

# The Flood Resilience Measurement for Communities (FRMC)



EGU2020-3934

<https://doi.org/10.5194/egusphere-egu2020-3934>

EGU General Assembly 2020

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## Flood resilience measurement for communities: data for science and practice

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Given the increased attention put on strengthening disaster resilience, there is a growing need to invest in its measurement and the overall accountability of resilience strengthening initiatives. There is a major gap in evidence about what actually makes communities more resilient when an event occurs, because there are no empirically validated measures of disaster resilience. Similarly, an effort to identify operational indicators has gained some traction only more recently. The Flood Resilience Measurement for Communities (FRMC) framework and associated, fully operational, integrated tool takes a systems-thinking, holistic approach to serve the dual goals of generating data on the determinants of community flood resilience, and providing decision-support for on-the-ground investment. The FRMC framework measures “sources of resilience” before a flood happens and looks at the post-flood impacts afterwards. It is built around the notion of five types of capital (the 5Cs: human, social, physical, natural, and financial) and the 4Rs of a resilient system (robustness, redundancy, resourcefulness, and rapidity). The sources of resilience are graded based on Zurich’s Risk Engineering Technical Grading Standard. Results are displayed according to the 5Cs and 4Rs, the disaster risk management (DRM) cycle, themes and context level, to give the approach further flexibility and accessibility.

The Zurich Flood Resilience Alliance (ZFRA) has identified the measurement of resilience as a valuable ingredient in building community flood resilience. In the first application phase (2013-2018), we measured flood resilience in 118 communities across nine countries, building on responses at household and community levels. Continuing this endeavor in the second phase (2018 – 2023) will allow us to enrich the understanding of community flood resilience and to extend this unique data set.

We find that at the community level, the FRMC enables users to track community progress on resilience over time in a standardized way. It thus provides vital information for the decision-making process in terms of prioritizing the resilience-building measures most needed by the community. At community and higher decision-making levels, measuring resilience also provides a basis for improving the design of innovative investment programs to strengthen disaster resilience.

By exploring data across multiple communities (facing different flood types and with very different socioeconomic and political contexts), we can generate evidence with respect to which

# 1 COMMUNITY DATA COLLECTION

1/25

**EDUCATION COMMITMENT DURING FLOODS**

Q: What are some reasons why the school students in this household might not attend school or classes due to flooding?

- Children help look after younger siblings or other family

**MIXED DATA COLLECTION METHODS**

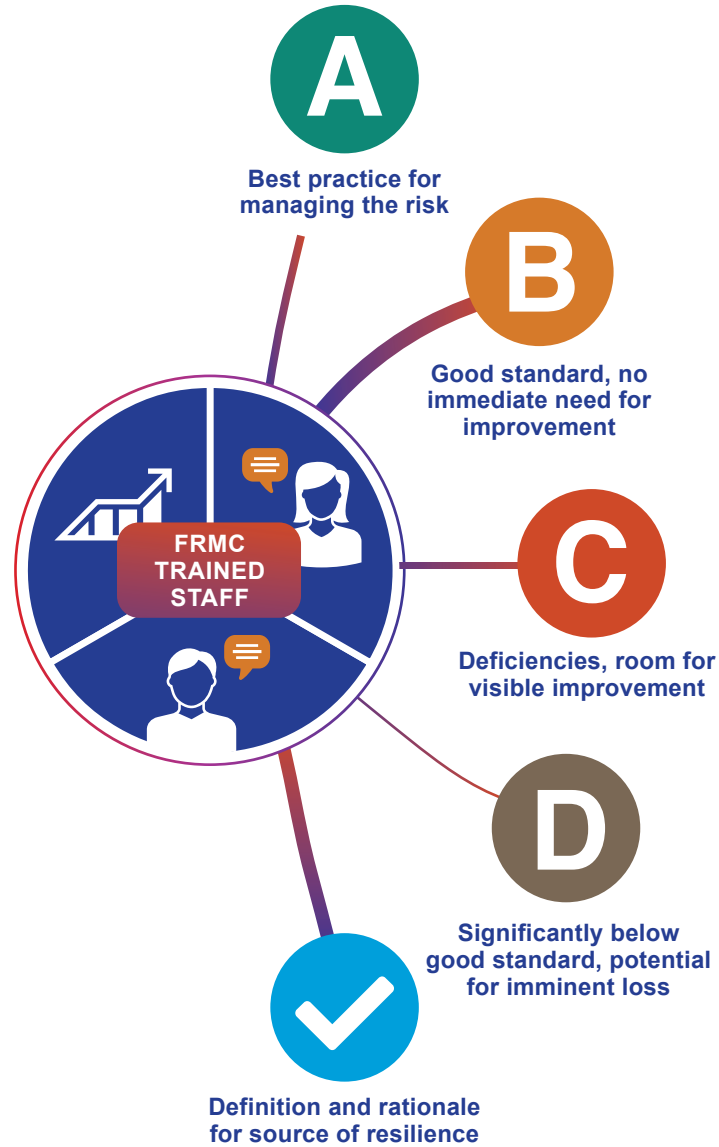
- HOUSEHOLD SURVEYS
- FOCUS GROUP DISCUSSIONS
- KEY INFORMANT INTERVIEWS
- SECOND SOURCE DATA



