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**Resilient Flood Loss Response Systems for Vulnerable Populations in
Mumbai: A Neglected Alternative**

by

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A Dissertation submitted to the
Graduate School-New Brunswick
Rutgers, The State University of New Jersey
in partial fulfillment of the requirements

for the degree of,

Doctor of Philosophy

Graduate Program in Geography

written under the direction of

James K Mitchell

and approved by

New Brunswick, New Jersey

October 2010

ABSTRACT OF THE DISSERTATION

Resilient Flood Loss Response Systems for Vulnerable Populations in Mumbai: A Neglected Alternative

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This dissertation examines different methods of sharing and redistributing flood losses borne by poor populations in Mumbai, India. It focuses on practices that are adopted to shift losses between economic classes and within specific populations at risk. It also develops a basis of knowledge about the impact of globalization on the vulnerability of poor communities in cities and calls for the development of hazard mitigation and economic assistance devices that can be applied at the micro level with a view to becoming sustainable means of reducing the burden of risks.

Multiple levels of analysis are employed. Information from interviews and discussions with government officials, and other influential informants in community development and planning organizations is combined with documentary evidence, to explain the nature of socio-economic and environmental challenges experienced by different groups. This sets the context for two in-depth surveys of fifty households each in slum settlements that are severely affected by flooding. Data collected include the extent and impacts of

flooding, formal (official) mitigation methods employed and the range of informal support systems used by individual families to recover from the consequences of floods.

Results show that local loss redistribution systems are extremely diverse but significantly effective in addressing important concerns about survival that are overlooked in public policy measures. Most are not integrated into the systems of flood hazard mitigation employed by public agencies and other institutions. Household vulnerability fluctuates over time and with different stages of the hazard cycle (preparedness-recovery-reconstruction). The loss redistribution systems are strongly shaped by inherent social characteristics of local communities and changing economic factors of affected households. In conclusion the results argue that though marginalized informal population in third world cities are affected by downward pressures of ongoing socio-economic and environmental processes at different levels of society, using the same processes they sometimes develop the capability to acquire networks of support that increase the range of their alternatives of environment risk reduction. Suggestions for improving public policy in light of these findings are included.

ACKNOWLEDGEMENTS

I want to take this opportunity to thank everyone for their belief in me while I went through this process. First, I would like to express my deepest gratitude to my advisor Prof. James K Mitchell for his guidance, support and patience throughout my years at Rutgers. Second, I am extremely grateful to Robin Leichenko and Dave Robinson for their consistent support and encouragement. I want to thank members of my dissertation committee – Robin Leichenko, Thomas Rudel, Trevor Birkenholtz, and Lee Clarke for their helpful suggestions and critical feedback. I hope to have many opportunities to work with them in the future.

The dissertation would not have been possible without the help of many people during my fieldwork in Mumbai. In particular I am thankful to the residents of Prem Nagar and Jari Mari who generously shared their experiences and opinions with me. I also want to acknowledge the support of members from Greater India Friendship, Kesav Gore Samarak Trust, Bombay Urban Industrial League for Development and Jagruti Kendra. In addition I am grateful to all government officials, members of NGOs, professors and researchers from educational institutions for sharing their views and contributing to my research.

I owe the completion of this dissertation to the amazing support of my family and friends. I want to thank my parents, sister and Vineet for being my pillars of emotional support. I am grateful to my friends and colleagues, Rosana, Za and Purba for keeping me focused by sharing their experiences and giving me constant encouragement.

DEDICATION

To my parents, for their unconditional love and support

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Chapter 1: Introduction

The year 2010 is estimated to mark the transition of a majority (50.6%¹) of the world's population from rural to urban. As this milestone is passed it is essential to explore the processes that shape, develop and threaten cities, with a view to balancing urban development and environmental conservation. The most alarming implications of rapid urbanization include irrevocable alteration of local and global environments, unsustainable exploitation of natural resources and widening social equity gaps within urban areas. The challenge is to find urban development processes that are sustainable as well as urban lifestyles that are balanced and equitable.

One particularly problematic aspect of this challenge is the selection of appropriate adjustments and adaptations to natural hazards that are exacerbated by urbanization. This problem is particularly thorny because one already difficult task (i.e. achieving safety under constraints of uncertainty and environmental change) is nested within another daunting objective (i.e. the design and implementation of sustainability in a world of scarcity). The present dissertation seeks to address these matters by critically examining existing approaches to flood hazard risk reduction at different scales in an Indian megacity.

¹ UNPD. (2007) World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2007 Revision, Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.

Study Rationale

Cities in developing countries are places of high population density and centers of infrastructure, investment, economic growth, networking, information and connectivity. Complex interactions between the social components of these cities and their local physical environments produce unique and dynamic human dominated ecosystems. Frequently, one of the byproducts is a socially-driven amplification of losses from extreme natural events (IPCC, 2007a; Mitchell, 2005). However fruitful opportunities for reducing risks and vulnerabilities are likely to be found in the socio-economic context of developing countries' cities. This finding is increasingly accepted in principle among academics and professional managers but applications are hampered by a lack of detailed supporting evidence that might be used to guide public policy decisions.

Papers on human adjustment to urban natural hazards in developing countries appear in the academic literature, but only as a minor theme. They are outnumbered by studies of haphazard urban development (Hardoy, 2001) and lack of basic facilities (McGranahan, 2001) as well as spatial segregation and the growth of marginalized populations that are exposed to degraded environmental conditions (Marcuse, 2000). When natural hazards are addressed, the focus is on disaster impacts, relief and immediate coping strategies (Aragon-Durand, 2007; Few, 2003; Whitehead, 2007). Hazard mitigation receives less attention compared to estimating risks (Wang, 2008), integrated risk management (Amendola, 2008; Wenzel, 2007) and technological solutions in support of preparedness and emergency response measures. A few papers focus on the design of strategies that

would assist in the development of environmental change mitigation and adaptation practices, efficient systems of resource use (Muller, 2007), just and adaptive institutions (Manuta, 2005) and options of risk redistribution (IPCC, 2007a; Mills, 2005; Yucemen, 2005). However, there is a striking lack of data on the hazard response decisions of individuals, families and other local groups. Further here is a dearth of information about loss absorption and loss-shifting strategies employed by individual and collective local actors. Although it is known that when loss redistribution, loss sharing, and loss shifting measures are embedded in long term adjustment mechanisms they can play a significant role in sustaining low income populations during and after times of crisis, apart from anecdotal evidence (Basu, 1997; Baydas, 1995; Goetz and Gupta, 1996; Sumarto, 2003; Zeller, 2000), little has been published about the salience, structure, function and varieties of these strategies as they are actually practiced.

Though its importance is much remarked on by commentators, the role of natural hazard management in sustainable development is also an understudied topic in the academic literature. Hazard management is now recognized as an important component of sustainable development but means of integration and balancing between safety and sustainability have not yet been elaborated. Moreover, concerns about increasing environmental risk have been linked to the issue of unsustainable urban development; cities have been identified as critical places for aggravated risks (Bigio, 2003). However cities are also considered to be the *‘key focal points for the linkages between mitigation*

*and adaptation*² (IPCC, 2007b) and hence are arenas of potentially sustainable hazard management. Though urban planners and hazard mitigation managers of developing countries are looking to acquire strategies that simultaneously address sustainable development and hazard risk reduction issues (Fernandez, 2006; Haque, 2007), urban hazard mitigation policies have typically prioritized plans for reducing losses of people, buildings, infrastructure, industries and other income generating facilities. Furthermore, integration of policies that affect multiple issues confronting urban managers is often limited to concerns about administrative coordination and the enhancement of organizational linkages among academic, developmental, municipal and infrastructural interest groups. Though hazard scholars believe that the empowerment and integration of marginalized sections of urban society into formal hazard mitigation systems is necessary for management plans to be effective, genuine efforts to close loopholes and articulate grassroots hazard reduction schemes with sustainable urban development programs are rare (Wisner, 2004). In particular, there are few initiatives to analyze and reduce the vulnerability of slum dwellers in urban areas (Jones, 2004; Pelling, 2003b; Uitto, 1998; Waley, 2005; Wisner, 1997; Zoleta-Nantes, 2002). There is a particular lack of information about loss sharing and shifting strategies adopted for long term recovery by marginalized communities in such cities.

² Page 359 -IPCC. (2007b) Industry, Settlement and Society, in: M. L. Parry, O F Canziani, J P Palutikof, P J Van Der Linden and C E Hanson (Ed.), Climate Change 2007: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge. pp. 976.

Addressing Knowledge Gaps and Policy Myopia

The present research attempts to address some of the above-mentioned gaps in knowledge. First, it examines the little-studied, high profile, fast-growing Indian city of Mumbai - known for its size, nodality, economic vitality and mass media celebrity. Second, it focuses attention on grassroots poor populations at risk, paying particular attention to collective mechanisms of hazard response as well as individual responses. Third, it seeks to illuminate alternatives to two highly imperfect strategies for the management of extreme natural events in Indian cities that are uncritically taken for granted by many citizens, and are much favored by India's national and municipal leaders. These include: (1) technological fixes intended to control nature (Kapur, 2005); and (2) economic policies intended to generate wealth to offset hazard losses but which also result in excessive resource exploitation (Visvanathan, 2002). Although commonly adopted these two approaches represent only a small fraction of the total range of choices available. In order to demonstrate the potential for incorporating grass roots hazard-reduction into formal urban sustainability policies, it is necessary to explore the following two objectives:

1. Are formal public means of hazard risk reduction totally or partially disconnected from the adjustment strategies of marginal populations?; and
2. Do slum households rely on diffuse local networks of support that are sometimes connected to larger systems of loss sharing and shifting?

The chapters that follow are based on analyses of documentary evidence about disaster policies in India, flood policies in Mumbai and on field investigation of two slum communities in the city using social survey techniques and interviews with a variety of formal informants who are experts or members of interest groups that have a stake in the neighborhoods or in hazard policy-making. They will show that both of the objectives are well supported by evidence from Mumbai and will further reveal that marginal populations experience socio-environmental pressures that aggravate their vulnerable conditions, and that future policies and management programs will need to simultaneously address factors that produce differential vulnerability and support resilience building practices.

Organization of Dissertation

Chapter 2 *Theory and Methodology* presents the conceptual design used in the research and explores connections to contemporary scholarship. It previews the theoretical implications of the research and identifies its main contributions. The second half of the chapter sets out the detailed methodology used for national and urban level analysis presented in chapters 3, 4, and 5.

Chapter 3 *Dealing with Disasters in India* presents the hazardscape of India and is a critical analysis of the emerging disaster mitigation policies adopted in the country. Using secondary data and texts from international and national organizations this chapter

summarizes types, frequencies and consequences of hazards and the mitigation approach in India. It then introduces the four broad problems that beset Indian disaster mitigation policies. These are illustrated in more detail in the subsequent chapters.

Chapter 4 *Mumbai: the Ever and the Never Changing* argues that efficient hazard mitigation for a megacity such as Mumbai requires the ability to efficiently negotiate changes in society, changes in nature and the relationship between the two. The case of Mumbai shows that some attributes of society and environment are transforming for the better in response to large scale processes of globalization, while others are either changing for the worse under the pressure of environmental changes or stagnating due to inertia in some segments of society. The chapter further argues that hazard mitigation in megacities is not informed by in-depth knowledge about these socio-economic and environmental changes, but instead employs dated assumptions about risk and vulnerability.

Chapter 5 *Flood Alleviation Policy in Mumbai* discusses the centrality of economic development and scarcity reduction as justifications for disaster mitigation policies in Mumbai. The chapter provides a critical appraisal of the technocratic strategies that have been adopted for flood mitigation in Mumbai, including their limitations.

Chapter 6 *Old and New Structures - Constraints and Alternatives* explains the research strategy employed for local scale analysis and presents results on flood mitigation for

marginalized populations in megacities. Using empirical data from two slum settlements in Mumbai the chapter illustrates the influence of local processes and social structures on the development of vulnerability and resilience. It finds that hazard mitigation policy does not take into account the coping strategies adopted by informal communities that are transforming themselves and fails to reap the potentially enormous benefits of these strategies.

Chapter 7 *Problems of Integration* identifies the problems associated with the lack of integration and cooperation among the many institutions and stakeholder groups in Mumbai and examines possibilities for expanding integrated hazard mitigation initiatives beyond administrative institutions to include multiple domains of civil society. This chapter argues that integrated approaches to hazard mitigation and adaptation require increased linkages among groups that are often separated from, and isolated by, the present decision-making system. It therefore suggests a more expansive decision-making system to transcend boundaries that separate formal/ informal, old / new, social/ecological, and local/global policy realms and suggests locations in society where potential sustainable methods can be integrated to balance these contradictory yet coexisting realities in megacities of developing countries.

Chapter 8 *Conclusion* revisits the arguments made in the dissertation, summarizes findings, notes limitations in the study strategy and offers suggestions for further research.

Chapter 2: Theory and Methodology

Uncertainties associated with extreme events have interested hazard scientists and professionals in many disciplines. Research on natural, technological, and anthropogenic extremes is well established in the physical, social and managerial sciences. Social science research on hazards has been classified into three broad categories (Mitchell, 1990); Disaster Research focuses on social behavior in post disaster settings and is established within the sociological and anthropological disciplines; Risk Analysis employs a wide range of quantitative methods to analyze the full spectrum of events that threaten society and is especially popular with biomedical and engineering experts; and Natural Hazards Research (NHR) is led mostly by geographers who work closely with policy makers to understand the interactions between physical and social environments that produce hazard risk and vulnerability. The present study is an extension of this last tradition and combines insights from the several subfields of human ecology, political economy, social constructivism and political ecology that now lie within it. The discussion presented in the dissertation theoretically connects with the existing body of environmental hazards literature at three levels – study of hazards and society, environmental hazard risks in cities of developing countries, and socio-environmental stresses on the growing informal sector.

In NHR, the theory of human adjustments (Kates, 1971; White, 1963) examines choices made by people living in hazardous areas and the variations in *‘human behavior between techno-social stages, specific hazards, specific classes of decisions, decision makers and*

*between individuals within a specific group of managerial decision makers*³. A perspective that was also employed by geographers in India exploring the connections between risk and vulnerability in the flood affected northern plains of Ganga Valley (Ramachandran, 1974). The other dominant perspective in NHR focuses attention on vulnerability as the preeminent subset of hazard and adopts a political economy perspective (Wisner, 2004) that emphasizes sociopolitical and economic processes that produce differential vulnerability in society. In this perspective, hazard vulnerability and risk is thought of in terms of *'social systems and how their associated power relations impact on different social groups'*⁴ and stresses on those *'less obvious political and economic factors that underlie the impact of hazards'*⁵ in society. NHR now incorporates both these behavioral and social structural perspectives which are sometimes categorized under the school of political ecology although others object to that term as an umbrella concept because it privileges the political rather than a broader set of human system processes that includes politics but also involves personality, culture, society, communication, etc. Important new features have been added to this broad theoretical base that illuminates the contextuality of responses to risk (Mitchell, 1989) and social adaptive capacities (Pelling, 2002a). However, the partition in this research tradition continues because hazard scholars often remain divided over the scope of hazard prevention choices available for population groups. Adjustment to hazard perspective assumes that the potential range of alternative choices is usually much wider than the choices that are practiced and puts emphasis on raising awareness of neglected

³ Kates R.W. (1971) Natural Hazard in Human Ecological Perspective: Hypotheses and Model. *Economic Geography* 47:438-451.

⁴ Page 7 - Wisner B., Piers Blaikie, Terry Cannon and Ian Davis. (2004) *At Risk: Natural Hazards, People's Vulnerability and Disasters*. 2nd ed. Routledge, New York.

⁵ Page 5 -Ibid.

alternatives, opening access to blocked choices and adding new alternatives (Alexander, 2000; Mitchell, 2006; Mitchell, 2008). Political economists, on the other hand, suggest that marginalized people have very little room for choosing, and instead focus on changing social institutions and constraints of binding structures in society (Pelling, 2002b; Sen, 1981; Wisner, 2003b). In the context of rapidly growing mega cities like Mumbai, where both societal and environmental systems are constantly changing, both perspectives are equally relevant. Under the impetus of social and environmental processes expansion of the range of alternatives, opportunities to open blocked choices and the development of new alternatives are all possible and therefore are important to consider (Appadurai, 2001; Nijman, 2008). Similarly, these large scale processes are widening the gap between the more and less vulnerable population groups and illustrate the ongoing deprivation of marginalized sections of society (Bannerjee-Guha, 2002; D'monte, 2006) – a problem that is crucial in examining hazards. The dissertation hence utilizes and contributes to issues raised by both theoretical perspectives.

Next, the dissertation engages with research on urbanization and the consequences of environmental change in less developed countries. Research on urban environmental change focuses on dynamics of urbanization (e.g. accelerated growth of large cities, restructuring of urban land uses and populations) and its intersection with human-altered environmental processes (Castillo, 2003; Davis, 1999; Hardoy, 2001; Harpham and Molyneux, 2001; McGranahan, 2001; Ngecu and Gaciri, 1998; Pugh, 1996; Satterthwaite, 1998). Changing physical environment risk in cities of developing countries like Mumbai is attributed to the underlying issue of rapid and unregulated urban

growth. This is a process that has resulted in compressed urban environment transitions in cities like Mumbai where concerns from each transition stage are overlapped simultaneously (Marcotullio and Lee, 2003). Overlapping burdens include problems like inadequate waste disposal, air pollution and ecosystem degradation. These are sometimes referred to as “brown”, “grey” and “green” issues respectively. Because they involve different combinations of natural and human components, they are also interconnected because solutions to one set of problems often aggravate the impact of others and therefore, mitigation becomes a complicated procedure (Marcotullio, 2001). The other challenge in cities like Mumbai is economic and political marginalization among urban populations, a common by-product of exploitation especially in capitalistic market-driven economies and territories without long traditions of independent indigenous governance (Bulkeley, 2003; Kamanga, 2003; Patel, 2003). Studies have combined issues of haphazard urban development with environment injustice in third world urban landscapes (Leichenko and Solecki, 2004), a consequence of expanded consumer culture and its impact on marginalized populations in terms of exposure to hazardous locations, environmental pollutants and ever-changing land use (O'Brien, 2004). The dissertation connects the issues of marginalization and entitlement in Mumbai with the growing climate risks of vulnerable populations to examine the role or influence of rapid urbanization and environmental change on local struggles and practices. Towards that end it contributes by illustrating the types of hazard prevention measures that are constrained and enabled by urban development goals in cities of less developed countries.

Finally the dissertation engages with research on informal 'slum' settlements. The informal sector comprises marginalized populations living within areas that suffer multiple stresses from the lack of political, economic, environmental, legal identities and rights to the resources of the city. Although informal populations do not have access to supports like infrastructure, economic development, or decision making facilities that are available to mainstream populations in the city, studies have found that informal sectors develop their own system of rights, identity and support mechanisms (Carpenter et al., 2004; Soto, 1990; Winayanti, 2004). In the case of hazards and sudden crises, studies have shown that informal sectors have a parallel set of mechanisms (Baydas, 1995; Buencamino, 2002; Dershem, 1998) that support vulnerable populations and assist in recovery. Opinion on slums vary, where some scholars view informal settlements as places of abject poverty, disempowerment and hopelessness (Davis, 2006; Neekhara, 2008; Pryer, 2003), while others consider them shadow places (Pelling, 2008) and incubators of new social experiments and cultural models (Cejas, 2006; Dawson, 2004); places that can be transformed by a combination of their own and others' efforts (UN-Habitat, 2003). The dissertation uses these contradictory views of slum settlements and explores shifts in vulnerability within these settlements to identify spatial, temporal and structural locations where slum settlements fluctuate back and forth between places of depravity and dynamic productive energy.

Conceptual Framework and Theoretical Linkages

The conceptual design of the study is guided by the previously mentioned theoretical approaches used to understand the following: the adjustment techniques employed by social units; patterns of entitlements; roles of human agency and culture; and the influence of geo-political factors in producing vulnerability (McLaughlin, 2008). It integrates the roles of structure and agency in comprehending the ways in which society and individuals negotiate environmental risk under the influence of changing social environmental pressures. Therefore the conceptual framework has connections with theoretical writings of White, Burton and Kates and focuses on understanding ‘*the determinants of human behavior in the natural environment and the processes that facilitate human adjustment to physical world through social organization*’⁶ (Mileti, 1980). Furthermore, the conceptual design is informed by vulnerability frameworks primarily introduced by Turner et. al. that emphasized the linkages between human – environment coupled systems ‘*in which vulnerability resides, including exposure and responses (i.e. coping, impacts, adjustments, and adaptations)*’⁷ (Turner II, 2003). Moreover, the framework borrows the concept of downward structural pressures highlighted by political economists who emphasize political and economic factors by ‘*which assets, income and access to other resources such as knowledge and information are distributed between different groups and various forms of discrimination that occur*

⁶ Page 334 - Mileti D.S. (1980) Human Adjustment to the risk of environmental extremes. *Sociology and Social Research* 64:328-347.

⁷ Page 8076 Turner II B.L., Roger E Kasperson, Pamela A Matson. (2003) A Framework for Vulnerability Analysis in Sustainability Science. *PNAS* 100:8074-8079.

*in the allocation of welfare and social protection*⁸(Wisner, 2004). Additionally the framework places the pressures and adjustments in contexts of time, space and scales in society and underlines the interplay of the *'subsystem of hazard components (such as physical processes, human populations, adjustments to hazards and net losses) with the subsystem of hazard contexts of changing exogenous factors'*⁹ (Alexander, 2000; Mitchell, 1989). The design utilizes theoretical writings on social capital, entitlements and empowerment used by social scientists to understand coping strategies and adaptive capacities of vulnerable communities and the role of *'material and non material expressions of power'*¹⁰ in society (Adger, 2006; Pelling, 2003a). The framework uses global environment and societal processes as the two main frames to combine problems and mitigation strategies under the binary sets of pressures (Leichenko, 2008) experienced by vulnerable communities and has theoretical linkages to the study of *'multiple stressors that are the real concern, particularly in developing countries, where food security is influenced by political, economic, and social conditions in addition to climatic factors'*¹¹ (O'Brien, 2004). Finally, the main argument of the research highlights the connections between slum households with socio-environmental pressures at different levels of society. It states that vulnerability, risk and resilience in the community are functions of multiple factors with which each household is separately and simultaneously connected to at any point in time. The consequent socio-environmental structure is

⁸ Page 5 - Wisner B., Piers Blaikie, Terry Cannon and Ian Davis. (2004) At Risk: Natural Hazards, People's Vulnerability and Disasters. 2nd ed. Routledge, New York.

⁹ Page 405 - Mitchell J.K. (1989) A contextual model of natural hazard. The Geographical Review 79.

¹⁰ Page 4 - Pelling M. (2003a) The vulnerability of cities- Natural Disasters and Social resilience Earthscan, London.

¹¹ Page 303 - O'Brien K.e.a. (2004) Mapping vulnerability to multiple stressors: climate change and globalization in India. Global Environmental Change 14:303-313.

compared to the framework of *semi lattice*¹² used by Alexander (1978). Slum households here are individual nodes in semi lattice structure where they are negatively affected by falling under some categories but benefit from linkages to other support networks within the same structure.

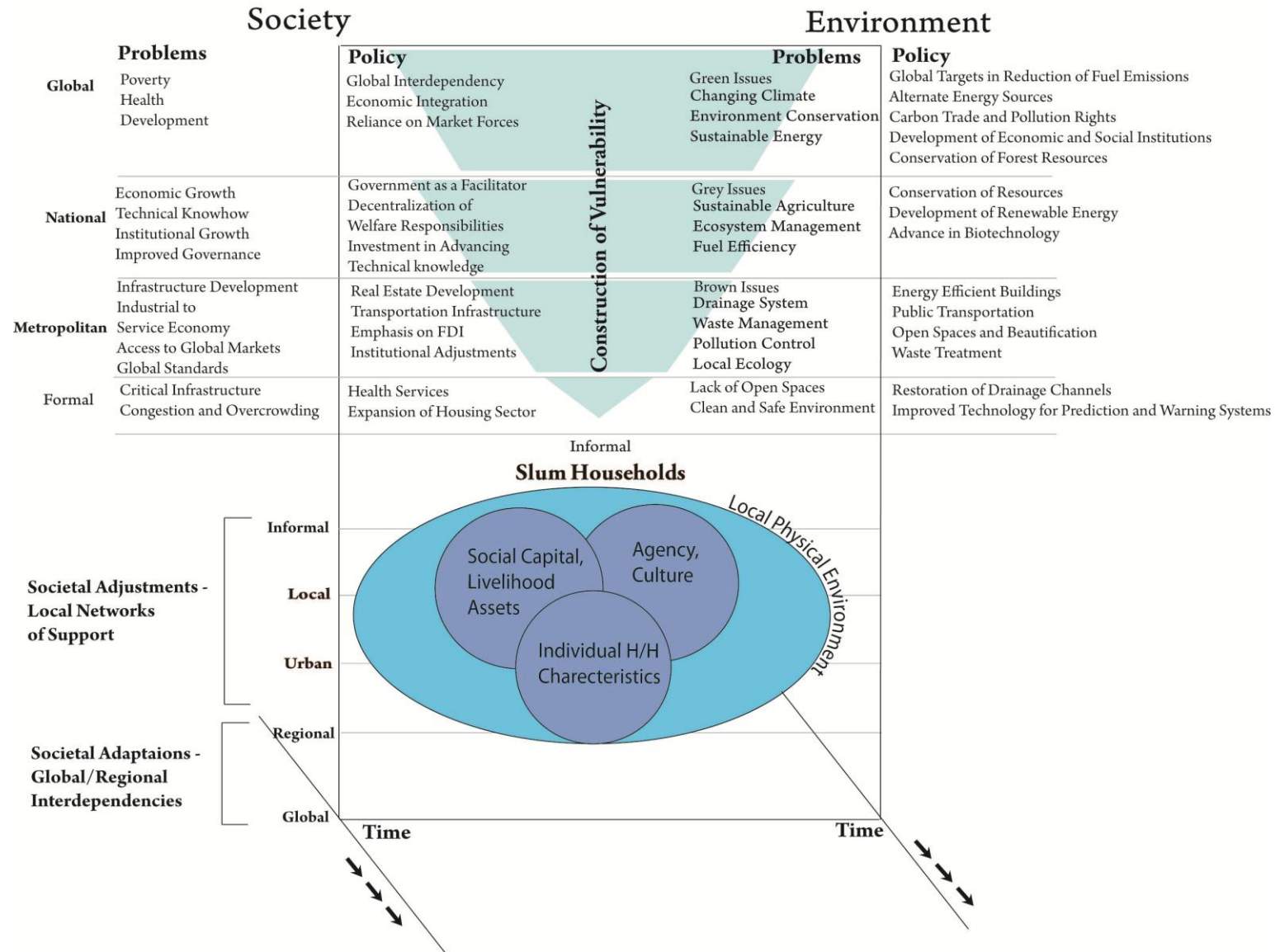
Conceptual Diagram

The dissertation focuses on one of the main challenges in developing a balanced hazard management system for third world mega cities - learning to negotiate the already existing imbalances, loopholes, and gaps that afflict marginal slum communities in these rapidly altering societies. Conceptual understanding of these places is limited by the complexity of overlapping societal processes that converge on them. In particular, hazard managers are poorly informed about the types of spillover pressures on slum communities that flow from the institutional approaches adopted to address other socio-economic and environmental problems at different scales. For example, separate sets of societal and environmental problems bear down on these neighborhoods from above, each accompanied by particular policy responses that often are shaped by different sets of responsibilities and capabilities at different scales, from the global through the local. In addition, within slum households there is a complex interplay of forces that affects the distribution and use of available resources to cope with these problems. Figure 1 is an effort to clarify the many different forces at work.

¹² Alexander C. (1978) A city is not a tree, in: S. K. a. R. Kaplan (Ed.), *Humanscape: Environments for People.*, Duxbury Press, Massachusetts. pp. 377 - 401.

The diagram can be broadly divided in two sections; the first section focuses on the construction of vulnerability and presents the multiple socio-environmental downward pressures while the second section shows the interplay of social structure, culture, agency and individual household characteristics within local ecological conditions and its combined impact on vulnerabilities and loss sharing strategies for slum dwellers. The diagram illustrates that slum households, while coping with flood risks are also constrained by stresses from social and environmental institutions that operate at different echelons. It argues that the influence of environmental and socio-economic problems and sets of policy approaches adopted to address these issues at global, national and metropolitan scales have considerable effect on the socio-environmental pressures experienced by slum households.

Figure 1: Conceptual Framework



This diagram highlights differences in the very nature of problems identified and addressed within the socio-economic and environmental frameworks and the apparent similarities and contrasts in the policy approach used to address these issues at each level. For example, at the global level, policies for addressing socio-economic problems of poverty, health and development have been articulated around notions of interdependent economic integration and accommodation of market forces. This partiality is also visible in other national and metropolitan levels as well in places where the problem of gaining access to global markets for local products is addressed by real estate development schemes. Furthermore, the identified global problems emphasize the need for improving human development by various means. These include: increasing income; adopting technologies to produce more resources such as food; increasing access to health services; and undertaking sociopolitical and cultural transformations to reduce inequalities based on gender, class and other socio-cultural identities (United Nations, 2007). Similar preferences are evident at metropolitan scales too. The Mumbai Human Development Report (2009) provides valuable indicators of absolute and relative deprivation in the city. It is patterned after the UN Human Development Index and also focuses on increases in income (MCGM, 2010) to resolve issues of inequity in Mumbai.

Similarly, global environmental change problems illustrate the increasing impact of green house gas emissions, large scale deforestation, sea level rise, changing weather patterns, loss of natural ecosystems, crop productivity, available resources such as land, water etc. The strategies adopted to deal with the imminent crisis at a global scale have been to invest in alternative energy sources, restructure economies to accommodate changing

environmental conditions, modify economic activities to adjust to changes in the environment, and the development of economic and social institutions to facilitate these adjustments (IPCC, 2007a). The approach to resolve ecological issues at the metropolitan level in Mumbai also focuses on procuring advanced technology to reduce fuel use, restore of local streams and designate open spaces.

The types of problems observed within both of these frames have apparent similarities and some differences. The evident buzz words in policy, such as inadequate resource base, advancement of technology to support larger population groups, etc., are common within both frames of analysis. The scarcity reduction-oriented approach that emphasizes improvement in technology and economic growth percolates down to other levels of governing and development institutions. As shown in the conceptual diagram, similar sets of socio-economic, environmental problems and goals move on to the national and metropolitan levels. However, interpretations of these problems and policy approaches at each level are also often altered under the influence of experiences from the past, or the ideologies and priorities of leaders and decision makers, etc. For example, at the national scale in India, problems are identified and the approaches to eradicate these issues are made in the context of the nation's focus on economic growth, reliance on scientific and technological methods and the remnants of a colonial past that primarily emphasizes political domination. This passage of ideas and priorities from global to national and national to metropolitan (via state level) therefore allows for transitions to occur in its interpretation and eventual implementation at a local scale.

The research here illustrates how cumulative pressures at every level aggravate risks and vulnerability for urban slum dwellers. In addition to the impact of these foregoing pressures, the slum communities are also subject to the physical risks of flooding. The societal adjustments that they deploy to offset flood impacts are influenced by sociopolitical entitlements, cultural ideologies, agency and individual household characteristics. The study determines the types of resources used by slum dwellers to address the manifold socio-environmental pressures and immediate hazard risks. In stressing the role of individual skills, cultural strategies and perceptions, social capital and livelihood entitlements, the study identifies frequently used hierarchical networks connecting resources from different sections of local and sometimes global society. These resources, depending on their scales of association, provide avenues for adjustments at the local level as well as adaptations at larger scales. Hence the study focuses on the potential cumulative effect that local practices may have on changing patterns of adaptation at larger scales by making non-linear multiple linkages with social and environmental institutions at different levels of society.

In this context, the research first argues that informal communities cannot rely on positive aids from formal/governmental institutions but must instead depend on alternative sources of support. Furthermore, it asserts that this disconnect is partly due to the types of strategies developed, and approaches adopted by formal planning and administrative institutions at larger scales of society. Hence, it contributes to the growing body of research that analyzes the ways in which marginalization is produced within the present structure of society (Cannon, 2002; Hoffman, 2003; Pomeroy, 2006; Prabhir, 2004;

Wisner, 2003b). The second broad contribution of the research is to highlight the importance of alternative support networks, and to examine how marginal populations such as slum dwellers in Mumbai acquire support from other formal and informal social institutions through networks, and how they deal with risks of hazards. It suggests that alternative sets of support developed by slum dwellers are products of a transforming society caught in a intersection of traditional and modern social structures, legal and illegal identities, and finally technocratic and democratic approaches to decision making. The dissertation focuses on societal adjustments that use locally available resources to produce required knowledge of the processes that affect acquisition, accumulation, arrangement and management of such resources.

Research Strategy

Collection of data for the study was undertaken during two trips to Mumbai; a short one month preliminary trip during floods in 2005 followed by another six-month visit in 2007. Field visits were used to collect primary and secondary, qualitative and quantitative data for national, metropolitan and household levels of analysis.

The study employs a baseline-trends departure method to identify and measure the shifting calculus of hazard vulnerability and resilience in transforming societies. It combines quantitative and qualitative data analysis to assess hazard mitigation policy approaches in India, and social response systems among marginalized urban population. The heart of the study is a series of questionnaire surveys, focus groups and interviews

with flood-exposed populations in Mumbai. These are supplemented by three levels (national, city, and local) of documentary research in public archives, government departments, local nongovernmental organizations, community development organizations and key interviews with representatives of government, development authorities, environmental conservationists, policy development officials at the national, state and metropolitan levels and other knowledgeable informants. It also uses field observations and analysis of maps and aerial imagery from different government and nongovernment agencies.

The research therefore has three different scales of analysis – a national level analysis of hazard events and its mitigation policy, a city level review of urban flood mitigation strategies adopted by municipal authorities in Mumbai, and a household scale assessment of flood risk, vulnerability and coping strategies of informal slum populations in L and P south wards of Mumbai. The methodology for household and focus group surveys is discussed in detail in chapter 6. The following paragraphs explain the research strategy employed at the national and urban scales and the analysis is presented in chapters 3, 4 and 5.

National Level Analysis

In the national level analysis the goal was to determine the trends in natural hazards, the changing impacts of disasters experienced and the hazard mitigation strategies adopted in the country. The analysis at this scale of study is exclusively based on secondary data

sources like the International Disaster Database of Center for Research on the Epidemiology of Disasters (CRED), Government of India, Planning Commission and Ministry of Home Affairs' documents on disaster management, environmental protection and climate change mitigation plans and status reports. First the national level analysis used CRED data¹³ to develop national trends in the frequency and impact of disasters in India from 1960 to 2008. Although CRED data has limitations such as missing information on the geographical extent of disaster impact, damages and insured losses, or from events with less than ten casualties, the dataset provides the basic information required to develop a general understanding of trends in natural hazards and their impact in India.

To examine the policy approach to disaster mitigation in India, the study first reviews national planning documents to critically analyze the underlying themes in addressing environmental risks and then employs textual analysis to identify priorities in policy approaches in different types of environmental policy documents. For the prior assessment it uses the eleven five-year plans since 1950 that were prepared by the Planning Commission of India to direct development goals for the country. For the second section of analysis the study uses acts, plans, reports and goals generated by the National Disaster Management Center with the Ministry of Home Affairs to discern the underlying conception of disasters and their mitigation in Indian policy approaches. Review of five-year planning documents focused on establishing the chronological progress of development priorities since independence in India. Furthermore, the review

¹³ For a disaster to be entered into the CRED database at least one of the following criteria must be fulfilled: (1) Ten or more people reported killed, (2) hundred or more people affected (3) Declaration of a state of emergency and (3) call for international assistance.

was used to determine the essential tones in interpretation of the environment, the influence of India's colonial past, and resultant challenges of resource scarcity on the value of environment and its impact on environmental policy design by the country. The textual analysis of environment/climate change and disaster mitigation policy was used to engage with the specific literature and identify deeper differences in tones towards environment and risk in society. For example, using the themes of risk, vulnerability, mitigation and disaster management, the objective was to identify the position taken by government to decide the approach the pools of knowledge used to address environmental conservation and disaster mitigation, the connections between challenges experienced, and the solutions implemented to address existing risk and vulnerability in society. The analysis was further used to determine if or how those solutions have become part of the present problem.

Urban Scale Methodology

At the metropolitan level of analysis, the study first aims to understand the impact of socio-economic changes on social vulnerability and environmental degradation and the changing relationships of hazard risk, vulnerability and mitigation in Mumbai (chapter 4). Second, it seeks to identify the specific approach to disaster mitigation in the city (chapter 5). This part of the study uses a wide range of sources and employs mixed methods of analysis. The first part of the urban scale analysis largely draws from secondary sources like meteorological records from regional offices at the Indian Meteorological Department, archives of the past newspaper reports, government

assessment reports of past flood events, evaluations on drainage in and around the city, assessments made by nongovernmental organizations, research and development organizations working in Mumbai. In order to understand the indirect impact of socio-economic, political and ecological processes on flood vulnerability the study uses published and unpublished development surveys and planning documents concerned with slum development, growth, composition and issues of older and newer slums, inadequate basic amenities, lack of land ownership among slum dwellers, as well as literature on political movements and struggles experienced in the city.

