

What Motivates Households in Vulnerable Communities to Take Flood Preparedness Actions? *Findings from Applied Research in Tabasco, Mexico*

Zurich Flood Resilience Alliance - Mexico



What Motivates Households in Vulnerable Communities to Take Flood Preparedness Actions? *Findings from Applied Research in Tabasco, Mexico*

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The Zurich Flood Resilience Alliance program aims to advance knowledge, improve capabilities and design strategies that can be implemented to help communities in developed and developing countries strengthen their resilience to flood risk. The Alliance builds on the complementary strengths of each partner institution bringing an interdisciplinary approach to flood research, community-based programs, and risk expertise with the aim of creating a comprehensive approach that will help to promote community flood resilience.

In Mexico, the Alliance's work is implemented through the **Mexican Red Cross**, in partnership with the **International Federation of Red Cross and Red Crescent**, **Zurich Insurance Mexico**, and the **Wharton School's Risk Management and Decision Processes Center**, across 21 rural flood-prone communities in the state of Tabasco.

- *Leveraging a baseline assessment conducted in communities in the Mexican state of Tabasco in 2015, we undertook a statistical analysis of the key drivers of adoption of flood preparedness activities in Tabasco at the household level. The baseline assessment was mostly used to assist in diagnosing key risks and existing capacities of a community leading to improved decision-making and in selecting activities aimed at reducing people’s risk to potential flood disasters. It consisted of data from a 63-question survey conducted with 682 households in ten communities.*

Results indicate that a number of elements already in place in the surveyed communities – such as flood risk maps, early warning systems, availability of shelter – are some of the significant drivers of preparedness actions. Our findings suggest several opportunities for improving and enhancing community preparedness for floods. For example, only 8 percent of the survey respondents indicated knowing their community’s risk map; having knowledge of the risk map is found to significantly increase likelihood of undertaking emergency preparedness.

This case study is intended for a broad range of decision makers interested in enhancing communities’ preparedness for floods, including those in government agencies, the private sector, humanitarian and relief non-profits and research institutions working in vulnerable communities.



<http://mexolions.com/images/tabasco004.jpg>

An estimated 80 percent of Tabasco was under water during flooding in 2007.

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— SUPPORTING COMMUNITIES IN TABASCO, MEXICO TO BECOME — MORE FLOOD RESILIENT

Floods in Tabasco are recurrent, occurring on almost a yearly basis, and flood preparation and response have long been part of the livelihoods and lifestyles of the region's residents.

However, ordinary seasonal flooding has been compounded by cases of extreme flooding such as between 2006 and 2010 when six extreme flood periods marked by continuous intense rainfall for several days occurred.¹ In particular, extreme floods in 2007 were the most severe in about 50 years. Flooding affected about 70 percent of the state. Over one million people were adversely affected (60 percent of the total population of the state of Tabasco),² with 158,000 requiring temporary shelter. The flood caused USD 2.55 billion in total damages (\$350 million insured) to personal and private property, agricultural crops and infrastructure,³ and cut off thousands of people in rural areas from essential services.

For rural riverside communities, the 2007 floods marked the coalescence of a number of significant changes that have been accumulating over time. Precipitation frequency increased between 1970 and 2011.⁴ Changes in land use, especially deforestation, have contributed to increased runoff, soil erosion,⁵ and higher water levels lasting for months. Residents are accustomed to seasonal rains and floods (living with half to one meter height of water for one to two months per year), but not to the new, longer-lasting, floods. Seasonal floods have now increased to one meter or higher, lasting five to six months of the year.⁶ This severe flooding impacts livelihoods, harvest opportunities, schooling, and other aspects of every-day life.

The central goal of our joint activities with these Mexican communities is to measurably strengthen their capacity to better manage this broad range of impacts through a holistic approach to improve their resilience to floods.



A team member of the Zurich Mexico Alliance walks along the San Antonio River. River bank erosion is visible. Conducting household surveys in rural Tabasco communities can involve walking long distances between homes.