# 2 44 SOURCES OF RESILIENCE

- Education during flood time
- Asset protection knowledge
- Governance awareness
- Access to well-planned flood services
- Community safety
- Flood exposure awareness
- Flood emergency infrastructure
- Continuity of education
- Flood emergency food supply
- Priority natural land units
- Household asset recovery
- Disaster response budget

# 3 EXPERTS ASSIGN GRADES TO EACH SOURCE



# 4 DATA ANALYSIS AND INTERPRETATION

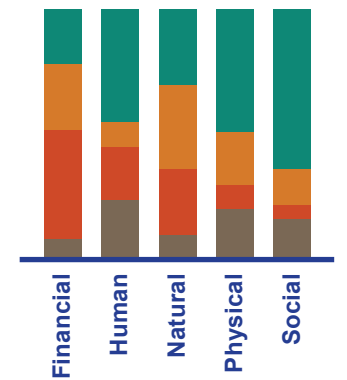
5 CAPITALS

4Rs

7 THEMES

DRM CYCLE

SYSTEM LEVEL VIEWS



BASELINE STUDY AT TIME 1  
44 SOURCES OF RESILIENCE

**FLOOD**

POST-EVENT STUDY  
29 OUTCOMES AFTER FLOODING

REPEATED STUDY AT TIME 2  
44 SOURCES OF RESILIENCE

This document provides detail on the conceptual framework behind the Flood Resilience Measurement for Community (FRMC) and explains how it is applied practically, including the software used.

Over 110 communities in nine countries participated in the roll-out of the FRMC in the first five-year phase of the Zurich Flood Resilience Alliance. The Alliance collected over 1.25 million data points, which it has used to improve and streamline the FRMC further, refining both the framework and tool into an easy-to-use approach.

As the Alliance we can now invite others to use the FRMC; so if your community needs to measure its flood resilience, see what the FRMC has to offer or you can contact us for more information:

[info@floodresilience.net](mailto:info@floodresilience.net)



# Who is the Zurich Flood Resilience Alliance?

The Zurich Flood Resilience Alliance focuses on building flood resilience. Flood prevention is cost-effective, but nearly 87 per cent<sup>1</sup> of disaster-related aid spending goes into emergency response, reconstruction and rehabilitation, and only 13 per cent<sup>2</sup> towards reducing and managing risks before they became disasters.<sup>3</sup> That is why, in 2013, a multi-organizational partnership – the Zurich Flood Resilience Alliance – was created to enhance community flood resilience.

