

KNOWLEDGE BRIEF

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Pan Asia
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Fellowship Program

Flood Risk Vulnerability of Peri-urban Communities: The Case of Surat

By: Aparna

INTRODUCTION

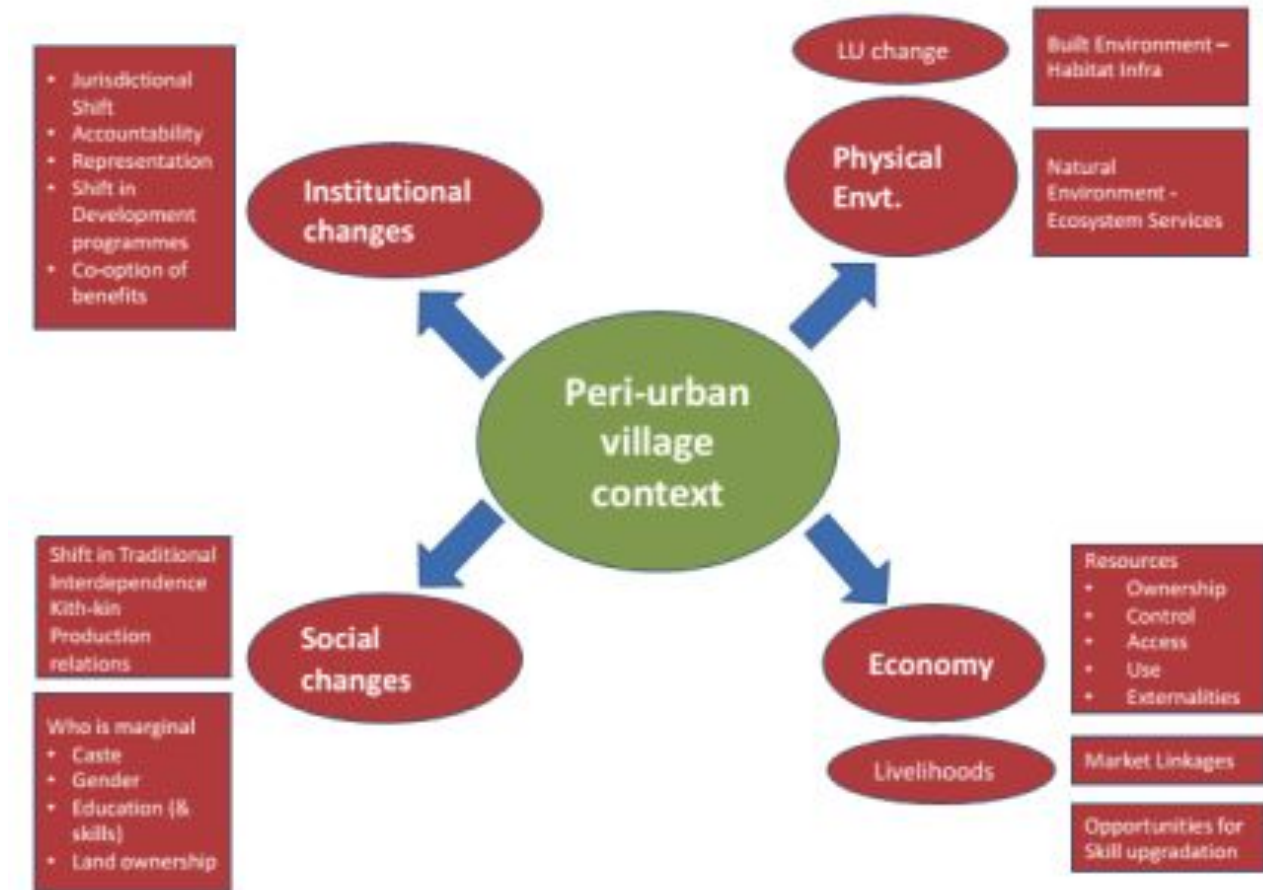
Surat, situated on the western coast of India, is one of the fastest growing cities in the country, with a population of 4.5 million as per the last census (2011). Historically, the city has experienced fluctuations in its population growth rate. Its average decadal population growth rate was 73% over the past five decades, increasing to 83.5% between 2001 and 2011 (Census 2011). Surat's economy is driven by several small-, medium- and large-scale manufacturing and infrastructure-based industries, such as textiles, diamond processing, chemicals, petrochemicals and ports. In addition, the district has a highly productive agrarian economy owing to its perennial water resources and high rainfall. The growing population, industrialization and active agricultural sector in Surat have resulted in contested resources, such as land and water.

The city is situated along the Tapi River, which has historically experienced frequent flooding during the monsoon season. According to the Disaster Management Plan of Surat (SMC, 2014), Surat has experienced 10 heavy floods

in the nineteenth century and more than 20 in the twentieth century. There have been nearly 17 floods since 1947 (post-independence), five of which were severe. After the major floods of 1968, a twin dam-reservoir system, known as Ukai-Kakrapar, was introduced around 80km upstream on the Tapi River, with its primary roles being irrigation and power generation, and its secondary role being flood control. The next two decades did not see any major floods in the areas downstream of the Ukai dam; however, in 1994, 1998 and 2006 major floods occurred, leading to significant human life, economic and social losses. The 2006 floods are considered the most devastating in the city's recent history with respect to the extent of directly affected areas: 75% of the city was inundated, with flooding stretching beyond the city's borders.

Now that a new end-to-end early warning system for flooding is in place (courtesy of the Rockefeller Foundation's Asian Cities Climate Change Resilient Network programme), the city appears to be better prepared in the short-

Figure 2 Parameters at play in a peri-urban context



revealing the coping mechanisms and adaptation strategies being used. Figure 2 presents the peri-urban context for the study.

1.2 Research Approach

The study identified four peri-urban villages around Surat, which were affected during the last major floods in 2006, when around 75% of the city area was submerged. The criteria for village selection were comprised of a combination of spatial, demographic and administrative indicators. Maps were procured from the irrigation department and the City Development Plan of Surat, showing the extent of flooding (Figure 3). Satellite imagery for Surat, showing LECZ areas, was used to identify low-lying peri-urban villages¹ (Figure 4). An important

1 Two villages are in the LECZ; the third one is at a higher elevation (above the LECZ), but bounded by the river, and therefore, has witnessed frequent inundation; the fourth village is up-

stream of Surat at a still higher elevation, however, it is in a low lying area surrounded by a tidal creek and a river.