Table 1: Interviews Conducted for Urban Scale Analysis

Respondents	Organizations
Government Officials	BrihanMumbai Municipal Corporation (BMC) Chairman, Mumbai Disaster Management Plan Secretary, Relief and Rehabilitation Additional Municipal Commissioner, Control Room Safety Officer, Co-coordinator –Disaster Risk Management Mumbai Section Officer, Disaster Mitigation Cell P South Ward Commissioner P South Assistant Ward Commissioner P South Ward Chief Engineer L Ward Commissioner L Ward Chief Engineer Zonal District Municipal Commissioner L Ward Scientist, Indian Meteorological Department, Mumbai
Scientists and Researchers	Indian Institute of Technology, Civil Engineering Department Tata Institute of Social Science International Institute for Population Sciences
Planners and Planning Authorities	Chief Planner, Mumbai Metropolitan Region Development Authority Transportation Section Engineer, Mumbai Metropolitan Region Development Authority

	Director, Mithi River Development and Restoration Authority
NGO Officials	Apnalaya Greater India Friendship Kesav Gore Samarak Trust Bombay Urban Industrial League for Development (BUILD) Bombay Community Public Trust Jagruti Kendra Karmayog CORO for Literacy Sankalp Center for Slum Studies CEHAT Center for Environmental Research and Education Hari Masjid Committee Janvi Charitable Trust Action Aid Mahila Vikas Mandal Saher – Jogeshwari
Representatives of Private Companies	National Insurance Company Tata A I G Larsen and Toubro Ashirwad Industrial State Vakharia Industrial Estate Amrapalli Industries Samrooj Industries

Besides the secondary sources, the second section of analysis at this scale relied heavily on individual interviews (Table 1) conducted with key informants representing the government, public, private and the non-government sectors of Mumbai. The aim was to speak with diverse groups of stakeholders involved in the process of development, administration and disaster mitigation in Mumbai. Departments were selected on the basis of direct and indirect relevance to the issue of floods in the city. Selection of interviewees in government offices was dependent on who was delegated by the concerned officials to answer questions in each department. In addition to interviews of

designated government officials on floods issues, general discussion on specific challenges of pertaining to the department's jurisdiction, approach, and decision making processes were conducted with other officials. In total, 21 interviews were undertaken with officials of state, metropolitan and ward level officials. The interviews comprised semi- structured and open-ended questions that discussed issues of urban growth, current status and approaches to urban planning and development of city and infrastructure development, challenges in development, slum settlements and environmental concerns, and issues of hazard vulnerability and emergency response in Mumbai. Disaster mitigation plans of the city and two wards (L and P south were selected for household surveys) were also collected to assess the administrative planning approach to disasters.

The information collected was used to document - the disaster mitigation mechanism adopted post-2005 by Mumbai city authorities to manage future flood problems; the policies employed to negotiate environment protection; to ascertain institutional perspectives regarding public disapproval of policies adopted; state views of political debates concerning environmentally vulnerable and economically marginalized populations; and the underlying political pressures influencing decisions concerning environment and development in Mumbai. Hence the analysis, in addition to evaluating flood hazards in Mumbai, also draws out challenges of urbanization and development that are interlinked with the problem of floods. This assessment, presented in chapters 4 and 5, explicates the underlying themes and frameworks connecting hazard mitigation to economic development in megacities such as Mumbai.

Chapter 3: Dealing with Disasters in India

Disasters in India are frequent events. The country experiences all types of hazards¹⁴ but this research specifically examines natural hazards (particularly floods) in urban areas. However, before proceeding with the critical analysis of risks and vulnerabilities from monsoon floods in Mumbai, this chapter reviews the trends in the frequency, consequences and existing problems and limitations of hazard policy interventions in India. In doing so, the chapter identifies four sets of issues that complicate issues of hazard and hazard mitigation in contemporary third-world megacities. These are: (1) failure to perceive the changing relations between nature and society; (2) a narrow approach to development; (3) inability to adjust hazard mitigation plans to take account of constraints of cultural diversity, the emergence of new social structures, and the scope of local capacities; and (4) problems of integration and coordination among the many different stakeholder groups.

Hazards in India

India's tropical location and topography makes the region active in geomorphologic and hydrologic processes. Approximately 59% of its land area is prone to seismic activities; 8.5% of land is vulnerable to tropical cyclones (hurricanes) and 5% of land is flood prone (Figure 2) (Government of India, 1994). Since the country is highly populated and has

¹⁴ Events that originate in the biosphere, lithosphere, hydrosphere and the atmosphere are defined as natural hazards, technological events are explosions, industrial and transportation accidents, release of toxic materials and contaminations and sociopolitical crisis are communal riots and terrorists attacks.

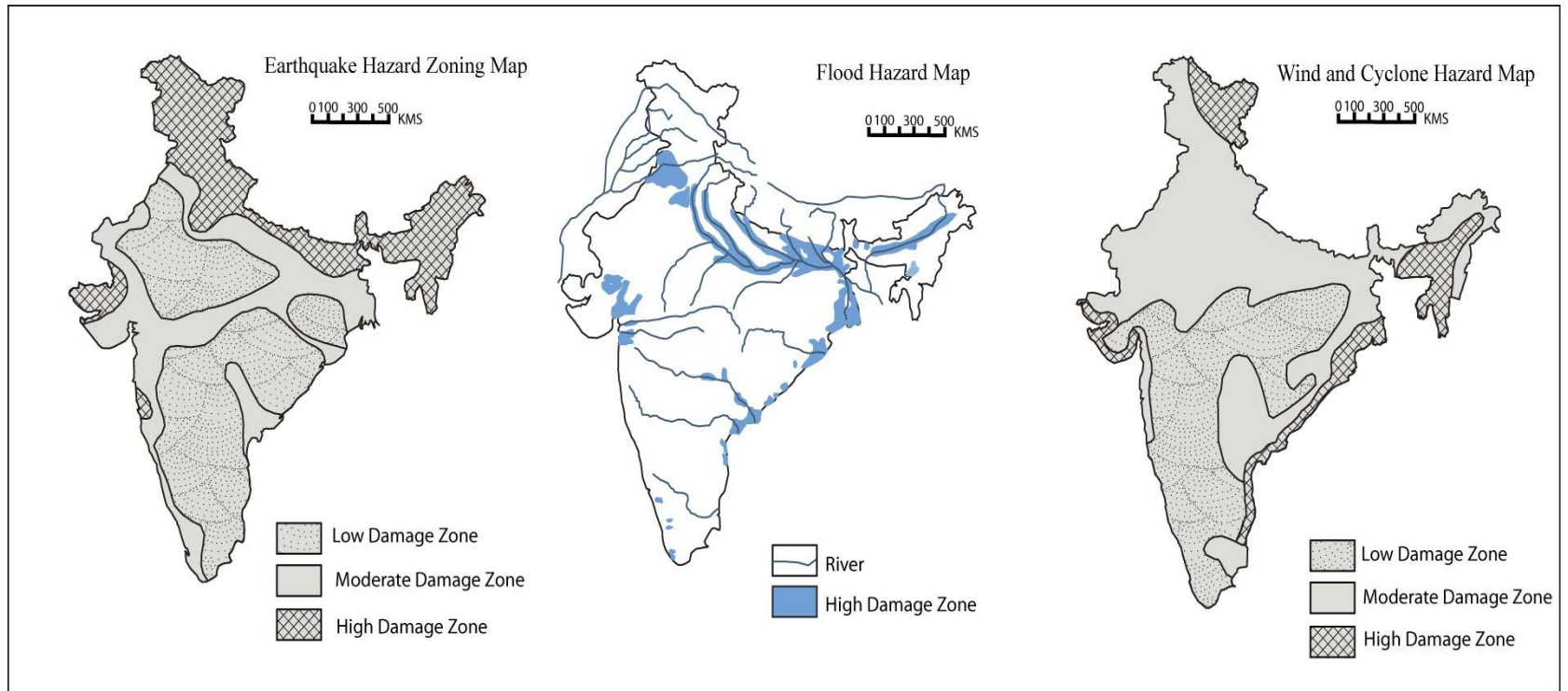
not applied a hazard preventive perspective to development, many of these events result in extensive damages and casualties that transform them into disasters.

The country experiences approximately nine disasters events per year¹⁵ (CRED, 2008). In the forty eight years from 1960 to 2008 there have been a total of 431 natural disasters¹⁶ in India. These include: 112 meteorological events (storm, local storms, tropical storms), 242 hydrological events (floods, flash floods, avalanche, landslide, storm surge), 22 geophysical events (earthquake, tsunami, landslide), and 55 climatological events (drought, cold wave, heat wave, forest fire) in India (CRED, 2008) (Table 2).

¹⁵ For a disaster to be entered into the CRED database at least one of the following criteria must be fulfilled: (1) Ten or more people reported killed, (2) hundred or more people affected (3) Declaration of a state of emergency and (3) call for international assistance. Although CRED data has limitations such as missing information on geographical extent of disaster impact, damages and insured losses, events with less than ten casualties, the dataset provides the basic information required to develop general understanding of trends in natural hazards and their impact in India.

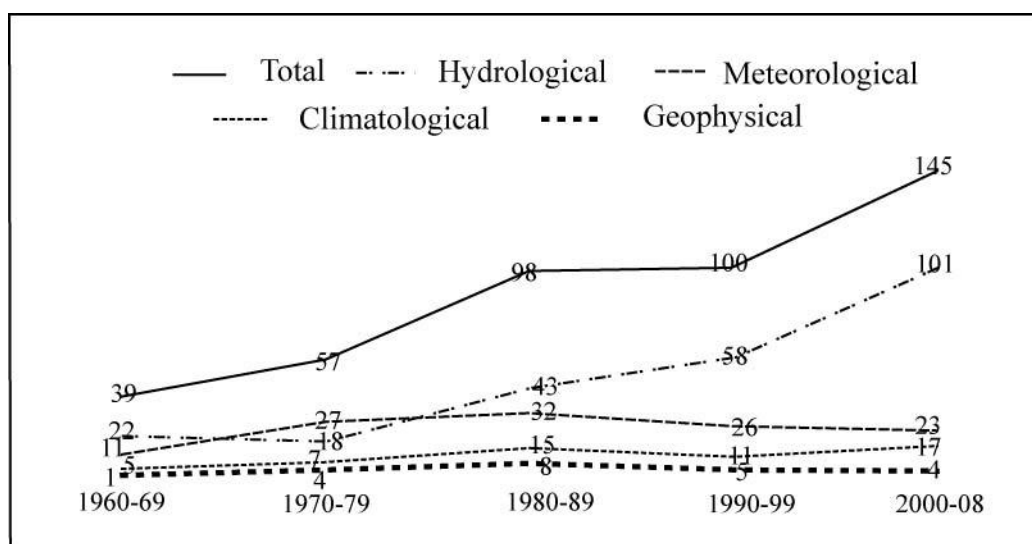
¹⁶ And 597 technological accidents (industrial accidents, miscellaneous accidents and transport accidents in air, rail, road and water)

Figure 2: Damage Zones in India



Source: (Government of India, 1994)

Figure 3: Natural Disasters (1960-2008)



Source: Compiled from CRED, 2008

The frequency of natural hazard events per decade since 1960 shows an increase from 39 events in 1960-69 to 145 incidences¹⁷ in 2000-08 (Figure 3). The data illustrates a rise in the frequency of all types of hazard events. The increase is however most pronounced for hydrological events, from 22 in 1960-69 to 101 in 2000-08. Meteorological and climatological events have increased markedly since the 1980s and they have also grown in intensity (Table 2). Processes of environmental change, extensive pollution and carbon emissions have played significant roles in increasing the intensity of climatological and hydrological events in this region. Drought conditions in the past ten years are partially the consequence of increasing regional pollution. For example, the observed ‘brown haze’ in 1999 led to a reduction of solar insolation (Ramanathan, 2003) that decreased the rapidity and intensity of atmospheric heating above the northern part of the Indian Ocean

¹⁷ Some of these increases could be attributed to better documentation

(Chung, 2006). This reduction has affected monsoon circulation in the region, with marked decreases in the rate of precipitation in the northern part of the Indian subcontinent. Furthermore, climate change related shifts in the frequency and intensity of rainfall have increased flood events in the western coastal and west central part of the country (Sathaye, 2006). Moreover, unusual meteorological events are also increasing due to quick and frequent increases in the ocean temperatures. However, in addition to the atmospheric factors that are producing more hazardous microclimates the increase of development and the concentration of populations in hazard-prone locations are also important drivers of losses.

Hazard Impact in India

In many parts of the world the analysis of hazard consequences is difficult and often incomplete because of the unreliability and ambiguity of disaster impact data (Alexander, 2000). These drawbacks are observed in the case of India too, but the general trends of losses in the country show that the impacts of hazards are directly dependent on factors like the type, timing and location of the events.

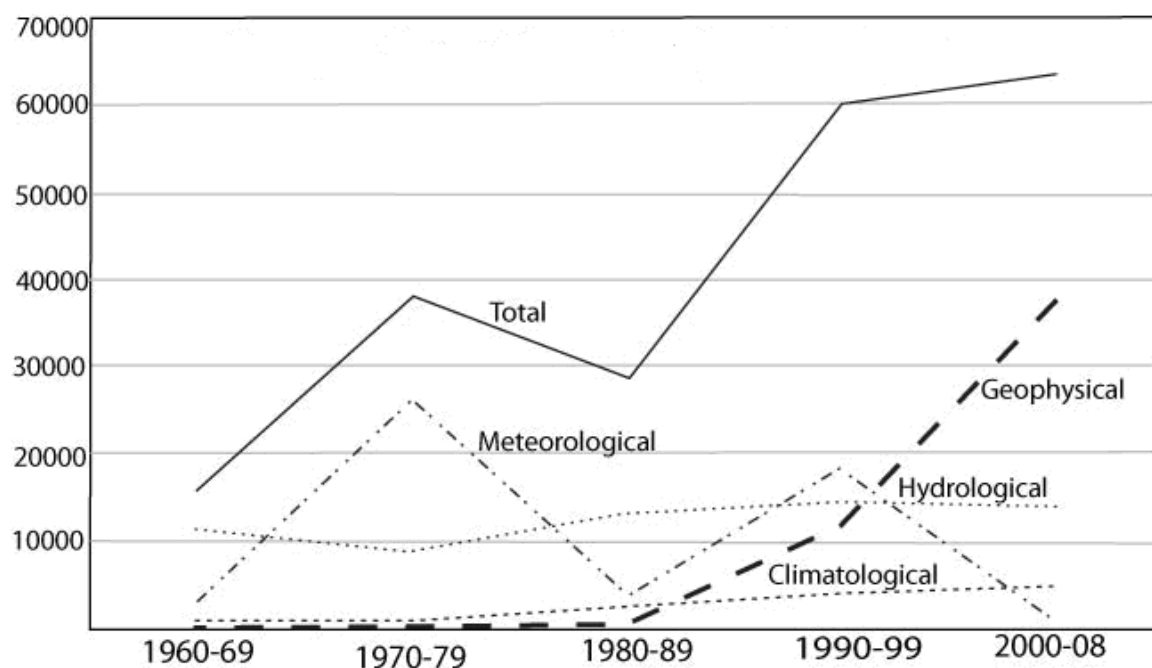
Table 2: Hazard Frequency and Impact in India (1960-2008)

Type of Disaster	Subtype	Numbers	In %	Casualties	In %	Total Population Affected	In %
Meteorological	Storm	26	21.8	2042	4.0	5287261	6.279
	Local Storm	16	13.4	2015	3.9	548918	0.652
	Tropical Storm	77	64.7	47624	92.1	78375116	93.070

Total		119	100.0	51681	100.0	84211295	100.000
Hydrological	Floods	184	76.0	50225	80.9	754345323	95.983
	Flash Floods	20	8.3	7212	11.6	23430801	2.981
	Avalanche	6	2.5	864	1.4	10456	0.001
	Landslide	29	12.0	3270	5.3	3828660	0.487
	Storm surge	3	1.2	489	0.8	4300000	0.547
Total		242	100.0	62060	100.0	785915240	100.000
Climatological	Drought	11	20.0	1500320	99.2	1061841000	100.000
	Cold Wave	23	41.8	4832	0.3	25	0.000
	Heat Wave	19	34.5	7448	0.5	200	0.000
	Forest Fire	2	3.6	6	0.0	0	0.000
Total		55	100.0	1512606	100.0	1061841225	100.000
Geophysical	Earthquake	20	90.9	33692	67.2	27264964	97.656
	Tsunami	1	4.5	16389	32.7	654512	2.344
	Landslide	1	4.5	45	0.1	0	0.000
Total		22	100.0	50126	100.0	27919476	100.000

Source: Compiled from CRED, 2008

Figure 4: Deaths from Disasters



Source: CRED, 2008

Deaths

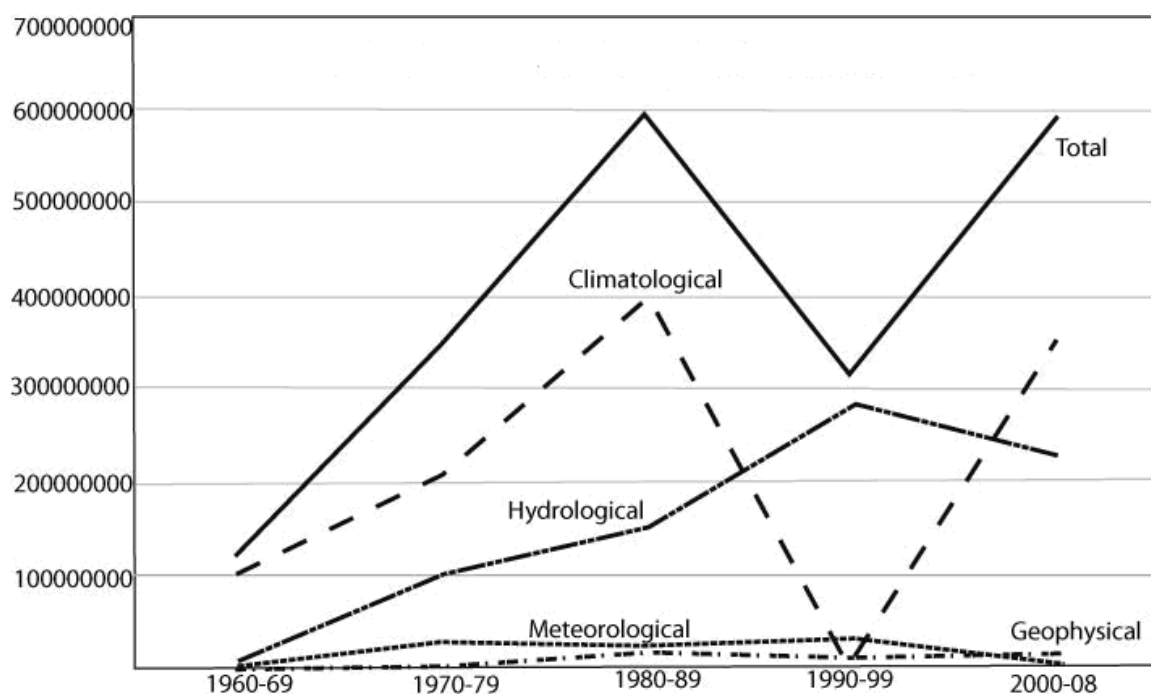
On the whole, numbers of deaths have increased significantly between 1960s and 2000s (from 15,000 per decade in 1960s to 63,000 in 2000s). There were sharp increases during two periods (1970-79 and 1990-99) with the latter trend being maintained to the present (Figure 4). Geophysical events have been particularly deadly during the 1990s and 2000s¹⁸, however climatological events like droughts are also responsible for an increasing number of deaths.

In the middle of the twentieth century, drought related famine and epidemics in India resulted in very high casualties. The consequences of the 1965 drought that continued for almost two years accounted for the death of 1.5 million people across the country. Although casualties from droughts have been much smaller since 1967, the number of droughts has been continuously on the rise. On average every year approximately 400 people die from tropical storms and cyclones in India, but in 1971 and 1999, the state of Orissa and in 1977, the state of Andhra Pradesh experienced high intensity cyclones that resulted in deaths of 9658, 9843 and 14,200 people respectively. Therefore, the decades of 1970s and 1990s were more deadly in this category of hazards too. Deaths from hydrological events in India have changed the least in the past forty-eight years. On an average 1300 people are killed from floods every year, with some exceptions such as specific events like a flash flood in 1968 that killed about 5000 people in Rajasthan and

¹⁸ Due to events such as the Uttarkashi Earthquake on 20th October 1991 that killed approximately 1500 people; Latur Earthquake on 29th September 1993 with 10000 deaths; Bhuj Earthquake 26th January 2001 – 20,000 deaths; and Tsunami on 26th December 2004 with 17,000 casualties.

Gujarat and floods in the Northeast region in the year 1978 that killed approximately 3800 people in one event.

Figure 5: Disaster Affected Population



Source: CRED, 2008

Affected Populations¹⁹

In India, population densities vary from 324 people per square kilometer to approximately 700 people per square kilometer in the Gangetic plains (Census of India, 2001) and more than 1000 people per square kilometer in parts of the vulnerable coastline (CIESIN, 2007). Hence the number of people affected by hazards is also growing rapidly. Between 1960 and 2008, the number of people affected by hazard events of all kinds increased from one hundred million to six hundred million (Figure 5). Increased numbers

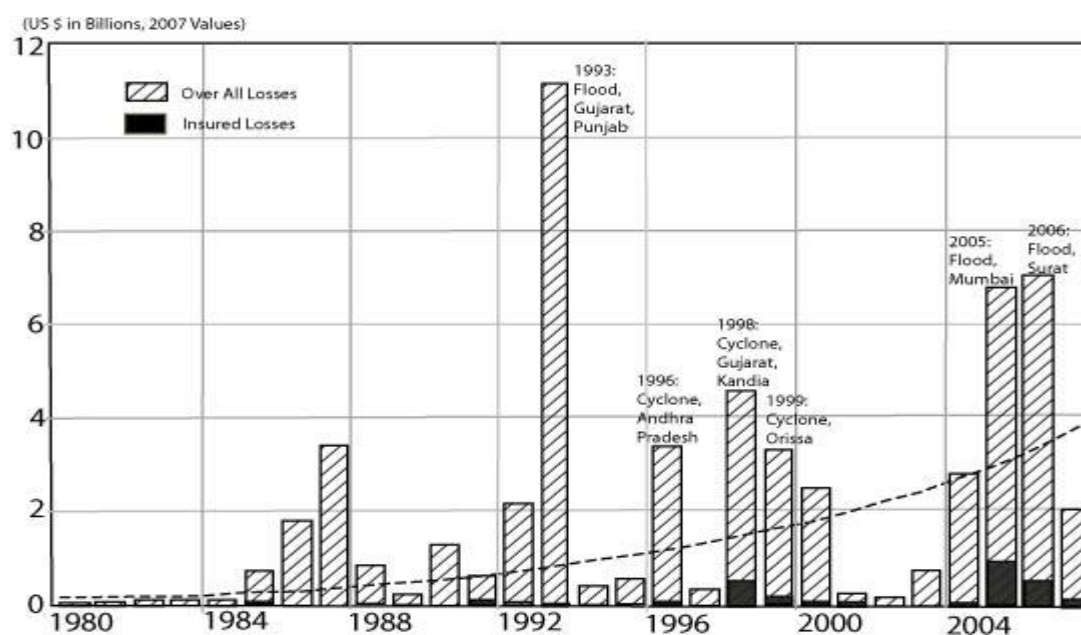
¹⁹ Affected populations are defined as the total number of people displaced as a result of the disaster event and need immediate assistance.

are due to the growing impact of these events on densely populated regions. Climatological and hydrological events have much larger spreads of affected populations than any other type of hazard. Furthermore, the patterns show that the decades of 1980s and 2000s have been more severe and have affected much larger groups of people. Differences between the temporal patterns of deaths and “populations affected” may be due to the prevalence of sudden-onset disasters (i.e. hurricanes and earthquakes) during the 1970s and 1990s and slow-onset chronic hazards (i.e. floods and droughts) during the 1980s and 2000s.

Cost

It is difficult to make an accurate assessment of hazard costs due to the lack of adequate data on the actual, direct and indirect cost of hazard events in India. However recent evaluations on the global scale show that annual losses from natural events have increased from approximately US \$10bn in 1990s to US \$190bn in 2000s (Munich Re, 2007). At a national scale, Munich Re’s review of increasing losses from weather related disasters in India since 1990s shows that economic losses have increased significantly in the past few decades (Figure 6). This trend is even more pronounced in the past few years with losses rising to US\$ 5.4 bn in 2005 and 6.2bn in 2006 (Munich Re, 2007).

Figure 6: Overall Losses and Insured Losses from Weather Related Catastrophes

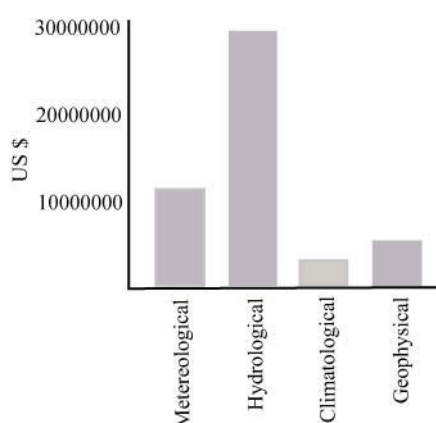


Source: (Munich Re, 2007)

Comparison of economic losses from different types of hazards shows that flood events are the most destructive type and that these events account for 77% of the overall losses and 66% of the insured losses in India (Munich Re, 2007). CRED data on damage costs from different type of disasters also assign maximum losses of US\$ 30 million²⁰ from floods in India (Figure 7).

²⁰ The difference between CRED data and Munich Re data could be attributed to the fact that CRED data is not adjusted to recent currency values.

Figure 7: Damages from Natural Disasters 1960 - 2008



Source: CRED, 2008

In addition to the threat of a changing climate and the increased intensity of weather and seismic hazards, several anthropogenic reasons including increasing populations and imbalances in development process contribute to the production of disasters and the rising consequences of hazards in India. Increasing population and the concentration of population in hazard prone places are putting more people at risk of physical hazards. Although percent decadal population growth rate for 1991-2001 shows a significant decline from 23.86 for 1981-1991 to 21.34, 181 million people were added to the population of India between 1991 and 2001 (Census of India, 2001). Projections for the next 100 years have many scenarios with the population of India crossing or nearly crossing the 2 billion mark in 2101 (Population Foundation of India, 2007). In addition to that, with excessive economic growth of approximately 6% per year since 1990s (Kohli, 2006), new assets have accumulated in form of development. This ongoing development is mostly located in places that are prone to severe hazards and therefore have contributed to producing new risks.

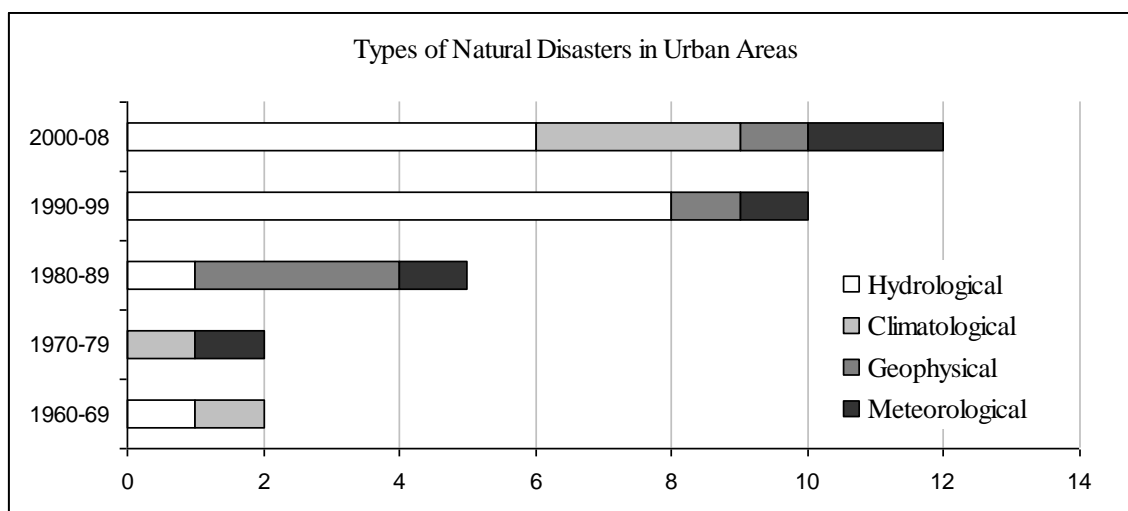
Hence, not all increases in hazard frequency and impact can be attributed to a worsening of natural risks. More serious consequences are also a product of failed development policies that have emphasized economic growth and wealth generation while neglecting sustainable and equitable development planning, which could have been implemented by integrating risk mitigation such as coping abilities and adaptation techniques in development strategies of the society (Wisner, 2003a). Instead, lopsided development has produced wide disparities between those benefitting from ongoing growth and those deprived of all advantages of progress. These discrepancies exist at different spatial and sectoral scales (Bankoff, 2004b) and are particularly pronounced and severe in urban areas (Mitchell, 1998).

Hazards in Urban Areas

Urban areas are examples of places where large scale disparities between the privileged and unprivileged populations are most apparent. Cities are also the centers where most of the ongoing economic development and population growth is located. As a result, it is no surprise that emerging trends show that urban hazards are becoming more common and devastating in India. An estimate of different types of disasters that have affected urban places in India between 1960 and 2008 shows 132 events; natural (31) and technological (101) (CRED 2008). These calculations do not include large area disasters that affected regions that contain cities. Although technological events like transportation accidents and industrial explosions are frequent in cities, they generally affect limited numbers of people in specific locations. Natural events usually affect a larger number of people in

cities and result in large scale losses. Furthermore, hazards in such urban settings are particularly complicated because any kind of extreme event triggers a hybrid set of events with natural, technological and social components (Mitchell, 1999).

Figure 8: Types of Natural Disasters in Urban Areas



Source: CRED, 2008

Hydrological events like floods are increasingly common in cities (Figure 8). Overcrowded cities without adequate drainage systems to draw off excess water during the rainy season have developed into a serious flood problem. Likewise faulty constructions in cities located in high seismic zones have resulted in heavy losses from destructive earthquakes. It is difficult to compare the specific urban impacts of different type of hazards because categorical data on the consequences of each type of event is not collected at the metropolitan level. However, considering the continuing concentration of people and development in urban locations, losses in cities are likely to increase.

In summary, a review of hazard events in India illustrates that (1) the country suffers from significant amounts of natural risks and these natural risks are increasing, possibly as a result of physical environmental changes only distantly connected with humans, and (2) losses are exacerbated by (Ross, 2008) lopsided development strategies that have been borrowed from places that are socially, culturally and historically different from India. Furthermore, unwise development practices and inadequate provisions for local social circumstances have increased risks from natural processes and social vulnerability.

Priorities in Development Planning

Planning for development has evolved through several stages in India under the supervision of a Planning Commission established in 1950 to assess the resources in the country and design plans that effectively utilize resources for development (Table 3). The task of the commission was to identify priorities for development and find strategies to resolve factors that encumber growth in the country (Planning Commission, 2009). The consequences of priorities that were pursued (and concerns that were neglected) at different phases of planning have played an important role in the production of environmental risks and socio-economic complexities that are apparent in the present-day distribution of vulnerability in Indian society.

Table 3: Priorities in Five Year Plans

Five Year Plans	Priorities
First (1951-1956)	Agricultural Production Land Rehabilitation

	Displaced Population
Second (1956-1961)	Economic Prosperity by Industrial Growth Employment Opportunities
Third (1961-1965)	Self Reliance in Agriculture and Industry Resource Management
Fourth (1969-1974)	Heavy Investments in Public Sector Industries Employment and Education Green Revolution
Fifth (1974-1979)	Inflation Food and Energy Scarcity Labor Intensive Technology, Self Employment
Sixth (1980-1984)	Regional Inequalities Employment Focused Production Targets Quality of Life
Seventh (1985-1989)	Emphasis on Employment Family Planning and Welfare Telecommunications and Transportation
Eight (1992-1997)	Inflation and Increasing Debt Diversification in Agriculture Private Sector Removing Global Trade Barriers Structural Modifications
Ninth (1997-2002)	Development in Rural and Agricultural Sector Infrastructure Development Liberal Market for Private Investment
Tenth (2002-2007)	Rapid Economic Growth Investor Friendly Market Reforms Improvement in Infrastructure Forest and Water Resource Management Science and Technology
Eleventh (2007-2012)	Rapid Economic Growth Increase in Employment Opportunities Infrastructure Growth in Rural and Urban Sectors Health and Education - specially for Women, Children and Marginalized Sections Climate Change

Source: Compiled from (Planning Commission, 1951; Planning Commission, 1956; Planning Commission, 1961; Planning Commission, 1969; Planning Commission, 1974; Planning Commission, 1980; Planning Commission, 1985; Planning Commission, 1992; Planning Commission, 1997; Planning Commission, 2002; Planning Commission, 2007)

The planning commission started with a centralized approach for its initial five-year plans. Immediately after independence, India's economy was weak with high unemployment rates, economic inequalities and lack of basic resources. The legacy of approximately 300 years of colonial rule in India left it with a broken and displaced society, depleted natural resources, and unavailable public goods (Banerjee, 2005; Iyer, 2004). The goals of the First Five Year Plan (1951-1956) therefore were to maximize production, increase employment, and establish an economically equal and just society (Planning Commission, 1951). Adopting a mixed approach, the Second Five Year Plan (1956-1961) continued to emphasize development and equity because;

'the task before an underdeveloped country is (was) not merely to get better results within the existing framework of economic and social institutions but to mould and refashion these so that they contribute effectively to the realization of wider and deeper social values' (Planning Commission, 1956).

The Third Five Year Plan (1961-1965) adopted a more intensive long term economic development strategy with goals of a 5% increase in national income every year, self sufficiency in the domestic agricultural production process, expansion of industries, and an increase in employment opportunities (Planning Commission, 1961). Since agricultural production did not register the growth that had been estimated, the Fourth Five Year Plan (1969-1974)²¹ stressed increasing agricultural output by introducing technological interventions like new varieties of cereal seeds, seeking higher prices, and better use of fertilizers, pesticides and water. Food security, reduced dependence on uncertain foreign aid and increased investment in public sector industries (Planning Commission, 1969) were the main priorities in this plan. The Fifth Five Year Plan (1974-

²¹ With widespread drought for two consecutive years in the country and the Indo Pak war in 1965-66 the years of 1966 to 1969 were operated on the basis of annual plans and the fourth five year plan was implemented from 1969.

1979) was formulated under the stresses of escalating inflation, reduction in food production due to drought conditions and shortages of power; therefore the food and energy sectors were prioritized (Planning Commission, 1974). Continued inflation and increasing poverty ensured the goals of improving economic growth, technological self reliance, progressive reduction of regional inequalities and reduction in the population growth of the country during the Sixth Five Year Plan (1980-1984) (Planning Commission, 1980). The Seventh Plan (1985-1989) was designed to lay the foundations for the next 15 years. Besides the basic agendas of the agricultural and energy sectors the seventh plan prioritized addressing the growing population and the lack of employment opportunities and infrastructure in the urban and rural sectors (Planning Commission, 1985).

The Eighth Plan was launched in 1992; it marked a clear change in the role of both the planning commission and the government in the development process. With growing corruption, economic stagnation, failure of the public sector and growing global pressure, it was deemed important to harness;

‘the latent energies of the people through people's involvement in the process of nation building and the creation of an environment which encourages and builds up people's initiative rather than their dependence on the Government and which sets free the forces of growth and modernization. The State has to play more of a facilitating role and has to concentrate on protecting the interests of the poor and the underprivileged’ (Planning Commission, 1992).

Hence, to be internationally competitive and address problems of budgetary deficits and public debts, the government adopted a free market outlook with the intent to enhance economic efficiency. With open market strategies, the Ninth Five Year Plan (1997-2002)

highlighted the need for equity in terms of development in the rural and agricultural areas to address the *'integral link between rapid economic growth and the quality of life of the mass of the people'* (Planning Commission, 1997). The Tenth Plan (2002-2007) continued with the transition of the government's role in the development process. As a facilitator, the government adopted flexible fiscal policies to encourage a suitable environment for improved performance of the private sector (Planning Commission, 2002). In the Eleventh Plan (2007-2012) *'growth (of 7.7 % per year) was not perceived as being sufficiently inclusive for many groups'* (Planning Commission, 2007) and therefore policies were made to be more inclusive especially for the schedule caste²², schedule tribe, religious²³ minorities and gender differentiation by a strategy of *'rapid growth that reduces poverty and creates employment opportunities, access to essential services in health and education especially for the poor, equality of opportunity, empowerment through education and skill development, employment opportunities'* (Planning Commission, 2007).

As the preceding paragraphs demonstrate, over the past half century India's development priorities and strategies were limited by the country's underlying socio-cultural, political and historical circumstances. Many of these were typical hardships faced by postcolonial countries attempting to acquire the institutional structures of modern society in the face of resistance by traditional structures and ideologies. However, differences in societal structures are not the only constraints that have affected the country's development

²² Scheduled Castes and Scheduled Tribes are population groups that are recognized as depressed classes by the Constitution of India.