The Zurich Flood Resilience Alliance is a cross-sector collaboration between Zurich Insurance Group, NGOs and academia. Zurich Insurance Group works with the humanitarian and civil society organisations Concern Worldwide, the International Federation of the Red Cross and Red Crescent Societies (IFRC), Mercy Corps, Plan International and Practical Action, as well as research partners the International Institute for Applied Systems and Analysis (IIASA), the London School of Economics, and the Institute for Social and Environmental Transition-International (ISET).

Between 2013 and 2018, Zurich's risk management experts and the Alliance's humanitarian, civil society and research partners focused on shifting the emphasis from the traditional one of post-event recovery to pre-event resilience. Our evidence-based approach – built through dozens of published research papers and implemented in community programs across the globe – has shown the value of investing in flood resilience. More than 110 communities in nine countries have benefited from Alliance projects.

According to the ClimateWise Investing for Resilience report, 2016<sup>4</sup> saw natural hazards (of which floods are a major part) result in USD 175 billion worth of economic losses, yet only USD 50 billion were insured. This USD 125 billion protection gap is due in part to the lack of evidence of what works and because there are few incentives and regulations to encourage investments in sound protection measures at all levels of society.



## Our vision:

Floods have no negative impact on people's and businesses' ability to thrive.

## Our goal:

To increase social, political and financial investment in community-based flood resilience-building through public, private and third sector partnerships.

## Our objectives from 2018 to 2023 are therefore to:

**Objective 1: Increase funding for flood resilience**

**Objective 2: Strengthen policy at global, national or sub-national level to support flood resilience**

**Objective 3: Improve flood resilience practice**

- 1 Zurich Risk Nexus: Turning knowledge into action – processes and tools for increasing flood resilience, 2015
- 2 Zurich Flood Resilience Alliance White Paper: Making communities more flood resilient: The Role of cost-benefit analysis and other decision support tools in Disaster Risk Reduction. White Paper, Zurich Flood Resilience Alliance, 2014
- 3 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.
- 4 Investing in resilience – Climate Wise report, 2016

# What is the FRMC?

The Flood Resilience Measurement for Communities (the FRMC) comprises two parts: the Alliance's framework for measuring community flood resilience, and an associated tool for implementing the framework in practice.

For the Alliance, community flood resilience goes beyond infrastructure resilience. Thus our definition of community flood resilience is:

*“The ability of a community to pursue its development and growth objectives, while managing its flood risk over time in a mutually reinforcing way”*

(adapted from Keating et al., 2017a<sup>5</sup>).

There is a lack of evidence about what pre-event resilience-building initiatives actually make a difference when a flood comes. In fact, the United Nations Development Program stated in one of its papers (Winderl, 2014) that: “no general measurement framework for disaster resilience has been empirically verified yet”.<sup>6</sup>

Measuring the change that resilience-building efforts have is key for demonstrating impact in communities. So, in December 2013, the Alliance set out to develop a framework for measuring community flood resilience, including a methodology for testing and empirically validating the framework, and a technology-based data-gathering and evaluation tool for measurement and assessment of flood resilience.



## How does the FRMC work?

### The FRMC framework

Our framework, also called the 5C-4R framework, combines 44 indicators – so called sources of resilience, on five complementary ‘capitals’ (5C)<sup>7</sup> as well as four properties derived from resilient system-thinking (4R), that can help people on their development path and also provide capacity to withstand and respond to shocks.

The 5Cs comprise human, social, physical, financial and natural capital. The 5Cs provide greater richness of data about a community's sources of resilience than any single metric such as average income.

### The five capitals (5Cs):



**Human** (education, skills, health).



**Social** (social relationships and networks, bonds that promote cooperation, links facilitating exchange of and access to ideas and resources).



**Physical** (things produced by economic activity from other capital, such as infrastructure, equipment, improvements in crops, livestock).



**Natural** (natural resource base, including land productivity and actions to sustain it, as well as water and other resources that sustain livelihoods).



**Financial** (level, variability and diversity of income sources and access to other financial resources that contribute to wealth).

