Exposure, Impacts and Responses to Recurrent Floods in Mumbai, India

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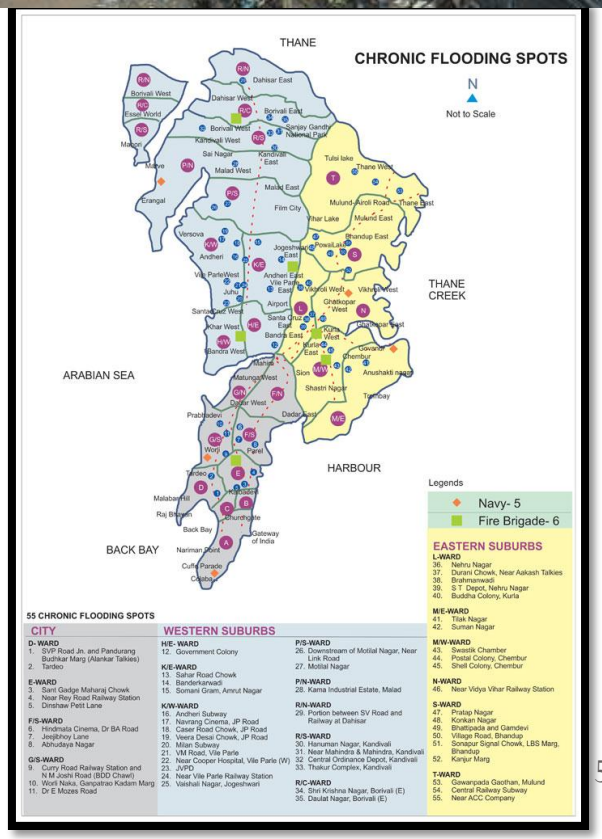
Presentation outline

- Empirical study on Mumbai floods
  - 2005 extreme floods
  - Recurrent floods
- Exposure – who and what is exposed
- Impacts – how much is lost/damaged
- Adaptive capacity – households responding to recurrent floods
- Conclusions and policy implications

Why Mumbai?

- Financial capital of India with 12 million people in residence and 5-6 million transit per day – Density of 28404 per sq.km
- Surrounded by sea on 3 sides and acutely vulnerable to floods, cyclones, storm surges and sea level rise
- Most parts of the city built on reclaimed land and only 10-12 meters above sea level
- Major residential and commercial areas situated in low lying areas and flood prone
- 55% people are living in slums or squatter settlements
- Acute income inequalities with 50% population earning below $330 and top 10% earning between $1700-2000 per month



