

## Flood Risks Reduction in Livelihood Risks: Thoughts and Insights from Mumbai

Hirokazu TATANO and Subhajyoti SAMADDAR

### Synopsis

Mumbai, the financial capital of India, came to complete halt due to heavy rainfall in one day on 26th July, 2005. The severest affected areas of 2005 flood are the poorest section of the city who are forced to live in the most vulnerable parts of the city. More than 60 percent of Mumbai populations live in such vulnerable settlement or slum. Limited economic and social resources and capital often put their livelihood itself into risks. The conventional studies on disaster risk management seldom consider linkage between livelihood issues and disaster preparedness. In our study we hypothesize that local community flood risks are very much related with their livelihood issues. The present study shows the impact of flood on the livelihood risks of the slum dwellers of Mumbai and also it shows how the exiting livelihood risks impinge the disaster risks of the people.

**Keywords:** Mumbai flood, livelihood risks, integrated disaster risks management

### 1. Introduction and background of the problem

Mumbai city, having an area of 437 Sq. Km with a population of more than 12 million, is the financial capital of India. It generates about 5% of India's Gross Domestic Product (GDP) and contributes to over 25% of the country's tax revenues (Gupta, 2007). The average annual rainfall of Mumbai city is 2050mm. The monsoon rainfall starts from June and continues till October, however, 70% of the annually rainfall occurs during July and August. In July, 2005, the city came to complete halt owing to the unprecedented rainfall of 944 mm during the 24 hours (Fact Finding Committee, Govt. of Maharashtra, 2006; Bhagat et al., 2007). According to Municipal Corporation of Greater Mumbai (MCGM), at least 419 people were killed due to flash flood and landslide only in Mumbai municipal area; moreover, another 216 people were killed due to water born disease during and after the flood. It is reported that 100,000 residential and commercial building were collapsed,

30,000 vehicles were damaged, the entire railway system, telephone line were collapsed and more than 60 % of the city area were directly or partially affected (Shinde, 2010) due to 2005 flood as shown in Figure 1. The local Government, Municipal Corporation of Greater Mumbai (MCGM) became reactive and took counter measures in response to it, however, the city Government has realized that the Government needs to be proactive and also along with structural or engineering measures, the local government must emphasis and encourage individual and household disaster preparedness and local community's capacity building and resource mobilization (Shinde, 2010).

The severest affected areas of 2005 flood are the poorest section of the city that are forced to live in the most vulnerable parts including along the railway track, marshy land, open storm water drain ( Bhagat et al., 2007, Pai, 2010). More than 60 percent of Mumbai population lives in such vulnerable settlement or slum locally called as "Jhuggi - Jhopri" (Risbud, 2003). Such settlements are not only severely affected areas of 2005 flood,

but flood is a common annual phenomena along with other disaster risks. Yet limited economic and social resources and capital often put their livelihood itself into risks, for example, living in vulnerable land, engaged in hazardous occupation, unemployment and economic insecurity and illiteracy and poor health condition.

The conventional studies on disaster risk reduction and preparedness often consider disaster risk as an isolated event or in other words, the prescribed counter measures for disaster risks

reduction seldom consider linkage between livelihood issues and disaster preparedness. In our study we hypothesize that local community flood risks are very much related with their livelihood issues. We hypothesize that in order to reduce their disaster risks, livelihood risks must be minimized. Therefore, in our study we attempted to examine livelihood status of the communities and the impact of flood on it and vice-versa. The another major outcome of the present study is that till date there is no micro-level filed study has been done on