5 Keating, A, Campbell, K, Mechler, R, Magnuszewski, P, Mochizuki, J, Liu, W, Szoenyi, M, and McQuistan, C (2017a). Disaster resilience: What it is and how it can engender a meaningful change in development policy, Development Policy Review 35 (1): 65-91. DOI:10.1111/dpr.12201.

6 Winderl, T. (2014) Disaster resilience measurements: Stocktaking of ongoing efforts in developing systems for measuring resilience. UNDP.

7 Robert Chambers' Sustainable Livelihoods Approach (SLA), which was adopted by the UK's Department for International Development (DFID).

Each capital group contains a set of generic and discrete sources of resilience (which can be thought of as sub-indicators). Across the 5Cs there are 44 sources of resilience, each specifically defined. Sources of resilience are grouped under the four headings of robustness (ability to withstand a shock), redundancy (functional diversity), resourcefulness (ability to mobilize when threatened), and rapidity (ability to contain losses and recover in a timely manner).<sup>8</sup>

This 'systems thinking' approach takes into account the assets, interactions and interconnections at community level, and provides consistency when it comes to identifying and testing sources of resilience.

### The four properties of a resilient system (4Rs):



**Robustness** (ability to withstand a shock), for example, housing and bridges built to withstand a flood.



**Redundancy** (functional diversity), for example having many evacuation routes.



**Resourcefulness** (ability to mobilize when threatened), for example a group within a community that can quickly mobilize to convert a community center into a flood shelter.



**Rapidity** (ability to contain losses and recover in a timely manner), for example quick access to sources of financing to support recovery.



<sup>8</sup> Based on the properties of a resilient system developed at MCEER at the University of Buffalo.



# The 44 Sources of Resilience

Asset protection knowledge	Business continuity	Communication interruption	Community disaster fund
Community disaster risk management planning	Community participation in flood related activities	Community representative bodies	Community safety
Community structures for mutual assistance	Conservation budget	Disaster response budget	Early Warning Systems (EWS)
Education commitment during floods	Environmental management awareness	Evacuation and safety knowledge	External flood response and recovery services
First aid knowledge	Flood emergency food supply	Flood emergency infrastructure	Flood energy supply
Flood exposure awareness	Flood healthcare access	Flood safe water	Flood waste contamination
Future flood risk awareness	Governance awareness	Household asset recovery	Household flood protection
Household income continuity strategy	Integrated flood management planning	Inter-community flood coordination	Large scale flood protection
Local leadership	National forecasting policy & plan	Natural capital condition	Natural habitat restoration
Natural resource conservation	Priority managed units	Priority natural units	Provision of education
Risk reduction investments	Social inclusiveness	Transportation interruption	Water and sanitation awareness

(For further details on the theoretical underpinnings and process for developing the phase 1 version of the framework, see Keating et al., 2017b)<sup>9</sup>.

<sup>9</sup> Keating, A, Campbell, K, Szoenyi, M, McQuistan, C, Nash, D, and Burer, M (2017b). Development and testing of a community flood resilience measurement tool, *Nat. Hazards Earth Syst. Sci.* 17: 77-101, doi:10.5194/nhess-17-77-2017.



# The FRMC tool

The second component of the FRMC – the tool – is a practical hybrid software application comprising an online web-based platform for setting up and analyzing the process and a smartphone- or tablet-based app that can be used offline in the field for data collection.

To measure each source of resilience in a given community, data can be collected in four different ways (i.e. household surveys, key informant interviews, focus group discussions, and the use of secondary sources) according to context and need.

After data is collected on the app, it is uploaded to the web application. Assessors grade each of the 44 sources of resilience on an A–D scale (A being best practice, D being poor). Trained assessors compare source definitions with the collected data, drawing on their experience, training, the user manual and related guidance.

