Working paper

Lessons Learned from Measuring Flood Resilience

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Summary

The Zurich Flood Resilience Alliance (ZFRA) has identified the measurement of resilience as a valuable ingredient in building community flood resilience. Measuring resilience is particularly challenging because it is an invisible or latent characteristic of a community until a flood occurs.

The Flood Resilience Measurement for Communities (FRMC) framework measures "sources of resilience" before a flood happens and looks at the post-flood impacts afterwards. The FRMC is built around the notion of five types of capital (the 5Cs: human, social, physical, natural, and financial capital) 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.

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 Phase II (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 characteristics contribute most to community disaster resilience before an event strikes. This contributes to meeting the challenge of demonstrating that the work we do has the desired impact – that it actually builds resilience. No general measurement framework for disaster resilience has been empirically verified yet[1], but the FRMC framework has been developed to eventually generate the data needed to demonstrate empirically which ex-ante measures are most effective for communities.

Our findings suggest that stronger interactions between community functions induce co-benefits among the five capitals, thus providing evidence for a virtuous cycle type effect where higher resilient capacity in one capital fosters the community's capacity for resilience in other capitals.

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[1] Winderl, Thomas. Disaster Resilience measurements: Stocktaking of Ongoing Efforts in Developing Systems for Measuring Resilience, 59pp. United Nations Development Programme, 2014

How the journey began…

In December 2013, the five members of the Zurich Flood Resilience Alliance (ZFRA)—International Federation of Red Cross and Red Crescent Societies (IFRC); International Institute for Applied Systems Analysis (IIASA); Practical Action; Wharton Risk Management and Decision Processes Center; and Zurich Insurance Company—identified the ability to measure resilience as an important step in designing interventions that build community flood resilience. From 2013 to 2017 the Alliance designed and implemented the first version of the **Flood Resilience Measurement for Communities (FRMC)** framework, and subsequently operationalized it into a hybrid platform for application.[1]

The purpose of this report is to present the lessons learned from user testing and feedback about the FRMC and from an empirical analysis of the data generated over the first phase of the Alliance.

Holistically measuring flood resilience

We define *community flood resilience as the ability of a community to pursue its social, ecological, and economic development objectives, while managing its flood risk over time in a mutually reinforcing way.*[2]

Measuring community flood resilience – as it is defined above - is particularly challenging because resilience remains an invisible or latent characteristic of a community until a flood actually occurs. Investigating what makes a community resilient to floods requires data to be collected both before and after a flood event (see Figure 1). With enough time and enough data, community capacities and functionalities can be tested to see whether they are strong enough to help a community withstand a flood and recover better. The systematic approach of the ZFRA is to measure resilience capacity periodically before a flood happens via the sources of resilience, and then to compare the measurements to post-flood measurements of outcomes that capture the impacts afterwards. This enables us to test empirically which qualities affect the ability of many different types of communities to actually manage risk and recover well.
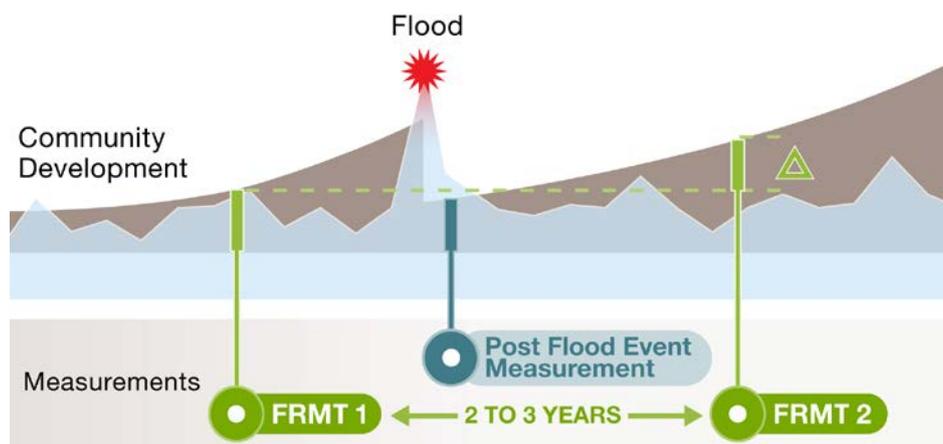
*Figure 1. FRMC 1 (PRE-EVENT) measurement based on 88 assigned grades of "sources of resilience"; POST-FLOOD impact data based on 29 outcome indicators (if a flood occurred in the community); FRMC 2 (repeated PRE-EVENT) measurement, conducted approximately two years after the FRMC 1; qualitative data collected on user experience of using the FRMC, interventions implemented in the community.[3]*