Exposure

Chronic and localized flood spots

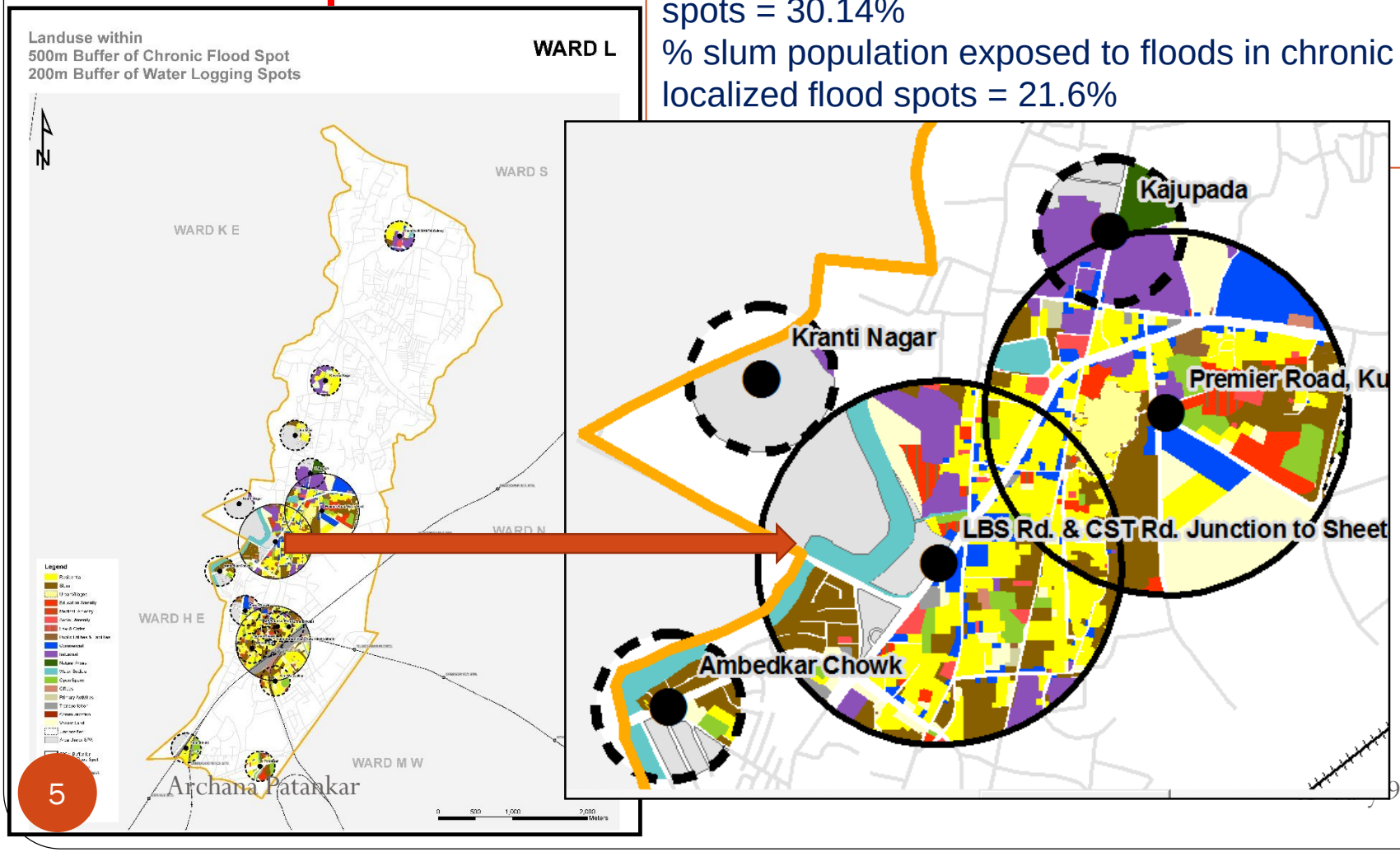
Ward L

Total ward population = 902,225

% population living in slums = 54.4%

% population exposed in chronic and localized flood spots = 30.14%

% slum population exposed to floods in chronic and localized flood spots = 21.6%

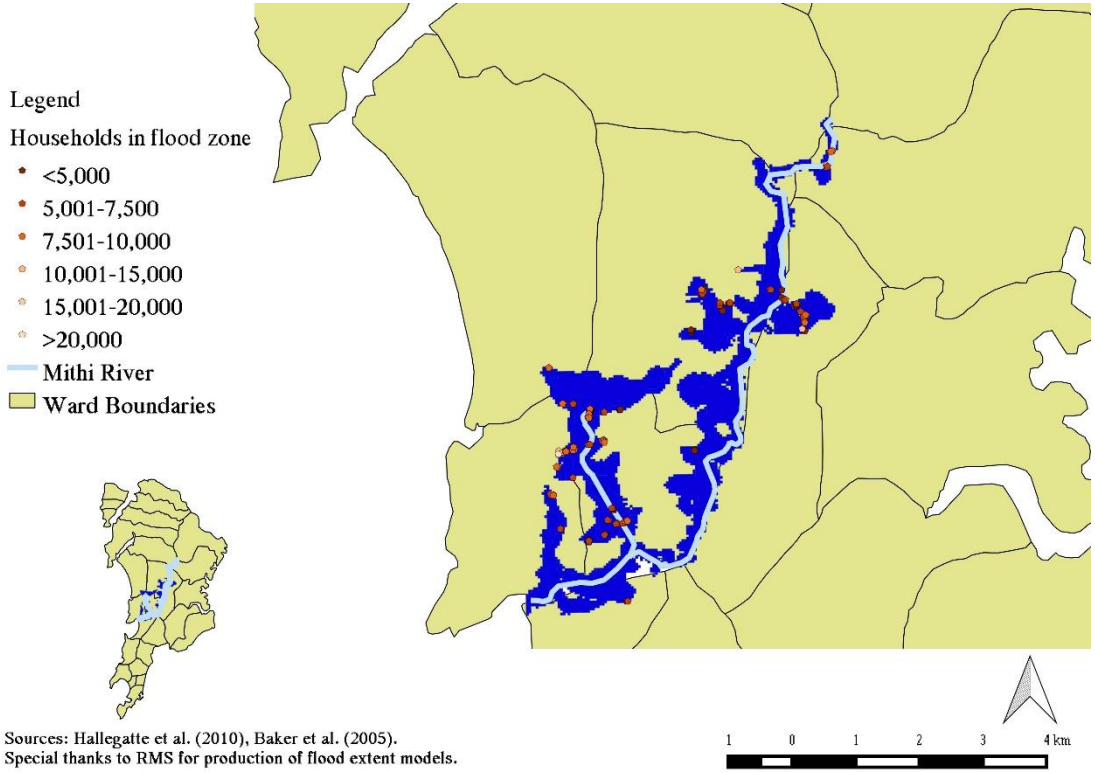


Exposure to floods

Ward	total area in sq. km.	Population	Slum population	Slum population as % of total	Area for residential use in sq. km.	Residential density per sq. km.	No of flood spots		Total vulnerable population	% of ward population	Slum population near flood spots	% of exposed slum population compared to total
							Chronic	Localized				
F South	9.79	360972	95200	26.4	2.34	154380	1	7	86071	23.84	11608	12.2
F North	12.28	529034	308400	58.3	4.03	131411	2	11	155812	29.45	19428	6.3