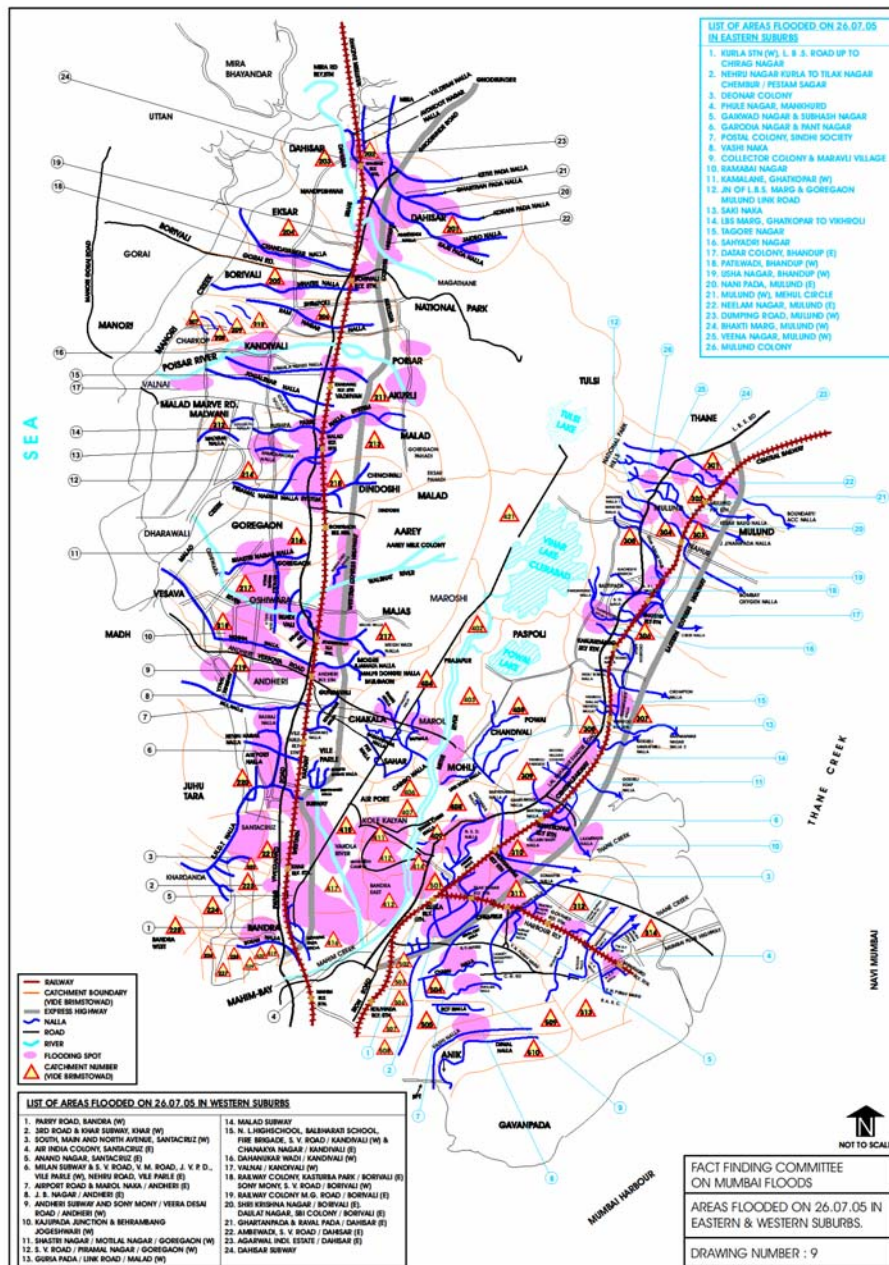


Fig. 1 Flood affected areas of Mumbai ( Fact Finding Committee, 2006)

Mumbai floods and its impact on the community, particularly on slum dwellers. Therefore, this study is also an attempt to collect baseline information on flood impact on the slum dwellers at micro hot-spot level in Mumbai. We have taken three flood prone settlements of Dharavi slum, the biggest slum of the Asia situated in Mithi river basin of Mumbai, as our case studies.

## 2. Methods

This study was conducted in three flood prone settlements of Dharavi slum at G/North Ward of Mumbai. All those three settlements, namely, Premnagar, Parsi-chawl and Rajiv Gandhi Nagar were taken as case study area based on the recommendation and suggestion of the field engineers and officers of G/North Ward, MCGM as those areas were designated as low lying and severely flood affected areas, particularly in 2005 Mumbai flood (Pai, 2010). A brief of each of the settlements are given in the next section of the paper.