²³ The Constitution of India recognizes sections of people who, on account of their non-dominant position in the country and state, and are considered as targets of discrimination – e.g. Muslims, Christians, Sikhs, Buddhists, Parsis

process. Plans in India have often had to address immediate political, social, economic, and environmental emergencies. After independence in 1947, the society was fragmented, impoverished, unemployed and unskilled, malnourished and lacking basic resources like food and shelter. In addition, the country also received high influxes of refugees from West Pakistan (approximately 9 million) and east Pakistan (approximately 6 million) (Planning Commission, 1951), who settled in urban places like Mumbai, Kolkata and Delhi. The resulting weak condition of the country's population after independence placed a great deal of pressure on the development strategies.

Approach to Disaster Management²⁴

During the 20th century, the Indian sociopolitical and economic system has gone through large scale changes that transformed the country from a group of loosely connected colonies to a newly independent modern state on a path of progressive economic growth. This transformation has initiated ideological, sociological and technological changes throughout society. These have altered the definition of basic concepts that guide society, influenced the nature and distribution of fundamental resources used by it, and affected the nature of interactions between society and environment. Most strikingly for the purposes of this study, these changes have also influenced the manner in which the physical environment is used and altered, including the ways in which risks and vulnerability are produced and distributed. Disaster mitigation strategies are changing but the approach that has been adopted is far from perfect.

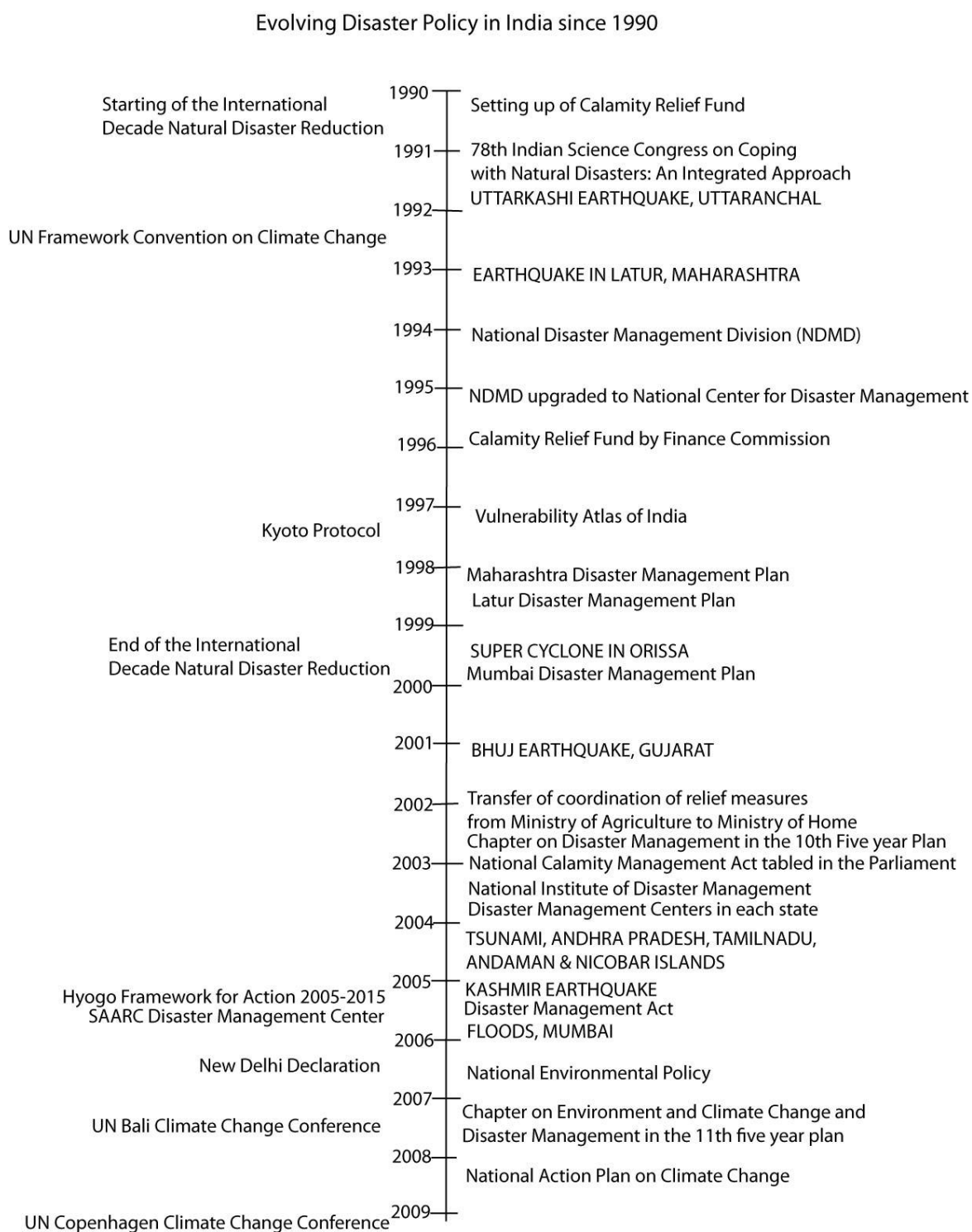
²⁴ Policy in India has approached hazard from a disaster perspective and therefore is focused at managing the disaster and not mitigating the hazard.

Disasters are common in India, yet planning specifically for disaster prevention and mitigation have emerged only recently. However, measures intended to reduce the impact of floods and droughts on crops and livestock were included in the national plans as early as 1965 under the jurisdiction of the Agriculture Ministry. As discussed before, at that time increasing agricultural production was a high priority so reducing the effect of floods and droughts via efficient water management techniques was included as a goal by the agriculture and irrigation divisions. Structural mechanisms (dams, canals, embankments) to control floods and effectively distribute water in arid regions were preferred. Vulnerability reduction measures were focused on traditionally ‘backward’ rural communities by providing them better means of irrigation. Some of the schemes undertaken by the Ministry of Agriculture to reduce the consequences of flood and drought hazards were: an integrated wasteland development program, drought-prone area program, and desert development program; an accelerated rural water supply program, and a rural livelihood program (Government of India, 2004). In addition to watershed management initiatives, sustainable livelihood strategies were also incorporated to support asset building for the rural poor. Rural development schemes such as *sampoorna gramini rozgar yojana* (comprehensive village employment plan), *indira awaas yojana* (indira housing plan), rural sanitation programs, credit cum subsidy schemes, information, education and communication, and national social assistance programs were all established to reduce rural vulnerability to socio-economic and environmental pressures. Besides issues of floods and droughts, other hazards were assigned to specific ministries; for example, earthquakes and cyclones were treated as emergencies and

therefore addressed by the Ministry of Home Affairs, technological events such as rail accidents fell under the jurisdiction of the Railway Ministry, air disasters under the Ministry of Civil Aviation, chemical disasters under the Ministry of Environment and Forest, epidemics under the Ministry of Health and nuclear disaster under the jurisdiction of the Department of Atomic Energy. Until the 1990s the national planning commission provided the state with funds to address sudden problems of a disastrous nature (Kapur, 2005), but no specific funds were assigned annually to each state for purposes of disaster prevention.

With growing losses from natural hazards in India and global concerns about environmental hazards, the approach to hazards and their mitigation underwent a shift in the 1990s (Figure 9). Planning in this decade accentuated the importance of building disaster prevention into the development process. These changes adopted since then have tried to restructure the government along these lines. The new perspective emphasized a multi-disciplinary approach that increased investment in preventive mitigation, which was intended to reduce the cost of losses and expenditures for relief and rehabilitation (Government of India, 2004). In 1994, to further develop this coordinated strategy, the national disaster management division (upgraded as the National Center for Disaster Management in 1995) was established under the Ministry of Agriculture. In 1994, responsibility for attending to loss of human life and relief from drought and famine was transferred to the Agriculture Ministry (Kapur, 2005). However, in 2002 responsibility for relief and rehabilitation was transferred from the Ministry of Agriculture to that of Home Affairs.

Figure 9: Evolving Disaster Policy in India Since 1990



Source: Compiled from (Government of India, 2004; Government of India, 2005; Government of India, 2008; Kapur, 2005; Planning Commission, 2002; Planning Commission, 2007)

The change was the first step taken at the national level to reorganize the disaster mitigation and prevention machinery in the country. The first separate chapter on disaster management was included in the Tenth Five Year plan. In 2003, it was followed by setting up 25 disaster management centers, one in each state. The Disaster Management Act of 2005 further consolidated this strategy by adopting institutional changes in support of disaster mitigation. It proposed creating a national and state level emergency management authority to prioritize several functions including pre-disaster mitigation, preparedness and coordination of different agencies and departments with a view to decrease disaster losses.

This approach organizes institutions into a multi-tiered system that connects national, state and district governments. It converts existing relief and rehabilitation departments into disaster management divisions that have combined responsibilities for regional relief, rehabilitation, preparedness and mitigation. The Act recommended measures at the national and state level to fund relief assistance by setting up a calamity relief fund (CRF) in each state, and a national calamity contingency fund (NCCF) at the center. The Act in 2005 has also initiated codes for developing suitable disaster management plans at all administrative levels, adopted building codes for construction in urban and rural areas, and established a national disaster management force to be exclusively trained for rescue and relief.

Following the passage of the Disaster Act of 2005, a separate chapter on climate change and disaster management was added to the Eleventh Five Year Plan (for 2007 through 2012), and the prime minister released the first National Action Plan on Climate Change (NAPCC) in 2008. The national environmental policy established in 2006 introduced new clauses requiring environmental clearance notification for development plans and this goal was strongly enforced in the Eleventh Five Year Plan. National policy now supports conservation of critical environmental resources, intra-generational equity (by securing livelihoods of the poor), inter-generational equity, integration of environmental concerns with socio-economic development, efficiency in environment resource use and environmental governance (Government of India, 2009). Likewise NAPCC proposed the identification of *'measures that promote (our) development objectives while also yielding co-benefits for addressing climate change effectively.'*²⁵ It categorized missions in eight sectors; solar energy; improved use of energy; sustainable habitat; efficient use of water; Himalayan ecosystem; green India; sustainable agriculture; and an increase of strategic knowledge on climate change (Government of India, 2008).

There has been progress over the past half century but existing environmental and disaster mitigation policies have the following general limitations. First, although policy makers have initiated attempts to mitigate consequences of climate change via policies and regulations, these efforts have not been integrated with strategies of disaster risk reduction. The reduction of climate change impacts is mostly addressed by policies that

²⁵ Page 1 - PEW Center on Global Climate Change. (2008) National Action Plan on Climate Change, PEW Center on Global Climate Change. pp. 3.

increase efficiency of energy use and conserve natural resources proactively in support of continuous economic growth, while disaster risk reduction is mostly undertaken only after disasters occur. Moreover, even though vulnerability is rising due to a combination of climate changes and other socio-environmental changes, national policy does not address both in an integrated manner. Second, environmental and disaster policies clearly focus on rural areas. For example, policies focusing on sustainable development have highlighted securing the livelihood of vulnerable populations in the rural sector. Cities have hosted a substantial share of the country's marginalized and displaced population since 1950s, which is a sector that is growing rapidly in all cities and towns in the country. However, very few attempts have been made to support the livelihoods and understand the vulnerabilities of the urban poor. Interventions and programs specifically designed for the urban poor are therefore lacking in the development plans of the country. Third, while there is much emphasis on developing and connecting socio-environmental institutions at the regional, national and global scales (like the SAARC, DMC), there are few efforts to understand the workings of local institutions or to build connections among them in order to increase their role in vulnerability reductions schemes (Duryog Nivaran Secretariat, 2008).

With the preceding as background, it is now time to summarize the main deficiencies of India's hazard policy approaches.

Gaps in the Emerging Disaster Policies of India

In the decades between 1950 and 1990, disasters were considered the consequence of a disaster-prone physical environment that generated periodic emergencies to be addressed only after their occurrence. Even with changes like the Disaster Management Act in 2005 and increased awareness of environmental change and its consequences, the approach to disaster mitigation is still inadequate to address the complexities of changing risks and vulnerabilities because it is particularly limited in its ability to reduce the underlying causes of hazards in India. These limitations stem from flawed assumptions that were used in designing development or risk reduction plans, from the narrow range of alternatives that have been employed, and finally from failure to take into account of essential socio-cultural constraints that complicate the disaster mitigation process. To understand and address the problems of worsening hazards and their consequences in India it is essential to develop policies that are informed about several matters. These include: the complex interaction of society and environment, the role of old social organizations and emerging socio economic structures in producing both vulnerability and resilience, a wider notion of development and the ability to integrate multiple perspectives to develop a holistic plan of sustainable and equitable development. Let us now examine each of these topics in more detail.

Failure to perceive the changing relations between society and nature

Since independence, problems with hazards in India are assumed to be a product of inadequate resources to fulfill the needs of the country's population. As a result, planning was driven to provide mechanisms designed to support maximum production of raw materials and food supplies. For example, the severity of famine in 1965-67 was due to agricultural drought conditions that were deemed to be caused by insufficient infrastructure to maintain soil moisture and thus maximize use of available resources to increase agricultural production. Subsequent national plans therefore emphasized technological and structural development like dams, channels, and advanced irrigation systems to better distribute water resources in the arid regions. Since then, the main causes of drought in India have changed significantly. Overexploitations of water resources and changes in metrological conditions have reduced rates of rainfall in the South Asia region. In 2002, 49% of districts in India experienced deficient rainfall (Center for Science and Environment, 2003) and recent research on monsoon trends shows a decrease in rainfall due to a reduction of sea surface temperatures (Chung, 2006). Droughts in India, therefore, are no longer attributed to inadequate resources or infrastructure but to altered weather patterns. Despite the changing nature of the risks however, the approach to mitigating risks of famine still exclusively focuses on *'increasing efficiency of water use, explore options to augment water supply in critical areas and ensure more effective management of water resources'*²⁶ (Government of India, 2008). Similarly in the societal sphere, the distribution of vulnerability has also

²⁶ Page 32

experienced significant changes. Social stratification in India has been the primary cause for the uneven distribution of resources and power. Hence development initiatives to assist poor and disadvantaged populations have been prioritized. Special programs and subsidies to assist classes like poor rural populations, schedule castes and tribes, women and children were implemented to include them in mainstream development. As a result, vulnerability is no longer concentrated in these sectors; poor marginalized populations are not concentrated in rural areas because many have moved to cities. However, development strategies continue to focus on *'social sector schemes like women and child development, rural development, drinking water, and sanitation'*²⁷ in rural areas (Planning Commission, 2007). Planning for disaster mitigation in India fails to understand the transitions experienced over the last sixty years and continues to focus on sectors that had needed attention during the beginning of development planning. It is therefore essential for effective disaster mitigation planning to be based on a clear understanding of the processes that are changing the environment and society and the relation between them. They need to identify the components that are improving for better, degrading for worse and /or remaining dormant in this process of transformation.

Narrow Approach to Development

The tyranny of technology has produced a constricted version of development in Indian society. Disaster mitigation and sustainable development have been reduced to what is technologically possible. Other means of societal adaptations have not been considered.

²⁷ Page 211

These involve the organization and development of robust civic societies based on reevaluations of national values, ideologies and goals of social equity and a participatory approach that encourages balanced strategies. The penchant for technological solutions also privileges the position of experts and authority agencies in decision making and diminishing the role of local populations and civil society (Visvanathan, 2002). Without inputs from the public, the plans become prescriptive and un-implementable. Disasters have been reduced to '*emergencies*' and mitigation has been minimized to '*response*' for the purpose of disaster management in India. Integration of disaster management with development processes is reduced to prioritizing '*development projects that address mitigation (emergency response)...according to the guidelines issued by the government*' (Government of India, 2004). These '*projects with disaster risk reduction built in*' (Planning Commission, 2007) treat hazard risk as a contingency requiring an emergency response plan and not as a condition that has to be either mitigated or adapted to by fostering different approach to development. It will not be possible to achieve effective disaster mitigation without finding a sustainable solution to the imbalances of increased risk and vulnerability in society.

Existing and Emerging structures in Society

A highly stratified Indian society divided on the basis of socio-cultural characteristics such as religion, caste, language groups, political ideologies, and region makes implementation of disaster mitigation strategy an intrinsically local process. The constricted mechanisms of existing plans are unable to provide for such a socially diverse

community. Although the development plans recognize *'the question of vulnerability in a comprehensive sense where vulnerability could also be social, ecological, organizational, educational, attitudinal, political, cultural and economical'* (Planning Commission, 2007) they do not operationalize this knowledge. Disaster mitigation plans in India are designed without taking these socio-cultural identities and perspectives into consideration.

The reduction of hazard risk and vulnerability requires robustness and redundancy (Ross, 2008) that make provision for flexibility and alternatives. Disaster policies in India however are lacking in these respects. Considerable efforts are put into the initial (emergency) stages of the hazard cycle, while very little attention is given to facilitate long term recovery, especially among vulnerable populations. Alternatives chosen to mitigate disasters in India are mostly limited to prediction, emergency preparedness and response. As described in official documents the government encourages the

'setting up of agencies that oversee and fund the predictions, preparedness and response process; a specialized national disaster response force; civil defense for local response; training and capacity building; including disaster management in curriculum of middle and high school education; training of engineers and by laws for safe construction techniques; web enabled inventory of resource to reduce emergency response time and do's and don'ts for public awareness'
- (Government of India, 2005).

As far as policy interventions are concerned, disaster vulnerability is considered a circumstance and not an underlying condition; therefore measurement, prediction and structural means of controlling the physical environment are considered the most important means of reducing vulnerability. However, because vulnerability is an

underlying condition this cannot be the only approach to effective risk and vulnerability reduction. Equal emphasis is required to develop societies' ability to reduce losses from disasters by improving their capacity to cope with the consequences.

Since it is important to incorporate the adaptive capacities of social institutions (Adger, 2006), lack of knowledge about the capacity of social and private institutions to redistribute losses and support recovery makes the present approach to disaster mitigation excessively rigid. Exclusive reliance on government leaves out sectors of the population and places the control of developing strategies and the decision making process in the hands of experts and government agencies. For example, informal settlements in cities cannot benefit from programs of safe construction laws, training or capacity building mechanisms because they fall outside the legitimate boundary of government jurisdiction. With limited alternatives, and being excluded by agencies that develop the strategies, such vulnerable communities are further marginalized. Under these conditions, vulnerable populations only indirectly rely on government agencies for assistance with the first three stages of the hazard cycle (prediction and preparedness, response, relief and rehabilitation) and use individually developed social support systems based on old and new non-governmental networks of assistance to recover from long term losses. These can add important layers of safety for vulnerable and marginalized populations even without being recognized and integrated into the formal means of long term mitigation.

Problems of Integration and Coordination

Issues of integration and coordination are not limited to India but are common in developed countries (Mitchell, 2004) and in the global context (ISDR, 2008). Furthermore, problems of integration are not limited to effective disaster response and mitigation strategies. In India until 2005, disaster mitigation was approached solely from a relief and rescue perspective. The Government of India enacted the Disaster Management Act in 2005 to change its limited approach to a holistic, multi disciplinary, multi dimensional, and multi sectoral disaster mitigation system (Swarup, 2007). This act was an effort to integrate different echelons in administrative departments and government agencies but its scope is limited to within the government's tree like structure. Understanding the socio-ecological complexities of hazard risk and vulnerability requires a common platform to find linkages between social and ecological realms, disciplines, socio-environmental and economic sectors within different cultures. Mitigation of risk is only possible with integrated and simultaneous implementation of all types of approaches. For example, integration and coordination is required even between the traditional and emerging structures and values of society so that such diverse perspectives can co-exist and substantiate mitigation and adaptation. Therefore, integration efforts within the government structure are just the restructuring and reorganizing of the governing body. The scope of integration and coordination is necessarily much larger in India's highly diversified and changing society. It requires multi level and sectoral interactions within society, which, cannot be limited just to its government agencies. Specifically in the case of India, it requires a platform to integrate

multiple voices to participate in the decision making process, something that is lacking in the present approach to disaster mitigation.

Conclusion

Disaster trends in India illustrate a steady decade by decade increase in frequency of hazard events. Deaths from these extreme events display a general but irregular upward trend, but there are much wider decadal swings in the affected populations. The trend in economic losses is a clear escalation although year to year total costs are highly irregular. About 30% of the hazard events have affected urban areas. Although urban areas have experienced a range of geophysical, meteorological and hydrological events, losses from floods are clearly predominant in cities of India. This is partly because official policies for economic development in cities have ignored hazard impacts and exacerbated urban flood hazards. National policies for hazard management have become more organized since 1990, often prompted by specific disaster events and a rising global concern for the potential impacts of climate change. The disaster mitigation approach adopted in India, however, is primarily reactive and relies on technological solutions. Although there has also been increased recognition of the need for improved hazard mitigation, progress to implement such schemes (especially in urban areas) has been slow and there is a general disconnect between national planning and specific programs for the management of hazards in urban areas. The existing system of hazard mitigation policy in urban areas has many deficiencies. First, it is not aware of changing characteristics of natural hazards and society in urban places. Second, it is weakened by loopholes and unplanned

consequences of development strategies. Third, it does not recognize the role of the diverse communities whose hazards require mitigation; nor does it explore opportunities for incorporating them; or for integrating the disparate elements that comprise hazard mitigation alternatives. Although emerging hazard mitigation policy propagates the integration of development and hazard issues, it does not spell out how the two frameworks are integrated and or how they can be applied at a local scale. *'The devil (therefore) is in the detail and it all depends on how development is defined'*²⁸. The rest of the dissertation uses the case of monsoon floods in Mumbai and the four sets of limitations identified here to examine in detail hazard and its mitigation in cities of India.

²⁸ Page 53 - Duryog Nivaran Secretariat. (2008) South Asia Disaster Report 2008, Duryor Nivaran and Practical Action, Colombo, Sri Lanka. pp. 90.

Chapter 4: Mumbai - The Ever and the Never Changing

Mumbai is a constantly transforming megacity, changing in name²⁹, population, land use and land cover, economic activities, democratic ideologies, political agendas, social identities, cultural expressions, physical risks and social vulnerabilities. An efficient disaster mitigation strategy for cities like Mumbai will need to understand and take account of these changes. It will also have to find ways of overcoming resistance to other changes that are sorely needed.

Physical Setting

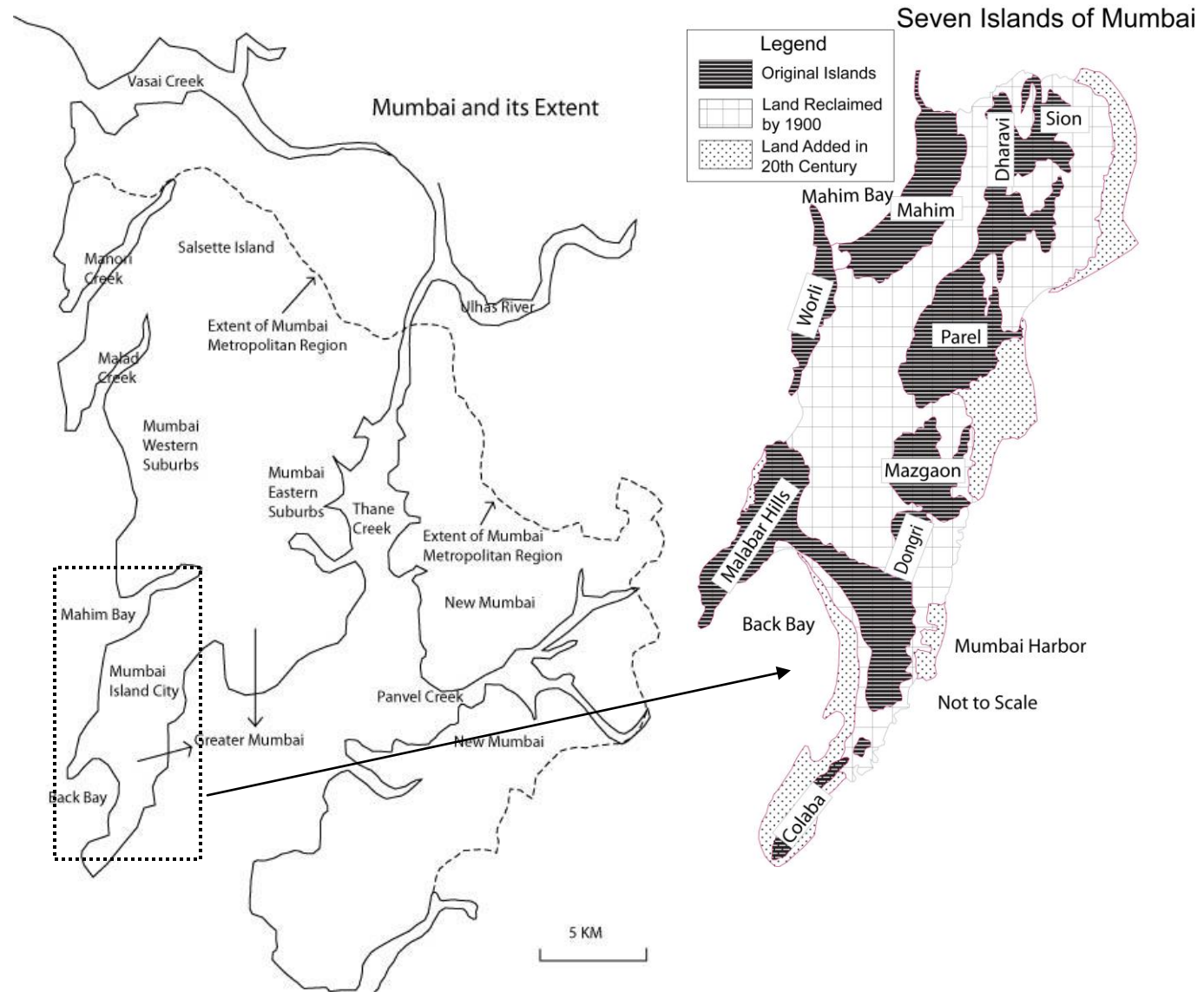
Mumbai city occupies an island separated from the mainland by Thane Creek and Harbor Bay. The land on which the city sits was reclaimed from swamps that separated seven smaller islands named Mahim, Worli, Malabar Hills, Dongi, Panel, Dharavi and Malegaon (Figure 10). Low ridges mark the western and eastern edges of Mumbai Island and the city proper is located in the low lying center that was filled with materials excavated from the surrounding hills. Mumbai has expanded to incorporate suburbs on its north and eastern sides and has grown into Salsette Island in the north and Trombay Island to the south east (Figure 10). These three sets of islands were separated by tidal flats and creeks which have been reclaimed and filled to support the expansion. The

²⁹ Mumbai's many names – Mamhai, Manbai, Mayambu, Mombaim, Mombayn, Boabaim, Boavida, Bombahia, Bombaiim, Bombayim, Bombeye, Boonbay, Bambai, Slumbai, Bombay, Mumbai (Dwivedi S.a.R.M. (1995) Bombay: The Cities Within India Book House Pvt Ltd: Eminence Designs, Bombay.)

climate of Mumbai is dominated by heavy southwest monsoon rainfall in the months between June and September. The rest of the year experiences an oppressive and humid summer during March to May and a mild winter from November to February. Most rainfall (approximately 95% of the annual total) occurs during the monsoon season (Appendix 2). Average annual rainfall during this period is approximately 1920 mm.

During monsoon season, Mumbai often experiences severe flooding. In the past, daily record rains have been recorded on 10th September 1930 (21.58"), 4th July 1974 (22") and on 26th July 2005 (37") (Government of Maharashtra 2005). However not all parts of the city have equal precipitation rates during such events. For example on July 26th 2005, Colaba, in the south, received only 73 mm (3") in comparison to Santa Cruz (977mm, 37") in the north. The 2005 event is explained as the result of four simultaneous atmospheric processes: (1) development of low pressure over the northwest Bay of Bengal; (2) intensification of the monsoon trough and development of convective vortices over central Asia; (3) an increase in the strength of the Arabian sea monsoon current; and (4) emergence and northward movement of a meso-scale offshore vortex over the northeast Arabian sea (Kelkar 2005). However, the extent of losses experienced in 2005 was the direct impact of land use changes in the low-lying areas within the city. Some of these changes are the direct consequences of development strategies adopted by the government, while others are the indirect by-products of economic activities pursued in the city.

Figure 10: Mumbai



Mumbai in Transition

Mumbai's growth started in the eighteenth century and until the early 20th century it was under the control of imperialist interests. From the beginning, Mumbai was connected to the world economy (Patel 1995). But before the establishment of the port, Mumbai was a group of seven fishing villages³⁰. It gained importance under British governance as a port for the shipment of raw materials (mainly cotton) from the agricultural hinterland of the Deccan plateau to England. Mumbai's connection to the global economy was boosted in the late eighteenth century because of a sudden increase in Europe's demand for cotton during the American civil war (1861-1865) (Yelda 2002). Opportunities for trade and enterprise have always attracted migrants to the city. For imperial interests, Mumbai changed from a marine supply point to a manufacturing city producing cotton textiles that were exported to China (Patel 2003). Textile mills attracted migrants looking for jobs and the city experienced many waves of migration in the early 20th century. In the middle of twentieth century, after British lost complete control over the market, the textile industry developed a domestic market. At this time, other new capital intensive industries (e.g. food processing, pharmaceutical and drugs, and small and medium engineering) started up in the city. During the independence struggle, nationalist movements developed strong linkages between elites from several regions and home grown capitalists moved from different parts of the country into Mumbai to start new industrial projects. During this period, the city attracted refugees from wars (partition in 1947), famine (like the drought

³⁰ These seven islands were given to Prince Charles by the Portuguese as a part of his dowry in 1661 and in 1668 it was leased to the East India Company. The control passed back to the British Government in 1877 - Gupta, K. (2007b) Urban Flood Resilience Planning and Management and Lessons for the Future: a Case study of Mumbai, India. *Urban Water Journal*, 4, 183-194.

in 1965-67) and communities facing discrimination elsewhere. As a result, during the 1940s there were momentous changes in the city's socio-economic structure. In the three decades that followed, the city attracted large waves of migrants seeking employment in the growing commercial and service sectors. Today Mumbai is the largest city in India and it continues to attract large numbers of migrants. Mumbai's population is highly heterogeneous in its socio-cultural, racial, ethnic and religious characteristics. As the city expands, each new migrant group develops its own means of survival and its own niche. At present, Mumbai is a classic example of a globalizing city of the south caught in the pressures that accompany joining the world urban system. This process gives tangible expression to the *'link between ideology and socio-spatial formations and the role of power in controlling urban space'*³¹. This process greatly complicates the factors that influence risk and vulnerability to natural extremes.

Socio-Economic Transformations

The early economic prosperity of Mumbai was connected with the success of textile industries, but after the 1960s this was no longer the case. Modernization and technological innovations segmented the industry into a large scale mechanized and factory-based sector and a small scale domestic handloom sector. In the process, large numbers of workers became subject to a continuous restructuring of the textile industry, eventually leading to strikes in 1982-83. These were a reaction to deindustrialization and the shifting of large manufacturing units to the suburbs as well as the state's rising

³¹ Page 121 - Bannerjee-Guha, S. (2002) Shifting Cities. *Economic Political Weekly*, January 12, 121-128.

preference for capital intensive industrial development. In the aftermath of the strikes, over 100,000 labors were displaced (Patel 2003) and many mills located in central Mumbai were closed. A large section of the manufacturing workforce had to find employment in the informal sector³². Many of these people were also spatially displaced from the residential quarters of workers in central Mumbai to locations around the margins and elsewhere. The closing of mills also coincided with the advent of neoliberal public policies that promoted reliance on the free market, transfer of government responsibility to civic society and a rejection of centralized government actions in favor of local interventions. As a result, instead of being revived and modernized, mills were abandoned or torn down and their land allocated to activities that could compete on the global market (D'monte 2006).

The downfall of the two stalwarts of Mumbai's society - the textile mills and the middle class workers - is directly connected to the planning approach adopted by Mumbai Metropolitan Regional Development Authority (MMRDA) in the 1990s. This focused on Mumbai as the national link to the global economy, and shifted financial resourcing and administration to the private sector, where business and commercial interests were prioritized, as opposed to local issues such as intraregional disparities and overconcentration in Mumbai (Bannerjee-Guha 2002). With this transition, the poor and marginalized sections of the urban population were pushed out of central locations according to a policy that focused not on the *'elimination of homelessness and*

³² Households or enterprises that are not part of the formal social, economic or administrative systems of the city

*joblessness but of jobless and homeless*³³. Over these years, Mumbai experienced an increase in the producer service sector; especially communication, financial, real estate, entertainment and transportation industries.

Since the 1990s, the wave of globalization and the accompanying decline of the manufacturing sector have resulted in unemployment and widened gaps between the new upper income class and the large lower income class that is now mostly employed in the manufacturing units of the informal economy that the prevalent development strategies of the city emphasize facilitating private transportation, trading of urban land with developers through Transfer of Development Rights (TDR) and other schemes that benefit large developers and builders (Burra 2005). The transition of capital from production and manufacturing enterprises to building space for financial manipulations (Harvey 1985) has created a new section of socio-economic activities that has gentrified and displaced large sections of urban workers and put limits on their participation in the ongoing progress. The oversized informal sector in Mumbai therefore has continued to grow in parallel with the deindustrialization and spatial reorganization of Mumbai. These changes have had an abysmal effect on the labor market and the economic circumstances of workers in the city. Loss of formal identity and bargaining powers in the formal economic system have undermined the living and working condition of workers in Mumbai.

³³ Page 122 - Bannerjee-Guha, S. (2002) Shifting Cities. *Economic Political Weekly*, January 12, 121-128.

Political Movements

Under the pressure of economic transformations, Mumbai has experienced several waves of political movements attempting to undo or control the effects of socio-economic change. The struggles of political ideologies under these movements demonstrate national-regional tensions and other changes in Mumbai. Until 1960, Mumbai (then Bombay) was the capital of a large Bombay state that also included provinces of present day Gujarat and Maharashtra. In 1960, after much struggle between the Gujarati and Maharashtrian communities, the state was divided into Gujarat and Maharashtra (states) with Bombay as the capital of Maharashtra. With this began the assimilation of Mumbai into Maharashtra state politics. Three main movements originated after the establishment of Mumbai as a capital of the state (Patel 2003). First was Shiv Sena in 1966, a group that represented the regional identity of the Maharashtrian community and aimed to establish control over the economic and political life of the city (Lele 1995). The second was a literature movement that was opposed to state and class privilege and represented the cause of *dalit* and disadvantaged populations in the city. The third movement involved the working class community in efforts to change the capitalistic system prevalent in the city. These three dominant political movements represented the class, caste and regional struggles in Mumbai. They operated occasionally in mutual support but mostly opposed each other, thereby further widening the differences that made them politically vulnerable.

In the 1960s, a workers' front developed to protest against the capitalist transformations occurring in the industrial sector of the city. The 1982 textile mills strike was organized under the aegis of this political movement. But with the fall of the textile mills and the workers front under Datta Samant, the communist base in the working class movement came to an end. The regional movement started by Shiv Sena initially supported the working class movement because a majority of textile workers were Marathi speaking households but, since Shiv Sena was not able to take control of the communist-inclined worker front, it opposed - and was instrumental in the demise of - the workers' movement. Shiv Sena turned into an organized anti-communist group that developed branches in every Marathi speaking neighborhood of Mumbai (Lele 1995). The organization held the non-Marathi speaking communities in Mumbai responsible for the disparities between the rich and the working class. The movement therefore diverted attention from the consequences of rapid capitalist development and the instability of the industry/agriculture-driven development policy at the national and state level (Planning Commission 1974). Sena worked to control the ethnically diverse formal sector and to establish Marathi youths in different echelons of bureaucracy, business and professional circles.

Whereas Sena in 1970s was seen as an upper caste organization, the Dalit panthers, a quasi-militant movement, emerged in the late sixties and early seventies to support and radicalize the incoming Dalit and low caste/religions. They sought to convert migrants from the rest of the country, including Maharashtra, who were living in informal and low income settlements in Mumbai (Rodrigues 2003). This movement struggled ideologically

as it experienced a split rooted in the incompatible philosophies of Buddhism and communism. The Dalits grew weaker because they did not have any political or economic support and their platform was too narrow to attract a broad support base in Mumbai (Rodrigues 2003). Dalit politics resurfaced at a national level during controversies related with Mandal Commission³⁴ in the 1980s and continues to be part of India's dynamic political scene, but the movement's control over Mumbai has collapsed. To some extent this can be attributed to the fact that in 1980s Shiv Sena adopted a religious perspective that allowed it to resurrect itself among different castes of Hindu Marathis and started to move into the informal sector of the city's population. It supported the informal population by encouraging growth of the informal economy, including financing and assisting in legalizing economic activities in return for political support and rent. Such activities led to the strengthening of extortion and protection rackets in the city (Patel 2003). Sena's access to slums also established its dominance in the housing and land markets as it joined with the local brotherhood and *mafia* gangs of Mumbai. Except in the 1995 election, Sena did not make much headway against national institutions like the Congress party in Maharashtra state, but it retained a strong power base in Mumbai city where it promotes the notion of the city as '*sacred national space, ethnically pure but globally competitive*'³⁵.

³⁴ Commission established with a mandate to identify the socially or educationally backward and to consider affirmative actions by increasing seat reservations and quotas (that gave exclusive access to a certain portion of government jobs and slots in public universities) from 27% to 49 % for people in these castes

³⁵ Page 644 - Appadurai, A. (2000) Spectral Housing and Urban Cleansing: Notes on Millennial Mumbai. *Public Culture*, 12, 627-651.

