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Wading Out the Storm

The Role of Poverty in Exposure, Vulnerability and Resilience to Floods in Dar Es Salaam

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Abstract

Dar es Salaam is frequently affected by severe flooding causing destruction and impeding daily life of its 4.5 million inhabitants. The focus of this paper is on the role of poverty in the impact of floods on households, focusing on both direct (damage to or loss of assets or property) and indirect (losses involving health, infrastructure, labor, and education) impacts using household survey data. Poorer households are more likely to be affected by floods; directly affected households are more likely female-headed and have more insecure tenure arrangements; and indirectly affected households tend to have access to poorer quality infrastructure. Focusing on the floods of April 2018, affected households suffered losses of 23 percent of annual income on average. Surprisingly, poorer households are not over-represented among the households that lost the most - even in relation to their income, possibly because 77 percent of total losses were due to asset losses, with richer households having more valuable assets. Although indirect losses were relatively small, they had significant well-being effects for the affected households. It is estimated that households' losses due to the April 2018 flood reached more than US$100 million, representing between 2–4 percent of the gross domestic product of Dar es Salaam. Furthermore, poorer households were less likely to recover from flood exposure. The report finds that access to finance play an important role in recovery for households.

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Wading Out the Storm[1]

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1 Background

The study explores the relationship between poverty and flood risk in Dar es Salaam. The focus is particularly on the role of poverty in exposure – who is affected by floods? – vulnerability – how much do people lose in floods? – and socioeconomic resilience – to what extent are the affected people able to cope with and recover from floods?

Dar es Salaam is East Africa's largest city, and on some accounts Africa's fastest growing metropolitan area. In 2012, the population reached 4.4 million – more than six times that of the next city, Mwanza – and the city is growing at a rate of 6.5% per year. Dar es Salaam will likely achieve megacity status (10 million plus population) before 2030 (TURP, 2015). The combination of high informality and climate hazards makes flood risk a critical challenge for sustainable urban growth and public health in the city (World Bank, 2017; Picarelli et al, 2017).

Tanzania is the most flood-affected country in East Africa,[2] and cities across the country are underprepared to meet the challenges of urbanization and increased vulnerability to climate-related hazards. Flooding is estimated to be the costliest hazard at the national level, causing 62% of losses from natural disasters from 1990 to 2014.[3] Tanzanian towns and cities have undergone a massive spatial expansion: an estimated 70-80% of Dar es Salaam residents live in unplanned settlements, and in Mwanza, the second largest Tanzanian city, it is estimated that 81% of households in hazard-prone areas are also in the low-income population bracket (Hambati, 2013). Today, about 8% of Dar es Salaam's total area is located in the low-elevation coastal zone below the 10m contour line, where exposure to floods is high (Kebede and Nicholls, 2011). These areas are typically characterized by limited access to adequate municipal services (water, sanitation, solid waste, electricity) and associated infrastructure, notably drainage. Only 13% of the city's residents are served by adequate sewerage systems, and 37% of solid waste is properly collected. Together these contribute to a deterioration of environmental conditions, with people suffering consequences which include major health risks, particularly at times of flooding (World Bank, 2011; Hambati, 2013).

Estimations suggest that floods in Tanzania could threaten thousands of people and several billions worth of assets in the future. This report shows that the situation could be even worse. The national costs of climate-related hazards are estimated to be around 1% of GDP in recent years. With projected climate change impacts – higher temperatures and more unpredictable and concentrated rainfall - net economic costs due to climate change could reach 2 to 3% of GDP per year by 2030. In Dar es Salaam, floods in 2009, 2010, 2011, early and late 2014, 2015, 2017, 2018 and 2019 caused losses of lives, injuries, and severely impacted diverse sectors. These included transportation, energy and social infrastructure such as schools and health facilities (COWI et al, 2013). In 2005, models estimated the number of persons exposed to a 100-year coastal flood at 30,000 and the level of asset losses at US$35 million (Kebede and Nicholls, 2011). Studies estimating the impacts of climate hazards in Dar es Salaam have found that the city has infrastructure assets worth approximately US$5.3 billion at potential risk from projected flood impacts under climate change and sea level rise scenarios (Kebede and Nicholls, 2010). These results are driven by the lack of a coordinated storm water drainage system, inadequate housing development and blocking of water streams by careless dumping of solid waste (Sakijege, Lupala and Sheuya, 2012). Results from the current report indicate that far more people are affected by floods than the models predict.

At the household level, the poor are disproportionately affected by flooding, and often do not have the means to recover. This study is an attempt to quantify the impacts for households living in Dar es Salaam both inside and outside known flood risk areas. Vulnerable populations, such as children, elderly and

[2] UN-Habitat 2014, using Global Urban Indicators, 2009 data.
[3] PreventionWeb, accessed 19 February 2019.

women, face particular challenges that are exacerbated by flood risk. Children often miss school during flood events and women are commonly responsible for staying home with children when schools are closed and to clean up the house after floods, forcing them to miss work or not work at all. Thanks to access to rich socioeconomic, gender-disaggregated data, the report also sheds light on the characteristics of affected households and helps us understand the policy relevant link between poverty and flood exposure.

With lack of governmental support, households must absorb the costs of flood damage and try to protect themselves from future exposure. Households in informal settlements take various measures to prevent flood damage (Sakijege, Lupala and Sheuya, 2012). The most common of these are the use of sandbags and tree logs; raised pit latrines and doorsteps; the provision of water outlet pipes above plinth level; the construction of embankments and protection walls; the elevation of house foundations; seasonal displacement; and the boiling and chemical treatment of water.

In April 2018, Dar es Salaam and other parts of Tanzania experienced heavy rains that caused floods in large parts of the city. Information on the impacts of the flood on households and businesses is scarce, an emergency plan of action issued by the Red Cross[4] indicates that the event affected close to 15,900 people across Tanzania –12,000 of them in Dar es Salaam. This flood followed several episodes of heavy rainfall that occurred in Tanzania mainland and Zanzibar between April 12 and April 18. Among the 15 regions affected by floods, Arusha, Dar es Salaam, and Zanzibar were impacted worst. Fifteen people died and 11 were severely injured in Dar es Salaam and one person died in Arusha. The Dar es Salaam Multi-Agency Emergency Response Team and the Tanzania Red Cross estimate that 2,151 households in the city were displaced, 42 houses and 21 latrines completely collapsed and 342 houses severely damaged. The current report provides results suggesting the number of affected households is much larger than official numbers and that the impacts of the flood were significant – households lost on average 23% of annual income.

Recent flooding events affecting Tanzania in May 2019 are yet another reminder of the urgency to address the flood risk problem in the country. During May 5-7, Dar es Salaam received 144mm of rain, which is close to the rainfall average of the entire month of May, leading to flooding and closure of several roads. In mid-May, flooding killed 5 and left 2,500 people homeless in the district of Kyela in the country's south after a week of torrential rain.

The Disaster-Poverty household survey analyzed the relationship between flood risk and poverty in Dar es Salaam. Two rounds of data collection were carried out between November 2017 and September 2018. The first round established an initial assessment and baseline of household exposure and behaviors in relation to flood events. The second round assessed the impact of the flood that happened in April 2018.

2 Methodology and Data

2.1 On project implementation

The study was conducted as part of the Tanzanian Urban Resilience Program (TURP), which is financed by the Government of the United Kingdom's Department for International Development (DFID).

The Disaster-Poverty study has incorporated the work conducted for other TURP components. For example, the team used maps based on the Ramani Huria community mapping project to identify areas exposed to floods, and collaborates widely with other teams under TURP to align objectives and maximize synergies. For example, different teams involved with community work on flood mitigation under TURP were invited to add questions to the questionnaire, and results are shared with partners continuously.

[4] https://reliefweb.int/sites/reliefweb.int/files/resources/MDRTZ021do.pdf

The project is a collaborative effort between GFDRR and the Poverty GP. This component improves the understanding of how disasters and poverty are related, to be able to (i) effectively guide policy on how to strengthen resilience; (ii) capture synergies between risk management and poverty reduction.

While other components under TURP focused only on priority areas, the Disaster-Poverty survey included all of Dar es Salaam in the project design and analysis. Creating a baseline with data from the entire city enables comparison between priority areas and the rest of the city in terms of exposure, vulnerability and socioeconomic resilience. It allows the benefits from TURP interventions to be monitored, and can be used to inform the allocation and prioritization of future TURP investments and public policy.

2.2 Sampling and data collection

The selection of households in the survey design had two objectives. First, to select a sample that represents the population of Dar es Salaam and second, to interview enough people who had experienced floods to be able to detect patterns in their socio-economic characteristics.

A large enough sample size was selected to confidently represent the population of Dar es Salaam given the income level and income distribution. A database of all enumeration areas (EAs) in Dar es Salaam was provided as a sampling frame, by Tanzania's National Bureau of Statistics. After data cleaning, it included 14,987 EAs. Sample size was chosen based on the combination of number of EAs and number of households per EA that produce acceptable relative standard errors (lower than 25%) given the budget constraint for data collection. We found that this could be obtained by selecting 105 EAs and 10 households per EA. Then, we randomly selected 10 households from each EA using satellite imagery. Later, we added 28 EAs to the original sample as part of an additional round of data collection. These were selected using a similar methodology with the objective to include more households from risk prone areas.

To capture enough households that had experienced floods, flood risk stratums were designed using the Ramani Huria community flood map. The community maps were created between 2015-2017 and used information from community members to identify flood prone areas. This generated a "flood prone tag," which was used to categorize EAs into "no risk", "low to medium risk" and "high risk" depending on how much of the area was covered by the tag. The city was divided into these three categories and this categorization was used to oversample in areas with flood risk. As a result, about 42.5% of households in the final sample are located in areas inside or adjacent to the flood prone tag (see Table 9 in Appendix 1 for sample selection by strata). The final sample includes a satisfactory number of households in flood prone areas, as well as low-risk areas to be able to draw statistically sound conclusions about the population. However, it is important to keep in mind that the uncertainty of being affected by a flood is higher in low-risk areas, which represents a much larger section of the city.

In November and December 2017, data were collected from 1,058 selected households in Dar es Salaam, and in September 2018, 282 households were added to the original sample. Additional households were added to increase the number of data points located in high risk areas in order to improve precision in those areas and cover more affected households in the sample. All the selected households were randomly drawn within each EA using satellite imagery. Surveyors used GPS tags to locate the households and interviewed them using CAPI software on tablets. Participation in the survey was voluntary and not compensated.

2.2.1 Poverty assessment using Survey of Wellbeing via Instant and Frequent Tracking and Coping Strategy Index

The project assesses the relationship between poverty and disaster risk through the innovation of introducing a statistical estimation of household income. This is achieved through a rapid poverty

assessment tool, Survey of Wellbeing via Instant and Frequent Tracking (SWIFT),[5] which makes use of the latest ML techniques to estimate expenditure levels and the incidence of poverty in 10 to 15 simple questions. SWIFT offers two key advantages. First, the poverty estimates are fully consistent with the official poverty estimates of the country. Second, producing poverty estimates traditionally requires one to two hours of interview and more than six months of data processing, but SWIFT needs only five to ten minutes of interview and less than a week of data processing. Both significantly reduce the time and costs needed to produce poverty estimates. This method is woven into a DRM (disaster risk management) questionnaire. With both SWIFT and DRM data, the team can assess direct and indirect impacts of floods and how these are related to poverty. Gaining insights in these areas is crucial for TURP as the project helps the government create an evidence-driven disaster risk management strategy, which promotes better targeting and informs investment decisions in disaster prevention. In addition, the questionnaire also collects information on food security status of the households. The Coping Strategies Index (CPI index) was developed by WFP and CARE International as an indicator of food insecurity. In Dar es Salaam, DRM interviews were completed with the comparative (reduced) CSI. It is composed of 5 questions on food access and coping strategies to deal with limited food access. It produces a score between 0-56, where a higher score means higher food insecurity.

2.2.2 Follow-up interviews over the phone

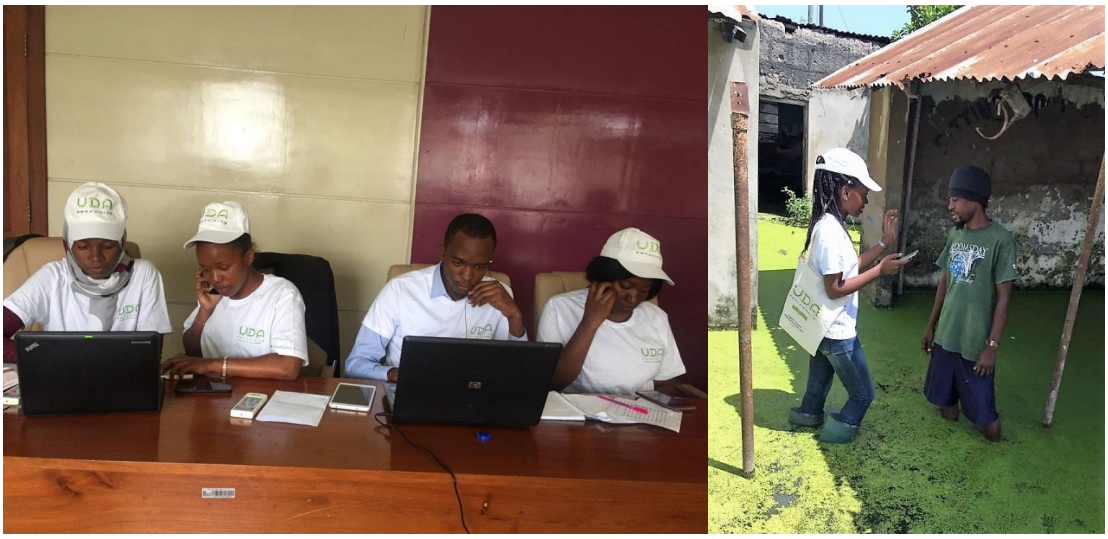
Follow-up interviews with 701 households were carried out in September 2018. After the floods of April 2018, it was decided to implement a follow-up phone interview to assess the impacts on the households included in the original sample. The follow-up interviews were carried out by a call-center in Dar es Salaam from September 3-11, 2018. Among the 730 households for which phone numbers had been obtained in 2017, 419 were reached and agreed to the follow up interview, which corresponds to a response rate of around 60%. 17% of households could not be reached, 20% were associated with a wrong number or a number no longer in service, and only 5% refused to participate in the phone interview. At the same time, data collection was complemented with the addition of 282 households to the sample. These additional households were also asked about impacts of the 2018 flood.

In total, the 701 households included in the follow-up rounds differ somewhat from the households that did not respond.[6] Income, for example, is 19% lower among the households that responded to the follow-up interview. In addition, households that responded to the follow-up interview seem to be located in slightly more risky areas. On average, the elevation is lower and household perception of future risk of floods is higher. These differences may affect the results in several ways: for example, the conclusions reached after comparison between affected and non-affected households could differ from the baseline in the case of the 2018 flood, since both groups are on average slightly poorer. Consequently, the data from the follow up interviews are primarily used in the analysis of vulnerability, in which comparison is primarily among the affected, and when calculating total losses of the flood in 2018.

[5] Survey of Wellbeing via Instant and Frequent Tracking, methodology found here: http://documents.worldbank.org/curated/en/591711545170814297/Survey-of-Wellbeing-via-Instant-and-Frequent-Tracking-SWIFT-Data-Collection-Guidelines

[6] See Table 10 in Appendix 1 for comparison between the households that responded in the follow-up interview with the ones that did not.

Figure 1 – Data collection using phone interviews and door-to-door survey



2.2.3 Complementary data

The survey data were complemented by geospatial data at the sub-ward level collected by the Ramani Huria team. Data include information on solid waste (location and quantity of trash) collected in July 2018 and information on the drainage systems collected from July 2017 onward. The team accessed these data in September 2018 and aggregated the information at the sub-ward level. The data collection is ongoing, the data used in the current study do not cover the entire city yet. To address inconsistencies, the data were only used in regression analysis and by applying ward-level fixed effects.

Distance from work was measured. The distance/travel time to work variable was computed from a multi-modal network based on OSM for pedestrian travel and a GTFS feed produced by WhereIsMyTransport for transit. The workplace of each household's breadwinner was geocoded in the data.[7] The network travel times and distances between the household dwelling and the geo-coded workplace were calculated using the GOSTnets python library.

