/whitepaper.pdf>

[http://opim.wharton.upenn.edu/risk/library/zurichfloodresiliencealliance\\_ResilienceWhitePaper\\_2014.pdf](http://opim.wharton.upenn.edu/risk/library/zurichfloodresiliencealliance_ResilienceWhitePaper_2014.pdf)

It is intended as a contribution towards the debate about building, understanding and enhancing community flood resilience.

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## Enhancing community flood resilience continued

### Overview

To put more emphasis on risk reduction 'ex-ante' as opposed to recovery 'ex-post,' three key aspects seem to offer great potential:

- **Community flood resilience needs a holistic approach:** More attention should be paid to communities' needs. To be effective, resilience activities should encourage efforts to maintain and raise the standard of living of those affected by floods. Development and flood resilience should be complementary, providing incentives to decision-makers in public and private sectors at national and local levels to manage flood risks before floods occur.
- **Communities need better information:** Good information and data will greatly improve the decision-making process. The better the information, the easier it is to calculate, record and analyze flood resilience. Not only will such information provide a baseline to measure progress; it will also help to understand what works in practice and how well it works. Communities can learn from each other and tailor their actions to their own context. One key piece of this is being able to measure and monitor flood risk. This will provide ideas how it can be reduced and the key functions and activities of the community system required to implement it. Doing this

in a transparent way will encourage public dialogue and foster innovative solutions backed by empirical evidence.

- **Communities must overcome behavioral, economic and institutional barriers:** Many factors can hinder change. Besides insufficient data to convince those in charge to prepare for floods, we also need to consider risk perception, cognitive biases, and financial concerns, as well as institutional barriers that thwart action.

### Taking a holistic approach to community flood resilience

The Zurich flood resilience alliance (see page 6 for further information) draws on the knowledge and skills of both researchers and practitioners in the field to enhance flood resilience. The alliance is working in communities and regions in both developed and developing countries to identify good practices for increasing flood resilience through 'ex-ante' activities, while learning through our efforts what makes communities more flood resilient. In this context, we define community flood resilience as a community's ability to absorb shocks caused by floods, and its capacity to recover quickly after the flood event.

### Issues at stake

Flood losses worldwide are significant and are expected to increase.

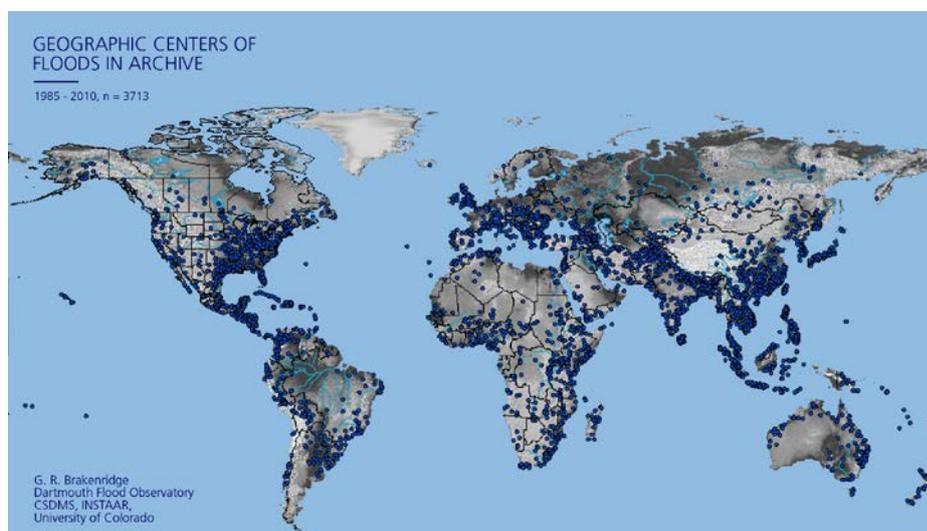


Figure 1: Geographic centers of large floods over the period 1985 to 2010. Large floods are defined by being classified as a 'disaster.' Source: Dartmouth Flood Observatory Archive in Kundzewicz, Z.W. et al. (2014) 'Flood risk and climate change – global and regional perspectives', Hydrological Sciences Journal.

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## Enhancing community flood resilience continued

Figure 1 shows the location of over 3,700 large floods observed globally from 1985 to 2010. Floods are truly a universal hazard. They occurred in virtually all countries during this period, resulting in significant losses.

### Some key facts observed:

- Losses from worldwide flood events nearly doubled in the 10 years from 2000 to 2009 compared with the prior decade.
- Coastal floods are likely to become more frequent due to climate change. This will add to losses (see Box 1).
- Population growth, urbanization and economic development in hazard-prone areas are the main reasons for the increase in losses. These will remain significant in the future.

### How flood risk, resilience and development are interconnected

Economic growth and well-being should be considered alongside risk preparedness.