2 While the City of Surat is governed by the Surat Municipal Corporation (SMC), other urban areas fall under the jurisdiction of town municipalities or even notified industrial areas. The Surat Urban Development Authority (SUDA) is a parastatal body constituted under the state or provincial government act. It prepares future development plans for the area beyond corporation boundaries. For the villages that are under the jurisdiction of SUDA, their tax revenue is managed by a three-tier panchayat administration, consisting of the district panchayat, taluka panchayat and village panchayat. Unless land development schemes have been announced for villages under SUDA jurisdiction, their services such as water supply, road networks, and drainage, are also overseen by the panchayat administration. For this study, two villages under SMC jurisdiction and two under panchayat administration jurisdiction, were chosen.

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Figure 3 Flooding in Surat Municipal Corporation (SMC) areas in 2006, outer boundary demarcates Surat Urban Development Authority (SUDA) limits (Source: Surat CDP 2006-12)

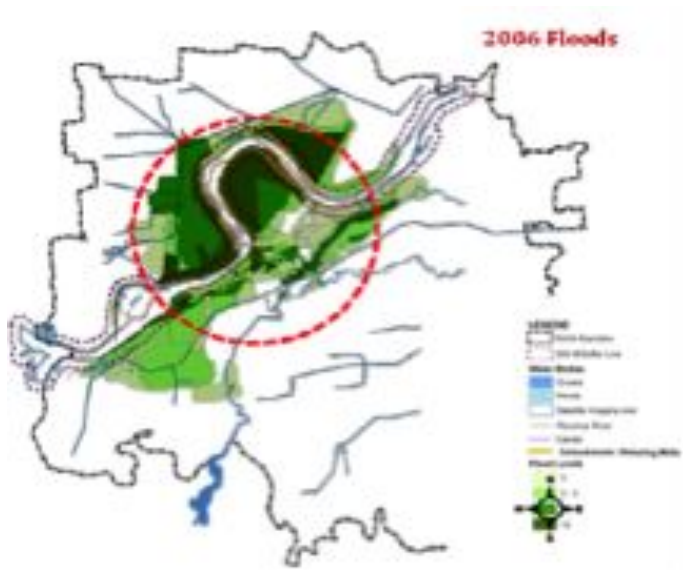


Figure 4 LECZ areas in Surat with study villages (Source: Karanth and Archer, 2014)

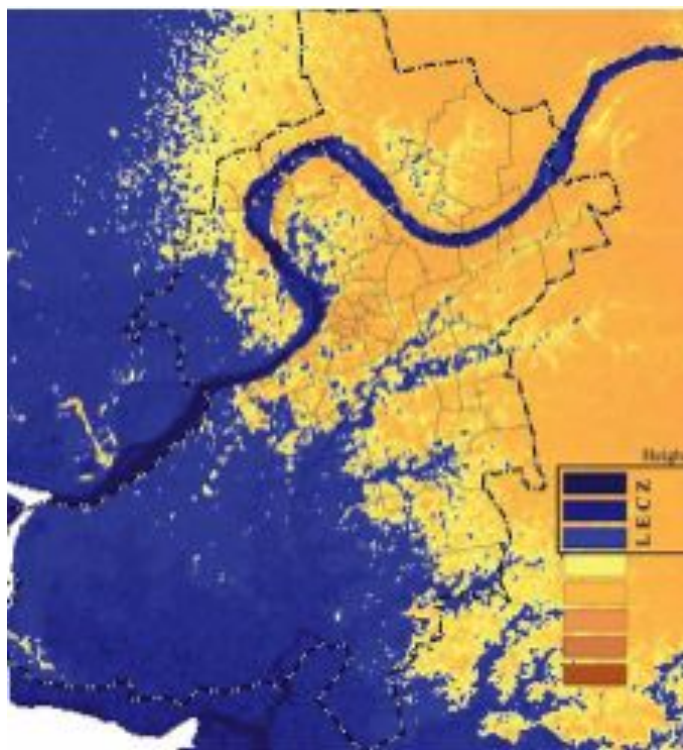


Figure 5 The four study villages on Google Earth (Source: Google Earth)



the village settlement (footprint); and 2) farmland and limited urban sprawl based on Google Earth satellite imagery (Figure 5). Highly urbanized and industrialized areas were avoided, as were the villages with a sex ratio equal to or lower than 757 (females per thousand males), which is the urban sex ratio for Surat as per Census 2011. Both of these factors indicate a high male migrant population.³

A structured survey was distributed to 216 households, spread across the four villages. Around one-third of the households sampled had female respondents. The questionnaire was framed around the situation regarding livelihoods and institutions in the villages before and after the 2006 flood. Parameters covered included description of losses, the process of recovery, coping mechanisms, assistance received, and present living conditions and adaptation strategies. Interviews were also conducted with academic experts and officials from relevant departments.

2. RESULTS OVERVIEW AND DISCUSSION

The four study villages had mixed populations of Scheduled Tribes (ST), Scheduled Castes (SC), Other Backward Classes (OCB), and the General

³ This was done to reduce the complexity of not only identifying and profiling the migrants who were present during 2006 floods, but also to determine the village-level dynamics and socio-economic transitions.

Table 1 Characteristics of the four study villages (shown in Figures 3 & 4)

No.	Village	Administrative Jurisdiction	Zone / Direction	Household Population	Proximity to the Tapi River	Elevation Range (above mean sea level)
1	Moti Ved	In SMC since 1980 (urban)	North Zone	600 (approx)	Riverside	14-17 m
2	Bhimrad	In SMC since 2006 - notified just before floods (urban)	South East Zone	255 (approx)	Inland	5-10 m
3	Bhesan	Chorashi Taluka panchayat (rural)	West	449	Inland	7-12 m
4	Abrama	Kamrej Taluka panchayat (rural)	East	603	Riverside	15-20 m

Population⁴. Out of the four study villages, while Abrama is the farthest village from Surat city, Bhimrad is located upstream on the Tapi River, and is at the highest elevation level.

