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Preparing for urban floods in Mozambique: A field experiment on risk communication

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A Field Experiment on Risk Communication

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Abstract

Accurate forecasts and risk information do not always bring about the desired preparedness actions from communities at risk of natural disasters. This paper provides evidence on the effectiveness of two video interventions aimed at increasing flood risk awareness and preparedness of households in a Mozambican coastal city. Awareness and the intention to prepare increase after watching the video in which public officials disseminate the information. The video featuring flood victims is less effective, but recent flooding experience matters for the results. Finally, I demonstrate that the information disseminates among neighbors.

JEL Classification: C93, D83, D91, O12, Q54

Keywords: Risk communication, urban flooding, video intervention, field experiment, Mozambique

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1 Introduction

Climate change has increased the frequency and intensity of extreme weather events such as heatwaves, heavy precipitation, droughts, and tropical cyclones (IPCC, 2021). These natural disasters undermine sustainable development and challenge efforts to reduce poverty. They destroy homes, assets, public facilities, and infrastructure. Moreover, they can have severe health impacts for the affected population, including loss of life. The associated economic losses disrupt livelihoods and adversely impact social and economic outcomes. The poor are most affected and least able to cope with disaster-related losses, making it more difficult for them to escape poverty (Carter et al., 2007; Morduch, 1994). Improving individual and community resilience to disasters is, therefore, crucial to promoting inclusive and sustainable economic growth (Benson, 2016). It is important to consider how cities address the risks associated with natural disasters and climate change, considering the rapid urbanization of Sub-Saharan Africa. In particular, small and medium-sized low-income cities are vulnerable to extreme climate events. Rapid population growth, limited financial resources, and low state capacity exacerbate the problem.

The management of risks related to climate and natural disasters requires local involvement and understanding. For facilitating this, information dissemination can be a powerful tool to guide, educate, and capacitate households in preparation for inevitable shocks affecting their livelihoods. Rational behavior is expected in response to information about disaster-related risks and, in particular, early warning messages (e.g., in the form of preparation or evacuation).[1] However, risk information and accurate forecasts do not always bring about the desired preparedness action from communities at risk of natural disasters (Ayeb-Karlsson et al., 2019). For example, in the case of the 2019 Cyclones Idai and Kenneth in Mozambique, even with accurate forecasts and warnings, many people failed to fully comprehend the storms' potential intensity and impacts and did not know how to take concrete actions to protect themselves and their livelihoods (Norton et al., 2020). Possible explanations for such failure of risk communication include problems with the design and delivery of the information, lack of trust in authorities, and misunderstanding of the risk perceptions of communities (Ayeb-Karlsson et al., 2019). When these issues are overcome, preparedness action can be improved. For example, while limited awareness and low literacy levels cause difficulties in understanding risk insurance in low-income countries (Churchill, 2007), Gaurav et al. (2011) showed that an intensive education campaign could improve risk insurance demand.

This paper provides evidence on the effectiveness of a disaster awareness campaign aimed at addressing the challenges associated with risk communication. I test the effectiveness of information for resilience-building by providing contextualized, actionable information aimed at increasing flood risk awareness and willingness to manage and mitigate risk among vulnerable urban households. Specifically, I evaluate two interventions disseminating

[1] Early warning systems warn citizens about the arrival of storms, flooding, or other disaster events and provide instructions.

information through videos about flood risk, the impact of flooding, and guidance on preparation. The video content is informed by the idea that risk information is particularly effective if bundled with practical information on protecting against floods (Haer et al., 2016; Wong-Parodi et al., 2018). The two interventions differ in the people speaking and featured in the videos. In the *public officials* intervention, the information is delivered by local government officials responsible for disaster risk management. Depending on trust in authorities, knowledge and professional experience are expected to contribute to the acceptance of the information. This intervention is essential from a policy perspective because any large-scale (country-wide) information campaign will be associated with the authorities. In contrast, the *flood victims* intervention features residents who draw on their recent flooding experience to deliver the information. This intervention is possibly more persuasive because it features speakers similar to the viewers (Bernard et al., 2015). Through this intervention, I examine the potential of peer learning related to risk mitigation and the importance of social norms.

The context of this study is the coastal city of Quelimane, located in the central region of Mozambique and vulnerable to a multiplicity of climate threats, such as cyclones, flooding from rain, storm surge, and rising sea levels. The intervention videos are shown during in-person surveys with chiefs and randomly sampled residents in the months preceding the 2021-2022 wet season. Measurements include multiple sources of data: surveys with households and chiefs and individual surveys conducted during scale-up visiting, a behavioral experiment, and behavioral measures based on SMS technology. I find the *public officials* intervention to increase risk awareness and the intention to prepare among households and community leaders. The *flood victims* intervention is less effective, but recent flooding experience matters for the results. The interventions are most effective among households without recent flooding experience. Gender analysis indicates that the *public officials* intervention is at least as effective for women as it is for men, making it gender-responsive. Finally, I demonstrate that the information disseminates among neighbors.

This paper contributes to a large and diverse literature on information provision interventions (Haaland et al., 2021), in particular through video (Bernard et al., 2015). The findings provide new evidence on the impact of risk information on flood risk perceptions and preparedness. The reported effectiveness of risk communication in recent studies is mixed. On the one hand, several studies find positive effects on stated risk perceptions and intentions to prepare (Bodoque et al., 2019; Lieske et al., 2014; Maidl and Buchecker, 2015; Karanci et al., 2005; Ronan et al., 2012; Keller et al., 2006), as well as an increase in the demand for flood insurance (Borsky and Hennighausen, 2022; Hudson et al., 2017). On the other hand, a number of papers conclude that risk communication has at most limited effects risk perception (O'Sullivan et al., 2012; Terpstra et al., 2009) and actual behavior (Osberghaus and Hinrichs, 2020; Attems et al., 2020; Soane et al., 2010).

Most of the studies on risk communication employ cross-sectional or quasi-experimental designs. Randomized experiments measuring real behavior are sparse. Several experiments in the Netherlands show that communicating flood risk increased information seeking and intention to prepare (Kievik and Gutteling, 2011; de Boer et al., 2014), demand for risk insurance Botzen et al. (2013), and flood risk related investment (Mol et al., 2022). In the United States, the results of a randomized survey experiment suggest that showing examples of protective actions alone or combined with risk information increased the intention to prepare (Wong-Parodi et al., 2018). In a randomized field experiment, Allaire (2016) find that providing practical information about neighbors' purchase of flood insurance increased the uptake of insurance among flood-prone households in Bangkok, Thailand. These studies show the potential of information provision interventions in the context of disaster risk management. I contribute to this literature by conducting a randomized field experiment in a low-income country.

This paper also contributes to an emerging literature studying the effectiveness of disaster risk management interventions in developing countries. For example, Sarabia et al. (2020) use a mixed-methods approach to evaluate a comprehensive program including risk assessments, training on prevention and mitigation plans at the individual and community level, capacity building with local authorities, and implementation of mitigation measures in Honduras. The program had positive effects on knowledge and preparedness of households, social cohesion and preparedness at the community level, and management of natural assets. Moreover, Newman et al. (2019) evaluate a randomized intervention aimed at promoting collective action through community-based organizations in Dakar, Senegal. They find evidence that social recognition and low-value in-kind incentives improved the cleanliness of treated neighborhoods and reduced levels of flooding.

The remainder of this paper is organized as follows. Section 2 discusses the context in which the experiment took place. Section 3 provides a detailed overview of the research design. The estimation strategy is described in Section 4. Section 5 discusses the results, and Section 6 concludes.

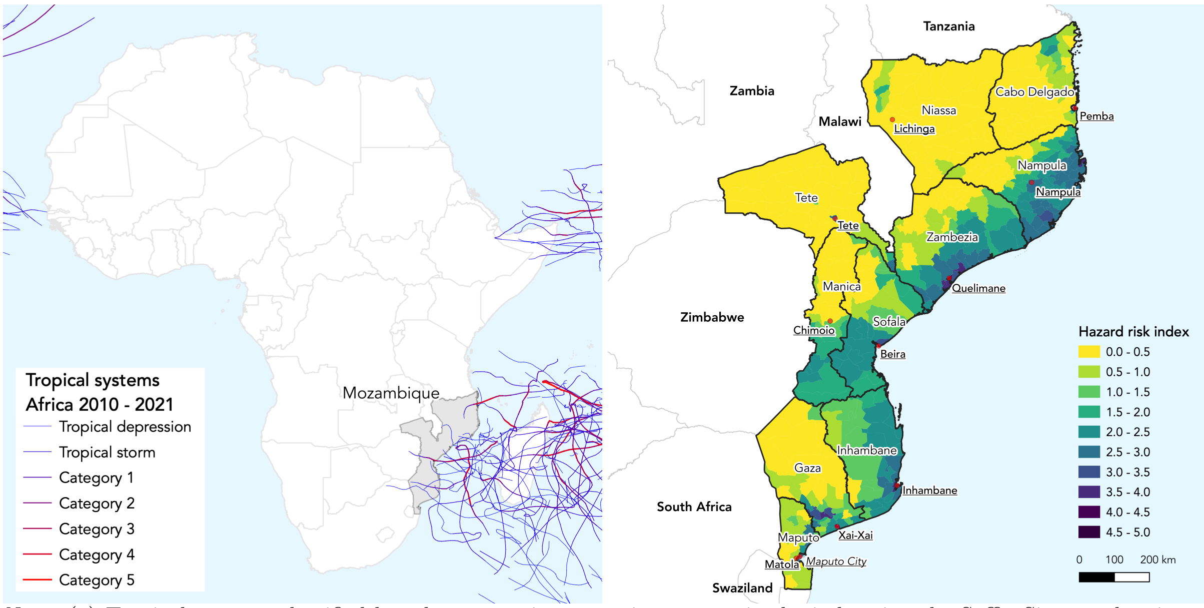
2 Context

The Mozambican coast is vulnerable to natural disasters and climate change. Figure 1a shows the tropical systems that have affected the African continent and, in particular, Mozambique from 2010 to 2021. Cities on the Mozambican coast are highly vulnerable to tropical storms, flooding from rain, storm surge, rising sea levels, and coastal erosion (World Bank, 2011). Figure 1b presents the geographic distribution of risk induced by winds, floods, and landslides. This map clearly shows the higher climate risk faced by coastal cities such as Quelimane compared to the rest of the country. The local weather is characterized by a tropical savanna climate with two seasons: a dry but humid season from May to November and a wet and oppressive season from December to April.

Figure 1: Tropical Systems and Hazard Risk Index

(a) Tropical Systems, Africa

(b) Hazard Risk Index, Mozambique



Note. (a) Tropical systems classified based on one-minute maximum sustained winds using the Saffir–Simpson hurricane scale. Data provided by NOAA International Best Track Archive for Climate Stewardship (Knapp et al., 2010). (b) Estimated risk index of extreme winds, floods, and landslides from 1 (*low risk*) to 5 (*extreme risk*). Raster data is averaged at the administrative post level. Data provided by Global Risk Data Platform (UNISDR, 2011).