In the first phase of the Alliance, our measure of community flood resilience consisted of 88 indicators[2], called sources of resilience, that are graded by trained FRMC users from A (best practice) to D (significantly below standard) based on data collected in the community (see Figure 2). Together, the sources provide a holistic picture of a community's assets and capacities to pursue its development goals while judiciously managing flood risk.

The sources of resilience are grouped into the five capitals of the Sustainable Livelihoods Framework[4] and other classifications that assist in interpreting the results. The post-flood study is conducted if a flood occurs in the community, consisting of three impact and 26 outcome indicators that add robustness to the decision-making process and help to test the interdependencies between sources of resilience and avoided flood impacts.

We developed the FRMC framework into an integrated, hybrid platform that allows the collection of data needed to measure community flood resilience. The FRMC enables users—usually stakeholders working with flood-prone communities—to create questionnaires, collect data, and assess community flood capacities. The platform generates and visualizes results. All data are anonymized, confidential, and stored on a protected central server

Flood Resilience Measurement for Communities (FRMC) is a web and mobile-based platform that implements the 5C-4R framework and provides the environment for collecting data, assessing sources of resilience, and exploring results.[2]
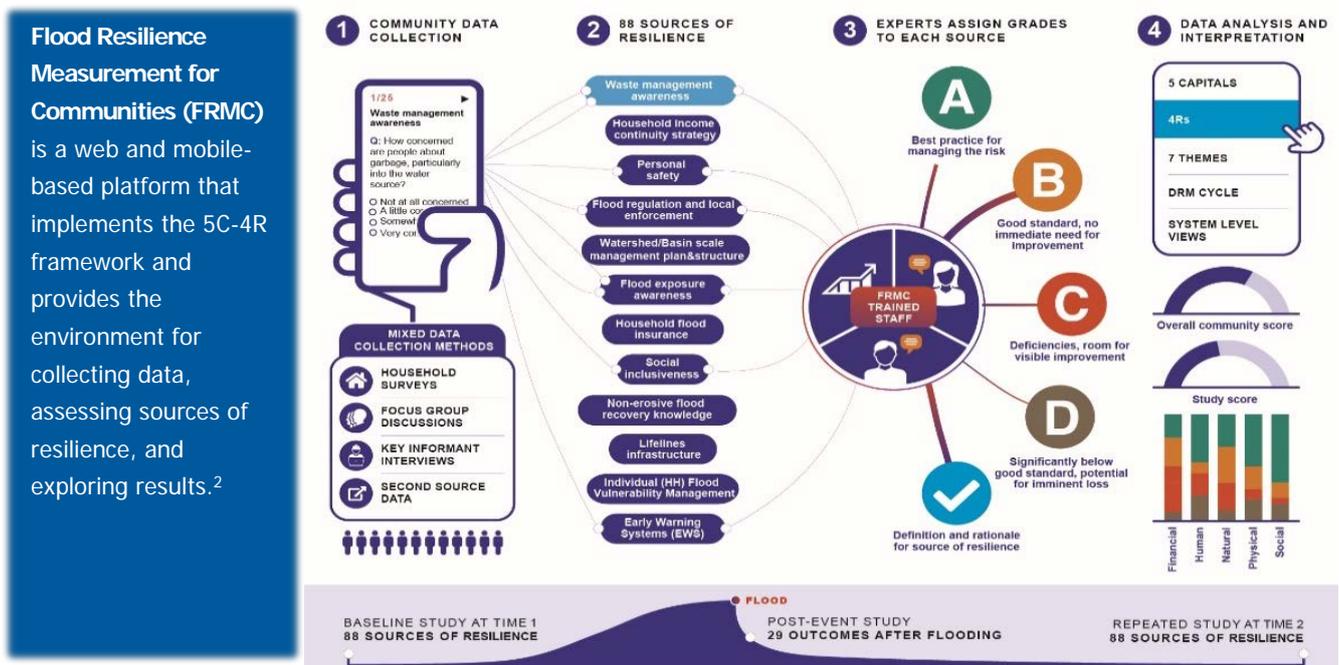
Figure 2 Application of the web-based FRMC platform including community data collection of 88 sources of resilience, grading process through trained staff and data analysis and interpretation through various lenses.[5]

