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Participatory Risk Mapping for Identifying Spatial Risks in Flood Prone Slum Areas, Mumbai

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Synopsis

The Kyoto University, Japan under their GCOE-HSE program made an attempt to practice "Participatory Spatial Risks Mapping" at a flood prone micro-hotspot located in Dharavi, Mumbai, India. It was carried out to obtain comprehensive spatial information to reduce data gap and to encourage and enhance the initiation of community's participation in risk identification and mitigation. This paper provides a comprehensive understanding of the methodological aspects of such community based urban diagnosis process which includes some vital steps like stakeholder identification, rapport building with community, exercising survey tools with the help of community such as hazard mapping, town watching etc.

Keywords: participatory spatial risks mapping, Mumbai flood risks, urban diagnosis

1. Introduction & Background

The importance of community-based approaches has been recognized since long in promoting a culture of risk free and resilient community through reducing local vulnerabilities and building capacities. These approaches have been practiced by various community groups, national and international organizations and government departments, in some cases, for over two decades now. The Hyogo Framework of Action (HFA) adopted by 168 governments at the World Conference on Disaster Reduction held in Kobe, Japan, in January 2005, also emphasized the need for "developing and strengthening community-based disaster risk management" (CBDRM) (United Nations International Strategy for Disaster Reduction, 2005). CBDRM fosters the participation of threatened communities in both the evaluation of risk (including hazards, vulnerability and capacities) and in the ways to reduce it. For communities to delineate hazard-prone and vulnerable areas, participatory mapping is increasingly promoted (De Dios, 2002; Cronin et al, 2004a, b; Benson et al, 2007). Participatory Risk Mapping is a tool of disaster risk reduction which involves spatially mapping disaster risks through community participation. It includes relevant aspects of visual representation of threats faced by vulnerable community through physical mapping of spatial risks and by ensuring public knowledge and views are given prime consideration. Participatory risks mapping is also now increasingly promoted among local governments in order to strengthen the links between the official disaster management system and community based organizations. All these qualities and elements of participatory risks mapping made the system become instrumental and prerequisite tool or means for the Integrated Disaster Risks Management (IDRiM). This paper introduced a related practice initiated by the Kyoto University GCOE-HSE program at Mumbai in 2011.

Before going into details of this participatory urban diagnosis process or practice, it is inevitable to give a brief of the area and the problem in order to comprehend the necessity of exercising the participatory risks mapping tool at micro-hotpots of Mumbai.

Mumbai, located on the west coast of India facing the Arabian Sea, is the land of 12 million people in an area of 437 Sq.Km. The city which is the financial capital of India contributes over 25% of the country's tax revenues and generates about 5% of India's Gross Domestic Product (GDP) (Gupta, 2007) . Unprecedented change in rainfall pattern along with rapid urbanization, inadequate city management and planning make the financial capital of India highly prone to floods, the severest one was on 26th July, 2005. According to the Flood Fact Finding Committee of Government of Maharashtra State (Government of Maharashtra, 2006) , the city received 940 mm rainfall in 24 hours on 26 July 2005. The financial cost of the flood was unprecedented and the flood halted the entire commercial, trading, and industrial activity for days. According to Municipal Corporation of Greater Mumbai, at least 419 persons died directly due to the flood and subsequent landslide in the Mumbai municipal area alone; moreover. Another 216 were dead after the event due to water born diseases that followed during and after the flood (Samaddar et al, 2011). It is reported that 100,000 residential and commercial buildings collapsed, 30,000 vehicles were damaged, the entire railway system and telephone lines had collapsed and more than 60 % of the city area was directly or partially affected due to the 2005 flood (Gupta, 2007 ; Samaddar et al , 2011). The poor people, who are forced to live in slums comprising the half of the population of the city huddled only on 10% of the entire city's land area, were most severely affected by the 2005 flood. Limited economic and social resources and capital often, we know, put the livelihood of the poor into risks. In addition, the problem is compounded because the city lacks a sustainable urban planning practice, where often decisions for short-term gains destroy the natural environmental safeguards and neglect the needs of majority of the city dwellers. Result, unplanned development weakens the natural safety valves of the terrain from hazards and helps persistence of slums and poverty that in turn exacerbate the risks and vulnerability.