We approach solutions in ways that respect both communities' need for development, while addressing specific risks associated with floods. These two different aspects – development and flood resilience – can be complementary.

Given the desirability of living and working near water, limiting development in areas with flood hazards is difficult to enforce on a large scale. Lacking ways to encourage people to build away from the water, it is important to make exposed communities more resilient to floods. At the same time, we should emphasize that resilience ought to be improved without compromising community development. Our research suggests that it is possible to do this by

#### Box 1. The scale of the problem

Average global damage from storm surge flooding alone can increase from several billion per year today to several trillion dollars per year by the end of the century if no action is taken. Proceedings of the National Academy of Sciences in the U.S., 2014.<sup>2</sup>

<sup>2</sup>J. Hinkel, D. Lincke, A. T. Vafeidis, M. Perrette, R. J. Nicholls, R. S. J. Tol, B. Marzeion, X. Fettweis, C. Ionescu, A. Levermann. Coastal flood damage and adaptation costs under 21<sup>st</sup> century sea-level rise. Proceedings of the National Academy of Sciences, Mar 4, 2014; 111(9): 3292–3297.

introducing cost-effective risk management measures; these could be immediate actions supplemented by further measures to augment resilience over time. In addition, development can bring technological changes that provide innovative ways to manage risk.

Measures to address flood risk must be considered in terms of their wider implications (for example, building a large levee system to protect a community from flooding could have a negative impact on the natural environment and encourage unwise development). Considering problems from different perspectives encourages stakeholders to identify more strategies and opportunities for managing risks, increasing their ability to address other community objectives such as improving their standard of living concurrently.

Doing this properly over time requires an iterative risk management process – one which allows questions and seeks answers in a dynamic way – inside the community. This will help the community to identify, mitigate, prepare for, respond to and learn about risks affecting it. By doing this, a community can put flood resilience into practice in a significant, specific, and tangible way.

### Managing risk well can bring new development opportunities

Definitions of 'resilience' abound. What is lacking are practical ways to help communities adopt and enhance it.

When looking to improve flood resilience, we must keep in mind how floods affect development, and vice-versa. Exposure to repeated flooding can trap households or entire communities in a cycle of poverty. By addressing flood risk effectively, communities can break this vicious cycle. Development, including construction and reallocating land in flood zones, can increase flood risks. But it can also strengthen a community's ability to respond to risks. Development gives communities avenues to build and/or reinforce their defenses and take measures to reduce vulnerability prior to a flood event.

Increasing the capacity to address risks through institutions and better governance

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## Enhancing community flood resilience continued

can contribute to the means necessary to increase flood resilience; for example, strengthening a community's financial situation prior to a flood can provide more savings to be drawn on when a crisis occurs. By reinforcing financial 'infrastructure,' communities and households are in a better position to invest in financial risk protection such as insurance. Stronger financial markets offer avenues to borrow for recovery and reconstruction. Development also means more income sources. This can significantly reduce flood losses and assist recovery by providing alternative livelihoods during floods.

### Improving information to enhance flood resilience

It is difficult to take informed and focused actions to improve resilience if we cannot understand or measure it. To understand how to improve flood resilience, we need to measure and monitor the key metrics and activities that make a community resilient. Accurate and comprehensive information offers several benefits. Data that are conscientiously collected, rigorously analyzed, and correctly employed allow limited resources to be used to best advantage. Data help us to establish a baseline to measure progress. Having quantifiable outcomes allows us to identify what works. It also makes it easier to replicate and scale up successful activities elsewhere.

Uncertainty needs to be quantified. Knowing where, how and why uncertainty exists increases the chance that projects will be robust even in the face of change. Acknowledging and working with unknowns lets us avoid using uncertainty as an excuse for preserving the status quo. Uncertainties include those related to socio-demographic, economic development and climate.

### Measuring community resilience

Our proposed framework brings together two sets of metrics. One set is based on four separate properties related to community resilience (the 'Four Rs'). The other is based on five types of capital that characterize a community (the 'Five Cs'). The advantage of the 'Four R-Five C' approach is that it can be applied to virtually any community worldwide.

### Resilience (the Four Rs)

- 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)

These are general properties found to be a source of resilience for complex systems: 'robustness' could include making communities more flood resilient through the presence of wetlands, studying soil absorption or slope for natural run-off; 'redundancy' (and possibly 'resourcefulness'), might include helping people affected by floods to develop the means to engage in other livelihoods when crop land is under water; 'Rapidity' refers to the capacity to meet priorities and achieve goals in sufficient time to contain losses, recover functionality and avoid future disruptions.

### Community capital (the Five Cs)

We characterize a community based on the Five Cs. These complementary sources of capital can help to improve inhabitants' standard of living. Judicious use of these different 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 resilience than any single metric, such as income, to provide a more holistic picture of a community's resilience level.

