THE CITY VULNERABLE:
NEW TOWN PLANNING, INFORMALITY AND THE GEOGRAPHY OF DISASTER IN
KOLKATA, INDIA

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Cities in the global South are increasingly at-risk from environmental hazards, but frameworks for understanding disaster vulnerability do not adequately explain urbanization or the role played by urban governance institutions in shaping disaster outcomes. Drawing on interview, archival, geospatial, and survey data, I argue that urbanization and the geographies of risk it produces are historically rooted and structured by political, economic, social, and institutional norms embedded in city environments. Disaster risk exists not just at multiple scales but also differentially across the city. As this dissertation demonstrates, individual and household vulnerabilities, and the norms and structural conditions that help shape them, are connected to a pattern of fractured urban development.

My study is based in Kolkata and centers on new town developments, one of the most significant spatial components of urban growth in India post-Independence. In such contexts, planning is one of the central urban governance institutions and sets of practices that shape the growth of Indian cities. While planning may be spatially or temporally distant from disaster events, the trajectory of urban development that planning lays out and the settlement logic it employs are foundational in shaping future disaster events. As such, I argue that planning should be considered a root cause of vulnerability or resilience. My work suggests a substantive shift in the conceptualization of urbanization in one major and widely used model of vulnerability within the hazards literature.

I use the case of Salt Lake, a mature new town project in Kolkata's eastern periphery, to analyze the likely outcomes of similar developments in the years and decades to come. One of my key areas of focus is how planning understands and engages with informality, a dominant characteristic of cities in the South. Salt Lake was planned and developed in the flood plain in Kolkata's eastern periphery. While Salt Lake residents and businesses are largely resilient to environmental hazards, they rely on thousands of low-income and informal workers who live in unsafe slums and squatter camps surrounding the township. As my research shows, informality does not arise independent of the formal economy or planned developments; the formal and the informal are deeply intertwined, and are co-constitutive of the broader urban fabric. My study highlights these relationships and argues that we must recognize the co-locational and co-evolutionary nature of informality in order to plan for disaster resilient cities.

My findings are relevant for planning and disaster management officials whose policies and practice today will help shape future geographies of risk. By failing to address the root causes of risk in cities, policies that focus exclusively on vulnerability in-place will fail to anticipate and mitigate the future growth of unsafe settlements.

BIOGRAPHICAL SKETCH

Andrew Rumbach grew up in Jasper, Indiana and received his Bachelors of Arts in Political Science from Reed College in 2002. He joined the Department of City and Regional Planning at Cornell University in 2005, where he earned a Master in Regional Planning in 2007 and a Ph.D. in City and Regional Planning in 2011. During the course of his doctoral studies he was awarded several fellowships to support his research including a J. William Fulbright Research Fellowship, a PERIship award from the Natural Hazards Center, the Public Entity Risk Institute, and Swiss Re, and a research fellowship from the Clarence S. Stein Institute for Urban and Landscape Studies. While in India for fieldwork, Andrew was a visiting scholar at the Centre for Studies of Social Science, Calcutta. He also worked closely with two community-based organizations in West Bengal: Prantik Jana Vikash Samity in Bidhannagar and Save the Hills in Kalimpong. Andrew will join the faculty at the University of Hawai'i at Manoa in the fall of 2011 as an assistant professor in the Department of Urban and Regional Planning.

the impacts of environmental hazards. I look forward to a long and productive friendship with Praful and other members of STH.

I would also like to acknowledge the organizations that provided material support for my dissertation work, without which my time in the field would not have been possible. They include the U.S.-India Educational Foundation, the Clarence S. Stein Institute for Urban and Landscape Studies, the Public Entity Risk Institute and Swiss Re, the U.S. State Department, the Foreign Language and Area Studies Fellowship Program, and the GeoEye Foundation.

Finally, and most important, I would like to thank my family, friends, and loved ones, for their support, encouragement, and senses of humor.

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LIST OF ABBREVIATIONS

ADB - Asian Development Bank

BDP - Basic Development Plan (1966)

BM - Bidhannagar Municipality

BPL - below poverty line

CBD - central business district

CC – cubic convolution

CIT - Calcutta Improvement Trust

CMPO - Calcutta Municipal Planning Organization

CMC - Calcutta Municipal Corporation

CMD - Calcutta Metropolitan District

CMDA - Calcutta Metropolitan Development Authority

CPI(M) - Communist Party of India (Marxist)

CUA - Calcutta urban agglomeration

DEM - digital elevation model

DMA – Disaster Management Act (2005)

DPP - Development Perspective Plan (1976)