Figure I shows the ten communities in Tabasco where the Zurich Mexico Alliance conducted baseline assessments in 2015. These ten communities are: 15 de Mayo; Constitución 1917; El Güiral; El Piñal; La Esperanza; Poblado Chanero; Pueblo Nuevo; Torno Largo 2nd Sección; Torno Largo 4th Sección; and Venustiano Carranza. The communities are located along or near the San Antonio and Usumacinta Rivers as depicted. (The Alliance has done fieldwork in 11 other communities in this Tabasco area in 2014, but those are not the focus of this case study analysis.)

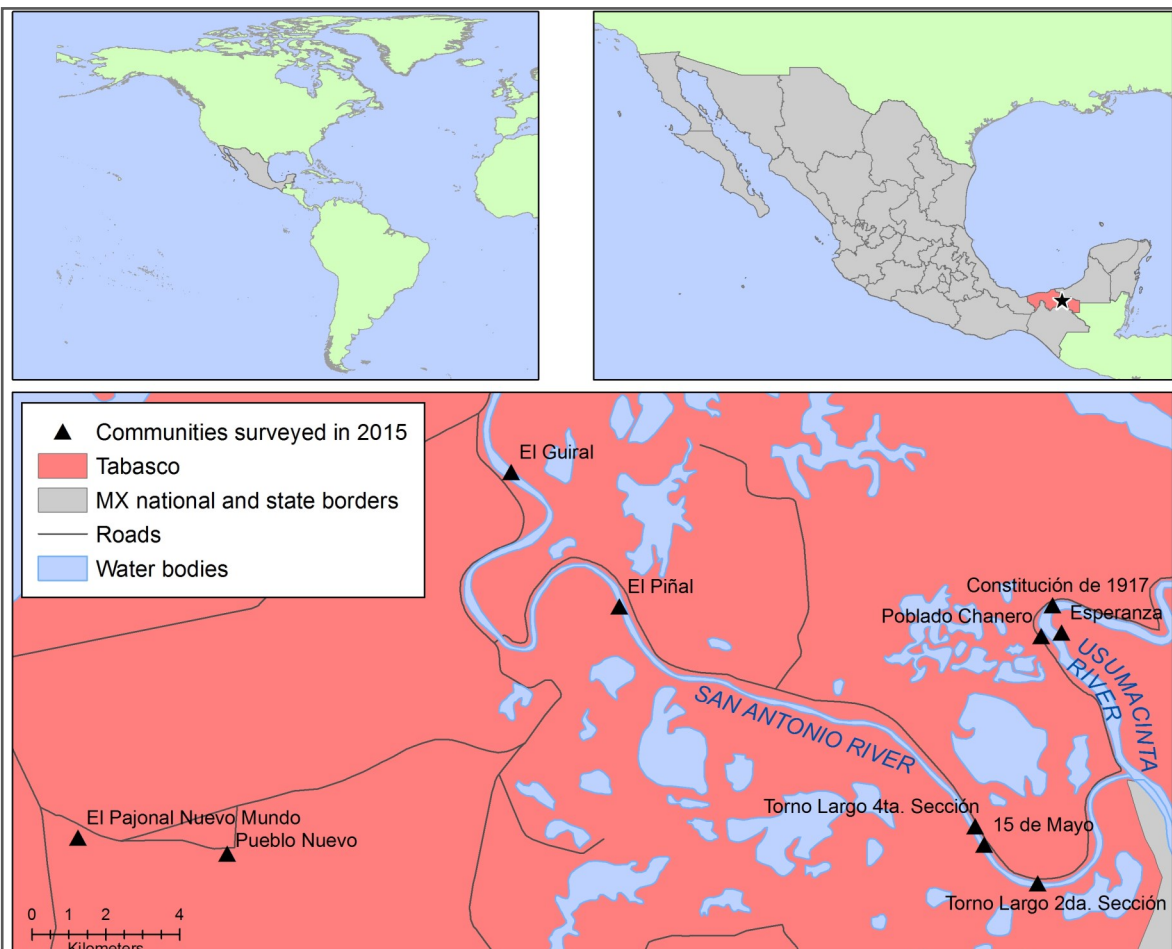


FIGURE I. THE TEN TABASCO COMMUNITIES IN THE STUDY

LEVERAGING BASELINE ASSESSMENT DATA TO UNDERSTAND WHAT DRIVES FLOOD PREPAREDNESS ACTIONS

Before implementing risk reduction and resilience enhancing activities in the ten Tabasco communities where we began working in 2015, the Mexico Alliance team utilized quantitative baseline assessments as well as qualitative methods – Vulnerability and Capacity Assessments (VCA)⁷ and focus group discussions – to determine the communities’ current vulnerabilities to floods and their ability to prepare for and respond to flooding disasters. The VCA process is concerned with collecting, analyzing and systematizing information on a community’s vulnerability to hazards.

Our baseline assessment⁸ complements the VCA by providing concrete data points of the key conditions and indicators prior to any project implementation. It thus serves as an initial reference point for measuring change and progress assessment in the communities over time. All information collected as part of the Red Cross’s community engagement process is used to diagnose the key risks and existing capacities of the community, and ultimately is

expected to lead to improved decision making for selecting activities aimed at reducing people’s risk to potential disasters.

For the 2015 Tabasco community baseline assessment, we designed a face-to-face 63-question survey that was conducted with 682 individual households in these ten communities. Questions were specifically adapted to address the reality of life in these disaster vulnerable rural communities with regard to literacy level, educational attainment, access to financial resources, housing conditions and adoption of certain risk reduction and disaster preparedness measures (the focus of this case study). These baseline data will be used to monitor affected change and impact over time in these communities.