Since, there is no baseline information or record on those settlements is available or documented by the local government or municipal authority, the study is predominately based on filed survey. In the study, we have collected data of these settlements on socio-economic profile, nature and growth of the settlements, status of physical infrastructure, in addition with extend and magnitude of 2005 flood and its impacts on the livelihoods of the people including job loss, loss of food, cloths, building materials, business raw materials, monetary loss etc. (mentioned preciously in next section) and also we have collected data on injury, death and health problem.

Primary data of the present survey were

collected by sample survey by conducting face to face structured and semi-structured interviews. The interviews were conducted by the hired surveyors who were oriented and trained for 3 days prior to the survey. In the orientation of the surveyors, the surveyors were explained about the purpose of the survey, each of the questions were interpreted and elaborated and mock surveys were conducted in order to get more accurate and reliable information. The head of the household was targeted for the interview, however, in case where head of the household were not available, the other member of the household was chosen as respondent. Apart from face to face structured interview, various other filed survey techniques were employed which include observation, unstructured interview of the local political and religious leaders, unstructured interview of the filed engineers, photography etc. Meeting with local leader also help to introduce the area prior to the in-depth survey. Population of the survey was selected randomly. Apart from the hired surveyors, the second author of this paper was also present in order to guide and monitor the filed survey.

Surveys have been conducted in 200 households in Premnagar, 203 households in Parsi-chawl and 208 households in Rajiv Gandhi Nagar. After the survey, all of the questioners sheet were scrutinized to verify the reliability, data-gap, and adequacy of information. After the scrutiny, 182, 203 and 208 household survey from Premnagar, Parsi-chawl and Rajiv Gandhi Nagar respectively were considered as final household sample. The survey was conducted during February and March, 2010.

Majority of the respondents in all three settlements are male members (see Table 1) as our study attempted to interview the head of the households who are mostly male members. In case

Table 1 Respondents at a glance

	Premnagar	Parsi-chawl	Rajiv Gandhi Nagar
Total Surveyed Respondent	200	203	208
Total Valid Respondent	182	202	208
Mean Age of Respondent	40	44	39
Gender (% of Male)	76	58	67
Literacy Rate (%)	76	90	62
Period of stay in the area (%)	22	33	15

of absence of the head, interview was taken from female member of the household. The mean age of the respondents in between 40 to 45 in all three settlements and a good number of them are literate, though the literacy rate of Rajiv Gandhi Nagar is comparatively low (see Table 1).

### 3. Results and Discussion

#### Settlement characteristics of the study areas

All three settlements comes under the Dharavi slum, the biggest slum of Asia, in the jurisdiction of G-North Ward considered as one of the flood prone area of Mumbai. A brief of all three settlements are given below in order to understand the causes, origin and nature of disaster and its impact on those areas –

*Premnagar* is famous for small scale industry, particularly for recycling factory. The settlement is low laying flood prone area very adjacent to the Mithi river. Mixed landuse (commercial and residential) can be observed in this area. Using ground floor for commercial activities and upper floor for residential use are very common in this area. Recycling factory is one of the most popular activities in Premnagar and such activity is responsible for generating garbage mostly thrown into the outfalls of Mithi River. Narrow streets, poor ventilation of building, hazards activities of the factory make the entire settlement prone to various kinds of environmental risks.

*Parsi-chawl* is also a low lying flood prone area.

