COPING WITH FLOODING IN INFORMAL SETTLEMENTS IN RAPIDLY URBANIZING PERIPHERIES IN THE MUMBAI REGION

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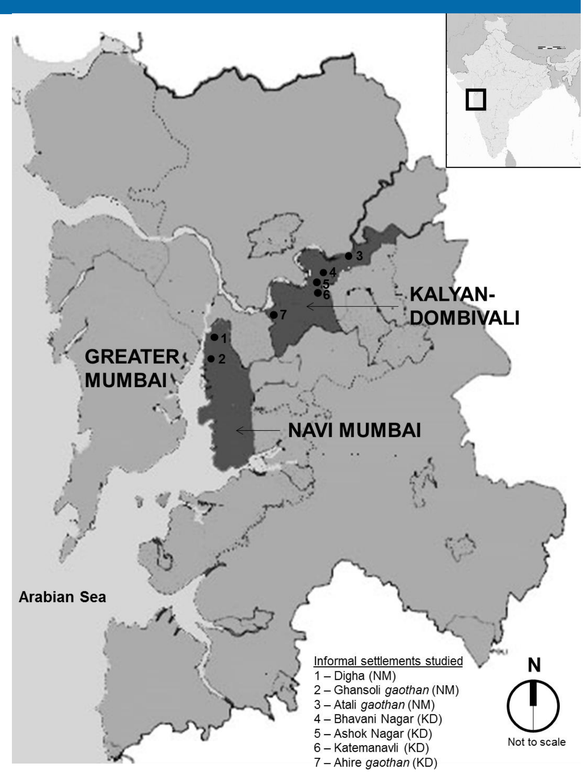
Research question

Coping strategies adopted by vulnerable, poor urban households in the global South in response to climate-related risks such as flooding is shaped by factors such as access to social, human and financial capital, tenure security, quality of the built environment, risk perceptions, and information from public authorities. As access to many of these factors lies beyond the household level at the community or city scales, local governments and civil society actors have a key role to play in augmenting household level coping.

- What factors shape risk perception and coping strategies at the household level in flood-prone informal settlements in two rapidly growing, mid-sized cities on Mumbai's periphery?
  - Are there any differences between old residents and more recent migrants?
- What are the gaps between the household and community perceptions of long-term flooding risk reduction measures and municipal disaster management strategies?

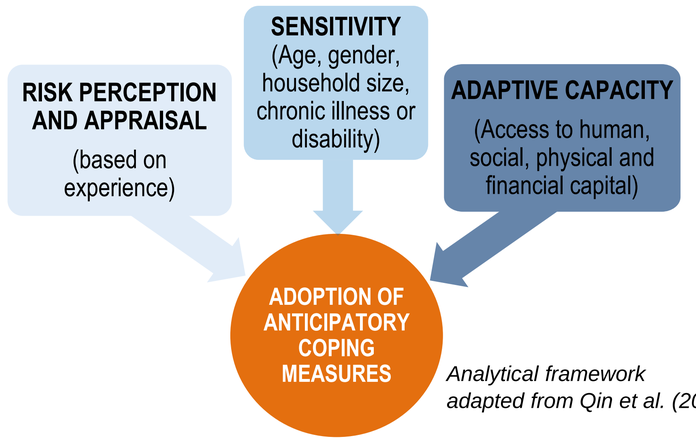
The geographic context

- Two mid-sized, satellite cities on the peripheries of Mumbai, India:
  Navi Mumbai: 1.11 million (19%)*
  Kalyan-Dombivali: 1.67 million (45%)*
  *estimated population in slums or informal settlements
- Climate science projections for the Mumbai region for the 21st century:
  - Intensity of extreme rainfall is likely to increase for all return periods (Ranger et al. 2011)
  - Average amount of rainfall to increase by 20% to 40% in various projections (Rana et al. 2014)
- Other local drivers of flooding risk: location at or below mean sea level, tidal inflows, riverine flooding (KD), increase in surface runoff due to rapid construction coupled with the low capacity of the existing drainage systems



Data and methods

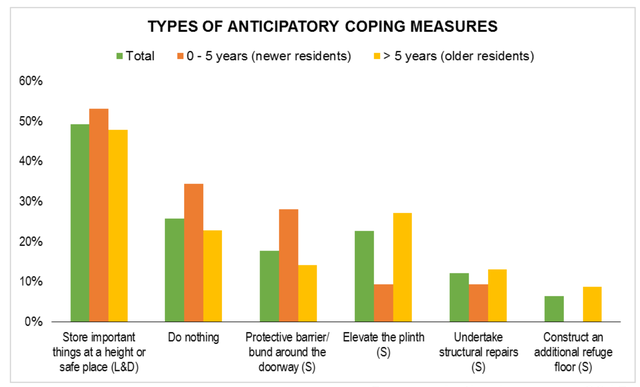
- Primary data on household coping strategies and municipal disaster management measures was collected during a three month period from June to August 2015 through:
  - A structured survey (n = 124, NM = 51, KD = 73) of households in seven flood-prone informal settlements in the two municipalities. Settlements were identified through a convenience sampling strategy following key informant interviews, observations and analysis of disaster management plans. Within these settlements, households were sampled using a simple random sampling strategy.
  - Semi-structured, open-ended interviews with municipal officials, elected representatives, and policy makers (n=20, snowball sampling)
- The integrated urban vulnerability-response framework proposed by Qin et al.(2015) was used to analyze how the adoption of anticipatory coping measures at the household level are shaped by flooding risk experience, risk perception, and social vulnerability indicators (sensitivity and adaptive capacity).
  - Bivariate analysis and multivariate analysis using a logistic regression model were used to evaluate the relative roles of the various factors in explaining the adoption of anticipatory coping measures at the household level.