The Wharton Risk Center and our Mexico Alliance partners (Mexican Red Cross, IFRC, and Zurich Mexico) utilize this collected 2015 baseline data to undertake a statistical analysis of the key drivers of adoption of flood preparedness activities in Tabasco at the individual household level.

As noted previously, the purpose of this work is aimed at reducing the consequences of severe floods for households in vulnerable communities. The specific context of this work motivates examining a broader set of activities than is typically considered; projects intended to reduce the consequences of floods often focus on public infrastructure or financial services such as insurance – activities that are out of reach for many of the rural communities with which we have partnered. Instead, we examine preparedness actions related to households’ potential financial exposure (protecting belongings), health and safety,⁹ and specifically those activities that some community members had already carried out that would be feasible for others.

We quantitatively measure what drives residents to take the following four actions:

- 1) **Protect Belongings:** Whether the family has taken actions to protect belongings after the last flood
- 2) **Safe Meeting Point:** Whether the family has identified a safe meeting point to go to during a flood threat
- 3) **Water Purification Method:** Whether the family changes their method of water purification during a flood
- 4) **Emergency Preparedness:** Whether the family has an emergency plan or has participated in first aid training, disaster drills, or training for disaster prevention

The existing academic literature and the Mexico Alliance experience on the ground reveals that these four actions make a big difference when severe flooding occurs, if widely adopted by households in the community. However, the degree of adoption of these actions and, more importantly, the drivers that lead to their adoption are not well understood.

Note: We asked about water purification methods because of the prevalence of waterborne illnesses following floods. Some households may use water purification methods that are effective during floods and so would not need to change their purification methods.

Two ways a family might protect their belongings are a tapanco (loft) (top photo) or tampesco (elevated platform on which to put, for example, a refrigerator) (bottom photo).



LEVERAGING BASELINE ASSESSMENT DATA TO UNDERSTAND WHAT DRIVES FLOOD PREPAREDNESS ACTIONS, cont'd.