Quelimane is Mozambique's sixth-largest city and the administrative capital of the Zambezia province. The approximately 350,000 inhabitants of Quelimane are spread over five administrative posts, 54 neighborhoods, and more than 500 city blocks (INE, 2017). The population of Quelimane is growing rapidly due to a continuous influx of rural migrants. This influx has increased the number of informal settlements in flood-prone parts of the city, which are particularly vulnerable due to their poor socio-economic conditions (World Bank, 2020). Quelimane is a seaport, but its position as a trade center has become less significant. The unemployment rate is high, and most of the city's residents live off informal trade, fishing, and agriculture.

Each administrative unit (i.e., administrative post, neighborhood, and city block) is headed by a chief (or community leader). The administrative post chiefs are public officials employed full-time and appointed directly by the governing party. Their responsibility is to assist the municipality in performing its public tasks, and they look after the administrative post in social terms. Neighborhood and city block chiefs are also appointed directly by the municipality, assisted by the administrative post chief. They support the administrative post chief in fulfilling responsibilities but do not enjoy full-time public employment. Therefore, these chiefs rely on other sources of income, such as an informal business, job, or farming.

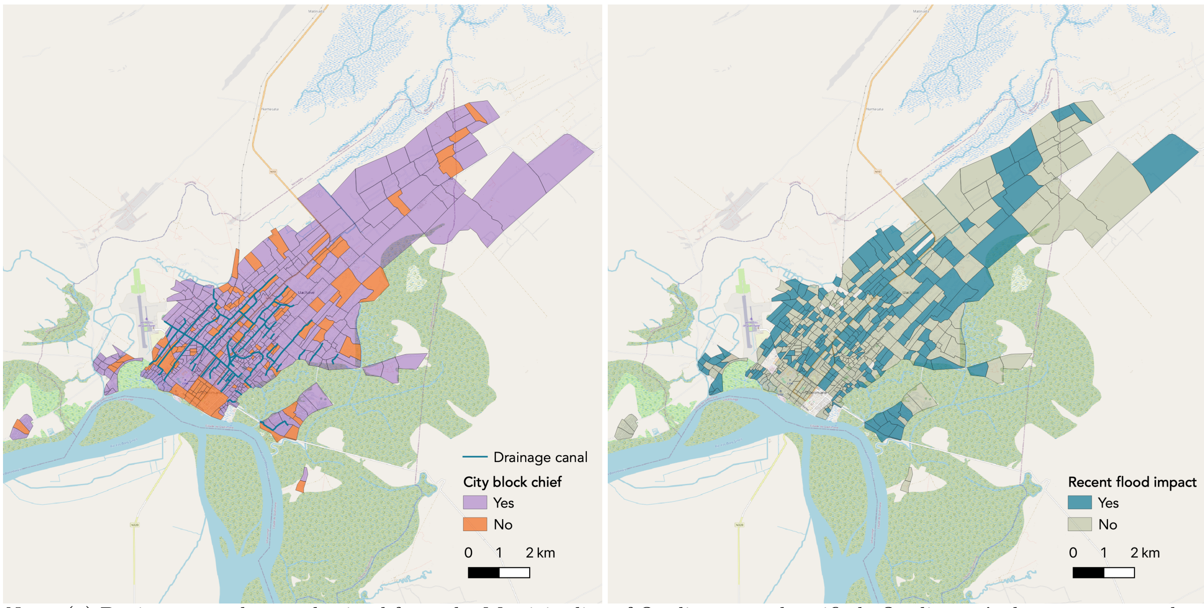
Within the local disaster risk management structure, chiefs play a critical role as the facilitators of communication between Quelimane's local government and its citizens. They also organize local risk mitigation efforts, such as cleaning streets and drainage canals. After the national disaster risk management institute, they are the most important source of disaster warning and mitigation information for households that were interviewed as part of this study. Public officials doing work related to disaster risk management and community leaders in Quelimane are also trusted more than neighbors and people in general.

The municipality's emergency operations center is responsible for disaster risk management at the local level, including the preparation and implementation of initiatives related to prevention, mitigation, and preparedness. Local flood risk management has been improving in recent years. The municipality has been improving and extending the drainage system, seeking to intensify early warnings, and establishing local disaster risk management committees. However, the municipality has difficulties maintaining this progress. First, large parts of the city are not yet connected to the drainage infrastructure (Figure 2a). Moreover, the drainage canals collect a large amount of solid waste, which prevents rainwater from moving away, causing local floods. Second, only one of the five administrative posts had a dedicated and active disaster risk management committee prior to the 2021–2022 wet season. In the other administrative posts, neighborhood chiefs have been charged with these responsibilities. Third, the early warning system depends heavily on neighborhood and city block chiefs to disseminate alerts door-to-door, but about 20 percent of the city blocks do not have a chief (Figure 2a), and Quelimane's residents generally do not know the name of their current chief.[2]

[2] Of the 642 household survey respondents, only 30 percent were able to recall at least the first or last name of the city block chief. For the neighborhood chief, this is 40 percent. While, this is not a perfect measure of knowing who the chief is, it is arguably more accurate than simply asking a direct question because 22 and 25 percent of the respondents mentioned another person for block and neighborhood chiefs, respectively.

Figure 2: Local Flood Risk Management Challenges

(a) Drainage Canals and City Block Chiefs (b) Recently Flooded City Blocks



Note. (a) Drainage canal map obtained from the Municipality of Quelimane and verified. Quelimane's downtown area close to the river is served by an advanced drainage system not shown on this map. City blocks are categorized as not having a chief if no chief was appointed or if it was not possible find the chief after multiple attempts during the period of a month. (b) City blocks are categorized as recently flooded if community leaders report flood events that impacted the city block in 2019, 2020 or 2021. Basemap: © OpenStreetMap contributors.

Local flooding events that affect the livelihoods of urban households occur every year in Quelimane. Of the household survey respondents, 55.5 percent reported to have been affected, and 33.5 percent reported a recent experience (last three years). Figure 2b shows the city blocks that, according to the community leaders, have been impacted by flooding in recent years (2019–2021). The map does not provide a clear pattern on the likelihood of being flooded based on location. The impact of flooding on households materializes mainly in damages to homes, loss of assets, and health problems. Based on self-reported damage assessments for a single flood event of 352 affected households, the economic damages are estimated at 43,064 meticais ($689). For these households, this is about 39 percent of the average annual household income of 111,426 meticais ($1,783).[3] This shock is absorbed primarily with assistance from family and friends, loans, additional work, and the selling of assets.

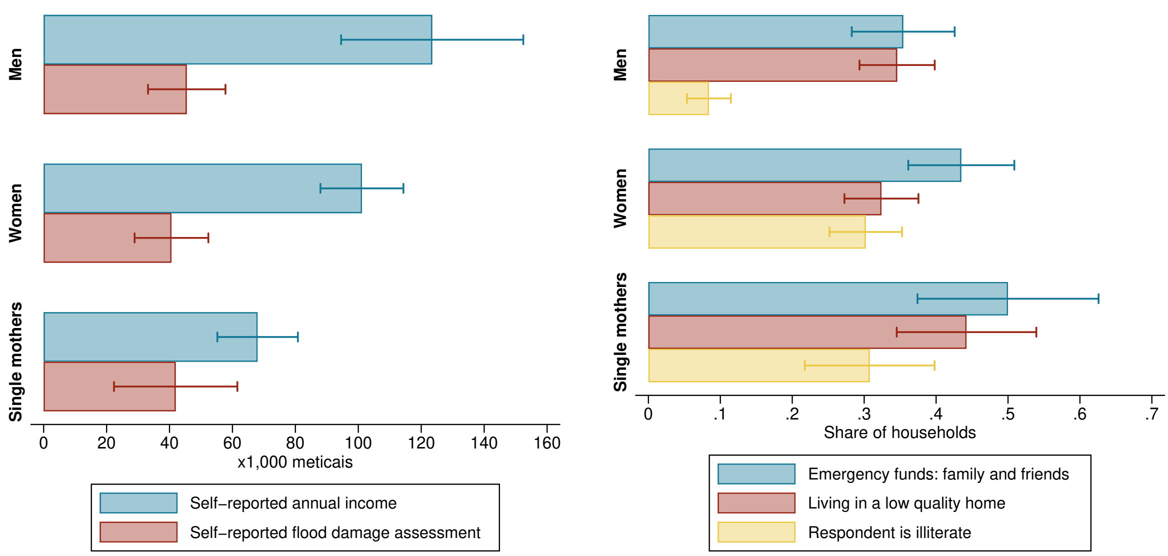
Women, especially single-mother households, are particularly vulnerable to the impacts of disasters (Erman et al., 2021). These households tend to be poorer and have less income, while the potential flood damage is similar to that in other households (Figure 3a). For single-mother households, the average flood damage for a single event is 62 percent of the average annual income. These households are also more likely to report their families and friends as their primary source of emergency funds and live in homes of lower build quality. Women, in general, have a higher illiteracy rate than men do (Figure 3b), which can prevent these households from receiving and understanding crucial disaster-related

[3] As of September 2021, 1,000 meticais is around $16.

information before, during, and after an event.

Figure 3: Vulnerability to Disaster Impacts by Gender

(a) Annual Income and Economic Damages (b) Vulnerability Indicators



Note. Capped lines indicate the 95 percent confidence intervals. Figures based on the household survey with 642 respondents (321 men and 321 women of whom 104 are single mothers). Low-quality homes include huts, improvised homes, and simple homes often without any bricks.

There are several low-cost mitigation measures available to urban households to reduce the impact of flooding. Households can prepare by discussing and implementing a domestic emergency plan, identifying sources of information as well as evacuation routes and shelters, storing valuable documents in a safe location, making home improvements, preparing food and drinking water kits, and helping clean the neighborhoods and their drainage canals.

3 Experimental Design

3.1 Interventions

I study two interventions disseminating information through six-minute videos, a *public officials* video, and a *flood victims* video. The videos were incorporated into surveys with the target population, which took place from September to November 2021. The goal of the interventions was to improve the respondents' flood risk perceptions and preparedness. The video interventions contained the same information about flood risk, the impact of flooding, and guidance on preparation. The visuals in the videos alternate between the speakers, images, and video recordings that help convey the message. Publicly available images and recordings of local news outlets were used for this purpose. The same visuals were used in both interventions. The standard Portuguese versions of the videos were also dubbed in Chuabo, the most common local language, to promote inclusiveness among all ages and education levels. In the *public officials* intervention (Treatment 1 or T1), the information was delivered by local government officials (one man and one woman) responsible for disaster risk management. The *flood victims* intervention (Treatment 2 or T2) featured two residents (one man and one woman). These actors drew on their recent flooding experience to deliver the information. Finally, to measure the effectiveness of the interventions, I created a *placebo* video (Control or C). This six-minute video contained general information about Quelimane, its history, and its main economic activities. This information was delivered by residents, contained images and video recordings, and was also made available in Chuabo. Online Appendix A provides the scripts used in each video.

