Urbanisation Meets the Environment

Can Community-level Technical Assistance Induce Local Adaptation and Protect Against Flooding?

Pre-Analysis Plan

Stefan Leeffers, Jacob Macdonald, Caroline Miehe, and Pedro C. Vicente*

December 2024

Abstract

The effects of climate-related disasters such as floods are exacerbated in cities due to rapid urbanization and increasing population density, particularly in environments characterized by inadequate city planning and widespread poverty. To help communities manage risks and build resilience, we designed an intervention that provides technical knowledge and small grants to address information and liquidity constraints. Central to this intervention is the organization of community meetings to promote cooperation, mobilize local communities, and facilitate decision-making. This community-driven approach to disaster risk management empowers treated communities to select and implement their own climate adaptation projects. To assess the effects of our intervention in the coastal city of Quelimane, Mozambique, we are conducting a clustered randomized controlled trial. Beyond evaluating the intervention's overall effectiveness, we will examine underlying mechanisms and test hypotheses regarding its effects on immediate outcomes (for example, risk awareness and community mobilization), intermediate outcomes (for example, flood mitigation behaviours among community members and leaders), and final outcomes (for example, flooding and its impact on livelihoods). To measure these, we conduct multiple rounds of surveys with 2,000 households and 500 community leaders, supplemented by data from structured community activities, systematic photographs of the drainage system, and enumerator observations, in order to broaden our pool of objective information.

JEL Classification: C93, D90, H40, O18, Q54

Keywords: Risk and uncertainty, climate-related disasters, flooding, urban development, community mobilization, community-based adaptation, randomized controlled trial, Mozambique

*Leeffers: University College London, s.leeffers@ucl.ac.uk; Macdonald: University of Sheffield, j.macdonald@sheffield.ac.uk; Miehe: Nova School of Business and Economics, caroline.miehe@novasbe.pt; Vicente: Nova School of Business and Economics, pedro.vicente@novasbe.pt. Author order is alphabetical. This document is registered at the AEA RCT registry (AEARCTR-00XXXXX). This work is supported by the International Growth Center (project codes MOZ-22259 and MOZ-24100). This study was approved by Nova School of Business and Economics's Ethics Committee on March 13, 2023.

1. Introduction

The effects of climate-related disasters are exacerbated in cities due to rapid urbanisation and increasing population density, primarily when poorly planned and occurring in a setting of widespread poverty. Mozambique's coastal cities are frequently hit by extreme weather events, like cyclone Idai, which hit Beira city in Sofala province, leading to 600 deaths and affecting more than 1.5 million people in 2019. Mozambique's coast is one of the world's hotspots for extreme weather events: it has a long history of catastrophic flooding, primarily influenced by La Niña and the Intertropical Convergence Zone.[1]

At the same time, urbanisation processes are happening across Africa, often quickly and unregulated. Sometimes due to conflict and climate change, both rural economic migrants and internally displaced individuals see coming to the city as an opportunity to start again and improve their lives. In this context, constructing new informal houses in risky areas is frequent. Mangroves, which are crucial for protecting against floods and erosion, are being cut down at an unprecedented rate.

In this project, we ask whether providing technical assistance and enhancing community cooperation can help control environmental and disaster risks, such as flooding and erosion in the coastal city of Quelimane. We are specifically interested in testing the impact of providing information about locally viable adaptation projects, complemented by a small grant and meetings to promote cooperation for their successful implementation. Hence, our intervention eases technical capacity, liquidity, and cooperation constraints. Our innovative approach to community-driven disaster risk management aims to facilitate the implementation of a climate adaptation project chosen by the community itself.

Bryan et al. (2020) argue that coastal cities are particularly vulnerable in a climate scenario of increasing extreme weather events. Nevertheless, the literature on the intersection of urbanisation and climate adaptation still needs to be explored,

1. See also the World Bank Climate Change Knowledge Portal.

especially in developing settings. The related literature comes from a diverse set of scientific fields. We highlight four key areas.

First, we build upon prior research led by our team, which identified tangible community responses to flood mitigation measures in Quelimane, particularly in waste management strategies (Leeffers, 2024). This work extends to understanding the critical role of cities' public policies in integrating rural migrants (Armand et al., 2022).

Second, we draw from evidence that underscores the importance of thoughtful urban planning and infrastructure investment as pivotal to reducing flood risks (Gandhi et al., 2022) and emphasise the necessity of financial and technical support to facilitate such endeavours (Abagat et al., 2017; Lumbroso et al., 2008).

Third, we acknowledge the significant role of local governance in adaptation strategies (Agrawal et al., 2008) and the success of community-based organisations in mitigating flood risks, as seen in Senegal (Newman et al., 2024). Our proposal ventures to answer how best to incentivise and foster the establishment of such community organisations.

Fourth, as flood-prevention infrastructure is a public service, and forming committees and holding meetings could induce community-based monitoring, we build on previous studies that investigate the impact of community-based monitoring on public service delivery. In the Ugandan health sector, Björkman and Svensson find that a community-driven local accountability project resulted in significant improvements in health care delivery, utilization, and health outcomes after one year (Björkman and Svensson, 2009) and in the longer run (Björkman Nyqvist et al., 2017). However, Raffler et al. (2020) test a related intervention in a similar setting and show that it does not increase community monitoring, nor generate improvements in health outcomes. Our study contributes to this literature by adding evidence on the effects of community-based monitoring on infrastructure as a public service.

2. Experimental Design

2.1. Intervention

To address three critical constraints to climate adaptation infrastructure—technical knowledge, liquidity, and cooperation—we have designed a multifaceted intervention. Based on recommendations from an engineering team and tailored to the unique characteristics of each city block, we propose locally viable flood mitigation projects to overcome technical knowledge gaps. Community meetings are organized to facilitate collaborative decision-making and strengthen local cooperation. Liquidity constraints are mitigated by providing a small grant. This innovative, community-driven approach to disaster risk management empowers communities to select and implement their own climate adaptation projects.

2.1.1. Technical Knowledge

To address constraints in technical knowledge, we propose one flood mitigation project for each city block. To ensure these projects are technically sound and contextually feasible, we establish partnerships with international and local experts.

Together with the Portuguese university Instituto Superior Técnico and the Swiss engineering company MHYD, we collect relevant in-situ data, conduct hydraulic and hydrological studies, and develop a macro water model for Quelimane. In collaboration, we map the drainage canal system, identify key flood risk areas and zones suitable for mangrove replanting, and produce detailed maps to guide our intervention. The international engineering team also recommends a set of flood prevention measures, which serve as the foundation for the proposed flood mitigation projects. Additionally, we partner with local engineers to integrate their insights on existing capacities. They validate the proposed flood prevention measures for both financial and practical feasibility. To further build expertise in mangrove replanting, we partner with the Centro de Pesquisa e Tecnologia do Mar (CePTMar) and two mangrove restoration associations based in Quelimane, ANAMA and ASSOPEZA. These collaborations—both international and local—are

critical to ensuring our proposed projects are technically robust and contextually appropriate.

2.1.2. Liquidity

To address liquidity constraints, we provide each city block with a small grant to support project implementation. Valued at 5,000 MZN (approximately 80 USD), the grant is announced during the first community meeting and allocated exclusively for purchasing materials needed for the project, rather than being distributed directly to the community.

2.1.3. Cooperation

To foster cooperation, we organize three rounds of community meetings. Block leaders are encouraged to invite all residents within their block to participate. To ensure adequate attendance, our team directly invites a share of residents through door-to-door mobilization activities and follows up with text message reminders.

First meeting During the first community meeting, the community discusses flooding-related challenges. Residents identify key issues affecting their blocks and propose potential solutions. These challenges and solutions are then classified into smaller, locally manageable ones and larger issues requiring broader responses. Once the list of locally manageable projects is finalized, community members rank them by priority, and our team commits to conducting a technical evaluation before the second meeting.
Additionally, local committees, composed of the block leader and elected members, are formed during the first meeting to facilitate community decision-making. We also announce the 5,000 MZN grant per block, explaining its purpose and allocation process.

Analysis between meetings Building on the accumulated expertise outlined earlier, we evaluate the measures proposed during the first meeting from a technical perspective. This process results in five types of flood mitigation projects, all

technically sound, financially feasible, and suggested by the communities themselves: 1) cleaning drainage canals; 2) opening and connecting canals to the drainage system; 3) *Entulho* (using debris to fill holes where water accumulates, reducing water build-up and improving road accessibility) or *Abaulamento* (using debris to create an elevation in the centre of the road to direct rainwater off); 4) replanting mangroves; and 5) constructing or repairing bridges.

To identify the most suitable recommendation for each block, we develop an algorithm that incorporates: a) the community's suggestions from the first meeting, b) the geographic location and specific characteristics of each block, and c) our engineering expertise, including the validated flood prevention measures, a detailed drainage system map, and a map of areas proposed for mangrove replanting.

This approach results in one flood-prevention project recommendation per city block, ensures that the selected project aligns with both local needs and engineering best practices, and fosters participation and ownership among community members.

Second meeting During the second community meeting, our team presents the flood-prevention project to each block as a recommendation rather than a directive, always allowing the community to make the final choice. This approach respects the community's deep understanding of local challenges and reinforces a sense of ownership over the selected project. To guide the discussion and support informed decision-making, our team provides detailed maps of the drainage system and mangrove replanting areas, down to the individual block level. As a result, the final project for each block is chosen through a collaborative process that combines community suggestions, our technical assessment, and a final group discussion during the second meeting.