Figure 2 provides the household responses to these four flood preparedness actions across 682 households in the ten communities we surveyed. (The smallest community is 19 household responses; the largest community is 109 household responses.)

On average, across these communities, we find that:

- **46 percent of Tabasco community households have taken actions to protect their belongings since the last flood** (across all communities, the range of values is 36 to 58 percent)
- **42 percent indicate they change their water purifying method during a flood** (range of values is 32 to 58 percent)
- **22 percent of Tabasco community households have identified a safe meeting point** (range of 8 to 30 percent)
- **14 percent have undertaken emergency preparation** (range of 7 to 42 percent)



Schoolhouse classroom and bathroom structures in El Piñal, Tabasco, are elevated to avoid inundation from flood water. The black tank on top of the bathroom provides water and pressure to maintain sewage disposal. The facility can serve as a safe meeting point and provide clean water for the community during floods.

Percentage of Community Respondents Undertaking Flood Preparedness Actions

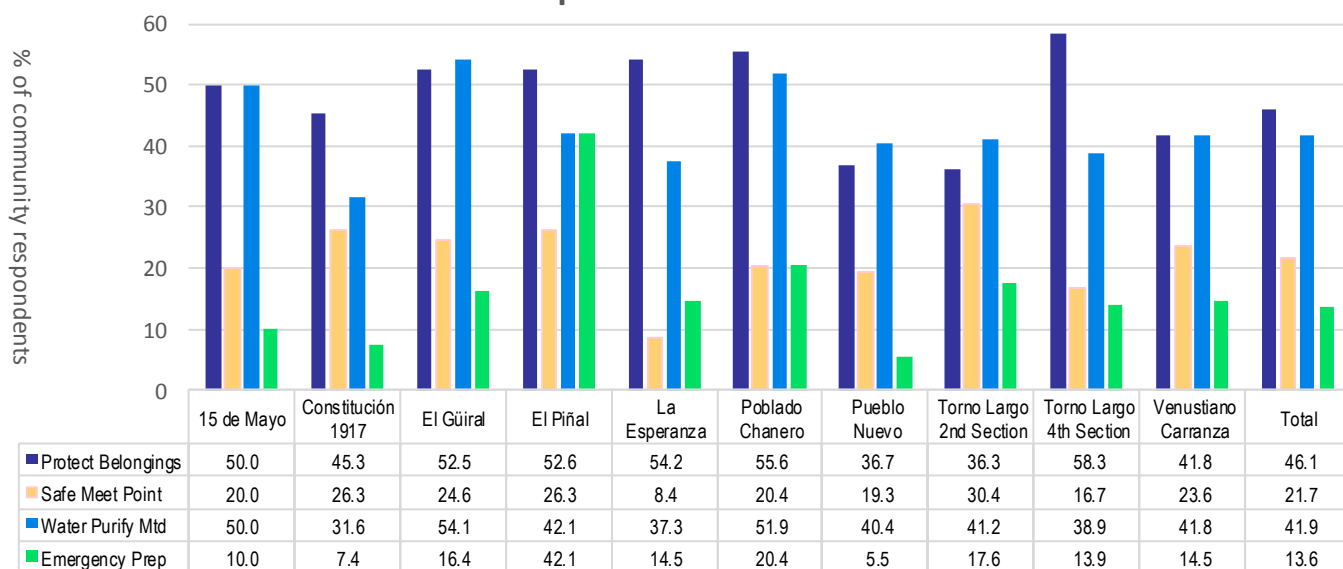


FIGURE 2. BASELINE ASSESSMENT: PERCENTAGE OF HOUSEHOLDS TAKING FLOOD PREPAREDNESS ACTIONS IN TABASCO COMMUNITIES (DATA AS OF 2015)

We see these findings as encouraging but they also demonstrate that much more could be done for many residents in these communities to improve their flood preparedness.

The next question is what leads some households to undertake some of these four identified flood preparedness actions while other households do not? To answer this, a statistical analysis is required, to which we now turn.