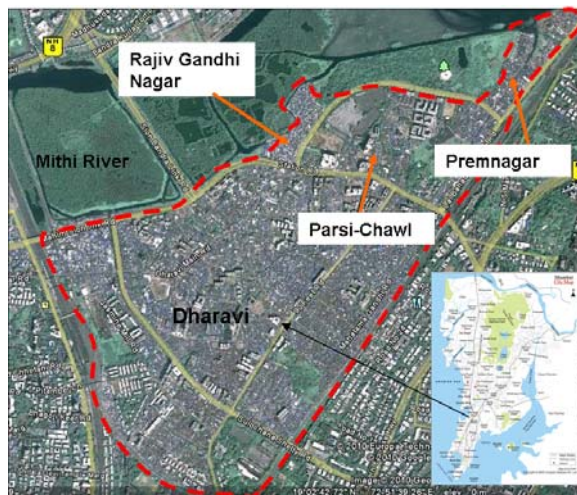


Fig. 2 : Dharavi slum and location of case-study areas

Apart from 2005 Mumbai flood, the water logging or local flood lasting for 1 to 2 hours in every monsoon is very common in the area. It is observed that the area is 4 feet below the road level. Predominantly residential land use is observed in the area. The area is one of the oldest settlements of Dharavi slum. According to the local people, the age of the settlement near about 60 to 70 years. The internal roads, quality of buildings, maintenance of infrastructure and solid waste management are observed as quite satisfactory as compare to other two study areas.

*Rajiv Gandhi Nagar* is the most recently developed settlement situated in the bank of Mithi River, particularly on the encroached areas of mangrove Forest of Mithi River. The road condition, building structure, solid waste management, drainage system and other public and private facilities are observed as worst in this area comparative to the other two settlements. Open drains, narrow internal lanes, garbage dumped on roadside, poor ventilation system characterized the area.

#### Age and growth of the settlement characteristics

All three settlements were developed in the marshy land which was used to be a mangrove forest surrounded by Mithi River. The process of development of settlement varies in three study areas as the Table 2 shows periods of staying in the area is different in three areas. Table 1 shows that Rajiv Gandhi Nagar is the most recently developed area where majority of the people staying for last 10 to 20 years. Whereas, Parsi-chawl is the oldest settlement where a good number of respondent have been staying in the area for more than 30 years so. During our field survey, the leader and elder citizen of the area informed us that this settlement started to develop 50 to 60 years back and a good number of residents have been staying here since their birth. Table no. 2 also depicts that Premnagar has developed in last 20 to 25 years back. It seems that the development in Rajiv Gandhi is still continuing as there are people who have started to stay in this area for last 10 years only.

Except Parsi-Chawl, migrants are from the nearby states of Maharashtra who presumably

Table 2 Nature of Migration

	Premnagar	Parsi-chawl	Rajiv Gandhi Nagar
<b>Period of Stay</b>			
Up to 10 years	6.5 %	11.9%	22.2
11 to 20 years	41.7 %	20.6%	65
21 to 30 years	42%	29.5%	12.8
31 to 40 years	9.8 %	37.7%	0
Total Respondents	100% (182)	100% (203)	100% (208)
<b>Origin of the Migrants</b>			
Not Migrated (by born)	0	34%	0%
Uttar Pradesh	70%	2%	24%
Maharashtra	3.8 %	60%	7.7%
Tamilnadu	26.2%	0%	61.3%
Others	0%	4%	7%
Total	100% (182)	100% (203)	100% (208)

came to Mumbai in search of job. Like several scholars, Risbud (2004) also found that majority of the slum dwellers in Mumbai are migrated from the underdeveloped provinces of India in search of job. Therefore, it seems that movement of the people from relatively better environmentally secured place to this vulnerable, unhygienic, environmentally areas is mainly due to secure their livelihoods.

#### Infrastructure facility

A poorer infrastructure facilities comparing to other parts of city are observed in all three settlements. However, all three settlements receive water supply from the municipal corporation ( see Table 3). Except Parsi-chawl, the community people depends for water mainly on community drinking water source shared by 4 to 5 households for each tap. In this regard, it is important to note that most of them use such water as drinking water without are very minimal water treatment. Except Parsi-chawl, water scarcity can be observed in other