Once a project is agreed upon, the focus shifts to identifying the materials and volunteers needed. This is still part of the second meeting. Each block receives a grant of 5,000 MZN, allocated specifically for purchasing materials required for project implementation. Our team also encourages community members to volunteer their labour and contribute materials they already possess to support the initiative, reinforcing collective effort and engagement.

Third meeting During the third and final meeting, the community, guided by its local committee and supported by our team, comes together to implement the project using the volunteers and materials agreed-upon during the second meeting.[2] In addition to the primary project selected by each community, an awareness-raising campaign is implemented to promote positive flood prevention behaviours and discourage harmful practices. Many blocks suggested this activity during the first meeting, and it is a cost-effective addition to the intervention.

Focus group discussions with a block leader, a member of ASSOPEZA, and other stakeholders determine the content of the awareness-raising campaign,[3] which comprises two phases: 1) Megaphone message: our team circulates with a megaphone, delivering concise messages in both Portuguese and the local language Chuwabu, ensuring broad understanding; 2) Community lecture: our team gathers residents for a 10-15 minute lecture, reinforcing key messages and fostering community engagement.

At the end of the lecture, communities are provided with two types of maps to enhance awareness and understanding: 1) a map of the drainage system, which identifies and categorizes the drainage canals within the block and surrounding areas, and 2) a flood risk map, which highlights the flood risk level for each block. In areas where mangrove planting is feasible, we also provide a one-page instructional guide with practical, locally tailored guidance to support successful planting efforts. This guide was developed in collaboration with CePTMar, ANAMA, and ASSOPEZA.

---

2. Our team purchases the materials, and block leaders collect them at a designated location and time with a voucher we have given to them at the pickup location on the same day. Block leader were reminded of the pickup via phone. For projects that involve *Entulho*, a truck delivers the sand. For projects that involve cleaning, another truck removes the collected waste after the activity. After project implementation, the materials remain with the communities, with local committees responsible for their maintenance and management to ensure continued use.

3. The megaphone messages and community lectures cover a range of critical topics, including: a) recommendations for effective waste management; b) advice against construction on drainage canals or wetland areas; c) guidance on implementing *Entulho* or *Abaulamento* with suitable materials; d) guidance on safe bridge construction; e) promotion of mangrove preservation and discouragement of mangrove cutting; f) encouragement of planting vegetation around homes; g) encouragement of communication within communities about weather alerts; h) promotion of community collaboration in flood prevention efforts.

Finally, we sent text messages to all contacts collected during door-to-door mobilization activities and the three community meetings to reinforce the information shared in the awareness-raising campaign.

2.2. Sampling

There are 557 blocks in 54 neighbourhoods in 7 administrative posts in Quelimane. Building on GIS data for the Quelimane basin area and exploratory surveys with local leaders, we select 489 urban and peri-urban blocks in the city of Quelimane. This implies that 68 blocks are excluded from the sample, namely the blocks within Administrative Post 5 (due to its rurality and low population density) and the down town blocks (due to the developed drainage system in this area).

2.2.1. Households

To sample households, six random houses within each city block were pre-selected and ranked in QGIS. The random locations were divided into male and female respondents, to enable a gender-balanced household sample. Enumerators were instructed to visit two locations per gender and interview the household head (or partner) of the assigned gender. Interviews with unavailable respondents were rescheduled for a later date.

If any of the households were ineligible (non-residential location, non-adult household head, gender assigned not applicable), the enumerators would visit the third randomly selected location. If more substitution was needed, the enumerators were instructed to visit the closest house to the yet unused location until they had surveyed two male and two female respondents per city block.

2.2.2. Block Leaders

For the block leader sample, one leader per city block was surveyed. If the block leader was unavailable for the entire duration of the baseline or if the block had no assigned leader at the time, the enumerator asked the neighbourhood secretary to name the second-best person to answer our survey. This person was requested to have a block leadership position or to be a long-time resident.

2.3. Clustering

We employ a clustered design with a single treatment group. To achieve this, the blocks are categorized into eleven drainage zones based on watersheds and drainage systems (Figure 1). Within each zone, a clustering algorithm is applied utilizing the heuristic approach outlined by Wei et al. (2020), implemented through the Max-P Regionalization Algorithm from the PySAL Library.

This clustering process involves setting a minimum of three adjacent blocks and considering attribute variables such as altitude and type of drainage canal. Subsequently, we refine these clusters in a post-processing phase, prioritizing allocations consisting of three blocks and promoting increased border sharing and drainage canal connectivity. Approximately 16% of the blocks are adjusted during this phase, resulting in the definition of 159 distinct clusters, see Figure 2 for an overview.

2.4. Randomization

Lastly, these 159 clusters are randomly allocated to treatment stratified by drainage zone and the number of blocks with drainage canals. This results in 80 clusters allocated to treatment, comprising 246 blocks. The resulting allocation of clusters, blocks, and households to treatment and control can be found in Table 1. See Figure 3 for an overview of treatment distribution. Note that randomization was performed at the cluster level to make sense of flood-prevention projects with clear geographical spillovers (e.g., block-level improvements in the drainage system), while treatment will be administered at the block level to leverage community cohesion and trust.

2.5. Statistical Power

We calculate the smallest effect size that can be reliably detected in a clustered randomized controlled trial using Stata's build-in *power* program, including 159 clusters—79 in control and 80 in treatment—for outcome variables at the household and block leader levels. Each cluster comprises two, three, or four city blocks and,

on average, twelve households. The whole experimental sample encompasses 489 blocks, their leaders, and 1,956 households.

We assume a 5% significance level and a 80% statistical power threshold, that is, a 80% probability that our test will yield a statistically significant result if the research hypothesis, in reality, is true. To calculate the smallest detectable effect size, we also measure the intra-cluster correlation coefficients for the different outcome variables based on household and leader baseline survey data. The baseline variables used here are standardized with mean zero and standard deviation one. We treat all clusters as if they had the same size (twelve households).

The results of our power calculations, which show our study's ability to detect meaningful effects, are depicted in Figures 4 and 5. For household-level outcomes, we show that the experiment is powered to detect treatment effects of 0.17 standard deviations for financial contributions to community-level adaptation efforts. The minimum detectable effect size is 0.22 standard deviations for the likelihood of having been impacted by flooding last year, and 0.25 standard deviations for having seen or participated in collective action.[4] At the local leader level, we are slightly less powered as there is only one leader per block. Here, the minimum detectable effect size is less than 0.3 standard deviations for the four chosen leader outcome variables.

3. Framework for Analyses

3.1. Theory of Change

We provide a theory of change in Figure 6. Beyond measuring the overall effectiveness of the intervention, we will investigate underlying mechanisms and test a range of hypotheses regarding its effects on immediate outcomes (demand for leader accountability; knowledge and awareness; community mobilization and cohesion; locus of control), intermediate outcomes (leader behaviour; collective and individual preventive behaviour; high-risk behaviour), and final outcomes (flooding;

4. These two overlap in the figure.

impact of flooding on livelihoods). We also describe in Figure 6 the links between the various outcome variables.

3.2. Hypotheses

Hypothesis 1. The intervention increases community members' demand for leader accountability.

Hypothesis 2. The intervention increases knowledge and awareness among community members and leaders.

Hypothesis 3. The intervention increases community mobilization and cohesion.

Hypothesis 4. The intervention increases locus of control among community members and leaders.

Hypothesis 5. The intervention affects community leaders' behaviours, namely it affects leader efforts.

Hypothesis 6. The intervention increases community members' collective preventive behaviours regarding floods.

Hypothesis 7. The intervention affects community members' individual preventive behaviours regarding floods.

Hypothesis 8. The intervention decreases community members' high-risk behaviours regarding floods.

Hypothesis 9. The intervention mitigates flooding.

Hypothesis 10. The intervention decreases the impact of flooding on community members' livelihoods.

3.3. Heterogeneity Analyses

We analyse heterogeneous treatment effects to gain insights into the underlying mechanisms. While allowing additional exploratory work, we perform heterogeneity analyses using the following baseline characteristics:

3.3.1. Investigating the Theory of Change

1. Community members' demand for leader accountability (for the variables to be used for this analysis, see 6.1.1, 6.1.2, and 6.1.3);
2. Knowledge and awareness among community members and leaders (for the variables to be used for this analysis, see 6.1.4, 6.1.5, 6.2.1, and 6.2.2);
3. Community mobilization and cohesion (for the variables to be used for this analysis, see 6.1.6, 6.1.7, and 6.2.3);
4. Locus of control among community members and leaders (for the variables to be used for this analysis, see 6.1.8 and 6.2.4);
5. Community members' high-risk behaviour (for the variables to be used for this analysis, see 6.1.11, 6.1.12 and 6.2.10);

3.3.2. Infrastructure and location

6. Infrastructure (e.g., prevalence of or distance to schools/roads/markets/health centres, variables in 6.1.9 and 6.2.8);
7. Connection to different types of drainage canals (i.e., not connected vs. connected to covered canal vs. connected to uncovered canal);
8. Geography and topography (e.g., elevation, adjacency to coast);
9. Location in or close to high-risk or flood-prone area;

3.3.3. Other block characteristics

10. Flooding experience (for the variables to be used for this analysis, see 6.2.11 and 6.2.12);
11. Characteristics and behaviour of the block leader (e.g., age, education, tenure, political affiliation, network, connections, fairness, social standing, authority,

respect, political influence, clearness of communication, risk preferences, and variables in 6.2.5, 6.2.6, and 6.2.7);

12. Diversity (ethnic, economic, linguistic, religious, and social);

3.3.4. Other household characteristics

13. Flooding experience (for the variables to be used for this analysis, see 6.1.13 and 6.1.14);

14. Vulnerability (e.g., female-led, low income, low education, recently arrived migrants);

15. Risk preferences;

16. Age of household head;

3.3.5. Variables related to intervention

Note: These only exist for treatment.