Finally, six focus group discussions were conducted with households from different areas that had participated in the survey. The team traveled to Dar es Salaam in March 2018 for this purpose. The information gathered during these discussions is used to complement the quantitative analysis with qualitative insights directly from the families who participated in the study.

[7] Workplace location was identified by respondents using landmarks (due to the lack of addresses in Dar es Salaam). Respondents primarily used names of bus stops, streets, markets and neighborhoods. Breadwinners were identified by the household itself and defined as the household member whose income the family relies on the most for subsistence (not necessarily the household head).

Figure 2 - Focus group discussion with community members of Sabasaba on March 18, 2018

2.2.4 Generalizing the results to the entire city

To generalize the results to a city level, sample weights were applied that had been calculated based on flood risk strata. Each household is assigned a sample weight corresponding to the number of households in the city that the sampled households represent, based on selected strata and population. By applying the weights, results can be scaled up to city level. Since we oversampled in areas affected by flood risk as per the methodology described above, we need to generate and use weights to "adjust" the sample to represent the city of Dar es Salaam in terms of flood risk. By using flood risk specific strata for weighting, we also generate more accurate results of the scaled-up results (number of affected people in the city and total losses from floods, etc.) by assuming that households within each stratum are facing similar risks and impacts of floods. Next, we will describe how we generated the flood risk weights.

The flood risk strata were identified using a machine learning (ML) approach, based on the reported occurrence of flood exposure by households in the collected data. The information from the Ramani Huria maps was complemented with elevation and population density by EA to more precisely and transparently categorize areas of Dar es Salaam according to their flood risk.[8] This information was used to build a risk model using an ensembled decision tree algorithm (Figure 3). The model identifies critical thresholds of the variables for different levels of risk of being affected. For example, "extra high risk" is defined as EAs for which area is covered by the Ramani Huria flood tag by 67% or more, located below 5.06 meters elevation and with a population density higher than 0.08 (people/square meter). Using these thresholds, four categories of risk level were identified – low risk, medium risk, high risk and extra high risk. The

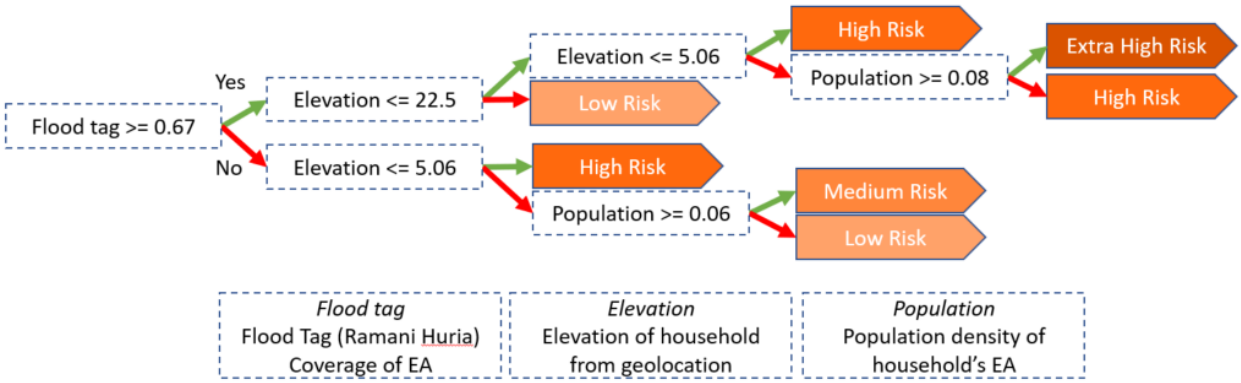
[8] This was done after sampling because it was found that many households in the "low risk" category using Ramani Huria maps only were affected due to unknown factors. In addition, it was found that surprisingly many households in the higher risk categories based solely on Ramani Huria maps were reporting not being affected. By adding population density and elevation it was possible to better capture affected households in flood risk categories and understand what was driving the flood risk categorization.

model, which has a general accuracy of 73%, performed best in predicting the affected households in the higher risk categories. For the low risk areas, more information would be needed to identify affected households with higher confidence. For example, among households located in areas covered by the flood prone tag but high elevation (identified as low risk areas by the model in Figure 3), the model's performance in identifying the affected households weakens. In those cases, additional information, such as quality of drainage, would be needed. According to the model, the likelihood of being directly affected by floods[9] is 83% in extra high risk, 42% in high risk, 24% in medium risk and 18% in low risk areas.

Table 1 - Number of EAs in city and number of households in sample by risk category

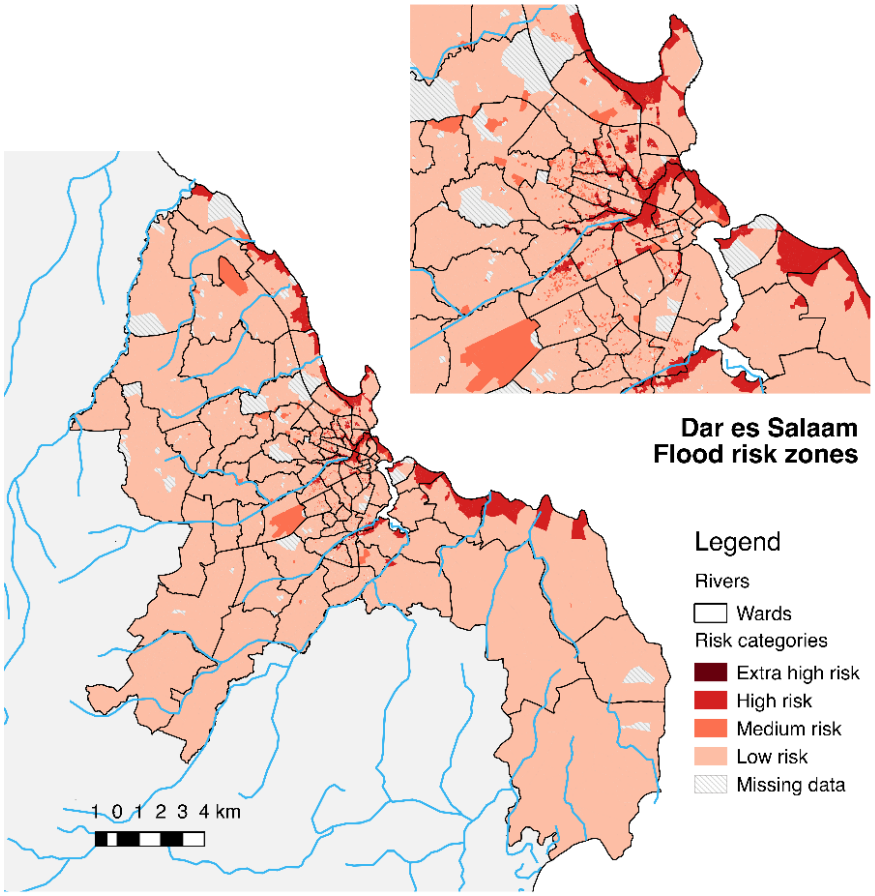
	Low risk	Medium risk	High risk	Extra high risk
Number of EAs in Dar es Salaam	13,265 (87.7%)	1,028 (6.8%)	806 (5.3%)	28 (0.2%)
Number of households in DRM sample	905 (66.3%)	183 (13.4%)	246 (18.0%)	32 (2.3%)

Figure 3 – Risk model (ensembled decision tree, darker colors correspond to higher confidence in classification, the importance of information decreases from left to right)



[9] Defined here as having had water in the house.

Figure 4 - Map of Dar es Salaam with EAs categorized according to flood risk categories[10]



3 Results

3.1 Exposure – poor people are more likely to be exposed to flood risk

3.1.1 Flood risk in Dar es Salaam is widespread

To establish the extent and nature of flood risk, it is necessary to establish who the exposed populations are, where these populations are located, how many residents are exposed, and what type of impacts they experience. In general, the focus of the study is on both directly and indirectly affected households. Directly affected households are defined as having had water in the house and/or having lost at least one valuable asset due to a flood. Households were asked what year they were exposed to the most recent and the most severe shock, rather than focusing on any isolated event. They were asked about both direct exposure – e.g.

[10] Masaki (Msasani) peninsula is a relatively affluent residential area generally considered safe from floods. The northern tip of the peninsula that is considered high risk according to our estimate is primarily made up of a military base and is not a residential area.

asset damages – and indirect exposure – e.g. infrastructure, labor, education and health – (Table 3). In total, about 39% of households reported being affected either directly or indirectly.[11] Table 2 summarizes the most recent and most severe for both direct and indirect effects – as reported by the households. The nature of the questionnaire design does not allow to exhaustively list the incidents experienced by households. Indeed, households were asked about the most recent event they had suffered from, and, in most cases, households had experienced floods the same year as data collection in 2017/2018. In 80% of cases, the most recent flood was also the most severe. This could be an indication that the situation is worsening, or that it is the households' perception that the floods are getting worse. There is also a concentration of events in 2018 due to the follow-up collection of data specifically about the 2018 flood.

Table 2 - Year of floods reported by households in the survey

Year	Reported incidents (number of households reporting being affected)[12]
2018	275
2017	229
2016	58
2015	63
2014	11
2012	6
2011	37
<=2010	28

In analyzing exposure, the focus is on households that have experienced direct and indirect effects of floods separately. Households that experience direct impacts are likely to also experience indirect effects (Figure 14 in Appendix 2). However, 42% of affected households experience only indirect effects and no direct damages to house and assets. Two subgroups were thus created for the consequent analysis - one for directly affected households, that may or may not also have experienced indirect effects, and one for households experiencing indirect effects but no direct effects.

Table 3 - Definition of being affected

Direct effects	Indirect effects
Water in the house, loss of valuable asset	Missed at least one day of work, missed at least one day of school, water or sanitation service disrupted, illness*
*Access to electricity was excluded because of the "noise" it introduces in the results. Most households in Dar es Salaam experience outages on a regular basis. It is difficult for residents to know if an outage is related to rainfall or other factors.	

Analysis for direct and indirect effects is separated to facilitate the exploration of the underlying determinants and effects of direct and indirect exposure. For example, for households experiencing direct effects, location is of greater interest in establishing potential reasons households settle in areas exposed to

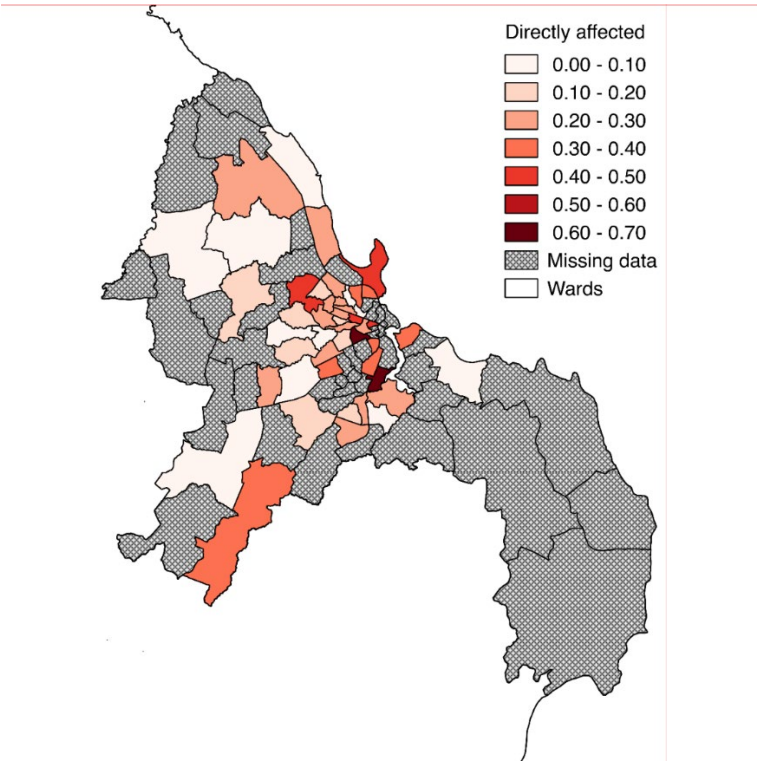
[11] See Figure 14 in Appendix 2 for a breakdown between indirectly and directly affected households.

[12] This list of floods will not necessarily match official records of floods in Dar es Salaam since they are based on household recollection of the most severe and the most recent flood that happened. If unprepared, a family can be affected severely by even a minor flood incident not recorded by the government or news.

flood risk. For indirectly affected households we are interested in the relationship between indirect exposure and quality of infrastructure among other things.

Flooding is a major problem for residents of Dar es Salaam. The map in Figure 5 illustrates the locations of directly affected households in the city. Directly affected households include people who have either had water in the house or lost an asset due to a flood. The share of directly affected households per ward is only displayed for wards where at least 10 households answered questions on exposure.[13] Therefore, ward data are reported as missing in two cases: (1) the ward was not included in the survey or (2) too few household observations were made in the ward. The cutoff point of 10 households per ward was set arbitrarily. Consequently, the maps are not representative at the ward level and should be interpreted with care, especially for wards with few observations (see number of observations in Table 11). Figure 5 shows that direct flood risk is present across the city with many wards having more than 20% affected households. However, some wards have a much higher concentration of affected households. These wards are located close to bodies of water. The findings are complemented with indirect exposure to the flood,[14] presented in Figure 6. Indirectly affected households are more evenly distributed across the city than directly affected ones. The overlap with directly affected households is not clear-cut: some wards with close to zero directly affected households have been indirectly affected.

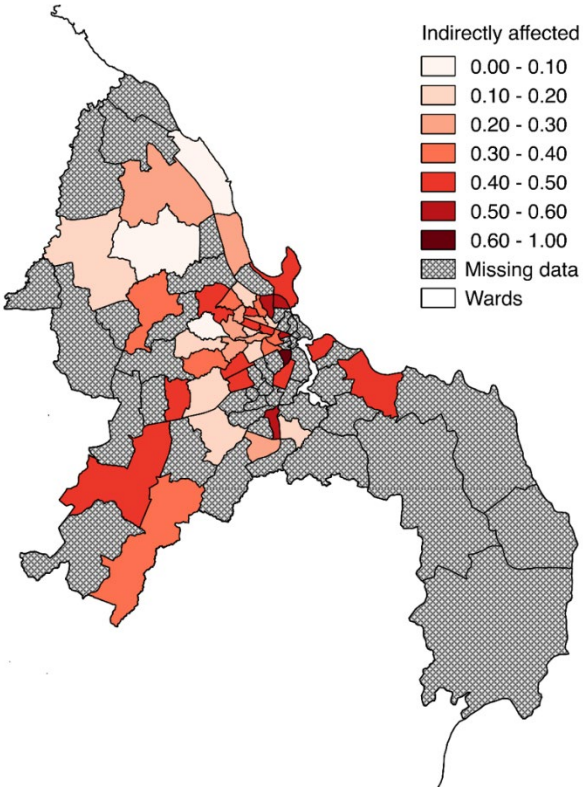
Figure 5 - Ward level map of share of directly affected households.[15]



Note: Data is not representative on a ward level and results are therefore indicative

[13] See Flood exposure by ward (Table 11 in Appendix 2) for underlying data.
[14] Households indirectly affected, as well as *both* directly and indirectly affected are included.
[15] Masaki peninsula (Msasani) shows up as highly exposed to floods despite being a primarily affluent area generally considered safe from floods. Twenty households located in informal areas in the southern parts of Masaki were included in the sample and 43% of them reported being flooded. See Table 11 for sample size and results by ward.

Figure 6 - Ward map of share of households indirectly affected



Note: Data is not representative on a ward level and results are therefore indicative

3.1.2 Estimates indicate that 39% of the city's population has experienced effects of floods

When applying sample weights, assuming selection strategy was successful in capturing representativeness of flood risk in Dar es Salaam, we compute an estimate of the number of households affected by floods in Dar es Salaam. The weights calculated using the flood risk categories as explained in section 2.2.4, are used estimating the number of affected people in the city. These are very rough estimates based on bold assumptions. It is assumed that the flood risk faced by households within each of the flood risk categories is representative for households living in that area. When making this assumption about representativeness of flood risk, the results of the survey can be extrapolated to the entire city.

Close to 1.9 million of the city's population are affected by floods, either directly or indirectly. It is estimated that 970,000 (230,000 households) have had water inside the house due to floods.[16] The number of affected households increases to 1,030,000 (250,000 households) when households that have lost at least one valuable asset during a flooding event are included (i.e. directly affected).