Table 3 Infrastructure Facility

	Premnagar	Parsi-chawl	Rajiv Gandhi Nagar
<b>Water Supply Source</b>			
BMC Supplied water outside the house ( Shared by 4 to 5 households)	93%	36.9%	78.8%
BMC supplied water inside the house	6.3%	63.1%	20.2%
Buying water supply from outside	1.2%	0%	1%
Total	100% (182)	100% (203)	100% (208)
<b>Is supplied water enough for you?</b>			
Adequate	20.5%	91.1%	78.3%
Inadequate	79.5%	8.9%	21.7%
Total	100% (182)	100% (203)	100% (208)
<b>Sanitation Facility</b>			
Nearby Community Facility	82.3%	20.7%	58.2%
Own Sanitation System	1.7%	79.3%	18.8%
Open Filed Defecation	16.1%	0%	23.1%
Total	100% (182)	100% (203)	100% (208)

Table 4 Housing Characteristics

	Premnagar	Parsi-chawl	Rajiv Gandhi Nagar
<b>Building Height</b>			
Ground Floor	53.5 %	30.5%	87.5%
Ground Floor + 1	37.2%	69.5%	12.5%
Ground Floor + 2	9.3%	0%	0%
Total	100% (182)	100% (203)	100% (208)
<b>Building Structure</b>			
Pucca House ( Pucca house is made of brick cement and iron etc)	61.0%	78.5%	78.8%
Semi-pucca	35.5%	19.4%	11.1%
Mud House	3.5%	2.1%	10.1%
Shack	0%	0%	0%
Total	100% (182)	100% (203)	100% (208)

two settlements, particularly in Premnagar as a good number of respondents reported inadequate water supply (Table 3).

Like water supply system, sanitation facility in Parsi-chawl is comparatively better, but in other two settlements bulk of the population in other two settlements depends on community sanitation facility which is inadequate and poorly maintained as observed during filed survey. Moreover, open filed defecation is still observed (Table 3).

#### Housing characteristics

In all three settlements, construction of ground floor is permitted; however, Table 5 shows that 2 storied building are also quite common. Moreover, poorly designed building susceptible to collapse in any kind of catastrophic disaster are very common in all three settlement. Majority of the houses are 'pucca' house, i.e., made by brick, cement and iron (Table 4).

Table 5 Socio-Demographic Characteristics

	Premnagar	Parsi-chawl	Rajiv Gandhi Nagar
<b>Religion</b>			
Hindu	58.7 %	96.6%	71.2%
Muslim	39.7%	1.5%	17.8%
Others	1.1%	1.9%	11%
Total	100% (182)	100% (203)	100% (208)
<b>Linguistic group</b>			
Hindi	95.7%	21.2%	31.3%
Marathi	2.7%	76.8%	14.4%
Others	1.1%	2.0%	54.3%
Total	100% (182)	100% (203)	100% (208)
<b>Household Size</b>			
Mean household size	6	6	5
Standard deviation	2.78	5	2
Maximum	1	1	1
Minimum	17	15	16
<b>Income ( in Rupees )</b>			
Mean	4651	5122	4348
Standard deviation	2755	2672	2721
Maximum	20,000	20000	25000
Minimum	900	1000	1000

### Socio-Demographic characteristics

All three settlements are quite homogeneous in terms of language, religion except some religious diversification can be observed in Premnagar. Each of the settlements is dominated by one particular linguistic and religious group (Table 5). Therefore, people having homogeneous social background may prefer to stay together in those settlements. There is not much difference observed among three settlements in regards to average monthly income of the household (see Table 5). Rs. 5000 or slightly more is average monthly income of the respondent all three settlements. It can be said that though they are poor, but their economic condition is relatively better than their native place.

From the above discussion, we found that expect few minor variation, inadequate infrastructure facility, along with fragile and hazardous geographical locations of the settlements and other man-made hazards activities made the entire area become vulnerable or susceptible to various environmental or disastrous risks. However, people have migrated from the others parts of India

and decided to or became forced to live in those areas presumably due to secure their livelihood which is in threat in their native place. Reflection of economic betterment can be observed in their income level. Now, it is inevitable to look how the flood has affected the livelihood of those people already vulnerable to disaster and its relation to their disaster preparedness.