RESEARCH METHODOLOGY

In order to determine the key drivers that motivate surveyed Tabasco households to undertake each of these four flood preparedness actions we collected data to perform multiple regression analyses.¹⁰ The regression analyses allow us to predict the variable of interest, that is, whether a household undertakes a risk reducing action or not – based upon a set of relevant explanatory variables observed in the baseline data.

For the purposes of the regression analysis, all the risk-reducing action variables are coded as 1 or 0, where 1 indicates that the household undertook the risk reducing action, and 0 indicates that the household did not. To illustrate, a household response would be coded as 1 if a respondent answers “yes” to the question as to whether after the last flood the family took actions to protect their belongings, and would be coded 0 if they had not taken these actions. (See Table I for coding descriptions of the four flood preparedness measures.)

TABLE I. DEFINITIONS OF FLOOD PREPAREDNESS ACTIONS (OUTCOME VARIABLES)

Flood Preparedness Actions	Survey items and coding
Protect belongings	After the last flood, has your family taken measures on improving what to do in case of flooding? If yes, what were the agreements? (coded 1 if yes, and agreement was actions to protect belongings, coded 0 if no) <i>Note that the other possible agreements responded to are people whom to call in case of flooding; moving to a relative’s home or shelter; and other. 80 percent of the agreements were for actions to protect belongings with the next closest agreement being 11 percent indicating people whom to call in case of flooding.</i>
Safe meeting point	Does your family know or have a safe meeting point? (coded 1 if yes, 0 if no)
Water purification method	Are your methods for purifying water different during floods? (coded 1 if yes, 0 if no)
Emergency preparedness	Does your family have an emergency plan? Has your family participated in first aid training, disaster drill, and/or training for disaster prevention? (coded 1 if yes to any of these items, 0 if no)

To determine the potential set of explanatory variables to be included as flood preparedness drivers based on the responses to our 63-question survey, we referenced the academic literature on risk mitigation decision making. Approximately 30 plausible flood preparedness drivers assessed in the baseline emerged as applicable for our analyses; of these, ten emerged as most relevant through an iterative statistical procedure.¹¹ (See Table 2 for the set of the ten most relevant flood preparedness explanatory variables and coding descriptions included in the regression models.) We also incorporated into the regression models applicable data gathered from the Mexican National Institute of Statistics and Geography (INEGI;

<http://www.inegi.org.mx>) on flood hazard, flood exposure, and socio-demographic characteristics of each of the ten communities. This data includes elevation in meters, distance to the nearest river (Usumacinta or San Antonio) in meters, percentage of the population employed, percentage of the population over 15 years old with no primary school education, percentage of households with a vehicle, percentage of households with a radio, percentage of households with a refrigerator, and percentage of households with a television. These additional regression analysis controls are collected at the community level. Their inclusion is important for proper causal identification of the individual household explanatory variables.

TABLE 2. DEFINITIONS OF FLOOD PREPAREDNESS DRIVERS (EXPLANATORY VARIABLES)

Flood Preparedness Drivers	Survey items and coding
Know the risk map	Do you know the risk maps in your community? (coded 1 if yes)
Sharing of experience	In your family, do grandparents, parents, children or grandchildren share the experiences and lessons learned from the floods? (coded 1 if yes)
Help neighbors	During floods, do you help your neighbors? (coded 1 if yes)
Early warning system	Has an early warning system (such as siren, whistles, bells, speakers, buzzers, etc.) been realized for the betterment of the community? (coded 1 if yes)
Shelter availability	Do you have a shelter available in case of flooding? (coded 1 if yes)
Services and programs to help after floods	Does this community offer services and programs to help people after the flood? (coded 1 if yes)
Protective actions at the household level	Have actions at the household level, such as raised floors, palafitos, tapescos, or tapancos been undertaken protect against the risk of flooding? (coded 1 if yes)
Protective actions at the community level	Have actions been undertaken by the community to protect against the risk of flooding at the community level, such as making embankments, constructing barrier walls?
Severely affected by flood	In the last 10 years, has your family been severely affected by flooding? (coded 1 if yes)
MXN pesos lost >5K	How much was lost during the worst flooding? (coded as 0 if less than or equal to 5,000 Mexican pesos and 1 if more than 5,000 Mexican pesos)