2.1 Livelihoods

The work force participation rate was found to be 45% overall. The highest work force participation rate is among the Scheduled Tribes, at 54%, followed by the Scheduled Castes at 48%, the Other Backward Classes at 42%, and the General Population at 37%. The villages had a range of livelihoods, which for the purposes of this study, have been categorized as cultivation, agricultural labour, animal husbandry, non-farm wage labour, non-farm self-employment, and trade. Land ownership is an important determinant of economic status in the rural areas. Urban villages recorded

much lower land ownership and cultivation than the rural villages. It became evident during discussions that land-based livelihoods, such as farming, had seen a significant change. However, it appeared to be more on account of rural to urban transition, resulting in access to urban jobs and competitive land use changes, rather than flood related causes. Very few households discussed land-based livelihood changes openly. Many farming and land owning households were extremely cautious in sharing details, as land transactions were common.

Sugarcane, followed by rice and vegetables were the primary agricultural products in the study villages. As the irrigation prospects of the region have grown over past decades due to large dams, sugar factories and contract farming have also taken on prominence. Moti Ved grows mainly vegetable crops and pulses,

⁴ SC and ST are the caste, race and tribal groups that have been historically marginalized and disadvantaged since pre-colonial times and designated as such by the Constitution through articles 341 and 342 respectively. OBC, also designated by article 340 of the constitution, lists the groups socially and educationally backward other than SC and ST. Lists of such community groups are notified as per the specific states (or provincial governments) and they qualify for affirmative action with special resources allocated in the form of schemes and welfare programmes. South Gujarat region, where Surat is situated, has a significant proportion of ST. Groups other than these are known as the General Population, or forward castes, whose definition again varies from state to state. The forward castes are often found to be in better social and economic situations.

Figure 6

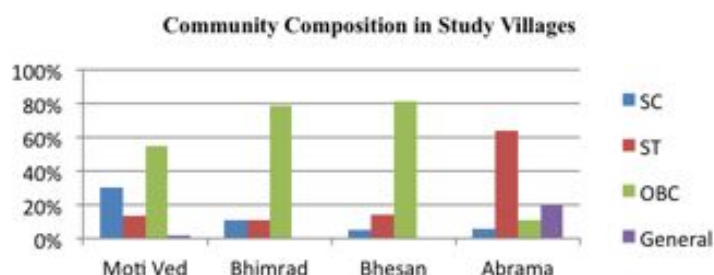


Table 2 Primary Sources of Household Income in Study Villages (in %)

	Moti Ved	Bhimrad	Bhesan	Abrama
Cultivation	6.7	18.9	51.6	16.4
Animal Husbandry	1.7	0.0	0.0	5.5
Farm labour	6.7	0.0	17.2	43.6
Non-farm wage labour	3.3	0.0	1.6	3.6
Non-farm self-employment	16.7	29.7	17.2	5.5
Regular Employment	55.0	32.4	9.4	10.9
Trade	10.0	18.9	3.1	14.5

while Bhimrad has only a small patch of farmland left, which has banana plantations. Bhesan village has had a sewage treatment plant since 1995, and its treated water is used to irrigate vegetable crops. The village farmers also reported cropping sugarcane and rice paddy in the northern parts of the village. Abrama has mostly sugarcane and rice paddy plantations. All of the villages, except for Moti Ved, had farmers report the selling of village farmland in the last decade, and replacement with new land purchased 15 to 20km away.

Employment data shows that nearly 66% of households from the Scheduled Tribes derive their primary source of income from agricultural labour, while nearly 46% of the Scheduled Caste households have regular employment, and 75% of the General Population and 35% of the Other Backward Classes are cultivators.

2.1.1 Women

A unique characteristic of the study villages was the above average number of female-headed households. The average percentage of female-headed households in rural Gujarat was found to be 10-11%; however, this percentage was found to be 18% for the sampled households. The percentage of female-headed households ranged from 7% in Abrama to 31% in Bhesan.

From the survey, 61% of males reported being engaged in economically productive work, and 28% of females reported engagement in wage labour. All of the villages, except for Bhimrad, had women working as

piece rated workers in the textile sector. These women were mostly from middle and upper income groups, with very few being from the Halpati community.

2.2 The flood

2.2.1 Source of the Flood and Early Warning

A majority of the sampled households were aware of the original source of the 2006 floods, which was a substantial release from the Ukai dam into the Tapi River. However, when asked to identify the source of the flood, a variety of responses were received, with 56% of respondents attributing the flood to the river or the dam; 28% to creeks, canals and poor city drainage; and 14% to the overflow from city areas. Interestingly, the riverside villages (Moti Ved and Abrama) exhibited the highest level of awareness, with nearly 82% of the households attributing the flood to the river and the dam. Conversely, 85% of households in inland villages (Bhimrad and Bhesan) attributed the flooding to creeks, canals, gutters, and the city areas. Overall, around 7% of the households from Moti Ved, Abrama, and Bhesan reported inundation due to breaches made to the river embankments, in order to avoid further flooding of the city.

Respondents were asked how they were notified and received information about the advancing floods. While a majority (58%) reported that their neighbours had informed them, 19% mentioned learning of the impending flood through various media sources (e.g. telephone/cellphone, television, radio, and newspapers). Another 12% stated that they

could see the river rising due to their village being located along the riverbanks, and some also stated that since the river was prone to flooding during the monsoon season, the flood was not unexpected. A discrepancy was noticed in responses to this question from urban and rural respondents. Responses from rural respondents indicate that they receive most flood warning and information from other villagers and neighbours. Responses from urban respondents indicate that they also receive information via various media sources.

2.2.2 Physical Impact of the Flood

The study villages present a range of flood impacts, recovery processes and adaptation strategies. Moti Ved and Bhesan were the worst affected villages with respect to the percentage of houses inundated and damaged. The most directly impacted in Abrama and Bhimrad were those from the Scheduled Tribe hamlets, whose settlements were concentrated in low-lying areas. More than 75% of the sampled households reported that their homes were inundated. Generally speaking, compared to urban households, the rural households appeared to have experienced greater losses. Of the rural households, Scheduled Tribe communities, followed by Scheduled Caste and Other Backward Caste communities, seemed to be the worst hit (refer to figure 7). These households tend to be perpetually impoverished, with respondents suggesting that the flood did not change their lives much:

“What did we have to lose, we just ran to save our lives... we still live hand to mouth...” – several respondents

Table 3 Percentage of households affected by floods in terms of:

Food grain supply	55.1%
Other food supply	57.9%
Cooking fuel	48.1%
Drinking water	64.4%
Water for domestic use	68.5%
Access to toilets	65.8%

from agricultural labour-based households gave this statement.