Table 4 - Number of households affected by floods in Dar es Salaam (scaled up to city level using sample weights)

Overall exposure:	**People affected**

[16] The focus is not on any flood event in particular. See Table 2 for a list of flood events reported by households.

Water in the house	970,000
Loss of asset	520,000
Directly affected total	1,030,000
Affected (incl. indirectly affected) total	1,860,000
Frequently affected	150,000

Note: numbers scaled up to a city level using sampling weights based on flood risk.

Among the households that have ever experienced floods, 7.8% experienced repeated direct impacts. A household is defined as frequently exposed if they reported in the first and second round of data collection being directly exposed more than once. Although this cannot be confirmed, it is likely that these households are flooded every time there is heavy rain and adds up to at least 150,000 people in 34,000 households. These households are primarily located in areas defined as "Extra high risk" which make up a small share of the city (Figure 4). Close to 50% of the residents of these areas are defined as frequently exposed.[17]

The total number of affected is close to 1.9 million when including indirect effects on access to infrastructure (excl. electricity[18]), workplace and education, as well as health impacts. It is clear from these estimates that flooding affects a huge portion of the city's population. Table 4 presents a breakdown of results.

[17] See Box 1 for a story of a family living with frequent flood exposure.

[18] Electricity is not included in the estimates here because outages in Dar es Salaam are so frequent that it is difficult for households to separate flood- and rainfall-related outages from other causes. However, if electricity outages are included in the estimate of affected households, the number increases to 2.8 million people.

Box 1. Living with floods – frequent exposure from a household perspective

Asha lives in Msisiri with her husband and kids. She runs a food catering business from her house, where she has lived for 15 years. Every year during the rainy season, her house is flooded. The frequent floods are disrupting her day-to-day life.

The water tends to stay in the house for months. To avoid damage to their possessions, she and her husband put all their furniture on concrete blocks. During the rainy season, Asha cannot maintain her catering business and the family must rely on the income of her husband, who is a driver.

Asha sends her children away to stay with relatives out of town when it gets really bad. Several members of her community do the same. "The kids cannot swim, and the water is dirty. It's dangerous for them," she explains.

The cost implications make it difficult to plan and to invest in their house and business. "It's discouraging," she says. "Maybe you improve something and next year it's damaged and you have to re-do it."

When they first moved there, it was not as bad, but since then, more and more families have moved in, and drainage systems have become blocked and blocked the drainage. During the rainy season, there is no garbage collection in the area, so waste floats everywhere.

Some of the more well-off families have moved from the area. If Asha and her family could afford it, they would also move.

Interview in Dar es Salaam on March 17, 2018

Affected by the 2018 flood

Estimates suggest that the 2018 flood affected far more people than available information reports. According to the analysis, it is estimated that between 500,000 and 950,000 people (110,000 and 230,000 households) had water in the house at the time of the flood. The lower bound estimate is calculated using the information from the households that responded to the follow-up interview applying the flood risk weights. The underlying assumption for the lower bound is that households that were not reached in the follow-up were not affected by the flood. On the contrary, the upper bound scenario assumes that the households that were not reached in the follow-up interview were affected in the same way as the respondents.[19] When asset losses are included, estimates increase to between 550,000 and 1,040,000 people

[19] As robustness checks, predictions of the likelihood of being affected were also derived from regression analysis, using the information on variables associated with being affected in 2018. Estimated coefficients were then applied to households that were not reached. Results were very similar to the ones obtained with the less sophisticated approach described above.

(120,000 to 250,000 households) - see Table 5. This estimate is significantly higher than the numbers of around 12,000 affected households provided in the post-disaster assessments of the Red Cross.[20] This is partly due to different definitions of "being affected". While the definition used by the Red Cross and the government is not provided in the note, it is possible that our definition is much broader. For example, many of the households experiencing water in the house are not severely affected, at least not monetarily. Consequently, exposure assessments hide an important heterogeneity in the way that households are affected by floods (see Section 3.1.3).

Analysis suggests that flood exposure is a widespread problem in Dar es Salaam. Different areas are affected at different times. Among the households that had water in the house during the flood in April 2018, only 31% had previously reported having ever had water in the house during initial data collection in 2017. This finding may explain why previous flood models seem to have underestimated the number of households exposed to floods in Dar es Salaam (see Kebede and Nicholls, 2011). Therefore, flood models may actually not be adequate in predicting which areas are exposed when considering policy options for flood mitigation.

Table 5 - Number of people affected by the flood in April 2018 in Dar es Salaam (scaled up to city level using the sample weights)

April 2018 flood:	**Population affected lower bound***	**Population affected upper bound****
Directly affected	550,000	1,040,000
Affected (incl. indirectly affected)	900,000	1,730,000
**assuming households that were not reached in follow up survey were not affected (weights based on flood risk strata)* ***assuming households that were not reached in follow up survey were affected in the same way as the ones with information (weights based on flood risk strata)*		

According to these estimates, a large share of residents suffers from the impact of floods in Dar es Salaam, but impacts are not homogenous. Some households suffer significant monetary impacts, associated with housing repairs, asset losses and long periods of time each rainy season when everyday life is disrupted by floods. However, a large share of affected households only misses a few days of work or no work at all, leading to low or even no monetary losses, even though water may have reached their houses. Similarly, while rain causes delays in commuting, roads may still be accessible, and households are able to shift to different transportation methods. It is important to keep this in mind when assessing these numbers. The size of losses that were incurred to households will be addressed in greater details in Section 3.2.

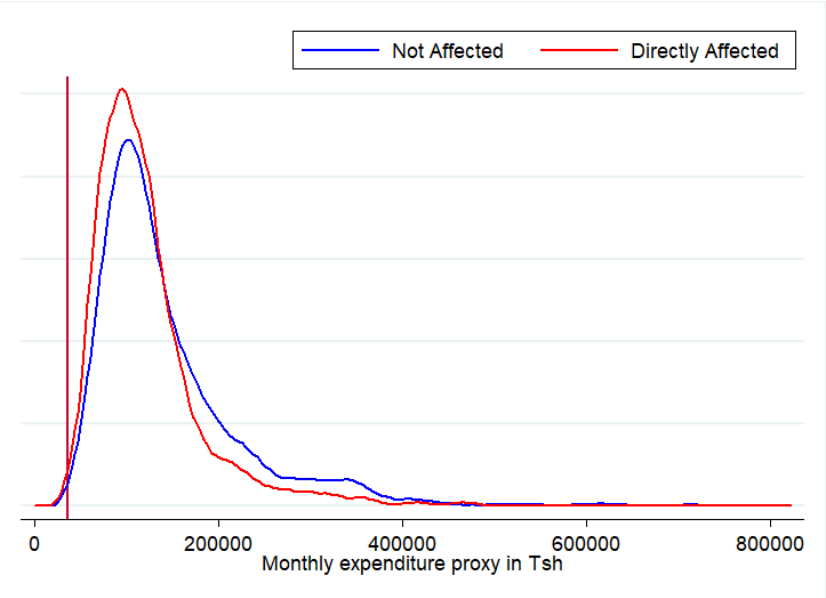
3.1.3 Who are the exposed?

Poorer households are over-represented among those exposed to floods in Dar es Salaam. The proxy of per capita expenditure[21] is lower among affected households, indicating that poorer households tend to settle in areas with high risk. Affected households are also significantly more food insecure than non-affected households, confirming the correlation between poverty and exposure to floods. The pattern is consistent for households directly affected by the 2018 flood. However, in the latter case, results are only statistically significant for food insecurity. Figure 7 shows the distribution of the estimate used for expenditure in

[20] https://reliefweb.int/sites/reliefweb.int/files/resources/MDRTZ021do.pdf
[21] See Section 3.2.1 for details on the methodology implemented in here.

households that have been directly affected versus households that have not been directly affected by floods. Directly affected households spend on average TSH 129,356 per month per capita on expenditure, while non-affected households display expenditure levels of TSH 150,554 per month per capita on average.[22] The relationship between poverty and the risk of being affected is also confirmed in regression results when controlling for other household characteristics (see Table 20 in Appendix 4). Results are consistent for the households that are frequently affected by floods.

Figure 7 - Distribution of the expenditure proxy and comparison between non-affected and directly affected households

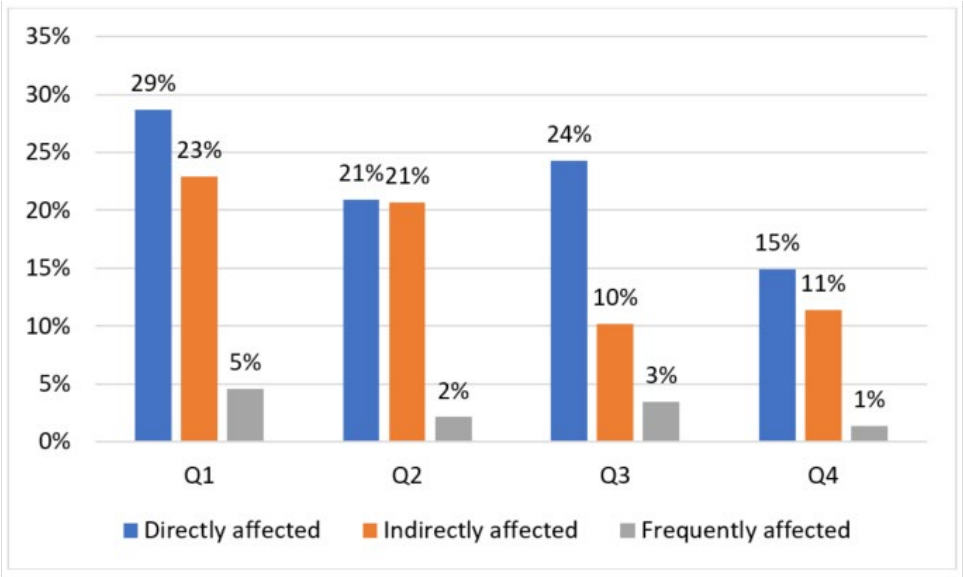


Note: Expenditure proxy are calculated with SWIFT. The vertical line represents the poverty line in Tanzania.

The relationship between poverty and indirect impacts of floods is even clearer. Poorer households are more likely to suffer from indirect impacts of floods – being cut off from access to roads, being affected by flood related illnesses, experiencing water disruptions, inter alia. The results confirm that income acts as a protection against the indirect effects of flooding by, for example, enabling the use of alternative means of transportation when the public transportation system is down. Figure 8 illustrates the percentage of directly and indirectly affected households by quartile. It also includes the share of frequently affected households. Figure 9 includes the distribution of the expenditure proxy of indirectly affected households compared to the ones not affected. On average, indirectly affected households spend TSH 129,139 per month per capita on expenditure, which is 0.8 times lower than expenditure of non-affected households. Results are confirmed in regression results, presented in Table 21 in Appendix 4.

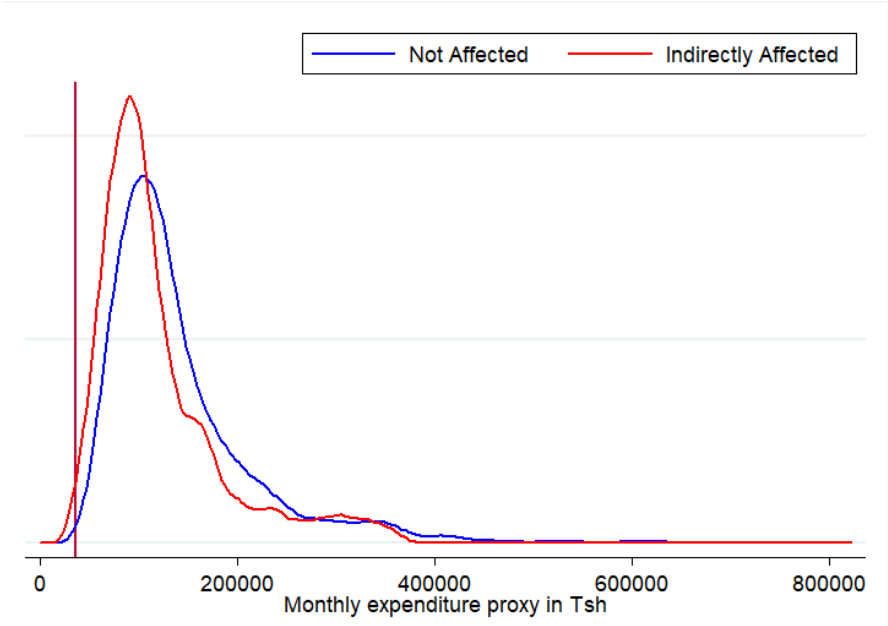
[22] T-test results can be found in Table 14 (Appendix 2).

Figure 8 – Percent of affected households by income quartile



Note: Expenditure proxy are based on the SWIFT estimates.

Figure 9 - Distribution of the expenditure proxy and comparison between non-affected and indirectly affected households



Note: Expenditure proxy are calculated with SWIFT. The vertical line represents the poverty line in Tanzania.

Female headed households with insecure tenure, residing in areas with low quality garbage collection systems are more likely to be directly affected by floods. Flood risk in Dar es Salaam goes hand in hand

with informality. Directly affected households have more insecure tenure arrangements than non-affected ones. Regression analysis shows that they are less likely to hold proof of tenure for the dwellings they rent. Female headed households are more likely to be directly affected than male headed households. Since women often have the double responsibility of provider and caretaker, they may face particular challenges when coping with floods. This will be discussed in more detail in the following sections. Directly affected households are less likely to pay for garbage services – a potential proxy for garbage collection quality. Finally, being directly impacted by floods is not related to housing quality or access to public services. This is in contrast with results found in Accra, Ghana (Erman et al, 2018), where a similar study was carried out.

Indirectly impacted households tend to be located in areas without access to reliable infrastructure. These households are less likely to have drains outside their dwelling and drains in the area tend to be overall rare and of poor quality as measured by data collected by Ramani Huria 2.0.[23] There is also evidence that other services such as water and sanitation are of lower quality among the indirectly affected households compared to the non-affected population. This seems to suggest that indirectly affected households live in areas where heavy rain can more easily affect infrastructure due to poor quality and bad drains. Therefore, improving the quality of infrastructure could mitigate the indirect effects of floods. In addition, indirectly affected households also tend to have a higher number of household members than other households. This is intuitive since having more household members increases the risk of having one of them miss work, school or fall ill due to floods.

Households residing in flood risk areas tend to live closer to work. The travel time of breadwinners of directly affected households is comparatively shorter than non-affected households.[24] They live 13 minutes closer to work. This suggests that households potentially face a trade-off between living close to work and lower flood risk. The contrast is even clearer for households that are defined as frequently exposed to floods. Average travel time for the breadwinners of these households is 17 minutes while it is 43.5 minutes for the rest of the sample – a difference of 61% (see Table 16 in Appendix 2). This result is confirmed in regression analysis (see Table 20 in Appendix 4). Frequently exposed households reside in low elevation, high population density areas close to economic opportunities. But this comes at a great cost.

Surprisingly, flood risk does not seem to affect rent values. Rent values seem to be the same or even higher among households experiencing the floods (directly, indirectly or frequently – see Table 14, Table 15 and Table 16 in Appendix 2). The result is confirmed in regression analysis (Table 22 in Appendix 4). This could be due to a number of factors. Dysfunctional and informal rental markets may cause rent values to not internalize factors that generally affect price – such as poor access to services and flood risk. In addition, many rental contracts in Dar es Salaam are annual, so the family may be unaware of the flood risk upon moving in. In fact, among the households that indicated that their dwelling was located in a flood prone area, 71% stated that they were unaware of the flood risk when they moved in. Observations from focus group discussions indicated that in many areas the situation has worsened with population growth and overcrowding without the necessary upgrading of drainage systems and other infrastructure. Moreover, among households that rent, 74% provided a down payment to access the house, which could make it more difficult to move. Finally, since floods seem to affect different areas on different occasions, it is difficult to predict which areas will be exposed to floods, even with access flood models. Consequently, it will also be difficult for the market to price flood risk exposure correctly.

However, affected households consistently value their own dwelling at a lower price than non-affected households. Households owning their dwelling were asked to estimate how much the dwelling would be worth if someone bought it at the time of the survey. The self-evaluation showed a clear trend. Directly, indirectly and frequently affected households consistently estimated their dwelling to be worth less than the

[23] The second phase of the Ramani Huria project launched in 2017 as part of TURP.
[24] See Table 14 with results from simple t-tests analysis in Appendix 2.