The city needs crash and coordinated efforts toward flood risk reduction and management. In order to promote disaster resilience in a community, sensitive and bottom-up planning and initiatives are required.

In this disaster-prone city, however, people's perception on disaster risk especially flood risks and its reduction has never been considered in the disaster management process adopted by the Mumbai city government. No spatial & socio-economic information at community level is available with the city government. Studies and pilot observations show lack of information on spatial & socio-economic characteristics of the people in vulnerable settlements and interaction with the communities in the context are the major cause for failure of many disaster countermeasures including planning for evacuation during disaster, stop of undesirable land development that exacerbate flood vulnerability, improvement of drainage, unplanned construction etc.

Keeping this in mind, Kyoto University, Japan under their GCOE-HSE program made an attempt to practice "Participatory Spatial Risks Mapping" at a micro-hotspot called Rajiv Gandhi Nagar, which comes under flood prone Dharavi slum in Mumbai. The participatory spatial risk mapping was carried in Mumbai by GCOE-HSE program to achieve three primary objectives –

a) To obtain comprehensive spatial information including land use, building use and flood risks information of flood prone micro-hotspots. This micro-level data may presumably support and strengthen the integrated urban diagnosis process of micro-hotspots; b) To reduce data gap; c) To encourage and enhance the initiation of community's participation in risk identification and selection.

While describing and examining such urban diagnosis process, this paper tried to address following objectives – a) to understand the methodology of participatory spatial risks mapping (including identification and networking between stakeholders) and b) to know how such practices can be successfully implemented and replicated in

the future in other micro- hotspots. The methodology includes some vital steps like stakeholder identification, rapport building, exercising tools like hazard mapping, group discussion and town watching etc. The report demonstrates the usefulness of the method as applied to communities vulnerable to flood disaster in the slums of Mumbai.

2. Role and Significance of Spatial Risks Mapping through Participatory Approach in Integrated Disaster Risks Management (IDRiM)General

The promotion of disaster resilient society requires a paradigm shift away from the primary focus on natural hazards and their quantification towards the identification, assessment and ranking of various vulnerabilities (Bogardi and Birkman, 2004). Spatial conditions that determine risk are unique and have distinctive impact on the settlement and community. Spatial features or conditions of the settlement are the expression of the dynamic interaction between natural and cultural forces in the environment. Cultural landscapes are the result of consecutive reorganization of the land in order to adapt its use and spatial structure better to the changing societal demands. It is critical to understand the interrelation between the spatial features and risks the community face in order to enhance the quality of integrated community development plan that aims to promote community resiliency capacity.There are many benefits of spatial planning; like it is easily communicated to community, planners, researchers and policy makers. Spatial planning allows cross-validation from other maps like contour, landuse etc. Community and individual local spatial knowledge has considerable value, as well as supplementary and cross-validating knowledge, for understanding disaster risk situations and designing community-based amelioration. Affected communities often have a comparative advantage in understanding the etiology, consequences, and nuances of complex problems. This is because, undoubtedly, it is the local community that is both, the primary victim and the first to respond to emergencies when disasters strike. So, involving local community is a prerequisite to sustainable disaster risk reduction. Community-based disaster risk reduction (CBDRR) fosters the participation of threatened communities in both the evaluation of risk and ways to reduce it. Also, sharing direct experiences from affected community helps to pinpoint the problems at the grass-root level and hence ensures successful implementation of strategies. Hence participatory approach is an important criterion for effective disaster risk reduction.

Participatory Risk Mapping is important for a planner to ensure that the vulnerable community easily understands the strategies they propose for disaster risk reduction. And the best way to represent the risks faced by the community from disasters is by visual representation. Risk Mapping is one such visual method of showing local perceptions of areas or people in a community (such as settlements, infrastructure, and resources) that face different levels and types of risk. It predominantly focuses on physical or natural risks such as flooding. Social, financial and health risks are, however, difficult to include in a map. When community participation is ensured in the process of spatial risk mapping, chances of the technique to be best accepted by community and also of its effectiveness in disaster risk reduction is maximum. Participatory research and rapid appraisal methods have become popular in recent years (Chambers, 1997, Holland and Blackburn, 1998). Participatory Risk Mapping is a powerful tool that increases stakeholder involvement and provides a means for participants to express their ideas in an easily understandable visual format. Facilitating local identification and prioritization of key issues thus becomes important aspects of Participatory Risk Mapping. Participatory Risk Mapping is well suited to extracting people’s local (or indigenous) knowledge which include mapping direct experiences and historical memories of inundations, floods, water-logging etc. Participatory Risk Mapping eventually helps to increase the capacities within a community.