DRR - disaster risk reduction

ECW - East Calcutta Wetlands

EKW - East Kolkata Wetlands

EMD - Eastern Metropolitan Bypass

GIS - geographic information system

GOI - Government of India

IDD - International Disasters Database

ILO - International Labor Organization

JNNURM - Jawaharlal Nehru National Urban Renewal Mission

KIT - Kolkata Improvement Trust

KMC - Kolkata Municipal Corporation

KMDA - Kolkata Metropolitan Development Authority

LIDAR - laser detection and ranging

LULCC - land use and land cover change

MSL - mean sea level

NATMO - National Atlas and Thematic Mapping Organisation

NEDECO - Netherlands Engineering Consultants

NGO - non-governmental organization

NDITA - Nabadiganta Industrial Township Authority

NN – nearest neighbor

NRI - non-resident Indian

NSSO - National Sample Survey Organisation

PAR - pressure and release model of disaster risk

PJVS - Prantik Jana Vikash Samity

Rs - rupees

RS - remote sensing

SAR - synthetic aperture radar

TMC - All India Trinamool Congress

TOI - Times of India (newspaper)

ULB - Urban Local Body

UN - United Nations

UN-ISDR - United Nations International Strategy for Disaster Reduction

US - United States

USGS - United States Geological Survey

WB - World Bank

WHO - World Health Organization

WV2 - Worldview 2 satellite

WWII – Second World War

PREFACE

This dissertation, a study of urbanization and disaster risk in India, grew from my experiences as a Masters student working in post-Katrina New Orleans. As part of the New Orleans Planning Initiative at Cornell University, I spent more than two years studying the impacts of the hurricane and the subsequent recovery planning process. Katrina was an entirely predictable disaster. Following the Second World War, the city of New Orleans grew from the high ground on the Mississippi River into the low-lying marshland and swamps nearby. After Katrina, it came as little surprise that flooding was concentrated in these low-lying areas. This was not the entire story, however. Even among and within flood-damaged communities, there was wide variation in the impacts on different groups of people.

As a budding planner, I was particularly struck by the performance of the city's hurricane evacuation plan (Renne, 2009; Renne 2006). The Contra-Flow system, which transforms the regional interstate highway network into a single outbound system, worked almost flawlessly and allowed more than a million residents of New Orleans and nearby parishes to evacuate in a 38-hour period (Varney, 2006). For the 33% of New Orleans residents without access to a private automobile, however, the evacuation was an utter failure. As Renne (2006) laments, "elderly, disabled, and low-income residents, as well as tourists without cars, had no evacuation options" (p. 45). Not surprisingly, these groups were also the hardest hit by the storm, particularly the elderly. Almost half of all storm victims (49%) were 75 years old or older, many of them housebound or medically disabled (Brunkard et al., 2008). Elderly residents were left stranded in their homes, nursing homes, or hospitals

because the city did not have a medical evacuation plan in place because of the collapse of the city's public transportation system.

It was then that I began to think critically about the uneven impact of disasters. I began to work my way through a rich hazards research literature that spans the academic disciplines, including planning, geography, sociology, anthropology, and the natural sciences. I became fascinated by the questions of who do planners plan for? And how does planning help shape the uneven impacts of hazards on different groups of people? I wanted to study these questions in the global South, where the vast majority of human impacts from disasters are felt. I settled on India, the world's largest democracy and one of the fastest urbanizing countries in Asia. Natural disasters have killed millions of people and caused hundreds of billions of dollars worth of damage in India in the past century. Kolkata, the capital of the state of West Bengal, is in many ways similar to New Orleans. Both are relatively poor deltaic river cities that routinely suffer from floods, tropical storms, and cyclones (hurricanes). Both have complicated colonial histories that influence governance institutions like planning. And like New Orleans, planners in Kolkata seem unequipped to manage the tension between urban development and disaster risk.

Today, Kolkata is following the same physical development trajectory that New Orleans did following WWII. It is expanding away from the natural levee of the Hooghly River and towards low-lying marshlands to the east and south of the urban core. New townships have sprung up across the urban fringe while marshes and swamplands are being filled-in to make room for real-estate development. This dissertation is a study of how such urbanization shapes disaster risk. The ways

in which the city's physical development occurs will help shape the outcome of future disasters, as more and more people settle on low-lying land in the periphery. Though I spend a significant amount of time describing contemporary geographies of risk and their relationship to planning decisions made decades or centuries ago, my ultimate goal is to look forward and to suggest some ways that planning and development policy might contribute to more disaster resilient cities.

CHAPTER 1: DISASTER AND THE INDIAN CITY

On March 23rd, 2010, a fire broke out in Stephen's Court, a sprawling 150-year old building in downtown Kolkata. Forty-three people died and several hundred more were injured by one of the deadliest disasters in Kolkata's recent history.[1] The poor performance of the fire brigade and other emergency management institutions shocked even the most cynical residents of a city accustomed to corruption, incompetence and mismanagement. The Times of India, a leading daily newspaper, published an editorial the following day that chastised disaster management officials and sounded a general alarm about the state of Indian cities:

> Given the pathetic state of urban infrastructure, lack of basic safety norms in public and private establishments, and paucity of efficient emergency services in most parts of urban India, there is no telling where disaster will strike next. Our cities are growing exponentially, but public infrastructure has not kept pace…Clearly, there is a problem in the way we go about the business of urban planning and management. It is shortsighted and does not take into account future needs…Rapid urbanisation is a reality. If we don't get the basics right, there'll be a heavy price to pay" ("Danger Zones," 2010).