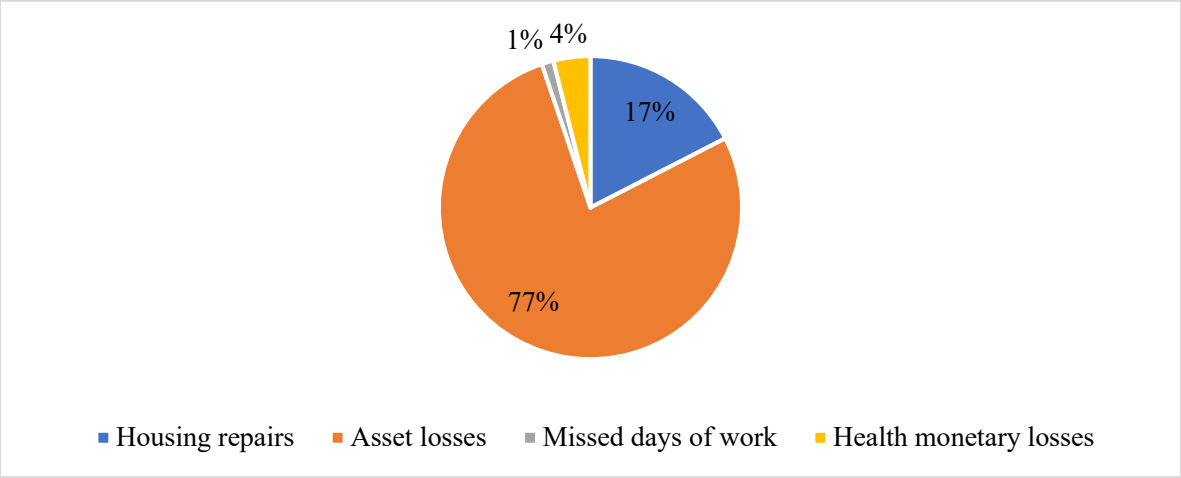
dwellings of the rest of the population. Surprisingly, the difference in estimation was also consistent, at between a 32% and 36% lower price estimation (see Table 14, Table 15 and Table 16 in Appendix 2). This mirrors the results of Erman, et al (2018), where housing costs in Accra were 30% lower for households that were affected by the 2015 flood.

When considering only the 2018 flood, there is no clear evidence that directly and indirectly affected households were poorer than non-affected households. As mentioned, different areas are affected in different years. When considering all the floods that the households surveyed have experienced in the past, poorer households are more likely to have been exposed to at least one. When considering only the 2018 flood, which was a relatively severe event, richer households were also affected.[25] This is consistent with the findings in Erman, et al (2018) where richer and poorer households in Accra were equally likely to be affected by the more severe flood event that happened in 2015. Sample selection could be one of the factors contributing to this: the households that responded to the follow-up interview in the aftermath of the 2018 flood spend 19% less on expenditure than households that did not respond. With fewer higher income households in the sample, the relation between poverty and flood exposure is more difficult to assess.[26]

3.2 Vulnerability – losses are massive but concentrated primarily on a smaller segment of the population

For the vulnerability analysis, the focus is on analyzing disaster losses of the April 2018 flood in relation to income. This was the only flood that all households answered questions about as part of the follow-up data collection in November 2018, and about 38% of the households surveyed in the follow-up interviews were affected by the event. Losses were calculated by adding up housing repair costs, the replacement value of lost assets (direct losses), the cost of missed days of work, and health costs (indirect losses).[27]

Figure 10 - Type of losses experienced by households affected by the 2018 flood



Note: Total number of observations is 274 households.

On average, affected households lost 23% of annual expenditure – i.e. 84 days of household expenditure – in the floods of April 2018. Direct losses – e.g. asset losses and housing repairs – make up the bulk of total losses: asset losses alone account for 77% of total losses (see Figure 10). About 42% of affected households,

[25] See Table 17 for t-test results for affected and non-affected households in the 2018 flood.
[26] See Appendix 1 for comparison between households covered and not covered in the follow-up interview.
[27] Appendix 3 provides a full description of the methodology of calculating disaster loss at the household level.

or approximately 16% of the total city population, lost a valuable asset due to the flood. The primary type of assets lost by households in 2018 included electronic equipment, kitchen appliances, furniture and clothes.[28] Most of these items were damaged when the water came into the house; the population that lost assets in the flood is thus primarily a subset of the ones that experienced water in the house. Housing repairs account for only 17% of total losses, even though 55% of affected households, or 21% of the city population, experienced water in the house. This is because a significant share (25%) of households that had water in the house did not carry out any repairs. The average value of a repair that was carried out was 520,000 Tanzanian shillings – US$200.

The fact that asset losses make up the largest share of losses indicates that flood risk mapping and modeling may not be enough to predict or calculate post-disaster losses. Having water in the house may not be a good indicator of flood impacts for households. Instead, it is more important to capture asset losses, which is costlier and more time consuming.

[28] Details may be found in Table 17 in Appendix 3.

Box 2. Health impacts are much more than monetary

"We live in fear. April is the most dangerous month," says Mary, who lives with her family in Ada Estate, a high flood risk area where 70% of the population was affected, and where, according to respondents from the area, the situation is getting worse and worse over time.

For Mary and her neighbors, the rainy season is the most worrying season of the year. When a flood occurs, the risk of diseases like cholera, malaria and urinary tract infections is her main concern, as she tries to limit her family's exposure to contaminated water. These are serious concerns, but Mary is conscious that she is relatively fortunate: the dwellings situated downstream are the worst affected, since people along the watercourses tend to empty their sanitary waste when it rains, and children find worms in the water.

In other neighborhoods of Dar es Salaam, the health consequences of flood are also a serious concern. For Twoha, who lives in Msisiri, a medium risk zone, north of the city center, the worst aspects of flooding are illness and its consequences: every year, stagnant water stays in his house for months, and he suffers from a fungal infection of the skin. Twoha has had to accept living in rhythm with the rainy season and its incurable impacts on health: "It [the fungus] comes with the rain, it goes with the rain," he says. As an independent business owner, he has no income during the periods in which he is forced to stay home because of illness – but believes that the symptoms of his illness are worse than the monetary losses.

When the flooding gets out of control, parents try to keep their children out of the water, on raised beds or even on the roof. Even in low risk areas, such as Sabasaba, children are kept inside during the rainy season for fear of malaria, pneumonia and fungal infections. However, these coping strategies are not always successful. During the 2018 flood, Fatuma's son got a skin infection after having been in the water. She had to carry him to the hospital where he received four shots of antibiotics.

The residents of Dar es Salaam who took part in the focus groups mentioned health as one of the most serious impacts of flooding. In addition to the inevitable health care costs, the psychological distress inflicted to them is great, and they all dread the month of April.

Focus group discussion with residents in Dar es Salaam on March 17 and March 18, 2018

Indirect impacts of the 2018 flood were widespread but they make up a small share of total monetary losses. For households affected by the 2018 flood, losses from indirect impacts made up only around 5% of total losses. However, health and labor impacts were widespread. Among affected households, 47% (18% of city population) reported health impacts and 68% (26% of city population) reported having missed days of work. Households that received medical treatment and medication due to flood related health impacts paid on average 110,000 shillings (US$50). However, the relatively minor monetary costs of health care conceal significant welfare impacts. Health impacts were repeatedly reported as the worst consequence of floods for affected households in the focus group discussions (Box 2). The cost of missing days of work for

households is low – averaging 50,000 shillings (US$22) per household,[29] despite an average of 19 missed days of work, which is substantial. The reason for this is that the average salaries in Dar es Salaam are low.[30] Women were more likely than men to miss work due to the 2018 flood. The average share of women in relation to men who stayed home from work due the 2018 flood is 60%. Men and women missed about the same number of days. On average, women missed 17 days of work while men missed 15.5 days. As with health effects, losses associated with missed days of work also conceal large welfare impacts for households: staying home to deal with flood impacts causes stress due to the fear of losing employment and income (Box 3). It is also important to note that floods lead to income impacts for households beyond missed days of work. Lost household income, for example, affects supply and demand for enterprise owners – and about 26% of households own enterprises.

Box 3. Income effects of floods

Fatuma has a food shop in Sabasaba. When it rains, the roads outside her house are often flooded. While the water has never entered her house, she experiences increased transportation costs by using the tuk-tuk mini-taxi more frequently to avoid the water. Fatuma has noticed that during floods, the products that she buys from wholesalers, including food and charcoal, increase in price. As a result, she has to increase prices as well, affecting demand. Demand also decreases during and after heavy rain since people tend to stay inside.

Robert lives in Ada Estate and works as a carpenter. The area is frequently flooded, but he rarely misses a full day of work. He will walk through the flood water, as long as it is not higher than up to his knees. However, due to the floods, he is often late to arrive at work - sometimes up to 5 hours, which makes him fall behind on work. He has never gotten in trouble because of delays. However, other residents in Ada Estate and Msisiri report being reprimanded and fired for not showing up due to floods. “And it is difficult to find another job,” remarks Robert.

Lucas, an IT consultant living in Ada Estate, and his wife Marie, a university student, take turns staying home when the house is flooded, to clean up, put up furniture, among other domestic duties. But since Lucas sometimes gets in trouble with his employer for missing work, so Marie tends to stay home more often. Another couple, Thomas and Eva, who are both enterprise owners and live in Msisiri, are unable to work during an average of three to four weeks per year due to floods.

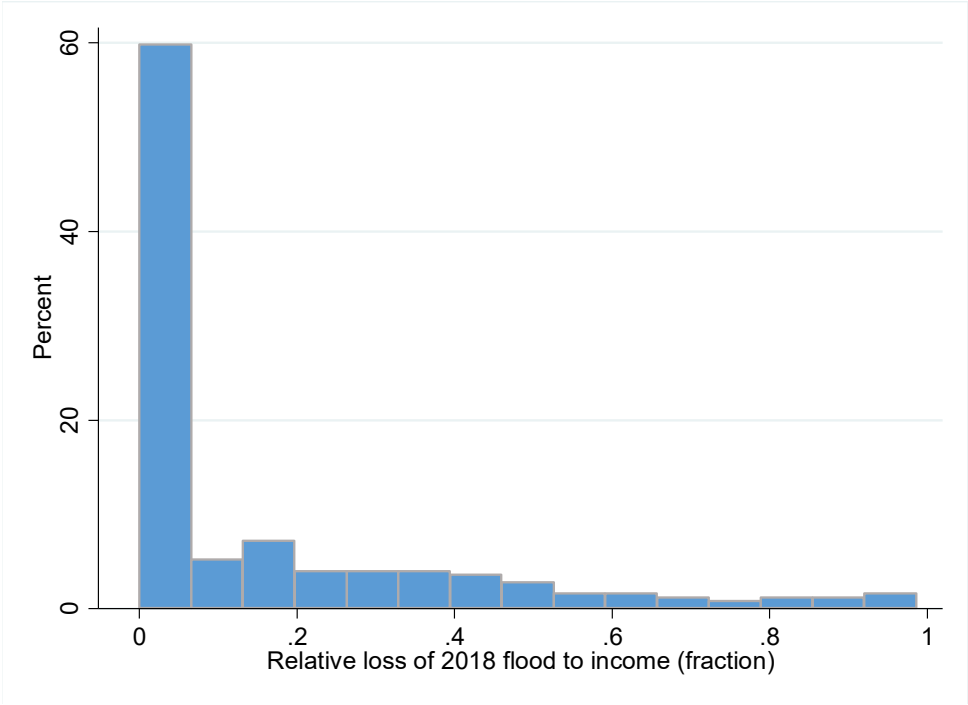
Focus group discussion with residents in Dar es Salaam on March 17 and March 18, 2018

Losses are unequally distributed among the population. The average losses of the 2018 flood discussed so far hide important heterogeneity. Figure 11 shows the density of distribution of relative losses of the 2018 flood in fractions. Most affected households experienced relatively small losses in relation to their income: around 40% of affected households lost less than 1% of their annual income. When looking closer at the households that lost less than 1% of annual income, they were less likely to experience asset losses (10%),

[29] Average of non-missing observations.
[30] See Appendix 3 for more details.

health impacts (29%) and water in the house (32%) but *as* likely to experience labor losses (70%). On average, these households missed 13 days of work due to the 2018 flood, while households losing more than 1% of annual income missed on average 24 days of work.[31] It is important to highlight that when Dar es Salaam is hit by floods, millions are affected in different ways but only a relatively small share of those suffer significant monetary losses (Figure 11**)**. However, when the small household level costs are aggregated on a city level, it adds up to significant total cost, as will be shown in section 3.3.

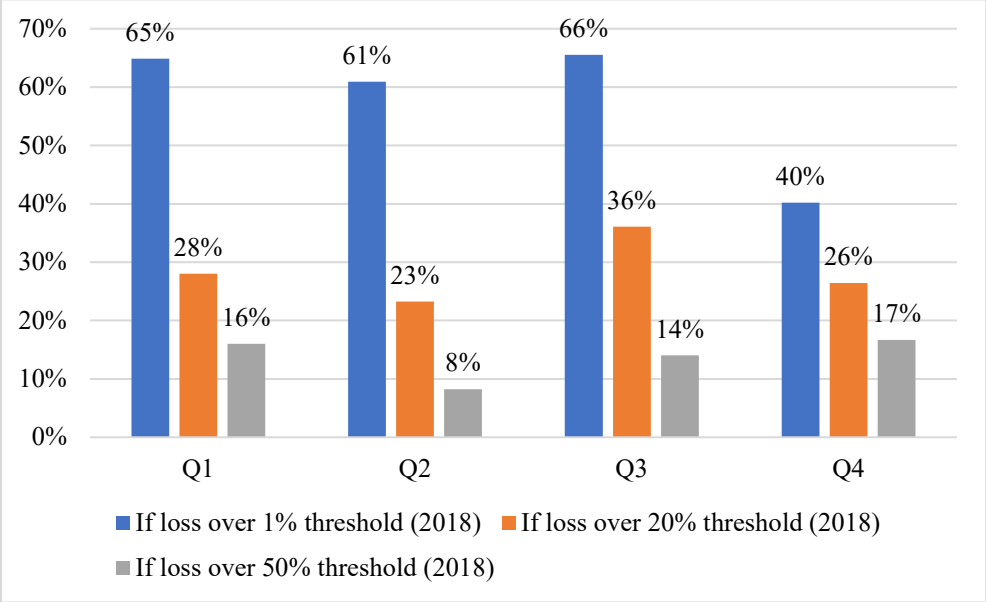
Figure 11 - Percent of observations by size of relative loss for affected households in fractions.



There is no clear relationship between losses and poverty. Figure 12 shows the percentage of *affected* households that experience losses above three different thresholds (1%, 20% and 50% of annual expenditure respectively) within each quartile group for the 2018 flood. While the richest quartile is under-represented among the households losing more than 1% of annual expenditure, the trend is not consistent for households losing 10% and 50% of annual expenditure. No relation can be statistically established in regression analysis (see Table 23 in Appendix 4). This somewhat counterintuitive result is inconsistent with the findings of a similar study in Accra, Ghana, where poor people were over-represented among those who lost the most in relation to their income due to a flood in 2015 (Erman, et al. 2018). A driver of this result could be that most of the losses were made up of asset losses. Poorer households have fewer assets that they could potentially lose in a flood and may also be unable to pay for repairs of a damaged house. This can result in lower monetary costs of floods, as per the methodology used to calculate losses in this study.

[31] Counting only the households that reported missing at least one day of work.

Figure 12 - Share of affected households by quartile and different loss thresholds



Other characteristics associated with larger relative losses include access and distance to economic opportunity and garbage collection. Regression analysis, presented in Table 23 in Appendix 4, indicates which factors are associated with larger losses in relation to income. As previously mentioned, distance to work of the breadwinner, measured in travel time, is associated with increased risk of exposure. Results suggest that shorter distance to work is also associated with larger relative losses for households. This confirms that accepting higher flood risk to live closer to economic opportunities comes at a high prize. It is also found that having the garbage collected by either private or informal operators is associated with lower relative losses than unauthorized heap or public garbage collection.

3.3 The 2018 flood cost the people of Dar es Salaam between 2 and 4% of city GDP

There is limited information about the gravity of the 2018 flood event. However, it was observed that schools were closed during the peak of the flood, and the Bus Rapid Transport system was down. Nonetheless, this was not considered an unusual event in Dar es Salaam. To get an idea of the total cost of an event of this gravity, sample weights were used to extrapolate the impact on households in the sample to the population of the rest of the city. Again, these very rough estimates should be taken with caution.