FINDINGS

We find that various drivers contribute to explaining whether households will engage in preparedness actions. Given the binary structure of those actions, the regression analysis provides the probability of the preparedness activity increasing or decreasing for each statistically significant explanatory variable.

For example, the analysis indicates that the probability of taking further actions to **protect belongings** is increased by:

- 23 percent for those who share experiences with family;
- 24 percent if services and programs are available to help after the flood;
- 16 percent if measures to protect against the risk of flooding were undertaken at the household level, such as raised floors, palafitos (housing on stilts), tapescos (elevated platforms, for example on which to put a refrigerator), tapancos (loft for storage);
- 13 percent if actions to protect against the risk of flooding were undertaken at the community level (making embankments, barrier walls);
- 43 percent for those who were severely affected by flood in the last 10 years;
- 18 percent for those who lost greater than 5,000 MXN during the most recent flood.¹²

This water system (under construction) will serve several homes and is managed by a local, community-based water committee. It is placed on an elevated concrete pad to avoid inundation from flood water.

Likewise, the probability that a family has a **safe meeting point** is increased by:

- 10 percent for those who share experiences with family compared to those who do not;
- 14 percent for those who know that a shelter is available during floods compared to those who are unaware of the availability of shelter in their community.

The probability of **changing water purification method** is increased by:

- 20 percent for those who know the risk maps;
- 18 percent for those who share experiences with the family.

The probability of taking part in **emergency preparedness** is greater by:

- 12 percent for those who know the risk maps;
- 13 percent if an early warning system is available;
- 7 percent if shelter during floods is available.



Table 3 reveals a number of unexpected statistically significant inverse relationships between the preparedness drivers and the water purification method during flooding conditions. We had expected that those who were severely affected by flooding in the past 10 years would have been more likely to have a different water purification method during the flood instead of less likely as our results indicate. After conferring with the IFRC, we determined that many community members

probably do not change their water purification methods during floods because they are already using methods that are safe in flood conditions, such as boiling water and buying bottled water.

Our findings also highlight difficulties in measuring and assessing the effects of a community’s social aspects (i.e., ‘help neighbors’), and reinforces the need to continue to explore ways to effectively measure social cohesion.

TABLE 3. REGRESSION ANALYSIS SUMMARY RESULTS

Flood Preparedness Drivers	Flood Preparedness Actions			
	Protect Belongings	Safe Meeting Point	Water Purification Method	Emergency Preparedness
Know the risk map			(+) ***	(+) ***
Sharing of experience	(+)***	(+) **	(+) ***	
Help neighbors			(-) ***	(-) ***
Early warning system				(+) **
Shelter availability		(+) ***		(+) **
Services and programs to help after floods	(+) ***		(-) ***	
Protective actions at household level	(+) ***		(-) ***	
Protective actions at community level	(+) ***			
Severely affected by flood	(+) ***		(-) ***	
MXN pesos lost >5K	(+) ***		(-) *	

Note: For each of the four preparedness actions, a (+) indicates a statistically significant positive relationship and a (-) indicates a statistically significant negative relationship between the flood preparedness driver and the applicable flood preparedness actions. The “*” indicates the statistical significance level (***1 percent, **5 percent, *10 percent). Only significant variables are reported. For coefficient values, please contact the authors.

≡ PUTTING FINDINGS INTO COMMUNITY RESILIENCE ACTION

These results suggest opportunities to work with communities to better select interventions that are more likely to lead to concrete preparedness actions taken.