17. Level of participation in treatment meetings: households that attended meetings and blocks with higher attendance;

18. Project implementation decision (i.e., cleaning drainage canals vs. opening and connecting canals to the drainage system vs. *Entulho* or *Abaulamento* vs. replanting mangroves vs. constructing or repairing bridges).

4. Empirical Analyses

4.1. Main Analysis

The impact of the intervention will be assessed by comparing outcome variable means between treatment and control groups, using this regression specification:

$$y_{i,b} = \alpha + \beta_1 T_b + \delta_1 \mathbf{X}_{i,b} + \theta_1 \mathbf{Z}_b + \omega_1 y_{0,i,b} + \varepsilon_{i,b} \tag{1}$$

where $y_{i,b}$ is the outcome of interest for respondent i in block b at endline. $y_{0,i,b}$ is the corresponding outcome at baseline.[5] T_b is a binary variable taking the value 1 if the block is assigned to the treatment. $\mathbf{X}_{i,b}$ is a vector of individual control variables, including the respondent's gender, age, education, and household size. $\mathbf{Z}_b$ is a vector of block-level control variables, including the number of houses, the area size in hectares, meters of drainage canals, neighbourhood and strata fixed effects. Finally, $\varepsilon_{i,b}$ is the usual idiosyncratic error term. The coefficient β_1 is our estimated treatment effect. Standard errors are clustered at the cluster level.

4.2. Heterogeneity Analysis

To enable subgroup analyses, the regression specification above is adapted to:

$$y_{i,b} = \alpha + \beta_2 T_{i,b} + \phi_2 S_{i,b} + \gamma_2 T_{i,b} \cdot S_{i,b} + \delta_2 \mathbf{X}_{i,b} + \theta_2 \mathbf{Z}_b + \omega_2 y_{0,i,b} + \varepsilon_{i,b} \qquad (2)$$

where $S_{i,b}$ is a binary indicator taking a value of 1 if the individual or block belongs to the subgroup under analysis.

4.3. Spillovers

To account for the possibility of spatial spillovers, we will examine whether the intervention in treatment clusters generates externalities that affect nearby control clusters. These spillovers may include negative externalities, such as the displacement of trash or flood impacts into neighboring areas, or positive externalities, such as the diffusion of flood mitigation behaviors or infrastructure improvements from treatment to control clusters. Such spillovers could lead to biased estimates of treatment effects if not properly accounted for, either by overestimating or underestimating the intervention's impact. To assess these potential spillovers, we will analyze whether the fraction of shared boundaries between treatment and control

5. We only control for baseline values to increase power in this ANCOVA specification if we have the corresponding variable (or all variables that constitute an index) at baseline. Some questions are added at endline only, so we will not be able to control for the corresponding outcome variable at baseline.

clusters influences key outcome variables, including cleanliness, flood mitigation behaviors, and flood impacts in control clusters.

4.4. Balance Tests

To check if the average values of baseline characteristics of households, block leaders, city blocks, and clusters are statistically different across treatment and control groups, our standard orthogonality tests include some variables that are unlikely to be affected by the intervention, see Table 2 for the preliminary results. Pairwise t-tests confirm balance for 19 variables included here. We will also test balance for the outcome indices that that will be used to measure the intervention's impact and explore the underlying mechanisms at play, see Section 6.

4.5. Attrition

Attrition in Leeffers (2024) is low—1.2% among households and 3.3% among block leaders—and we anticipate even lower rates in this study as we allocate more time and resources to locate participants. Our field team has detailed contact information of the respondents, including their relatives, neighbours, and friends, to facilitate follow-up. We also recorded the location of the baseline interview, which took place at the respondent's home in 98% of cases. Finally, we will introduce flexible scheduling for follow-up interviews, allowing leaders and households to choose the most convenient time for the interviews.

While we do not foresee significant differences in attrition between treatment and control groups, we will test for any potential biases related to baseline characteristics in dropout rates. To compare attritors to individuals that remain in the sample, we will use the same variables as for testing balance (see 4.4), including some that are unlikely to be affected by the intervention and the outcome indices. Using the same variables, we will also test if non-response is related to the treatment by regressing the likelihood of leaving the sample on the treatment indicator.

4.6. Multiple Hypothesis Testing

As we plan to explore a variety of outcomes and subgroups, managing the risk of drawing incorrect conclusions due to multiple comparisons is essential. We address this challenge in two ways:

Firstly, we aggregate related outcome variables into indices, according to Kling et al. (2007). Secondly, we adjust our p-value calculations by computing sharpened q-values (Anderson, 2008).

4.7. Data Transformation

To ensure our analysis is not distorted by variables that show very little change, we exclude any variable where over 95% of the observations within the relevant sample are identical. Additionally, responses of "do not know" or "refuse to answer" are treated as missing data—we do not attempt to fill in these missing values.

For continuous variables, trimmed values are used to reduce the influence of outliers. In particular, we trim 2.5% of each side of the distribution for household level outcomes and 1% of each side of the distribution for block level outcomes.

Inverse hyperbolic sine (IHS) transformations are used if variables are skewed, with skewness being defined as the adjusted Fisher-Pearson coefficient of skewness exceeding 1.96. To address the recent critiques by Mullahy and Norton (2022) and Chen and Roth (2024), we will apply the IHS transformation cautiously when dealing with outcome variables that have many zeros and impacts on the extensive margin. Specifically, we will estimate and document treatment effects on the extensive margin, note the proportion of zeros in the data, carefully evaluate how much we value extensive versus intensive margin effects in our estimations, and exercise caution in interpreting the magnitudes of treatment effects on IHS-transformed outcome variables as percentage changes.

5. Data

Several rounds of household, block leader, and neighbourhood secretary surveys serve as an important data source. To broaden our pool of objective information, enumerators will conduct inspections and note down observations. These are supplemented by data from a set of structured community activities (Casey et al., 2012; Armand et al., 2020) and systematic photographs of the drainage system.

5.1. Surveys

During the baseline survey, implemented between November and December 2023, the field team interviewed four households and one leader per city block, resulting in 1956 household and 489 block leader surveys.[6] The endline surveys will follow the same individuals targeted at baseline. Conditional on securing more funding, we plan to collect an additional round of endline survey data to measure longer-term outcomes.

In addition to household and block leader surveys, and also conditional on securing more funding, we will survey one neighbourhood secretary per neighbourhood at endline.[7]

The exact survey questions can be found in Subsection 6.1 for the household surveys, in Subsection 6.2 for the block leader surveys, and in Subsection 6.3 for the neighbourhood secretary surveys. Questions that were not asked at baseline but will be asked at endline are market with "[not in baseline]". Some questions to block leaders will already be asked shortly after the intervention and before the rainy season starting in December 2024. These ones are marked with "[also asked at midline]" in Subsection 6.2.

5.2. Enumerator Observations and Inspections

6. High-frequency checks were performed daily to ensure data quality and protocol compliance. Moreover, control calls and/or back-checks were done to 10% of the sample, where the enumerator would ask a random set of 5-10 questions from the baseline survey.

7. Neighbourhoods are the administrative level above blocks.

5.2.1. Enumerator Observations

Enumerators note their observations regarding collective and individual preventive behaviour, high-risk behaviour, block accessibility and walkability, and flooding. Details can be found in Subsection 6.4.

5.2.2. Inspecting the Water Level

Enumerators measure the water level, i.e., the depth of floodwater, a) in front of four baseline household houses and b) at 2 GPS coordinates in a likely flooded area (based on the elevation map), using reference points like a corner of a house or a tree in both cases. This results in a measure of flooding (Hypothesis 9).

5.2.3. Inspecting Walkability

Enumerators walk a) from baseline household house to baseline household house (from HH1 to HH2, from HH2 to HH3, from HH3 to HH4) and b) from the final baseline household house (HH4) to the closest tarmac road and measure the time this takes. This measures walkability and hence the impact of flooding on livelihoods (Hypothesis 10).

5.3. Structured Community Activities

Structured community activities will be conducted between December 2024 and December 2025. These activities follow Casey et al. (2012) and Armand et al. (2020).

5.3.1. Community Gathering

We ask block leaders to gather their communities to discuss the challenges that arise with the approaching rainy season and potential preventive measures. The leader is responsible for contacting the block members and mobilizing them to participate in the gathering.

We provide leaders with an incentive to support the organization of the gathering. We also ask them to note on paper whom they have contacted to attend the gathering (names, phone numbers, and the way they have contacted them).

On the day of the gathering, enumerators visit the blocks and record the number of community members who are present, the number of community members who speak during the meeting, and the topics covered in the discussion. They will also collect the paper with the community members who have been contacted by the block leader to attend the gathering.

This structured community activity measures community mobilization and cohesion on the one hand (Hypothesis 3) and leader effort and behaviour on the other hand (Hypothesis 5).

5.3.2. Postcards

This structured community activity closely follows the one in Armand et al. (2020) and is described in detail in their Online Appendix. It measures the demand for leader accountability (Hypothesis 1).

5.3.3. Public Goods Game

This standard game closely follows the one in Armand et al. (2020) and is described in detail in their Online Appendix. It measures community mobilization and cohesion (Hypothesis 3).

5.3.4. Matching Grants and Related Meetings

This structured community activity closely follows the one in Armand et al. (2020) and is described in detail in their Online Appendix (a version was also included in Casey et al. (2012)). It measures community mobilization and cohesion (Hypothesis 3).

By involving block leaders in the organization of this activity and the mobilization of participants, we can measure their efforts regarding specific tasks. We will also record their own financial contribution. Both will serve as measures for leader effort and behaviour (Hypothesis 5).