The 2006 flood resulted in complete destruction of several houses made of temporary materials, mainly those with earthen walls and clay tile roofs, while those with permanent construction had much of their furniture and belongings either washed away or damaged.

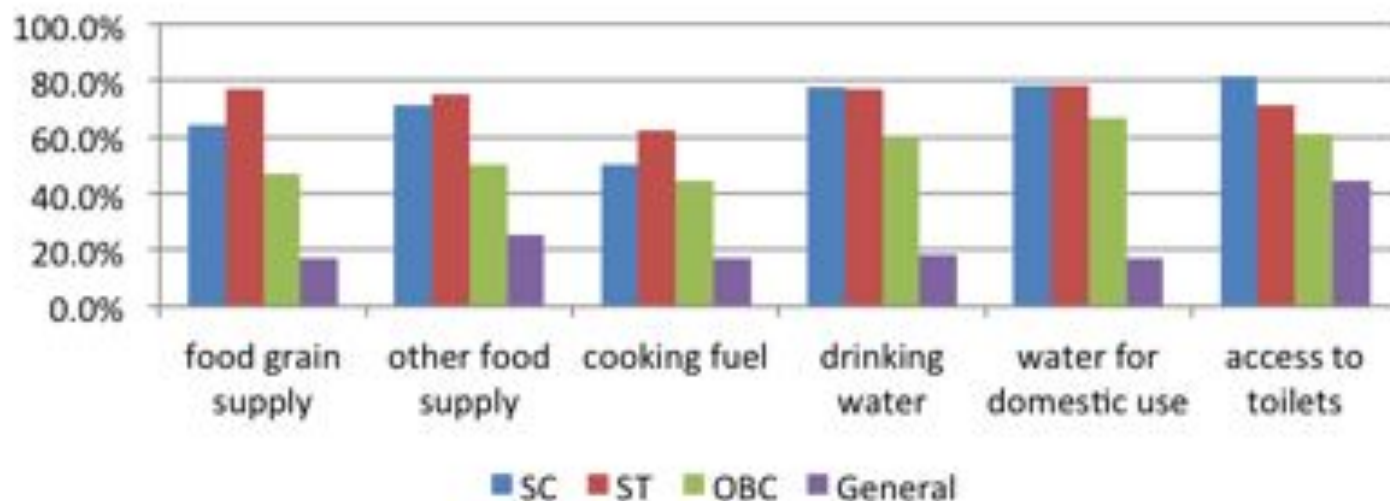
Food and water supplies were severely disrupted in the villages, as were other services such as sanitation, transportation, power supply and communication, for three days, to months for some respondents.

Some households reported going without food for three to four days, eating little to avoid having to visit a toilet, and even rationing limited drinking water for the children as well. Some had to resort to using flood water as drinking water due to disrupted water supply networks. A significant proportion of low-income households reported using floodwater to wash and clean.

Overall, 73% of the 216 sampled households reported that the flood affected their houses. Of those reporting an impact to their house, nearly one-third reported that their entire house was submerged, and a majority of these claimed more than three months of recovery time. Importantly, the government provided Scheduled Tribe households with emergency shelter and monetary assistance, as well as help with house reconstruction, while the other groups relied on neighbours and relatives.

Many respondents found it difficult to talk about their losses, especially those related to valuables. The timing of the survey was questioned as the respondents said that nobody spoke to them after the 2006 flood. Some also confused the 2006 flood with the recent urban flooding in 2013⁵.

⁵ There were reports of flooding in 2013 in the urban areas, which had not caused inundation in the rural areas. A few houses in the Halpati hamlet of Bhimrad reported one foot-deep waterlogging that cleared in half a day. The year 2013 has been re-

Figure 7 Percentage affected by each type of flood impact

“We don’t want to remember and talk about it; we would not be able to sleep (thinking about the losses)” – said a woman respondent when asked about valuables lost in the floods.

“Which floods are you talking about, there have been so many... it’s difficult to fall and stand so many times... sometimes there are riots, sometimes floods” – an elderly woman when she related the damage and losses over the years due to disasters, including riots and floods.

Deaths and serious injuries were also reported by the sample households due to the flood and lack of immediate medical attention. In addition, the monsoon season had triggered a wave of chikangunya disease even before the onset of flooding in Bhesan. Several respondents reported extreme fatigue due to flood recovery operations; others cited chikangunya as the reason for exhaustion, while many reported prolonged respiratory troubles, such as asthma, triggered by the flood.

Immediate relief largely depended upon economic status, as well as social networks. Poor households still have not obtained the same quality of shelter

they had prior to the 2006 flood. Damaged walls, broken roofs and toilets, abandoned structures, and destroyed furniture across the villages stand testament to the aftermath of the 2006 flood (Photographs 4, 6, 12). It was observed during the field visit that there were several houses with broken walls and makeshift arrangements being used almost a decade after the flood (Photograph 13).

2.2.3 Disaster Relief and Coping Strategies

Almost all the affected households cited their neighbours as an immediate source of assistance and support, followed by relatives from other villages. Higher income families often prepared food for lower income families as community service. Shelter was provided by the neighbours, and high-income villagers, and at the village temple and schools (except for in Bhesan, where the government primary school was inundated from being in a low-lying area). ‘Sheths’ – large-scale farmers employing agricultural labourers – reportedly provided shelter to three to seven households, in some cases for up to 15 days, with one household reportedly housing 35 individuals for more than a week. Three households reported that they were hosted by family and neighbours for up to one year, while their own shelter was under repair or construction. Some households also reported staying on their own or others’ terraces without any cover.

corded as a flood year in the Disaster Management Plan of Surat (SMC, 2014).