3. Methodology

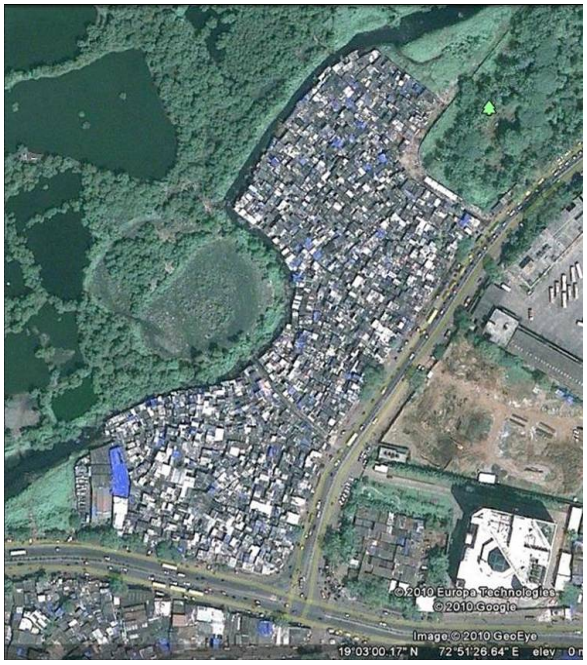

Fig 1: Google Image of Rajiv Gandhi Nagar

3.1 Case Study: Rajiv Gandhi Nagar – An Overview

Rajiv Gandhi Nagar in Dharavi was one of the worst affected settlements during 2005 Mumbai floods. Considering the population, intensity of disaster and the extent of damage, Rajiv Gandhi Nagar was identified as one of the hotspots of Mumbai and Participatory Risk Mapping has been carried out in this area (See Fig . 1)

Rajiv Gandhi Nagar is a 25 years old settlement in Dharavi, Mumbai with a population of almost 20000 people and area of 100 sq. m. Majority of people are immigrants from Uttar Pradesh, probably due to better job opportunities. It is predominantly a Hindu area with majority of people Hindi-speaking.

It is one of the most recently developed slum areas of Dharavi. Rajiv Gandhi Nagar was developed on the verge of Mithi river bed which was previously a marshy land bound by mangrove forest. Due to the low lying terrain, the area experiences water logging or local flood every year. The area was very severely affected by the 2005 Mumbai flood disaster.

3.2 Techniques/Tools Used in Participatory Risk Mapping

A large range of participatory risk mapping tools exists. This section gives an overview of some of the key mapping tools and techniques that have been applied in Participatory Risk Mapping at Rajiv Gandhi Nagar.


Fig. 2 : Group Discussion

Open ended interview with key informants: Demographic and socio-economic information as well as information like impact of flood disaster in terms of loss, duration and height of water level during flood etc were noted down.

Group discussion: Group discussion is carried out through informal and voluntary gathering of local community and people from local organizations to exchange ideas, information, and suggestions on needs, problems, subjects, etc., of mutual interest (See Fig. 2). Group discussions with respect to the worst affected areas, the extent of damage, coping strategies adopted by local people were conducted.

Town watching: The different stakeholders survey the features relating to disaster risk by walking around the area. The exercise is conducted


Fig 3: Observation Technique

in order to learn the history, topographic condition, housing characteristics, flood characteristics, culture and economic situation etc of the targeted communities.

Observation: Observation is an important criterion for noting relevant aspects of the community related to disaster risks. It requires attention and understanding of matters which can be contextual to matters relate to natural disaster. Observation with regards to built environment, existing landuse and changes in landuse, condition of roads etc. was conducted by the GCOE team members and the survey team (See Fig. 3).

Mapping: Mapping is an important tool in disaster risk reduction. It is a visual representation of the community's characteristics, resources, infrastructure and other aspects related to disaster threats. Mapping generally includes physical aspects rather than social or economic. However, zones of socio-economic vulnerability (apart from physical risk vulnerability) can also be physically represented by demarcating on maps (See Fig. 4).