3.2 Sampling and Randomization

A mapping exercise was conducted in preparation for the experiment for which all Quelimane's city blocks were visited from July to August 2021. During these visits, GPS data points were collected to establish the blocks' limits, and an interview with the block chief was conducted. The chief's assistant or neighborhood secretary was interviewed for blocks without a chief, due to either traveling or not existing. This activity resulted in a map with 508 blocks, excluding three neighborhoods for which block limits and chiefs were unspecified at the time of field work. From this list, the following selection criteria were applied. First, given the importance of chiefs in formal information dissemination, I only selected blocks for which the chiefs were available, and they could only participate for one block.[4] Second, I excluded one administrative post and four other distant neighborhoods. These neighborhoods can be characterized as rural given their low population density, the large number of farms, and lack of connection to the city's water drainage infrastructure. Finally, I excluded three relatively highly developed neighborhoods with multistory apartment buildings and an advanced water drainage infrastructure. This exclusion procedure resulted in 330 blocks.

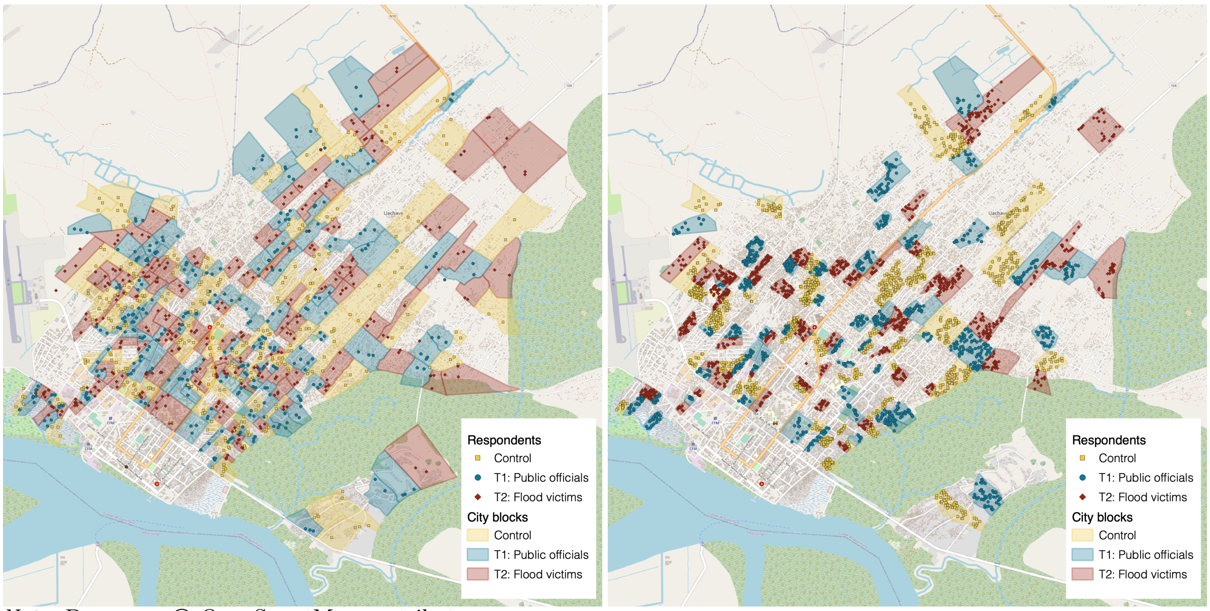
The 330 blocks were randomly allocated into the two treatment and control groups stratified by neighborhood. The objective was to revisit at least 300 blocks. Therefore, 30 of these blocks were assigned as substitutes and were visited only if a chief could not be interviewed due to traveling or rejecting the interview. In total, 21 chiefs could not be revisited, 20 because of their absence and one because of rejection.[5] Besides the chiefs, two households were visited in each block. During each visit, the head of household or spouse was interviewed. Within each block, a man and a woman were interviewed to ensure the collection of gender-disaggregated data. The households were selected by randomly selecting "male" and "female" houses using satellite imagery. In total, 321 blocks were visited, resulting in 642 household and 300 chief interviews. Figure 4a shows the locations of the enumeration areas and interviews by treatment.

[4]Five chiefs were responsible for two blocks. In these cases, only the block in which the chief lived was eligible.

[5]The attrition is similar across the groups (C: six cases, T1: seven cases, T2: eight cases) and cannot be attributed to the treatments since these only took place during the interviews.

Figure 4: Enumeration Area: City Blocks and Respondents by Treatment Group

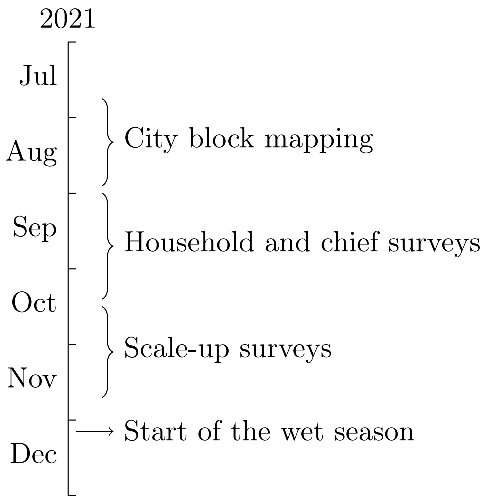
(a) Household and Chief Surveys (b) Scale-up Surveys



Note. Basemap: © OpenStreetMap contributors.

Next, the intervention and placebo visits were scaled up in 150 city blocks randomly selected from the 300 city blocks in which chief surveys were successfully conducted. Each city block maintained its initial treatment status, but, now, 33 percent of the houses were randomly selected for a visit using satellite imagery. These were visits of about 20 minutes on average, during which the enumerators showed the assigned video and conducted a survey. This round of data collection reached a significant portion of the population. In total, 3,536 visits were completed. Figure 4b shows the locations of the enumeration areas and visits by treatment. See Figure 5 for an overview of the timeline of activities.

Figure 5: Project Timeline



3.3 Data

Measurements include multiple sources of data: surveys with households and chiefs and surveys conducted during the scale-up visiting, a behavioral experiment, and behavioral measures based on SMS technology.

3.3.1 Household and Chief Surveys

The household survey questionnaire was divided into four parts. The first part included detailed questions about the household's composition, economic status, access to public services and financial instruments, flooding experience, and trust. The second part was the video, and the third part included detailed questions about risk awareness, concern, preparedness, and risk and time preferences. The final part of the questionnaire was the behavioral experiment. The chief survey was similar to the household survey. Although the same topics were covered, there were two main differences. First, the chief and block characteristics were collected during the mapping exercise and, therefore, not included in the chief survey. Second, questions were framed to cover knowledge and perceptions about the city block rather than the household.

3.3.2 Scale-up Surveys

The scale-up surveys included questions before and after showing the video. Gender, age, flooding experience, and exposure to the previous round of visits (household and chief survey visits) were recorded before showing the video. After the video, the survey covered a subset of the risk perception questions. This survey also included a new set of questions about the intention to prepare for flood risk.

3.3.3 Behavioral Experiment: Insurance Game

The behavioral experiment was conducted with all respondents and was incentivized. All respondents received 100 meticais as a token of appreciation for their participation.[6] They could gain additional 200 meticais by playing an insurance game. In this game, the participant played six identical rounds for which one would be selected for payment. While the outcome of each round did not impact the outcome of other rounds, the outcome was revealed immediately at the end of each round. In each round, the participant was given 200 meticais and needed to choose to play without or with insurance. Next, the participant was asked to roll a six-sided die. If the participant played without insurance and rolled 1, they would lose the 200 meticais. However, for any other result (rolling 2–6), the participant would keep the 200 meticais. If the participant played with insurance, they would pay 100 meticais for the insurance and keep 100 meticais independently of the result of rolling the die. Payments were made through mobile money platforms one day

[6] As of September 2021, 100 meticais is around $1.6.

later. The objective of this game was to measure whether the experience of rolling 1 has an impact on the behavior in the following rounds.

3.3.4 Behavioral Measure using SMS

The survey measures were also supplemented with behavioral measures based on SMS technology. After the survey, I sent respondents two different invitations through text messages to the phone numbers provided by the respondents. The first invitation, which took place the day after the interview, offered some useful information about the cyclone warning system currently active in Quelimane. Respondents had to reply "yes" to receive the information. Responses were processed until one week after the last interview took place. The second invitation asked respondents to send anonymous feedback and suggestions about disaster risk management to the local government. This invitation was sent one week after the last interview and included a reminder two days later. Responses were processed for one week. These text messages involve costly actions, are unlikely to be influenced by the enumerator, and are, therefore, less likely to be subject to social desirability bias relative to survey questions.

3.3.5 Summary Statistics

Table 1 describes the respondents' and blocks' characteristics by presenting the means of the control and treatment groups. Among the respondents to the household survey, by design, the share of women was 50 percent. Their average age was 41 years. Seventy percent completed primary education, and 44 percent completed secondary education. On average, households had 5.5 members, and 37 percent experienced flooding during the last three years. Out of all the scale-up survey respondents, 68 percent were female. The average age was 37 years, and 49 percent had recent flooding experience. The demographic profile of chiefs was different from that of the randomly selected household respondents in several ways. Most chiefs were male, only 31 percent of chiefs were female. They were, on average, older (50 years) and less educated (55 percent completed primary school, and only 9 percent completed secondary school). According to the chiefs, 39 percent of the blocks had recently experienced floods. City blocks were, on average, 6.4 hectares in size and contained 76 houses.[7]

[7] The number of houses was estimated using OpenStreetMap (September 2021).

Table 1: Balance Tests

Variable	(1) Control N/[Clusters]	(1) Control Mean/SE	(2) T1: *Public officials* N/[Clusters]	(2) T1: *Public officials* Mean/SE	(3) T2: *Flood victims* N/[Clusters]	(3) T2: *Flood victims* Mean/SE	T-test P-value (1)-(2)	T-test P-value (1)-(3)	T-test P-value (2)-(3)
Household survey: Female	212 [106]	0.500 (0.000)	214 [107]	0.500 (0.000)	216 [108]	0.500 (0.000)	N/A	N/A	N/A
Household survey: Age	210 [106]	41.200 (1.091)	214 [107]	42.154 (0.942)	216 [108]	39.481 (0.990)	0.508	0.244	0.051*
Household survey: Primary education	212 [106]	0.698 (0.028)	214 [107]	0.687 (0.032)	216 [108]	0.745 (0.030)	0.791	0.250	0.178
Household survey: Secondary education	212 [106]	0.439 (0.033)	214 [107]	0.379 (0.032)	216 [108]	0.458 (0.037)	0.196	0.692	0.104
Household survey: Flooding past 3 years	212 [106]	0.354 (0.034)	214 [107]	0.327 (0.034)	216 [108]	0.324 (0.034)	0.580	0.540	0.950
Household survey: Household size	212 [106]	5.472 (0.153)	214 [107]	5.589 (0.162)	216 [108]	5.208 (0.148)	0.600	0.217	0.084*
Scale-up survey: Female	1251 [50]	0.681 (0.017)	1157 [50]	0.679 (0.017)	1128 [50]	0.697 (0.013)	0.944	0.471	0.419
Scale-up survey: Age	1245 [50]	37.126 (0.724)	1155 [50]	37.568 (0.632)	1126 [50]	37.362 (0.650)	0.645	0.808	0.820
Scale-up survey: Flooding past 3 years	1247 [50]	0.485 (0.039)	1157 [50]	0.450 (0.026)	1126 [50]	0.463 (0.030)	0.454	0.646	0.754
Chief survey: Female	100 [100]	0.310 (0.046)	100 [100]	0.390 (0.049)	100 [100]	0.370 (0.049)	0.238	0.373	0.772
Chief survey: Age	100 [100]	49.950 (1.290)	100 [100]	49.450 (1.228)	100 [100]	47.780 (1.243)	0.779	0.227	0.340
Chief survey: Primary education	100 [100]	0.550 (0.050)	100 [100]	0.550 (0.050)	100 [100]	0.560 (0.050)	1.000	0.888	0.888
Chief survey: Secondary education	100 [100]	0.090 (0.029)	100 [100]	0.160 (0.037)	100 [100]	0.130 (0.034)	0.136	0.369	0.549
Chief survey: Flooding past 3 years	100 [100]	0.390 (0.049)	100 [100]	0.490 (0.050)	100 [100]	0.440 (0.050)	0.156	0.476	0.481
Block: Area size in hectares	106 [106]	6.392 (0.686)	107 [107]	6.096 (0.637)	108 [108]	6.644 (0.844)	0.753	0.817	0.606
Block: Number of houses	106 [106]	75.802 (5.124)	107 [107]	75.467 (5.255)	108 [108]	68.259 (3.966)	0.964	0.246	0.275