Ecological Transitions

Socio-economic transformations and political ideologies have influenced the changes in the physical landscape of the city. The Mumbai metropolitan region³⁶ (MMR) has experienced large scale alterations in its physical environment and local ecology to accommodate the changes that have come with growth and expansion of a megacity. A study of land use and land cover change in the Mumbai and Navi (new) Mumbai area (Samant 1998) shows that land use under the category of forest and agriculture has been reduced significantly from 521.86 to 263.28 square kilometers (approximately 55%) in the seventy years between 1925 to 1994. Similarly, wetlands have been reduced from 235.23 square kilometers in 1925 to 160.00 in 1995. The built-up area has increased 300%, from 102.90 square kilometers in 1925 to 436.71 square kilometers in 1994. Since the central business district of the island city was already extensively developed, the city grew largely by suburban sprawl during the two decades from 1967 to 1987 (MMRDA 1996). An annual rate of 4.3% growth was observed in this period for western and eastern suburbs of the greater Mumbai region (MMRDA 1996). Changes in the land use and land cover in Mumbai have occurred mostly to accommodate the rapidly growing population, developing economic sectors and infrastructural demands of a globalizing megacity.

³⁶ Data for Mumbai and its surrounding regions are documented by different agencies that have different units of jurisdiction. Different units used to present data here are Mumbai City (island district), Municipal Corporation of Greater Mumbai (MCGM), Mumbai Metropolitan Region (MMR), Greater and New Mumbai. The Development Authority (MMRDA) is responsible for planning in the larger metropolitan area that comprises Mumbai City district, Mumbai Suburban District, and part Thane and Raigad Districts. This research however pertains to Mumbai city and suburban districts and therefore would use data for these specific sections.

The population of greater Mumbai (island city and suburbs) grew from approximately 850,000 in 1901 to 11.4 million in 2001; this number is expected to increase to 15 million by 2011 (MMRDA 1996). The population of the metropolitan area (MMR) was approximately 14.4 million in 1991 and is expected to increase to 22-24 million by 2011 (Acharya and Nangia 2004). Consequently, population densities are already very high and increasing (Appendix 3). Projections suggest that suburban densities will have risen from 7340 persons per square kilometer in 1971 to 25,578 in 2011 (Acharya and Nangia 2004). Consequences for the physical environment are striking (Table 4). By 2011, the MMR is expected to have lost additional amounts of forest area, agriculture land and wetlands with maximum changes in suburbs like Thane, Bassain, Bhivandi, Kalyan, Panvel, Uran, Khalapur and Karjat (Acharya and Nangia 2004). The total built-up area in the region is projected to increase from 9.1% in 1991 to 27.8% in 2011 (Acharya and Nangia 2004). Built up areas include residential and economic activity areas as well as other infrastructural uses like roads and rail network.

Table 4: Land Use in Mumbai

Existing land Use in 1971			Existing Land Use in 1991		Proposed Land Use in 2011	
Type	Area	Percent to Total	Area	Percent to Total	Area	Percent to Total
Built Up	149.1	3.9	351.0	9.1	1074.04	27.8
Industry	45.2	1.2	101.7	2.6	140.02	3.6
Agriculture	2098.3	54.4	1445.9	37.5	1381.3	35.8
Forest	1045.4	27.1	1471.6	38.2	879.2	22.8
Wet Land	374.3	9.7	362.0	9.4	91.9	1.6
Water Body	83.4	2.2	67.1	1.7	68.06	1.8
Others	59.5	1.5	54.7	1.4	252.64	6.6

Source: (Acharya and Nangia, 2004)

Changes in land use and land cover reflect the effects of global economic restructuring and government policies adopted for economic growth (Mukhija 2002). Responding to prevailing global neoliberal economic policies, the municipal government of Mumbai has emphasized development of land for maximum profit. This means making land purchases more attractive to foreign investors. To promote this, projects have been adopted by municipal authorities to develop infrastructure to attract global investment (Raiser 2005). Among others, these include: the expansion of the international airport by encroaching on the natural course of the Mithi River (Arunachalam 2005, Sekhar 2005); development of new Bandra Kurla business district by removing mangroves in Mahim Bay; the loosening of coastal building regulations and removal of protection for open spaces (Srivastava 2005); changes of floor space indexes (FSI) in favor of real estate builders (Burra 2005); and construction of 55 flyovers to accommodate the increase in private commuting (Bannerjee-Guha 2002). At the same time, there has been reduced investment in developing and maintaining basic infrastructure that was designed to help the general public and protect the environment. This includes schemes for mass transportation, water and sanitation systems, health and emergency facilities; and basic housing. The result is greatly increased human vulnerability; the designs of development adopted by the city authorities have increased demand for land, but lack of adequate control by government has resulted in highly skewed land markets and inflated land and housing prices (Revi 2005) that are clearly outside the reach of ordinary citizens.

Table 5: Built Up Area in Different River Basins in and near Mumbai City

Basin Number	Total Area	Area Built Up	% Area Built Up	Total Length of Streams	Length under Built up Area	% Length under Built up
1	8.98	3.93	43	23.58	9.13	39
2	27.20	2.86	10	81.20	6.55	8
3	37.44	6.80	18	95.69	4.67	5
4	16.56	8.13	49	35.40	13.69	38
5	24.21	12.09	50	40.49	14.97	37
6	42.07	22.73	54	86.81	17.56	20
7	14.81	6.36	43	28.33	10.46	37
8	20.24	9.25	46	31.89	5.71	18
9	14.59	7.40	42	28.25	11.47	40
10	12.75	4.87	38	31.70	7.16	23

Source: (Samant, 1998)

In Mumbai, rapid urbanization overwhelms the ability of natural drainage channels to accommodate increased water volumes (Samant 1998), leading to increased flood risk during the monsoon season. Furthermore, many infrastructure and housing projects encroach upon the natural stream channels (Table 5). Out of ten drainage basins in the MMR, five have more than 35% of their channel length under built up areas, three others are 18-23% built up and the remaining two are urbanized along 10% of their lengths (Samant 1998). Until the floods in 2005, urban planners were unaware of the flood implications of long term basin urbanization in Mumbai.

In addition to the large scale and direct changes designed by the MMRDA and MCGM, rapidly growing population is the other primary agent that is constantly altering the local environment. In particular, populations groups who do have access to infrastructure and facilities built by city developers encroach on open spaces. Such agencies play a considerable role in altering the local and often critical environment of the city. Mumbai

also has one of the highest percentages of informal population, as high property prices have rendered more than half its population incapable of affording formal housing and basic facilities in the city. As a result, the MCGM is estimated to have 1959 slum settlements that house approximately 54% of the total population in 2001 (Risbud 2003).

Informal settlements in Mumbai are mainly of three types. First are the multi-story *chawls* built in the 1950s to accommodate low income workers employed in the textile or other industries. These buildings are rent controlled, and therefore lack proper maintenance and are in dilapidated condition fit for demolition (Mohanty 2005). They often lack adequate infrastructure such as toilets, piped water, drains, etc. The second type of informal settlement is composed of semi-permanent structures along the roads that house the pavement dwellers. Besides the complete lack of basic facilities for people living in these settlements, such encroachments often obstruct open spaces around roads and block drainage during monsoons. The third type is the *jhopadpatti* or the hutment colonies that are widespread in all parts of Mumbai (Figure 16). These settlements are mostly located in low-lying or high-slope areas around formal land uses; they impinge on and irrevocably alter adjacent open and natural spaces.

Informal populations have grown very quickly in the past few decades. In 1976, 41% of city's population lived in informal settlements, increasing to 55% by 1991 (Swaminathan 2003). This large population occupies only 6% of the city's total land area (Patel 2003) but has a disproportionately negative effect on the local environment. For instance, it has

increased the quantity of garbage and pollution in the city. Due to the lack of proper sewerage and treatment systems in the suburban and the informal sections of the city, the Mithi river exhibits very high BOD (biological oxygen demand, e.g. biological water pollution) and COD (chemical oxygen demand, i.e. industrial pollutants) (Mithi River Development Authority 2006a). The river is, in effect, a large sewer. Moreover, many of these settlements are located in marshy areas that have been improperly reclaimed, thereby doing permanent damage to the local wetlands and vegetation. Furthermore, these same areas are liable to sinking and flooding during high tides and in the monsoon season. The social fabric is also altering at a fast rate. Societal changes play a crucial role in producing vulnerability and resilience among population groups and therefore are important in determining vulnerability mitigation strategies for sections of society that are susceptible to excessive losses from floods. Since this study focuses on flood mitigation adopted by the informal sector, the next section of the chapter explicates the impact of transforming processes on informal settlements.

Impact on Informal Sector – Changing for the Worse

‘Slums (in Mumbai) are like the ocean, it is always changing yet it is always there’

- Danny Boyle

Neoliberal advocates of urban development assume that continuous urban growth and rural to urban migration will be followed by regional balance and sustainable development. Yet slums are permanent features on Mumbai’s landscape. Moreover,

emerging trends show a slowdown of urbanization in developing countries, including India. More alarmingly, they indicate a reduction of employment potential within the formal sectors of urban areas (Kundu 2007). They point instead to increasing numbers of people being employed in the rapidly growing informal sectors and to the consequent shifting of such populations to low income informal settlements.

The concentration of people in the compact city of Mumbai makes it very dense, with 4,080 persons per kilometer square in the MMR, 27,348 in the administrative city, 34,269 in the inner city, and a peak density of 101,066 that is higher than other Indian megacities like Delhi, Kolkata, Bangalore, as well as world megacities like New York and Shanghai (Table 6). High densities result in excessive pressure on land resources. With a shortage of space and consequent high prices of real estate, more and more people in Mumbai are unable to afford basic housing, thus increasing the problem of slums.

Table 6: Population Densities in Different Cities

Cities	Metropolitan Area	Administrative City	Inner City	Peak Density
Mumbai	4080	27348	34269	101066
Delhi	1227	9340	19636	96460
Kolkata	7978	24454	20483	78355
Bangalore	1050	19040	18225	75169
New York	783	9551	15361	53000
Shanghai	2619	2619	24673	96200

Source: (Urban Age 2007)

Proximity is the most important factor in cities like Mumbai. Despite having 300 kilometers of suburban rail system, the largest in South Asia, the transportation system of the city is unable to accommodate the demand for mass transportation; 55% of the commuters in the city walk to their workplace (Parasuraman 2007). Access to jobs, investment opportunities, and affluent populations that might provide other livelihood benefits often attract squatter settlements to environmentally marginal public land near business districts. Living in slum settlements that are close to places of employment allows individuals to hold more than one job, work long hours and be available to their employers for extra assistance, all of which in turn helps them to consolidate their livelihood and their relationship with employers. In addition, proximity to city centers means that these households are locally exposed to global processes and to opportunities for adaptation and advancement. Householders also prefer to live in communities with people of similar socio-cultural characteristics (Takeuchi 2008), who can help during crises of health, disaster or political instability (Chatterjee 2008, Emmel and Soussan 2001). However, by living in slums these people have to live in congested, unhygienic conditions, frequently without facilities. Although 62% of houses in slum settlements are permanent structures made of brick and cement material with as many as 42% having two or more stories (Risbud 2003), basic facilities in these settlements are in despicable condition. Only 1% of households have access to individual toilets, 73% use community toilets and the rest do not have access to any toilet facilities. Similarly, only 49% have access to tap water while another 40% have to rely on more than one source of water (Risbud 2003). With as many as 15 people sharing 300 square feet of area (Jacobson 2007) conditions in centrally located slums are even harsher.

“The exhaust is so thick; the air boils like a soup. There are too many people touching you, in the trains, in the lifts, when you go home to sleep...Why would you want to leave your brick house in the village with its two mango trees and its view of small hills in the east to come here? ...So that someday your eldest son can buy two rooms in Mira Road, at the northern edges of the city. And the younger one can move beyond that, to New Jersey. Your discomfort is an investment.”³⁷ - Suketu Mehta

Slum Development Policies

Slum development schemes have been attempted several times in past decades. Beyond issues like the magnitude of rural urban migration and inadequate resources, slums have continued to grow because of lack of cooperation between different public and private agencies, manipulation of policies to benefit parties other than slum dwellers, the inability of slum residents to participate in developing and implementing schemes of slum improvement, and because planning for slum development in India has privileged ‘neeti’ (institutional justice) over ‘nyaya’ (realized justice) (Sen, 2009).

Three kinds of policy interventions have been tried: Low cost housing; basic services; and subsidized credits (Neekhra 2008). These approaches have ebbed and flowed in popularity since 1947. Recent trends in planning for the urban poor show a steady increase in funds to support the welfare of the urban poor, and a tendency to grant land tenure to slum dwellers (Burra 2005). However, the main difficulty lies in negotiating with large government agencies like airports, port trusts and defense authorities, which

³⁷ Page 43 Mehta, S. (2007). Maximum City. Urban India: Understanding the Maximum City, Mumbai, Urban Age.

are the main land owners in urban areas of India.³⁸ This creates a paradox: *'...politically, it is not possible to demolish the homes of thousands of slum dwellers who live on government land, but the central (and other) government departments that own the land refuse to allow the inhabitants to receive tenure and basic services'*³⁹ which would legitimize slum dwellers in those spaces permanently.

The division of public responsibilities among different echelons of government also complicates the matter. Since housing and urban development sectors fall under the jurisdiction of state governments, policies made at the national level may not be implemented by the state. Furthermore, the state government may design policies that are separate from and sometimes contradictory to those propounded at the national level (Table 7). As a result, a discrepancy has evolved because available funding from the central government for certain types of schemes is not used by the state government agencies in improving conditions of the urban poor. Furthermore, policies designed by the central government do not apply to settlements located on land owned by other government agencies and vice versa. Similarly, most of these policies apply only to legal or notified slums and exclude the illegal settlements from any benefits of slum improvement. Management of these schemes by the contesting agencies, all of which have different philosophies, approaches, areas of jurisdiction, and political affinities, has

³⁸ Slum land ownership in Mumbai shows 48% of slums being located on private land and the rest (52%) on government land (state – 21%, municipal – 18%, State/ central – 7%, Railways/ Airport authority – 6%) Urban Age (2007). Urban India: Understanding the Maximum City. Urban India, Mumbai Urban Age.

³⁹ Page 69 - Burra, S. (2005). "Towards a Pro-poor framework for slum upgrading in Mumbai, India." Environment and Urbanization 17(1): 67-90.

also added to the complications. Many schemes have failed to deliver due to inadequate institutional ability to integrate all stakeholders in the execution of the program without long delays and obstructions (Burra 2005, Das 2003, Neekhara 2008, Risbud 2003).

Table 7: Policies for Welfare of Urban Poor Since 1947

Year Government Agency	Name	Main Features
1947 – State Government	Mumbai Rent Control Act	Was introduced to freeze rents at 1940 levels and ensure the rights of tenants against evictions. This approach had adverse effects on private investments in rental housing markets and property tax collection.
1954 – State Government	Mumbai Municipal Corporation Act – Slum clearance amendment	Municipal Corporation of Mumbai was given the power to clear slums
1969 – State Government	Mumbai Repair and Reconstruction Program	To repair and reconstruct old dilapidated chawls in Mumbai. Repair focused on existing unsafe conditions and extended the life of these buildings for 10-15 years but did not improve other living conditions.
1971 – State Government	Maharashtra Slum Areas (Improvement, Clearance and Redevelopment) Act	State government identified overcrowded places without basic facilities unfit for human habitation as ‘slums’. However, only squatter settlements on state government land were assigned to be addressed in the city development plans.
1972 Central Government	Environmental Improvement of Slums	Central government scheme for developing the infrastructure and amenities of the slums to improve its environment. The scheme mostly benefited the settlements on state government land, however; environment was not significantly improved as settlements with better facilities attracted more new migrants.

1974 Central Government	- National Dwellers Federation (NSDF)	Slum NSDF was established to support 70,000 families to resist an eviction order in 1974. Later it developed alliance with Mahila Milan and Society for the Promotion of Area Resource Centers (SPARC) to work with community based development projects.
1975 – State Government	Maharashtra Land Act	Vacant All lands occupied by squatter settlements were declared ‘vacant’ lands and could be cleared by the government, granting these settlements temporary status, compensations in form of service charges had to be paid by unauthorized settlers.
1985 Central Government	- Prime Minister’s Grant Project	Initiated the planned redevelopment of slum settlements. Though the scheme made some improvement to prevent public health hazard by upgrading living conditions, especially in Dharavi, it suffered from delays and mismanagement due to lack of awareness.
1985 Central Government	- Slum Program	Upgradation Major intervention to regularize slums and provide services to these settlements. 100,000 households from slums located on state owned land to be given land tenure and basic services other households from the settlements to be relocated. Generated serious protests from those excluded and poor relocation sites. Scheme was given up after the change of political party in state.
1991 – State Government	Public – Private Partnerships Redevelopment Scheme	Slum Introduced participation of private developers in slum development. Applied only in notified or registered settlements where same site is redeveloped with increased floor area ratio and after housing previous slum settlers, remaining residential spaces could be sold at market price for profit limited to 25% of production cost. The scheme raised concerns about exploitation of slum households by private builders, increases in density, inadequate facilities and technical and managerial skills to reduce delays.

1995 – State Government	Public Partnerships in Slum Rehabilitation Scheme	Private Scheme started by Shiv Sena when it came to power in 1995 to provide 4 million households free tenements. Under the newly constituted Slum Rehabilitation Authority the scheme recognized the need of housing for urban poor. The scheme highlighted that slums should be rebuilt in the same place whenever possible, pavement dwellers should have similar rights as other slum dwellers, and that those settlements that could not be upgraded in the same place should be resettled in other locations and negotiations with government or private land owning, developing or building agencies could be done on the basis of transferring development rights that provided them with alternative buildable land in addition to increased Floor Space Index of 2.5. The scheme had limited effect due to corruption practices and exclusion of slum communities in decisions regarding resettlement.
1996 – Central Government	National Slum Development Program	Annual allocation of Rs. 3000 million to improve basic facilities and infrastructure like water supply, sanitation and waste disposal, health care, housing, education, environmental conditions. Scheme was infrastructure oriented, and did not involve community participation, was limited to legal slums, and suffered problems of management and auditing.
2001 – State Government	Slum Areas (Improvement, Clearance and Redevelopment) Act	All slum dwellers on the election on January 1995 were protected and would get rehabilitation but in the act the rehabilitation package was not defined.
2001– State Government	Government – NGO – CBO Partnership in Mumbai Sanitation Project	Community toilets made by Municipal Corporation and maintained by communities, and regulated garbage collection by local NGOs and picked up by Municipal waste collection division.
2001– State Government	Government – NGO Partnership in Slum Resettlements	Partly successful resettlement of 60,000 slum households along the railway tracks to expand the local railway service. In the program, slum households were heavily supported by the NSDF, SPARC and Mahila Milan to identify households to be moved and determining the terms of resettlement and Indian railways contributed in the financial responsibility of resettling displaced household.

2001 Central Government	– Vambay (Valmiki Ambedkar Awas Yojana)	Housing subsidy scheme for urban poor, where central government provides 50% subsidy in construction and upgrade of slum dwelling, however, the amount assigned (to qualify total cost of house has to be less than Rs. 60,000) is inadequate to support construction of multistory buildings that are plausible solutions in cities like Mumbai.
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Source: Compiled from (Burra, 2005; Das, 2003; Neekhara, 2008; Risbud, 2003)

Most of the newer slum development policies are being designed to reduce the gap between the affluent and impoverished population groups by providing avenues of equity and justice in access to resources and inclusive roles in participation. They are not being realized or implemented, however, due to existing conflicts in the distribution of benefits and responsibilities, lack of cooperation, and institutional inabilities to collaborate and manage these schemes. These limitations have rendered slum policy insufficient to address the considerable problem of informal settlements in the cities of India. Additionally, these interventions have not yielded suitable results because they have not taken the organic nature of slum settlements into consideration, where the identities of households within it are not just connected to the approximately 200 square feet area that they occupy but also to the numerous socio-economic, cultural and political networks that they belong to. To be effective, resettlement or upgrading schemes have to keep this organic aspect intact, because in these communities such underlying structures play a crucial role in supporting slum households' ability to cope with everyday issues (Emmel and Soussan 2001) and unforeseen disasters of urban life.

Hence, certain aspects of life in Mumbai that are already unsatisfactory are worsening despite the city's increased exposure to the global economy and to avenues for economic development. The divide between rich and poor (formal and informal) is widening at an alarming rate (Marcuse 2000). The differences express themselves most clearly in contrasting rights to urban space (e.g. access to basic facilities), rights to participate in the decision making processes, and rights and capacity to respond to and recover from crises. The formal sector is increasingly connected with the rest of the world and disconnected from the informal local population. While benefiting incidentally from some aspects of globalization, the informal population is steadily diverging from the rapidly developing formal population. The growing size and self sufficiency of the informal sector with respect to economic activities and market needs make it a distinctly separate world within the larger urban setup. There are many connections between the informal and formal worlds, yet they are mostly limited to economic and political matters of supply and demand. Structurally and ideologically, people in the two sectors are separate and becoming more so.

Stagnant Civic Society

The division between the formal and informal begins with the illegitimate status of informal settlements. Throughout the vast transformations that have affected Mumbai, no institutional and legal means of resolving the problems that flow from this status have emerged. Illegal settlements and their inhabitants persist outside the realms of official urban development strategies. They are often considered temporary problems of uneven

income distribution that will be resolved as the city becomes wealthier. In reality, even with increased income, people living in these settlements seldom move from the informal settlements to formal settlements, but instead establish them in that informal space and place. Though these informal settlements consolidate over time without political leverage, such settlements rarely turn into formal colonies.

Hence, in Mumbai the institutions of civil society have not developed or kept pace with the socio-economic changes that have affected the city in recent decades. Integration with the global economy and exposure to different cultures and political systems have contributed to an advanced sense of civil society among the population of Mumbai and in some few cases have worked to benefit marginalized communities (Nijman 2008). Local political movements have emerged and interventions by citizen's groups have occurred. However, in most cases strategies developed to improve affordable housing conditions have alienated the population (Das 2003). The government has always opposed moves to legalize the slum dwellers and has denied them rights to participate in policies for affordable housing or improved environment. Although citizen's groups lobbying for the public interest have used the judicial system to arrest some of the neoliberal policies adopted by the government, these interventions in general have generally not had much success (Das 2003) because they are not popular with a majority of the urban population.

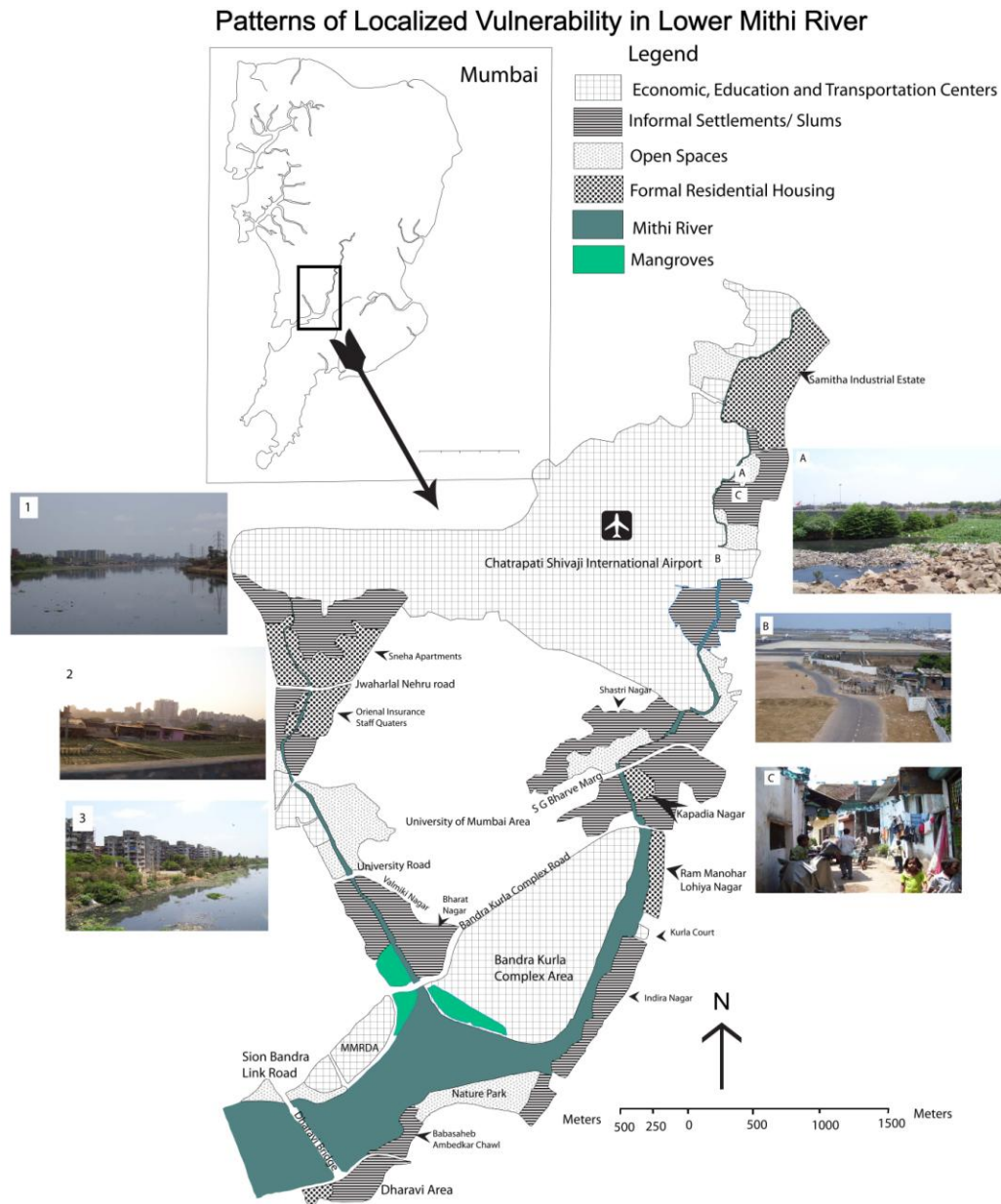
Growing risk and vulnerability is a consequence of changes in environment and society, but in an urban context exacerbated risk and vulnerability is also the consequence of

conditions and attributes that continue to remain unchanged. The complex interaction of changing socio-economic and political processes, and haphazard alterations to the built up and open areas, have produced an intense mixture of improving, worsening and stagnant spatial units and population groups, which complicates the issues of hazard mitigation for urban hazard planners in Mumbai.

Changing Local Patterns of Hazard

The changing socio-economic, political and environmental factors have affected local environmental and social vulnerability conditions in Mumbai. The physical landscape in Mumbai demonstrates a complex arrangement of different types of land use, buildings, building material, population groups and density in close proximity that produces intense localized patterns of hazard in the city. Figure 11 presents the case of lower Mithi River to show the existing variety in land use and to display the challenges of designing hazard mitigation in such complicated physical and social conditions.

Figure 11: Patterns of Localized Vulnerability in Lower Mithi River



The area along lower Mithi River comprises different types of formal and informal land uses. It contains formal business, commercial, educational, ecological, residential areas and informal settlements that include household huts, markets, religious buildings,

schools within these shanty towns. Photographs 1 and 2 (Figure 11) present the panoramic view along the lower Mithi River to show the different types of structures built in this area, but which are simultaneously at risk from inundation during monsoon season. The area includes: formal low lying residential neighborhoods such as Kapadia Nagar (Photograph 3); the International Airport (Photograph B); Business Districts that house corporate headquarters of transnational companies; development authority main offices that are built of concrete material, all with regular population densities, developed drainage systems, access to other transportation, communication and critical infrastructure. It also contains informal settlements with very high population and building densities, narrow lanes (Photograph C), inadequate or constrained drainage (Photographs A), and clusters of minority, impoverished and marginalized populations that suffer the same risk of floods during monsoon as their more advantaged neighbors. Such intense spatial complexities are unique to cities such as Mumbai and require special strategies to administer hazard mitigation. Hence, planning for a socio-environmental unit such as the lower Mithi River will have to incorporate ways of negotiating the different types of land uses, demographic and physical attributes of these parcels. For example, due to high rates of congestion in informal settlements, faulty and inferior building materials, limited drainage, and impoverished and peripheral status of communities settled in these locations, these colonies are more prone to excessive losses. Furthermore, though the occurrence risk of an event is the same for all, losses from an event and vulnerability will be different within such spatial units. In formal areas, vulnerability will be comparatively less because these sectors have access to structural support to reduce vulnerability. But such places will have more property and infrastructure and hence more

potential economic losses, should risk mitigation fail. Similarly, discrepancies for the different spaces and population groups in the area will also exist for the relief and recovery process. The case of lower Mithi River shows the extent of diversity present in the localized patterns of hazards based on existing spatial and social complexities within any unit of space in cities such as Mumbai, and highlights the need for specialized studies to understand these complexities and negotiate with them.

Conclusion

The socio-economic characteristics of Mumbai are generally changing for the better. On the other hand, environmental conditions and associated risks are changing for the worse throughout the city as a whole, and for the informal sector in particular. With a few exceptions, the disadvantaged are disempowered. Trends towards more effective civil institutions are absent. Though the city is undeniably energetic, this energy has not been able to resolve the underlying causes of uneven and unsustainable development that contribute to the increase and irregular distribution of risk and vulnerability. How this process affects responses to monsoon floods is the subject of the next chapter.

Chapter 5: Flood Alleviation Policy in Mumbai

In a speech that stated '*Dams and Laboratories are the temples of Modern India*'⁴⁰ Jawaharlal Nehru established control of nature as the central notion of India's environmental policy. Extensive reliance on natural sciences and engineering disciplines to manage the physical environment has resulted in a technocratic tyranny (Visvanathan 2002) that relies heavily on building structures and on bureaucratic hegemony. Technocratic solutions, prescribed by scientists and experts, show a serious absence of multidisciplinary thinking and public participation. The propensity to adopt structural engineering measures to mitigate environmental risks without attending to increasing human vulnerability is evident in the case of Mumbai too.

As we have seen, Mumbai prioritizes economic growth. The perception of city leaders is that floods affect development, and therefore require mitigation. Flood prevention, storm water drainage, improved and elevated transport networks, clean and restored drainage systems, advanced communications and effective rescue and relief mechanisms designed to reinstate normality are important agenda items for municipal authorities, development agencies and government departments in the city. Flood mitigation has been included in the Mumbai restoration and development plan to buttress its status as a globalizing world city. Formal flood mitigation in Mumbai is a combination of technological and structural measures that are only partly intended to reduce flood risks and losses, but as just as often

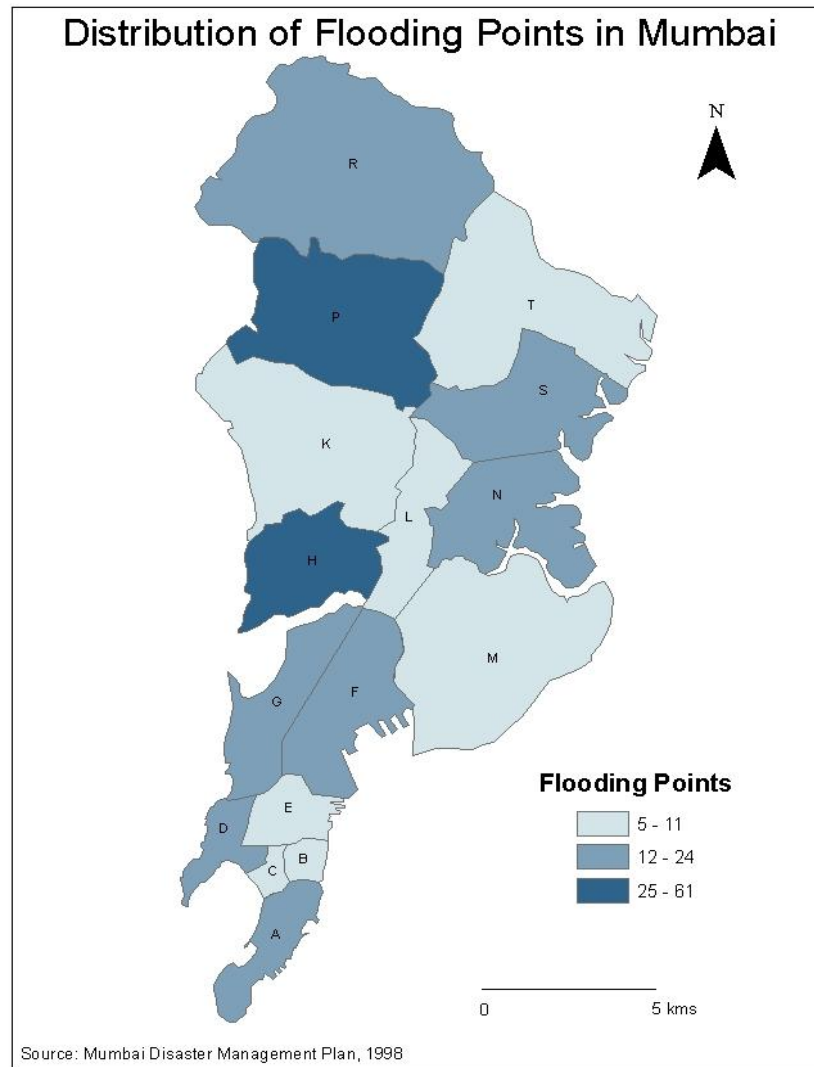
⁴⁰ Narasimha, R. 2008. Science, Technology and the Economy An Indian Perspective. In *Technology in Society: China, India and United States*, 330-338. Bangalore: Jawaharlal Nehru Centre for Advanced Scientific Research.

meant to inject development capital. However, structures do not address many underlying drivers of flood losses such as a low standard of living, limited and unequal distribution of resources and facilities, as well as declining levels of public welfare. Although formal mitigation mechanisms in Mumbai are geared towards elevating the city above monsoon flood levels, the more than 50% of its population that live in low lying informal settlements are not included in this strategy.

Floods in Mumbai

Mumbai's complicated drainage system has always been a challenge, and flooding during monsoon season has always been a part of the city's history. In the 1870s when there was insufficient knowledge of the monsoons, the drainage system was installed on a trial and error basis (Gupta 2007b). Later the situation was not improved by the—massive reclamation of the mudflats which left many locations below the high tide level. Subsequently, much of the city has been perennially waterlogged. Further deterioration occurred as mangroves were destroyed; marshes were damaged and unplanned settlements proliferated in low lying areas. The initial localized and occasional problem has escalated to the level of severe annual floods throughout the region. But land use alterations are not the only reason for increasing flood risks. Historic records show a significant increase in Mumbai's rainfall during the twentieth century (1901-2000) (De 2005). In 1996, 235 known chronic flooding points (Figure 12) were identified (MMRDA 1996), most of them in P, N, H, K, L, D and A wards of the city.

Figure 12: Wards in Mumbai



Source:(MMRDA, 1998)

There have been many drainage and sewage disposal initiatives. Among the first was the building of the old main drain (in 1856), followed by a low level sewer system designed by Aitkins (in 1866), and then the separation of the drainage system from the sewage

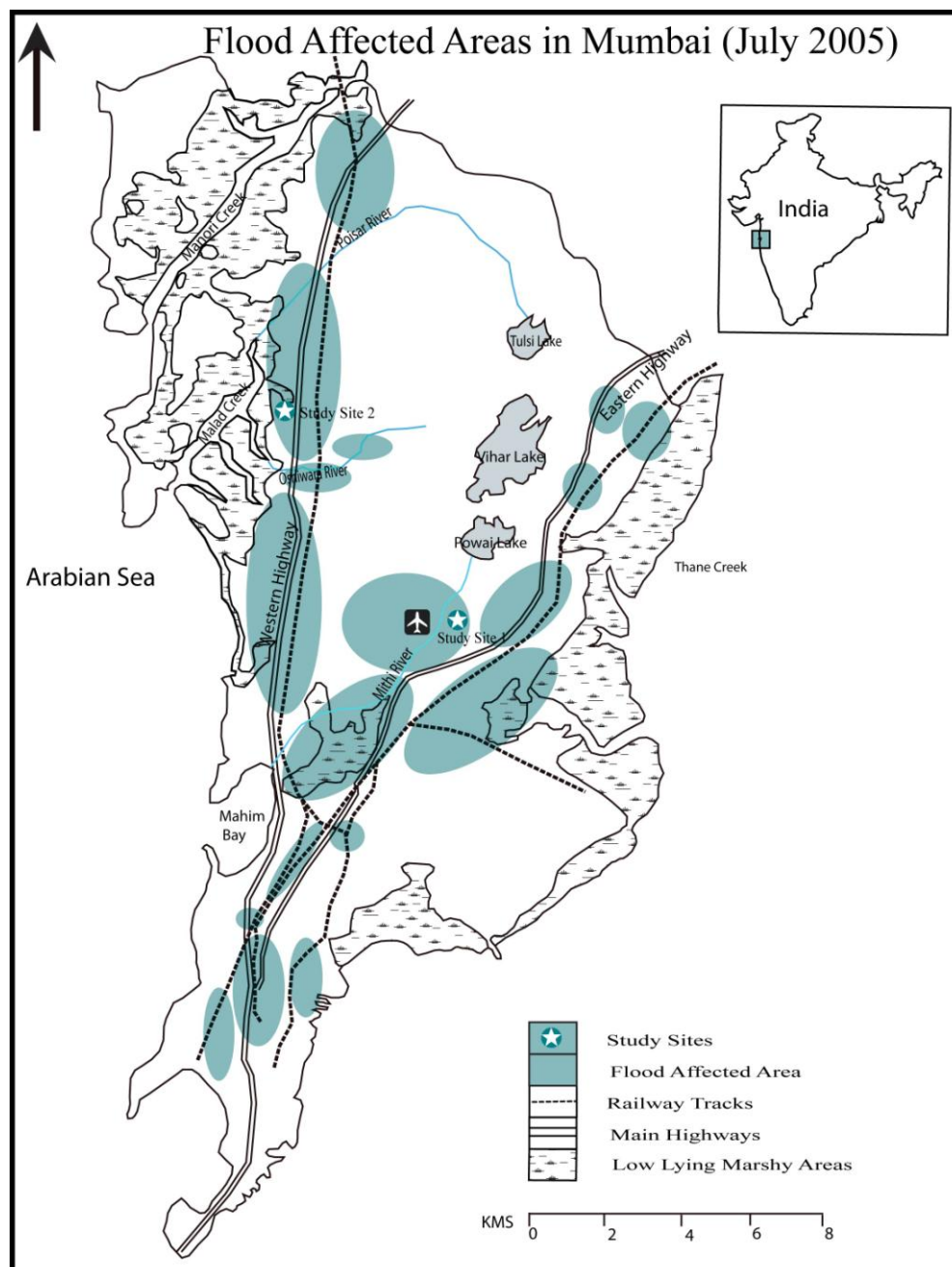
system (Hunter Commission). Drainage recommendations and strategies developed in the early 20th century have guided management until recently. The BRIMSTOWAD (Brihan Mumbai Storm Water Drainage) project commissioned by the municipal corporation of greater Mumbai in 1993 was the only major effort made to improve the drainage system since independence (Gupta 2007b). Funded by the World Bank, this project recommended the augmentation of Mumbai's drainage system to accommodate rainfall intensity of 50 mm/h and involved increasing the number of pumping stations. Due to lack of funds, this scheme was only partially implemented. Even if it had been fully put in place it would have been inadequate because analysis of rainfall intensity between 1999 and 2004 showed that the peak rainfall intensity for more than 80% of this period was more than 72 mm/h (Gupta 2007b). During the floods of 2005, rainfall intensity reached a maximum of 190 mm/h in the afternoon of 26th July. Flooding in July 2005 was exceptionally severe, affecting 60% of Mumbai (Figure 13)(Gupta 2007a). That event provides a suitable benchmark for studying Mumbai's present flood risks.