K East	23.96	823885	403800	49.0	6.85	120200	4	6	199391	24.20	36796	9.1
K West	24.55	748688	108800	14.5	8.25	90739	4	11	265892	35.51	25103	23.1
H East	12.42	557239	234800	42.1	2.83	197085	0	14	115309	20.69	38578	16.4
H West	9.03	307581	118500	38.5	4.22	72935	3	8	74409	24.19	10954	9.2
L Ward	15.68	902225	490400	54.4	5.45	165573	3	14	271945	30.14	106092	21.6
M West	17.4	411893	217200	52.7	3.92	105094	4	5	192586	46.76	67945	31.3
P North	46.72	941366	504500	53.6	10.27	91645	3	10	188593	20.03	40970	8.1

Exposure to large-scale (1/100-year RP) event in Mumbai

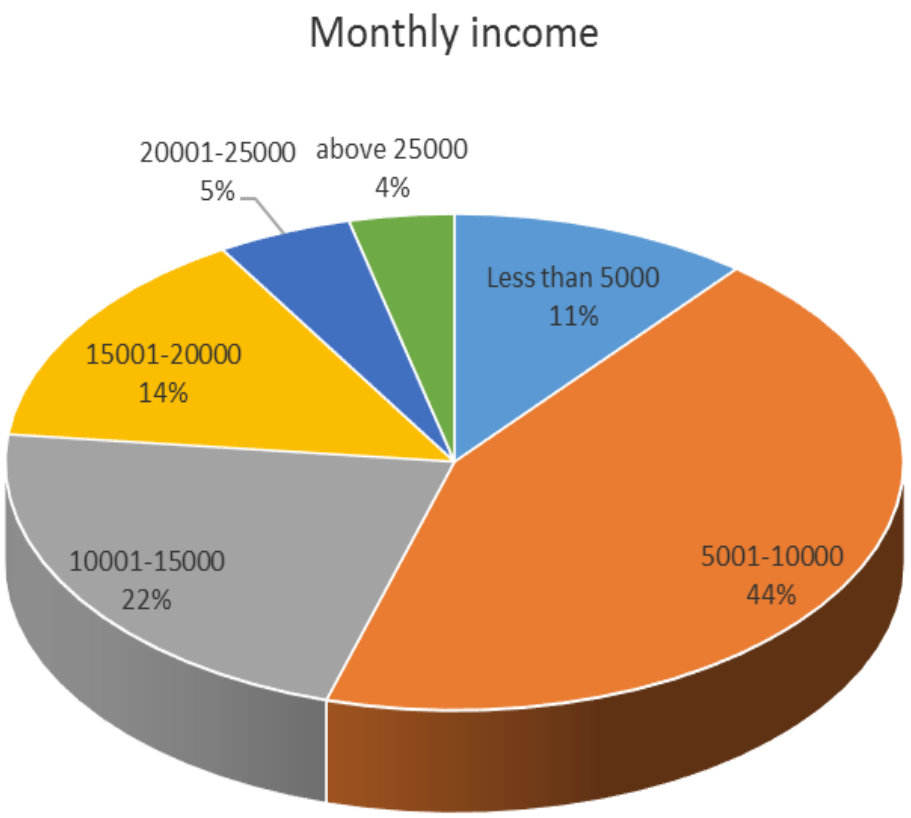
Household income (Rs./month)	Share of population in survey (%)	Share of population exposed (%)
<5000	24%	41%
5001–7500	28%	34%
7501–10000	23%	19%
10001–15000	12%	5%
15001–20000	6%	1%
>20000	6%	1%
	n=21,691	**n=930**