Note. The value displayed for t-tests are p-values. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

4 Empirical Analysis

Table 1 presents balance tests across the control and two treatment groups. Specifically, I ran t-tests of equality of means on the characteristics of respondents and city blocks. The results show only two significant differences, namely between the two treatment groups in terms of age and household size. There are no statistically significant differences for the remaining 43 tests. I conclude that the randomization procedure has produced comparable groups in terms of respondent and block characteristics. Therefore, the impact of the interventions can be evaluated by comparing outcomes across groups in a simple regression framework. The main estimation equation is:

$$y_{i,b} = \alpha + \beta \mathbf{T}_b + \delta \mathbf{X}_{i,b} + \epsilon_{i,b} \tag{1}$$

where $y_{i,b}$ is the outcome of interest. T_b is a vector of two binary variables taking a value of 1 if the city block is assigned to the corresponding treatment group and a value of 0 otherwise. $\mathbf{X}_i$ is a vector of control variables, including the respondent's gender and age, an indicator for recent flood experience (last three years), and neighborhood fixed effects. Finally, $\epsilon_{i,b}$ is the usual idiosyncratic error term. Standard errors are clustered at the city block level.

For subgroup analysis, the treatment indicators are made to interact with a binary indicator for the subgroup of interest as follows:

$$z_{i,b} = \alpha + \beta \mathbf{T}_b + \gamma \mathbf{T}_b Y_i + \eta Y_i + \delta \mathbf{X}_i + \varepsilon_{i,b} \tag{2}$$

where Y_i is the subgroup indicator. Section 5 presents the results of estimating Equations (1) and (2) with control variables. Online Appendix B shows the results controlling only for strata fixed effects.

5 Results

5.1 Risk Awareness

Table 2 presents the estimates of treatment effects on flood risk awareness, concern, and preparedness. Columns 1 and 2 show that risk awareness raised after watching the intervention videos. The awareness index composed of four variables from the household survey increased by 0.26 standard deviation as a result of T1, which is significant at the 1 percent level.[8] T1 increased the belief that the respondent's household will be affected by flooding during the next wet season (scale-up survey) by 0.21 standard deviation, significant at the 5 percent level. The treatment effects of T2 on these variables are positive (0.10–0.12 standard deviation) but not statistically significant different from zero. Figure C1 in Online Appendix C shows the treatment effects on the individual variables that form the awareness index. These disaggregated results show that T1 had an impact on beliefs about future risks to the household, while T2 had an impact on beliefs about past events beyond one's household. These results show that risk awareness can be improved even in a city where climate risk is extremely prevalent and that the *public officials* video is more effective in doing so. While watching flood victims increased awareness about the past and community, the message from public officials increased the understanding of individual exposure to flood risk.

[8] All indices are constructed using principal component analysis.

Table 2: Treatment Impact on Flood Risk Perceptions and Preparedness Intentions

	Dependent variable:					
	Risk awareness		*Risk concern*		*Risk preparedness*	
	(1) Index	(2) Flood probability	(3) Index	(4) Level of concern	(5) Perception index	(6) Intention index
T1: *Public officials*	0.258***	0.210**	0.196*	0.079	0.139	0.452***
	(0.094)	(0.082)	(0.113)	(0.087)	(0.101)	(0.166)
T2: *Flood victims*	0.118	0.103	0.024	-0.033	0.242**	0.030
	(0.090)	(0.076)	(0.107)	(0.097)	(0.101)	(0.155)
Mean dep. variable (*control*)	0.000	0.000	0.000	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.153	0.170	0.092	0.228	0.290	0.005
R-squared	0.252	0.219	0.099	0.083	0.241	0.192
Observations	626	3509	636	3515	636	3508
Clusters	320	150	321	150	321	150
Survey	Household	Scale-up	Household	Scale-up	Household	Scale-up

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$. All specifications include the following controls: respondent's gender, age, flood experience, and neighborhood fixed effects.

5.2 Risk Concern

Turning to the concern about flood risk, Columns 3 and 4 of Table 2 present the treatment effects on an index of variables measuring the concern about specific ways that flooding might impact the respondent's household (household survey) and the level of concern about the potential impact of floods on the respondent's household (scale-up survey). I find T1 to increased concern by 0.08–0.20 standard deviation but significant only at the 10 percent level for the index. T2 does not seem to have impacted the respondent's concern about flooding. Figure C2 in Online Appendix C shows the treatment effects on the individual variables that form the concern index. These disaggregated results show that the T1 treatment effect is consistent across the different types of concern and driven by the concern about household health and assets. In sum, the increased awareness did not directly translate into a raised concern about flood risk. The high level of reported concern can be a possible explanation for this. Indeed, more than 70 percent of the sample claimed to be "*very concerned*".

5.3 Risk Preparedness

Column 5 of Table 2 reports the treatment effect on a preparedness perception index. This index is based on three *agree-disagree opinion* statements about preparedness and a measure of the likelihood of sharing risk information with neighbors. The statements are measured in such a way that higher values mean better outcomes. Figure C3 in Online Appendix C ilustrates the treatment effects on the individual variables that form the preparedness intention index. The results show that perceptions about risk preparedness increased for both treatments and significantly for T2. The perception index increased by 0.24 standard deviation after watching the *flood victims* video, significant at the 5 percent level. This result is driven by the perception that others would approve of taking measures and the willingness to share disaster risk information with neighbors.

Scale-up survey respondents were asked about the likelihood of taking certain actions in preparation for the wet season. Columns 6 of Table 2 shows that the intention to prepare increased for T1 by 0.45 standard deviation at the 1 percent level. Table 3 reports results for the individual actions. I find T1 to increased the intention to prepare a household emergency plan, store valuables in a safe place, and make home improvements with 0.35–0.41 standard deviation, significant at the 1 percent level. While also positive, the effects of T2 on these same variables are significantly lower than those of T1 (at the 5 percent significance level). The effects on the likelihood with which households will identify an evacuation center and participate in cleaning drainage canals are not significant. Moreover, the estimates for T1 are positive, while those for T2 are negative. These actions depend on local state capacity and collective action among neighbors, explaining the lack of results here. The results for risk preparedness taken together suggest that personal experiences from flood victims can help shifting social norms and facilitate interaction, while the *public officials* intervention raised individual intentions to prepare.

Table 3: Treatment Impact on Preparation Intentions

	Dependent variable: *Probability of action taking*				
	Emergency plan	*Store valuables*	*Home improvement*	*Identify shelter*	*Drainage cleaning*
	(1)	(2)	(3)	(4)	(5)
T1: *Public officials*	0.406***	0.352***	0.409***	0.170	0.038
	(0.137)	(0.098)	(0.145)	(0.134)	(0.140)
T2: *Flood victims*	0.087	0.177*	0.147	-0.222	-0.189
	(0.138)	(0.091)	(0.144)	(0.144)	(0.142)
Mean dep. variable (*control*)	0.000	0.000	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.011	0.050	0.047	0.004	0.123
R-squared	0.136	0.112	0.144	0.138	0.132
Observations	3514	3517	3517	3515	3513
Clusters	150	150	150	150	150

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include the following controls: respondent's gender, age, flood experience, and neighborhood fixed effects.

5.4 City Block Chiefs

Section 2 highlights the importance of city block chiefs for the organization of disaster risk management. They are an essential source of information for urban households and key for collective action. However, they are not necessarily more aware or prepared regarding flood risks. Therefore, the interventions can benefit the whole city block through the chief. Table 4 shows the estimates of treatment effects on the chiefs' flood risk awareness, concern, and preparedness. The dependent variables are indices comparable with those for households in Table 2. The pattern of results is similar to that of the households, with positive effects on risk awareness and preparedness. An interesting difference is that preparedness perceptions increased significantly as result of T1 but not for T2 as was the case for households. The chiefs seem to respond better to other public officials, which can be explained by the existing institutions related to disaster risk management. Figure C4 in Online Appendix C presents the treatment effects on the individual variables that form the three indices.

Table 4: Treatment Effects for City Block Chiefs

	Dependent variable (indices):		
	Awareness	*Concern*	*Preparedness*
	(1)	(2)	(3)
T1: *Public officials*	0.246*	0.055	0.279**
	(0.143)	(0.141)	(0.137)
T2: *Flood victims*	0.108	-0.180	0.080
	(0.131)	(0.165)	(0.150)
Mean dep. variable (control)	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.297	0.137	0.167
R-squared	0.286	0.147	0.244
Observations	296	300	299

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include the following controls: respondent's gender, age, flood experience, and neighborhood fixed effects.

5.5 Behavioral Outcomes

In addition to taking the survey measurement, I collected behavioral outcomes. I examine whether participants requested additional information and whether they provided feedback or suggestions to improve disaster risk management. Table 5 shows the results of the treatment effects on the behavioral outcomes. Columns 1 and 3 pool the household respondents and chiefs together. Subgroup effects can be derived from Columns 2 and 4, wherein the treatment dummies are made to interact with an indicator that takes the value of 1 if the observation concerns a city block chief. On average, I do not observe a significant treatment effect on subscribing to the information. Moreover, there seems to be a negative impact of T1 on requesting more information of 8.4 percentage points, but this impact is negated by the significantly different impact on chiefs (15.7 percentage points, at the 5 percent significance level). The effect of T2 on requesting the information is similar but not significant. In contrast, providing feedback and suggestions increases as a result of T1 by 7.5 percentage points, significant at the 5 percent level. This is a large effect relative to the control group's mean of 17 percent. The result is driven by the intervention's positive impact on the behavior of chiefs.

A possible interpretation of these results can be the potential impact of T1 on existing institutions. As discussed in Section 2, chiefs in this setting play a critical role as facilitators of communication between Quelimane's local government and its citizen. While residents turn to chiefs for information, the chiefs themselves increase their efforts to collect and communicate risk information.