5.3.5. *Waste Disposal Game*

In case there is sufficient funding, we ask community members to dispose of waste and record their behaviour. This structured community activity measures individual preventive behaviour (Hypothesis 7).

5.4. Systematic Photos of the Drainage System

Enumerators take photographs every 50 meters along the drainage system of the city and at random locations in every block. For each location, they capture images from five different perspectives to document the condition of the drainage ditches and the designated locations within each block. We will employ machine-learning techniques to process the photos as in Leeffers (2024) and consider newer techniques if appropriate.

In addition to taking photographs, enumerators answer a set of questions at these locations, see 5.2.1 and 6.4.

5.5. Geographic Data

To evaluate the impact of the intervention on flooding, we plan to use Sentinel-1 Synthetic Aperture Radar (SAR) satellite imagery as a primary data source. Sentinel-1 offers level-1 Ground Range Detected (GRD) imagery with high resolution (20x22m) and a 6-day exact repeat cycle at the equator, which is particularly advantageous given Mozambique's relative proximity to the equator. SAR imagery is well-suited for flood detection due to its ability to penetrate cloud cover, its high temporal resolution, and the sensitivity of radar backscatter to smooth water surfaces.

However, applying SAR imagery for flood detection in urban areas presents unique challenges. False positives can arise from radar shadowing caused by tall structures, as well as from smooth, water-like surfaces such as roads and rooftops that may be misclassified as floodwater. To address these challenges, we aim to build on the standard flood detection techniques by integrating additional methods to improve the reliability and accuracy of flood detection in urban settings. These

methods could include incorporating ancillary geospatial data, such as digital elevation models, urban land cover maps, and local infrastructure data, as well as exploring advanced machine learning models to differentiate between true flood signals and urban artifacts.

By refining these techniques, we aim to develop a robust framework for detecting and quantifying urban flooding. The resulting flood extent maps will serve as a critical outcome variable for assessing the intervention's impact. Moreover, we will validate our methods using local ground-truth data collected during the study to ensure accuracy and provide transparency through sensitivity analyses and robustness checks.

6. Survey-based Outcome Variables

6.1. Household Surveys

6.1.1. Role of the Block Leader (Hypothesis 1)

- What is the name of your block leader? [G6]
- How much trust do you have in community leaders. For example, if we want to pass money through them, are you confident that you will receive your transfer? [H4]
- Are you satisfied with the efforts of your block leader invests in addressing flooding? [not in baseline]
- It is the responsibility of the block leader to keep me and my house safe from floods. [not in baseline]
- How many community meetings related to flood prevention has your block leader organized in the past year? [not in baseline]
- Has your block leader organized Awareness raising// Cleaning of drainage system or block// *Entulho* or *Abaulamento*// Connection of water channels//

Mangrove replanting// (Re-)Constructing bridges in your block in the past year? [not in baseline]

6.1.2. Role of Other Leaders (Hypothesis 1)

- What is the name of your neighbourhood secretary? [G6.1]
- How much confidence do you have in the people who work with the municipal government. For example, if we want to pass money through them, are you confident that you will receive your transfer? [H5]
- It is the responsibility of the government to keep me and my house safe from floods. [N20.3]

6.1.3. Pressure on Leaders (Hypothesis 1)

- How many times have you contacted your block leader about matters related to flood prevention in the past year? [not in baseline]
- How many times have you contacted your neighborhood secretary about matters related to flood prevention in the past year? [not in baseline]
- Did you vote in the last election? [not in baseline]

6.1.4. Salience of Flooding (Hypothesis 2)

- How likely are floods to affect your household during the upcoming rainy season? [L2]
- As a consequence of climate change, do you expect the risk of flooding in Quelimane to increase, decrease or remain the same? [L12]
- Are you worried that floods will affect your household? [L13]
- Imagine that it was possible to purchase disaster insurance, which would give you funds to cover all the damage and losses caused by natural disasters, such as Cyclone Freddy. How much would you be willing to pay, annually, in meticais? [M26]

- Have you spoken to relatives and/or friends about your experiences and how the flood has affected them? [N25]

- These caps represent the next 10 years (2024, 2025, ... by 2033). Each cap represents a year. If you pull the cap to yourself, this year there was a flood. If you leave the cap in place, there was no flood. Please arrange the caps as you see fit. In the next 10 years, how many years do you anticipate floods will affect your household? [L3]

- Now imagine that these 10 caps represent EVERYTHING that you and your household own. Examples: House, goods, productive items (trees, bicycle, agricultural materials), personal items (clothing). How many of these 10 would be destroyed by a flood situation? [L4]

- Now imagine that these 10 caps represent the current monthly income of your household. In the month following a flood situation, what part of your income would be lost? [L5]

6.1.5. Knowledge (Hypothesis 2)

- In your opinion, what actions can we take collectively to protect ourselves against floods? [N10]

- In your opinion, what are drainage ditches for? [L16]

- Do you know how we should take care of drainage ditches? [L17]

- What should community members do with their garbage to reduce flooding?[8] [not in baseline]

- Why are mangroves important for the community?[9] [not in baseline]

8. a) Burn it, b) Bury it, c) Place it in the nearest garbage container, d) Throw it in the drainage ditches

9. a) They provide wood for construction, b) They attract visitors to the region, c) They require little maintenance and grow quickly, d) They help filter water and reduce erosion, protecting coastal areas from flooding

- How should houses be built to avoid increasing flood risks?[10] [not in baseline]
- How can *Entulho* worsen flooding?[11] [not in baseline]
- What is the recommended way to address improper practices in your neighborhood?[12] [not in baseline]
- How dangerous is the issue of Mangrove cutting// Improper house construction// Improper waste disposal for your community? [not in baseline]

6.1.6. Community Cohesion (Hypothesis 2)

- How much confidence do you have in the people on your block. For example, if we want to pass money through them, are you confident that you will receive your transfer? [H2]
- In case of financial difficulties, which of the following groups of people can ask for help? [I1]
- What is the probability of being able to raise 4,000 MT during the next month: from family, friends and residents of your block? [I2]
- In the last 6 months, has there been tension/conflicts between residents of your block? [I3]
- Do you work with your block to achieve common goals? [I4]
- Do you feel close to other residents on your block? [I5]
- If you didn't have a direct benefit from a community project, would you contribute time, money, or goods to that project? [I7]

10. a) Away from drainage ditches and natural water flow paths, b) Over natural watercourses, c) On stilts above flood-prone areas, d) With concrete walls

11. a) It can alter the natural water paths and reduce the drainage capacity, b) it can contaminate the soil and water, c) a and b, d) neither a nor b because *Entulho* is a good practice.

12. a) Confronting and punishing individuals immediately, b) Working collaboratively with community members, c) Reporting everyone to the municipality, d) Ignoring the issue unless it affects you directly

6.1.7. Community Mobilization (Hypothesis 2)

- Have you ever seen the residents of the block participate in a street or drainage ditch-cleaning action in the past? [N16.1]
- If yes: How often did you see the residents of the block participate in street or drainage ditch-cleaning actions *in preparation for and during the last wet season*? [not in baseline]
- Have you ever seen the residents of the block participate in an action to replant vegetation or mangroves in the past? [N16.2]
- If yes: How often did you see the residents of the block participate in actions to replant vegetation or mangroves *in preparation for and during the last wet season*? [not in baseline]
- Have you ever seen the residents of the block engage in *Entulho* or *Abaulamento* in the past? [N16.3]
- If yes: How often did you see the residents of the block engage in *Entulho* or *Abaulamento in preparation for and during the last wet season*? [not in baseline]
- Have you ever seen the residents of the block participate in the construction of protective barriers in the past? [N16.4]
- If yes: How often did you see the residents of the block participate in the construction of protective barriers *in preparation for and during the last wet season*? [not in baseline]
- Have you ever seen the residents of the block participate in or organize flood information campaigns in the past? [N16.6]
- If yes: How often did you see the residents of the block participate in or organize flood information campaigns *in preparation for and during the last wet season*? [not in baseline]

- Have you ever participated in a street or drainage ditch-cleaning action in the past? [N13.1]
- If yes: How often did you participate in street or drainage ditch-cleaning actions *in preparation for and during the last wet season*? [not in baseline]
- Have you ever participated in replanting of vegetation or mangroves? [N13.2]
- If yes: How often did you participate in replanting of vegetation or mangroves *in preparation for and during the last wet season*? [not in baseline]
- Have you ever participated in *Entulho* or *Abaulamento*? [N13.3]
- If yes: How often did you participate in *Entulho* or *Abaulamento in preparation for and during the last wet season*? [not in baseline]
- Have you ever participated in the construction of protective barriers? [N13.4]
- If yes: How often did you participate in the construction of protective barriers *in preparation for and during the last wet season*? [not in baseline]
- Have you ever participated in or organized information campaigns on floods? [N13.6]
- If yes: How often did you participate in or organize information campaigns on floods *in preparation for and during the last wet season*? [not in baseline]

- How well coordinated are community activities aimed at preventing floods and reducing the impact of flooding in your block? [not in baseline]
- How many hours have you contributed to all the mentioned community activities last year? (All community activities together) [not in baseline]
- Imagine that you started a collective fundraiser at the level of your block to protect yourself from floods. They would have 2 months to raise the amount. With the amount raised, an intervention would be made to reduce the impact

of floods, for example drainage ditch, or bulging of roads. How much were you willing to contribute from your personal money, in meticais? [I8]