- Physical (things produced by economic activity from 'other' capital, such as infrastructure, equipment, improvements in crops, livestock, etc.)
- Financial (level, variability, diversity of income sources and access to other financial resources that contribute to wealth)
- Human (education, skills, health of people)
- Social (social relationships and networks, bonds that aid cooperative action, links to exchange and access 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)

## Enhancing community flood resilience continued

This framework provides a system and a type of matrix to measure the sources of community flood resilience. It can allow comparisons within and across communities to 'empirically validate' resilience; to measure in clear, concise terms how resilient a community is to floods. By agreeing on a set of metrics and weighting them, it is also possible to profile a community based on a rating for each one of the Five Cs and then test how changes in one of these affect a community's overall resilience level. Figure 2 compares two hypothetical communities using this approach.

### Mapping the 'Five Cs'

Measuring community flood resilience

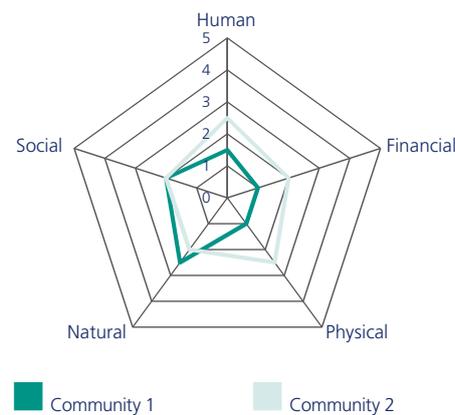


Figure 2: Mapping of the five sources of capital used to measure community flood resilience Source: Nelson, D. et al. (2007) 'Adaptation to environmental change: contributions of a resilience framework,' Annual Review of Environment and Resources 32:395-419.

### Overcoming behavioral, economic and institutional barriers to prepare for floods

Flood resilience efforts must overcome reluctance to increase protection before a flood occurs. Successful implementation of ex-ante flood resilience activities requires establishing the right incentives for communities, households and businesses, and ensuring genuine representative stakeholder participation in the decision-making process; the importance of both these factors in flood resilience has only recently been more widely understood and appreciated. Even when decision-makers are fully aware of the risks, they might not

appreciate the benefits. One example is risk financing, which tends to be underutilized. This is particularly the case when businesses and households are given access to free (often government-funded) relief, or in situations where low financial literacy prevails, or if solutions are beyond the means of those who could benefit from them.

Our research has shown that risk perception, cognitive biases including maintaining the status quo, and economic concerns all hamper efforts to reduce flood risks. We are studying these behavioral, economic and institutional barriers in more detail as part of the Zurich flood resilience alliance remit.

A growing body of data shows that decision-making units across the globe, ranging from individual households to national and international organizations, are significantly biased with respect to low-probability events. Such events are often underestimated and disregarded. They are seen as being below the level of concern. Once a crisis occurs, all attention is focused on this event. But it takes only a short time for flood events to lose their salience. Then they are forgotten.

Rather than to justify taking no action and maintaining the status quo due to uncertainties, good decision-making takes uncertainties into account. This might include projecting future socio-demographic, economic and climatic conditions; that uncertainty needs to be quantified and properly used to select projects that are robust to change.

Being able to demonstrate to communities the importance of taking action before a flood disaster increases awareness about the importance of resilience and makes it easier to take the necessary steps towards improving resilience.

### Putting our approach into practice

By testing the data we collect and sharing the insights we derive, we can build a useful, empirical measure of flood resilience, something that otherwise may be based on anecdotal evidence and intangibles. Ultimately this framework will aid in identifying and assessing flood resilience strategies in communities around the world, so that they

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## Enhancing community flood resilience continued

not only survive a flood, but also have the ability to continue to thrive in the face of flood risks.

In summary, resilience can be defined by distinct properties, put into operation through a participatory and iterative risk management process, reliably measured at a certain point in time and repeatedly over time. The Zurich flood resilience alliance is testing the 'Four R-Five C' measurement framework by systematically collecting data as it works with communities together generating knowledge and facilitating actions to incorporate flood resilience in wider development initiatives. We are now in the early stages of implementing this approach, together with select communities in Indonesia, Mexico, Nepal, and Peru.

The alliance also conducts flood resilience work in Europe and the United States. While these are much more advanced areas with significant flood resilience efforts under way, there is still important progress to be made there as demonstrated by some of the costliest flood disasters in recent history, namely the central European floods in 2013 and storm Sandy in 2012. Lessons from developed countries are also relevant to developing ones.

We will share early results and findings on an ongoing basis through our alliance network and on our homepage: <http://www.zurich.com/aboutus/corporateresponsibility/flood-resilience/flood-resilience.htm>

### 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), the Wharton Business School's Risk Management and Decision Processes Center (Wharton) 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 framework 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.



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