Photography: Photographs also played a major role in the mapping process. Photographs helped at a later stage to identify a location and its physical conditions and aspects.

Secondary data collection: (Example: Content analysis) Data was collected in the form of maps or in the form of statistical data from the Municipal Corporation of Greater Mumbai (MCGM), G-North Ward Office, MASHAL (NGO), School of Planning & Architecture, New Delhi and many other organizations.

3.3 Scope of Mapping / Data Collection

The significance of spatial planning on community and the risks it faces has already been discussed before. There can be many components of spatial planning depending upon the type of disaster risk and the particular vulnerable area. The components which were identified for Rajiv Gandhi Nagar to have considerable impact on disaster risk are **physical features** (slope, landcover, soil type, proximity to waterbody), **landuse** (Commercial, Industrial, Public / Semi-Public, Playground / Parks, Water bodies / Ponds, Roads), **infrastructure** (Religious Structures, Doctor's Clinic, Community Toilet, Community Tap, School / Balwadi, Burial Ground, Drains / Nallas, Waste Dumping Site, Water Pipe Line, High Tension Lines, road width), built environment (Building Height, Building Materials, Building Condition, Plinth Level, Built-up Area, F.A.R.). Accordingly, these spatial components were either marked on the map or noted down. **Hazard exposure** was also noted through the method of open ended questions. The hazard exposure was based on three hazard parameter criteria: Flood Duration, Water Level during Flood and Areas Frequently Affected during Flood.

Fig 4: A sheet of landuse survey map

3.4 Roles and Involvement of Stakeholders

A key step in Participatory Risk Mapping is to identify the relevant stakeholders. Involving these individuals and organizations early on will help ensure the long-term success of the project. Stakeholder involvement in PRM in Rajiv Gandhi Nagar was ensured through regular interactions with MCGM officials, local community and other local religious/political organizations, in the form of meetings and phone calls. Establishing a relationship with local leaders who are willing to introduce the project and the project team to the community offers the dual benefits of providing important information on stakeholders and gaining community trust and support.

In the case of Rajiv Gandhi Nagar the following stakeholders were identified and involved with the Participatory Risk Mapping process.

GCOE-HSE Research Team: The GCOE-HSE team members were the key surveyors in the PRM process and were also responsible for mapping. They played an important role in explaining and introducing to the community, the role and

objectives of the survey. The GCOE-HSE team members also were totally responsible for identification of the stakeholders and establishing coordination among them. Establishing a link or network between the stakeholders is a difficult and time-consuming process, which is still going on.

Local Community: Local residents are the people who live in the settlement and directly face the threat of disaster risk. Their everyday lives and well being are directly connected to the issue. They are also the key informants of the impacts of flood, exiting socio-economic conditions and settlement characteristics.

MCGM (Field Officials), G-North Ward Office: The Government is deeply involved with the procedural, legal and financial aspects of an issue in the area. In Rajiv Gandhi Nagar, the MCGM officials worked as facilitators and introduced the GCOE-HSE team to the area and people in the area. They also contributed by providing relevant information in the form of secondary data collection like flood data , exiting socio-economic conditions, settlement characteristics etc.

Religious / Political Organization: Various local religious and political organizations played important roles in PRM conducted in Rajiv Gandhi Nagar. They were also the key informants of the impacts of flood, exiting socio-economic conditions and settlement characteristics. They have supported the research team (including surveyors) by introducing them to the area and people.

3.5 Process of Participatory Spatial Risks Mapping:

The participatory spatial risks mapping, which has been designed by Kyoto University GCOE-HSE program, has three different and interlinked phases or steps based on different objectives in each phases. The scopes of each of these three phase are –

Phase – 1 (Stakeholder Identification and Base Map preparation)
Scope: a) Preparation of Base Map (Landuse map, hazard map, Built Environment); b) Identification of Stakeholders ; c) Establishing a relationship of trust with the local community.

P**hase – 2 (Risk Mapping and Prioritization)** - Scope : a) Identification of missing information in maps and Updating the maps; b) Incorporation of Community's perceived risks (Exm. Which area is more risky and why ?); c) Completion of hazard and contingency mapping.

Phase – 3 (Integrated Community Development Plan Development) - a) Community's perception of priority of issues that need to be addressed; b) Alternative solutions discussed; c) Action Plan formation

This paper only focused on the 1st step or "Stakeholder Identification and Base Map" preparation phase.