Impact of Floods in 2005

The 2005 flood event caused extensive damage to Mumbai and surrounding areas. MMR authorities reported 700 deaths, 244,110 houses destroyed or partially damaged, 97 collapsed school buildings, 5667 damaged electricity transformers, together with vehicular losses to national highways and transportation systems (52 broken local trains, 41,000 taxi cabs, 900 buses, 10,000 trucks). Trade and commerce suffered losses of 50 billion U.S. dollars (5000 crores) (Government of Maharashtra, 2005). Floods also

caused extensive damage to the livestock and dairy industries; 15,321 cattle deaths were reported within the city limits (South Asia Disaster Report, 2005).

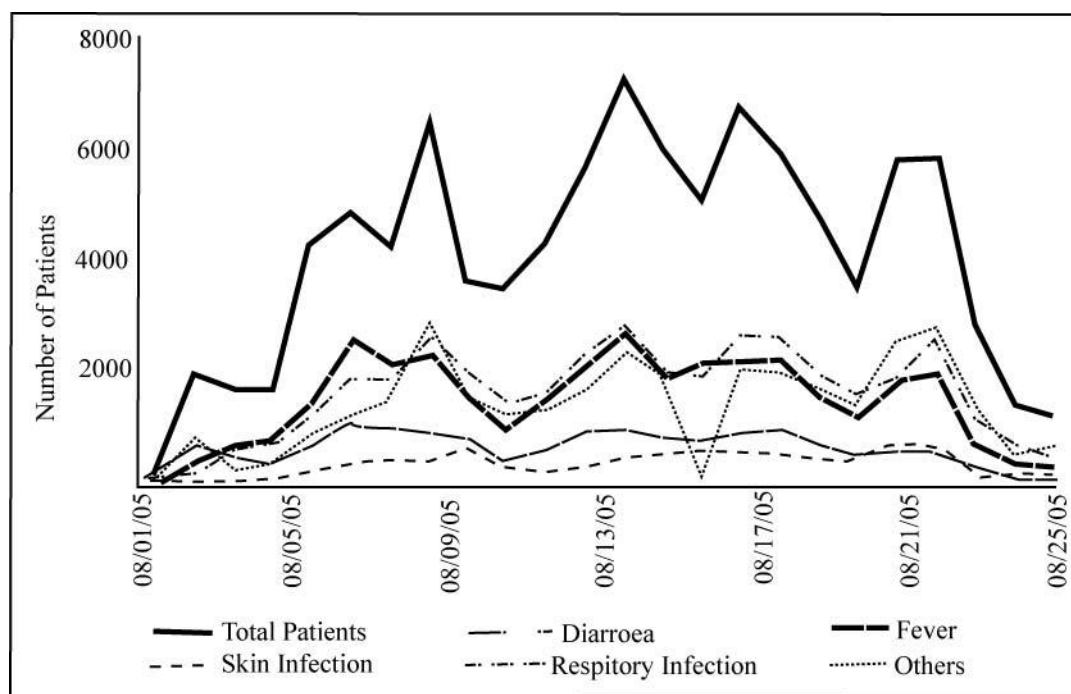
Figure 13: Flood Affected Areas in Mumbai (July 2005)



Source: Base Map (MMRDA, 1996) Flood Information adapted from (Gupta, 2007)

Beyond the immediate losses there were epidemic outbreaks and continuing rains turned recovery into a haphazard process (Kshirsagar et. al. 2006). Some of the diseases that were reported within two weeks of the deluge included gastroenteritis, hepatitis, enteric fever, typhoid, malaria, dengue, leptospirosis, and other types of infections and fevers (Government of Maharashtra, 2005). One hospital treated the following cases: 15,536 with diarrhea, 37,696 fever, 9731 skin infection, 40,368 acute respiratory infection and 36,540 other cases including broken bones, referrals, etc. (L.T.M Medical College, 2005). The number of patients was highest in the period between the second and fifth weeks (Figure 14) of flooding (August 2nd – 25th 2005).

Figure 14: Distribution of Disease



Source: (L.T.M Medical College, 2005)

In addition to the direct impacts, the flood event had cascading effects at different scales and sectors. These were felt at the regional and global level (South Asia Disaster Report, 2005). The transportation system was one of the worst hit sectors. Due to the MMR's nodality, size and layout, its people are extensively dependent on mass transportation, especially for travel to work. Since the flood inundated and damaged local trains, tracks, buses and roads, communication within the city was entirely disrupted. Likewise, several national highways that connected Mumbai with its hinterland were cut off. Operations at the national and international airports of Mumbai ceased due to flooded runways. This, in turn, disrupted worldwide passenger and freight movements. Furthermore, global financial transactions were interrupted because the national and Bombay stock exchanges were closed for two days.

Table 8: Insurance Claims with New India Assurance

Category	Claims Reported	
	Number	Amount in Lakhs ('00000) of Rupees
Fire	5868	64276
Marine Cargo	41	260
Motor	13028	4232
Householders	509	426
Shopkeepers	2721	4305
Engineering	135	1307
Misc. Others	784	1289
Total	23086	76095

Source: New India Assurance, Mumbai 2007

One other global impact was the extensive insurance losses claimed by industries and storehouses in Mumbai. For the first time in Mumbai, these losses reached US\$10 billion (1000 crores) (Krishnan, 2005). Data from New India Assurance for this event shows that the highest numbers of claims by owners were made for automobiles and property losses in buildings (fire insurance covers natural events like floods). Claims for loss of business

commodities were also made by shopkeepers (Table 8). A further indirect impact was a reduction of real estate market transactions, especially in the worst affected areas of central and northeastern Mumbai (Times News Network, 2005). Finally, the flood affected formal and informal businesses and livelihoods of both low and middle-income populations. Although these were of great importance, lack of systematic data hampers assessment of their extent and severity.

The Threshold Event

Flood events in the past have created a certain degree of chaos, losses, and inconvenience in Mumbai. The flood in 2005 was different on account of its intensity, levels of impact, and the extent and types of losses. Before 2005, monsoon rains had not resulted in any direct deaths. The deaths of 2005 made this event unusual enough to procure attention from government authorities and the general community.

Who is afraid of a little rain in Mumbai? It is common for a Mumbaikar to wade through some water now and then. But when I started hearing that in the nearby neighborhood two bodies were recovered in the water, I realized this was different. In fact I think when the bodies started appearing everybody got worried and everyone started calling each other to discuss actions - Irfaan Merchant, Rahat Organization

Floods in Mumbai are usually perceived as an inconvenience for the general public. Previous annual inundations have mostly been observed in the low lying informal settlement areas that are expected to flood in the rainy season.

The slums outside our colony are always flooded during monsoons. Every year I see more huts along the edge of the marshy land, near the drains. Here in monsoons it rains very heavily for three months and those are the places which will get flooded when it rains like that. I think the people living there know the problem and still choose to live there - Manoj Khandekar, Motilal Nagar

Similarly, the water logging experienced in the low lying sections of the road and rail networks are considered the result of haphazard growth and inadequate drainage systems along the transportation channels. But the floods in 2005 inundated formal sections of the city, flooded entire stretches of western and eastern highways, forcing the general public to take shelter on isolated islands on top of flyovers and multistoried buildings.

I was sitting in my school where I work in Bharat Nagar slum, since morning it was raining heavily, I have to travel some distance to get home but I continued to work because I have lived in Bombay for 30 years and I thought that I am used to such rains. At four our school manager told me that I should go because water was rising quickly and there was a strong current. I took my bag and at that time the water was already waist high. I was with the school manager and it was extremely difficult to walk in the flowing water. It was a strange phenomenon for us bombayais⁴¹ to walk in water. It took us two hours to walk a small patch of distance. I kept walking and after a couple of more hours I reached the highway. At the highway as I looked north there were about 10000 cars stranded and people were walking from everywhere. I met people who had walked for 4/5 hours to cover two to three kilometers to reach this highway. We held hands and managed to walk up the flyover and spent the night on the flyover inside cars and buses – Ahmed, Bharat Nagar

Although the informal population suffered the most severe and lasting consequences during the event, people from all sectors (irrespective of their economic, socio-cultural and political identities) were considerably affected.

⁴¹ Colloquial word to refer to a person living in Mumbai/ Bombay for a long time

On 26th (July 2005) I was at office and it was raining, and it continued raining and water was rising, all shops were closed, everyone in the office who left in the evening came back and decided to stay in office for the night. In the office kitchen we cooked some khichadi⁴² for everyone. Phones went dead; power went off... everything went off. This never happened in this part of the city – Raj Mohan, National Insurance Company, Church Gate

Impact on communication and transportation was felt at different levels too. With rich and poor stranded in similar conditions, this event created a lot of discomfort and losses at all levels of society. Affected people included national celebrities like Aamir Khan⁴³ (stranded in traffic) and Amitabh Bachhan⁴⁴ (inundated basement) (Ranjan 2005). Flooding of the first floors of formal government colonies such as the Air India Colony (Whitehead 2007) caused concern in all circles of society. In addition to direct impacts, interruption of the commercial activities in the city produced an open outcry for flood mitigation. This concern was also visible at the global level as losses and disruptions suffered at the local level also had ripple effects in the global air transportation, communication and economic sectors.

Multi Sector Failure of Flood Management

Formal institutions responsible for hazard mitigation and recovery failed during the 2005 floods. In the aftermath different departments and agencies tried to avoid responsibility by laying blame on others. Departments in the Mumbai Disaster Management Committee

⁴² Food preparation made of boiled rice and lentils

⁴³ Actor in Indian Film Industry

⁴⁴ Same

(MDMC) and agencies in charge of railways, relief, rehabilitation, state roads and police usually excused their failures by citing a lack of warning from the Brihanmumbai Municipal Corporation (BMC) or the Indian Meteorological Department (IMD).

IMD had issued a warning of ‘rather heavy to heavy rain’ between 22nd and 29th July, but the amounts predicted were only from 35 to 125 mm of rain instead of the 944mm that was received in just 24 hours. Furthermore, lack of representation in and communication among different departments (E.G. IMD, Police) in the monsoon preparedness and flood mitigation committees that were set up by the government, were also considered detrimental. The police department claimed that it did not have the equipment, personnel training, clear role in disaster management, or statutory authority to launch an exhaustive emergency operation after the floods. The lack of information from the IMD was again attributed to lack of equipment and rainfall gauges necessary to provide data about rainfall intensity.

The Maharashtra state department of relief and rehabilitation was criticized for being distracted elsewhere, first by drought relief operations in the Vidharbha (eastern Maharashtra) and Marathwada (central districts of Maharashtra) (until July 15th) and then in flood rescue activities in Nanded (district in south east Maharashtra), Konkan (coastal Maharashtra) and Thane districts (district in the north of Mumbai) (after July 21st). The relief and rehabilitation department claimed that the first warnings about the flooding in north Mumbai were only received on the afternoon of the 26th, and that within 48 hours

relief was distributed to all flooded areas. However, accounts of flood victims illustrate a high rate of irregularity in the relief distribution process.

I was in my room with my children and around 2 in the afternoon suddenly water started rushing in. I just had time to pick my children and climb up my neighbor's two storey house ... I spent the rest of the day and night on the roof of that building praying the water would stop rising until some people came to rescue us about 18 hours later. My two children 7 and 4 had nothing to eat and stayed in wet clothes sitting in torrential rain the entire time. We all fell sick after that. - Prem Nagar Resident

The relief process was flawed due to the political tensions between different agencies that were working to gain political mileage. For example, the relief packages that were distributed carried the names and political affiliations of local leaders.

We lost everything in the floods; the local restaurant people were making food packets and the church people were distributing food in our neighborhoods. Sometimes they would give them to us and we survived on that. I had to look for work so I couldn't wait to collect relief from other people and my wife has two small kids to look after so she couldn't run after relief distribution groups either. Kholis⁴⁵ by the road got compensation from government but nothing was distributed to us inside the settlement. Later we got to know trucks full of relief material were distributed in Maland - Adarsh Nagar Resident

BMC and other metropolitan-wide agencies in Mumbai such as MMRDA and the fire brigade were conspicuously absent in the flood relief and rehabilitation process, having been given a two-day holiday declared by the state government. These and other clues suggest that corruption and political maneuvering are among the roots of immediate and long-term vulnerability to flood losses in Mumbai.

⁴⁵ Rooms in slum settlement

Recommended Strategies for Flood Mitigation in 2005

Failure to mitigate the massive losses experienced by every section of society as a result of floods in 2005 generated concerns in all socio-economic sectors of Mumbai. Public outrage about inadequate information and administrative response mechanisms led to the emergence of several public delegations that examined the underlying causes of the disaster and made recommendations to mitigate its losses. For example, the Concerned Citizen's Commission (CCC) was set up by a group of non-governmental organizations in August 2005 to address the '*...reports of administrative apathy and incompetence, political interference in the relief distribution process, a lack of accountability and indications that the lessons that should have been learnt from disaster were being ignored...*'⁴⁶. It issued a report based on twelve public hearings that gathered information from 13,890 statements made by officials, experts, NGOs, flood victims, and concerned citizens in different parts of the city.

The CCC report gave an account of the loopholes observed and identified many deficiencies. These included: lack of prior warning information; an inoperative control room at the ministry; lack of coordination both between and within departments; flawed executive decisions such as declaration of a two-day government holiday immediately after the downpour; inapproachability of the government and elected representatives; and non-implementation of long term recommendations made in the disaster management

⁴⁶ Page 6 - Concerned Citizen's Commission. 2005b. Mumbai Marooned: an enquiry into the Mumbai floods, 2005 Full Report. 115. Mumbai: Conservation Action Trust.

plan designed in 1993 (Concerned Citizen's Commission 2005a). It concluded with a set of short and long term recommendations for the city authorities to implement in order to reduce the risk of floods in future.

Short Term Recommendations

Box 5.1: SHORT TERM RECOMMENDATIONS

Disaster Management:

1. Periodic inventory and restocking of essential items in the disaster management plan. Provision of items needed such as inflatable boats, Ham radio sets, tents, demolition equipments etc for emergency response in the city.
2. Identified locations within community equipped to function as emergency centers
3. Upgraded communication system – better information dissemination
4. Flood modeling and use of GIS technologies to forecast expected rainfall and inundation.
5. Instead of Chief Minister managing the disaster, a clear disaster management authority responsible for flood mitigation in the city.
6. Financial independence for disaster management authority to operate separately.
7. Training programs for citizens
8. Provide statutory authority to disaster management cell
9. Update disaster management plan with inputs from bureaucrats, technocrats, and other sections such hospitals, educational sectors.
10. Citizens' Helpline to disseminate information

Relief and Rehabilitation:

1. Full compensation should be provided to people who suffered damages from floods including illegal hutments in informal settlements.
2. Regular meetings between government authorities and civic groups to continue regularly to assess disaster preparedness every year.
3. Public audit of relief and rehabilitation process to restrict discriminatory practices. Public audit should become an integral process in the democratic system where citizens are able to participate in planning for the city.

SHORT TERM RECOMMENDATIONS CONTINUED...

Infrastructure:

1. Implementation of BRIMSTOWAD report, improvement in the drainage capacity should take place.
2. BMC's Slum Sanitation Program to be expanded to provide community toilets in large number of informal settlements. Treatment plants to be installed to ensure better sewage disposal.
3. Steps to be taken to reduce the amount of waste produced, packaging to be changed, plastic bags to be banned, encourage recycling, composting wet waste locally.
4. Emphasis on developing mass transit system therefore less emphasis on mega road projects such as Worli-Nariman Point and Sewri-Nhava links for car users and more funds to develop railways. Limit the entry of private cars in crowded downtown areas.

Housing:

Terminate the Slum Rehabilitation Scheme and giving land rights to slum residents under its supervision. Only slums located in the low lying areas prone to floods should be relocated. Stricter building codes to be applied to all constructions in the city. Affordable housing should be provided to low income population with the help of state government.

Communications and Public Health System:

Development of wireless communication system such as satellite phones for emergency responders. Responders need to be trained to use Ham radios. Invocation of Notifiable Diseases Act to get more accurate estimations of medically affected populations after every event. Increase the number of health workers to monitor basic health services in informal settlements.

Natural Drainage:

Restoration of natural drains should begin with suspension of mega development projects that are using reclaimed land such as Bandra Kurla Complex, Bandra Worli Sea Link, and Mumbai Airport. Encroachments on the river banks should be removed and open spaces, marshy areas, creeks, mangroves and salt pans should be left free from construction and reclamation.

Source: (Concerned Citizen's Commission, 2005)

Recommendations made by the CCC to mitigate some of the immediate risks of floods were focused on: (1) building the emergency response strategy of the city; (2) upgrading of infrastructure and administration to support response; and (3) better management of relief and rehabilitation after the event. The short term recommendations also highlighted a need to reduce vulnerability by improving inadequate housing, public health services and environmental restoration.

Long Term Recommendations

Long term recommendations were also made to address underlying causes of vulnerability to floods in Mumbai.

*‘The focus of planners, administrators, industry and citizens must shift from a purely statistical growth-based approach to an approach that looks at maintaining and enhancing the quality of life of all citizens of the megapolis’.*⁴⁷ - CCC Report

The committee recommended resource assessments to examine the capacity of Mumbai’s infrastructure to provide people with basic amenities such as affordable housing, clean drinking water, and drainage and sewage systems. It also supported a comprehensive carrying capacity study to look at population, human impacts on environment, problems zones, potentials for growth (if any) and options to prevent further deterioration in urban conditions. The committee also proposed a transparent process of decision making and

⁴⁷ Page 78 - Concerned Citizen's Commission. (2005) Mumbai Marooned: an enquiry into the Mumbai floods, 2005 Full Report, Conservation Action Trust, Mumbai. pp. 115.

planning for the city that would include clear governmental strategies for soliciting opinions and informing citizens about decisions and their consequences.

In addition, the committee recommended development of the public health sector, including an increase in the government budget for health services from 15-16% to 30-35% of total spending. To improve the local environment of Mumbai the committee urged a reevaluation of ongoing large scale projects such as the slum rehabilitation scheme, Bandra-Worli- Nariman Point and Sewri-Nhawa Trans harbor Sea link and mill land development; it also promoted the importance of open spaces and public amenities. There were suggestions to develop strategies to reduce the flow of in-migrants to Mumbai by revitalizing rural agriculture, including new projects for stimulating smaller cities outside Mumbai. It was recommended that planning for development in the future should also be aware that risks that are increasing as a consequence of the region's growing exposure to global environmental and societal changes.

The CCC report was an attempt to understand the complete range of issues that affect flooding and flood mitigation in Mumbai. Although it leans heavily on technological fixes and does not explore the full gamut of risk reduction and redistribution techniques, the report does a valuable service by pointing out contributory causes of flooding and unresolved issues. However, the recommendations made by the committee are merely advisory. They also reveal an underlying societal perception that holds the government solely responsible for the prevention and mitigation of flood hazards. For example, the

report identifies the need for ‘decentralization’ of responsibility and authority within the government structure but not within other institutions of society. Therefore the responsibility of civil society and multiple stakeholders within communities is not acknowledged and advanced. Furthermore, it doesn’t address the limitation of incomplete and erratic decentralization efforts that pass the responsibilities of risk reduction and social welfare to local bodies and civil society but do not provide authority, funding, or institutional ability to pursue these goals (Whitehead, 2007). These deficiencies suggest that disaster mitigation in India is not yet informed by the strategies of prevention, risk reduction and resilience building that are encouraged by international disaster management agencies and other component bodies (ISDR, 2008). However, despite these shortcomings the CCC report informed public leaders and the larger society about most of the problems and potential solutions.

Flood Mitigation Strategies Adopted after 2005

The Government of Maharashtra set up the Madhav Chitale Committee to assess the causes of floods in Mumbai. The committee blamed the unprecedented and unplanned growth in the city as the main cause, and specifically identified problems of inadequate and obstructed drainage, loss of water-holding ponds, reclamation of marshes, encroachment of channel beds (Desai, 2008; Mhaske, 2008) and insufficient information for the delivery of effective relief and other responses. Although the CCC report was forwarded to the government authorities for action, the municipal authorities decided only on selective adoption of recommendations made by the Madhav Chitale committee

(Table 9). They recommended the detailed study of watersheds, rainfall patterns and intensity, the maintenance of drains and the implementation of the BRIMSTOWAD report after suitable updating and revision (Gupta, 2007). Following these recommendations flood mitigation in Mumbai was initiated by BMC in three primary ways; (1) improvement of the disaster mitigation plan, in particular by developing the emergency response mechanism in the city; (2) decongesting the city with a view to restoration of the natural drainage system, especially for the Mithi River basin; and (3) the provision of transportation, storm water and drainage infrastructure.

Table 9: Range of Applied Actions

Post Flood Actions				
Immediate			Recovery and Reconstruction	
Disaster Preparedness	Relief and Rehabilitation	Institutional	Infrastructure Development	Decongesting Mumbai and Restoration of Ecology
Upgraded rainfall forecast - Weather radar systems and rainwater monitoring Upgraded communication system	Personnel training in fire, police, home guard and other Periodic inventory and restocking Equipments for emergency Identified emergency centers and help lines	Financial autonomy and statutory authority to disaster management department Disaster Management plans for each ward	BRIMSTOWAD Transportation and Communication	Cleaning and clearing of bottlenecks in Mithi river Buffer Zones in Lower Mithi River Area

Various steps were taken to aid disaster response. Thirty automatic weather stations with alarm systems were added in Mumbai to improve the coverage and timeliness of rainfall data. The automated weather stations, capable of monitoring rainfall every 15 minutes, provide warning updates every hour during heavy rainfall. In an effort to improve

emergency response the Municipal Corporation of Greater Mumbai (MCGM) constituted a specially trained task force with proper equipment, a well equipped emergency response center at the ministry office, additional trauma centers in hospitals, special parking areas for people to safeguard their cars, 120 temporary shelters, as well as additional pumps to extract water from high risk zones, and they improved connections with other local and national emergency response organizations (MCGM, 2006). Detailed disaster mitigation plans in each ward provide background information and address a wide range of functions. These include: ward level disaster management committee members; descriptive overviews of each ward; ongoing and proposed development projects; the emergency response structure with defined responsibilities of each member in the committee; hospital contacts during emergencies; lists and contacts of relevant NGOs; maps showing high risk zones and the location of control rooms, hospitals, school building, shelters, fire stations and emergency parking; and directories of the ward (BMC, 2006).

Restoration of the natural drainage system is the second crucial element prioritized for flood mitigation by the BMC. In re-establishing the natural channels, until now precedence has been given to the Mithi River that flows through the center of Mumbai, which is the most prominent stream system in the city. The Government of Maharashtra set up the Mithi River Development and Protection Authority (MRDPA) in 2006 to restore the river's channel to its original size and extent. The Mithi is 17.83 KMS in length (11.07 miles) and flows through Powai, Marol, Sakinaka Sahar, Santa Cruz Airport, Kurla, Bandra Kurla Complex to reach the Arabian Sea through the Mahim

Causeway (Figure 11). It passes through central locations of the city with complex industrial, commercial and residential land uses and it carries a heavy pollution load of 34,162 and 87,499 kg per day of BOD and COD respectively (Mithi River Development Authority, 2006b). There are many bottlenecks at different locations. Lack of adequate sewage and industrial waste treatment plants in the city have turned the Mithi River into a large *nalla*⁴⁸ carrying sewage and garbage through different commercial, residential, industrial and informal areas. The action plan to restore the Mithi River includes deepening, desilting and widening, construction of bunds, retaining walls at each side, development of environmental buffer zones, installation of sewage treatment plants and demolition of structures within 200m of the channel (Mithi River Development Authority, 2006a; Mithi River Development Authority, 2006c). The Restoration plan contains four components; river flow improvement, river front development, reduction of pollutants, and removal of encroachments (Mithi River Development Authority, 2006c). In June 2006, approximately 4066 households (Faleiro, 2006) were removed from the encroached areas in preparation for their replacement by recreational parks that would act as buffer zones in the event of future floods.

Upgrading Mumbai's outdated drainage system is the third major goal. Concerns about the limited drainage system of the city and recommendations for improvements had been published by the Natu Committee in 1974, Central Water Power Research Station (CWPRS) in 1978, and BRIMSTOWAD (World Bank) in 1993 (Gupta 2006). However, it was only after the 2005 event that the Government of Maharashtra initiated action. The

⁴⁸ Channel

BRIMSTOWAD project is regarded by the BMC as the answer to flood problems in Mumbai. The central government sanctioned 1200 Crores (250 million US dollars) for construction and 600 Crores (125 million) for rehabilitation of 26,600 families that would be affected by the project (Vyas 2008). The first phase is underway and includes the construction of pumping stations, and the widening and deepening of four main drains on the city island, as well as seven in the western and eight in the eastern suburbs. The project will have to relocate households that were either living too close to the river systems or were in the way of storm water drain construction plans. MRDPA and MCGM both have used 2000 as the cutoff date to qualify for government-assisted rehabilitation. Any households settled after that year will be forced to leave without any compensation (Singh 2006).

Choices of Strategies

The acceptance and enactment of flood mitigation strategies in Mumbai is strongly influenced by the views of those who are well represented in a formal decision-making process that excludes many of those at risk. The inequities and vulnerabilities of others are not taken into account.

Mumbai's drive to become a world leader in finance and technology industries is a guiding force for public action. In the words of one government report: Mumbai '*... must develop the capacity to compete (globally) to acquire its share in global market...*'⁴⁹ and

*'...glaring deficiencies in its urban infrastructure need to be addressed and rectified on war footing. Mumbai's deficiencies include: crumbling housing in dilapidated buildings pervading the city; poor road/rail mass transit as well as the absence of water borne transport in what is essentially an island city; absent arterial high speed roads/urban expressways; poor quality of airports, airlines and air linked connections domestically and internationally; poor provision of power, water, sewerage, waste disposal, as well as a paucity of high quality residential, commercial, shopping and recreational space that meets global standards of construction, finish and maintenance.'*⁵⁰

This focus has often made politicians and urban managers support and legitimize business and commercial projects at the cost of community interests (Bannerjee-Guha, 2002). As a result the city contains two separate universes; '*in all sectors, viz., housing, transportation, recreation land, ownership, health of education segmentation got pronounced leading to a visible dualism in social and economic space of the metropolis.*'⁵¹ In the case of floods too hazard mitigation has merely become a reason to further pursue the objective of economic development through technological fixes and structural developments.

⁴⁹ Page xv-Government of India. (2007) Mumbai - An International Financial Center, Ministry of Finance, New Delhi. pp. 224.

⁵⁰ Page xxix - Ibid.

⁵¹ Page 122- Bannerjee-Guha S. (2002) Shifting Cities. Economic Political Weekly January 12:121-128.

The goal of ‘...*making every citizen of Maharashtra a lakhpati*⁵², by the year 2010 AD’⁵³ clearly indicates that the priority is to increase income. Increases in income, however, do not guarantee safe and healthy living standards or sustainable livelihoods for everyone. For instance, the low income households in Mumbai earn more than their counterparts in the rural areas but are unable to meet the expenses of basic living. They can expect little help from planners who want to transform Mumbai into a world class city that incorporates large scale infrastructural development of roads, power systems, information technology and real estate in order to attract global economic clients and commercial growth. Examples of investments that rely on foreign capital include the centrally located Bandra Kurla Complex (BKC) on a reclaimed mangrove area that is flood prone, and the extension of the airport by altering the channel of Mithi River. The Mithi River Development and Restoration Authority (MRDPA) that was established after the floods in 2005 is mostly concerned with the removal of illegal settlements encroaching on the river and restoration of its natural channel, but doesn’t question other encroachment and reclamation projects that were undertaken for the development of BKC. Furthermore, the rehabilitation of households in low lying areas near BKC (e.g. Mandala in Mankhund and Tunga village) is not so much for the purpose of providing safer and better places of habitation as for (Faleiro, 2006) restoration of a landscape that would befit the image of an mega city. In short what is occurring is the production of a human controlled environment fostered by the hegemonic government that seeks to facilitate economic

⁵² Hindi term for someone who has one lakh (100,000) of rupees

⁵³ Page 9 - MEDC. (2005) Maharashtra Vision 2005: Fast Track Development of Maharashtra strategy and action - Review, Analysis and Recommendations, Maharashtra Economic Development Council, Mumbai pp. 127.

development at the cost of displacing marginal populations and forcing them to lose their livelihoods.

Likewise, the multimillion dollar project BRIMSTOWAD ‘...touted as the panacea to Mumbai’s flood problem’⁵⁴ is just a narrow and inadequate technological fix. Technology can assist in flood mitigation, but the case of Mumbai requires resolution of widespread socio-economic and political inequalities that are the realities existing on the ground.

Strategies adopted by city authorities do not explore options for resolving the inequities by developing affordable housing. Instead they treat informal settlements as temporary illegal inhabitants that are required to be moved out of the city. In regards to flood vulnerability, the government only provides rescue and relief services to informal settlements. Thus informal settlements are not considered for loss compensations, assistance in rebuilding, or benefits of structural mechanisms to reduce the risk of floods. The CCC report recommended ‘...that all people who suffered damages must be compensated to the fullest extent. The state government’s actions not to rehabilitate people whose houses were illegal are deplorable and needs to be condemned.’⁵⁵ However, none of the recommendations including land rights for slum population were addressed. As a result the underlying causes of vulnerability to floods are only exacerbated by the BMC’s flood mitigation strategies.

⁵⁴ Page 1- Author. 2008. G+2 in 60 Days. *The Times of India* 11th April.

⁵⁵ Page 66 - Concerned Citizen's Commission. 2005b. Mumbai Marooned: an enquiry into the Mumbai floods, 2005 Full Report. 115. Mumbai: Conservation Action Trust.

Without addressing the needs of the informal population of Mumbai, the proposed and ongoing technological fixes will be inapplicable and ineffective. These include BRIMSTOWAD, the 375 million dollar project to increase the storm water drainage capacity to mitigate the problems of inundated roads and residential colonies. The large scale evacuations intended to restore the Mithi River channel will be useless unless a well distributed sewage and waste disposal system is developed to serve all of Mumbai's population, including the informal sector. Without suitable sewage and waste disposal, the wider and deeper storm water drains are only likely to get clogged during monsoons. Composition of garbage in Mumbai shows a large percentage of paper and sewage (MCGM 2005). Hence, an effective flood mitigation strategy would be to promote recycling of paper and treatment of sewage. Investment in restoring natural drainage and storm water drainage without resolving the issue of garbage will only render the strategy futile. Likewise, evacuating low lying areas and forcing the informal population to the outskirts of the city will only lead to a reappearance of the problem because old households will return or new migrants will settle in the newly available space. Relocation can be a good mitigation strategy because it provides poor households with fundamental housing requirements, but it also affects their ability to maintain a feasible livelihood (Parasuraman 2007). If the choice is between reducing environment risk and retaining livelihood, low income populations prefer an assured livelihood and therefore keep returning to low lying areas located near the commercial areas in the city. Instead of developing means of shifting livelihood options to different locations that are not vulnerable to environment risks, urban authorities in Mumbai have preferred simply to

identify households to be shifted, in consort with builders and developers, and to negotiate with politicians whose electoral support might be affected.

Conclusion

Mumbai's emphasis on technological strategies and structural fixes to control environmental risk is consistent with development and disaster management priorities observed at the national level in India. Moreover, the management approaches employed have further aggravated the patterns of inequity and marginalization of informal populations.. The strategy adopted after the threshold event of 2005 followed the example of other cities in developing and developing countries by focusing on large scale land alterations and engineering structures (Erdik 2008, Faisal 2003, Wang 2008). This approach, however, does not balance risk mitigation with the risk sharing and redistribution strategies that are often adopted in developed countries (Kunreuther 2006, Gulkan 2002). These provide additional layers of safety and loss sharing for at risk populations. Very little has been done to understand the processes that produce social vulnerability in cities by assessing the many ways in which marginalization is constructed in the city (Wisner 1998, Huq 2003).

It is true that Mumbai requires large scale infrastructural development to support its large population, but addressing flood risk as a 'demand and supply' problem rather than an uneven and unequal distribution of resources problem disregards major aspects of the issue. By means of technological and structural interventions, urban planners and hazard

managers will develop the knowledge to understand and manipulate the physical environment; the actual struggle in Mumbai is to understand and manage the imbalances that occur at the interface of environment and society. Flood mitigation strategies adopted in Mumbai do not address that gap but focus on provisional solutions like increasing resource use, elevating buildings, and removing and displacing marginalized sections of population. Instead, urban managers should attempt to understand the socio-environmental complexities where risks and vulnerabilities exist in urban places, and also mobilize societal means to overcome these constraints. Improved knowledge of what creates risks and vulnerabilities and how a society develops resilience by adopting multiple layers of mitigation and adaptation strategies is key. Such a strategy would assist in designing an urban flood mitigation and adaptation system that is well connected with different aspects of urban life, and uses alternatives that are not just based on structural and technological fixes but societal adjustments and ethical reorganization.

The present system of flood management in Mumbai is clearly flawed, but alternatives that take advantage of social resources already present among informal populations may be possible. The next chapter explores some of them.

Chapter 6: Old and New Structures - Constraints and Alternatives

Informal settlements house more than 50% of Mumbai's population and are most frequently and severely affected by floods. During the flood season in 2005, authorities reported no apparent difference in flood impacts for both rich/poor, formal/informal communities. Emergency response focused on slum settlements as the 'vulnerable sections' of society, but the benefits of large scale flood mitigation strategies adopted to mitigate perennial problems of monsoon floods were intended mostly for formal populations, while little attention has been given to the problem of reducing the hazard vulnerabilities of informal populations in Mumbai. Even within the emergency response system, the practice was not based on sound understanding of the composition and dynamics of vulnerability within slum settlements, but instead on static general indicators of vulnerability such as age, poverty level, and gender. Characteristics that have serious roles in the distribution of vulnerability and resilience are not considered when formulating an effective emergency response and flood mitigation policy for the city. Furthermore, it is important to understand the workings of inherent cultural systems that are crucial in the development of a well-balanced and dynamic flood mitigation system. Researchers have identified some of these already. For example, unresolved issues of inequity, other forms of injustice and the current neoliberal approach to development that exclude informal settlements are known to further aggravate hazard vulnerability for marginalized populations. But equally important, and far less acknowledged, is the influence of large scale emergent processes that are restructuring these communities and generating new systems of acquiring resilience. Although these processes operate

unevenly and intermittently, they signal the existence of underlying mechanisms developed by society to respond to disasters. This chapter uses the field data collected from selected slums of Mumbai to identify the pre-existing socio-cultural and new socio-economic structures in informal societies, and to assess their role in the distribution of vulnerability and resilience.