The 44 grades between A and D awarded to each community are then aggregated in different ways for analysis. Aggregations, or “lenses”, by which resilience can be viewed include the 5Cs and the 4Rs. Further lenses are the seven themes by which questions are sequenced thematically (such as healthcare, education, livelihoods etc.), the five steps of the Disaster Risk Management (DRM) cycle (preparedness, response, recovery, prospective risk reduction, and corrective risk reduction) and many more.

## How do we measure the sources of resilience?

We grade each source based on the quantitative and qualitative data points and the benchmarks for best practice.



# What does the FRMC do and not do?

**The FRMC focuses on flood resilience at the community scale.** After long review, and while many aspects or elements of resilience are more general, we believe many are very specific to one peril – in our case flooding – that we wanted to focus our attention on. Also, while resilience can be measured at different scales (national, regional, local), we have chosen to focus on the community level, where flood impacts are felt most strongly, and where much action on improving flood resilience needs to be taken. Also, many humanitarian and civil society organisations (including our Alliance members) primarily work at community level.

Our approach to measuring resilience can be applied to other perils. We can discuss with you how to apply our approach to a different peril using our expertise and approach.

**The FRMC is a decision-support tool** to highlight strengths and weaknesses in community resilience using different perspectives. Results generated with the FRMC can be visualized, arranged and displayed flexibly. This visualization of results provides data for discussions and prioritization exercises, together with the programme communities, to identify interventions to use that could improve community flood resilience. It is also possible to measure the change in resilience in the community over time as strengths are extended and weaknesses improved.

**The FRMC is not a decision-making tool.** It will not identify and select solutions. The grades and scores should provide insight into planning processes as one of many sources of information.

**The FRMC supports decision-making and provides evidence of how resilience in a community changes over time. It is not an M&E tool.** The FRMC is a fully integrated framework and tool to deploy at various stages of a long-term (multi-year) community resilience-building programme to support decision-making and give evidence of how resilience in a community changes over time.

**The FRMC is not a Monitoring & Evaluation tool.** It is not intended to be used as an ex-post project or intervention evaluation framework by external assessors to evaluate a project's efficiency or effectiveness.

**The FRMC framework helps you think deeply about resilience.** It helps you think about the community with all its interdependencies and lets you visualize the system in which a community functions, with its linkages to higher and smaller scales (e.g. regional and precinct or household scales). It helps you identify connections to other aspects of resilience and the interdependencies that connected them. It also helps you think about how interventions and solutions can support more than just one element or source of resilience, and helps you identify intended as well as unintended consequences.

**The FRMC provides information about changes in flood resilience** and the direction of the journey for the communities themselves.

The FRMC is not a competitive tool to compare the performance of communities. The aim is not to compare overall resilience scores or compare individual sets of strengths and weaknesses of communities. The numbers/grades and the quantitative aspects of the FRMC are a guide to what the data means, not the outcome. Numbers should not be used as absolutes, rather as relatives and as part of a trajectory over time.

To find out more about the theory and practical use of the FRMC: [www.floodresilience.net/FRMC](http://www.floodresilience.net/FRMC)

# Can I use the FRMC?

If you operate in a not-for-profit environment to meet community needs, we will consider your interest happily.

The FRMC has been and continues to be applied by the nine organizations comprising the Zurich Flood Resilience Alliance across the world in different geographic, cultural and flood-peril related contexts. Critically, the tool has been designed to be as broadly applicable as possible. For instance, it is currently being deployed in both developed and developing countries, as well as urban, peri-urban and rural settings. It can be applied in communities facing all types of flood threats.

The framework works the same universally – the framework, tool and the data collection processes are the same everywhere – but the interpretation of results and therefore the decision-making processes are highly contextual and can be adapted to specific needs.

The underlying 5C-4R framework and data collected remains comparable and structured so that it will add to our growing pool of data. We can then analyse that data to further refine the framework and improve the overall understanding of what resilience is and how resilience works.

If you fulfil the criteria below, we encourage you to get in touch to discuss how you could benefit from applying the framework in your context of community work.