After the 2006 flood, it was reported that assistance and relief materials were sent to Surat from the adjacent villages. However, based on this study's findings, it appears that there was a two-way flow of resources between the city and the villages through social networks. The source of assistance was quoted as most often being the parents and siblings of the women in the household. Most of the sampled households also acknowledged the role of local village sarpanchs in setting up community kitchens and finding shelter for the households. Urban villages recognized the role of the city administration in quickly organizing cleaning operations, restoring services, and minimizing epidemic breakouts. Cash doles, ranging from Rs.500 to Rs.10000, were given to the affected households in all of the villages by the government, one to four weeks after the floods.

Those living on the margins of the villages reported that they barely received any relief from the government, and mostly depended upon their neighbours. There were fights over relief material, while some households also complained of bias in distribution of cash assistance and relief material. Most of the time, the better off households passed relief assistance along to the poor and vulnerable. However, there were also a few households—all Scheduled Tribes in Moti Ved and Abrama—who reported that the powerful groups in the village denied them relief material. One woman from a household of agricultural labourers in Moti Ved reported:

“Rich villagers who stay in the colony across the road were asking those who came to assist with food, water and utensils that nobody in the village required help and they should go back... we overheard them.”

It is unclear how much assistance reached the most impoverished households, or what the long-term effects of any assistance are. It is important to mention that several farm labourers reported cleaning up the farmers' and elite villagers' houses for days after the floods in return for food and shelter. These findings correspond to literature on the community dynamics in relief distribution and disaster rehabilitation and

do not necessarily indicate any long-term benefit for the marginalized (Pelling, 2003 and World Disaster Report, 2014).

2.2.4 Impact of the Flood on Livelihoods

The households were asked about the impact of the flood on their livelihoods. Here, mainly four livelihoods are presented: livestock rearing, fishing, cultivation and farm labour.

2.2.4.1 Livestock owners

During the flood, households resorted to measures ranging from tying the cattle at raised areas like railway tracks or canal embankments, keeping them in neighbours' or relatives' houses, or untethering the animals so that they could find higher ground on their own. There was a significant decline in livestock immediately after the flood in Bhesan. During group discussions, several households reported stopping engagement in animal husbandry after experiencing loss of their animals in the 2006 flood. A lack of dairy farmers and cattle sheds in most of the newly build houses was observed during the fieldwork. Some households expressed losing heart after seeing their cattle die by drowning or catching serious infections.

“Had bought buffaloes two months before floods as a means to support my widow daughter and her children... could not bear to see the animal die in front of my eyes... stopped rearing any since.” – said a woman in Bhesan.

There were also observed shifts in livelihood activities as a result of the flood. For example, a goat herder who lost his entire flock of around 20 goats to the flood, became a farm labourer for many years, and only two years ago was able to start herding goats again on contract for another goat farmer (Photograph 11).

2.2.4.2 Cultivation and farm labour

Small and medium-scale farmers who grew vegetables, rice and pulses were the worst affected. Sugarcane farmers fared the best due to its harvesting period occurring three times per year and it being a natural water-intensive crop. Sugarcane farmers plant

strategically so that they may harvest a sugarcane crop almost continuously. Therefore, for the most part only the recently planted sugarcane was damaged by the inundation. Sugarcane has emerged as a profitable crop that is more resilient to floods than other crops.

Non-sugarcane crops in the fields were damaged and the land had to be prepared for sowing again, after waiting for a month for the floodwaters receded. Some households also reported needing to aggressively weed for months after the flood due to the deposition of seeds by the floodwaters and silt. It was reported that water coming from the Tapi River, south of Bhesan, rendered farmlands saline as a result of proximity to the Tapi estuary, while the land north of Bhesan became more fertile for a year from fresh water that overflowed from the canal.

Farm labourers reportedly found it difficult to find farm work for at least one month, until the fields were drained and ready for another planting cycle. However, many of them were engaged by the rich farmers and homeowners to clean their houses after the flood, often in return for shelter and food.

2.2.4.3 Fishing

Scheduled Tribe households in Abrama engaged in subsistence river fishing during lean agricultural seasons prior to the 2006 flood, but they lost their boats and equipment in the flood and have not been able to replace them (Photograph 14). Some of these fishermen have taken up casual labour jobs, while others now depend upon contract fishing with hired boats. Competition from migrant fishermen has increased, and communities also claim far reduced fish catch due to increased pollution and effluent discharge by industry over the past decade.

2.2.4.4 Other

Those who were working in the city as wage labour or were self-employed, were unable to commute into the city for one to two weeks. Some business owners reported needing to close their businesses permanently after assets (shops, vehicles, equipment, etc.) were lost or damaged in the flood. Food sellers reported heavy

losses not just owing to inundation of their shops, but also due to vandalism and theft by families looking for food and other necessities.

2.2.5 Effects of Urbanization

2.2.5.1 Livelihoods

The increase in sugarcane plantations has had a negative effect on local farm labourers, as plantations frequently bring in migrant workers for harvesting periods. The Scheduled Tribes have been the most affected by this, as they are the most impoverished



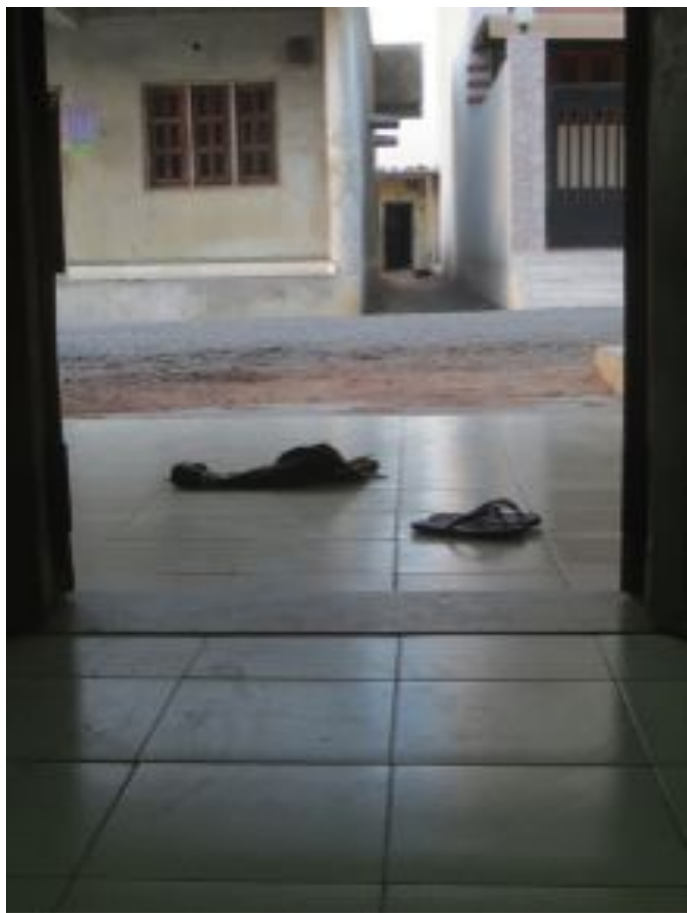
Photograph 1: Bhimrad main village (red circle) separated from the Halpati settlement (yellow circle) by new residential and commercial developments in the city