Notes: Flood risk data comes from maps of flood extent for a 1/100-year event based on historical records produced by RMS for Hallegatte et al. (2010) and Ranger et al. (2011) in a study funded by the OECD. Data on household coordinate location is from a 2003-04 survey by Baker et al. (2005) of 5,000 households in the Greater Mumbai Region; we extract a subset of households in the flood extent area.

Vulnerability and impacts

Vulnerability to recurrent floods



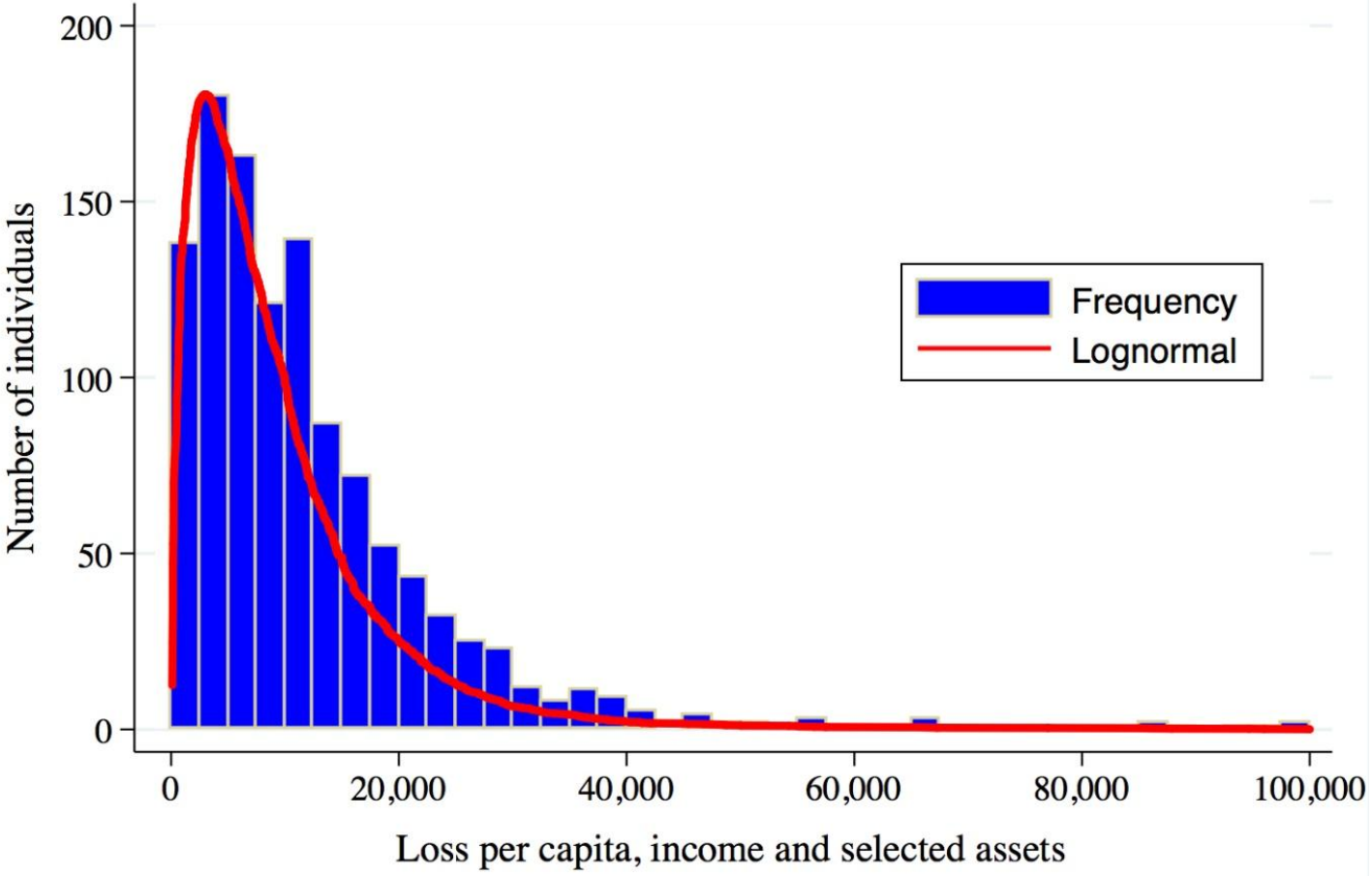
Poor HHs (Income<10000pm) = 55%
Non-poor HHs (Income>10000pm) = 45%