Table 5: Treatment Effect on Behavioral Measures

	Dependent variable:			
	Info requested		*Feedback sent*	
	(1)	(2)	(3)	(4)
T1: *Public officials*	-0.034	-0.084*	0.075**	0.046
	(0.038)	(0.048)	(0.029)	(0.039)
... x Chief		0.157*		0.090
		(0.080)		(0.070)
T2: *Flood victims*	-0.017	-0.051	0.006	-0.022
	(0.039)	(0.049)	(0.030)	(0.039)
... x Chief		0.106		0.089
		(0.081)		(0.068)
Chief	-0.098***	-0.186***	-0.017	-0.077*
	(0.036)	(0.058)	(0.031)	(0.046)
Mean dep. variable (control)	0.421	0.421	0.170	0.170
T-test: T1=T2 (*P-val*)	0.677	0.497	0.025	0.084
T-test: T1+T1xChief=0 (*P-val*)		0.259		0.011
T-test: T2+T2xChief=0 (*P-val*)		0.394		0.200
R-squared	0.080	0.084	0.056	0.058
Observations	935	935	935	935
Clusters	321	321	321	321

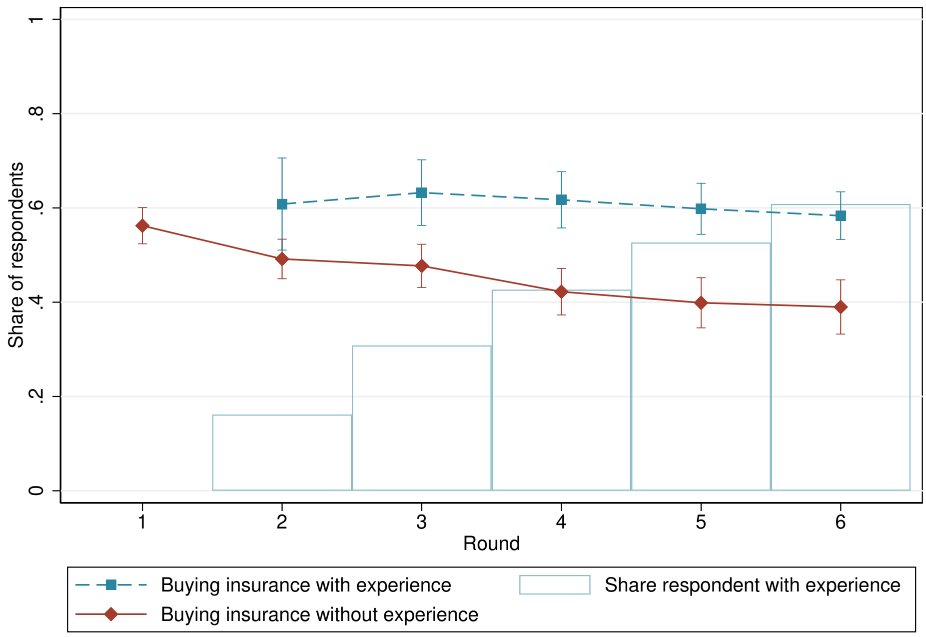
Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include the following controls: respondent's gender, age, flood experience, and neighborhood fixed effects.

5.6 Recent Flooding Experience

According to existing literature, past experiences shape risk beliefs and mitigation behavior.[9] To test this hypothesis among urban households in Quelimane, I designed and implemented a behavioral experiment during the household survey. Figure 6 shows the share of respondents choosing to play without or with insurance for each round, conditional on whether *1* (the loss event) was rolled in any of the previous rounds. The solid red line indicates that people without the experience of rolling *1* are gradually less likely to buy insurance. However, the dashed blue line shows that the share of people with that experience buying insurance stays stable at around 60 percent and 11.7–20.9 percentage points higher than for people without experience. In conclusion, experiencing a loss event does cause people to make a costly effort to be better prepared.

[9]For risk beliefs, see Leiserowitz (2006); Deryugina (2013); Cameron and Shah (2013); Sullivan-Wiley and Gianotti (2017); Brown et al. (2018). For risk preferences, see Callen et al. (2014); Cassar et al. (2017); Hanaoka et al. (2018), and for mitigation behavior, see Bradford et al. (2012); Sawada (2017).

Figure 6: Insurance Game



Note. Capped lines indicate the 95 percent confidence interval. The number of observations is 642 for each round.

To test whether flooding experience matters for the impact of the interventions, I estimated Equation 2 on the outcome variables included in Table 2 and an index of the intention to prepare variables from Table 3. Table 6 shows the results of the subgroup analysis for flood experience. Indeed, I find that seven of the eight interaction terms are negative for risk awareness and concern, suggesting that the treatment effect is more minor for households with recent flood experience. This result is most profound for the expectation that a household will be affected by a flood during the next wet season in Column 1. The treatment effects for T1 and T2 on inexperienced households of 0.32 and 0.20 standard deviations, respectively, are significantly higher than those on experienced households. The difference is a 0.20–0.24 standard deviation at the 5 percent significance level. While mostly consistent in signs, the coefficients for risk concern are generally insignificant different from zero. Finally, the estimates for risk preparedness intentions follow a different pattern. On the one hand, the effect of T1 on the intention to prepare is 0.40 standard deviation for inexperienced households and even larger, although not significantly, for experienced households. On the other hand, the effect of T2 on inexperienced households is negative but close to zero, and the effect on experienced households is significantly larger at the 10 percent significance level. This different pattern in the result highlights the importance of including examples of actionable mitigation measures in risk awareness campaigns because even experienced households might not yet be familiar with these measures.

Table 6: Heterogeneous Treatment Effects for Recent Flooding Experience

	Dependent variable:					
	Risk awareness		*Risk concern*		*Risk preparedness*	
	(1) Index	(2) Flood probability	(3) Index	(4) Level of concern	(5) Perception index	(6) Intention index
T1: *Public officials*	0.321**	0.319***	0.213	0.105	0.187	0.399**
	(0.126)	(0.109)	(0.132)	(0.102)	(0.129)	(0.169)
... x Recent flood experience	-0.175	-0.235**	-0.043	-0.058	-0.141	0.111
	(0.189)	(0.102)	(0.189)	(0.111)	(0.184)	(0.122)
T2: *Flood victims*	0.227*	0.198*	0.060	-0.052	0.265**	-0.069
	(0.122)	(0.100)	(0.131)	(0.108)	(0.120)	(0.155)
... x Recent flood experience	-0.314	-0.204**	-0.103	0.037	-0.065	0.210*
	(0.194)	(0.100)	(0.197)	(0.110)	(0.184)	(0.115)
Recent flood experience	0.844***	0.818***	-0.020	0.248***	0.115	-0.153
	(0.137)	(0.070)	(0.126)	(0.083)	(0.133)	(0.100)
Mean dep. variable (control)	0.000	0.000	0.000	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.476	0.223	0.179	0.140	0.511	0.003
T-test: T1+T1xExp=0 (*P-val*)	0.277	0.293	0.309	0.652	0.748	0.006
T-test: T2+T2xExp=0 (*P-val*)	0.538	0.939	0.792	0.897	0.200	0.425
R-squared	0.256	0.222	0.099	0.083	0.241	0.194
Observations	626	3509	636	3515	636	3508
Clusters	320	150	321	150	321	150
Survey	Household	Scale-up	Household	Scale-up	Household	Scale-up

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include the following controls: respondent's gender, age, and neighborhood fixed effects.

5.7 Gender

Existing inequalities and poverty negatively affect women's capacity for managing shocks. The gender-differentiated impacts of disasters and climate change are well documented. Recent research has shown that women and other vulnerable groups are more susceptible due to many pre-existing inequalities and gender gaps.[10] It is crucial to systematically collect and evaluate gender-disaggregated data to promote and inform gender-responsive disaster risk management policies and interventions. Table 7 presents the results of the subgroup analysis for gender. The treatment effect of the *public officials* intervention for the scale-up survey respondents is never statistically different across gender, and the coefficient is close to zero. Moreover, the positive treatment effect of T1 on awareness and concern among household survey respondents is driven by women. The coefficients of the interaction term are 0.29 and 0.26 standard deviation and significant at the 10 percent level. These results indicate that this intervention is at least gender-neutral, with women benefitting the same as or more than men from the intervention.

[10] See Erman et al. (2021) for a recent review on natural disasters and gender.

Table 7: Heterogeneous Treatment Effects for Gender

	Dependent variable: *Risk awareness*		*Risk concern*		*Risk preparedness*	
	(1) Flood probability	(2) Index	(3) Level of concern	(4) Index	(5) Perception index	(6) Intention index
T1: *Public officials*	0.115	0.241**	0.068	0.090	0.206	0.465***
	(0.126)	(0.102)	(0.127)	(0.108)	(0.130)	(0.156)
... x Female	0.288*	-0.048	0.256*	-0.016	-0.133	-0.018
	(0.169)	(0.082)	(0.141)	(0.092)	(0.148)	(0.097)
T2: *Flood victims*	0.136	0.242**	-0.164	-0.017	0.191	0.022
	(0.122)	(0.094)	(0.131)	(0.119)	(0.132)	(0.155)
... x Female	-0.036	-0.203***	0.376**	-0.024	0.103	0.011
	(0.169)	(0.078)	(0.161)	(0.092)	(0.153)	(0.085)
Female	-0.080	0.096	-0.243**	0.006	-0.164	-0.101
	(0.124)	(0.058)	(0.101)	(0.057)	(0.115)	(0.072)
Mean dep. variable (control)	0.000	0.000	0.000	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.867	0.991	0.100	0.381	0.901	0.006
T-test: T1+T1xFem=0 (*P-val*)	0.001	0.023	0.020	0.417	0.544	0.014
T-test: T2+T2xFem=0 (*P-val*)	0.424	0.624	0.122	0.684	0.015	0.839
R-squared	0.258	0.221	0.105	0.083	0.243	0.192
Observations	626	3509	636	3515	636	3508
Clusters	320	150	321	150	321	150
Survey	Household	Scale-up	Household	Scale-up	Household	Scale-up

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include the following controls: respondent's age, flood experience, and neighborhood fixed effects.

The *flood victims* intervention did positively impact the awareness among male scale-up survey respondents but not for female scale-up survey respondents. However, this result is not robust to the household survey sample, which has the same number of men and women. A possible explanation for this result can be the fact that women were more likely to report a recent flooding experience.

5.8 Social Desirability Bias

Social desirability bias is a common risk associated with survey measures. I address this concern by estimating the treatment effects on reported past behaviors. After watching the video, respondents of the household survey were asked whether they had taken any of the suggested preparedness actions prior to the intervention. Treatment effects on these measures could indicate the presence of social desirability bias. Table 8 presents the results. I do not identify a clear reason for concern because there are no significant effects on any of the actions, and the coefficients are both positive and negative.