3.6 Steps of 1st Phase (Stakeholders Identification & Base-map Preparation) of Participatory Risk Mapping, Rajiv Gandhi Nagar

Step 1 - Area identification/selection: The selection criteria of the area was based on the suggestions of the stakeholders like MCGM, local organizations and also from surveys conducted prior to risk mapping. Some of the criteria of selection were area, population, impact of flood disaster in the area etc.

Step 2 - Stakeholder identification: Stakeholders in the area were identified on the basis of their functions and responsibilities. The involved stakeholders in the area are MCGM, G-North Ward Office, local community, religious and political organizations.

Step 3: Information collection from secondary sources: Information was collected by the GCOE-HSE team from MCGM, G-North Ward Office through meetings and telephonic discussions. A survey conducted in the area, on the local people, also contributed much towards the information collection. Information was also collected from secondary sources in the form of maps, drainage network, demographic data from MCGM and other organizations (including NGOs).

Step 4: Rapport building with stakeholders: This was done through meetings and telephonic conversations with different stakeholders like the local people, MCGM, local religious and political organizations etc.

Step 5: Fixing time and methods of risk mapping: The method for Participatory Risk Mapping was fixed after literature review by

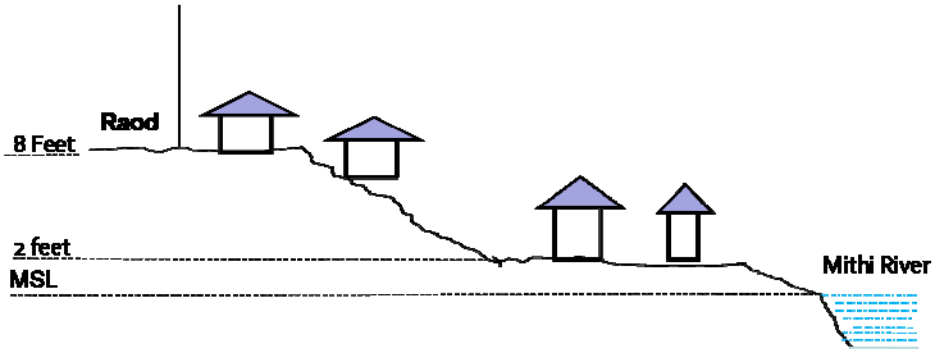

Fig 5 Natural Slope of Rajiv Gandhi Nagar

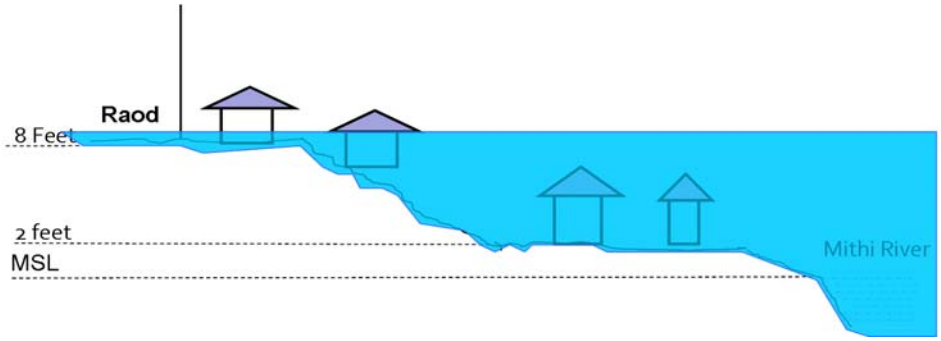

Fig 6 Situation During Flood in Rajiv Gandhi Nagar

GCOE-HSE team and also upon discussions with MCGM members.

Step 6: Town watching and area appraisal: This was done through observation and exchange of dialogues between different stakeholders namely GCOE-HSE team, surveyors, local religious and political organizations and MCGM. The area watching included identification of landmarks and boundary of the area as well.

Step 7: Mapping: Landuse mapping, building use, risk identification and mapping, resource identification etc were mapped through observation, group discussion, face to face open ended interviews etc with the help of the surveyors, GCOE-HSE team members, local religious and political organizations and MCGM.