To review the framework and test the platform more widely with communities, four NGO partners (Concern International, Mercy Corps, Plan International, and the National Academy of Sciences of America) joined the Alliance practitioner partners IFRC and Practical Action. In June 2017, pre-event measurements were

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[2] Second version of FRMC consists of 44 sources of resilience

undertaken in 118 communities across nine countries, of which 63 communities repeated the studies after two years. In 20 communities a flood event occurred which triggered a post-flood study.

Why is measuring flood resilience important?

Flooding is a major hazard for communities worldwide, and its impacts cause devastating losses and damage. The 118 communities in our sample (selected because they are at risk and vulnerable) experience floods very frequently—on average every 2.4 years. The communities reported experiencing 499 floods in the last 10 years, of which 76 (15%) were classified by them as being catastrophic in nature. Households in our sample reported that family members were injured, or their property damaged by a flood on average 4.3 times in the last 10 years. The financial impacts of such events can be felt for months to over a year in many communities.[7]

At the community level, the FRMC enables users to track community progress over time in a standardized way. It provides vital information for prioritizing the resilience-building measures most needed by the community. By exploring data across multiple communities, we can generate evidence of which characteristics have contributed the most to community resilience before an event strikes; the research provides the evidence needed to mobilize investment in disaster resilience at the community and higher scales.

Learning from practice and empirical evidence

Our endeavor to be active in 118 communities is, to our knowledge, one of the most extensive applications of a standardized community-orientated resilience measurement framework implemented by diverse partners from NGOs, international organizations and academia. As measuring and validating a measure of flood resilience requires a significant effort in terms of data collection, the usability of the FRMC platform is arguably as important as the measurement framework itself. Throughout the implementation phase, we collected insights from users on their experience of using the platform, together with their perspectives on its content and application in community programs. The research partners in the Alliance—IIASA and Wharton— gathered in-depth feedback from users via surveys, interviews, and two workshops, to explore the consistency and usability of both the framework and the hybrid platform.

Once the process was complete, we complemented this practice-based insight with an analysis of the pre-event study data collected in order to: 1) understand whether the FRMC is consistently measuring the concepts we intend it to, and 2) put together information about the communities that provides us with a picture of community flood resilience across the globe—something that will be critical when we ultimately test the post-event and repeated pre-event data against the benchmark. The initial analysis was performed on pre-event data from 118 communities. The data generated consist of 10,384 (88*118) sources graded from A to D and more than 1.25 million responses to questions at the household and community level. While this analysis is preliminary and does not yet permit an assessment of whether individual sources of flood resilience are effective, it does enhance our understanding of the relationships among the sources and also facilitates user learning in other participating communities.