Photograph 2: A garbage collection box at the entry to Halpati settlement with mud houses showing urban development in the background at Bhimrad village

groups and lack education and skills for alternative sources of employment. There appears to be an erosion of traditional farmer-labourer interdependence, which has been a survival strategy for labourers, although, as noted by Breman (1985), this relationship has not helped the poor households to lift themselves out of poverty. Nearly 86% of the individual workers who were farm labourers in 2006 are still labourers, while the rest have moved to non-farm wage labour, regular employment, farming, and trade. Non-farm wage labour is irregular informal work available only seasonally, such as casual cleaning jobs held mostly by women and children from poor households. Men refuse to do this work and often remain unemployed. As mentioned earlier, women were also often engaged in 'piece-rated' textile finishing work.

Households whose subsistence directly depends on use of natural resources have not fared well in the rural to urban transition. Land is privately held and the rivers are poorly regulated and managed by the government. Communities have gradually become marginalized over the course of urbanization. One example is the Halpati vaas in Bhimrad—a small hamlet of 25 to 30 Scheduled Caste, Scheduled Tribe and Other Backward Classes households—continuing to live on the margins of the village, now surrounded by residential apartments. The city's urban development now stretches to the village (Photographs 1 and 2).



Photograph 3: Front porch of a house in Halpati Settlement, Bhimrad at the same level as road that has been raised during repair works; Cement bags are kept every year to avoid water entering the house during rains



Photograph 4: Toilet doors in a house damaged during 2006 floods and still being used in the same state at Moti Ved



Photograph 5: A newly constructed house with raised plinth and terrace (yet to be completed and occupied) adjacent to the older house affected by 2006 floods at Moti Ved

2.2.5.2 Basic Services

Further, while there is reportedly a sewer drainage system in place in these villages, it is up to the individual households to connect their waste-water disposal system to the main drainage system. It was observed that the poorest families often do not prioritize toilet construction and connection of drainage and resort to open defecation (this explains the relatively lower incidence of flood impacts on toilets for Schedule Tribe and Scheduled Caste communities in figure 6). In all of the poor hamlets where some households confirmed that they had drainage connections, closer examination found that sewage was being disposed of in septic tanks, while the grey water was being disposed of in open drains that flow into the rivers and creeks (Photograph 9). This incomplete sewage disposal contributes to the spread of diseases; not surprisingly, Bhesan reported a chikangunya epidemic just before the floods owing to this improper waste disposal. Floods causing the polluted creeks and rivers to overflow magnify the threat of disease.

2.2.6 Adaptation Strategies

At the city level, as part of the flood adaptation strategy, the SMC and the state department have invested heavily in a flood embankment scheme and sluice gate self-regulating systems all along the river. The embankment construction is being carried out in



Photograph 6: Plastic sheets being as partition between the two neighbouring houses after the wall broke down in 2006 floods at Moti Ved

phases and requires regular upgrading.

Another high profile intervention is that of an end-to-end early warning system with SMS-based end user warning that includes basin management through monitoring and assessment of rainfall, and reservoir inflows and discharge. As of now, the end user group includes those living within the SMC's jurisdiction. Furthermore, the Tapi River basin has a large catchment area (nearly 65,145 km²), spread across three states, and although there are 50 weather stations in the basin, there may still be areas that are not covered. Moreover, these interventions do not mitigate the possibility of a high tide coinciding with high rainfall in the catchment (Bhat et al, 2013), especially with the limited absorptive capacity of the river, which already suffers from rapid siltation (Haynes, 2012; Campbell, 1877).

One of the most important adaptation measures at the city-scale would then be to protect the flood plains and creek system. Studies have highlighted urban development infrastructure, such as bridges, rail embankments, and road networks that have altered the topography of the city (photograph 10) along with land reclamation from the sea for industrial development (Bhat et al; SCCT, 2007). Enhancing community, environmental, and livelihood resilience is also important.

2.2.6.1 Shelter and settlement in the study villages

The flood of 2006 resulted in changes to house construction. There were examples in all of the villages of houses under construction with much higher plinths, ceilings and upper floors, as compared to the older houses in the vicinity (photograph 5, 6 and 7). While having two or more floors to a house is common, building houses and apartment buildings on stilts is a new development. The ground floor is left open for parking or other uses. These adaptation measures, alongside the following, were taken by the better off households:

- Converting from traditional wood and clay tiled roofs to concrete houses



Photograph 7: Houses of brothers reconstructed after 1998 floods with only parking at the ground level, Bhesan village

- High raised plinths (some places four to six feet)
- At least two or three stories in the houses with high ceilings (14 to 15 feet in some cases)
- Ground floors were often used as parking spaces or storage rooms, and animal sheds were removed
- Addition of toilets on the upper floors

Resources for housing improvement

It was observed during the field visit that some households were in the process of refurbishing and reconstruction of their houses, almost a decade later and a few others expressed a desire to do home repairs in the future. However, these measures often require high capital investments and are affordable for only a few and are undertaken in stages.

Those who obtained credit for house repairs and construction reported banks as the source of nearly 27% of all loans. Other formal institutional credit has been mainly used for vehicles and livelihoods, such as livestock and medical. Acquiring of this credit has almost entirely been reported by the Other Backward Classes households, and is significant since banks have strict collateral requirements that can be met more easily by land owning households. No loans were reported in Abrama, although poor households in Abrama and Moti Ved reported being affected by a micro-finance scam. No General Population households reported taking any formal or informal credit, while all the Scheduled Tribe households who reported taking credit obtained it from their employers and relatives.