Debates about Informal Settlements

Large scale urbanization and industrialization have often been accompanied by prolific growth of informal settlements. Issues associated with dilapidated human settlements have concerned urban planners working in both developed and developing countries. Historically, accounts of abject poverty, residential segregation, disease, and unsafe housing for low-income populations in European cities like London, Naples, and Paris have been extensively addressed by social scientists in the late nineteenth century (Jones 1971; Dauntton 1990; Snowden 1995). Research on informal settlements in the twentieth and twenty-first century is especially focused on the rapidly growing cities of third world countries. Informal settlements or slums are defined in many ways, but in every cultural region they are mostly characterized by high densities, poor housing, inadequate basic infrastructure (such as potable water, drainage, sewage and garbage disposal) and they suffer from degraded environmental and health conditions. Slums have often been interpreted as places of gross inequities and injustice (Davis 2006), but at other times of as centers of dynamism with great potential for change (Owusu 2008), and occasionally as iconic places of cultural expression and solidarity (Cejas 2006). Literature on this

subject is mostly produced by and for urban managers, planners, social scientists and contemporary literary philosophers.

Predictions for urban growth and consequent expansion of informal settlements in third world cities have been discussed by scholars (Brockhoff 1999, Drakakis-Smith 1997, Gugler 2003). Some studies have particularly focused on complex issues such as measuring slum populations in cities that have high rates of daily and/or floating migrants (Taylor 1988), and the role of urban migrants in ethnic-religious violence (Verkaaik 2004). However, a significant part of this literature is addressed to understanding: (1) the consequences of uneven development (Hardoy 2001, Kelly 1995, McGranahan 2001); (2) the changing spatial order of cities in developing countries (Marcuse 2000, Raiser 2005); and (3) challenges of advancing the basic living standards of low-income populations of cities (Lau 2003, Minton 1996, Satterthwaite 2009, Tipple 2005). Another section of this literature deals with increasing knowledge about the expanding informal economy in third world urban places and puts particular emphasis on discerning its growing macroeconomic connections (Funkhouser 1996, Kelly 1994, Mosley and Hulme 1998). Yet another extensively studies the livelihood and assets of low-income populations including women and children, and the everyday survival strategies of slum dwellers (Dercon 2003, Moser 1998).

Transformations associated with informal growth and agency of informal populations have sometimes been interpreted as processes of power and societal revolution (Soto 1990), some of which have prompted the launch of slum upgrading and self-help

programs by international development organizations, including the World Bank. Others look critically at the role of capitalist states and interpret slum settlements as the by-product of globalization and as a consequence of capitalist “triage”, predicting an increase in violence and uprisings of losers against winners along the boundaries of civilization, class and religion in the future (Davis 2006).

A separate section of the literature focuses on innovative ways of interpreting slums as ‘new contact zones’⁵⁶ wherein it is possible to experience exotic spaces in different cultures and expand interpretations of impoverished communities through exposure and increased travel (Azarya 2004). Positive images of slums are promoted by urban development professionals and scholars who emphasize the value of promoting ‘better shelter’ as a policy goal rather than ‘slum up-gradation’. The latter term renders slums and the people living in them as the disagreeable underside of modern society in developing countries. Such negative associations are then used to justify inequitable actions adopted for such places and the people living in them (Gilbert 2007, Huchzermeyer 2003). Some of these interpretations are visible in the case of informal settlements of Mumbai and the policy approach to flood mitigation in the city.

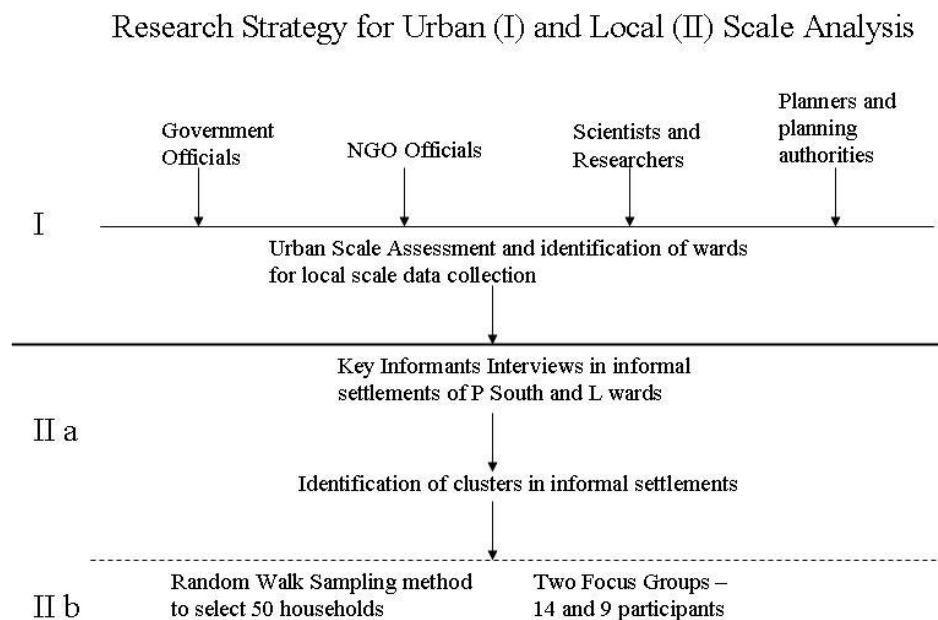
Research Strategy and Study Sites

The selection of slum communities was made on the basis of two criteria: their proximity to industries and past experience of floods and related risks. To select appropriate

⁵⁶ 224 - Cejas, I. M., El C De Mexico (2006). "Tourism in Shantytown and Slums: A new 'Contact Zone' in the era of globalization." *Intercultural Communication Studies* XV(2): 224-230.

communities, interviews were held, interviews were held with community development organizations working at the grass root level with slum development issues across the city (Figure 15). At the city level (Figure 15 - I) interviews with 17 NGOs working in different wards were conducted to document community experiences of floods in the past including that of 2005 event, and also to get a socio-economic and ecological profile of slum households in those communities.

Figure 15: Research Strategy for Urban (I) and Local (II) Scale Analysis



In addition to the interviews, field visits were conducted with each of the slum communities in which each organization was active (17 in total) to observe conditions of flood risks and random interviews were conducted with key informants in these neighborhoods to determine extent of flood impact and losses suffered. Two slum

settlements (Figure 16) located in L and P South wards of Mumbai city were chosen for questionnaire and focus group data collection (Figure 15 – Iib). These wards (1) contained high percentages of slum dwellers, (2) were heavily affected by floods in 2005 and 2006, and (3) were located near or in major industrial land use areas with large numbers of industrial workers.

Characteristics of Two Sample Settlements

Jarimari Settlement in L ward is located next to the Chatrapati Shivaji International Airport and on the banks of Mithi River (Figure 16) close to the 15 flooding points identified by the ward disaster mitigation plan. Following floods in 2005, the area around this settlement was extensively changed and flood walls were constructed, and the Mithi River was re-channelized to protect the airport from future flood events. Consequently, this settlement is likely to receive more than its share of rainwater; excess water that would have inundated the airport area will be pushed towards this settlement in future monsoon flood events. Similar to Dharavi community, the residents of this slum settlement are coordinating with National Slum Dwellers Federation to negotiate their relocation and redevelopment of this area with government authorities and other stakeholders (Patel 2007). More than 90% of residents in the settlement have been settled here for more than 10 years and approximately 40% have been living in the settlement for more than 20 years. Households in this old settlement are likely to have more than one family member employed, some households also have members who hold multiple jobs and have additional side businesses. Family members are equally likely to

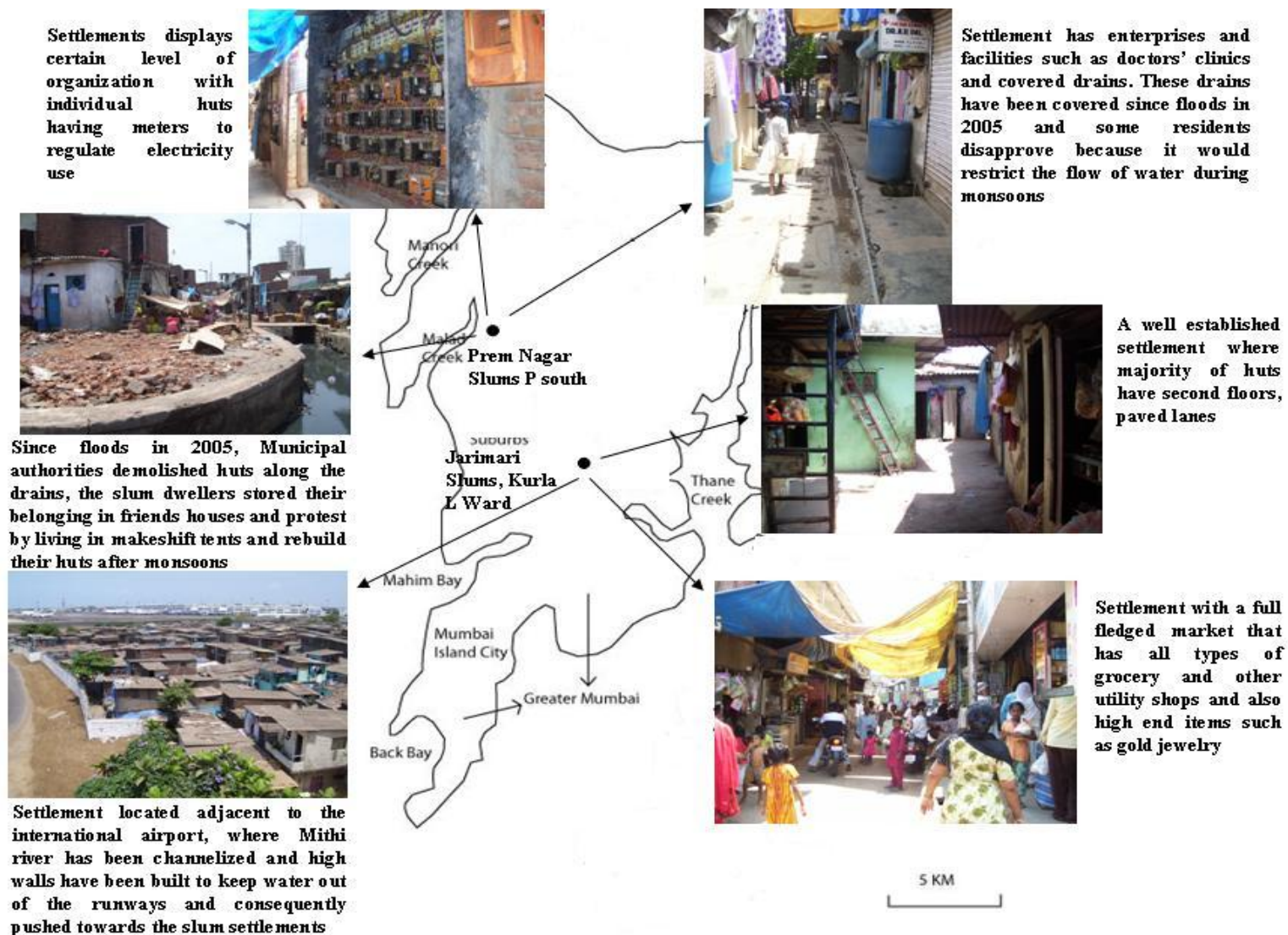
be employed in informal or formal sectors, but the majority of them work as manufacturing workers in informal cottage type textile/ sewing units, plastic factories, or are shop owners, self-employed as wholesale vegetable sellers, domestic helpers, workers in shops, drivers, etc. Lanes within the slums are segregated on the basis of religion, language, and caste. The settlement is well developed with flourishing markets that sell different types of general household and specialized items. The houses in the settlement are constructed with *pucca*⁵⁷ materials, often have more than one floor, and have separate stairways outside or inside the house to access the upper floors. The lanes of this settlement, though narrow, are paved (Figure 16).

Prem Nagar Settlement in P south ward is located next to Malad Creek in Goregaon, located in low lying area adjacent to Goregaon link road and police colony. The ward of P south has 32 flooding points identified in its disaster management plan, and they are located around this settlement. Prem Nagar is different from Jarimari settlement because it is a comparatively new settlement; only 10 to 15% of households have been living here for more than 20 years. A majority of families (approximately 85%) have moved here only in early 1990s after the downfall of textile mills and hence are likely to be employed in other manufacturing industries such as pharmaceuticals, engineering, diamond processing factories and the information industry. Segregated neighborhoods within the settlements based on religion, caste and language are also observed here. However, family units are more intact in this settlement, with less animosity and stronger sense of community within households. Though relatively new, the settlement is slowly

⁵⁷ Concrete materials

establishing itself as a prominent settlement in the ward. With separate electrical units for each household (Figure 16), covered drainage, some two or more storied buildings and a growing market for specialized services (including medical doctors) the settlement is in the process of growing into a large and well established neighborhood for low income populations in the northern suburbs of Mumbai. Because of its distance from the city center, the settlement has not received much attention from government authorities for the purpose of flood mitigation. The only visible step taken by the government is the demolition of huts along the drains before monsoon season (Figure 16). Although the rest of the settlement does not face any immediate threat of evacuation for flood mitigation, many residents are willing to relocate if provided with relocation options.

Figure 16: Study Sites



Research Strategy for Local Scale Analysis

The objective of household level investigation was to generate qualitative and quantitative data to examine: (1) the coping strategies of populations living in informal settlements to deal with recurrent floods; (2) types of risk redistributive mechanisms (formal or informal) adopted by these populations and their influence on the production of vulnerability and resilience in informal societies; and (3) different kinds of support networks used and the ways in which these networks of assistance can be integrated with the mainstream flood mitigation strategies of the city.

Once the settlements of Jarimari and Prem Nagar in L and P South wards respectively were identified, interviews with key informants (Figure 15 – IIa) such as community doctors, social workers, teachers, local politicians, religious leaders, businessmen and traders were used to identify clusters or neighborhoods that housed factory and industry sector workers. Internally these clusters displayed a great degree of heterogeneity. In these neighborhoods, random walk sampling was conducted and 50 households were selected for a detailed questionnaire survey (Figure 15 – IIb). The survey comprised both structured and open-ended questions. Data was collected on aspects ranging from socio-economic status of the slum dwellers, their extent of losses from floods, coping mechanisms to lessen these consequences and recover their prior conditions. The structured questionnaire contained eight sections⁵⁸: (1) basic information profile on socio-

⁵⁸ Appendix 1 Questionnaire for slum dwellers.

economic status of the respondents including their legitimate or non-legitimate status as residents, lack of land ownership, permanent employee status, type of employer, type of product, markets of product and hence their employer's connection with regional or global markets; (2) characteristics of flood vulnerability including physical vulnerability, infrastructure availability, access to basic amenities; (3) flood impact, extent of losses, type of direct and indirect losses; (4) methods adopted by individuals to immediately survive from floods; (5) government, NGO and other institutional support or aid and relief received; (6) access to formal and informal financial facilities, and sources of credit and loans; (7) specific loss sharing mechanisms adopted and sources applied to share and reduce losses; and (8) awareness and perceptions about insurance coverage for flood losses, and insights into their idea of suitable products to redistribute flood risks. Representatives from insurance companies and industries and factories were also interviewed to determine their role in flood recovery and redistribution for slum households in informal settlements of Mumbai.

In addition to surveys, other methods such as focus groups (with 14 and 9 participants in Jarimari and Prem Nagar respectively) were conducted in both communities to get insights about issues related to flood risks in these settlements (Table 10). Focus groups were particularly used to obtain data on combined local perspectives that also informed about the underlying ironies, contradictions, and tensions in these communities. Furthermore, observation and participation in community development activities were undertaken during visits to these settlements to increase the sense of place and understand the interaction within households and between residents and their local environment.

Table 10: Types of Methods used for Local Scale

Technique	Respondents	Identity and/or Location
Interviews (17)	Local Community Development Organization and NGOs	Apnalaya Greater India Friendship Kesav Gore Samarak Trust Bombay Urban Industrial League for Development (BUILD) Bombay Community Public Trust Jagruti Kendra Karmayog CORO for Literacy Sankalp Center for Slum Studies CEHAT Center for Environmental Research and Education Hari Masjid Committee Janvi Charitable Trust Action Aid Mahila Vikas Mandal Saher – Jogeshwari
Visitation and Observation (17 visits)	Residents and community organizations of 17 settlements	Settlements where the above listed organizations are active.
Key Informants Interviews (15)	NGO Workers Doctors Local Member of Legislative Assembly (MLAs) Religious Leaders Local Businessman and Traders	Prem Nagar Jari Mari
Questionnaire Surveys (50)	A total of 50 selected households	Prem Nagar and Jari Mari settlements in P/South and L wards respectively
Focus Groups (2)	Slum Residents	Prem Nagar (9 Participants) Jari Mari (14 participants)
Participationry and Observation (approximately 95 visits in total)	Slum Population including residents, businessmen and traders, officials, religious organization members, NGO	Visitation to each settlement and participation in community activities, discussions, hearings, meetings on topics such as determining market

to Jari Mari and Prem Nagar)	officials	timings, domestic violence issues, political agendas
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Data Analysis

Data collected was separated on the basis of definitive and qualitative classifications. Quantitative information was organized in arrangements based on topics like occupation, income, family type, property ownerships, access to infrastructure, amenities, financial services, decision making process, extent of flood impact, type of losses incurred, immediate shelters, sources of support, etc. Statistical tests like cross tabulations and chi square analysis were used to analyze the empirical data collected from structured questions to develop patterns and structures of flood assistance and loss redistribution among slum dwellers. Results from focus groups and answers to open-ended questions of slum households were textually analyzed to determine the underlying themes, frameworks and perceptions about the flood problem, and register the role of socio-economic practices in facilitating its mitigation in these communities. Qualitative data on several other aspects of flooding was also systematically extracted from the surveys. These included: interpretation of floods; factors affecting the selection of emergency shelters; sources of support; ideologies of loss sharing; loss-reduction practices of individuals and institutions, perceptions about insurance, preference for informal mechanisms of insurance, methods of coping after floods, relationships developed and maintained to cope from floods, opinions about the future of flood mitigation, etc., were categorized separately. At the data analysis stage, information was grouped according to evolving themes where common cases were classified together to develop different

typologies of practices, processes, choices and opinions. In addition to answers from focus groups and surveys, observation and ethnographic methods were used to understand and evaluate lifestyles, resources and attitudes of slum dwellers about their vulnerability, potential risk from recurrent floods, their perception on the causes of these losses and responsibility for dealing with it. This assessment helped in determining the general attitude of the targeted low-income population towards hazard loss reducing mechanisms and their role in this process.

Results from the survey on mitigation measures used by slum dwellers at different stages of the 2005 flood event (during, immediately after, and in the long term recovery stage) were juxtaposed with socioeconomic, political and cultural characteristics of the households. Cross tabulation of these variables for all households were used to identify existing patterns. A chi square test established the statistical relation between socioeconomic variables and ability to acquire support during, immediately after and long term recovery after floods.

Changing Characteristics of Slum Households

There is a great deal of diversity in the informal settlements in Mumbai. Initially, the informal section of Mumbai's society was composed of refugees, low caste migrants and other socially marginalized groups. However, lack of affordable housing for low or middle income class groups and the transformation of Mumbai into a predominantly

service and commercial city has driven a much larger section of city's population, unable to seek formal housing, into the informal sector (Banerjee Guha 2009). This has consequently changed informal settlements into a socially, economically, ethically and culturally diverse community. Furthermore, characteristics of migrants settling in informal settlements of Mumbai have been changing over the last fifty years. Though there has been a general decline in the percent of migrants among the total population of the city (from 50 percent in 1951-61 to 37 percent in 2001) the proportion of female migrants has grown. Likewise, migration from the northern states of Uttar Pradesh and Bihar has increased, but has decreased from neighboring Gujarat (Singh 2009). Another significant transition is the increased rural to urban migration in comparison to trends of people moving to Mumbai from other towns and cities in 1980s.

Since informal households are the primary unit of analysis for this study and results show that these characteristics play a crucial role in the household's ability to cope with floods, an in-depth analysis of the changing socio-economic profiles of selected household samples is presented here (Table 11). To understand the changing characteristics of slum households over the past decades, the sample pool is divided into three categories: old ⁵⁹ (total of 14 households), medial ⁶⁰ (24 households), and new ⁶¹ (12 households) residents. Socio-economic factors for these households illustrated different patterns. Each of these categories demonstrated a considerable degree of diversity in terms of religion, regional background, employment, type of industry, level of education and type of residence

⁵⁹ Households settled before 1985

⁶⁰ Households settled between 1985-1995

⁶¹ Households moved to Mumbai since 1995

ownerships. The majority of households experienced six to twelve feet of inundation during floods.

Table 11: Composition of Sampled Households

Years of Residence	Subcategories	Less than 10 years	Between 10-20 years	More than 20 years	Total	%
Religion	Hindu	7	22	4	33	66
	Muslim	1	1	7	9	18
	Christian	4	1	3	8	16
Originally from State	Maharashtra	5	9	3	17	34
	Karnataka	4	1	2	7	14
	Gujarat	0	8	3	11	22
	Tamil Nadu	0	0	3	3	6
	Andhra Pradesh	0	0	3	3	6
	Uttar Pradesh	3	6	0	9	18
Ownership of Room	Owned	9	23	14	46	92
	Rented	3	1	0	4	8
House Type	Semi Constructed	3	3	0	6	12
	Built Up	9	17	8	34	68
	Two Storied	0	4	6	10	20
Number of Family Members	3	0	4	0	4	8
	4	5	8	1	14	28
	5	1	4	5	10	20
	6	5	5	4	14	28
	7	0	1	1	2	4
	8	0	1	3	4	8
	more than 8	1	1	0	2	4
Education	Illiterate	4	1	3	8	16
	Primary	3	8	5	16	32
	Middle	4	6	1	11	22
	High	1	8	3	12	24
	College	0	1	2	3	6

Employment	Temporary	2	4	5	11	22
	Permanent	10	17	8	35	70
	Seasonal	0	3	0	3	6
	Unemployed	0	0	1	1	2
Industry	Manufacturing	11	14	5	30	60
	Construction	1	0	2	3	6
	Transportation	0	6	1	7	14
	Chemicals and Pharmaceuticals	0	4	2	6	12
	IT/Data Processing	0	0	3	3	6
	Unemployed	0	0	1	1	2

Old resident households show maximum heterogeneity. They include a mix of Muslim, Hindu and Christian families (ranked in that order). Among newer residents, there are more Hindu than Christian families. The distribution, therefore, suggests that immigrants to Mumbai in the 1980s and before were predominantly Muslim, while in more recent years larger numbers of Hindu and Christian families have migrated to the city.

The regional background of older residents displays the greatest diversity. Twenty years ago, skilled laborers from southern and western states of Karnataka, Tamil Nadu, Andhra Pradesh and Gujarat would migrate to Mumbai. Since then, Mumbai has received significant number of unskilled migrants from states in northern India like Uttar Pradesh and Bihar. One consequence of this transition is escalating regional backlash among the in-state (Maharashtra) population, whose members resent the increase of migrants from other parts of India; this has been labeled ‘ethnic chauvinism’ (Appadurai 2001).

Older and medial residents have received higher levels of education. Medial residents display a higher rate of literacy; only 5 percent of are illiterate in comparison to older residents who include more than 20 percent illiterate respondents. Illiteracy is highest of all among new residents (more than 30 percent). Education level also reflects the type of industry and occupation of each member of the household. Higher diversity is again observed among older and medial residents. Members of these households had better and more developed skill sets, and consequently moved to industries like IT and pharmaceuticals. New residents tend to work in industries like construction or informal manufacturing, which require little or no skills. Length of residence also correlates with slum tenement ownership which in turn affects membership in the local community. While older and medial residents are considered as owners, significant numbers of new residents are only considered as tenants and pay rent to some of the older residents.

Old residents who settled before 1985 are a diverse group with many different religious and regional backgrounds, possessing specialized skills, and able to find employment in various economic sectors of the city. Medial residents who settled between 1985 and 1995 were more qualified in comparison to the other two groups; they were capable of joining the urban system but displayed less diversity. New residents are the least established group of migrants, who survive on temporary employments in the disappearing economic and social sectors of the city. Implications of the changing socio-economic characteristics of slum population shows that new residents are the most vulnerable section of population in terms of employment, education, social network and ability to survive the risks of urban life in Mumbai.

The physical attributes of these settlements are also changing. For example, most buildings in the sampled slum settlements were made of brick and cement covered with asbestos sheets. Many were two or more stories high, and had access to electricity. These households were able to afford televisions, air coolers and sometimes refrigerators for personal use. Older settlements generally had narrow but concrete-covered lanes, well developed mixed markets selling local and other commodities, access to telephones lines and networks of transportation.

Table 12: Changing Trends in Type and Level of Education between Generations

Type of Residents	Education Level of Head of the Household		Education of First Child in Household	
			Government School	Private School
New	College	0	1	0
	High	1	1	1
	Middle	4	0	1
	Primary	3	0	8
	Illiterate	4	0	0
Medial	College	1	4	0
	High	8	0	0
	Middle	6	2	9
	Primary	8	0	8
	Illiterate	1	1	0
Old	College	2	5	0
	High	3	1	1
	Middle	1	4	0
	Primary	5	0	1
	Illiterate	3	2	0

To examine how the socio-economic characteristics of these households will change under the influence of shifts in human capital, a comparison between the education levels of the head of the household is made with the type and level of education received by the first child in the household (Table 12). The comparison shows that second generation migrants tend to be more educated in comparison to first. Even in cases where the head of the household is illiterate, children are sent to schools. Secondly, new generations in these families are likely to be taught in private⁶² (English Medium) schools as opposed to local schools run by government aid. And finally, knowledge of English is considered an essential skill that will help the next generation get employment in the service sector economy of Mumbai. It is therefore coveted by slum dwellers.

Role of Networks in Flood Mitigation adopted by Slum Dwellers

*'Mumbai functions on such invisible networks of assistance. In a Mumbai slum, there is no individual, there is only the organism. There are circles of fealty and duty within the organism, but the smallest circle is the family. There is no circle around the self.'*⁶³ – Suketu Mehta

Coping During and After Floods

Means of flood mitigation were compared with characteristics such as: years of residence at present address; religion; original home state; number of employed in households; type of industry employed in; and employment position. During the flood event of 2005,

⁶² English medium schools, where students are more likely to learn to read, write and converse in English, these schools have higher fees and other expenses in comparison to government schools where most expenses are subsidized.

⁶³ Page 43 - Mehta, S. (2007). Maximum City. Urban India: Understanding the Maximum City, Mumbai, Urban Age.

respondents took shelter in different types of buildings or on higher ground near their slums. Cross-tabulation of survey results show that old and new residents are less dependent on relatives for shelter; Christian families are likely to take shelter in religious centers; and families from nearby areas in Maharashtra live with relatives, whereas families originally from more distant states rely more on other types of socio-cultural connections. Families with members working in the Information Technology (IT) and service sectors are able to take shelter in formal places like hotels. Most families (80%) could not safeguard anything, including important documents, or collect money to carry with them because water rushed in suddenly. After the flood, immediate relief was distributed by government, nongovernment, private and local agencies (Table 13); NGOs helped 64%; private institutions, 62%; local people, 50%; government, 40%; and political parties, 26% of the surveyed population. This underscores the relatively limited role played by government. After the event, households had support from more than one agency. For example, 72% received rations (food material cooked and uncooked) from three or more sources. NGOs and private institutions commonly distributed in-kind material aid to 50% and 26% of the surveyed population, respectively. Only 44% of households received medical assistance. NGOs and government helped 34% and 28% of households with medical support. Flood compensation funds were distributed by the government to 38% of households. It was also observed that members in 56% of households were absent from work for an average of two weeks and 82% of households surveyed suffered health disorders after the floods. Chi square tests⁶⁴ show significant statistical relationships between relief received in the form of food and household

⁶⁴ The Chi Square test is used in this study to examine if two variables are independent or related. A chi-square probability of 0.05 or less is commonly interpreted as a justification for rejecting the zero hypothesis that the variables are unrelated.

commodities with socio-cultural variables, like years of residence, religion and state of origin. There was also a direct relationship between compensation received with state of origin and years of residence.

Table 13: Support Immediately after Floods in 2005

Social Characteristics/ Type of Support	Food/Ration	Household Commodities	Medical Assistance	Compensation
Years of Residence in the present place	$\chi^2 < 0.00$	$\chi^2 < 0.00$ 70% of Medial, 58% of New and 57% of Old residents received help.	8% of New, 50% of Old and 58% of Medial Resident received medical assistance.	No Specific Pattern or Relation
Religion	Christian families - dependent on government and religious agencies. Hindu and Muslim families - dependence equally distributed between state and community organizations. $\chi^2 < 0.00$	89% of Muslim, 70 % Hindu and 63% Christian families received help from Non governmental agencies like NGOs, Private Institutions, and Local People. $\chi^2 < 0.00$	51% of Hindu, 44% of Muslim, and 12% of Christian families received Medical Assistance.	55% of Muslim, 39% of Hindu and 12% of Christian Families received compensation from Government.

State of Origin	Families from Mumbai and Maharashtra region received help from government and political agencies. Households from other parts of the country were dominantly helped by Non Governmental and private sector. $\chi^2 < 0.00$	Families from states like Tamil Nadu (100%), Uttar Pradesh (50%) did not receive any help. Households primarily from Mumbai (65%) and Maharashtra (70%) received help. $\chi^2 < 0.00$	People originally from outside of Mumbai and Maharashtra were the main recipient of Medical service.	90% of families from Mumbai received compensations from government. $\chi^2 < 0.00$
Number of employed people in Households	No Specific Pattern or Relation	Families with one working member receive relief from government and religious organizations. Families with more working members rely on NGOs and private sector. $\chi^2 < 0.00$	Families with one working member receive relief from government; families with more working members rely on NGOs and private sector. $\chi^2 < 0.00$	Higher percentage of Households with more working members received compensation.

Type of Industries	No Specific Pattern or Relation	No Specific Pattern or Relation	No Specific Pattern or Relation	Households with members working in manufacturing (75%) and transport (71%) industries received compensation.
Type of Employment	No Specific Pattern or Relation	No Specific Pattern or Relation	No Specific Pattern or Relation	No Specific Pattern or Relation

Source: (Chatterjee 2008)

Survey results show that social, economic and cultural characteristics of households are important factors in determining their vulnerability to floods. They also illustrate the shifting nature of vulnerability and how a particular characteristic can exacerbate or reduce a household's vulnerability at different stages of the hazard cycle (Table 14). For example, new residents (less than 10 years) and old residents (more than 20 years) are dependent on randomly available places for shelter during the event and are more at risk in comparison to those in the medial residence category (10-20 years) who find refuge with the assistance of the social networks they have developed *in situ*. Immediately after the event, new and old residents are again more vulnerable, as they are likely to acquire less relief from different agencies. Exclusion accounts for the high degree of vulnerability among new and old; new residents do not have access to networks of support, old residents, because of their established lifestyle, do not maintain connections to support

systems. However, old residents are able to renew social connections and use these resources for long term recovery after the flood event, and therefore are much less vulnerable at the recovery stage. Medial residents are least vulnerable to floods because they are the most socially connected section of population in a megacity. This section of the population is active in the process of consolidating their presence in the city system; when a sudden event occurs, they are able to exercise all resources immediately.

Table 14: Shifting Vulnerability at Different Stages of the Hazard Cycle

Indicator	During Flood Event	Immediately After Event	Recovery & Mitigation
Years of Residence in the present place	New and old residents are more dependent on random places for shelter and are more vulnerable. Medial residents rely mostly on relatives and social connections.	NGOs and Private Institutions are main supporters after the event. New and old residents are more vulnerable as they receive less relief in comparison to medial residents.	Old and Medial residents have access to more resources of recovery, new residents are less resilient
Religion	Christian families have support of formal institutions. Hindu and Muslim families are dependent on social institutions and more vulnerable as individual household capabilities play a significant role.	Muslim and then Hindu families are better connected and receive help from social and political agencies. Christians rely only on religious organizations.	Christian families have institutional support for loss redistribution, financial and flood mitigation consultancy. Muslim families have institutional support for loss redistribution and financial consultancy. Hindu Families are most vulnerable because they rely on social networks, support from which depends on individual capacities.
State of Origin	Residents originally belonging to other states than Maharashtra are more vulnerable.	Government assistance received by families from Mumbai and Maharashtra are significantly higher than others like from Tamil Nadu and Uttar Pradesh	Households from Maharashtra have more support for long term Recovery and are less vulnerable.

Number of employed people in Households	No Specific Pattern or Relation	Households with less working members rely more on government support, families with more working members are likely to receive support from NGO and private sector.	Employers are important source of financial support for families with less working members.
Type of Industries	Households with members working in IT and service sector have more resources and information and are less vulnerable.	Manufacturing sector employees are more likely to receive compensation.	People in IT and service sectors have more information and support for flood mitigation.
Type of Employment	No Specific Pattern or Relation	Permanent workers are able to resume work faster than other type of workers	Seasonal and daily workers are most vulnerable as permanent and to some extent temporary workers have significant support from employers.

Source: (Chatterjee 2008)

Shifting vulnerability is also evident in the case of different religious groups. At the time of the floods, Hindu and Muslim households relied on social connections and were more vulnerable than Christian families who had access to local religious buildings. However, immediately after the event, vulnerability shifted as Muslim and Hindu families were able to receive help from more agencies than Christian households. The latter are primarily dependent on religious organizations and hence have limited sources of cultural support. During long-term recovery, vulnerability changed again as Christian and Muslim households were able to receive additional support in the form of (1) technical information on mitigation, as well as (2) advocacy for financial services and economic assistance. In this case Hindu households are marginalized because they are dependent on

their own capacity to procure support for recovery and they do not receive any aid from religious organizations at this stage.

In addition to years of residence and religion, the original home state is another social factor that affects vulnerability among slum dwellers in Mumbai. Survey results show that households originally belonging to other states than Maharashtra are more vulnerable because they lack resources and access to decision makers. In comparison to households from other states like Tamil Nadu and Uttar Pradesh, Maharashtrian families or those originally from other parts of Mumbai received more aid of all kinds after the events.

Distinct effects of these socio-economic characteristics are even more apparent at the long-term recovery stage when families from Mumbai and nearby areas have economic and institutional support from more networks.

Recovery and Mitigation

Loss redistribution is an embedded coping mechanism and plays a significant role in sustaining low income populations during times of crisis. The cases of Mumbai slums provide evidence of existing and emerging loss redistribution practices that may be representative of slums in many other third world megacities. The analysis in Mumbai shows that the flood loss redistribution system of the low income population living in cities of developing countries is a set of diversified and multilayered, complex

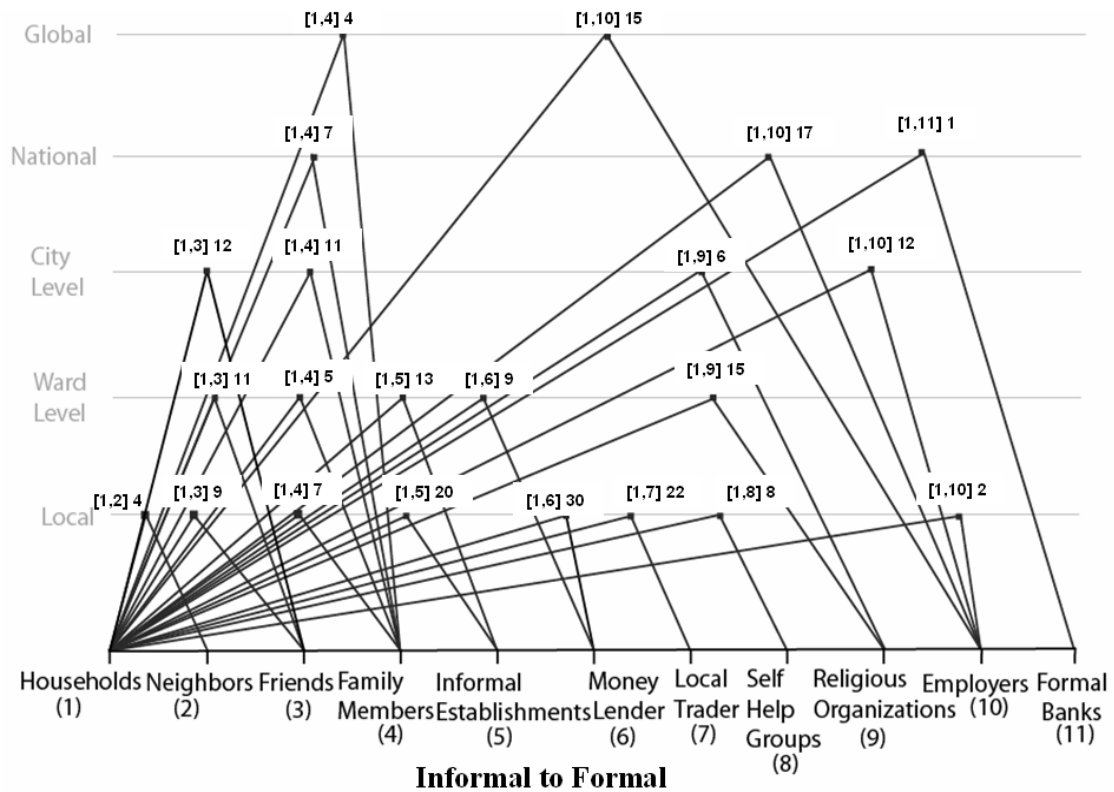
arrangements. Furthermore, the study confirms that although this system is an effective method of empowerment and loss reduction for slum households in general, there are marginalized population groups left out of these support networks due to internal (cultural, social and political) discriminations or external (labor demands, skill, type of industry) exclusions. On average each household had access to approximately five (4.8) sources of emergency economic assistance in the form of monetary support for damage coverage, bonuses, allowances, easy loans, etc. Table 15 below demonstrates that all 50 households had at least one source of economic assistance (rank 1). The great majority (80 per cent) could draw on up to five sources simultaneously (rank 5). After floods, employers and money lenders are the leading sources of financial help, followed by family members, informal establishments and friends.