- Have you ever seen the residents of the block participate in or organize community meetings for the preparation or organization of the block in the past? [N16.5]
- If yes: How often did you see the residents of the block participate in or organize community meetings for the preparation or organization of the block *in preparation for and during the last wet season*? [not in baseline]
- Have you ever attended or organized community meetings to prepare or organize the block? [N13.5]
- How many meetings have you been present in the last 12 months? [I10]

6.1.8. Locus of Control (Hypothesis 4)

- I would feel regret if a flood affected my house and I had not taken action. [N20.1]
- It is my own responsibility to prepare for an emergency. [N20.2]
- It is not always necessary for me to plan far ahead because many things turn out to be a matter of good or bad luck. [N20.5]
- I believe that there are a number of measures that people can take to reduce their risk of flooding. [N20.6]
- Disasters, such as floods, are an act of God. [N20.7]
- It is too expensive/difficult to take flood and flood protection measures that limit the damage caused. [N20.8]
- If the community organized itself, it would be possible to avoid some of the impact of floods. [N20.9]

6.1.9. Collective Preventive Behaviour (Hypothesis 6)

- How clean are drainage ditches in or closer to your block? [G7]
- How clean is the block in general, for example the streets and green spaces? [G8]
- Since last summer, is there new *Entulho / Abaulamento* in this block? [not in baseline]
- Since last summer, is there a new water channel in this block? [not in baseline]
- Is there a bridge in this block? [not in baseline]

6.1.10. Individual Preventive Behaviour (Hypothesis 7)

- Have you ever collected preparedness, evacuation, and warning information? [N4.1]
- If yes: Did you collect preparedness, evacuation, and warning information *in preparation for and during the last wet season*? [not in baseline]
- Have you ever prepared and discussed a domestic emergency plan? [N4.3]
- If yes: Did you prepare and discuss a domestic emergency plan *in preparation for and during the last wet season*? [not in baseline]
- Have you ever prepared an emergency kit? [N4.5]
- If yes: Did you prepare an emergency kit *in preparation for and during the last wet season*? [not in baseline]
- Have you ever made improvements to your house? [4.6]
- If yes: Did you make improvements to your house *in preparation for and during the last wet season*? [not in baseline]
- Have you ever bought sandbags or other materials to create barriers or weight? [N4.7]

- If yes: Did you buy sandbags or other materials to create barriers or weight *in preparation for and during the last wet season*? [not in baseline]
- Have you ever found alternative sources of water or electricity? [N4.8]
- If yes: Did you find alternative sources of water or electricity *in preparation for and during the last wet season*? [not in baseline]
- Have you planted vegetation around your house? [not in baseline]
- If yes: Did you plant vegetation around your house *in preparation for and during the last wet season*? [not in baseline]
- Did you have a drainage in or around your house *in preparation for and during the last wet season*? [not in baseline]
- Was the foundation of your house elevated *in preparation for and during the last wet season*? [not in baseline]
- Have you made your house waterproof *in preparation for and during the last wet season*? [not in baseline]
- How many hours did you and your household members spend adapting *in preparation for and during the last wet season* (All activities together) [not in baseline]

- Here at home, do you do any separation of garbage? For example, separating food scraps and plastics/metals. [G4.1]
- How is food scrap waste treated? [G4.2]
- How is the waste of plastics, metals, papers treated? [G4.3]
- How do you treat solid waste (garbage) from home? [G4.4]

6.1.11. Community Monitoring (Hypothesis 8)

- Do you think these people are harming the rest of the block? (After: Do you consider that there are improper constructions in your block that block water paths, drainage ditches or accesses?) [L21]
- Do you think that these people/buildings should be relocated? [L22]
- What would you do if you saw someone cutting mangroves or constructing a house over a water course?[13] [not in baseline]
- In your opinion, should citizens be punished if they cut mangroves or construct houses over a water course? [not in baseline]

6.1.12. High-risk Behaviours (Hypothesis 8)

- Do you consider that there are improper constructions in your block that block water paths, drainage ditches or accesses? [L19]
- How often have you or a household member personally witnessed mangrove cutting or improper house construction in your block in the past year? [not in baseline]

6.1.13. Flooding (Hypothesis 9)

- Has your household been affected by a flood in the past rainy season? [not in baseline but similar to M1 and M8]
- How many times has your household been affected by a flood in the past rainy season? [not in baseline but similar to M2]
- How was your household affected by floods in the past rainy season? [not in baseline but similar to M3]

13. a) Ignore the activity and do nothing; b) Talk to the person and advise against it; c) Report the activity to block leader; d) Join with others to discourage the activity; e) Other

- Floods cause high water levels in streets, houses, rivers, among others. In the past rainy season, what was the maximum water level INSIDE your house? [not in baseline but similar to M6]
- How would you rate the severity of the most significant flooding event in the past rainy season in your block? [not in baseline]

6.1.14. Impact of Flooding on Livelihoods (Hypothesis 10)

- About your household's food consumption in the last month, which phrase applies? [J1]
- About the housing of your household in the last month, which phrase applies? [J2]
- About your household's clothing in the last month, which phrase applies? [J3]
- About the health care received by your household in the last month, which phrase applies? [J4]
- Taking into account the income level of your household, I would say that they live... [J5]
- Taking everything into account, I would say that at the moment you are... [J6]

- In the last month, how often have you been upset about something that happened unexpectedly? [J7]
- In the last month, how often did you feel like you couldn't control the important things in your life? [J8]
- In the last month, how often have you felt nervous, tense, or worried? [J9]
- In the last month, how often have you felt sad? [J10]
- In the last month, how often did you have trouble concentrating on what you were doing? [J11]

- In the last month, how often have you had confidence in the future? [J12]

- Did floods in the past rainy season cause you any of the following damages or losses? [not in baseline but similar to M12]
- Health-wise, have you and your family suffered from any of the following impacts following floods in the past rainy season? [not in baseline but similar to M13]
- How much did you need to replace all the valuables damaged by floods in the past rainy season? [not in baseline but similar to M14]
- How much did it take to rebuild the damage to your home from floods in the past rainy season? [not in baseline but similar to M15]
- Think about the economic activity you develop. How much do you assess the monetary losses in your income from floods in the past rainy season? [not in baseline but similar to M16]
- In total, how much does the damage and losses caused by floods in the past rainy season in total? [not in baseline but similar to M17]
- Think about your life before the past rainy season. Would you say that today your family's quality of life is better, worse or the same? [not in baseline but similar to M25]

- What strategies have you used to cope with and recover from the impact of floods on your household? [M4]
- How prepared are you in case a flood affects your household? [N18]
- We would like to ask you about your household's ability to respond to a flood if one affected your community tomorrow. Please indicate the extent to which you agree or disagree with the following statements. If a flood occurred tomorrow, your household would be well prepared in advance. [N21.1]

- During due to floods in the past rainy season, how easy was it for you to access the *closest market / healthcare centre / school*? [not in baseline]

6.2. Block Leader Surveys

6.2.1. Salience of Flooding (Hypothesis 2)

- How likely is flooding to affect your block during the upcoming rainy season? [L2, also asked at midline]
- These caps represent the next 10 years (2024, 2025, ... by 2033). Each cap represents a year. If you pull the cap to yourself, this year there was a flood. If you leave the cap in place, there was no flood. Please arrange the caps as you see fit. In the next 10 years, in how many years do you expect floods to affect your block? [L3]
- As a consequence of climate change, do you expect the risk of flooding in Quelimane to increase, decrease or remain the same? [L11]
- Are you worried that flooding will affect your block? [L12]
- Imagine that it was possible to purchase disaster insurance, which would give you funds to cover all the damage and losses caused by natural disasters, such as Cyclone Freddy. How much would you be willing to pay, annually, in meticais? [M15]

6.2.2. Knowledge (Hypothesis 2)

- In your opinion, what are drainage ditches and water drops for? [L16]
- Do you know how we should take care of drainage ditches and water write-offs? [L17]
- In your opinion, what actions can we take collectively to protect ourselves against floods [N11]

6.2.3. Community Cohesion (Hypothesis 3)

- How much trust do you feel you have in the people on your block? For example, if we want to pass money through them, are you confident that you will receive your transfer? [H2]
- In case of financial difficulties, which of the following groups of people can ask for help? [I1]
- What is the probability of being able to raise 4,000 MT during the next month: from family, friends and residents of your block? [I2]
- In the last 6 months, has there been tension conflicts between residents of your block? [I3]
- Do you work with your block to achieve common goals? [I4]
- Do you feel close to other residents on your block? [I5]
- If you didn't have a direct benefit from a community project, would you contribute time, money, or goods to that project? [I7]

6.2.4. Locus of Control (Hypothesis 4)

- I would feel regret if a flood affected my block and I had not taken action. [N20.1]
- It is my own responsibility to prepare for an emergency. [N20.2]
- It is not always necessary for me to plan far ahead because many things turn out to be a matter of good or bad luck. [N20.5]
- I believe that there are a number of measures that people can take to reduce their risk of flooding. [N20.6]
- Disasters, such as floods, are an act of God. [N20.7]
- It is too expensive/difficult to take flood and flood protection measures that limit the damage caused. [N20.8]

- If the community organized itself, it would be possible to avoid some of the impact of floods. [N20.9, also asked at midline]

6.2.5. Block Leader Responsibility and Motivation (Hypothesis 5)

- It is my own responsibility to prepare my block for an emergency. [N20.2, also asked at midline]
- It is the responsibility of the government to keep my block safe from flooding. [N20.3]
- What is the most important reason for becoming a block leader? [P4]
- What is the most important reason for you to do a good job as a block leader? [P5]

6.2.6. Political Dynamics (Hypothesis 5)

- How were you elected as Block Leader? [P3]
- Normally, how are important decisions made here on this block? [P7]
- How do you think decisions should be made in the blocks? [P8]
- In the last 12 months, how many times did you contact the population in your block/neighborhood before making decisions? [P9]
- In the last 12 months, how many times have you been contacted by the population in your block/neighborhood? [P10]