# How do I apply to use the FRMC?



The FRMC has come out of a not-for-profit multi-organizational alliance and required a heavy in-kind and financial investment. As such, the FRMC will remain purely for not-for-profit societal use and cannot be used in a for-profit business environment.

The Alliance also needs to review what additional cost it might incur by using the FRMC with you (e.g. cost of conducting training, additional IT infrastructure use, etc.), and how you could help cover that cost.

Please fill in the following questionnaire so we learn about your organization, the program in which you intend to apply the FRMC, and the purpose of your FRMC application.

Send the form to [info@floodresilience.net](mailto:info@floodresilience.net) and use a subject title of "FRMC usage request".

We will review your application and then get in touch with you to discuss next steps. In this discussion with you, we will clarify the exact conditions under which this collaboration will work.

## Conditions will include things like:

- signing a terms of reference document laying out the terms and conditions of the collaboration
- the time frame in which you intend to operate
- the level of mutual engagement we foresee.

## Conditions also include more technical agreements of:

- how you will use the tool
- how you will help us grow the underlying database to analyze flood resilience (including agreement of the corresponding data protection)
- your training needs to get ready to use the tool
- the support you will need to successfully implement the entire process
- how any cost incurred by doing this can be covered.



# Expression of interest in using the Zurich Flood Resilience Alliance's Flood Resilience Measurement for Communities

We would like to learn more about the FRMC.

Please review our information provided below and contact us to discuss next steps.

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## Contact details:

Name of organization:

Website:

Contact name at organization (last name and first name):

Function of contact person:

Full address:

Telephone number:

Contact email address:

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## Organization details:

Type of organization (non-profit, research/academic, government, public or civil society sector, other<sup>10</sup>):

Focus area of organization (briefly describe what programs you typically implement):

Area of operation (which global/regional/national/local programmes you typically implement):

Key expertise (briefly explain which key areas of expertise relative to disaster risk management, resilience-building or similar your organization has):

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## Project details:

Type of project where you intend to use the FRMC (briefly describe the aim and scope of the project):

If known, which geographic area is this project operating in and at what scale (name of region, communities, etc.):

Project duration:

Need/motivation to measure community flood resilience (briefly explain how you intend to use the FRMC to measure community flood resilience as part of your project):

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<sup>10</sup> Non-profit groups may include groups such as community groups, non-governmental organizations, labor unions, indigenous groups, charitable organizations, faith-based organizations, professional associations, foundations, and more.

For more information  
visit [floodresilience.net](https://floodresilience.net)  
or follow [@floodalliance](https://twitter.com/floodalliance)  
on social media.

Photo credits: Michael Szönyi, Zurich Insurance

**Intellectual Property note:**

- a)** The Flood Resilience Measurement for Communities (FRMC) has been developed as a product of the Zurich Flood Resilience Alliance (the Alliance) and consists of 1) the measurement framework and associated materials, 2) a hybrid online and mobile app-based software tool, and 3) the data the measurement generates.
- b)** The FRMC framework and associated materials were developed by organizations working through the Alliance. The framework and associated materials are the joint intellectual property of the Alliance. Materials pertaining to the FRMC may be used and reproduced freely for research and non-profit purposes only.
- c) The software:** Zurich Insurance contracted and paid IBM to develop and maintain the FRMC software, and hence Zurich owns the IP that is the software and associated technical guidance. Use of the software may be provided for non-commercial purposes only.
- d) The data:** All data are collected in accordance with ethical data collection practices, and are anonymous at the individual and household levels. The data within the tool ultimately are controlled by the organizations that collected it. As a condition of using the framework, all organizations have agreed that data will be stored in a central database and be used for research purposes following the signing of an access agreement that Zurich is managing.
- e) Use-rights:** The Alliance are keen for the FRMC to be used as widely as possible, within the time-frame of the current phase running until 2023. Existing partners are encouraged to expand use of the tool within the remit of the Alliance. The Alliance invites expressions of interest by new organizations wishing to use the FRMC by filling out an access request.

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