Table 15: Rank Wise Distribution of Sources of Financial Support after Floods

Sources of economic assistance after floods	Rank 1	%	Rank 2	%	Rank 3	%	Rank 4	%	Rank 5	%	Rank 6	%	Total	%	No Rank	%
Neighbors	0	0	0	0	3	6	1	2	0	0	0	0	4	1.7	46	17
Friends	3	6	6	12	5	10	5	10	5	10	8	16	32	13.8	18	6.6
Family Members	12	24	6	12	4	8	1	2	11	22	0	0	34	14.7	14	5.1
Religious organization	1	2	7	14	0	0	6	12	0	0	0	0	14	6	36	13.3
Money Lenders	4	8	8	16	5	10	5	10	14	28	3	6	39	16.3	16	5.9
Local Traders	11	22	5	10	4	8	2	4	0	0	0	0	22	9.3	28	10.3
Self Help Associations	3	6	1	2	1	2	3	6	0	0	0	0	8	3.4	42	15.5
Informal Establishments	0	0	2	4	8	16	12	24	10	20	1	2	33	14.2	17	6.2
Employers	15	30	13	26	11	22	6	12	0	0	1	2	46	19.8	4	1.4
Formal Banks	1	2	0	0	0	0	0	0	0	0	0	0	1	0.4	49	18.1
Total	50	100	48	96	46	94	43	86	40	80	13	26	240	99.6	270	99.4

It is noteworthy that formal banks and neighbors are the least likely sources to be approached after floods; 98% and 92% of households' respectively chose not to rank formal banks and neighbors as options. First options of economic support selected by respondents are employers (30%), family members (24%) and local traders (22%). Accepted alternatives that are ranked second are again employers for 26% of respondents. However, family members and local traders are replaced by money lenders (16%) and religious organizations (14%). Employers remain a prominent source of help, even as the third option for 22% of surveyed households followed by informal establishments (16%). As the fourth and fifth options, informal establishments turn into an important source. At rank 5, options like arrangements with money lenders (28%), and family members (22%) are observed to be other means of support. Almost two-thirds of the population have used friends as sources of economic assistance; friends are not prominent in any specific ranks, but are generally present as a preference in all ranks.

Figure 17: Loss Redistributive System (LRS) of Slum Dwellers



Note: Support networks are stated in sets; for example, [1,2] 4 shows that this local network comprises affected households (1) and neighbors (2) and 4 households have used this support network for long term recovery after floods.

The flood Loss Redistribution System (LRS) of slum residents can be compared to a lattice (Figure 17). A lattice is a branching system comprised of many links among its constituent elements. Depending on the lattice's degree of development, its links may be simple and unidirectional or bidirectional, between just a few nodes, or arranged in complex series and hierarchies that include nested subsets and connections with larger contexts. Flood affected households are represented as nodes on the lattice; these are

linked to other nodes that stand for the different individuals or groups among whom losses are redistributed. Slum dwellers are connected with multiple agencies at different scales of society for support after floods, and less developed LRS could be a cause for aggravated vulnerability for these populations.

Collected data clearly indicate that the LRS for slum residents is multilayered and spatially complex (Figure 17). The same household often has access to several different types of financial support concomitantly, and vulnerable populations can avail themselves of assistance from networks at many overlapping spatial scales. These can involve communities that are geographically, socially and economically separate from them. Jewellery shop owners who exchange cash for pawned items and storekeepers who provide goods and credit both are part of exclusively local networks. Networks of self-help groups, religious organizations and informal establishments are local or citywide. Family members and employers are part of networks that can be local, metropolitan or global in scope. Therefore, loss redistribution strategies of slum dwellers are affected by internal, local and regional, national and global factors.

The impact of structural forces is evident in the role of employers and deserves further comment. In the contemporary era of global economic restructuring, employers at the municipal, national and global level have become significant providers of emergency support for Mumbai's hazard affected slum dwellers. This is partly due to the growing ease with which skilled individuals can access easy loans, information, and support

networks that permit them to leave present employers and set up their own businesses. The indirect impact of globalization in Mumbai therefore has made skilled workers a valuable asset for employers.

Why will employers not help? After all who will help? I gave easy loans to my workers affected by floods. Where will they get money? They lost everything. If you take a walk along this road you will see so many notices for skilled workers. You don't find any. As soon as they learn some work they open their own business. Everyone wants to be the Malik⁶⁵. – Ajith Nayyar, Factory Owner, Goregaon

As a result, employers are careful to extend support to their employees to ensure minimum attrition. This inclination, however, is particularly noticeable in the case of permanent workers (with or without contracts) (Table 16). Cross-tabulation of employment type and employer-provided economic assistance shows that employers are the most preferred source of support for 31% of the survey respondents. The statistical relationship (Chi Square test⁶⁶) between employee type and employer-provided economic assistance is also highly significant ($\chi^2 < 0.00$).

Table 16: Economic Assistance from Employer Categorized by Employment Type of Respondents

Employee Type and Economic Assistance from Employer	Economic Assistance Source Employers (Ranks 0-6)						Total
	0	1	2	3	4	6	
NA	0	0	1	0	0	0	1
Permanent	0	11	9	10	5	0	35
Seasonal	3	0	0	0	0	0	3
Temporary	1	4	3	2	0	1	11

⁶⁵Employer

⁶⁶The Chi Square test is used in this study to examine if two variables are independent or related. A chi-square probability of 0.05 or less is commonly interpreted as a justification for rejecting the zero hypothesis that the variables are unrelated.

Total	4	15	13	12	5	1	50
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Neoliberal economic policies probably also play a role in encouraging employer-provided emergency support. Employers seem to prefer assisting individual workers to absorb the costs of flooding, because this relieves employers of responsibilities to protect entire communities at risk. Moreover, in a mobile labor market, factory owners who are unable to support and retain workers might otherwise be subject to the indirect impacts of the flood hazard (Basu 1997). For the employer, therefore, advancing financial assistance or easy loans to the worker is a form of insurance to assure that the future income is not affected.

‘As soon as the water went down, Memsahib⁶⁷ sent us food, dry clothes, blankets and she gave each one of us Rs. 5000. She really looked after us. We were back on our feet in a day and our karkhana⁶⁸ started immediately.’ – Sheela, Tailor at one of the sewing units located in slum settlements

A common arrangement adopted in Mumbai is to work additional hours for the employers in repayment of the support forwarded after floods. Approximately 70% of the workers surveyed affirmed working extra hours after floods. However, working extra hours in some cases is not a formal repayment of the loan but a gesture of gratitude and assurance for future support. Among the surveyed population, only 63% of the respondents that worked extra hours claimed to have made a formal (written or verbal) contract for financial support and repayment of a loan. For the 37% of respondents that worked extra hours, the arrangement is a matter of understanding between the malik and the worker. In the later case, workers are more likely to be exploited because the number

⁶⁷ Wife of employer or female employer

⁶⁸ factory

of extra hours worked could be worth more than the support provided. Furthermore, working extra hours for future aid is also an investment without having the means to claim a repayment; getting support in the future is not in the workers' control, but is dependent on the attitude of individual employers.

The practice of seeking assistance from employers appears to be confined to employees of companies that produce goods for non-local markets. Respondents who work in factories that produce local goods for local markets do not get significant economic assistance from their employers. One possible reason for this inconsistency is that local employers do not hire skilled workers and therefore do not need to support them during emergencies to keep them available for later employment. Another reason might be that locally situated employers cannot call on extra-local resources; after suffering flood losses themselves, they do not have the means to assist their employees.

The other prominent group that provides economic assistance to slum populations is the immediate or extended family living near or abroad. Family members living in other parts of the city are the foremost sources of support for slum inhabitants. This is for two reasons. First, those family members are not likely to be so affected by flooding. Second, because they live relatively close, these relatives can be contacted quickly in the event of a flood. Applying to and getting support from them is both faster (due to proximity) and more straightforward (because of their heightened awareness) than for other potential sources of support. Furthermore, the relationships with relatives that live in the same city are not only likely to be semi-continuous, they are also easier to maintain and available

for quick activation when needed. Although there is no clear evidence whether these appeals are primarily horizontal (i.e. between siblings or cousins) or vertical (i.e. between generations and those related by marriage), an apparent dependency exists between new migrants and relatives who have been living in the city for some years. Chi square tests show that the association between years of residence and reliance on economic assistance from family members is highly significant for this dataset ($\chi^2 < 0.00$). New migrants are more likely to be located near water bodies and therefore are more at risk from floods in the monsoon. Furthermore, since they are recent settlers, they do not have access to a well-developed aid network and consequently are reliant on older family members in the city or back in the villages. Older migrants (living in the city for more than 20 years) also show a degree of dependence on family members. Often this involves horizontal exchange but when it is vertical, the flow of resources is from younger family members (e.g. people working in the Middle East) to older relatives in Mumbai.

'Everything was ruined in the floods. I did not get any compensation from the political parties. You have to run after them and then you may or may not get something. My nephew works in Dubai and he sent me money to refurnish my room and also raise the foundation. I didn't worry for anything' – Mary, Jarimari

Although employers, family members and local traders dominate the informal loss redistribution system, other agents have also been significant for certain types of marginal populations. Inherent social and cultural factors are important influences on the effectiveness of these sources. For instance, religious organizations are an important source of aid to small ghettos of religious minorities within larger slum settlements (Table 17).

Table 17 shows religious organizations ranked as second and fourth sources by seven and six households, respectively. Chi square tests of variables like the religion of the household surveyed and financial assistance from a religious organization are highly significant with $\chi^2 < 0.00$. Table 17 illustrates a relationship where religious organizations are higher ranked support sources for minority groups of Muslim (44%) and Christian (50%) households. For Hindu households, however, it is an additional source of support for only 12% of surveyed households. Religious organizations are most effective at the ward and city level because such associations need to be continuously nourished if they are to be useful. As a result, it is noteworthy that 72% of respondents did not receive support from religious organizations.

Table 17: Economic Assistance from Religious Organizations

Religion of respondent and economic assistance from religious organizations	Economic assistance from religious organizations (ranks 0-4)					Total
	0	1	2	3	4	
Christian	3	0	4	0	1	8
Hindu	29	0	0	0	4	33
Muslim	4	1	3	0	1	9
Total	36	1	7	0	6	50

Informal establishments are in a special category, since victim members need to participate in them for a long period of time before they can approach the other members with requests for support. To be able to use informal networks, it is essential to have made continuing contributions to the financial pool. Participating in informal arrangements provides extra remuneration and therefore is a common practice among slum dwellers. Collected data indicates that informal establishments provide acceptable

sources of loss redistribution, and that 33 households have used them for additional support after floods. However, they are not the chief network of support for any family. The chi square test shows that religion ($\chi^2 < 0.00$) and years of residence in the present place ($\chi^2 < 0.00$) are associated with the use of informal establishments for support after floods. This suggests that the cultural and socio-economic characteristics of individual households, like religion and the number of years they have been living at the present address affect their ability to use support from informal establishments to recover after floods.

Self-help groups are the first source of support for 3 families in the survey (Table 15). Here the financial arrangements among members of the group are more formal in nature because the money is openly accounted for and the affected population is entitled to support simply by joining the association. This offers some advantages because members can claim support first and contribute later, which is the reverse of practice for members in informal establishments.

Results from the study show that both internal and external agencies are important components of the flood loss redistribution system. However, all sources of support are not equally influenced by local and global forces. Type of loss redistribution is reflected in the kinds of arrangement observed between the affected and supporting members.

Table 18 explains the type of arrangements organized by scale. For instance, local traders and money lenders are dominant sources in the local loop of assistance, whereas employers and family members are more prominent as the wider circles of support. This distinction further highlights the emerging impact of local and global forces on flood loss redistribution. It also demonstrates the co-existence of traditional and contemporary mechanisms where flood victims use two or more different types of safety networks simultaneously. Because of the diversity in cultural, social, political and economic groups found in cities like Mumbai, the range of alternatives is more complex for urban dwellers than for rural residents.

Table 18 shows that the transaction is more likely to change from informal to the formal as the victims begin to draw on non-local sources of support. However, a considerable amount of flexibility exists even within the formal circles, since both formal and informal arrangements can be made with different types of employees.

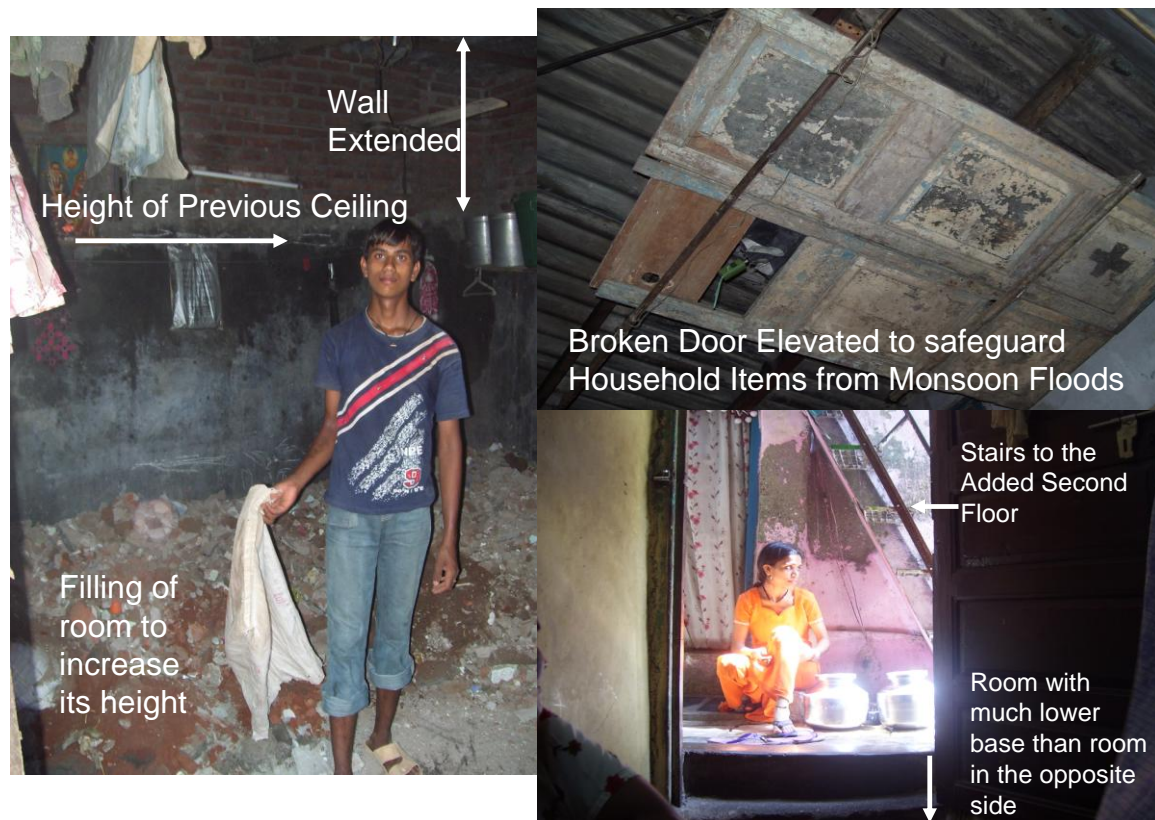
Table 18: Formal and Informal Arrangements of Support

Sources of economic assistance after floods	Neigh-bors	Friends	Family members	Informal establish-ments	Money Len-ders	Local Tra-ders	Self Help Groups	Religious Organizat-i-on	Empl-oyers	Formal Banks
Local	IN	IN	IN	IN	IN	IN	F	NA	IN	NA
Ward	NA	IN	IN	IN	IN	NA	NA	F	NA	NA
City	NA	IN	IN	NA	NA	NA	NA	F	IN/F	NA
National	NA	NA	IN/F	NA	NA	NA	NA	NA	IN/F	F
Global	NA	NA	IN/F	NA	NA	NA	NA	NA	IN/F	NA

Legend: Here informal (IN) means that the exchange is not accounted for in any formal system. Similarly, formal (F) means of economic assistance are those where the transaction is accounted in some formal agency.

Emerging trends show that individuals in the slums of Mumbai are connected on many levels with expanding sources of support. The urban environment provides an enhanced degree of complexity in networks which are used by affected low income households simultaneously to redistribute their losses. The growing presence of employers in the flood redistribution of slum dwellers illustrates the gradual penetration of private sector commercial institutions into what was formerly a support system that relied mainly on intimate bonds among kin and loosely organized involvement by government or community organizations.

Figure 18: Structural Adjustments by Slum Dwellers



Having access to multiple sources of flood loss redistribution was observed to be directly related to recovery among the affected households. Ethnographic study of the surveyed households demonstrated that households with diversified loss redistribution had regained their prior lifestyle, i.e. had required household assets, children studying in private schools, etc. Furthermore, many of these households were able to adopt structural adjustments like raising the foundation of their rooms, adding a higher platform or second floor to their house to ensure against future losses from floods (Figure 18). Households with access to fewer networks of loss redistribution absorbed the losses by themselves

and therefore were living in degenerated conditions. Type and number of loss redistribution sources were observed to play an important role in defining resilience among slum dwellers of Mumbai.

After 2005, approximately 53% of households surveyed raised their foundation before monsoons in 2006 in an attempt to ensure that the event of pervious year was not repeated. Another structural adjustment observed among 22% of surveyed slum dwellers was the construction of second floors. This method was adopted by higher income households in the settlement. The most common adjustment observed was an elevated platform in the house, adopted by 72% of households surveyed. The elevated platform primarily serves the purpose of a storage place for all important things in households and to shelter the household in case of flooding. Poor households resort to elevating a board to secure some of the important and expensive items of the households (Figure 18). Widening and covering of drains (Figure 16) were also applied in some neighborhoods in Prem Nagar where local groups collectively cleaned, widened and covered drains in the settlement before monsoons. Although covering of drains improved the sanitary conditions of the neighborhood, some residents of the settlement found it to be restricting, and therefore increased the risk of inundation in the area.

Structural adjustments, however, have a limited effect on reducing the risk of floods because these settlements are located in places like creek areas, stream channels and other natural flood zones. Therefore, permanently mitigating the hazard is impossible.

Furthermore, since not every household was able to invest the money, the ability or inability to adopt structural adjustments has also produced differential vulnerability within the same neighborhood from subsequent monsoons. It was observed that in the same lane of houses there were differences in the height of rooms ranging up to a few feet, making some households more vulnerable to excessive inundation in comparison to others (Figure 18). Due to the limited effectiveness of house raising and other structural adjustments to flooding, slum households will continue to rely heavily on networks of assistance that facilitate quick recovery.

Conclusion

For low income households that do not have institutional support, networks of assistance play a vital role in surviving the hardships of urban life. Some of these networks are the remnants of old socio-cultural systems that get revived when migrants move into a new city and some are continuously maintained as support networks for use in the event of sudden disasters. In Mumbai, religion and caste divisions are some of these older categories that provide social capital to households during floods. Though members of these groups support each other when in need and contribute to the resilience of each member in the group, they also withhold support to other households outside the cultural groups, thereby widening a vulnerability gap. Since these networks are not likely to change and grow more inclusive, their restrictive scope will only add to the relative vulnerability of the worst affected over time. On the other hand, with economic development, integration and transformation, emerging socio-economic networks have

the potential to expand and be inclusive for workers in different echelons or sectors of the economy, including the low income groups irrespective of cultural loopholes such as religion and region. The designers and managers of all flood mitigation strategies therefore have to understand the functions of old and emerging factors that influence networks of assistance for low income vulnerable groups. For them, a key task will be to identify the sustainable avenues that can be promoted effectively in order to integrate different types of low income groups into the comprehensive flood mitigation plan of the city.

Chapter 7: Problem of Integration

This chapter discusses problems of integration and cooperation among public agencies that aggravate the issue of flood mitigation in Mumbai. It also explores the realm of alternative perspectives, mechanisms and strategies that can be integrated with present approaches to produce a better articulated and more inclusive strategy for dealing with flood hazards.

Lack of Integrated Public Policies and the Consequences in Mumbai

Formal and informal neighborhoods, both new and old, are intricately intertwined within Mumbai. During the course of a single day, an individual may move in and out of several such spaces. The boundaries of contrasting neighborhoods are often clearly evident during episodes of flooding. As one resident of Prem Nagar in Goregoan district reported:

‘With all these new drains and highways it has become easier (since 2005) for me to travel during heavy rains (to and from my work place). The ten kilometers is smooth sailing but the last 500 meters from the bus stop to my house in Adarsh Nagar is still impossible in the rainy season’

In other words, though the main through roads are well engineered to avoid flooding, the marshy floodplain of a small canalized stream that bounds the northern edge of the informal neighborhood in which he lives has not received comparable protection. These comments underscore the failure of Mumbai’s disaster managers and urban development authorities to extend their plans and actions to improve the informal sector that includes

almost half of the city's population. In addition, these same institutions often pursue strategies that benefit formal neighborhoods at the expense of shifting risks and losses to nearby informal settlements.

For example, Jarimari Slum, an old informal settlement, is located close to centers of basic infrastructure like the international airport and the recently developed business district of Bandra Kurla Complex in Mumbai. Flood mitigation strategies adopted here by the municipal authorities have prioritized safeguarding and further extension of these formal amenities and spaces, while disregarding impacts on nearby low income informal settlements like Jarimari.

'We have been living here for the past forty years, this is not a new settlement ... my grandfather settled here when he came to work at the mills. We have never had as much water during monsoons as we had in 2005. It is not just because of rain, if you just look at the other side (of the river) you will see that they have expanded the airport and build these large walls to keep water off from the runways and now our settlement is the one that is getting all the excess water. They have designed it in such a manner that our place gets flooded' – Jarimari Slum Resident, Kurla

Although assistance packages are available for flood affected households, the amount of paperwork required to obtain compensation and the disruptive impacts of relocation on people's livelihoods and socio-cultural linkages have rendered them unattractive to shantytown dwellers.

In effect, government sponsored planning for hazard mitigation in Mumbai has interpreted informal settlements as illegal settlements, and therefore as outside the scope

of official flood protection efforts. The stigmatization of informal settlements is only one aspect of governmental inadequacy. A myopic perspective on environmental protection is also an important factor. Past experience confirms that only natural lands (e.g. forests and marshes) are judged worthy of protection in existing environmental policies. Since informal settlements are often interspersed with such ecosystems and are sometimes dependent on them, the distinction between natural and human-altered systems is spurious. In the words of one scholar, *'most of today's leading environmental cases are against the interest of a majority of people. These cases do not consider the issue of housing of the poor and the working class as an integral subject of environment concern'*⁶⁹ Allocating exclusive zones for flora and fauna and wetlands results in the division of local environments into natural and human zones. This approach can only produce limited success in environmental protection or flood mitigation programs; a more realistic approach would require integration of management initiatives across both human and natural sectors in urban ecosystems. Yet very little effort is made to find such sustainable balances and cultivate these applications. Some of the initial limitations to an integrated approach are the gaps and disconnections between governing agencies in the city.

Lack of clarity in assigned roles and disconnections between different agencies were primary causes of failure of the disaster management plan during 2005 floods in Mumbai (Concerned Citizen's Commission 2005b, Concerned Citizen's Commission 2005). In particular, there were serious administrative disconnections among meteorological

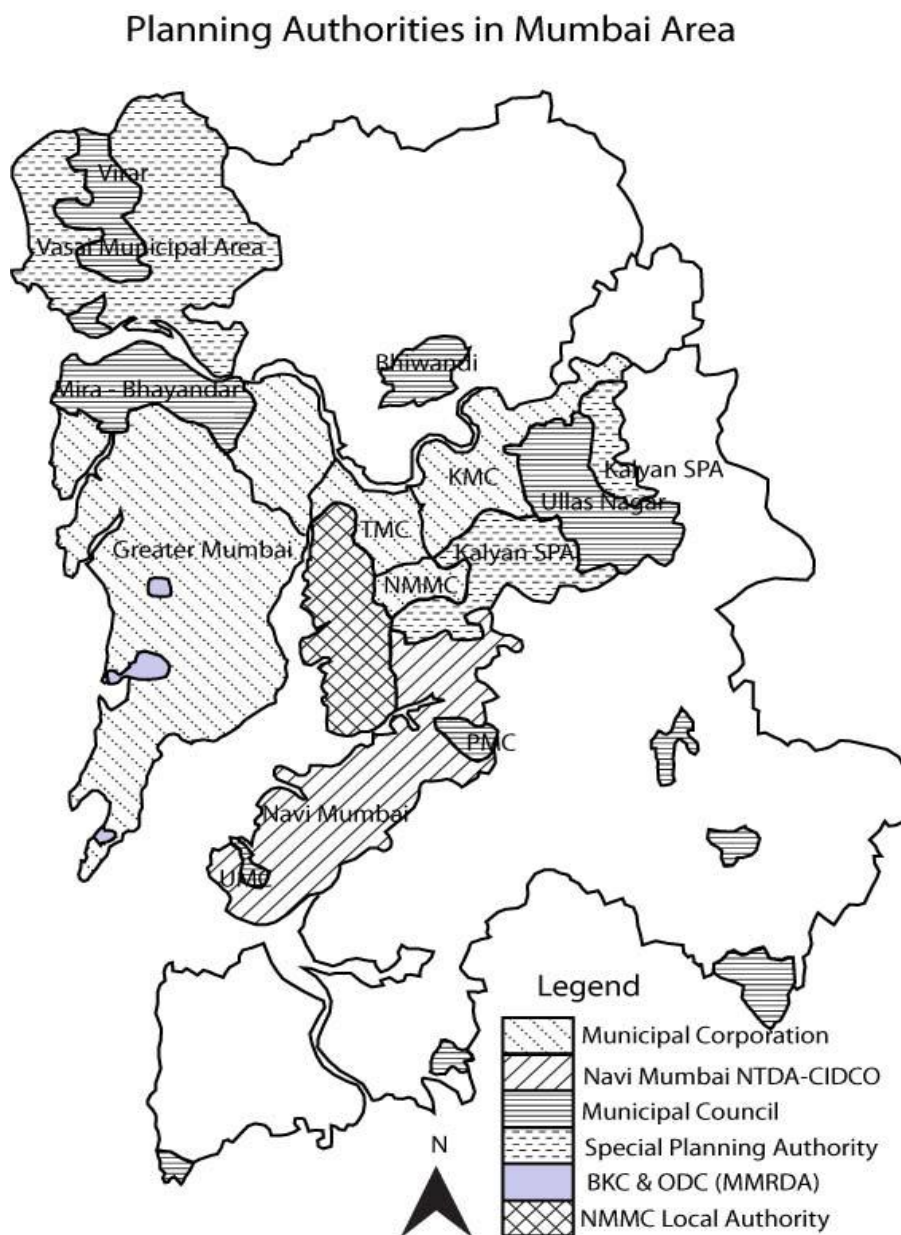
⁶⁹ Page 209, Das, P. K. 2003. Slums: The Continuing Struggle for Housing. In *Bombay and Mumbai: The City in Transition*, ed. S. a. J. M. Patel, 207-234. Bombay: Oxford University Press.

agencies charged with responsibilities for monitoring and warning about floods and urban management agencies responsible for land use management and development. Other agencies that have obvious relevance to problems of flooding are also hampered by unclear jurisdictions and lack of statutory authority. The Concerned Citizen Report highlights this problem in the case of the Mumbai police which has *'become both the first and last recourse in such cases of public emergency (but could not act as) they have not been given any statutory role in such situations. They need to be given a statutory role and equipped and trained accordingly'*⁷⁰ (Concerned Citizen's Commission 2005b).

Jurisdictional complications are the long-term consequence of the failure of administrative arrangements to keep pace with continuous urban restructuring. In 1981, there were 38 urban centers, which, by 1996 had merged to approximately 22 urban centers and 8 villages (MMRDA, 1996). Because the metropolitan area of Mumbai is expanding so rapidly, administrative and planning authorities (Figure 19) for this region are always changing. Most of the problems discussed previously pertain to administration and planning functions of government.

⁷⁰ Page 21, Concerned Citizen's Report

Figure 19: Planning Authorities in Mumbai Area



Source: (MMRDA 1996)

Operational agencies are also numerous and poorly integrated. Each administrative unit has separate agencies for utilities, transport and communication infrastructure. The result is often mismanagement and wasted resources as different agencies fail to inform each

other about matters of mutual interest that fall within their areas of responsibility or to arrange their work to facilitate common goals. One informant in Goregaon commented as follows:

'We call this road a nalla⁷¹ now, because it is perpetually dug up. Only two months back sanitation department had dug it to lay larger sewage pipes, and now they are taking those pipes out and making a even bigger hole for the Metro, and perhaps after they finish and fill this up and build the road on top of it somebody else will come to put in something else' - Local tea shop owner, Goregaon

In the aftermath of disaster these kinds of uncoordinated actions can have serious repercussions for prospects of successful recovery. It is worth remembering that problems of integration and coordination are by no means unique to cities like Mumbai. They also occur in the cities of developed countries too (Godschalk, 2003; Kraas, 2007a; UN - Habitat, 2006; Wenzel, 2007). Although localized patterns of hazard risk can vary among cities in Africa, Latin America and elsewhere, problems of integrating different areas of jurisdiction across domains, sectors, natural and societal realms are generic. They require the development of methods that transcend different types of spaces, systems of jurisdiction and administration, safety meshes, networks of support, opinions and interests. Integration is vital not simply because it permits existing adjustments to work more effectively, but also because it opens avenues to develop new alternatives for reducing hazard risk.

⁷¹ Drain

Expanding the Scope of Integration in Hazard Risk Reduction and Adaptation

Progress is being made regarding efforts to integrate different components of hazard risk reduction, but they are presently restricted to just a few aspects of the global urban system. Most research addresses specific feedback relationships between certain environments and their associated societies and between local and global scales of analysis within separate environmental and societal systems. For example, the feedback between environmental change and human responses has been examined (Holling, 2001; IHDP, 2005; Leichenko, 2008). Others have examined the relationship between vulnerability and adaptive capacity (Adger, 2006; Adger, 2003; Adger, 2001; Bohle, 2001) for a suite of brown and grey environmental threats (Hardoy, 2001; Harpham, 2002; McGranahan, 2001). Some have studied the role of political economy in the distribution of risk in society (Bankoff, 2004a; Davis, 2004; Gilbert, 2005; Wisner, 1998) and the potential of human systems to develop sustainable means of adapting and adjusting to changing risks by developing connection between society and nature (Kraas, 2007b; Manuta, 2005; Mitchell, 2008; Yang, 2005).

Yet much more needs to be done, especially with respect to emergent social and environmental processes. In developing countries, the adjustment of people to the physical environment follows different paths through regulated (formal) and unregulated (informal) sectors of society. Since the informal sector of developing world cities is growing very rapidly, efforts to understand and facilitate adjustment should be focused there. This means studying the contribution of the informal sector in individual cities to

the production of local and global environmental changes and also the consequences for the informal sector of local and global scale changes that originate elsewhere. The informal sector is identified here as the ‘*shadow space that allows individuals or subgroups to experiment, imitate, communicate, learn and reflect on their actions*’⁷² (Pelling, 2008), and strategies of flood mitigation must be developed as an effective means of response. Finally, networks that link the informal and formal sectors need to be understood and integrated into an urban-environmental risk-management system that is sensitive to different scales of analysis and action.

In carrying out this work, it will be important to remember that the tree-like models of urban societies and governance institutions popular in past analyses should be replaced by semi-lattice models that more nearly match the circumstances of today. As Alexander (Alexander, 1978) 1978) has observed “... *this lack of structural complexity, characteristics of trees* (and assumption about the structures of human systems), *is crippling our conceptions of the city*”⁷³ (society and its workings)’. For example, results from this dissertation research show that individual households are often simultaneously members of several networks that support disaster recovery. Likewise, a unit of space could fall under the jurisdiction of multiple agencies concurrently and may suffer the consequences of mismanaged and disconnected administration during hazard events. It is crucial for hazard mitigation systems to be able to negotiate such overlaps and gaps in

⁷² Page 868 Pelling, M., C High, J Dearing and D Smith (2008) Shadow Spaces for social learning: a relational understanding of adaptive capacity to climate change within organizations. *Environment and Planning A*, 40, 867-884.

⁷³ Page 382 Alexander, C. 1978. A city is not a tree. In *Humanscape: Environments for People.*, ed. S. K. a. R. Kaplan, 377 - 401. Massachusetts: Duxbury Press.

human systems and to develop means of accommodating highly complex social structures.

Recognition of additional components of society and environment and the changing structure of interactions indicates the extent of integration required for effective hazard mitigation planning, the drawbacks of the present approach, and the scope of emerging tools in changing socio-ecological systems that can be used to design alternatives. Non-linear urban processes, increasing connectivity between diverse groups of people, and growing interdependencies among all agents involved in these societal processes are particular characteristics of the evolving society. They can be used as tools to develop a balanced approach to mitigate hazard and adapt to living with a changing environment.

Alternatives in Hazard Mitigation and Adaptation System

Cities in developing countries are places of disparities; not all benefits are available to every citizen. Economic restructuring and neoliberal governance trends in cities like Mumbai produce uneven social and economic structures. As observed in other analyses (Leichenko, 2008; O'Brien, 2004) and also in Mumbai (Bannerjee-Guha, 2009), population groups privileged by the large scale processes of globalization in megacities are also the groups that profit by environmental risk reduction strategies, better living conditions, improved means of transportation and communication, access to the market and means of risk redistribution. Populations not gaining from global processes are also excluded from the advantages of policies adopted for loss and risk reduction. These

inequalities are the result of both the city authorities' repudiation of slum populations in general, and of the limitations of existing planning and development strategies when applied to informal neighborhoods (Prabhakar, 2009). The scope of integration therefore has to be expanded to include connections not just between city agencies that have responsibilities for different aspects of disasters, but also between formal and informal urban sectors that are differentially affected by hazards.

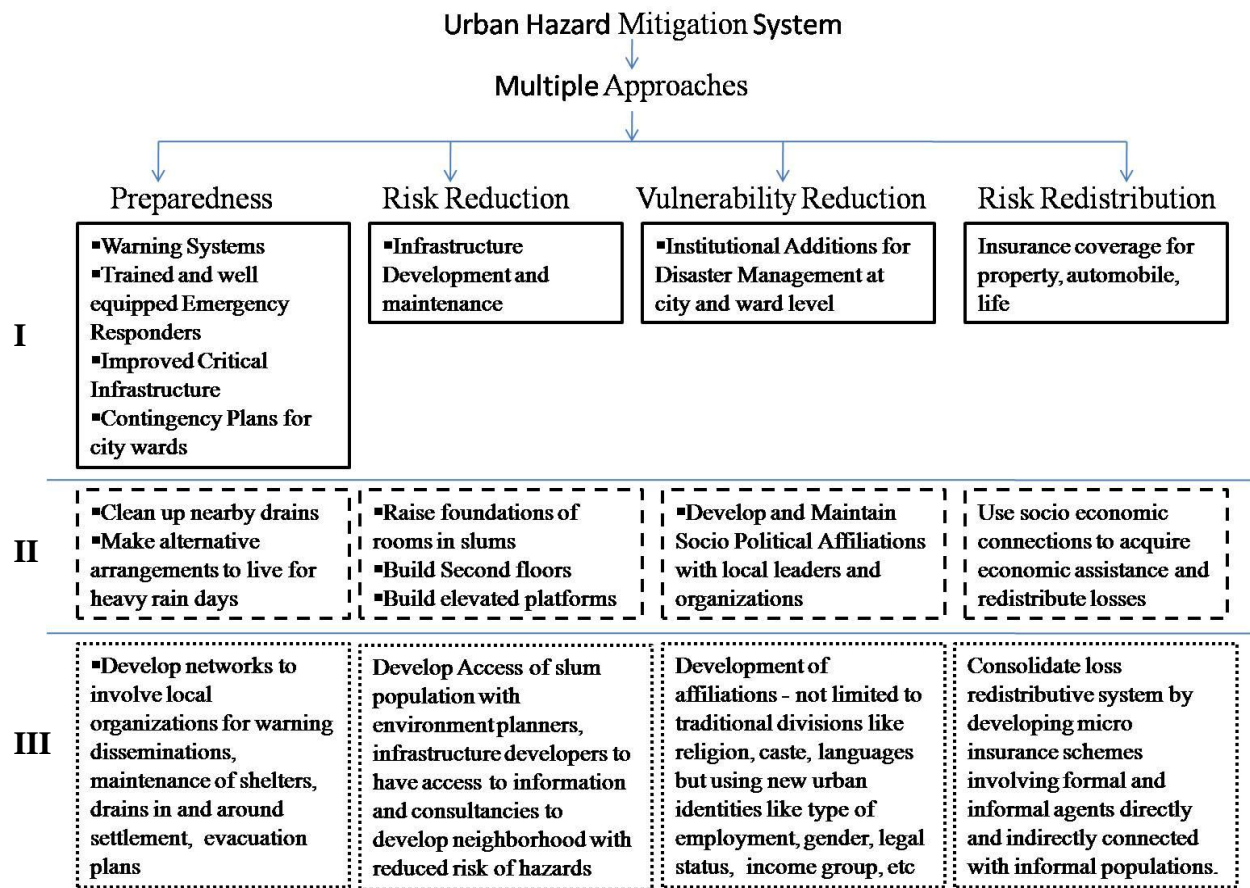
The case of Mumbai shows that informal populations are often not considered in risk reduction plans of the city because the neighborhoods in which they live are viewed as lacking in legal legitimacy, and because of their excessively hazard prone locations. Yet this approach does nothing to reduce the overall disaster burden of the city. It is more productive to devise methods that can be applied to all populations at risk. Irrespective of neighborhoods' legal legitimacy, a new system is needed that corrects the present lopsided distribution of resources that is devoted to risk reduction and recovery for the benefit of formal populations and formal neighborhoods. Such a structure might be built around underused and underestimated disaster support mechanisms that already exist in most poor cities (Pelling, 2002b).