	% Poor HHs	% Non-poor HHs
Type of house		
Semi pucca	16.8	9.5
pucca	72.3	78.6
single storey	14.9	21.4
multi storey	5	34.5
Floods as stressor	65.3	79.8
Health impacts		
Malaria	72.3	63.1
Typhoid	36.6	35.7
Jaundice	28.7	22.6
Diarrhea	41.6	42.9

Estimates of uninsured average losses per HH

	K East	H East	F North	F South	L Ward	P North
(Figures in bracket as % of average household monthly income)						
Income loss due to floods	10474 (69.8)	8543 (57.0)	5164 (25.8)	8323 (41.6)	22578 (112.9)	14894 (74.5)
Amount spent on repair/rebuilding of house/premises	22270 (148.5)	26191 (174.6)	34335 (171.7)	42967 (214.8)	22457 (112.3)	27118 (135.6)
Losses due to damage to household appliances (TV, refrigerator, music system, desktop, laptop, washing machine, stove)	13190 (87.9)	15469 (103.1)	13442 (67.2)	10081 (50.4)	11325 (56.6)	23923 (119.6)
Losses on account of damage to household assets (Furniture and utensils)	9735 (64.9)	11061 (73.7)	11756 (58.8)	6602 (33.0)	7121 (35.6)	10417 (52.1)
Losses due to damages to vehicles (Car, Motorcycle, Bicycle)	12974 (86.5)	9153 (61.0)	11833 (59.2)	1250 (6.3)	5478 (27.4)	7232 (36.2)
Source: Calculations based on primary data						

Distributional impacts



Source: Patankar and Patwardhan (2014)

2005 Mumbai Floods, n=1144

Other impacts of floods in 2005

Problem	% among surveyed HHs
House flooded with water	70
Non-availability of local transportation	87
Price rise of essential commodities	67
Non-availability of food and other supplies	62
Disruption in communication services	61
Disruption of electricity	83
Non-availability of clean drinking water	75
House flooded with sewerage/garbage	80
Non-availability of fuel	51