### Magnitude of flood and its impact on livelihood of the Community

Table 6 shows that average flood level inside the house in all three settlements is between 5 to 6 feet which is quite high and water inside the house continued for around one and half day, in case of Rajiv Gandhi Nagar is slightly higher. Whereas, water outside the house stayed for near about 2 days. Both the flood water level and duration of water logging was slight higher in case of Rajiv Gandhi Nagar.

In Parsi-chawl two people were killed, whereas in other two settlements no human loss has been reported. Number of injured person is not significant; however, a lot of households reported

Table 6 Magnitude of Flood

	Premnagar	Parsi-chawl	Rajiv Gandhi Nagar
<b>Flood level inside the house ( in foot)</b>			
Mean	5.87	5.07	5.18
Standard deviation	1.87	1.09	2.28
Maximum	3	3	3
Minimum	12	9	15
<b>Flood level in details</b>			
3 to 5 feet	0%	72.8%	70.5%
6 to 10 feet	51.4%	27.2%	28.5%
11 to 15 feet	48.1%	0%	1%
Total	100% (182)	100% (203)	100% (208)
<b>Duration of flood inside the house (in hours )</b>			
Mean	31.26	35.92	42
Standard Deviation	15.71	18.06	26.75
Minimum	4	6	10
Maximum	78	96	120
<b>Duration of flood outside the house (in hours )</b>			
Mean	37.43	45.94	47.55
Standard Deviation	16.11	21.12	26.75
Minimum	8	12	12
Maximum	96	96	120

water borne disease just after the flood ( Table 7). Significantly, Parsi-chawl as mentioned in the previous section having better infrastructure facility and lesser environmentally risky zone has reported lesser number of health due to flood.

Working day loss due to flood is quite high all three settlement as shown in Table 7. The worst among the three settlements is Premnagar as most the people in this settlement are engaged in small scale industry which was disabled to function due to flood. Since, majority of the people earn on day to day basis, the loss of working days may have direct threat to their livelihood.

It is also observed that total self estimated losses due to flood is also quite high in all three settlements. Damage due to flood was mostly observed on food storage and household durable assets in all three settlements (Table 7). In case of damage of business raw materials is quite significant in Premnagar which is predominantly a commercial area. Damage to cloths is not so reported so significant in all three settlements.

The above mentioned results show that impacts of flood on the livelihood of the people are omnipresent. On the other hand, settlement which is comparatively lesser livelihood risks has been less affected by flood. It is interesting that though the settlements are vulnerable to various kinds of disasters and environmentally, however, people migrated from the rural areas and decided to stay here. It seems that though the people might have lesser environmental risks in their native place, but the livelihood risks might be very high that became a direct threat to their survivability. As a result, though they were forced to stay in those vulnerable places, but staying in such areas might have helped them to improve the livelihood security through getting secured job and as a result they could overcome the risks predominant in their native place. Such findings indicate that considering disaster risks as an isolated event will not provide fruitful insights for the better disaster preparedness. Rather, disaster risk reduction must pay attention to the livelihood security; otherwise any such initiative may not be accepted by the community. During our study, the remarks of few respondents may also strengthen the above mentioned findings. A wage laborer of Rajiv Gandhi Nagar when he was

asked that how he thinks about the flood, the person replied *“This is Mumbai darling. People come here in search of job and better life. Where do we get house. Forget about flood. We need to send our children to school and need to run our business. Flood may or may not come, but what’s the hell we could do. We are poor people”*. Similarly another respondent of Premnagar replied when he was asked whether or not he will evacuate in case flood come in future – “Flood may come and go, but if property goes, it will never come back. If I evacuate who will take care of my property. I will not evacuate”. Such individual feeling echoed that in order to reduce disaster risks it is inevitable to secure the livelihoods of the concerned community.