Status of housing for the vulnerable

After the 2006 flood, only in Abrama have the hamlets prone to flooding moved to alternate locations on higher ground, with support from the government. Also, houses have been provided to several of the poor households through the government housing schemes of Sardar Awas Yojana and Indira Awas Yojana. In other villages like Bhimrad, this change was brought about after earlier episodes of floods, mainly in 1968, albeit only a few individual households requested alternate land.



Photograph 8: Raised plinth (4'-6") of a house constructed after an earlier flood, in an elevated hamlet at Bhesan. Notice a deep empty hall on the ground floor of the house on right; The family lives on the first floor

Most of the low income households from different socio-ethnic backgrounds are still living in houses that are not ‘flood-proof,’ that is, made of temporary material, such as earthen walls, on low plinths almost at the road level (Photograph 3), sometimes devoid of floor finish, in low lying areas, and often without a toilet or waste water disposal facility. Importantly, almost all the Halpati settlements in the villages exhibited several of these characteristics.

2.2.6.2 Respondents’ Insights on Adaptation

All of the households were asked if any adaptation exercises had been led by external organizations after the flood and all households said no, that this was the first time any discussions on the flood had occurred and somebody had come to their villages to learn about the flood’s impacts. When asked about their preparedness for future floods, most of the households did not know what to do. Some women from the households stated the following:

“What adaptation strategies can we have, we would just run away to the village school” – a Halpati household talking about their adaptation strategy.

“If floods happen again, we would just go to seek help from the ‘Sheth’ (employer and farmer)... some of the days when there is no daily wage, we just go to them”



Photograph 9: A small creek carrying treated waste water from the sewage treatment plant in Bhesan is also used to dispose of the untreated waste water from homes; this water is used for irrigation.

– another Halpati household mentioning their future adaptation strategy.

However, there were some women from the community in Moti Ved, an urban village, who stated, *“if such calamity befell them again, nobody would come forward to help, ‘Sheths’ of the present generation are no longer such who would extend help. As such we get sporadic work from them”*.

Many households showed a sense of complacency against taking any adaptive measures since, *“the river embankments have been raised after 2006 and no more floods will come now.”*

On rare occasions, there were some, who also claimed, *“There would definitely be floods in the future... Surat floods every 3 years... Whether or not it will harm us is not sure but it will come.”*

After they related the horrors of flood, respondents were often asked if they were angry that they had to bear the brunt of floods in order to save the city, which was clearly given priority. The responses were found to be along the lines similar to the following statement:

“How can we think of ourselves only, would not the entire city sink, it is more important to save the city with



Photograph 10: A highway on one side of Bhesan at an elevated plane cutting off the village drainage from the lands on other side; at a railway track running parallel and higher than this road, animals were tethered to protect them from floods

so many people” – affected households from Moti Ved.

There was also a sharp observation by a wealthy woman from Abrama village, who questioned the logic of developing urban and industrial infrastructure in the low elevation areas around the river’s mouth. She said: *“although our village is at much height, we were affected due to floods in order to save the city... we all know the natural course of the river and the terrain, then why those areas are being developed.”*

3. CONCLUSIONS AND RECOMMENDATIONS

This study has helped to deepen understanding on the intersection of urbanization processes and flood disasters in peri-urban villages. While many villagers appreciated the roles played by the panchayat and the city administration in taking action to prevent epidemics and restore services after the flood, it was obvious that the worst losses were to households in the long term. Those living in single storied shelters or ones made out of temporary materials were deeply impacted. However, as these villages frequently experienced flood disasters, villagers were accustomed to helping each other; they even organized themselves and sent assistance for the city dwellers.



Photograph 12: A household kitchen at the edge of the Tapi River in Abrama; the riverbank erodes a little every year during monsoon



Photograph 11: A goat-rearer in Abrama who had lost his entire flock during 2006 floods and has re-started his work only recently by rearing someone else’s animals on lease



Photograph 13: A private river embankment, built from stone and concrete for INR 3.5 million, was destroyed during the 2006 flood at Abrama



Photograph 14: A Halpati fisherman who lost his boat and equipment during the 2006 flood, now depends on casual work on farms or occasionally contracting a local fish vendor's boat to fish

Female-headed households, small-scale farmers, daily wage labourer households, and livestock owners saw impacts to their livelihoods. Any kind of capacity building or awareness generation regarding flood risk and management appeared to be absent in the peri-urban villages studied. Key lessons learned are:

3.1 Working towards future resilience

1. In Surat, which is a rapidly growing city in an LECZ, the cost of damages from future floods will rise unless integrated adaptation measures are implemented. It is also evident that damage and loss assessment is confined to the urban areas. However, it is pertinent to account for such costs and losses beyond the city boundaries in city vulnerability assessments and resilience planning strategies.
2. Since Surat has made it into the 'smart city' programme of the Government of India⁶, it is important to include the surrounding villages in the disaster risk reduction strategies and resource allocations.
3. Building community resilience should emphasize:
 - a) exploring the role of social networks, especially

in transitioning urban-rural spaces; and b) extension of assistance to the most poor and marginalized.

4. Development and disaster resilience are related. A few points to consider are:
 - It is important to build toilets with drainage connections for the poorest households to ensure complete household coverage for sanitation and drainage.
 - As villagers lose community ties in the cities, maintaining social networks is important and could be done through capacity building by local administrative structures for multiple activities, combined with employment related programs and credit extension.
 - Surat does not have an active civil society base generating public discourse. However, it is home to several small, medium and large industries, which dominate even the social development sector through collaboration between the Confederation of Indian Industries (CII) and the multiple philanthropic trusts and small organizations. It is important that the private sector goes beyond giving relief after floods to strategically helping poor communities and settlements to reduce vulnerability through enhancing skills and human capital.

3.2 Disaster response and recovery

1. Continued reliance on fast eroding socio-economic relations, such as farmer-labourer interdependence, is not an effective strategy for dealing with future floods. Trainings and awareness generation are important not only for managing flood risk, but also for avoiding complacency in housing and settlement development by both individuals and village stakeholders, as well as for creating future adaptation strategies.
2. An important lesson from Bhesan is that government schools are important neutral spaces, especially for the poor households to set up shelter during emergency situations; therefore, it is necessary that they are built in safe locations and are appropriately designed.