What we learned about community flood resilience

Feedback from users and data analysis generated a number of findings relevant for knowledge and advocacy around flood resilience at community to global levels. We found that strengths and weaknesses with respect to flood resilience capacity vary considerably across **community and settlement types**; in other words,

sociodemographic and development characteristics are linked with community flood resilience. Particularly important are community **wellbeing, historical flood exposure, education levels, assets, and livelihood strategies, as well as institutional and governance capacity**.[5]

By analyzing flood resilience results according to community characteristics, we developed a typology of community flood-resilience. The typology can be used to guide more general local decision-making processes and to support community programming at higher (regional) and lower (household) scales. Specifically, we found that urban, peri-urban, and rural communities have substantially different challenges when it comes to building flood resilience, and these differences need to be considered when flood resilience interventions are designed. Moreover, **greater emphasis is needed on designing interventions for poor and struggling rural communities with very low coping capacity**.[5]

Building flood resilience requires investment throughout the disaster risk management (DRM) cycle: in both systemic and long-term approaches, as well as in pre-event preparedness. Comparisons across settlement types show that although rural and peri-urban communities are relatively stronger than urban communities in terms of crisis preparedness and corrective risk-reduction measures, the latter are relatively stronger in terms of coping strategies and prospective risk reduction.[63]

We also found that waste management, environmental conditions and management, along with governance and institutional capacity need the most attention for building flood resilience. For rural communities, food security during and after a flood event can also be a critical factor. For urban regions, environmental issues and weak governance are key inhibitors of flood resilience capacity, while the transportation, communication, education and water sectors perform better.[6]

From self-reports of past post-flood financial recovery time, we can show that the sources of resilience most highly associated with faster financial recovery are in the financial and physical capital categories. After a flood, having a household income continuity strategy was particularly important for recovery. Physical access to food markets was also found to support faster financial recovery.[7]

What we learned about measuring resilience

When it comes to measuring resilience, a joint effort on the part of researchers and practitioners is needed to allow the design of flexible approaches that are both rigorous and practical. This was the approach taken by the Alliance, and according to a panel of external expert reviewers: **the FRMC was found to be both conceptually sound and appropriate for use in the field.**

Measuring resilience promotes capacity building and program effectiveness

The process of measuring resilience requires a big investment of time and resources, but users overwhelmingly reported that the FRMC is a very valuable instrument for NGO/humanitarian organization teams in terms of capacity building. The holistic approach encourages practitioners to undertake a deeper analysis of the key strengths and areas of development in the community. This benefit was extended to local field staff, other stakeholders working with the user organization, and importantly, the community members themselves. **The FRMC process fosters the awareness of community members of the multiple and interconnected elements that contribute to their flood resilience, and encourages them to think about the future of flood risk in their community.**

The FRMC allows field teams to collect relatively complex data sets themselves without the need to engage expert consultants or survey companies. The process generates holistic knowledge that is difficult to collect in traditional baseline methodologies. Users in Phase I valued the fact that the platform stores and organizes this wealth of information about communities and their sources of resilience in a secure, integrated, web-based system. This has benefits throughout the project cycle—from intervention, through design, to reporting. **The possibility to analyse and display results in multiple ways was seen as especially beneficial for reaching people in different organizations and sectors.**

Data triangulation and selection of data collection methods are critical to ensure data quality

We find that it is possible for key informants to participate more directly if practitioners have a strong and established relationship with communities. This has a positive impact on the quality of the data collected and better informs resilience grading. As a general conclusion, we recommend that practitioners establish a deep and trusting relationship with communities prior to implementing the FRMC and that they use multiple data collection methods to improve data quality.

Data triangulation, namely, the use of multiple community data input methods, is a critical way of building trust in the decision-making process. As a rule of thumb, **the use of two or more data collection methods can help provide sufficient confidence to the overall process.** The experience of the assessors is a critical contribution to the grading process and should not be seen as being independent from the data.

The type of data collection method selected for each source of resilience is also important. Different methods suit different contexts. For example, a good way of collecting information on **human and physical capital** are **household and community** input methods. Questions regarding **natural capital** require **third-party sources,** and **social capital** questions require **community group–based** input methods. **Household and key informant** input methods are most appropriate for **financial capital** questions.