6.2.7. Block Leader Behaviour (Hypothesis 5)

- Per week, approximately how many hours do you use for block leader tasks? [P2]
- If you didn't have a direct benefit from a community project, would you contribute time, money, or goods to that project? [I7]

- Imagine that you started a collective fundraiser at the level of your block to protect yourself from floods. They would have 2 months to raise the amount. With the amount raised, an intervention would be made to reduce the impact of floods, for example drainage ditch, or bulging of roads. How much were you willing to contribute from your personal money, in meticais? [I8]

- Let's talk about community meetings, that is, moments when the community meets with its community leaders to discuss and/or decide on certain issues that concern the block and/or neighbourhood. Which of these phrases applies the most? [I9]
- Have you ever attended or organized community meetings to prepare or organize the block? [N13.5]
- How many meetings have you been present in the last 12 months? [I10, also asked at midline]

- What is the name of the neighbourhood secretary? [G8.1]
- Have you talked to the neighbourhood secretary about cleaning up drainage ditches or streets? [N8.1, also asked at midline]
- Have you talked to other leaders of the neighbouring quarters about cleaning up drainage ditches or streets? [N8.3, also asked at midline]
- How many times have you contacted the administrative post chief/ mayor/ municipality in the past year? [not in baseline]

- Have you ever participated in a street cleaning or drainage ditch cleaning activity? [N13.1]

- If yes: How often did you participate in street cleaning or drainage ditch cleaning activities *in preparation for and during the last wet season*? [not in baseline]
- Have you ever participated in a replanting of vegetation or mangroves? [N13.2]
- If yes: How often did you participate in a replanting of vegetation or mangroves *in preparation for and during the last wet season*? [not in baseline]
- Have you ever participated in *Entulho* or *Abaulamento*? [N13.3]
- If yes: How often did you participate in *Entulho* or *Abaulamento in preparation for and during the last wet season*? [not in baseline]
- Have you ever participated in the construction of protective barriers? [N13.4]
- If yes: How often did you participate in the construction of protective barriers *in preparation for and during the last wet season*? [not in baseline]
- Have you ever participated in or organized information campaigns on floods? [N13.6]
- If yes: How often did you participate in or organize information campaigns on floods *in preparation for and during the last wet season*? [not in baseline]
- How many hours have you contributed to all the mentioned community activities last year? (All community activities together) [not in baseline]

6.2.8. Collective Preventive Behaviour (Hypothesis 6)

- Have you ever seen the residents of the block participate in a street or drainage ditch-cleaning action in the past? [N16.1]
- If yes: How often did you see the residents of the block participate in street or drainage ditch-cleaning actions *in preparation for and during the last wet season*? [not in baseline]

- Have you ever seen the residents of the block participating in an action to replant vegetation or mangroves in the past? [N16.2]
- If yes: How often did you see the residents of the block participating in an action to replant vegetation or mangroves *in preparation for and during the last wet season*? [not in baseline]
- Have you ever seen the residents of the block making *Entulho* or Abaulmento in the past? [N16.3]
- If yes: How often did you see the residents of the block making *Entulho* or Abaulmento *in preparation for and during the last wet season*? [not in baseline]
- Have you ever seen the residents of the block participate in the construction of protective barriers in the past? [N16.4]
- If yes: How often did you see the residents of the block participate in the construction of protective barriers *in preparation for and during the last wet season*? [not in baseline]
- Have you ever seen the residents of the block participate in or organize community meetings for the preparation or organization of the block in the past? [N16.5]
- If yes: How often did you see the residents of the block participate in or organize community meetings for the organization of the block *in preparation for and during the last wet season*? [not in baseline]
- Have you ever seen the residents of the block participate in or organize flood information campaigns in the past? [N16.6]
- If yes: How often did you see the residents of the block participate in or organize flood information campaigns *in preparation for and during the last wet season*? [not in baseline]

- In your opinion, how do you classify the current treatment and management of solid waste in your block? [G5]
- How clean are drainage ditches in or close to your block? [G9]
- How clean is the block in general, for example the streets and green spaces? [G10]
- Is this block connected to the drainage system of Quelimane? [not in baseline]
- Is there a bridge in this block? [not in baseline]

6.2.9. Individual Preventive Behaviour (Hypothesis 7)

- How do you treat solid waste (garbage) from home on your block? [G4]
- Have you seen any of the following types of individual preparation take place among the households on your block? [N10]
- Did you see any of the following types of individual preparation take place among the households on your block *in preparation for and during the last wet season*? [not in baseline]

6.2.10. High-risk Behaviour (Hypothesis 8)

- Do you consider that there are improper constructions in your block that block water paths, drainage ditches or accesses? [L20]
- Has there been mangrove cutting in your block? [not in baseline]
- Do you think your community is actively monitoring high-risk behaviors like cutting mangroves or improper house construction? [not in baseline]
- How often have you received reports about mangrove cutting or improper house construction in your block in the past year? [not in baseline]

6.2.11. Flooding (Hypothesis 9)

- Has your block been affected by a flood in the past rainy season? [not in baseline but similar to M1 and M7]
- How many times has your block been affected by a flood in the past rainy season? [not in baseline but similar to M2]
- During the most severe flooding event in the past rainy season, how much of the block was covered by floodwater? [not in baseline]
- During the most severe flooding event in the past rainy season, what was the maximum depth of floodwater in this block? [not in baseline]
- During the most severe flooding event in the past rainy season, how many days did floodwaters remain within your block? [not in baseline]

6.2.12. Impact of Flooding on Livelihoods (Hypothesis 10)

- How was your block affected by flooding last year? [M3]
- Did flooding in the past rainy season cause any of the following damage on your block? [not in baseline but similar to M8]
- Health-wise, did your block suffer from any of the following impacts after flooding in the past rainy season? [not in baseline but similar to M9]
- Think about your life before flooding in the past rainy season. Would you say that today the quality of life on your block is better, worse or the same? [not in baseline but similar to M14]

- What strategies do people on your block use to cope with and recover from the impact of floods? [M4]
- How prepared are the residents of your block in the event of a flood? [N19]

- We would like to ask you about your block's ability to respond to a flood if one affected your community tomorrow. Please indicate the extent to which you agree or disagree with the following statements. If a flood occurred tomorrow, your block would be well prepared in advance. [N21.1]

- During the most severe flooding event in the past rainy season, in what condition were the main pathway in your block?[14] [not in baseline]

6.3. Neighbourhood Secretary Surveys

6.3.1. Demand for Leader Accountability (Hypothesis 1)

- How often have you been contacted by citizens about flood prevention in the past year? [not in baseline]

6.3.2. Leader Behaviour (Hypothesis 5)

- Has leader x organized Awareness raising// Cleaning of drainage system or block// *Entulho* or *Abaulamento*// Connection of water channels// Mangrove replanting// (Re-)Constructing bridges in their block in the past year? [not in baseline]

- How many community meetings related to flood prevention has leader x organized in the past year? [not in baseline]

- How often have you been contacted by block leader x in the past year? [not in baseline]

6.4. Enumerator Observations

6.4.1. Collective Preventive Behaviour (Hypothesis 6)

For all drainage canal locations (see Subsection 5.4):

- What type of drainage ditch is it? [not in baseline]

14. Dry and clean/ Wet but manageable/ Slippery or muddy/ Eroded, severely damaged, or fully flooded

- Are there solid waste materials inside the drainage canal? [not in baseline]
- On a scale from 0 (very clean) to 10 (very dirty), how dirty is the drainage canal at this location? [not in baseline]
- Are there solid waste materials outside the drainage canal? [not in baseline]
- Are there any signs of recent cleaning done by community members? [not in baseline]
- Are there any other signs of flood preparation done by community members? [not in baseline]
- If wooden bridge: what is the condition of this bridge? [not in baseline]

For the location at the centre of the block (see Subsection 5.4):

- Is there visible solid waste in the area? [not in baseline]
- On a scale from 0 (very clean) to 10 (very dirty), how dirty is the general area at this location? [not in baseline]
- Are there any signs of recent cleaning done by community members? [not in baseline]
- Are there any other signs of flood preparation done by community members? [not in baseline]
- If wooden bridge: what is the condition of this bridge? [not in baseline]

6.4.2. Individual Preventive Behaviour (Hypothesis 7)

- What does this household do with its waste?[15] [not in baseline]
- Has this household planted vegetation around its house? [not in baseline]

15. a) Burn it, b) Bury it, c) Dispose it in the nearest garbage container, d) Throw it in the drainage ditches, e) I cannot observe this

6.4.3. *High-risk Behaviour (Hypothesis 8)*

- Do you see that mangroves have been cut in this block? [not in baseline]
- Do you see improper house construction in this block? [not in baseline]

6.4.4. *Flooding (Hypothesis 9)*

For all drainage canal locations (see Subsection 5.4):

- Are there flooded areas at this location? [not in baseline]
- How deep is the water in these flooded areas? [not in baseline]

For the location at the centre of the block (see Subsection 5.4):

- Are there flooded areas at this location? [not in baseline]
- How deep is the water in these flooded areas? [not in baseline]

6.4.5. *Accessibility/ Walkability (Hypothesis 10)*

- Is the main pathway passable for pedestrians? [not in baseline]
- Is the main pathway passable for vehicles? [not in baseline]
- What condition is the main pathway in?[16] [not in baseline]
- At 6 points described in 5.2.3: Can pedestrians walk here? [not in baseline]

7. Ethical Clearance

This research received clearance from the Ethics Committee of Nova School of Business and Economics (#202255) on March 13, 2023.