⁶ <http://www.smartcitiesprojects.com/list-of-nominate-cities-developed-as-smart-cities-amrut-cities/>

Table 4 Matrix showing important study findings: Flood risk management and future adaptation strategies

	Food security	Water supply	Shelter	Livelihoods	Other services
Flood Impacts	<p>Stored grains washed away/ rot</p> <p>Disruption in access to market</p> <p>No availability of milk and vegetables</p> <p>Dry fuelwood difficult to find</p>	<p>Water supply damaged</p>	<p>Inundated</p> <p>Fully or partially damaged</p> <p>Loss of belongings and household items</p>	<p>Loss of livestock, fodder</p> <p>Loss of equipment such as fishing boats, farm equipment, vehicles</p> <p>Inundation of farm lands</p> <p>Unavailability of work for farm labours in medium term</p>	<p>Transportation and communication disrupted.</p> <p>Healthcare inaccessible for some, leading to casualties and deterioration in health</p> <p>Sanitation services disrupted – toilets as well as open fields (for open defecation) were inundated; this affected the women, elderly and disabled the most</p> <p>Power supply terminated temporarily</p>
Coping Mechanism	<p>Relief assistance</p> <p>Remained hungry for 3-4 days</p> <p>Spoilt furniture was used as fuelwood with the help of plastics and kerosene</p>	<p>Used stored water</p> <p>Harvested rain water after boiling/ without boiling</p> <p>Used flood water after boiling/ without boiling</p>	<p>Others gave shelter</p> <p>Took shelter at village school</p> <p>Went to the village temple</p>	<p>Took credit for regular expenses</p> <p>Poor households depended on their employers for loans and advances</p>	<p>Stayed at home</p> <p>Control on food and fluid consumption to reduce use of toilets</p> <p>Coped with darkness and kept watch against thefts</p>
Source of Assistance	<p>Neighbours</p> <p>From relations outside the village (neighbour's relatives)</p> <p>From the government (panchayat)</p> <p>From the government (air-dropped)</p>	<p>Neighbours</p> <p>Village community</p> <p>From relations outside the village (neighbour's relatives)</p> <p>From the government (air-dropped)</p>	<p>Neighbours</p> <p>Employers (Farmers, large homeowners)</p>	<p>Neighbours and relatives</p> <p>Local grocers</p> <p>Employers</p>	<p>Neighbours for access to toilets if at all</p> <p>Village community for access to any urgent services</p>

(Table continues on next page)

<p>Future Adaptation Strategy</p>	<p>Those who are better off store the grains on upper floors or lofts during monsoon Poor households live hand to mouth with no strategy except for taking help from the neighbours</p>	<p>Water supply systems installed in most of the hamlets House to house connections depend upon the individuals' means</p>	<p>New construction on high plinths/ stilt columns Two storied houses Ground floor left free of construction that could hinder flow of water Relocation of the most vulnerable households in the rural villages to safer locations</p>	<p>None stated</p>	<p>Toilet construction by those who did not have sanitation facility at home Connection with the drainage lines by households who can afford it Toilets being constructed on the upper floor as well <u>Government:</u> Flood embankments along the river and sluice gate regulators on the major creeks Relocating the most vulnerable to safer locations and construction of toilets</p>
<p>Remarks if any</p>	<p>Air-dropped relief material was often spoilt in the floods Injuries while people collected air-dropped material Villages sent consignments of food and other necessities for the affected areas of Surat city while many in the village reported getting material support from the outside</p>	<p>Most of the hamlets reported a better water supply system than before the floods However, poorer households could not get connections due to their inability to bring their own contribution</p>	<p>Some remote hamlets inhabited by vulnerable communities tend to be alienated as an outcome of urbanization Some households from vulnerable communities said they would go to their employers (mostly farmers) or the village school seeking shelter in the face of future floods Others, already witnessing shifts in livelihoods and production relations wondered if they could still seek help</p>	<p>Shift in livelihoods (impact of peri-urban transition too)</p> <ul style="list-style-type: none"> • Farm to non-farm • Farm labour to casual wage labour • Farming to service sector self-employment 	<p>Trainings and capacity building measures were not reported in any of the settlements for coping against and preventing future flood risks Many households suggested their settlements are entirely flood proof now due to the embankments, while few others mentioned with conviction that owing to the past trends and geographical location, the city will have floods; however, there seemed no answers for preparedness</p>

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AUTHOR ACKNOWLEDGEMENTS

This work would not have been possible without the support and inspiration received from many quarters. First of all, I am extremely grateful to START International Inc. for creating a platform like PARR Fellowship Programme. Next, I thank my Host and Home Institutions - CEPT University and Kyoto University respectively for all the support extended during this fellowship. I express deep gratitude to my supervisor Prof. R. Parthasarathy and mentors during the fellowship Prof. Rajib Shaw and Prof. Hassan Virji for important feedback and discussions. Also, I would like to thank Prof. Biswaroop Das for the insightful

deliberations. I am immensely thankful to the APN for funding my field work with follow-on research grants. From the field, I am deeply indebted to the villagers who agreed to interact with me and participated in the survey. I wish to thank Jaimin and Jigar for field assistance and Harish Joshi for translation and data collation support. This work would not have seen its current form without the editorial feedback from Niki West from START, Harish Joshi and Sheema Fatima. Finally, I truly appreciate Sarah Schweizer and the START team for all their support and patience.

We would like to acknowledge the collaboration of the PARR Alliance, a collection of science-focused, research, education and capacity building organizations that share a common goal and complementary track records for advancing resilience and sustainability in the Asia-Pacific. We appreciate the financial and administrative support of the Oscar M. Lopez Center (Philippines), Kyoto University (Japan), Manila Observatory (Philippines), National Science & Technology Center for Disaster Reduction (Taiwan), University of Philippines Los Baños, Thammasat University (Thailand), and START (USA). Finally, we recognize the financial support of Asia-Pacific Network for Global Change Research, the United States Global Change Research Program, and the International Centre of Excellence for Integrated Research on Disaster Risk (IRDR-Taiwan).