Post-event studies are essential to understand what makes a community flood resilient

As described above, the FRMC framework generates evidence for what makes communities resilient to floods. Post-event studies are essential for this; when a **significant flood event hits a community, this needs to be documented in a post-event study.** Post-event studies not only contribute to the global research effort of empirically identifying which sources of resilience make a difference across communities, but act as a structured and comprehensive approach to flood impact assessment at the local level, which has **multiple benefits for user organizations** (e.g., monitoring and evaluation support of planned interventions).

Resilience measurement leads to better development programming thanks to richness of data and multiple perspectives of analysis

Measuring community flood resilience allows interventions to be prioritized and designed based on rich information and evidence.[6] In the communities investigated by the Alliance, pre-event studies were able to inform the revision of project plans, enhance project log-frames and revise the community's own development plan. In some instances, the measurement process confirmed or validated the original intervention design. In other cases, it successfully identified gaps to be filled and/or strengths to be built upon, which the user organization could either address itself or support others in doing so.

Regardless of whether or not the FRMC implementation resulted directly in interventions that had not been considered before, teams overwhelmingly reported that the process helped them, their stakeholders, and

communities to see flood resilience in a much more holistic and interconnected way. It facilitated a breaking away from narrow project objectives to consider the underlying issues that the community could directly change with the support of the project, while also providing evidence to advocate for changes in the enabling environment at higher governance levels.

The multiple perspectives of analysis of the FRMC framework (i.e., 5C, 4R, themes or DRM cycle) help to make the most out of the gained data-driven information, showing strengths and weaknesses in a holistic way. It also helps to systematically investigate the interactions among community functionalities (e.g., between social and financial capital, or between waste management and water) and thus to find innovative solutions for flood resilience.

> **Sharing lessons learned in community decision making**
> Communities with access to a variety of lenses by which to understand the sources of resilience (5C, 4R, themes, DRM cycle) can also grasp critical elements that may not have been considered in the past. For example, we found that in terms of coping capacity (DRM cycle), protecting assets and livelihoods is failing significantly, and that coping is largely defined by possessing financial capital. Building financial capital, however, is an abstract strategy, and clear solutions are difficult to find. Thus, by making communities' livelihood strategies more diverse and less dependent on agricultural production, financial capital will profit, and communities will be able to cope better with disaster impacts over time.[6]

What next?

The FRMC data collected in Phase II of the ZFRA will allow us to learn more about flood resilience in a systematic and comparable way at multiple scales. This will continue to build the body of knowledge that can help practitioners, allowing them to make more holistic and risk-informed decisions, and also support stronger evidence-based advocacy. Ultimately, it will help communities build their capacity to be more flood-resilient—this is critical given that flood risk is growing across the globe, and increasingly devastating more and more communities.

We have collected a large amount of data and qualitative feedback on the pre-event implementation process for using the FRMC. We are using the lessons learned from this analysis as part of our research validation process to determine if our sources of resilience can and truly do measure flood resilience. We are not there yet. This is a multi-year process and many more communities need to be added. The communities and implementing organizations collaborating with us in this endeavour have spent many hours training to use the FRMC, training others to use it, gathering and grading data, and providing excellent feedback. The effort has been massive, and after four years of testing and applying, we are confident of having made significant strides toward measuring flood resilience. This system could also be transferable to other perils.

Based on the findings outlined above, and many more, the Alliance revised the FRMC in 2018 and developed the FRMC Next Gen. This revised framework, with only 44 sources of resilience, builds on the success of Phase I with improvements in content and usability. Between 2018 and 2023 the FRMC is being applied in at least 72 communities in 11 countries, generating even more robust data for understanding and improving community flood resilience.

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The **Zurich Flood Resilience Alliance** is a multi-sectoral partnership which brings together community programmes, new research, shared knowledge and evidence-based influencing to build community flood resilience in developed and developing countries. We help people measure their resilience to floods and identify appropriate solutions before disaster strikes. Our vision is that floods should have no negative impact on people's ability to thrive. To achieve this, we are working to increase funding for flood resilience; strengthen global, national and subnational policies; and improve flood resilience practice.
Find out more: www.floodresilience.net

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