4. Fact Findings

The main focus of this report is on the methodology of Participatory Risk Management rather than on the findings. Still some very apparent observations have come up on the surface through a simple yet systematic method of Participatory Risk Management.

4.1 Physical Profile of Rajiv Gandhi Nagar

Origin and Growth of the settlement- Rajiv Gandhi Nagar is located between the road on the east and the Mithi River on the west. So the development naturally took place from the edges of the roads and gradually extended towards the river on the west. This is when people in the area started facing threats from flood disasters. Those who came early were able to settle down close to the road, whereas people who came later were forced to encroach upon areas closer to the river to set up their houses. It is these houses which face the highest threat from flood disaster, because closer the distance from the river, higher is the possibility of flood (See Fig. 5 and 6).

Landuse and Built Environment: Comparing the landuse of Rajiv Gandhi Nagarover the last 10 years, it has been found that the landuse has not changed much after the flood, only the roadside plots changed to commercial use (See Fig. 7).

Fig: 7 (Left) 2007 Landuse Map Cluster C, Rajiv Gandhi Nagar and (Right) ; 2011 Landuse Map Cluster C, Rajiv Gandhi Nagar

Built Environment: It was observed that a significant number of residential structures were converted into G+ 1 structures after the 2005 Mumbai flood. Similarly, many of the semi–concrete structures have been converted into concrete structures.

Water Supply: Pipe water supply in form of free public taps and private supply with cost was introduced by BMC in 2009 to parts of the community. In areas where piped water supply has not been introduced yet, people buy water from BMC water tanker with a cost of INR 200 per month. Those who cannot pay or afford the water pipeline installation cost, normally borrow water from those who have private water pipe line and in return pay 200 or 300 INR to the owner. One public water-tap is shared by 4 to 5 households. Water supply is generally for 5 to 6 hours in the morning.
Condition of Roads: Access streets within Rajiv Gandhi Nagar settlement are narrow with an average width 2 to 3 feet. A large number of streets have been raised by 1 to 2 feet by the inhabitants after the 2005 flood disaster to keep out flood water.

4.2 Early Evacuation during 2005 Flood:

The2005 Mumbai flood was totally unpredictable. There was no early warning my media or Government or any other organization. In most cases the head of the household (male member) was outside the house and could not return to the house during flood as the roads were blocked. In the absence of male members, the family members could not decide whether to evacuate or not. In many cases families did not evacuate due to fear of losing property or theft. In some cases people did not have the knowledge about where to evacuate and the least risky route of to be taken. Within short period of time the entire area was submerged leading to huge losses of property. People who could evacuate managed to find shelter only at roof tops or on to the main road which being at a higher remained un-flooded. Many people also evacuated to the nearby railway station or the neighbors' upper floors.

5. Conclusion

Participatory Risk Mapping in Rajiv Gandhi Nagar had a major role in initiating the process of disaster risk reduction in the area. For the first time, a base map was developed along with relevant base information in the context of spatial risks and its nature and characteristics. It will help in a great extent to reduce the data gap. Building up networks and interaction between all the stakeholders was a

major outcome of the Participatory Risk Mapping. Through PRM a major platform was created for implementation of Integrated Community based Action Plan (like Yomenkaigi System). It is important that communities build their own coping strategies to minimize the impacts of disaster and for speedy recovery from a disaster. Participatory Risk Mapping at the community level can be a very empowering tool in disaster risk reduction. In the context of disaster risk reduction, participatory risk mapping such as this enables an assessment of the people's perception of risks and coping strategies and triggers network-building between stakeholders.

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洪水に脆弱なムンバイのスラム地域における空間リスクを証明するための参加型空間リスクマッピング

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要　旨

京都大学のＧＣＯＥ－ＨＳＥプログラムでインドのムンバイのダラビにある洪水になりがちな危険地帯における参加型空間リスクマッピングの実施を試した。それはリスク証明とリスク軽減においてデータのギャプを減らし，コミュニティの参加開始を促進・強化する総合的空間情報を得るための実施であった。本研究はステークホルダの証明，コミュニティでの関係作り，ハザードマッピンッグ，まち警備などコミュニティを手伝う調査ツールの実行のようないくつかの絶対必要な段階を含む都市診断プロセスベースの方法論的側面における綜合理解を提供することである。

キーワード：参加型空間リスクマッピング，ムンバイの洪水リスク，都市診断