To generate these estimates, it is assumed that households within each flood risk category are exposed to similar levels of risk (equally likely to be exposed in the 2018 flood event) and similar impacts and losses. Since flood risk categories are designed to reflect flood exposure, there is a fair degree of confidence about the first assumption that households within each flood risk category face similar risk. The second assumption suggests that households are also facing similar impacts *when exposed*. This is a bold assumption – especially since a lot of heterogeneity is observed in how the households are affected. There is no way to confirm or reject this assumption, so it is important to use these results as indicative rather than absolute. With those two assumptions, the total cost of the 2018 flood event for affected households in Dar es Salaam is estimated. This estimate includes the cost that households carry themselves and excludes all the costs that the government captures through damages and repairs to public goods.

As presented in Table 5, it is estimated that between 550,000 and 1,040,000 people were affected directly by either having water in the house or losing a valuable asset. If indirect impacts are also included, the number goes up to 900,000 to 1,730,000 people.

On a city level, the household losses discussed in section 3.2 translate to very large total costs for households. Through a quick phone survey, data on losses could be collected and used to generate city-level estimates of household losses. Due to the 40% attrition rate and some refusal (see Section 2.2.2 for details), about 50% of the sample was covered in this quick assessment. In line with the methodology to count the number of affected households, reported information using the non-missing will serve as a lower bound of losses. Losses for households due to housing repairs and asset losses (direct losses), city-wide, due to the 2018 flood add up to between 236 billion and 502 billion shillings (US$101 million – US$216 million). As previously mentioned, the largest share of these losses is from damaged and lost assets. Health costs and income losses due to missed days of work (indirect losses) add up to between 13 billion and 28 billion shillings (US$6 million – US$12 million) - see Table 6.

To get a better sense what these numbers mean for Dar es Salaam, they are compared with the GDP of the city. The GDP per capita of Dar es Salaam from 2011[32] was adjusted for annual growth on a country level up until 2018.[33] GDP was then calculated using the official population number of 4.5 million (last official estimate and the population estimate on which the sample weights are based). Dar es Salaam GDP adds up to 13 trillion shillings (US$5.6 billion), and total losses due to the April 2018 flood account for between 2 and 4% of it.

Table 6 - Total losses experienced by households on a city level in US$ and % of city GDP

April 2018 flood:	**Losses lower bound***	**Losses upper bound****
Direct losses (house and asset)	US$101,480,000	US$215,860,000
Indirect losses (health & labor)	US$5,547,000	US$11,825,000
Total losses	US$107,027,000	US$227,685,000
% of city GDP	1.9%	4.0%

**assuming households that were not reached in follow up survey were not affected (weights based on flood risk strata)*

***assuming households that were not reached in follow up survey were affected in the same way as the ones that were reached (weights based on flood risk strata)*

The cost is most likely an underestimation of the true cost of flood exposure for households in Dar es Salaam. It does not take into account the non-monetary well-being impacts, such as health impacts or the cost of having water and sanitation service disrupted. It also does not fully take into account the impacts on income and career development that not showing up for work or having the family business damaged or disrupted can have. Finally, it does not account for the behavioral impacts that flood exposure can have on, for example, the propensity to invest in housing or business or other decision making which can affect the long-term welfare of the household.

3.4 Resilience – access to finance helps households recover

To analyze recovery, a variable was constructed indicating whether the household had recovered at the time of the interview from any reported shock in any year prior to 2018. The reason 2018 was excluded was

[32] 1,961,074 shillings.
[33] 2,898,931 shillings.

because the April flood happened only 6 months prior to the follow up interview. By focusing on events that happened further back in time, elements associated with low resilience could be better captured.

Among affected households in the sample, 29% reported not having recovered from a shock.[34] These households are poorer than other affected households. Table 7 and Figure 13provides evidence of the relative poverty of households that had been unable to recover compared to affected households that did recover in terms of proxied expenditure. Similar results are obtained when measuring poverty with the food insecurity index. Moreover, the relationship between poverty and low resilience holds when controlling for other characteristics (see Table 24 in Appendix 4), differing from the results of a similar analysis in Accra (Erman, et al, 2018). The households that did not recover tend to live closer to work in low elevation areas with relatively poor-quality infrastructure. Fewer low-resilience households have access to in-house piped water and electricity. There are twice as many households belonging to the category "frequently exposed" among the low-resilience households than among the households that recovered from flood events. This indicates that some of these households live in a constant state of recovery.

Low-resilience households have systematically lower access to finance. Fewer of the households that were unable to recover have access to finance. It includes informal lending and remittances from friends and family. But also access to formal bank accounts. Access to formal credit is very limited in Tanzania. Fewer of the low-resilience households have proof of ownership of their dwelling. It was also found that while owning insurance against flood damages is uncommon overall, it is even more scarce among households that did not recover. They also have lower access to community saving groups – especially the ones that support income generating activities. The importance of the community in recovery was confirmed in the focus group discussions with the households (Box 4). However, households highlighted that community saving groups do not work to cover for disaster losses since the entire neighborhood is affected at the same time putting strains on pooled resources.[35] The gender of the household head is seemingly unrelated to the likelihood of having recovered. However, gender seems to matter for access to coping mechanisms that can help households recover. Male headed households are 9% more likely to have access to a formal bank account and 11.5% more likely to practice saving than female headed households. Female headed households, on the other hand, are more likely to be engaged in community saving groups than male headed.

Low-resilience households rely more on self-generated income and less on private companies. Since many of the variables are interconnected and the number of observations is low (only affected households were included in this comparison), we were unable to confirm some of these findings through regression analysis (Table 24 in Appendix 4). However, informal lending remains an important driver of recovery, even when controlling for other characteristics. The regression analysis also indicates, surprisingly, that households with breadwinners who work for the government are less likely to recover. And that household size matters for recovery: larger families are more resilient, even when controlling for other factors.

Table 7 - Comparison between households that recovered and households that reported not having recovered. Includes results from simple t-tests.

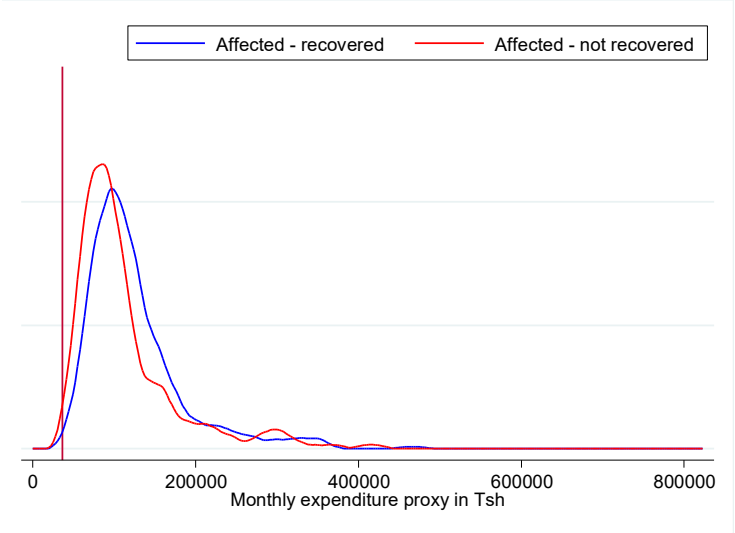
Variables	Low resilience	High resilience	Difference	Significance	Observations
Proxy expenditure	117,588	133,854	16266	*	560
Food insecurity	7.554	5.219	-2.335	*	581
Head of household male	72%	70%	-2%		581

[34] Table 7 presents summary statistics for low-resilience households.

[35] The way the question on saving group membership was phrased was (deliberately) broad. There are many different models of savings groups, some of which may be better suited to insurance functions than others. This is something that is currently being explored in the follow-up research within the scope of TURP.

Travel time to work for breadwinner	27.02	45.4	18.37	***	581
Volume of drainage system per capita by sub-ward	0.06	0.13	0.07	**	581
Elevation of dwelling location	26.84	34.12	7.285	*	581
Electricity	77%	90%	13%	**	581
Piped water in dwelling	20%	31%	12%	**	581
Access to informal lending	53%	76%	23%	***	581
Proof of ownership dwelling	79%	88%	10%	**	581
Holds a bank account	33%	45%	13%	**	581
Access to community saving group	18%	26%	8%	*	581
Option of lending towards income generating activities within saving group	10%	16%	7%	*	581
Owns insurance against floods	2%	6%	4%	*	581
Source of income breadwinner: Private company	13%	22%	10%	*	574
Source of income breadwinner: Self-employed	65%	55%	-11%	*	574

Figure 13 - Distribution of the expenditure proxy and comparison between households that recovered and did not recover from flood



Note: Expenditure proxy are calculated with SWIFT. The vertical line represents the poverty line in Tanzania.

Box 4. The role of the community in recovery

The residents of Msisiri and Ada Estate rely on support from the community to cope with the impacts of the floods. Help from neighbors and community saving groups play a key role in recovery.

Neighbors frequently help to rebuild houses, provide materials and financial support and shelter for affected households. Maria and Lucas, a young married couple from Msisiri, once stayed with their neighbors with their two kids until the water had subsided and the house had been restored.

Saving groups provide small, cheap loans to members using pooled resources. In areas that are frequently impacted by floods, it becomes more difficult to obtain support during the rainy season because many families are affected at the same time. In the case of multiple shocks, either the saving group will not allow for disaster related loans, or the fees go up and saving group support become a less attractive option.

Focus group discussion with residents in Dar es Salaam on March 17 and March 18, 2018

3.4.1 Preventive actions differ depending on flood risk exposure

In general, households take actions to protect themselves against floods, both in high risk and low risk areas. However, the type of actions they take differ. Households in extra high and high-risk areas are much more likely to take actions such as dig a ditch, put sandbags and build a wall around the house than households in low risk areas (Table 8). However, less elaborative actions such as removing garbage from the areas surrounding the house and the nearby drainage systems are commonly practiced by all households.

Table 8 - Preventive actions taken by households by risk category

Variables	Extra high risk	High risk	Medium risk	Low risk	Total
Clean house surroundings	38%	66%	62%	52%	54%
Clean nearby drainage	25%	49%	45%	29%	32%
Participate in flood prevention activities organized at the community level	41%	40%	34%	30%	30%
Put together an emergency kit	15%	6%	1%	4%	4%
Dig a ditch around the house	4%	35%	19%	16%	17%
Build a wall around the house	29%	21%	12%	11%	12%
Put sandbags	18%	32%	13%	13%	14%

4 Conclusions

Tanzania's economy is highly sensitive to climate. The national costs of climate-related hazards are estimated to be around 1% of GDP in recent years. With projected climate change impacts – higher temperatures and more unpredictable and concentrated rainfall - net economic costs due to climate change could reach 2 to 3% of GDP per year by 2030. Flooding is estimated to be the costliest hazard at the national level, causing 62% of losses from natural disasters from 1990 to 2014.[36]

While the costs are unknown, flooding presents an economic burden for households. Studies estimating the impacts of climate hazards in Dar es Salaam have found that the city has infrastructure assets worth approximately US$5.3 billion at potential risk from projected flood impacts under climate change and sea level rise scenarios (Kebede and Nicholls, 2010). At the household level, the poor are disproportionately affected by flooding, and often do not have the means to recover. This study is an attempt to quantify the impacts for households living in Dar es Salaam both inside and outside known flood risk areas. It also sheds light on the characteristics of affected households and helps us understand the policy relevant link between poverty and flood exposure.

The impacts of floods on households in Dar es Salaam are more wide-spread and costly than previous evidence suggests. Urbanization and lack of investments in infrastructure have transformed the city into a place where families that used to not worry about floods are having their dwellings flooded every year. Families report that the situation continues to get worse. Female headed households, that face particular challenges, are more likely to live in areas affected by floods. Poorer people are particularly at risk of both direct and indirect impacts. The flood that affected Dar es Salaam in April 2018 was not a particularly severe event in terms of casualties and did not receive much attention outside Tanzania. Nonetheless, it affected 38% of the population and cost households an estimated US$110 to US$228 million, representing about 2-4% of the city's GDP.

On average, affected households lost about 23% of their annual income due to the flood in April 2018. Asset losses represent 77% of total losses. The second largest source of losses were housing repairs. Consequently, to understand the impact of floods on households, it is necessary to assess asset losses and not only housing damage, highlighting potential flaws in the traditional modeling of disaster losses.

Losses caused by indirect impacts, including health and labor, are monetarily small but have large effects on well-being. A conclusion from the focus group discussions with affected households is that the welfare effects of illness and labor are not well-captured in monetary terms. For households living in areas affected by flood risk, health impacts tend to be highlighted as the worst, and missing work is associated with increased stress and fear of losing current and future income. Women are more likely than men to miss work due to floods. No support from the government is available to the households to deal with these losses that for many households happen repeatedly.

Informal support and financing are helping households to cope with the costs of floods – but it is not enough. Poorer households are less likely to have recovered from being affected by floods. However, access to informal sources of finance, including community saving groups, seems to help households recover. While community saving groups are a positive tool to assist households with recovery, the instrument is not ideal for dealing with aggregate shocks. When many members are affected at the same time, it puts strains on the

[36] PreventionWeb, accessed 19 February 2019.

resources and becomes either more expensive to borrow from or stops working altogether. Pooling resources across more than one community or insuring the groups against aggregate shocks could potentially help the saving groups to manage risk better. Although the gender of the household head does not seem to be associated with recovery, women and men face different levels of access to coping mechanisms that help families recover, such as a formal bank account.

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Appendix 1

Details of sampling strategy

Table 9 - Sampling selection by flood risk strata

	Number of EAs	**Percent**
No risk	77	57.5%
Low to medium risk	43	32%
High risk	14	10.5%

Follow up data collection – coverage analysis

Table 10 - Comparison of household covered in follow up interview in 2018 with the rest of the sample

VARIABLES	Not covered	Covered	Observations	Difference	Significance
Household size	3.701	4.521	1,335	0.821	***
Access to early warning	0.391	0.597	1,335	0.207	***
Concerned about tenure	0.303	0.116	1,335	-0.186	***
Monitors the weather with frequency	0.448	0.626	1,335	0.178	***
Risk perception of area	0.152	0.27	1,335	0.119	***
Cleans drains to prevent flooding	0.215	0.356	1,335	0.141	***
Expenditure proxy (real per capita)	157,733	132,706	1,289	-25027	***
Invested in house in past year	0.233	0.135	1,335	-0.0986	***
Participated in flood prevention activity	0.224	0.339	1,335	0.115	***
Pays for garbage disposal	0.796	0.88	1,335	0.084	***
Cleans surroundings to prevent floods	0.434	0.578	1,335	0.144	***
Age of hh head	42.7	45.82	1,330	3.115	***
Pit latrine	0.3	0.434	1,335	0.133	***
elevation	36.83	29.87	1,335	-6.959	***
Access to flush toilet	0.36	0.261	1,335	-0.0999	**
Lived in house 20 years or more	0.459	0.565	1,335	0.106	**
Pipe outside dwelling	0.142	0.0757	1,335	-0.0664	**
Participate in community clean up events	0.64	0.747	1,335	0.107	**
Built a wall around house to prevent flood	0.0836	0.139	1,335	0.0557	**
Risk perception of dwelling	0.107	0.177	1,335	0.0694	**
Put sandbags and bulkheads around house to prevent flooding	0.108	0.163	1,335	0.0553	**
Food insecurity (CSI)	4.151	5.386	1,335	1.235	**
Affected by flood in 2017	0.154	0.107	1,335	-0.0466	*
Owns enterprise	0.232	0.3	1,335	0.0685	*
Received remittances	0.307	0.251	1,335	-0.0556	*
Access to informal lending	0.755	0.704	1,335	-0.0503	
Drain outside dwelling	0.269	0.333	1,335	0.0641	
Affected by flood in 2016	0.0517	0.0607	1,335	0.00901	
Travel distance to work	41.51	43.82	1,335	2.308	
Access to bank account	0.467	0.47	1,335	0.00271	

Appendix 2

Flood exposure by ward

Table 11 - Underlying data to exposure maps (exposure by ward in general and for the 2018 flood)