Hazard mitigation in Mumbai should be an overarching system comprising many approaches, one that combines infrastructure and management-related risk reduction techniques with networks of redistribution and vulnerability reduction mechanisms. These broad approaches of risk and vulnerability reduction have to be joined and utilized

simultaneously to produce an integrated and inclusive hazard mitigation and adaptation system (Figure 20). This would have four components: (1) an effective preparedness and warning system, efficient immediate response, development of resilient critical infrastructure; (2) risk reduction measures such as better land use zoning methods and building codes, improved transportation and communication infrastructure, increased drainage capacity; (3) reduction of social vulnerability by means of appropriate social, political, cultural, economic and civil initiatives; and (4) development of a flexible and pervasive web of redistributive techniques connecting different sections of society.

Figure (20) illustrates: (I) how these components are included in Mumbai's present system of flood mitigation; (II) how they are addressed by slum dwellers; and (III) how the slum dwellers' responses might be integrated with formal plans of the city. The effect would be to reinforce existing structural risk reduction techniques and support networks for spatially vulnerable locations, with additional layers of protection that would increase robustness in society; the inadequacies of present adjustments will be compensated for by other forms of assistance.

Figure 20: Integrated and Inclusive Approach to Hazard Mitigation



Since slum dwellers do not gain much from structural mechanisms that are meant to blunt the thrust of natural processes, a strong resilience system that provides layers of support networks to assist recovery is a suitable alternative for these marginalized communities. Furthermore, this kind of mechanism can be more readily integrated with other people-centered community development programs. The precedent for strengthening social networks already exists in the form of mutual aid agreements among relief and rescue agencies (Ferrier, 2003; Linnerooth-Bayer, 2005), but the approach has received fewer applications in the field of urban hazard mitigation. Findings from the present study point

to opportunities for modifying these approaches to account for the special needs and circumstances of slum communities.

Networks for Diverse Slum Communities

To integrate slum communities in hazard mitigation and adaptation systems, it is essential to understand attributes of informal societies in cities like Mumbai. For example, it is important to remember that informal communities are heterogeneous, and therefore not every household is equally marginalized or vulnerable at a given time. In slums, factors like religion, caste, region, employment type and economic sector, language group, gender, demographic composition of households, etc. play a significant role in determining the level of vulnerability each household suffers. Moreover, vulnerability for households with different religious, regional and economic identities undergoes shifts at different stages of the hazard cycle (chapter 6). When developing support networks, it is important for informal communities to consider socio-cultural characteristics that render households more vulnerable or resilient during, immediately after and at later recovery stages of flood events.

Variety in Support Networks

To ensure that there are support networks for all types of households in slum settlements, it is important to develop a resilient system that has diverse components of assistance and is integrated with the full range of approaches to hazard mitigation and adaptation

systems (as indicated in figure 2). Support networks need to be diverse and not be limited to distribution of relief material and compensations. Such networks could also be designed in tandem with risk reduction and preparedness strategies, including: providing and sharing information about building techniques, warning about hazards; and establishing consultancies to advise on responses to changes in the local environment, as well as legal assistance to deal with flood issues of slum households.

In Mumbai, networks were primarily utilized to distribute relief and assist in disaster management, but even in this capacity they were not used to optimal effect. It was observed during the event that people were getting certain types of assistance from multiple sources and not receiving other types of aid from any agency. Cleaning rooms in neighborhoods, for example, was a time consuming and important component of response to floods, yet no institutional or community help provided support for such activities in affected settlements. Instead, all assistance after floods was focused on providing food, water and other household items. Though these things are important resources, after some point they are useless unless the household has a clean place to store and use these materials.

‘Once the water receded, our representative (Member of Legislative Assembly) came and he distributed food, mattresses, and water to us. Medical camps were also put in the main play ground. They gave us tablets to clean water before drinking. A dead buffalo had got stuck in our lane and that was the biggest problem, days later the youth committee members took it out for us. Food and clothes were distributed by colony people (nearby apartment complex), at community office (local community development organization) too but I didn’t go to get it because cleaning the rooms took a very long time and where will I put all these food when the room was all clogged with water and dirt’ – Adarsh Nagar Resident, Goregaon

Hazard mitigation therefore has to be sensitive to the real requirements of flood-affected slum households, and has to be designed to provide support so that affected households can quickly resume their normal lives after the event. Similarly, in the long term recovery process, slum settlements suffer from a lack of information and expertise about how changes in the local urban environment affect risk of floods. Easily available sources of information, legal support and mitigation counseling can assist vulnerable households to make informed decisions and adopt strategies that could prevent losses from future events without adversely affecting the local environment. Such strategies could be integrated with the risk reduction interventions in hazard mitigation and adaptation systems.

Consolidation of Existing Networks

In addition to designing new networks of support, it is essential to secure networks that are already informally in place and operating successfully. A well developed loss redistribution system is a safety network for populations that are in imminent risk from hazards like floods. Slum populations already show a certain degree of enterprise and ability to mobilize networks of support for economic assistance at different scales of society. To have a resilient system, it is therefore important to harness existing networks and consolidate them to reduce exploitation and randomness. For example, economic assistance networks between affected households and employers are inconsistent and are based on an individual employer's sense of responsibility and an employee's ability to acquire an arrangement. Although these types of assistance were observed in high numbers and hence contributed to resilience in Mumbai, randomness makes for an

unsustainable and unpredictable system. However, if the strategy is institutionalized, then loss redistribution will become more robust and effective. Furthermore, this type of risk reduction could be applied to other types of crises as well. Results from the fieldwork shows that slum dwellers use similar strategies for different types of uncertainties and crises. In addition to flood losses, such crises include health or income problems experienced by households. Based on household perceptions of the surveyed population, the types of insurance or redistribution system coverage most preferred are health, income and then property (Table 19). With exposure to global processes and consequent options and strategies, slum dwellers are also exploring ways to reduce their risks and add safety nets further afield. These mechanisms are flexible and designed to fit the requirements of slum communities. Supporting and building on them would add and consolidate their resilience.

Table 19: Insurance Preference for Slum Dwellers

	Rank 1	Rank 2	Rank3
Property Insurance	15	20	14
Income Insurance	16	13	20
Health Insurance	18	16	15
Total	49	49	49

Moreover, affiliations used for support by low income populations are of a socio-cultural-political and economic nature. Marginal households unable to acquire assistance from the conventional and new connections fall through the gaps and are severely affected in terms of livelihood, standard of living and future development. To make the system more

consistent across different types of slum household different, civic agencies are to be identified and supported to produce innovative layers of safety and support networks. A vibrant civic society and networks with memberships of different civic identities could generate diverse ways of integrating marginal populations with structurally separate agencies. Such communities could range from local organizations that maintain and develop infrastructure to global youth awareness and outreach groups. In this way, new clusters of alliances are formed that include local and global; state and private institutions are established and initiated in urban society, adding new layers of safety from different approaches to produce a balanced hazard mitigation and adaptation system that integrates marginal populations in mainstream flood mitigation plans for the city.

Conclusion

Cities are centers of knowledge, information, actors and stakeholders. Concentration of diverse socio-economic, cultural, political and public agencies initiates and supports interactions to produce overlapping and effective schemes of hazard mitigation and adaptation. Hazard mitigation requires a system that adopts multiple approaches that are in sync with the changing calculus of hazard risk and vulnerability in society. Keeping pace with alterations is possible with easy access to information, and communication between different actors in society. However, by limiting the integration to only the government and municipal agencies, one misses the role of organization and participation in society. Increasing the scope of integration (by adding different stakeholders, administrators and agencies) is imperative in not only getting diverse perspectives to

better understand the concerns related to environment, but also to be able to utilize the full range of possibilities available for the different members of society. However, to produce a balanced hazard mitigation and adaptation system, knowledge of all resources available to different sectors of society has to be joined with a fair and just resource distribution system.

Chapter 8: Conclusion - Reimagining Hazard Mitigation in India under the forcing action of accelerating environmental and societal changes

Hazard risk, vulnerability and resilience exist in the three dimensional *arena*⁷⁴ of space, scale and time. The main challenge in hazard research is to understand the production of specific combinations of risk, vulnerability and resilience at particular convergences of space, scale and time and to negotiate among the varied combinations that characterize different places, scales and periods. This, in turn, requires recognizing types, rates and direction of changes in society and nature as well as the interactions between them.

Environmental Hazards and Informal Urban Households

Students of global environmental change often argue that the present era is different from all others that humans have experienced because it is characterized by unprecedented rapid rates of environmental (especially climatic) change. A great deal of effort is now being deployed, by scientists and public policy makers, to help society cope with these changes (e.g. IPCC etc.). In many respects, the same level of recognition and commitment to action is required if the burgeoning hazards of informal settlements in the large cities of developing countries are also to be successfully addressed. Only, in this case, the forces that are increasing the vulnerability of slum populations to natural

⁷⁴ Massey D. (1999) Space-Time, 'Science' and the relationship between Physical Geography and Human Geography. Transactions of the Institute of British Geographers 24:261-276.

hazards also operate on the capacity of affected communities to absorb and redistribute losses in addition to increasing the exposure of humans to worsening physical risks.

In this study it has been shown that vulnerability is not simply a static property of marginalized people in the informal settlements of Mumbai that are at risk to flooding; it is a constantly changing condition that alters with spatial, structural and temporal changes. Hence, one of the primary conclusions of this research is that vulnerability is a continuously emergent phenomenon that ebbs and flows in response to an array of upward and downward pressures. They include downward pressures of social and environmental forces at the global, national and local scales, forces that are changing the system of rewards and penalties that influences the lives of the settlements' inhabitants, and upward counter-forces that are continuously cultivating and rearranging the coping resources available to these populations. The downward forces are formidable, as shown in chapters 4 and 5. They tend to convey the image of a city burdened by nearly impossible problems that increase vulnerability gaps among diverse population groups in the city. As those chapters illustrate, socio-economic and political transitions in the city play a crucial role in the spatio-temporal distribution of vulnerability in the city. Furthermore, under these influences, flood mitigation programs are excessively skewed towards technocratic and physical alterations in local environments and are not informed by in-depth understanding of vulnerability in such transforming conditions. Moreover, here the dissertation argues those socio-environmental pressures experienced at different levels and times in society and the strategies adopted to address these challenges together produce downward pressures that influence the type of risk and vulnerability experienced

at the local urban scale. Policies implemented at larger scales of society have uneven impacts at the local urban scale, often marginalizing impoverished and already excluded sections of urban society. The case of Mumbai shows that existing flood mitigation policy does not incorporate the ongoing changes in socio-environmental characteristics of the city, and is not sensitive to the layers of socio-ecological vulnerabilities produced by these changes. Instead, these policies are geared towards supporting foreign investments and economic development.

Yet vulnerability is not entirely determined by downward societal forces. The upward processes of loss absorption and redistribution are heavily reliant on the settlements' social capital and carry real seeds of hope. As shown in chapter 6, marginal populations, under the influence of changing socio-economic and political characteristics, acquire and maintain multiple sources of assistance to recover after hazards like floods. The networks of support range from local social connections such as families and friends, to informal and formal economic arrangements with other members of society, including employers and colleagues. These forms of loss sharing and risk redistribution, operating informally yet systematically between marginalized households with structurally and spatially separate groups of population, signal the existence of coping strategies that have not been adequately explicated and explored by hazard scholars. Furthermore, research in hazard mitigation has concentrated on developing productive interdependencies between global, national and metropolitan levels emphasizing the critical role that alliances between institutions at each level can play in improving hazard mitigation in society. The emerging role of linkages between local agencies and households with public and private

institutions in different levels of society are crucial but missing in the efforts at finding means to mitigate hazards and adapt to climate risks.

Policy Implications for Hazard Mitigation in Cities of Developing Countries

Policy intervention in India focuses on mitigating the ‘disaster’-- the disruption of social order -- instead of the ‘hazard’, which entails alleviating underlying factors that produce risk of and vulnerability from extreme natural events. For example, the research illustrates that increased hazard risk in Mumbai is primarily the result of large scale alterations in local environment, the location of new development and/or socially vulnerable people in places of high risk from natural extremes and lack of multi-layered safety networks to support different sections of vulnerable societies. Instead, the present approach to hazard mitigation in Mumbai emphasizes mitigating the disaster after it has occurred, and does not address the pre-conditions of aggravated risk or incorporate hazard prevention in the city’s basic urban planning and development strategies. The increased hazard risk and vulnerability in India is the product of limited ideas of development and restricted goals, and a narrow approach to these objectives and unsystematic results in the distribution of development within society.

Improving urban hazard prevention in India requires researchers and policy makers to design a comprehensive response to issues that produce risks and vulnerability in society. In Mumbai these can be addressed by (1) policing the built environment with land use

zoning and building codes; and (2) balancing existing programs of infrastructure development (e.g. improving storm water drainage, investing in private transportation, and encouraging globally competitive real estate development) with greatly improved programs of waste management, affordable basic housing and mass transportation. In addition, decision makers should increase access to health services, design safety networks for loss shifting, sharing, transferring and other means of risk redistribution, and integrate multiple voices of the various stakeholders in the decision-making process for urban development.

In terms of policy development, the dissertation argues that long term hazard risk reduction plans are limited because they are not interlinked with long term urban development plans which are themselves in need of improvement because of failures to address certain urban problems like the prevalence of slums. This is no small task, for slum settlements are a consequence of inadequate low income housing in megacities with escalating real estate values. As one community development officer noted:

'How would you deal with slums? Do you think if everyone was a crorepati⁷⁵ they would all have palaces? Or do you think adopting the American model of developing and irrevocably altering the countryside into suburban complexes by increasing our ecological foot print is a sustainable environment solution? The question is of limited space and we need to come up with ways to simultaneously reduce the risk of losses and house large number of people in small places with a certain standard of life' – Leena Joshi, Apnalaya

Currently popular development strategies that focus on facilitating increased incomes only increase purchasing power to a certain degree, but do not provide the means to

⁷⁵ Owner of ten million rupees

eradicate the problem of basic housing. Cities are overcrowded places which require greater emphasis on providing basic facilities like safe buildings, potable water, drainage system, electricity, and access to transportation and livelihood. Furthermore urban hazard prevention in India must address processes that generate differential vulnerability in society.

‘Some Indians are rich; most are not. Some are very well educated; others are illiterate. Some lead easy lives of luxury; others toil hard for little reward. Some are politically powerful; others can not influence anything. Some have great opportunities for advancement in life; others lack them altogether. Some are treated with respect by the police; others are treated like dirt. These are different kinds of inequality...’⁷⁶ – Amartya Sen

These underlying inequalities are exaggerated in the case of extreme events that produce irrevocable losses to specific groups of population. Specific attention therefore is needed to develop strategies, institutional capacity and participatory approaches to reduce different types of inequalities and improve the access and entitlement of vulnerable people to resources and memberships in society. One way of addressing vulnerability reduction is to explore the critical transformational role of social capital in local vulnerable communities to create new alternatives for hazard reduction. As discussed in chapter 7, formal flood mitigation strategies are not integrated with social networks that assist in recovery and hazard reduction. Coping strategies based on support networks are especially effective for marginalized informal populations in the city, and can be used to minimize the risks suffered by these households.

⁷⁶ Page 210-211- Sen, A. 2005. *The Argumentative Indian: Writings on Indian History, Culture and Identity*. New York: Farrar, Straus and Giroux.

Next Steps

This research examined the impact of multi-scale socio-economic and environmental processes on flood risks experienced at a local urban scale. It presents a picture of spatial and temporal complexity both with respect to patterns of risk and trends in coping. However, the analysis is limited to one megacity and two informal settlements. This limitation grows out of the decision to develop in-depth knowledge about the uneven results of market-oriented flood mitigation strategies adopted in Mumbai, a flagship city that is the financial center of India and a trendsetter for many others. Slum household flood experiences and coping mechanisms are an understudied topic in contemporary research and knowledge about them may serve as a corrective to increasingly stagnant debates about land ownership. While local adaptive practices are examined at some length herein, this study does not assess their cumulative contribution to -- or effect on -- global patterns of resilience. In this regard, the scope of the study could have been expanded to include other megacities in India or in neighboring countries to develop a broader and more comparative picture on urban hazard risk and vulnerability distribution in South Asian cities. By focusing exclusively on India and Mumbai, it has not been possible to capture patterns of local geopolitics that are likely to be different elsewhere. It might also be worthwhile to repeat the investigation of Mumbai at a later time. The fact that the research was conducted after unprecedented floods in 2005 may have affected the kind of results that would have emerged if studied after “normal” chronic flooding. Though the study has suffered this bias, it has also benefited as the floods in 2005

heightened flood awareness and was able to magnify pre-existing but otherwise dormant vulnerability issues in Mumbai.

As illustrated by this study, localized patterns of risk and vulnerability are complex in distribution and are influenced by *glocal*⁷⁷ factors in society. Scholars interested in studying urban hazard risk research first need to understand localized patterns of risk that are continuously developing in third world urban spaces. Such localized patterns should be assessed by mixed methods. For example, scholars interested in examining slum households in urban areas should employ different types of quantitative and qualitative techniques to collect similar sets of data. In this study it was observed that patterns from data collected by questionnaire surveys were substantiated and corroborated with results from focus group interviews. Not juxtaposing results from both methods would have resulted in ambiguous gaps in information compromising the comprehensive understanding of flood vulnerability among slum households. Second, considering the heterogeneous nature of society in cities of developing countries, hazard mitigation will benefit considerably if hazard policy research could aim at developing means to integrate diverse and multiple voices in plans for hazard risk reduction. Finally, urban sustainability is a function of balance among social, economic and environmental components and the feedback cycles within them. Research to understand these feedback cycles and to determine adjustments made in society, economy, and environment under the influence of changes occurring in each of these components would be valuable in

⁷⁷ Combination of global and local processes

integrating hazard research to overarching themes of sustainable development in developing countries.

Postscript

Being the hub of Indian film industry, Mumbai embodies the importance of rebuilding different accounts of reality. Although it often uses the concept of idealized and fantasy worlds, films provide ways of reimagining realities and finding the beats within society. Mumbai has always fascinated filmmakers who have attempted to capture the city's rhythm, energy and survival capabilities and to mark threshold events and pulses that cause shifts in its society. A closer look at trends in the film industry shows that many of these stories echo socio-political struggles experienced by incoming migrants, labor resistance in late 1970s and early 1980s, restructuring in the 1990s, or are situated in the backdrop of threshold events such as communal riots in 1992 (Bombay), the bombing in 1993 (Black Friday), the Mumbai train bombing in 2006 (Mumbai *Meri Jaan*); and have influenced perceptions and opinions of its patrons. Until 2009, films had only used socio-political instabilities across the country and region as settings for film scripts, but the floods of 2005 made yet another impact as it was the first environmental tragedy to have captured the attention of prevailing Indian film industry (*Tum Mile*). Although trivial, the event could mark a slow change in established cultural views on challenges existing in the progress of Indian society. It is hoped that this breakthrough in popular media will be followed by other films associated with socio-ecological events and issues and in the long run be instrumental in changing perceptions, finding alternate views and expanding the

exclusive focus from consequences of socio-economic, political and cultural divisions and conflicts within Indian society to the equally severe and forbidding effects of the changing relation between nature and society in India.

Appendices

Appendix 1

Questionnaire for Slum dwellers

I. Demographic and Socio Economic Profile

1. Present Address
2. Caste and Gender
3. Years of residence in present address
4. Prior address of residence
5. Originally from: State, District
6. Ownership of house: owner, rented, rented by other family member
7. Type of house: built up concrete structure, semi constructed, thatched roof, plastic roof, plastic squatters
8. Number of family members: adults, children
9. Level of education: illiterate, literate, primary, middle, high, college, others
10. Occupation of bread winner/s
11. Designation
12. Type of employment: permanent, temporary, seasonal, daily
13. Type of industry employed in
14. Commodities produced in industry
15. Clients for the commodities produced: local, regional, national, global
16. Other sources of employment

17. Income group: less than 1000 per month, 1000-2000, 2000-5000, 5000-10000, more than 10000 (in Rs.)

II. Flood Vulnerability

18. Type of water/ sewage disposal system: nonexistent, open drains, concrete drains constructed by municipal authorities
19. Distance from water body, type of water body
20. Source of water: for drinking, household work
21. Water logging and its level in the months of: June, July, August, September, October, others
22. Period of water logging (in hours)
23. Does water enter your house during monsoon season? Yes/ no
24. Level of water inside the house? (In inches)
25. Do you experience falling or damaged walls after floods events?
26. Does natural phenomenon like tide affect the intensity of the flood event in and out?
27. What do you understand by floods? What does it mean in your daily life?

III. Flood Loss

28. What types of direct losses do floods incur in monsoon season?
- Property, building, means of transport, house assets, kitchen garden products and Soil, domesticated animals
29. What types of indirect losses from floods?

Absence at work place, school, difficult to get daily wage jobs, difficulty to reach work place, health disorders, loss of important papers, loss of convenience as shops and convenience stores, closed medical stores

30. Is there any loss due to wind damage?

31. Do floods lead to contamination from pollutants or infestations from animals?

Snake or insect bites? Oil?

32. How do floods affect the domesticated animals? Do you have any specific place to shift them during floods?

IV. Mitigation & Recovery

33. In case of flood, where do you take shelter? Why?

34. Is the shelter assigned? Is it accessible?

35. What type of risks does the shelter have from floods?

36. What belongings do you carry with yourself?

37. Do you pack important things up during monsoon season? If not why?

38. Do you save money for such incidents?

39. What methods do you adopt to stop water from getting inside your house?

40. What are the immediate steps you take when you see the water rising?

41. Do you have anyone to help you keep water out of your house?

42. Do other households in the neighborhood follow similar methods to avoid floodwater?

43. New relationships that have developed while recovering from floods? Do social boundaries get permeable during and immediately after floods?

44. What should be done to make the mitigation process more effective? What are you willing to do to make it more effective?

V. Institutional support

45. What types of public/ private organizations working in this area?

46. Are you associated with any of the community development efforts organized by NGOs?

47. Have you been approached to be assisted by any organization? Yes/No

48. Have you received any relief from government/ non-government/ private institutions? Yes/No

49. What kind of relief: food material, clothes, medicines, water, services like free medical checkups, others?

50. Does any organization offer flood mitigation mechanisms to deal with flood problems?

51. Does any of the organization working in your area offer financial consultancy and access to credit services?

VI. Financial services

52. Do you have a bank account?

53. Have you applied to get a bank account? Yes/No

54. Reasons for not having a bank account.

55. What are your sources of taking credit?

- 56. What are your usual reasons of taking credit?
- 57. What is standard range of amount of credit taken?
- 58. What is the interest rate you have on that credit?

VII. Informal Loss Sharing Mechanism

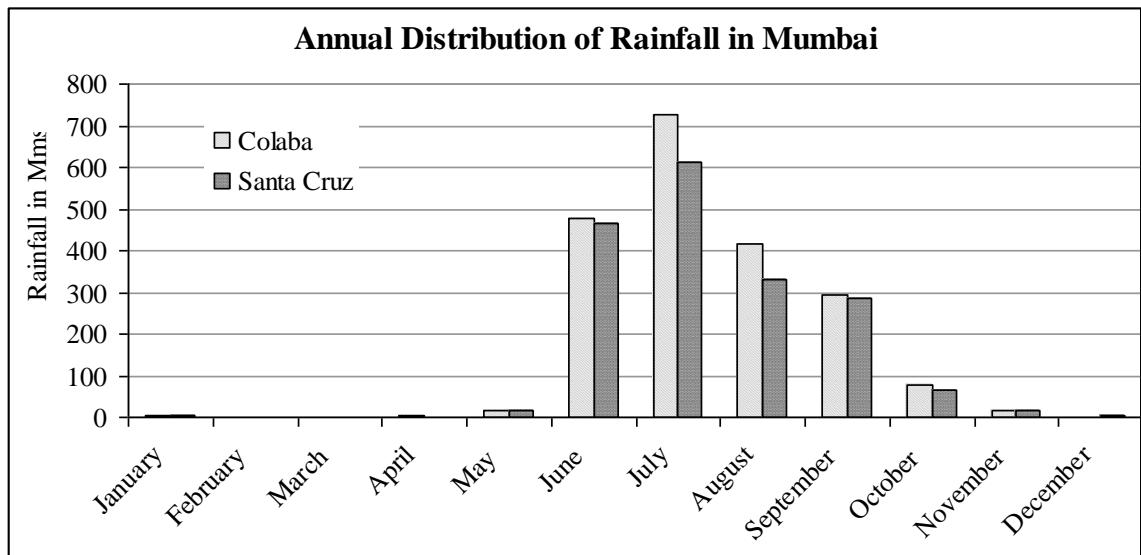
- 59. What source of money do you have that support you during recovery from a flood event?
- 60. Have these sources changed over a period of time? Do you find new sources of money lending?
- 61. What kind of assistance do you get to help you resume your daily work?
- 62. What resources help you in getting your property and home restored?
- 63. Do you get money from your employers? If no, why? If yes, is it a gift, loan or credit?

VIII. Insurance

- 64. Do you know what insurance is?
- 65. Do you know anyone who has insurance; life/ health/ auto/ other
- 66. Do you have any insurance? Yes/No? Why?
- 67. Does your employer provide you with any insurance coverage? While at work?
- 68. Would you be interested in applying for insurance to be able to claim losses from floods? Yes/No? Why?
- 69. Why do you think you have not applied for any insurance support?

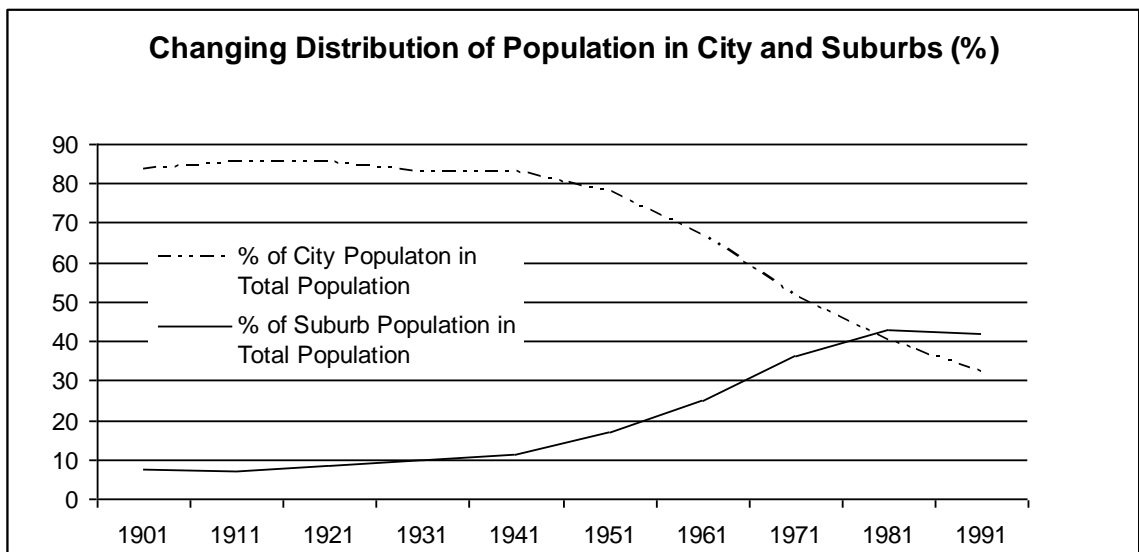
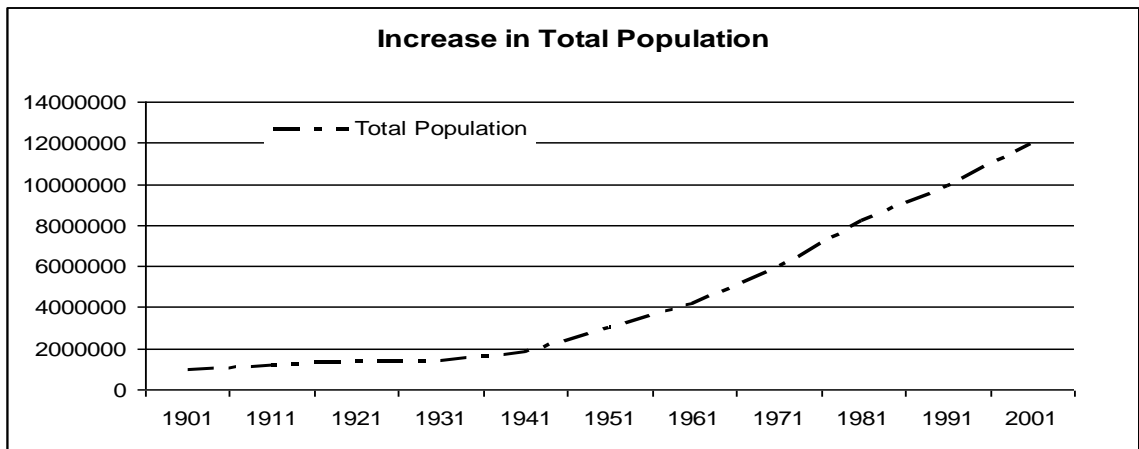
70. What type of insurance do you think would be more useful for you? Property loss from physical event, economic crisis from lack of income, health benefits for you and your family, others?

Appendix 2



Source: (MMRDA, 1996)

Appendix 3



Source: (MMRDA, 1996)

Appendix 4

Table 1: Planning Authorities in MMR

Regions	Divisions	Type of Planning Authority	Name	Areas in sq. km.
Greater Mumbai	a. Greater Mumbai Excluding b, c, d and e below	Local Authority	MCGM	437.71
	b. Back bay Reclamation Area	Special Planning Authority	MMRD A	2.23
	c. Bandra Kurla Complex	Special Planning Authority	MMRD A	12.62
	d. Oshiwara District Center	Special Planning Authority	MMRD A	1.02
	e. Dharavi Area	Special Planning Authority	MHAD A	1.75
	f. Marol Industrial Area	Special Planning Authority	MIDC	1.30
Thane Municipal Corporation	-	Local Authority	TMC	128.23
Kalyan Complex	a. Kalyan Municipal Corporation	Local Authority	KMC	137.79
	b. Ulhasnagar	Special Planning Authority	MMRD A	27.54
	c. Ambernath	Special Planning Authority	MMRD A	34.93
	d. Badlapur	Special Planning Authority	MMRD A	48.58
	e. Rest of Kalyan	Special Planning Authority	MMRD A	132.59
Navi Mumbai	a. Navi Mumbai excluding b, c	New Town Development Authority	CIDCO	343.70
	b. Panvel Old Municipal Area	Local Authority	PMC	5.19
	c. Uran	Local Authority	UMC	2.10
Navi Mumbai Municipal Corporation	(Outside Navi Mumbai)	Local Authority	NMMC	33.94
Bhiwandi -	-	Local Authority	BNMC	28.31

Nizampur				
Mira - Bhayandar	-	Local Authority	MBMC	88.75
Vasai - Virar Notified Area	a. Vasai Municipal Area	Special Planning Authority	CIDCO	380.00
	b. Virar Municipal Area	Special Planning Authority	CIDCO	8.00
	c. Nalla – Sopara Municipal Area	Special Planning Authority	CIDCO	19.58
	d. Navghar – Manikpur Municipal Area	Special Planning Authority	CIDCO	31.62
	e. Rest of VVNA	Special Planning Authority	CIDCO	-
Khopoli	-	Local Authority	KHMC	30.23
Karjat	-	Local Authority	KAMC	7.53
Pen	-	Local Authority	PMC	9.82
Alibag	-	Local Authority	AMC	1.81
Matheran	-	Local Authority	MHSM C	7.38

Source: (MMRDA, 1996)

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CURRICULUM VITAE MONALISA CHATTERJEE

EDUCATION

PhD in Geography, Rutgers University – October 2010
 Masters in Philosophy (M. Phil) of Geography, Delhi University – 2002
 Masters of Arts in Geography, Delhi University – 1999
 Bachelor of Arts with Honors in Geography, Delhi University – 1997

PUBLICATIONS

Chatterjee, M. 2010. Slum dwellers response to flooding events in the megacities of India. *Mitigation and Adaptation Strategies for Global Change*. Vol15. 4. 337-353

Chatterjee, M. Forthcoming. “Urban Vulnerability – Case Study: Floods in Mumbai” in Lever-Tracy, Constance (ed.) *Handbook for Climate Change and Society*. Routledge (In Print)

Chatterjee, M. Forthcoming. 'Flood Loss Redistribution in Third World Mega City: The Case of Mumbai'. in H. G. Brauch et. al. (eds.) *'Coping with Global Environmental Change, Disasters and Security Threats, Challenges, Vulnerabilities and Risks'*. Hexagon Book Series on Human and Environmental Security and Peace. Vol. 5 (Berlin – Heidelberg – New York: Springer-Verlag, In Print)

Chatterjee, M. 2008. 'Shifting Vulnerabilities: A Study in Flood Affected Slums of Mumbai'. *UNU-EHS Source*. Vol 10:100-109

Mitchell, J.K and M Chatterjee. 2007. „The Changing Environment“, in *Wilderness Medicine: Management of wilderness and environmental emergencies*. Paul S. Auerbach (ed.), St. Louis: Mosby Year Book Inc. (Fifth Edition). 2184-2198

Chatterjee, M. 2005. „The Scope of Natural Hazard Insurance in Developing Countries“ in Feng, H et.al. (eds) *Urban Dimensions of Environmental Change: Science, Exposures Policies and Technologies'*, Science Press, Monmouth, NJ. 130-139

FELLOWSHIPS AND ACADEMIC DISTINCTIONS

Student Award (Fall 2009 - Spring 2010), Climate and Environment Change Initiative (CECI), Rutgers University (\$11,500)

Bunting Cobb Women in Science, Technologies, Engineering and Mathematics Disciplines Graduate Fellowship 2008-2009, Douglass Project, Rutgers University (Housing & Stipend)

Mary Fran Myers Scholarship 2008, Natural Hazard Center, University of Colorado
<http://www.colorado.edu/hazards/awards/myers-scholarship.html#winner>

Invited Fellow to Summer Academy on Social Vulnerability 2007 - United Nations University, Munich, Germany

Featured in Social Vulnerability Bulletin, Munich Re Foundation
<http://www.munichre-foundation.org/StiftungsWebsite/Projects/SocialVulnerability/>

Graduate School Excellence Fellowship (2003-2005) for doctoral study in Geography at Rutgers, State University of New Jersey, USA (*tuition and stipend*).

Pre-Dissertation and Special Study Opportunity Award, Graduate School-New Brunswick, Rutgers, the State University of New Jersey, 2005

The *Canada Commonwealth Scholarship* selected at the national level in India by International Council of Canadian Studies (Declined as had accepted Fellowship in Rutgers).

NET Qualified (National Eligibility Test, a national level examination) conducted by, University Grant Commission, India in Resource Management in 1999, eligible to teach in any Indian University.

ASSISTANTSHIPS

Teaching Assistantship (2007-2009) Writing Program, School of Arts and Sciences Rutgers University (*tuition and stipend*)

Teaching Assistantship (2005-2007) Department of Geography, Rutgers University (*tuition and stipend*)

EMPLOYMENT

Instructor 'Expository Writing in English', (August 2007 – June 2009) Writing Program, Rutgers University

Co-Instructor for courses on 'Cities' (Spring 2007, approx. enrollment 70), „World Cultural Regions“ (Fall 2006, approx. enrollment 100) „Cultural Geography“ (Spring 2006, approx. enrollment 100)

Instructor for 'Introduction to Geography' (Physical and Human) (Summer 2004, 2005, 2006, Winter 2005, Approx. enrollment 25 in each course)

Teaching Assistant (TA) for 'Earth Systems' (Fall 2004, approx. enrollment 250) „Transforming the Global Environment“ (Fall 2005, approx. enrollment 250) at Department of Geography, Rutgers University

Research Assistant March - August 2008 with Dr. Niki Dickerson, School of Management and Labor Relations, Rutgers University

Research Assistant August 2006 – March 2007: with Dr. Niki Dickerson, School of Management and Labor Relations, Rutgers University

Research Associate 2002- 2003: Institute of Social Sciences, New Delhi

OTHER POSITIONS

Co-Organizer (2008-2009) - Research Conference on Climate Change in South Asia: Governance, Equity and Social Justice to be held on April 16-17, 2009 in Rutgers University, New Brunswick, NJ

Search Committee Member for Department Faculty Search, Fall 2006

Coordinator for the Third Annual MaGrann Research Conference on Future of Disasters in Globalizing World held on April 21- 22 2006 at Rutgers University.

Speaker Series Coordinator for the Graduate Geographers' Project (GGP) and have invited and organized twelve speaker series events in Fall 2004 and Spring 2005.

Graduate Geographers Project (Graduate Student Association) *Delegate* to Geography Faculty Council from September 2005 - May 2006.