Table 8: Social Desirability Bias—Treatment Impact on Past Preparation

	Dependent variable: *Actions taken*					
	Emergency plan	*Store valuables*	*Home improvement*	*Prepare food kit*	*Identify shelter*	*Drainage cleaning*
	(1)	(2)	(3)	(4)	(5)	(6)
T1: *Public officials*	0.132	-0.094	-0.028	0.019	-0.049	0.072
	(0.116)	(0.109)	(0.102)	(0.107)	(0.102)	(0.104)
T2: *Flood victims*	0.148	-0.111	0.019	0.079	0.129	-0.037
	(0.111)	(0.106)	(0.096)	(0.108)	(0.107)	(0.095)
Mean dep. variable (*control*)	0.000	0.000	0.000	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.886	0.879	0.642	0.603	0.093	0.265
R-squared	0.085	0.170	0.112	0.096	0.095	0.131
Observations	640	639	640	639	640	640
Clusters	321	321	321	321	321	321

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$. All specifications include the following controls: respondent's gender, age, flood experience, and neighborhood fixed effects.

5.9 Information Diffusion

For large-scale implementation, it is crucial to think about if and how information diffuses through a neighborhood. Table 9 presents the effects of living within 100 m from a household that was shown either the T1 or T2 video a couple of weeks earlier on awareness, engagement, and knowledge about the videos. I find that respondents living close to T1 households were more likely to know about the visits and had more often engaged in conversation about these visits with those households. Living close to T1 households also increased the likelihood of discussing flood risk preparation and cleaning drainage canals. For living close to T2 households, only having engaged in conversation and discussing preparation methods are significantly higher than when living further away. These results show that the intervention had a positive effect on community resilience and that it is not necessary to cover the whole target population. Important information, in this case possibly new information on how to prepare for floods, does disseminate among neighbors.

Table 9: The Diffusion of Treatment Information Among Neighbors

	Dependent variable:					
	Aware of visits	*Engaged in conversation*	*Flooding related topics discussed:*			
			Risks	*Effects*	*Preparation*	*Drainage*
	(1)	(2)	(3)	(4)	(5)	(6)
Within 100 m from T1 seed	0.016**	0.012***	0.005	0.005	0.007**	0.007**
	(0.006)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Within 100 m from T2 seed	-0.002	0.007*	-0.006	0.002	0.007**	-0.000
	(0.007)	(0.004)	(0.005)	(0.003)	(0.003)	(0.004)
Mean dep. variable (*>100m from T1 and T2*)	0.020	0.003	0.009	0.008	0.005	0.005
T-test: 100m(T1) = 100m(T2) (*P-val*)	0.045	0.299	0.051	0.523	0.949	0.114
R-squared	0.022	0.016	0.017	0.019	0.018	0.011
Observations	3520	3520	3520	3520	3520	3520
Clusters	150	150	150	150	150	150
Survey	Scale-up	Scale-up	Scale-up	Scale-up	Scale-up	Scale-up

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$. All specifications include the following controls: respondent's gender, age, flood experience, and neighborhood fixed effects.

6 Conclusion and Policy Implications

In this paper, I evaluated two interventions aimed at improving flood risk perceptions and the intention to prepare. The *public officials* video increased risk awareness and the intention to prepare among all respondents. The *flood victims* video was less effective, but recent flooding experience mattered for the results. The interventions were most effective in increasing awareness among households without recent flooding experience. Gender analysis indicated that the *public officials* intervention was at least as effective for women as it was for men, making it gender-responsive. Finally, the results showed that the information disseminated among neighbors.

Based on the findings, I conclude that providing contextualized and easy to understand risk information to urban households before the wet season may present large benefits. The first step towards improving resilience is increasing awareness. The results suggest that risk awareness can be improved even in a city where climate risk is extremely prevalent.

Risk awareness campaigns should include examples of actionable mitigation measures. Households with recent flooding experience are more aware about risk but are not necessarily familiar with effective mitigation measures. The results also suggest that raising concern was not a prerequisite for increasing the intention to prepare. Moreover, personal experiences from flood victims in risk communication can help shifting social norms regarding flood preparation. The video featuring flood victims also raised awareness among households without recent flooding experience.

Neighbors talk, and a suitable channel to start information dissemination is the community leader. These leaders are trusted and well connected and have the capacity to facilitate collective action. However, for successfully using community leaders in communication strategies, all neighborhoods and city blocks should be covered, and these leaders should have access to updated and actionable information.

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Online Appendix

Preparing for Urban Floods in Mozambique
A Field Experiment on Risk Communication

Stefan Leeffers

This online appendix contains the following sections. Section A provides the scripts used in each video. Section B presents the results of estimating Equations (1) and (2) controlling only for strata fixed effects. Section C shows the treatment effects on the individual variables that form the awareness, concern, and preparedness perceptions indices for household and chief surveys.

A Appendix: Video Scripts

A.1 *Public officials* video script

Man My name is (. . .), I have been an employee of the Municipal Council of Quelimane since 2013, as director of the environment and climate change department. I have 6 years of experience in disaster risk management. Today I'm going to talk a little about natural disasters, risk management and what families should do to be prepared in the event of a disaster event. The city of Quelimane is located in a low-lying area, which makes flooding more frequent compared to other cities in the province. By floods I mean exceptionally high-water level events that can affect the city block where you live, thus harming the dwellings, goods, resources, or other valuable items of your household.

Woman My name is (. . .), I have been an employee of the Municipal Council of Quelimane since 2012. I have been director of EMUSA since 2019. I have 6 years of experience in disaster risk management. You are viewing this video because you live in an area prone to flooding. Every year, we have neighborhoods that suffer from flooding in the wet season from December to April and, in times of major storms, almost the whole city is flooded due to the poor drainage of rainwater and high tide. The combination of these threats has resulted in health problems such as malaria and cholera, loss of life, and destruction of infrastructure and livelihoods. The scientific community warns that cyclones and extreme storms are increasing in frequency over the years and predicts that storms will become increasingly intense due to the change in seawater temperatures associated with global warming.

Man Our main concern as an institution is to prepare families for the periods before disasters occur (through preventive measures); in the period of the occurrence (through alerts) and after the occurrence (monitoring of diseases and social reintegration). Before the occurrence of disasters, it is important to adopt preventive measures such as:

a) creating an emergency plan which must be known to all family members;
b) creating food, medicine, and water reserves in easily accessible places, to use if you are stuck for a few days;
c) know the evacuation routes and centers defined for each neighborhood;
d) keep valuables, such as personal documents, bank cards, and schoolbooks, in a safe place; and
e) make improvements to the house, such as reinforcing the roof, doors, and windows.

Woman As we may know, garbage and debris block the drainage canals in the city of Quelimane. To this end, we must keep the canals other water ways clean. To facilitate the flow to the sea, we must avoid throwing garbage and solid waste in the drainage ditches and create activity plans that allow us to keep our city block and the ditches always clean. It is expressly forbidden to throw garbage in the ditches or deposit it in the streets.

To gather specific information about flood hazards within your block or neighborhood, you can contact your community leader; either the block chief, neighborhood secretary, or local risk management committee. You should also monitor the emergency and alert information systems, for example on radio, television, mobile phone, or through the community leader. It is important that you familiarize yourself with your community's emergency plan. Talk to your neighbors and friends as it is essential to prepare the community to face the impacts of climate change and natural disasters.

Thanks for listening.

A.2 *Flood victims* video script

Man My name is (...), I am 42 years old, and I have lived in the Manhaua B neighborhood for over 8 years. I am the head of a household of a family of 4; with my 2 children and my wife. I work as a servant in a commercial establishment in the city center of Quelimane. Today, I would like to talk a little about my experience with natural disasters, risk management, and floods and what we should do to be more prepared in the event of a disaster event. The city of Quelimane is located in a low-lying area, which makes flooding more frequent compared to other cities in the province. You are viewing this video because you live in an area prone to flooding.

In January 2020, my family was affected by floods caused by the intense rains that were felt in the city of Quelimane. Our house was totally destroyed due to the flooding of water in the backyard; we lost several goods such as chairs, stove, beds, clothes, and other appliances. During the rainy season, the city block is completely flooded and isolated from the other part of the neighborhood, which compromises the well-being of my family. When this happened, we spent nights without electricity and without meals because all our food had been soaked. We were stuck on a table because the water in the house was knee-deep. Our clothes and blankets were totally wet. It was a very difficult experience for me and my family.

Woman My name is (...), I have lived in the Manhaua B neighborhood for over 5 years. I belong to a household consisting of 8 people, I have 7 children. I work as a peasant. Every year, we have neighborhoods that suffer from flooding in the wet season from December to April and, in times of major storms, almost the whole city is flooded due to the poor drainage of rainwater and high tide. The combination of these threats has resulted in health problems such as malaria and cholera, loss of life, and destruction of infrastructure and livelihoods. The scientific community warns that cyclones and extreme storms are increasing in frequency over the years and predicts that storms will become increasingly intense due to the change in seawater temperatures associated with global warming.

Man What happened to us could happen to you. Therefore, it is our responsibility together to protect our families, communities, and ourselves. Due to our negative experience, today our family is more aware of the risks of floods that may occur on our city block. We are on alert whenever we approach the wet season and in this way we can:

a) create an emergency plan, known to all my family;
b) know the nearest evacuation routes and centers;
c) store valuables, such as personal documents, bank cards, and schoolbooks, in a safe place;
d) make improvements to the house; and
e) have the possibility of conserving food, water, and medicines for times of crisis.

Woman As we may know, garbage and debris block the drainage canals in the city of Quelimane. To this end, we must keep the canals other water ways clean. To facilitate the flow to the sea, we must avoid throwing garbage and solid waste in the drainage ditches and create activity plans that allow us to keep our city block and the ditches always clean.

To gather specific information about flood hazards within your block or neighborhood, you can contact your community leader; either the block chief, neighborhood secretary, or local risk management committee. You should also monitor the emergency and alert information systems, for example on radio, television, mobile phone, or through the community leader. It is important that you familiarize yourself with your community's emergency plan. Talk to your neighbors and friends as it is essential to prepare the community to face the impacts of climate change and natural disasters.

Thanks for listening.

A.3 *Placebo* video script

Man My name is (...), I have been a resident of the Samugue neighborhood for over 20 years. I am the head of a household consisting of 9 people. I have 7 children. I am a teacher.

Woman My name is (...), I have been a resident of the Samugue neighborhood since I was born. I belong to a household of 9 people. I have 7 children. I'm a businesswoman and I have my own beauty salon. I would like to talk a little about our city of Quelimane.

Quelimane City is located in the central region of Mozambique, in Zambézia Province, Quelimane District. It is the capital and largest city of Zambézia Province. The city of Quelimane emerged as a small group of houses that belonged to large companies. All facing the river Rio Dos Bons-Sinais, on the waterfront, which functioned as a port, and was the center of social life. It should be noted that, at the time, the port was located on the avenue at the waterfront, served by railway lines and by landing ramps. Later, the trees and the railway lines disappeared, and the port was relocated to one of the avenue's ends. Meanwhile, the waterfront was becoming a space for walking and leisure, a place for young people who, sitting on its walls, stayed until sunset.