16. Dry and clean/ Wet but manageable/ Slippery or muddy/ Eroded, severely damaged, or fully flooded

References

Abagat, Racquel Helena, Efraim Roxas, Joan Pauline Talubo, and Edwin Abucay. 2017. "Adaptation and adaptive capacity to flooding of farming households: Insights from Mabitac, Laguna, Philippines." *Climate, Disaster and Development Journal* 56–64. 10.18783/cddj.v002.i02.a06. [Cited on page 2.]

Agrawal, Arun, Catherine McSweeney, and Nicolas Perrin. 2008. "Local institutions and climate change adaptation." Publisher: World Bank, Washington, DC. [Cited on page 2.]

Anderson, Michael L. 2008. "Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects." *Journal of the American Statistical Association* 103 (484): 1481–1495. 10.1198/016214508000000841. [Cited on page 15.]

Armand, Alex, Alexander Coutts, Pedro C. Vicente, and Inês Vilela. 2020. "Does Information Break the Political Resource Curse? Experimental Evidence from Mozambique." *American Economic Review* 110 (11): 3431–3453. 10.1257/aer.20190842. [Cited on pages 16, 17, and 18.]

Armand, Alex, Frederica Mendonça, Wayne Sandholtz, and Pedro C. Vicente. 2022. "A Field Experiment on Integrating Rural Migrants in Cities: Mapping the City of Quelimane." https://www.theigc.org/project/a-field-experiment-on-integrating-rural-migrants-in-cities-mapping-the-city-of-c [Cited on page 2.]

Björkman, Martina, and Jakob Svensson. 2009. "Power to the people: Evidence from a randomized field experiment on community-based monitoring in Uganda." *The Quarterly Journal of Economics* 124 (2): 735–769. 10.1162/qjec.2009.124.2.735. [Cited on page 2.]

Björkman Nyqvist, Martina, Damien de Walque, and Jakob Svensson. 2017. "Experimental evidence on the long-run impact of community-based monitoring." *American Economic Journal: Applied Economics* 9 (1): 33–69. 10.1257/app.20150025. [Cited on page 2.]

Bryan, Gharad, Edward Glaeser, and Nick Tsivanidis. 2020. "Cities in the Developing World." *Annual Review of Economics* 12 273–297. 10.1146/annurev-economics-080218-030303, Publisher: Annual Reviews. [Cited on page 1.]

Casey, Katherine, Rachel Glennerster, and Edward Miguel. 2012. "Reshaping Institutions: Evidence on Aid Impacts Using a Preanalysis Plan." *The Quarterly Journal of Economics* 127 (4): 1755–1812. 10.1093/qje/qje027. [Cited on pages 16, 17, and 18.]

Chen, Jiafeng, and Jonathan Roth. 2024. "Logs with Zeros? Some Problems and Solutions." *The Quarterly Journal of Economics* 139 (2): 891–936. doi.org/10.1093/qje/qjad054. [Cited on page 15.]

Gandhi, Sahil, Matthew E. Kahn, Rajat Kochhar, Somik Lall, and Vaidehi Tandel. 2022. "Adapting to Flood Risk: Evidence from a Panel of Global Cities." 10.3386/w30137. [Cited on page 2.]

Kling, Jeffrey R., Jeffrey B. Liebman, and Lawrence F. Katz. 2007. "Experimental analysis of neighborhood effects." *Econometrica* 75 (1): 83–119. [Cited on page 15.]

Leeffers, Stefan. 2024. "It Will Rain: The Effect of Information on Flood Preparedness in Urban Mozambique." Unpublished manuscript. [Cited on pages 2, 14, and 19.]

Lumbroso, D., D. Ramsbottom, and M. Spaliveiro. 2008. "Sustainable flood risk management strategies to reduce rural communities' vulnerability to flooding in Mozambique." *Journal of Flood Risk Management* 1 (1): 34–42. 10.1111/j.1753-318X.2008.00005.x. [Cited on page 2.]

Mullahy, John, and Edward C. Norton. 2022. "Why transform Y? A critical assessment of dependent-variable transformations in regression models for skewed and sometimes-zero outcomes." [Cited on page 15.]

Newman, Carol, Tara Mitchell, Marcus Holmlund, and Chloë Fernandez. 2024. "Group Incentives for the Public Good: A Field Experiment on Improving the Urban Environment." *The World Bank Economic Review* 38 (4): 824–845. 10.1093/wber/lhae011. [Cited on page 2.]

Raffler, Pia, Daniel N. Posner, and Doug Parkerson. 2020. "Can Citizen Pressure be Induced to Improve Public Service Provision?", Unpublished manuscript. [Cited on page 2.]

Wei, Ran, Sergio Rey, and Elijah Knaap. 2020. "Efficient Regionalization for Spatially Explicit Neighborhood Delineation." *International Journal of Geographical Information Science* 35 (1): 135–151. doi:10.1080/13658816.2020.1759806. [Cited on page 8.]

Tables

Table 1 — Allocation to treatment and control

	Treatment	Control	Total
Households	984	972	1956
Blocks	246	243	489
Clusters	80	79	159

Note. Used on page [8]

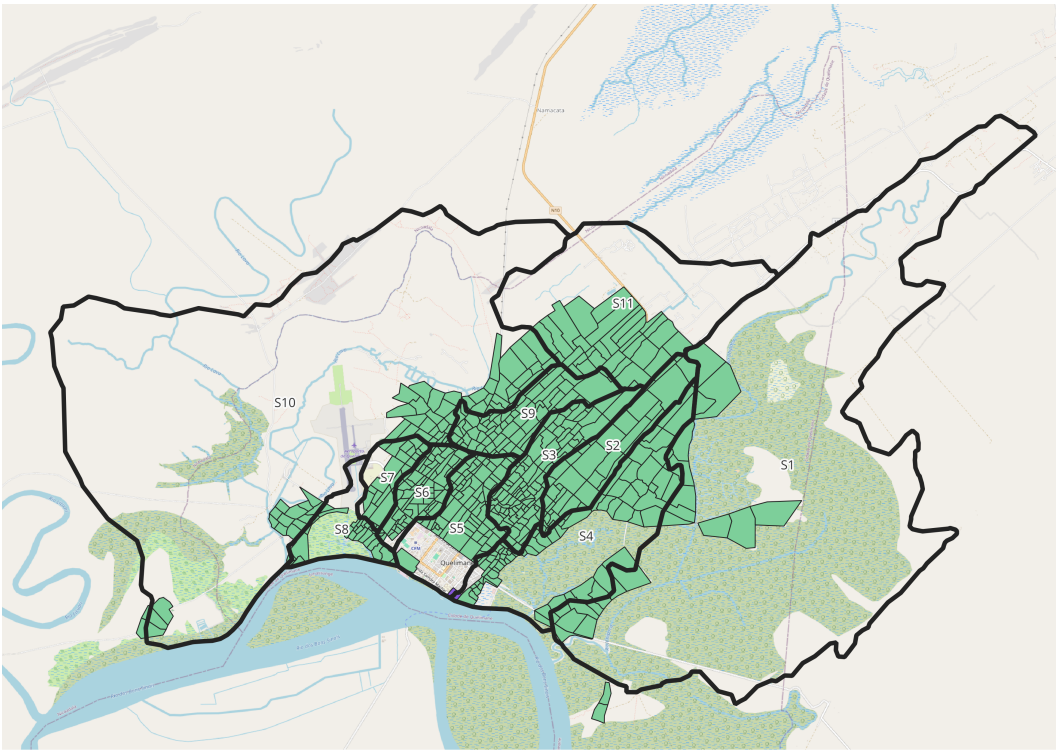
Table 2 — Balance Across Survey Respondents and Blocks

Variable	(1) Control Mean/(SE)	(2) Treatment Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
Households			
Female	0.500	0.500	0.000
	(0.000)	(0.000)	
Age	39.393	38.556	0.837
	(0.544)	(0.595)	
Completed primary education	0.719	0.715	0.004
	(0.020)	(0.020)	
Completed secondary education	0.414	0.390	0.023
	(0.022)	(0.023)	
Worked during the last 12 months	0.675	0.679	-0.004
	(0.022)	(0.021)	
Number of household members	5.315	5.409	-0.094
	(0.078)	(0.075)	
Block leaders			
Female	0.362	0.370	-0.008
	(0.037)	(0.032)	
Age	49.826	49.955	-0.129
	(0.977)	(0.988)	
Completed primary education	0.675	0.675	0.000
	(0.035)	(0.029)	
Completed secondary education	0.173	0.215	-0.043
	(0.027)	(0.030)	
Worked during the last 12 months	0.745	0.740	0.005
	(0.028)	(0.033)	
Number of household members	6.350	6.004	0.346
	(0.161)	(0.186)	
Urban blocks			
Drainage canals	0.675	0.654	0.020
	(0.044)	(0.042)	
Canal type 1	0.045	0.041	0.005
	(0.017)	(0.021)	
Canal type 2	0.214	0.191	0.023
	(0.041)	(0.036)	
Canal type 3	0.416	0.423	-0.007
	(0.048)	(0.045)	
Area size (h)	7.354	6.210	1.144
	(0.896)	(0.653)	
Elevation (m)	7.772	7.580	0.192
	(0.195)	(0.190)	
Number of houses	191.169	193.081	-1.913
	(11.358)	(11.201)	

Note. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Standard errors (reported in parentheses) are clustered at the cluster level. The values displayed for t-tests are the differences in the means across the groups. The block variables are defined by the following: (i) Area size in hectares: variable calculated using the mapped borders in QGIS; (ii) Elevation in meters: variable capturing the average elevation in meters calculated using SRTM data V4 and the mapped borders in QGIS; (iii) Number of houses: variable calculated using OpenStreetMap and the mapped borders in QGIS. Used on page [14]