Ward name	Directly affected		Indirectly affected		Directly affected 2018		Frequently exposed	
Magomeni	6%	30	16%	30	4%	22	0%	30
Makurumla	23%	70	43%	70	26%	46	5%	70
Ndugumbi	24%	60	22%	60	33%	20	0%	60
Tandale	24%	50	45%	50	38%	21	3%	50
Mwananyamala	35%	30	52%	30	23%	26	14%	30
Masaki (Msasani)	43%	20	43%	20	38%	20	0%	20
Kinondoni	38%	20	54%	20	43%	10	16%	20
Mzimuni	50%	10	50%	10			0%	10
Kigogo	24%	111	28%	111	18%	86	4%	111
Mabibo	20%	20	20%	20	20%	10	0%	20
Manzese	20%	41	25%	41			0%	41
Ubungo	50%	10	40%	10			0%	10
Goba	10%	10	0%	10			0%	10
Kawe	24%	41	24%	41	25%	15	4%	41
Kunduchi	10%	10	10%	10			0%	10
Makuburi	20%	10	10%	10			0%	10
Mburahati	20%	10	20%	10			0%	10
Makumbusho	7%	19	33%	19	7%	19	0%	19
Sinza	20%	10	30%	10			0%	10
Kijitonyama	24%	40	19%	40	32%	14	5%	40
Mbezi	0%	10	20%	10			0%	10
Saranga	20%	30	33%	30	31%	13	0%	30
Wazo	24%	20	25%	20			0%	20
Ukonga	27%	31	40%	31	29%	15	2%	31
Msongola	30%	20	35%	20			0%	20
Tabata	8%	40	26%	40	0%	10	0%	40
Ilala	60%	10	30%	10			20%	10
Mchikichini	27%	60	36%	60	22%	37	1%	60
Vinguguti	24%	149	43%	149	14%	84	3%	149
Kipawa	0%	20	20%	20			0%	20
Buguruni	13%	39	13%	39	75%	10	2%	39
Jangwani	47%	20	57%	20	16%	13	19%	20
Kiwalani	30%	10	40%	10			10%	10
Segerea	20%	10	30%	10			0%	10
Kitunda	20%	10	20%	10			0%	10
Majohe	10%	10	40%	10			0%	10
Kimanga	9%	20	19%	20	0%	12	0%	20

Kigamboni	30%	10	40%	10			0%	10
Mbagala	25%	32	58%	32	17%	27	0%	32
Charambe	26%	20	23%	20	44%	7	6%	20
Miburani	30%	20	47%	20	40%	8	5%	20
Mtoni	70%	10	100%	10	100%	5	40%	10
Keko	34%	20	61%	20	35%	13	10%	20
Mbagala Kuu	10%	10	20%	10	33%	3	10%	10
Mjimwema	10%	10	40%	10	0%	5	0%	10
Kijichi	25%	20	90%	20	10%	10	0%	20
Kiburugwa	14%	52	89%	52	11%	36	4%	52

Type of impacts of floods

Figure 14 displays the link between indirect and direct effects of floods. The result is intuitive - a directly affected household is also likely to experience indirect effects. However, the inverse is not true: 42% of affected households experienced only indirect impacts and no direct effects.

Figure 14 - Type of impact (direct and indirect)

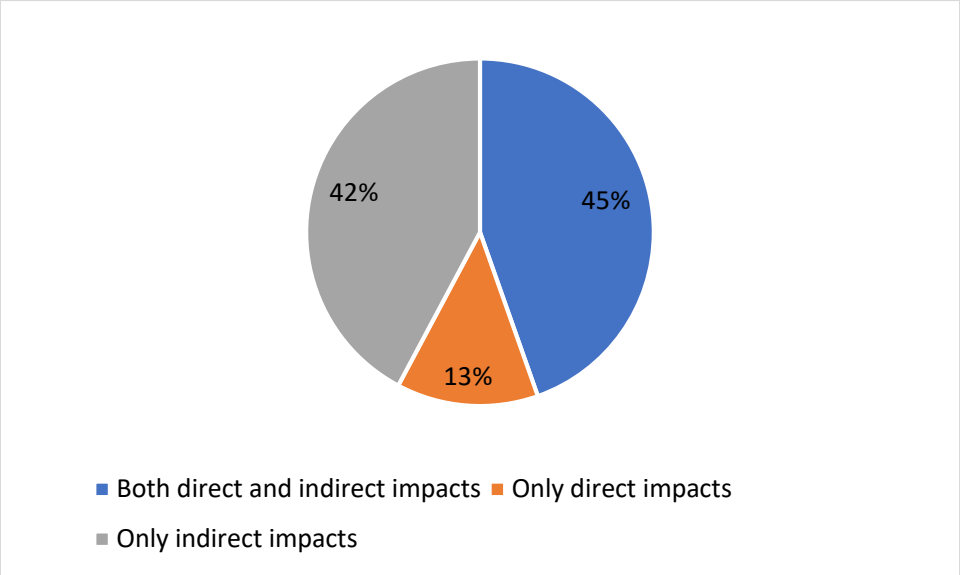

Table 12 - Type of indirect impacts of floods experienced by affected households in Dar es Salaam

Types of indirect impacts	% of households in Dar es Salaam
Roads	24%
Workplace access	17%
Health	11%
Education	7%
Water	6%

Drinking	6%
Sanitation	3%

Table 13 - Type of indirect impacts of floods experienced by households depending on risk area

	Road	Workplace	Health	Education	Water	Drinking water	Sanitation
Extra high risk	59.8%	54.4%	43.4%	19.8%	1.2%	5.1%	0.0%
High risk	43.4%	27.8%	14.6%	8.7%	13.1%	11.0%	6.5%
Medium risk	34.4%	18.4%	7.0%	10.2%	5.9%	4.8%	3.7%
Low risk	21.7%	16.1%	11.3%	6.9%	6.1%	5.3%	2.3%

T-test results exposure

Table 14 - Directly affected t-test results

VARIABLES	Not directly affected	Directly affected	Observations	Difference	T-test results
Expenditure proxy (real per capita)*	150,664	129,356	1,289	-21,309	***
Food insecurity (CSI)	3.922	7.542	1,335	3.62	***
Head of household is male	75%	65%	1,335	-10%	***
Housing and services					
Value of dwelling (self-estimate)*	96,280,000	61,740,000	632	-34,500,000	***
Annual rent (among renters)*	774,873	846,418	470	71,545	-
House was gifted/Inherited	11%	17%	1,335	6%	**
Pipe outside dwelling (drinking water)	12%	7%	1,335	-6%	**
Flush toilet with cistern	34%	24%	1,335	-10%	**
Pit latrine	35%	43%	1,335	8%	**
Pay for garbage service	85%	78%	1,335	-7%	**
Walking distance to work	79.5	65.82	1,335	-13.67	*
Made housing improvement in past year	17%	26%	1,335	9%	**
Finance					
Has insurance including disaster protection	3%	7%	1,335	4%	**
Access to emergency informal lending	75%	68%	1,335	-7%	*

**in Tanzanian shilling (tzs)*

Table 15 - Indirectly affected t-test results

VARIABLES	Not affected (or directly affected)	Indirectly affected (only, not directly affected)	Observations	Difference	t-test results
Expenditure proxy (real per capita)*	149,202	129,139	1,289	-20064	***
Food insecurity (CSI)	4.942	3.642	1,335	-1.3	**
Household size	3.988	4.591	1,335	0.603	***
Head of household male	72%	79%	1,335	8%	**
Housing and services					
Value of dwelling (self-estimate)*	92230000	61340000	632	-30900000	**
Annual rent (among renters)*	800,429	731,728	470	-68701	-
Flush toilet with cistern	34%	19%	1,335	-14%	***
Pit latrine	34%	47%	1,335	13%	**
Pipe outside dwelling	12%	7%	1,335	-5%	**
Dwelling gifted/inherited	13%	8%	1,335	-5%	*
Spring well water source	6%	13%	1,335	7%	*
Walking distance to work	75.08	83.45	1,335	8.363	-
Holds bank account	49%	36%	1,335	-13%	***
Has drainage outside dwelling	31%	22%	1,335	-10%	**
Volume of drainage system in sub-ward (per capita in sub-ward)	0.104	0.0768	1,335	-0.0275	*

**in Tanzanian shilling (tzs)*

Table 16 - Frequently affected t-test results

VARIABLES	Not frequently affected	Frequently affected	Observations	Difference	T-test results
Expenditure proxy (real per capita)*	146,670	121,220	1,289	-25451	**
Food insecurity (CSI)	4.579	9.588	1,335	5.008	*
Household head male	73%	58%	1,335	-15%	*
Housing and services					
Value of dwelling (self-estimate among owners)*	88790000	60240000	632	-28600000	*
Annual rent (paid by renters)*	780,572	1162000	470	381783	-
Pipe outside dwelling	11%	0%	1,335	-11%	***
Public tap	34%	47%	1,335	14%	*
Pit latrine	36%	57%	1,335	21%	**
Walking distance	77.92	29.02	1,335	-48.91	***
Travel time (BRT, walking and mini-bus)	43.53	17.33	1,335	-26.2	***
House improvement in past year	18%	38%	1,335	20%	**
Elevation	33.97	20.71	1,335	-13.26	***
Finance & DRM					
Has received early warning	48%	70%	1,335	22%	**
Access to informal emergency lending	74%	56%	1,335	-17%	**

**in Tanzanian shilling (tzs)*

Table 17 – Directly affected in 2018 flood t-test results

VARIABLES	Not directly affected 2018	Directly affected 2018	Observations	Difference	t-test results
Expenditure proxy (real per capita)*	134,636	125,944	682	-8692	
Food insecurity (CSI)	4.881	7.099	701	2.218	**
Head of household is male	73%	64%	701	-9%	**
Housing and services					
Value of dwelling (self-estimate)*	74470000	79480000	278	5006000	
Annual rent (among renters)*	725,707	802,516	222	76809	
Pit latrine	41%	51%	701	10%	*
Pour flush toilet	32%	23%	701	-9%	*
Pipe outside dwelling	9%	3%	701	-6%	***
Walking distance to work	83.33	64.69	701	-18.64	**
Pay for garbage service	90%	83%	701	-7%	
Made housing improvement in past year	12%	19%	701	8%	*
Finance					
Access to emergency informal lending	72%	66%	701	-6%	
Has insurance including disaster protection	3%	9%	701	6%	**

**in Tanzanian shilling (tzs)*

Appendix 3

Methodology for calculating disaster loss at the household level

To calculate the losses at the household level, housing repairs, value of asset losses, cost of missed days of work and medical costs are combined. Housing repairs and medical costs were obtained directly through self-reporting. The value of asset losses was obtained by combining data collected in the 2017 survey on asset values and the reported losses of the 2018 flood from the phone interviews. In the phone interviews, respondents were asked only for the assets lost, and not the value of those assets. Instead the average asset values of the reported asset losses from the 2017 survey were used, and these were applied to the items reported damaged or lost in the 2018 flood. Table 18 contains the results of this estimation.

Table 18 - Estimated value of assets calculated based on price of self-reported asset losses

Assets	Average estimated value in tzs
bed	410000
business	2375000
carpet	106250
cellphone	128333.3
clothes	406000
door	150000
electronics	767272.8

fan	40000
food stuff	246000
fridge	657142.9
furniture	450000
house	8220000
iron	205000
livestock	366666.7
mattress	180625
radio and iron	70000
sofa	1200000
stove	70000
toilet	10000
tv	370000

For loss due to missed days of work, information from the flood impact module (number of missed days of work by each family member) was combined with the household member roster to assess the total labor loss. The household member roster provides information about the profession of each family member. To compute the losses, a total of 20 workdays in a month is assumed. This gives a rough estimate of the value of one missed workday, provided that the value generated to be able to sustain the expenditure level is generated by labor income. To obtain the value of each category of jobs to household income, we regressed the number of household members in each occupation group on total household expenditure. This strategy estimates the attribution of having a household member working in a specific occupation on the overall household expenditure.

Table 19 contains the results of the regression analysis and the values can be used as estimates of wages for different occupations – assuming a straightforward relationship between labor and expenditure. We then multiply the number of missed workdays of the household member who could not go to work by the average daily wage of his/her occupation based on occupation information.

Table 19 - Estimated value of monthly salary by different type of occupation

Job	Estimated "wage" (monthly in tzs)
Wage employee, non-farm	76490.87
Wage Employee, Farm	74389.83
Self-Emp Nonfarm-Business	54883.18
Self-Emp Nonfarm-Independent	55420.68
Self-Employed Agriculture	41705.94
Assistance in family enterprise	58099.03
Casual /Day Laborer	34707.35
Intern/free labor	50172
Other	28046.48

Appendix 4

Regression results

Table 20 - Determinants of being directly affected by floods

VARIABLES	Directly affected by floods

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expenditure proxy (SWIFT)	-0.606***	-0.585***	-0.637***	-0.672***	-0.581**	-0.704**		-0.792	-0.288
	(0.156)	(0.198)	(0.220)	(0.226)	(0.260)	(0.304)		(0.863)	(0.415)
food insecurity score (CSI)							0.0381***		
							(0.00936)		
Annual rent								2.83e-07	
								(2.62e-07)	
Self-evaluation of dwelling value									-4.39e-09***
									(1.43e-09)
Male head of household		-0.405**	-0.384**	-0.382**	-0.413**	-0.398*	-0.443**	-0.422	-0.255
		(0.177)	(0.180)	(0.182)	(0.184)	(0.210)	(0.211)	(0.382)	(0.292)
number of household members		-0.0263	-0.0459	-0.0568	-0.0420	-0.0386	-0.00612	-0.160	0.0241
		(0.0427)	(0.0545)	(0.0507)	(0.0503)	(0.0593)	(0.0447)	(0.180)	(0.0783)
Main income source of breadwinner (base: private company):									
Public company		-0.750	-0.706	-0.715	-0.723	-0.499	-0.282	0.439	-1.145
		(0.677)	(0.676)	(0.669)	(0.674)	(0.848)	(0.691)	(1.658)	(1.294)
Government		-0.0134	-0.0673	-0.0186	-0.0112	-0.00389	-0.101	-1.088	0.199
		(0.321)	(0.327)	(0.318)	(0.323)	(0.361)	(0.359)	(0.757)	(0.517)
Non-profit		-1.224	-1.081	-0.938	-1.191	-0.687	-0.786	-1.524	0.0587
		(0.791)	(0.778)	(0.794)	(0.895)	(0.956)	(0.983)	(1.529)	(1.364)
Private individual		0.361	0.409	0.372	0.289	0.485	0.719**	1.310**	0.626
		(0.345)	(0.351)	(0.320)	(0.320)	(0.368)	(0.359)	(0.565)	(0.773)
Self-employed		-0.197	-0.199	-0.159	-0.217	-0.0772	0.0166	0.257	-0.0602
		(0.266)	(0.273)	(0.257)	(0.270)	(0.287)	(0.290)	(0.462)	(0.428)
Family business		0.361	0.258	0.354	0.350	0.0682	0.216	0.108	-0.000210
		(0.402)	(0.413)	(0.443)	(0.468)	(0.477)	(0.521)	(1.268)	(0.784)
Other		-1.357	-1.478	-1.532	-1.793	-0.784	-0.465		
		(1.175)	(1.209)	(1.257)	(1.268)	(1.251)	(1.319)		
Distance to work (travel time in minutes)		-0.00129	-0.00163	-0.00173	-0.00183	-0.00139	-0.000973	0.00342	-0.00170
		(0.00207)	(0.00202)	(0.00201)	(0.00221)	(0.00275)	(0.00265)	(0.00346)	(0.00247)
Tenure status (base: self-built):									
Purchased from previous owner			0.137	0.0437	0.129	0.0770	0.397		0.623
			(0.548)	(0.557)	(0.622)	(0.872)	(0.823)		(0.907)
Gifted/Inherited			0.233	0.158	0.243	0.0846	0.148		0.00817
			(0.218)	(0.225)	(0.214)	(0.239)	(0.244)		(0.314)
Rented			-0.532*	-0.694**	-0.629**	-0.548*	-0.440		
			(0.305)	(0.304)	(0.277)	(0.297)	(0.275)		
Free			-0.627	-0.849*	-0.733	-0.795	-0.727		
			(0.494)	(0.481)	(0.490)	(0.535)	(0.488)		
Other			-0.478	-0.569	-0.289	0.226	0.328		0.180
			(1.119)	(1.069)	(1.007)	(0.934)	(0.972)		(1.469)
Concerned about tenure or refused to respond			-0.0911	-0.206	-0.188	-0.167	-0.272	-0.869	-0.580
			(0.198)	(0.227)	(0.230)	(0.227)	(0.225)	(0.524)	(0.380)
Holds tenure documentation (for either rental or ownership)			-0.384	-0.482*	-0.405	-0.604*	-0.608**	-0.767	-0.993*
			(0.257)	(0.266)	(0.272)	(0.335)	(0.289)	(0.555)	(0.536)
Length of stay in dwelling (base: less than 3 years):									
4-5 years			-0.323	-0.304	-0.347	-0.259	-0.306	-0.332	-1.103