#### **4. Conclusion and Future Study**

Based on the filed survey methods, our study has attempted to show the impacts of flood on the livelihoods of the slum dwellers of Mumbai as well as the study also shows that how livelihood risks lead the community towards greater disaster risks. We found that community having better infrastructure facilities and better livelihood security was less affected by the flood. Similarly, a significant number of individuals are staying in the disaster prone and environmentally risky areas as because staying they may on the other hand help the community to improve their livelihood; otherwise their survivability would be in threat. Therefore, planner and policy makers may not consider disaster risks as an isolated event, rather in order to improve community’s disaster preparedness; livelihood of the community must be enhanced. The study is also significant as there is no micro-level filed survey has been done on Mumbai flood prone slum areas. Results of the study will also help the local government, researchers and policy makers to get first hand information of the Mumbai flood magnitude and its impact on the slum dwellers.

The future task of the study is to measure the livelihood risks or background risks and integrate flood risks reduction with livelihood risk reduction.



Table 7 Impact of Flood on the Livelihood of the Community

	Premnagar	Parsi-chawl	Rajiv Gandhi Nagar
<b>Flood level inside the house ( in foot)</b>			
No. of Death	0	2	0
No. of persons injured	1	1	5
No. of household reported water borne disease at least one member of the household	60.1 %	40.4%	55%
<b>No. of working days loss</b>			
Mean	30	18	10
Mode	15	11	14
Standard Deviation	14.93	19.83	11.19
% of people reported no working day loss	1.1%	15.8 %	2%
<b>Damage to food storage in house (self-reported)</b>			
Total	54.4	39.9	28.4
Major	26.6	32.5	50
Little	14.2	22.2	16.8
None	3.8	5.4	4.8
Total respondents	100% (182)	100% (203)	100% (208)
<b>Damage to cloths (self-reported)</b>			
Total	16.3%	3.9 %	3.8%
Major	26.1%	18.2%	24%
Little	27.7%	24.1%	44.7%
None	29.3%	53.7 %	27.4%
Total respondents	100% (182)	100% (203)	100% (208)
<b>Damage to household durable assets</b>			
Total	17.9 %	3.0 %	.5 %
Major	50.5%	37.4%	31.3%
Little	15.2%	21.7 %	40.9%
None	15.7 %	21.7 %	27.4%
Total respondents	100% (182)	100% (203)	100% (208)
<b>Damage to building/ house (self-reported)</b>			
Total	1.1%	0%	.5%
Major	7.1%	.5 %	5.8%
Little	39.1%	28.6%	36.5%
None	52.2%	70.9 %	57.2%
Total respondents	100% (182)	100% (203)	100% (208)
<b>Damage to raw materials used for business</b>			
Total	28.4	2.5	8.2
Major	16.3	13.3	8.7
Little	12.5	23.2	34.1
None	41.8	61.1	49
<b>Total Estimated loss ( in Rupees) (self estimated)</b>			
Mean	16734	12641	13453
Standard deviation	15581	9368	12678

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## 生活リスクの中の洪水リスク軽減：ムンバイからの知見

多々納裕一・Subhajyoti SAMADDAR

### 要 旨

インドの経済的な中心都市であるムンバイは2005年6月26日に豪雨によって完全に機能を停止した。2005年の洪水でもっとも深刻な被害を受けた地域は、ムンバイの中でももっとも脆弱な区域であり、最も貧しい区域である。ムンバイの人口の60%以上がそのような脆弱な居住地域やスラムに暮らしている。そうした地域は限られた社会経済的資源、生産資本しか所有しないことにより非常に高いリスクの下で生活を営んでいる。伝統的な災害リスクマネジメント研究は日常生活の問題と災害へのプリペアドネスの関係について研究をしてきた。本研究では、地域コミュニティの洪水リスクがその生活リスクに非常に密接に関係していると仮説づける。本研究はムンバイのスラムに暮らす住民の生活リスクに及ぼす洪水の影響を示す。また、現在の生活リスクが住民の災害リスクにどのように影響を与えているのかを示す。

**キーワード：** ムンバイ洪水, 生活リスク, 総合的災害リスクマネジメント