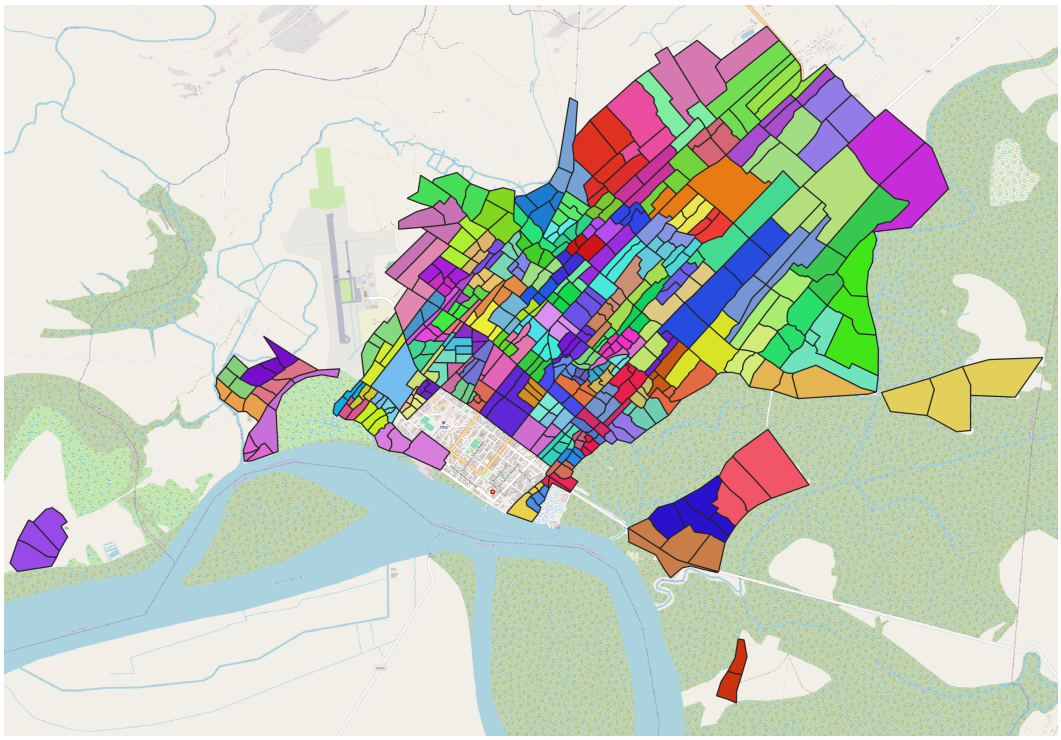
Figures

Figure 1 — Blocks by Drainage Zones



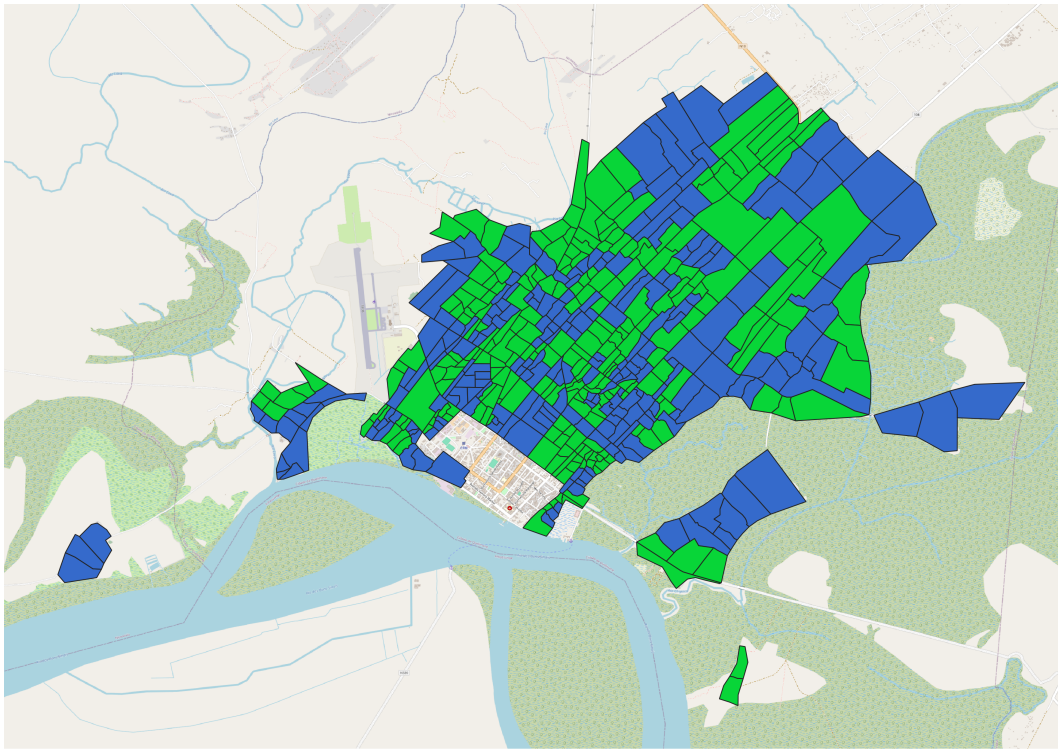
Note. Basemap: © OpenStreetMap contributors. Used on page [8]

Figure 2 — Blocks by Cluster



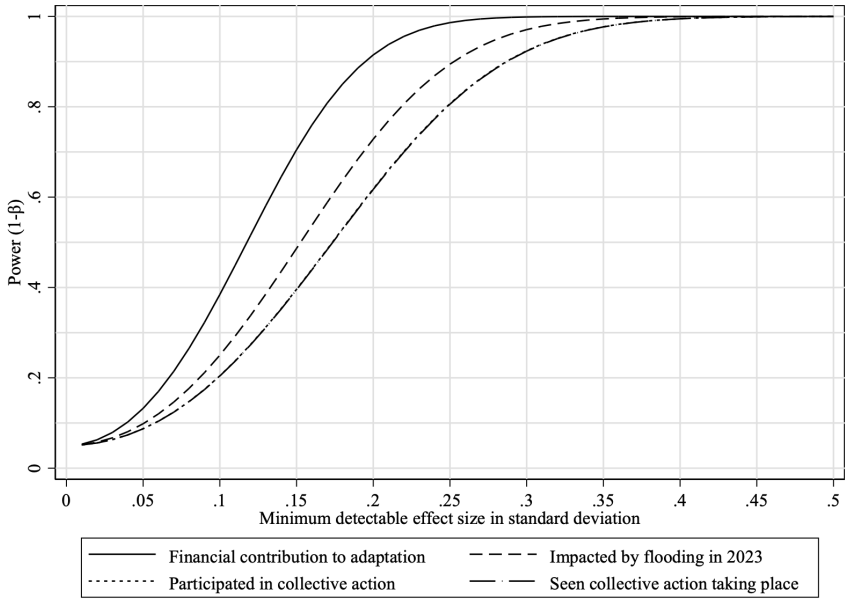
Note. Basemap: © OpenStreetMap contributors. Used on page [8]

Figure 3 — Blocks by Treatment Group



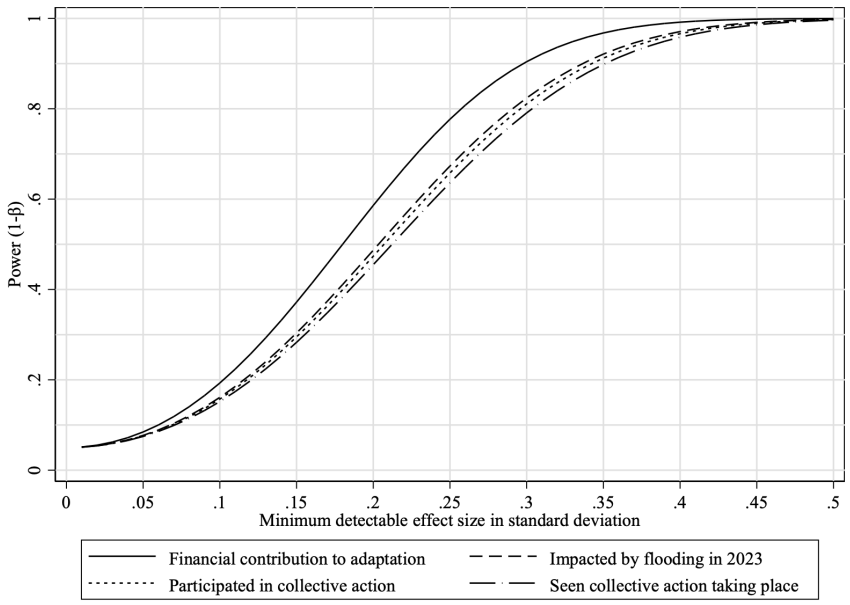
Note. Basemap: © OpenStreetMap contributors. Used on page [8]

Figure 4 — Statistical Power Calculations (Households)



Note. Significance level is 0.05, both groups have 79 clusters and the sample standard deviation is 1. The average cluster size is 12. The intra-cluster correlation varies by outcome variable and is calculated using the baseline dataset. Used on page [9]

Figure 5 — Statistical Power Calculations (Leaders)



Note. Significance level is 0.05, both groups have 79 clusters and the sample standard deviation is 1. The average cluster size is 3. The intra-cluster correlation varies by outcome variable and is calculated using the baseline dataset. Used on page [9]

Figure 6 — Theory of Change

Note. Used on page [9,9]