			(0.396)	(0.415)	(0.429)	(0.482)	(0.468)	(0.574)	(1.197)
6-10 years			-0.237	-0.221	-0.225	-0.359	-0.386	-0.142	-0.771
			(0.300)	(0.300)	(0.308)	(0.331)	(0.316)	(0.566)	(0.519)
11-20 years			-0.0611	-0.0537	-0.0980	-0.177	-0.320	-0.124	0.0150
			(0.272)	(0.269)	(0.278)	(0.312)	(0.296)	(0.586)	(0.706)
More than 20 years			-0.432*	-0.558**	-0.563**	-0.568*	-0.572*	-1.942***	-0.165
			(0.254)	(0.268)	(0.275)	(0.330)	(0.322)	(0.570)	(0.596)
Type of dwelling (base: free-standing):									
Attached house				-0.0395	-0.0794	0.0298	-0.0526	-0.0284	0.129
				(0.216)	(0.204)	(0.223)	(0.215)	(0.327)	(0.388)
Flat /apartment				-0.124	-0.275	0.0484	-0.155	-0.417	1.107
				(0.940)	(1.111)	(0.999)	(1.080)	(1.694)	(1.240)
Shared house				0.281	0.284	0.0989	0.0613	0.378	-0.598
Floor material (base: Earth, mud):				(0.347)	(0.350)	(0.404)	(0.408)	(0.446)	(0.770)
Concrete, cement and timber, tiles				0.239	0.448	0.808	0.893	2.011*	-0.183
				(0.546)	(0.515)	(0.647)	(0.721)	(1.093)	(0.849)
Other				-2.479**	-2.172*	-1.045	-0.943	-0.752	-1.530
				(1.212)	(1.192)	(1.086)	(1.110)	(1.713)	(1.314)
Wall material (base: Mud bricks/sundried bricks/poles/mud):									
Baked bricks /burnt bricks				-0.0916	-0.172	-0.338	-0.297	-1.418*	-0.0787
				(0.449)	(0.494)	(0.528)	(0.514)	(0.829)	(0.550)
Concrete, cement or stones				-0.477	-0.496	-0.822*	-0.753*	-1.888***	-0.965*
				(0.386)	(0.459)	(0.457)	(0.439)	(0.718)	(0.536)
Other				2.599**	2.673**		1.228		
				(1.101)	(1.100)		(1.871)		
Roof material (base: concrete, cement, stone):									
Metal sheet (GCI)				0.0503	0.0754	0.416	0.416	-0.813	0.822
				(0.368)	(0.362)	(0.441)	(0.414)	(0.891)	(0.502)
Absestos sheets				0.362	0.529	0.480	0.570	1.008	-0.0164
				(0.537)	(0.540)	(0.595)	(0.557)	(1.452)	(0.920)
Other				-	-	-	-	-	
Type of toilet (base: pit latrine):									
Pour flush toilet					0.236	0.415	0.183	0.779	0.919*
					(0.251)	(0.302)	(0.273)	(0.490)	(0.512)
Flush toilet with cistern					-0.0263	0.193	-0.0397	0.201	0.206
					(0.331)	(0.372)	(0.331)	(0.662)	(0.534)
Other					-0.552	-0.158	-0.627		1.356
					(1.060)	(1.013)	(1.028)		(1.088)
Water source (base: Pipe inside dwelling):									
Pipe outside dwelling					-0.653*	-0.612*	-0.565	-2.006*	-0.631
					(0.335)	(0.363)	(0.377)	(1.063)	(0.471)
Neighbor/communal pipe					0.0120	0.0998	0.110	-0.230	-0.000772
					(0.212)	(0.221)	(0.219)	(0.681)	(0.445)
Public tap					0.0476	0.0535	0.0195	-0.622	0.605
					(0.329)	(0.356)	(0.351)	(0.706)	(0.556)
Water vendor					-0.279	-0.393	-0.226	-1.320	-0.107
					(0.396)	(0.475)	(0.469)	(0.829)	(0.704)
Spring or well					-0.0323	0.169	0.300	1.194	-0.182

					(0.316)	(0.414)	(0.422)	(1.013)	(0.508)
Other					0.468				
					(0.860)				
Garbage collection (base: gov. collection):									
Collected by informal operator					0.0441	0.207	0.274	0.249	0.337
					(0.299)	(0.353)	(0.345)	(0.653)	(0.419)
Collected by private company					0.113	0.298	0.388	1.055**	0.626
					(0.294)	(0.303)	(0.290)	(0.478)	(0.499)
Government bin /public waste container					-0.444				
					(0.856)				
Disposal within compound (pit)					0.452	1.065*	0.827	0.407	1.821**
					(0.552)	(0.632)	(0.574)	(1.285)	(0.701)
None or Unauthorized Heap					0.917	1.193	1.183*	3.073*	1.246
					(0.637)	(0.815)	(0.685)	(1.681)	(1.246)
Pay for garbage collection					-0.255	-0.315	-0.489	-1.554	0.278
					(0.514)	(0.568)	(0.518)	(0.956)	(0.691)
Has street drainage outside dwelling					0.306	0.0526	0.0152	-0.273	0.161
					(0.234)	(0.230)	(0.232)	(0.441)	(0.352)
Truckload						0.00530	0.00570	-0.00549	0.0105
						(0.00569)	(0.00581)	(0.0104)	(0.00923)
population density						5.281	4.625	-5.338	9.421*
						(4.673)	(5.116)	(6.788)	(5.367)
Elevation of household dwelling location						-0.00889*	-0.00851*	-0.0148	-0.00481
						(0.00491)	(0.00464)	(0.0101)	(0.00612)
Constant	5.858***	6.171**	7.660***	8.384***	7.037**	7.979**	-0.532	11.49	2.646
	(1.847)	(2.465)	(2.824)	(2.915)	(3.301)	(4.000)	(1.052)	(10.98)	(5.360)
Observations	1,289	1,274	1,274	1,270	1,270	1,001	1,038	384	446
Prob > F	0.000168	0.000668	0.000165	0.000879	0.00118	0.000390	1.92e-06	0.000178	0.110

Table 21 - Determinants of being indirectly affected by floods

VARIABLES	indirectly (only) affected minus electricity in general								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expenditure proxy (SWIFT)	-0.684***	-0.729**	-0.636**	-0.601*	-0.0595	0.129		-0.132	-0.209
	(0.240)	(0.306)	(0.313)	(0.321)	(0.315)	(0.367)		(0.785)	(0.566)
food insecurity score (CSI)							-0.0160		
							(0.0143)		
Annual rent								-2.17e-07	
								(2.95e-07)	
Self-evaluation of dwelling value									-6.10e-10
									(1.23e-09)
Male head of household		0.352*	0.287	0.276	0.237	0.0859	0.169	-0.167	-0.137
		(0.206)	(0.207)	(0.213)	(0.217)	(0.257)	(0.261)	(0.503)	(0.479)
number of household members		0.0416	0.0418	0.0418	0.0663	0.119*	0.114**	0.356*	0.0660

		(0.0552)	(0.0601)	(0.0615)	(0.0602)	(0.0691)	(0.0572)	(0.201)	(0.114)
main income source of breadwinner (base: private company):									
Public company		-0.00688	-0.0296	-0.178	-0.345	-0.0770	-0.111		1.450
		(0.889)	(0.883)	(0.939)	(1.176)	(1.254)	(1.233)		(1.039)
Government		-0.192	-0.204	-0.170	-0.265	-0.488	-0.546	0.275	-0.480
		(0.397)	(0.387)	(0.409)	(0.388)	(0.488)	(0.494)	(0.780)	(1.030)
Non-profit		-0.664	-0.669	-0.815	-0.918				
		(1.152)	(1.165)	(1.150)	(1.126)				
Private individual		-0.511	-0.470	-0.518	-0.473	-0.440	-0.530	-2.005***	-0.0402
		(0.588)	(0.611)	(0.581)	(0.581)	(0.682)	(0.694)	(0.716)	(1.162)
Self-employed		-0.416	-0.418	-0.404	-0.328	-0.321	-0.330	-0.872*	0.196
		(0.306)	(0.293)	(0.301)	(0.246)	(0.292)	(0.279)	(0.504)	(0.465)
Family business		-0.532	-0.462	-0.393	-0.140	-0.260	-0.251		0.0577
		(0.476)	(0.460)	(0.471)	(0.426)	(0.505)	(0.526)		(0.812)
Distance to work (travel time in minutes)		0.000902	0.00125	0.00176	0.00136	0.000698	0.000269	0.000152	0.000599
		(0.00203)	(0.00196)	(0.00185)	(0.00173)	(0.00197)	(0.00206)	(0.00460)	(0.00266)
Tenure status (base: self-built):									
Puchased from previous owner			0.420	0.271	0.254	-0.151	-0.193		0.388
			(0.593)	(0.543)	(0.517)	(0.726)	(0.724)		(1.400)
Gifted/Inherited			-0.451	-0.485	-0.492	-0.228	-0.167		0.0596
			(0.336)	(0.355)	(0.355)	(0.331)	(0.338)		(0.438)
Rented			0.349	0.421	0.448	0.700**	0.796**		
			(0.256)	(0.291)	(0.297)	(0.338)	(0.341)		
Free			0.456	0.463	0.557	0.0677	0.426		
			(0.493)	(0.540)	(0.547)	(0.786)	(0.753)		
Concerned about tenure or refused to respond			-0.294	-0.0948	-0.195	-0.236	-0.286	-0.489	0.457
			(0.238)	(0.262)	(0.313)	(0.392)	(0.383)	(0.544)	(0.698)
Holds tenure documentation (for either rental or ownership)			0.315	0.301	0.360	0.197	0.296	0.164	2.192**
			(0.295)	(0.310)	(0.327)	(0.432)	(0.444)	(0.727)	(0.852)
Length of stay in dwelling (base: less than 3 years):									
4-5 years			-0.0875	-0.121	0.0398	0.213	0.237	0.0701	0.906
			(0.476)	(0.475)	(0.420)	(0.505)	(0.488)	(0.743)	(1.272)
6-10 years			0.397	0.466	0.645*	0.916**	0.913**	0.859	2.290**
			(0.380)	(0.396)	(0.348)	(0.374)	(0.374)	(0.578)	(1.011)
11-20 years			0.180	0.180	0.390	0.528	0.697	0.571	0.452
			(0.445)	(0.437)	(0.422)	(0.443)	(0.428)	(0.813)	(1.168)
More than 20 years			0.449	0.408	0.660**	0.767**	0.864***	1.117***	1.232
			(0.347)	(0.335)	(0.291)	(0.305)	(0.301)	(0.421)	(1.070)
Type of dwelling (base: free-standing):									
Attached house				-0.00602	-0.0440	-0.139	-0.133	-0.875*	0.396
				(0.305)	(0.293)	(0.314)	(0.299)	(0.490)	(0.547)
Flat /apartment				-0.771	-0.745	-0.780	-0.878	-0.0428	
				(1.022)	(0.982)	(1.045)	(0.998)	(1.100)	
Shared house				0.108	-0.201	-0.187	-0.192	-0.0962	0.405
				(0.342)	(0.375)	(0.369)	(0.371)	(0.490)	(1.064)
Floor material (base: Earth, mud):									
Concrete, cement and timber, tiles				0.285	0.389				
				(0.757)	(0.583)				
Other				-1.152	-0.854				

				(1.215)	(1.071)				
Wall material (base: Mud bricks/sundried bricks/poles/mud):									
Baked bricks /burnt bricks				-1.619***	-1.558***	-0.914	-0.888	-1.978	1.657
				(0.517)	(0.549)	(0.609)	(0.613)	(1.379)	(1.567)
Concrete, cement or stones				-0.166	-0.0132	0.502	0.543	0.0602	2.943*
				(0.324)	(0.367)	(0.374)	(0.366)	(0.557)	(1.505)
Other				1.056	0.696				
				(1.837)	(1.590)				
Roof material (base: concrete, cement, stone):									
Metal sheet (GCI)				-0.819**	-0.880***	-0.655	-0.674	-1.403*	1.220
				(0.316)	(0.321)	(0.401)	(0.419)	(0.756)	(1.134)
Absestos sheets				-0.819	-0.681	-0.352	-0.450	-3.211	2.965**
				(0.694)	(0.693)	(0.824)	(0.798)	(2.021)	(1.457)
Type of toilet (base: pit latrine):									
Pour flush toilet					-0.155	-0.185	-0.175	-0.145	-0.460
					(0.304)	(0.351)	(0.337)	(0.558)	(0.575)
Flush toilet with cistern					-0.876***	-0.641*	-0.598*	-0.611	-0.906
					(0.335)	(0.386)	(0.355)	(0.724)	(0.658)
Water source (base: Pipe inside dwelling):									
Pipe outside dwelling					-0.426	-0.642	-0.499		-0.227
					(0.415)	(0.445)	(0.453)		(0.460)
Neighbor/communal pipe					0.223	-0.248	-0.247	-0.0655	-0.600
					(0.293)	(0.318)	(0.302)	(0.729)	(0.538)
Public tap					-0.315	-0.428	-0.493	-0.0473	-0.762
					(0.337)	(0.343)	(0.356)	(0.750)	(0.550)
Water vendor					1.027**	1.079**	1.047**	1.817**	0.853
					(0.426)	(0.452)	(0.464)	(0.819)	(0.787)
Spring or well					0.437	-0.682	-0.545	-0.693	-0.543
					(0.446)	(0.650)	(0.619)	(0.996)	(0.895)
Garbage collection (base: gov. collection):									
Collected by informal operator					0.0370	-0.0931	-0.165	-0.763	-0.0350
					(0.338)	(0.394)	(0.387)	(0.831)	(0.548)
Collected by private company					0.671**	0.145	0.180	0.391	-0.387
					(0.259)	(0.313)	(0.307)	(0.732)	(0.564)
Disposal within compound (pit)					0.0132	-0.630	-0.447	-0.877	-1.614**
					(0.691)	(0.922)	(0.953)	(1.597)	(0.802)
None or Unauthorise Heap					-0.617				
					(0.856)				
Pay for garbage collection					0.181	-0.0779	0.0657	-0.815	-0.547
					(0.636)	(0.890)	(0.877)	(1.532)	(0.658)
Has street drainage outside dwelling					-0.573**	-0.418	-0.473	-0.491	0.508
					(0.250)	(0.321)	(0.314)	(0.464)	(0.438)
Truckload						0.00522	0.00451	0.0140	-0.00599
						(0.00594)	(0.00590)	(0.00970)	(0.0105)
population density						6.334	5.927	-0.0230	1.062
						(4.104)	(3.863)	(9.506)	(5.940)
Elevation of household dwelling location						0.00495	0.00476	-0.00322	0.0187**
						(0.00667)	(0.00624)	(0.0122)	(0.00870)

Constant	6.375**	6.739*	5.050	5.320	-1.492	-4.137	-2.889**	1.767	-6.560
	(2.835)	(3.805)	(3.911)	(3.931)	(3.915)	(4.554)	(1.147)	(9.944)	(7.421)
Observations	1,289	1,270	1,263	1,259	1,241	930	960	329	405
Prob > F	0.00514	0.0851	0.341	0.00112	1.45e-05	0.000139	0.000220	0.00240	0.0666