Adaptive capacity - responding to floods

Responding to floods – Measures

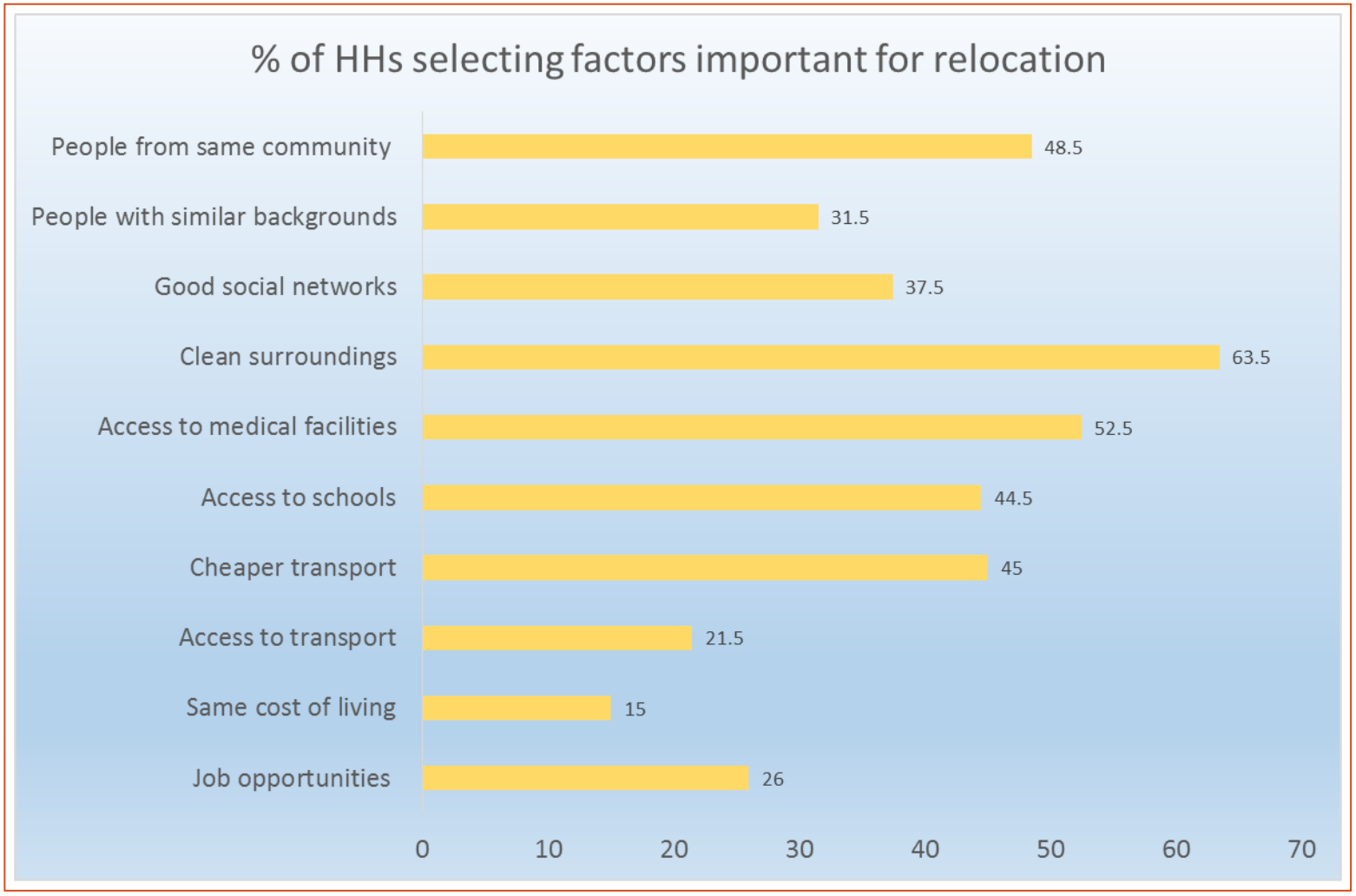
Measures taken by HHs	% of poor HHs	% of non-poor HHs	Cost (in Rs.)
Cleaning house surroundings	56.4	61.9	200
Cleaning nullah	48.5	53.6	200
Repairing roof	39.4	29.8	1300
Overhauling vehicle	5.9	4.8	600
Repairs inside house	26.7	15.5	800

Measures after 2005 floods	% of HHs
Increasing height of surrounding ground	42
Reconstruction of house with stilt parking	11
Repairing & elevating electrical meters	27
Repairs inside house to elevate furniture	31
Repairs inside house to elevate electronic gadgets	33
Repairing/ modifying toilets	11

Ability to respond

	Responses	% Poor HHs	% Non-poor HHs
Awareness of nearby shelter	Yes	10.9	4.8
	No	89.1	95.2
Do you receive flood warning	Yes	6.9	7.1
	No	92.1	92.9
Have you shifted to a shelter	Yes	11.2	6.0
	No	88.8	94.0
Whom do you contact when flood water rises	No one	75.2	83.3
	Disaster control room	2.0	2.4
	Ward office	--	1.2
	Local corporator	22.8	13.1
Source of loan after flood event	Family and friends	40.6	41.7
	Informal money lender	5.0	4.8
	Bank	36.6	44.0
	Microfinance or NGO	--	2.4
	Government	2.0	1.2

Relocation as an option



Policy implications

- Poor and households with low incomes more vulnerable given poor resource base and limited ability to cope
- Local government needs to be more responsive to their needs
- Important actions suggested by HHs - Clean gutters/nullahs regularly, Stop encroachment, Stop dumping garbage on streets, Ban use of plastic bags
- Multiple govt./planning authorities within city hinder effective decision-making – poor coordination and overlapping jurisdictions– urgent need to have coordinated efforts to tackle recurrent floods
- For relocation to work as a possible option, authorities have to consider preferences and priorities of HHs

Conclusions

- Households living in informal settlements or old, dilapidated housing most vulnerable to floods
- High exposure of poor people in the chronic and localized flood spots
- Poor suffer losses beyond their means during floods and have low adaptive capacity
- They suffer uninsured losses putting tremendous monetary burden on them
- The ability to respond to recurrent floods is restricted by resources at their disposal, lack of training, no early warning system and no government assistance
- Well directed adaptation efforts required to minimize the burden on the poor

Thank you

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