Analytical framework adapted from Qin et al. (2015)

Key findings

- Previous flood experience and impacts contributes to heightened risk perception. Older households are more likely to have been experienced the damaging impacts of past flooding incidents and therefore, have greater risk perception as compared to more recent migrants. They are also more likely to have received information and early warnings about flooding risks from public authorities, as well as help from their social network at the time of flooding.[1,a]
- Nearly 70% of surveyed households took anticipatory coping measures
  - Structural coping measures: 48%
  - Loss and damage minimizing measures: 53%
  - No measures: 26%

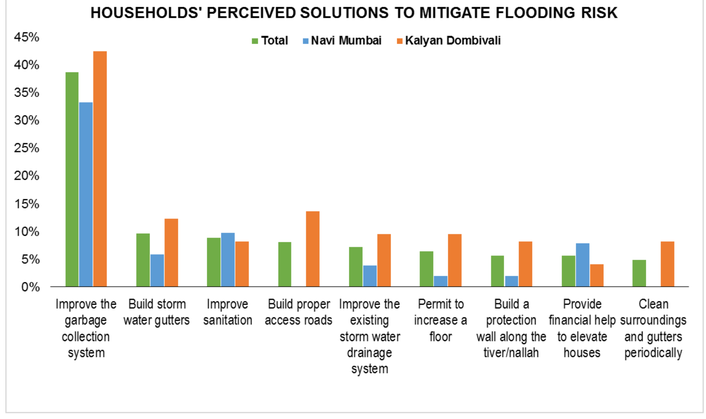


Source: Author's survey, 2015

- Bivariate analysis revealed that anticipatory coping measures at the household level are significantly associated with the household head's employment status, perceptions of flooding risk, and previous flood experience.[1,b] It is marginally associated with the age of the household head.[2,a]
  - No statistically significant differences between older residents and new migrants in their adoption of anticipatory coping measures but there is a weak but statistically significant difference in the adoption of structural coping measures.[c]

Structural modifications such as elevating the plinth and cement bunds around doorways are structural coping measures. Source: Photograph by author, 2015

- Logistic regression analysis reveals that <u>previous flooding experience affects the adoption of anticipatory coping measures</u> at the household level within our study context.[1] For a household that has experienced flooding, the odds of adopting anticipatory coping measures is quadrupled, controlling for other factors.
- On paper, city-level disaster management plans align with community needs and perceptions of risk reduction measures. These plans identify long-term infrastructural improvements to the storm water drainage and sanitation systems, raising community awareness, and regulating growth in flood-prone areas. However, gaps arise since implementation is largely focused on short-term preparedness (desilting gutters, cleaning major drains and *nallah*s) and on response during flooding emergencies (stockpiling equipment and training staff for rescue and relief). Many of these measures are not taken in flood-prone informal settlements as they are considered 'illegal encroachments.'



Majority (80%) are aware of long-term, community or city scale solutions to reduce flooding risk. Source: Author's survey, 2015

- Local governments face challenges in taking pro-poor, community-based measures because of a lack of localized knowledge on the vulnerabilities to and impacts of flooding, lack of human resource and technical capacity, and higher community reliance on political leaders rather than the municipal administration to initiate neighborhood development or for assistance during flooding events.

[1]Significant at the 5% level; [2]Significant at the 10% level
[a]Results of an independent t-test; [b]Results of chi-squared test; [c]Results of Cramer's V test

Conclusion and policy implications

- Previous flood experience shapes risk perception and influences the adoption of anticipatory coping measures at the household level. In rapidly growing areas, recent migrants might lack this experience, knowledge or the social and financial capital that is necessary for taking risk mitigation measures.
- In addition to planning for long-term risk reduction through land use planning and infrastructural development, municipalities need to understand the magnitude and localized impacts of flooding, and raise community awareness on coping measures (e.g. proper solid waste disposal) through creative public engagement that involves local political representatives.
- State level disaster management departments can create programs and financial incentives for capacity-building and retention within local governments.

REFERENCES
- Qin, H.; Romero-Lankao, P.; Hardoy, J. & Rosas-Huerta, A. 2015. Household responses to climate-related hazards in four Latin American cities: A conceptual framework and exploratory analysis. *Urban Climate*, 14: 94–110.
- Rana, A.; Foster, K.; Bosshard, T.; Olsson, J. & Bengtsson, L. 2014. Impact of climate change on rainfall over Mumbai using Distribution-based Scaling of Global Climate Model projections. *Journal of Hydrology: Regional Studies*, 1: 107–128.
- Ranger, N.; Hallegatte, S.; Bhattacharya, S.; Bachu, M.; Priya, P.; Dhore, K.; Rafique, F. et al. 2011. An assessment of the potential impact of climate change on flood risk in Mumbai. *Climatic Change*, 104(1): 139–167.
- Subramanyam, N.; MacAlister, C. 2016. Governance of flooding risks in informal settlements in satellite cities in the Mumbai region. *South Asian Water Studi*es, 5(3): 12-27.

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