Man Since colonial times, Quelimane has grown a lot in administrative and commercial terms, thanks to the unusual agricultural wealth. In terms of urban beauty, it is possible to observe beautiful landscapes along the avenues and streets that reflect the combination of old and modern dwellings such as: the old town hall of Quelimane, the Governor's Office, the old submarine cable station, Catholic church, Hospital, Águia cinema, parks, harbor, and other views of the city of Quelimane.

Woman The housing, in both colonial and modern times, is characterized by traditional and improved houses for most of the population. The Quelimane has a tropical climate which is warm and humid and accentuated by its location on the bank of the Cua-Cua River and its proximity to the Mozambique Channel. The city has two distinct seasons, the hot season, and the wet season. The wet season takes place from December to April in almost every year.

Man Quelimane has tourist and transit infrastructures (Hotels, Pensions, Restaurants, Bar, Disco, Nightclubs, Take-Aways, etc.), and has the potential to grow with positive monetary benefits. Additionally, there are factories in Quelimane, which provide direct employment to thousands of employees and workers, and which have a significant local tax impact. The city of Quelimane, which has the port as one of its main economic activities, has seen a stark increase in the use of bicycles (taxi) that guarantee urban passenger transport in the city. This gives the city council a challenge. In the city of Quelimane, the bicycles play a prominent role in informal commerce. The circulation and flexibility of the bicycles allow these activities to be distributed along the roads and their intersections, close to schools, health units homes and especially in markets.

Thanks for listening.

B Appendix: Results with Strata Fixed Effects

Table B1: Treatment Impact on Flood Risk Perceptions and Preparedness Intentions

	Dependent variable:					
	Risk awareness		*Risk concern*		*Risk preparedness*	
	(1) Index	(2) Flood probability	(3) Index	(4) Level of concern	(5) Perception index	(6) Intention index
T1: *Public officials*	0.170*	0.183*	0.187*	0.078	0.180*	0.413**
	(0.101)	(0.101)	(0.105)	(0.089)	(0.100)	(0.171)
T2: *Flood victims*	0.072	0.087	0.046	-0.039	0.246**	0.065
	(0.097)	(0.097)	(0.105)	(0.092)	(0.101)	(0.140)
Mean dep. variable (*control*)	0.000	0.000	0.000	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.348	0.340	0.145	0.225	0.521	0.035
R-squared	0.139	0.109	0.133	0.083	0.210	0.200
Observations	627	3525	638	3531	638	3524
Clusters	320	150	321	150	321	150
Survey	Household	Scale-up	Household	Scale-up	Household	Scale-up

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include strata fixed effects.

Table B2: Treatment Impact on Preparation Intentions

	Dependent variable: *Probability of action taking*				
	Emergency plan	*Store valuables*	*Home improvement*	*Identify shelter*	*Drainage cleaning*
	(1)	(2)	(3)	(4)	(5)
T1: *Public officials*	0.384***	0.341***	0.355**	0.169	-0.013
	(0.139)	(0.106)	(0.138)	(0.143)	(0.146)
T2: *Flood victims*	0.099	0.211**	0.153	-0.178	-0.129
	(0.115)	(0.092)	(0.131)	(0.136)	(0.130)
Mean dep. variable (*control*)	0.000	0.000	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.040	0.199	0.145	0.029	0.442
R-squared	0.155	0.109	0.173	0.162	0.166
Observations	3530	3533	3533	3531	3529
Clusters	150	150	150	150	150

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include strata fixed effects.

Table B3: Treatment Effects for City Block Chiefs

	Dependent variable (indices):		
	Awareness	*Concern*	*Preparedness*
	(1)	(2)	(3)
T1: *Public officials*	0.214	0.088	0.270**
	(0.136)	(0.139)	(0.130)
T2: *Flood victims*	0.101	-0.126	0.073
	(0.135)	(0.155)	(0.143)
Mean dep. variable (control)	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.405	0.169	0.172
R-squared	0.239	0.161	0.277
Observations	296	300	299

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include strata fixed effects.

Table B4: Treatment Effect on Behavioral Measures

	Dependent variable:			
	Info requested		*Feedback sent*	
	(1)	(2)	(3)	(4)
T1: *Public officials*	-0.026	-0.076	0.080***	0.050
	(0.040)	(0.049)	(0.028)	(0.038)
... x Chief		0.156*		0.093
		(0.080)		(0.071)
T2: *Flood victims*	0.013	-0.021	0.024	-0.004
	(0.040)	(0.050)	(0.028)	(0.038)
... x Chief		0.107		0.088
		(0.082)		(0.069)
Chief	-0.132***	-0.220***	-0.029	-0.089*
	(0.034)	(0.055)	(0.029)	(0.047)
Mean dep. variable (control)	0.421	0.421	0.170	0.170
T-test: T1=T2 (*P-val*)	0.335	0.273	0.068	0.169
T-test: T1+T1xChief=0 (*P-val*)		0.221		0.009
T-test: T2+T2xChief=0 (*P-val*)		0.195		0.099
R-squared	0.064	0.068	0.085	0.087
Observations	937	937	937	937
Clusters	321	321	321	321

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include strata fixed effects.

Table B5: Heterogeneous Treatment Effects for Recent Flooding Experience

	Dependent variable:					
	Risk awareness		*Risk concern*		*Risk preparedness*	
	(1) Index	(2) Flood probability	(3) Index	(4) Level of concern	(5) Perception index	(6) Intention index
T1: *Public officials*	0.278**	0.316***	0.220*	0.113	0.212	0.370**
	(0.121)	(0.111)	(0.129)	(0.108)	(0.128)	(0.168)
... x Recent flood experience	-0.248	-0.229**	-0.100	-0.058	-0.093	0.080
	(0.191)	(0.102)	(0.188)	(0.106)	(0.185)	(0.116)
T2: *Flood victims*	0.182	0.181*	0.120	-0.030	0.273**	-0.030
	(0.114)	(0.105)	(0.129)	(0.102)	(0.123)	(0.152)
... x Recent flood experience	-0.262	-0.166*	-0.228	-0.007	-0.078	0.197*
	(0.193)	(0.096)	(0.191)	(0.103)	(0.193)	(0.112)
Recent flood experience	0.912***	0.821***	0.018	0.249***	0.061	-0.138
	(0.138)	(0.068)	(0.128)	(0.079)	(0.136)	(0.095)
Mean dep. variable (control)	0.000	0.000	0.000	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.452	0.219	0.393	0.187	0.625	0.016
T-test: T1+T1xExp=0 (*P-val*)	0.828	0.313	0.436	0.583	0.408	0.021
T-test: T2+T2xExp=0 (*P-val*)	0.586	0.863	0.490	0.736	0.225	0.261
R-squared	0.256	0.224	0.137	0.094	0.210	0.202
Observations	627	3519	638	3525	638	3518
Clusters	320	150	321	150	321	150
Survey	Household	Scale-up	Household	Scale-up	Household	Scale-up

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include strata fixed effects.

Table B6: Heterogeneous Treatment Effects for Gender

	Dependent variable:					
	Risk awareness		*Risk concern*		*Risk preparedness*	
	(1) Flood probability	(2) Index	(3) Level of concern	(4) Index	(5) Perception index	(6) Intention index
T1: *Public officials*	0.057	0.225*	0.054	0.071	0.256**	0.435**
	(0.138)	(0.125)	(0.118)	(0.107)	(0.129)	(0.172)
... x Female	0.227	-0.062	0.264*	0.010	-0.148	-0.031
	(0.175)	(0.090)	(0.142)	(0.090)	(0.147)	(0.080)
T2: *Flood victims*	0.062	0.206*	-0.149	-0.046	0.201	0.081
	(0.134)	(0.116)	(0.130)	(0.107)	(0.134)	(0.156)
... x Female	0.020	-0.174**	0.386**	0.011	0.092	-0.023
	(0.179)	(0.084)	(0.163)	(0.090)	(0.152)	(0.082)
Female	-0.068	0.132**	-0.241**	0.006	-0.149	-0.086
	(0.130)	(0.064)	(0.101)	(0.055)	(0.114)	(0.060)
Mean dep. variable (control)	0.000	0.000	0.000	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.971	0.885	0.131	0.317	0.671	0.038
T-test: T1+T1xFem=0 (*P-val*)	0.029	0.109	0.019	0.389	0.368	0.024
T-test: T2+T2xFem=0 (*P-val*)	0.530	0.746	0.080	0.721	0.014	0.679
R-squared	0.142	0.111	0.140	0.084	0.219	0.202
Observations	627	3525	638	3531	638	3524
Clusters	320	150	321	150	321	150
Survey	Household	Scale-up	Household	Scale-up	Household	Scale-up

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include strata fixed effects.

Table B7: Social desirability—Treatment Impact on Past Preparation

	Dependent variable: *Actions taken*					
	Emergency plan	*Store valuables*	*Home improvement*	*Prepare food kit*	*Identify shelter*	*Drainage cleaning*
	(1)	(2)	(3)	(4)	(5)	(6)
T1: *Public officials*	0.132	-0.048	-0.002	0.130	0.002	0.075
	(0.105)	(0.107)	(0.100)	(0.103)	(0.096)	(0.101)
T2: *Flood victims*	0.119	-0.153	0.022	0.122	0.147	-0.066
	(0.108)	(0.104)	(0.099)	(0.106)	(0.105)	(0.097)
Mean dep. variable (*control*)	0.000	0.000	0.000	0.000	0.000	0.000
T-test: T1=T2 (*P-val*)	0.899	0.327	0.801	0.943	0.158	0.141
R-squared	0.113	0.170	0.114	0.113	0.114	0.110
Observations	642	641	642	641	642	642
Clusters	321	321	321	321	321	321

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include strata fixed effects.