Table 22 - Determinants of annual rent including flood exposure

	(9)	(35)	(27)	(51)
VARIABLES	**Annual rent**			
Directly affected	-14,772	62,864		
	(57,113)	(86,038)		
Indirectly affected				
Frequently affected			-42,175	284,731*
			(178,314)	(167,025)
Expenditure proxy (SWIFT)	409,290***	574,069***	407,049***	588,663***
	(138,202)	(138,594)	(145,346)	(140,727)
Water source (base: Pipe inside dwelling):				
Pipe outside dwelling	-98,288	-177,668	-95,934	-185,911
	(132,245)	(210,750)	(132,291)	(203,746)
Neighbor/communal pipe	-142,289	-253,516*	-138,925	-269,107*
	(116,338)	(143,745)	(115,496)	(140,589)
Public tap	-221,413*	-486,015***	-216,780	-502,005***
	(131,203)	(158,957)	(134,462)	(152,844)
Water vendor	-271,411	-268,203*	-265,370	-304,475**
	(166,687)	(149,390)	(165,268)	(147,688)
Spring or well	792,054	595,638	799,762	546,775
	(724,710)	(829,679)	(714,211)	(786,139)
Type of toilet (base: pit latrine):				
Pour flush toilet	62,446	7,358	61,696	3,750
	(73,918)	(77,053)	(71,184)	(73,374)
Flush toilet with cistern	404,789***	410,230***	408,617***	382,852***
	(120,472)	(135,233)	(124,588)	(133,080)
Garbage collection (base: gov. collection):				
Collected by informal operator	-30,943	-131,502	-32,497	-120,491
	(117,312)	(136,441)	(117,263)	(137,746)
Collected by private company	191,555	383,454*	191,004	378,610*
	(210,747)	(200,624)	(211,393)	(195,227)
Government bin /public waste container	209,134	356,199	209,948	357,277
	(365,016)	(253,058)	(366,826)	(265,551)
Disposal within compound (pit)	149,828	-130,500	146,537	-107,877
	(161,575)	(122,116)	(162,749)	(125,291)
None or Unauthorized Heap	-14,050	-115,388	-23,809	-69,561
	(112,946)	(126,878)	(106,807)	(108,591)
Has street drainage outside dwelling	-45,252	-89,170	-42,681	-106,342
	(81,576)	(91,752)	(81,738)	(91,288)

Volume of trash in sub-ward	2.419	-2.405	2.485	-2.572*
	(1.921)	(1.536)	(1.915)	(1.491)
Distance to work (travel time in minutes)	143.6	-185.2	129.6	-111.8
	(412.7)	(460.7)	(404.1)	(468.2)
Type of dwelling (base: free-standing):				
Attached house	-870.3	-111,017	747.9	-118,038
	(74,682)	(92,029)	(74,133)	(92,630)
Flat /apartment	-380,449*	-449,241***	-373,490*	-505,055***
	(197,388)	(150,153)	(201,567)	(168,361)
Shared house	-147,903	-191,144	-145,425	-212,146*
	(158,989)	(115,641)	(157,133)	(121,564)
Wall material (base: Mud bricks/sundried bricks/poles/mud):				
Baked bricks /burnt bricks	-193,299	-11,121	-197,975	22,074
	(149,967)	(112,821)	(147,488)	(118,625)
Concrete, cement or stones	35,704	151,695	30,621	191,403
	(151,133)	(135,727)	(148,660)	(141,417)
Other	234,575	1.351e+06***	212,611	1.457e+06***
	(215,938)	(461,680)	(247,767)	(417,348)
Roof material (base: concrete, cement, stone):				
Metal sheet (GCI)	-289,301	-298,430	-287,917	-304,812
	(329,280)	(390,583)	(328,003)	(387,654)
Absestos sheets	-278,796	-466,830	-272,482	-518,208
	(367,142)	(375,442)	(359,524)	(378,135)
Other	-171,497	-243,049	-171,092	-243,585
	(342,279)	(423,014)	(341,778)	(418,424)
Floor material (base: Earth, mud):				
Concrete, cement and timber, tiles	41,026	30,061	36,529	54,354
	(79,203)	(78,466)	(76,003)	(78,607)
Other	261,367	74,403	260,550	90,241
	(261,109)	(277,053)	(260,886)	(277,883)
Number of rooms	-9,216	-1,071	-9,453	-526.7
	(29,396)	(25,749)	(28,948)	(26,358)
Ward level fixed effects	**YES**		**YES**	
Constant	-4.529e+06**	-5.599e+06***	-4.504e+06**	-5.787e+06***
	(1.762e+06)	(1.645e+06)	(1.865e+06)	(1.664e+06)
Observations	299	299	299	299
R-squared	0.541	0.397	0.541	0.400

Table 23 - Determinants of loss in relation to income (among hh affected by 2018 flood)

VARIABLES	relative loss in the april 2018 flood								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expenditure proxy (SWIFT)	0.0690	0.0859	0.112	0.0980	0.0877	0.0483	0.0424		
	(0.0846)	(0.0830)	(0.133)	(0.116)	(0.118)	(0.116)	(0.146)		
food insecurity score (CSI)								0.00942	0.00925*
								(0.00580)	(0.00555)

Male head of household		-0.114	-0.0430	-0.0542	-0.0528	-0.0553	-0.0696		-0.0462
		(0.0933)	(0.0858)	(0.0892)	(0.0929)	(0.0813)	(0.0902)		(0.0750)
number of household members			-0.00939	-0.00957	-0.00838	-0.00698	-0.00970		
			(0.0139)	(0.0176)	(0.0178)	(0.0183)	(0.0276)		
main income source of breadwinner (base: private company):									
Public company			-0.0603	-0.0184	0.0188	0.0378	0.0829		
			(0.169)	(0.163)	(0.172)	(0.166)	(0.229)		
Government			0.138	0.137	0.145	0.218	0.283		
			(0.151)	(0.173)	(0.171)	(0.176)	(0.216)		
Non-profit			-0.0493	0.0943	0.0746	0.224	0.211		
			(0.0488)	(0.118)	(0.133)	(0.175)	(0.214)		
Private individual			0.101	0.113	0.126	0.118	0.139		
			(0.125)	(0.125)	(0.124)	(0.112)	(0.144)		
Self-employed			0.0947	0.129	0.139	0.191*	0.201		
			(0.0676)	(0.0830)	(0.0887)	(0.102)	(0.128)		
Family business			0.217	0.276	0.273	0.260	0.299		
			(0.253)	(0.256)	(0.255)	(0.267)	(0.261)		
Other			0.295***	0.282	0.263	0.304	0.360		
			(0.109)	(0.193)	(0.207)	(0.208)	(0.284)		
Distance to work (travel time in minutes)			-0.00173***	-0.00196***	-0.00196***	-0.00106	-0.00153**		
			(0.000694)	(0.000731)	(0.000729)	(0.000790)	(0.000747)		
Carried out housing investment			-0.0391	-0.0375	-0.0414	-0.0593	-0.0392		
			(0.0746)	(0.0720)	(0.0740)	(0.0832)	(0.0924)		
Tenure status (base: self-built):									
Puchased from previous owner				-0.212*	-0.196	-0.237*	-0.145		
				(0.116)	(0.121)	(0.139)	(0.176)		
Gifted/Inherited				-0.100	-0.0971	-0.0925	-0.0371		
				(0.0997)	(0.101)	(0.103)	(0.116)		
Rented				-0.0726	-0.0685	-0.0685	0.0572		
				(0.129)	(0.132)	(0.142)	(0.130)		
Free				-0.145	-0.166	-0.125	-0.152		
				(0.154)	(0.160)	(0.148)	(0.141)		
Concerned about tenure or refused to respond				0.0425	0.0393	0.0417	0.0472		
				(0.133)	(0.134)	(0.130)	(0.141)		
Holds tenure documentation (for either rental or ownership)				0.00875	-0.00128	0.00428	0.0737		
				(0.0788)	(0.0784)	(0.0758)	(0.0851)		
Length of stay in dwelling (base: less than 3 years):									
4-5 years				-0.0701	-0.0705	-0.0855	-0.0653		
				(0.258)	(0.259)	(0.243)	(0.281)		
6-10 years				-0.0549	-0.0375	-0.0722	-0.0559		
				(0.147)	(0.151)	(0.157)	(0.162)		
11-20 years				-0.170	-0.184	-0.165	-0.107		
				(0.149)	(0.155)	(0.136)	(0.142)		
More than 20 years				-0.184	-0.191	-0.235	-0.135		
				(0.162)	(0.165)	(0.162)	(0.162)		
Type of dwelling (base: free-standing):									
Attached house					0.0291	0.0347	0.0729		
					(0.111)	(0.104)	(0.112)		

Flat /apartment					-0.178	-0.246	-0.198		
					(0.156)	(0.167)	(0.150)		
Shared house					-0.0693	-0.0436	-0.0306		
					(0.118)	(0.0998)	(0.106)		
Roof material (base: concrete, cement, stone):									
Metal sheet (GCI)					0.0738	0.0993	0.128		
					(0.0944)	(0.116)	(0.198)		
Absestos sheets					0.0588	0.0556	0.177		
					(0.125)	(0.132)	(0.203)		
Type of toilet (base: pit latrine):									
Pour flush toilet						0.0455	0.0712		
						(0.0868)	(0.122)		
Flush toilet with cistern						-0.0274	0.0160		
						(0.0940)	(0.104)		
Garbage collection (base: gov. collection):									
Collected by informal operator						-0.213*	-0.157		
						(0.118)	(0.131)		
Collected by private company						-0.150*	-0.221**		
						(0.0889)	(0.103)		
Government bin /public waste container						0.0615			
						(0.120)			
Disposal within compound (pit)						0.146	0.109		
						(0.155)	(0.170)		
None or Unauthorized Heap						0.282**	0.379***		
						(0.133)	(0.138)		
Pay for garbage collection						0.119	0.184		
						(0.103)	(0.136)		
Has street drainage outside dwelling						-0.0787	-0.0506		
						(0.0650)	(0.0748)		
Access to informal financing		0.0208							0.0648
		(0.0760)							(0.0743)
Volume of trash in sub-ward							-2.71e-07		
							(1.86e-06)		
population density by sub-ward							-0.471		
							(1.007)		
Constant	-0.574	-0.704	-0.994	-0.680	-0.628	-0.289	-0.485	0.177***	0.165***
	(0.983)	(0.961)	(1.598)	(1.476)	(1.472)	(1.485)	(1.933)	(0.0382)	(0.0623)
Observations	264	264	260	260	260	260	201	264	264
R-squared	0.004	0.018	0.068	0.092	0.096	0.139	0.163	0.043	0.049
Prob > F	0.417	0.478	0	0	0	0	0	0.108	0.390

Table 24 - Determinants of recovery from flood exposure (pre-2018)

VARIABLES	Have not recovered from shock									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure proxy (SWIFT)	-0.899**	-1.416***	-1.167**	-1.397***	-1.192**	-1.025**	-1.001**	-1.338***	-1.295**	

	(0.369)	(0.451)	(0.492)	(0.504)	(0.464)	(0.508)	(0.495)	(0.436)	(0.507)	
food insecurity score (CSI)										0.0185
										(0.0154)
number of household members		-0.187**	-0.168*	-0.189**	-0.190*	-0.170*	-0.155	-0.172*	-0.202**	-0.278***
		(0.0909)	(0.0924)	(0.0927)	(0.0974)	(0.0965)	(0.1000)	(0.0957)	(0.0976)	(0.0824)
Male head of household		0.273	0.262	0.287	0.281	0.253	0.244	0.228	0.233	0.256
		(0.239)	(0.245)	(0.241)	(0.245)	(0.248)	(0.256)	(0.258)	(0.277)	(0.402)
Main income source of breadwinner (base: private company):										
Public company		-0.167	0.155	-0.185	-0.0821	0.181	0.0628	-0.345	0.00815	-0.170
		(0.976)	(0.901)	(0.977)	(0.976)	(0.910)	(0.937)	(1.019)	(0.902)	(1.344)
Government		1.534***	1.676***	1.530***	1.505***	1.630***	1.467**	1.453***	1.365**	1.105
		(0.555)	(0.546)	(0.551)	(0.562)	(0.559)	(0.562)	(0.520)	(0.523)	(0.767)
Non-profit		-	-	-	-	-	-	-	-	-
Private individual		-0.195	-0.125	-0.223	-0.229	-0.152	-0.136	-0.362	-0.376	0.163
		(0.598)	(0.593)	(0.591)	(0.605)	(0.602)	(0.625)	(0.669)	(0.524)	(0.815)
Self-employed		0.489	0.501	0.472	0.491	0.515	0.431	0.449	0.391	0.781
		(0.400)	(0.402)	(0.403)	(0.410)	(0.400)	(0.394)	(0.372)	(0.364)	(0.581)
Family business		0.591	0.417	0.549	0.436	0.357	0.344	0.662	0.545	1.099
		(0.606)	(0.604)	(0.607)	(0.672)	(0.656)	(0.690)	(0.598)	(0.623)	(0.773)
Other		-	-	-	-	-	-	-	-	-
Distance to work (travel time in minutes)		-0.0105**	-0.0100**	-0.0103**	-0.00851*	-0.00846*	-0.00833*	-0.00918**	-0.0125**	-0.0120*
		(0.00455)	(0.00452)	(0.00448)	(0.00456)	(0.00462)	(0.00458)	(0.00454)	(0.00482)	(0.00617)
Member of saving or mutual aid		-0.271				-0.0953	-0.245	-0.265	-0.417	
		(0.270)				(0.275)	(0.288)	(0.290)	(0.290)	
Ability to save in past month			-0.629**			-0.512	-0.444			
			(0.295)			(0.326)	(0.336)			
HH holds bank account				-0.127		0.115	0.163			
				(0.287)		(0.298)	(0.316)			
access to informal financing = yes					-0.742**	-0.649**	-0.641**			
					(0.316)	(0.306)	(0.302)			
Tenure status (base: self-built):										
Puchased from previous owner							0.427			
							(0.707)			
Gifted/Inherited							-0.330			
							(0.512)			
Rented							-0.241			
							(0.425)			
Free							0.842			
							(0.651)			
Other							-			
Concerned about tenure or refused to respond							0.147			
							(0.363)			
Holds tenure documentation (for either rental or ownership)							-0.339			
							(0.401)			
Length of stay in dwelling (base: less than 3 years):										

4-5 years							0.147			
							(0.612)			
6-10 years							-0.278			
							(0.458)			
11-20 years							-0.861*			
							(0.463)			
More than 20 years							-0.0809			
							(0.380)			
Type of dwelling (base: free-standing):										
Attached house								-0.00184		
								(0.367)		
Flat /apartment								-0.0252		
								(1.041)		
Shared house								-0.297		
								(0.543)		
Floor material (base: Earth, mud):										
Concrete, cement and timber, tiles								-0.187		
								(0.899)		
Other								2.549		
								(2.030)		
Wall material (base: Mud bricks/sundried bricks/poles/mud):										
Baked bricks /burnt bricks								0.191		
								(0.796)		
Concrete, cement or stones								-0.0938		
								(0.475)		
Other								-1.298		
								(1.252)		
Roof material (base: concrete, cement, stone):										
Metal sheet (GCI)								-1.348***		
								(0.400)		
Absestos sheets								-1.322		
								(0.950)		
Type of toilet (base: pit latrine):										
Pour flush toilet									0.261	
									(0.377)	
Flush toilet with cistern									0.361	
									(0.473)	
Other									-	
Water source (base: Pipe inside dwelling):										
Pipe outside dwelling									-0.655	
									(0.728)	
Neighbor/communal pipe									0.391	
									(0.351)	
Public tap									0.149	
									(0.615)	
Water vendor									0.750	
									(0.500)	
Spring or well									1.267**	

									(0.564)	
Garbage collection (base: gov. collection):										
Collected by informal operator									0.181	
									(0.461)	
Collected by private company									0.441	
									(0.339)	
Government bin /public waste container									-	
Disposal within compound (pit)									0.945**	
									(0.472)	
None or Unauthorise Heap									-1.921**	
									(0.951)	
Pay for garbage collection										-0.491
										(0.518)
Has street drainage outside dwelling										0.0194
										(0.386)
Amount of Garbage by sub-ward										-0.00898
										(0.00901)
population density by sub-ward										-1.873
										(7.249)
Elevation of household dwelling location										-0.0278***
										(0.00975)
Constant	9.520**	16.12***	13.26**	15.89***	13.90**	11.94**	12.11**	16.64***	14.24**	0.588
	(4.284)	(5.298)	(5.756)	(5.894)	(5.415)	(5.898)	(5.767)	(5.173)	(5.987)	(0.952)
Observations	560	549	549	549	549	549	548	549	544	408
Prob > F	0.0162	0.000720	3.26e-05	0.000540	1.43e-05	2.84e-05	0.000294	0.000425	0.00256	0.0109