For example, our regression analyses indicate that knowing the risk maps increases people's likelihood of purifying water and undertaking emergency preparedness activities. However, only 8 percent of the respondents indicated knowing the risk map in their community (about two-thirds of those who knew the risk maps changed their method to purify water). Other low respondent percentages exist for knowledge of early warning systems (2 percent), shelter availability (15 percent), and services to help after floods (17 percent). Better communicating this information is thus crucial.

Understanding the key drivers also helps resilience practitioners and change agents within communities to target their interventions to specific activities that have been shown to lead to resilience-building actions by families and communities. For example, sharing experiences of previous floods is positively related

to three of the key actions (protect belongings, have a safe meeting point, and change water purification method) that families can take to increase their resilience to floods. Resilience programs should thus ensure that interventions include the opportunity to share information, as this will contribute to more families taking action.

We also see evidence that community level protective actions already in place, such as community embankments, lead to better individual household flood preparedness. This is an important finding in light of the implementation of community level resilience activities by the Alliance program in Mexico.

Following the baseline survey, the Mexico Alliance is engaged in community activities focusing on the key drivers of flood preparedness actions as suggested by the survey findings (see Table 4).

The Alliance shall continue to support assessments that capture the needs, risks, vulnerabilities and capacities of all members of the community, as well as the dynamic and complex context in which a community exists.

This home (left side of the photo) in El Piñal can avoid flooding, since water would collect in the drainage ditch (lower right side of the photo).



Since the baseline survey implementation, for each of the key drivers of preparedness actions, the program in Mexico has engaged in activities in the communities to enhance capacity and capability of community members (Table 4).

TABLE 4. MEXICO ALLIANCE PROGRAM ENGAGEMENT ACTIVITIES SUGGESTED BY THE SURVEY FINDINGS AND KEY FLOOD PREPAREDNESS DRIVERS IN TABASCO, MEXICO

Flood Preparedness Drivers	Number of Engaged Communities (out of 10)	Engagement Activities
Knowledge of risk map	10	VCAs, possibilities to explore technical risk maps
Sharing of experience	10	Through community based exercises, education courses, and assemblies
Help neighbors	10	Reinforced through our community based interventions
Early warning system	To be determined	Planning currently underway for prototype EWS
Shelter availability	1	E.g., community center
Services and programs to help after floods	2	Implementing trainings to communities interested in learning how to seek government support (e.g. application for grants, requests for services)
Community actions at household level	10	E.g., as a community, households agree to make individual family plans
Community actions at community level	10	E.g., all communities have trained and equipped emergency response teams

≡ SUMMARY AND NEXT STEPS

The Alliance team leveraged collected baseline household survey data to undertake a statistical analysis of the key drivers of the adoption of selected number of flood preparedness activities in Tabasco at the individual household level. This quantitative approach complements qualitative approaches of community work through workshops and training on the ground.

A number of factors were found to be significant drivers of flood preparedness. Many of these are included in the flood resilience measurement tool being developed by our Alliance. The Alliance team has also developed and piloted a pre-flood event survey in a number of other Tabasco communities prior to the annual flood season in 2015. The aim

of this work is to highlight the importance of perceptions and behaviors of individuals, as we have done in other flood-prone community environments including New York City.¹³

Based on academic and practical expertise, the survey questions are clustered along the following five categories: (1) perceptions of flood risk; (2) attitudes and feelings towards floods; (3) experience with and knowledge of flood; (4) activities that reduce flood risk; and (5) expectations about disaster relief. The results of the pre-flood event survey along with the data described here will further inform interventions in collaboration with the local communities in Mexico in the coming months and years.



Endnotes

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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 (IFRC), the International Institute for Applied Systems Analysis (IIASA), the Wharton 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. Our collective goal is to work closely with a number of communities in need on the ground, and also to develop a body of new knowledge and expertise that can be applied much more broadly as we work with business leaders and policymakers in OECD and non-OECD countries.

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