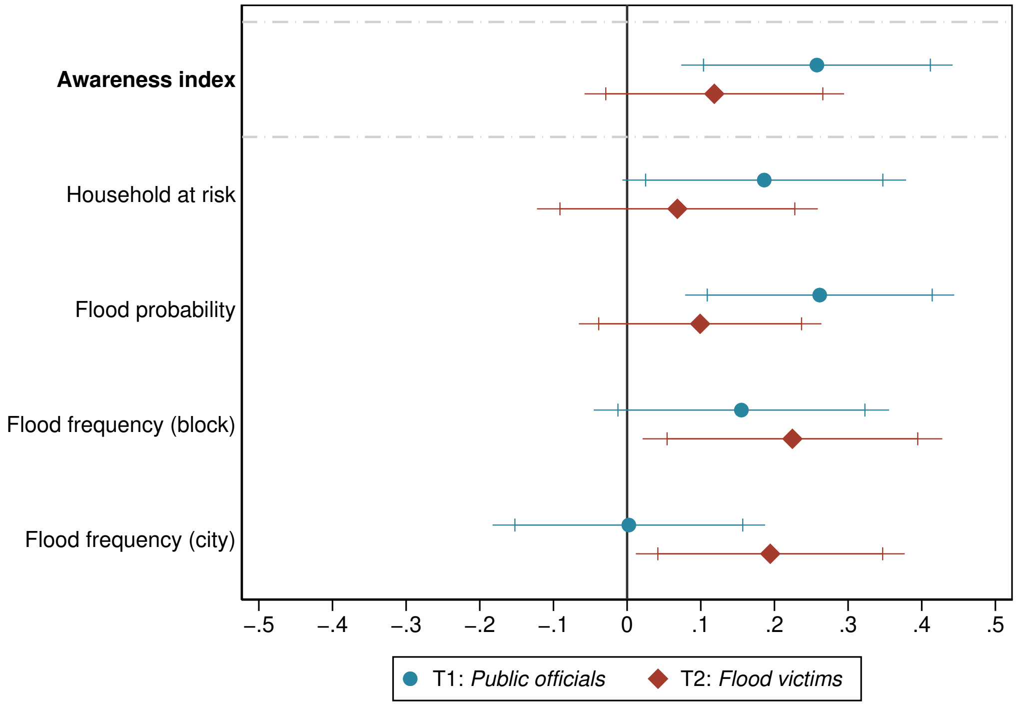
Table B8: The Diffusion of Treatment Information Among Neighbors

	Dependent variable:					
	Aware of visits	*Engaged in conversation*	*Flooding related topics discussed:*			
			Risks	*Effects*	*Preparation*	*Drainage*
	(1)	(2)	(3)	(4)	(5)	(6)
Within 100 m from T1 seed	0.017***	0.012***	0.009**	0.005	0.006**	0.006*
	(0.006)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Within 100 m from T2 seed	-0.002	0.007*	-0.008*	0.001	0.007**	-0.001
	(0.007)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)
Mean dep. variable (*>100m from T1 and T2*)	0.020	0.003	0.009	0.008	0.005	0.005
T-test: 100m(T1) = 100m(T2) (*P-val*)	0.026	0.397	0.003	0.340	0.955	0.179
R-squared	0.028	0.021	0.024	0.018	0.017	0.014
Observations	3536	3536	3536	3536	3536	3536
Clusters	150	150	150	150	150	150
Survey	Scale-up	Scale-up	Scale-up	Scale-up	Scale-up	Scale-up

Note. Standard errors (reported in parentheses) are clustered at the city block level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. All specifications include strata fixed effects.

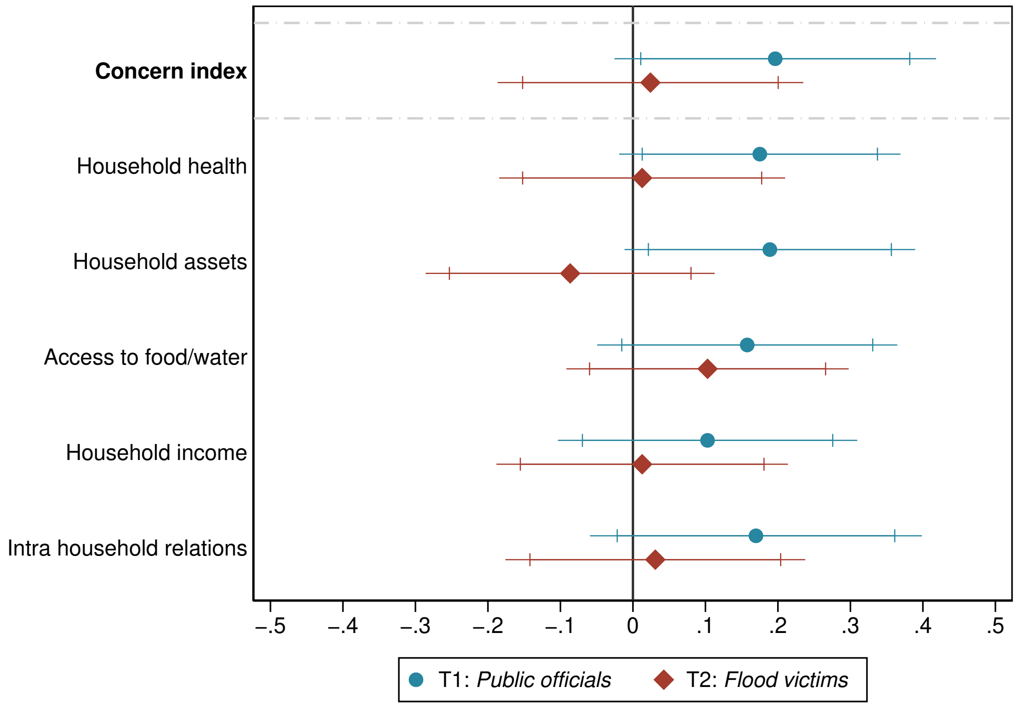
C Appendix: Results for Individual Outcomes

Figure C1: Treatment Effect on Flood Risk Awareness



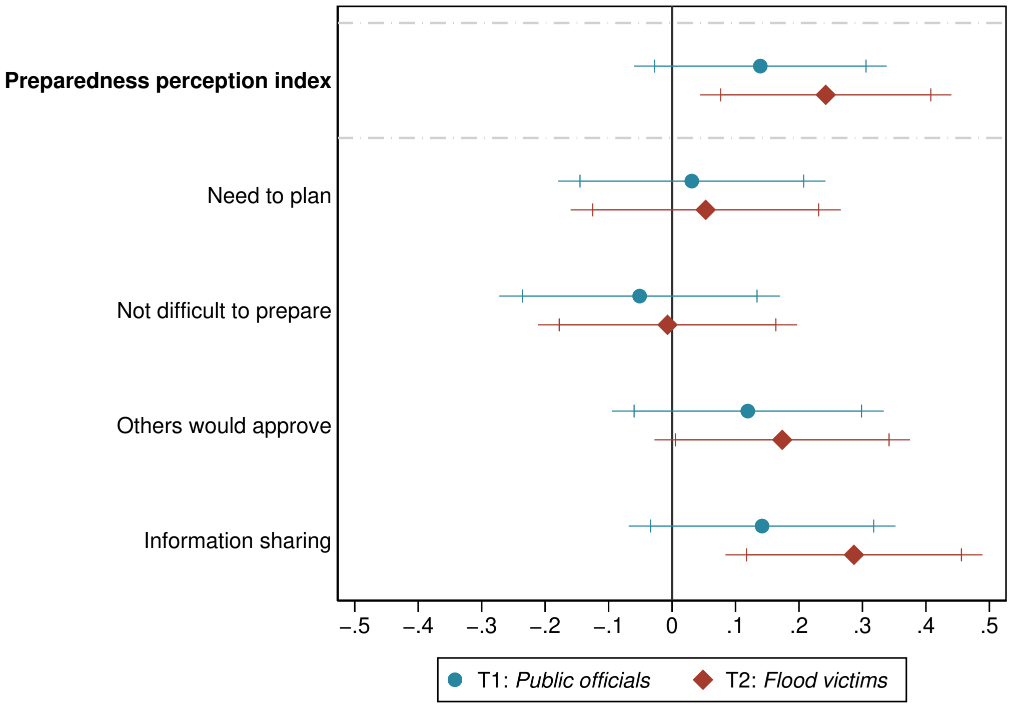
Note. Coefficient points in standard deviations. Lines indicate the 95 percent confidence intervals, with a cap at 90 percent.

Figure C2: Treatment Effect on Flood Risk Concern



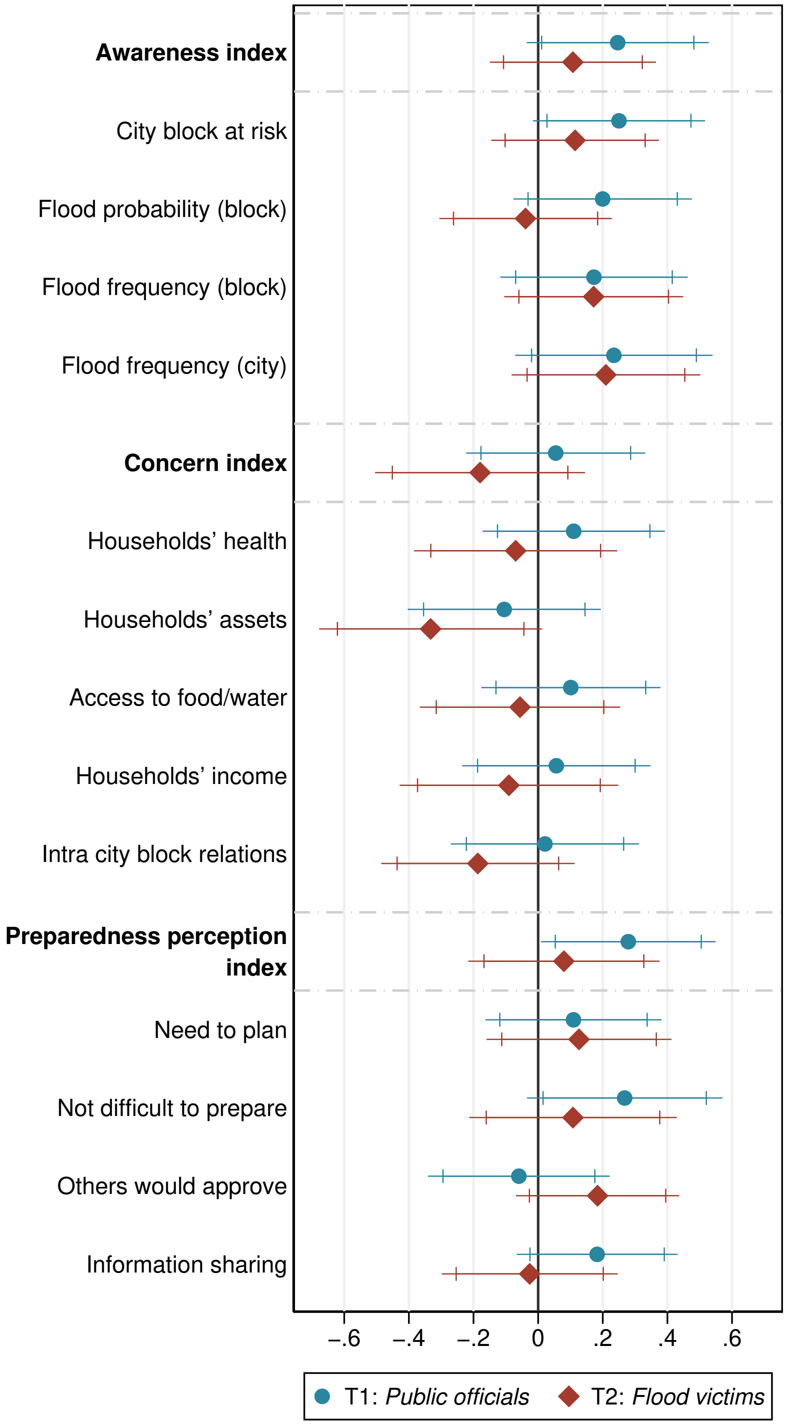
Note. Coefficient points in standard deviations. Lines indicate the 95 percent confidence intervals, with a cap at 90 percent.

Figure C3: Treatment Effect on Flood Risk Concern



Note. Coefficient points in standard deviations. Lines indicate the 95 percent confidence intervals, with a cap at 90 percent.

Figure C4: Treatment Effect on Chief Outcomes



Note. Coefficient points in standard deviations. Lines indicate the 95 percent confidence intervals, with a cap at 90 percent.