The goal of this dissertation is to explore the tension between India's rapid urbanization and the costly effects of disasters, large and small. I am especially interested in what the Times of India termed the "problem in the way we go about the business of urban planning and management." I argue that planning is a root cause of disaster risk in India because it shapes city growth over time but excludes poverty and informality, further concentrating risk in low-income communities. As

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[1] The government of the state of West Bengal changed the name of Calcutta to Kolkata in 2001. The change reflects a larger trend in India of shedding colonial names of cities; Bombay became Mumbai (1995), Madras became Chennai (1996), Pondicherry became Puducherry (2006) and Bangalore became Bengaluru (2007). For the sake of consistency I will refer to Kolkata by its current name, even when discussing the city prior to 2001, unless directly quoting a source.

the Times of India observed, it is not just a lack of planning that is at the core of urban disaster risk, but the ways in which planning is done. Using a mixed methods research design that incorporates data from surveys, interviews, archival research, and remote sensing imagery analysis, I also show how the formal and informal sectors are locationally and economically interdependent, rejecting the currently prevalent notion that vulnerability can be examined in place and separate from the contexts in which it is embedded.

Disasters, like all urban phenomena, are manifestly complex things (Harvey, 1970). The subject of urban risk in the global South has gained ground in the hazards research literature (e.g. Sanderson, 1997; Timmerman, 1997; Pelling, 2003; Shaw, 2008; Pelling & Wisner 2009). Cities are a concentration of people, capital, and infrastructure and are often exposed to multiple and layered hazards, both natural and man-made. As such, cities have been described as "crucibles of hazard" (Mitchell, 1999). Cities, however, do not suffer from disasters – people do. Much of the hazards research in the past several decades has tried to understand which groups of people tend to suffer most during disaster events; that is, who is most vulnerable, and why. Many of these studies examine vulnerability in place, however, without examining its main underlying causes.

My dissertation situates urbanization as a dynamic process that shapes the outcomes of future disaster events. In the hazards literature, risk, the probability of loss or suffering when a vulnerable population is exposed to an environmental hazard, is often analyzed only at a single scale and as a static condition. More importantly, only a few studies have examined the emergence of disaster risk from

the urbanization process itself. The particular ways that urbanization unfolds shapes risk; as Mark Pelling argues, "urbanization affects disasters just as profoundly as disasters can affect urbanization" (Pelling, 2003, p. 7). Urbanization, however, is much more than rapid population increase and attendant spatial growth, a common simplification in the hazards research literature. I argue instead that urbanization and the geographies of risk it produces are historically rooted and structured by political, economic, social, and institutional norms embedded in city environments. Disaster risk exists not just at multiple scales but also differentially across the city. As this dissertation demonstrates, individual and household vulnerabilities, and the norms and structural conditions that help shape them are connected to a pattern of fractured urban development.

My study is based in Kolkata and centers on new town developments, one of the most significant spatial components of urban growth in India post-Independence (Chakravorty, 2005). In such contexts, planning is one of the central urban governance institutions and sets of practices that shape the growth of Indian cities. While planning may be spatially or temporally distant from disaster events, the trajectory of urban development that planning lays out and the settlement logic it employs are foundational in shaping future disaster events. As such, I argue that planning should be considered a root cause of vulnerability or resilience. My work suggests a substantive shift in the conceptualization of urbanization in one major and widely used model of vulnerability within the hazards literature (Wisner et. al, 2004). I use the case of Salt Lake, a mature new town project in Kolkata's eastern

periphery, to analyze the likely outcomes of similar developments in the years and decades to come.

One of my key areas of focus is how planning understands and engages with informality, a dominant characteristic of cities in the South (Kudva, 2009; Davis, 2006; Roy, 2003a; 2003b; Breman, 1996; Gooptu, 2001). Informality, in the economy and in patterns of settlement and shelter, has proven to be the "overwhelming and enduring reality of Indian urban economies, both past and present" (Gooptu, 2001, p. 2; Breman, 1999).[2] That disaster risk is concentrated in informal settlements or among households working in the informal economy is also well established (e.g. Bull-Kamanga et al., 2003; Davis, 2004; Wisner et al. 2005; Wamsler, 2007). Informality does not arise independent of the formal economy or planned developments, however; the formal and the informal are deeply intertwined, and are co-constitutive of the broader urban fabric. My study highlights these relationships and argues that we must recognize the co-locational and co-evolutionary nature of informality in order to plan for disaster resilient cities. Before laying out my arguments in detail and describing the structure of the overall

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[2] In planning and public policy, informality is typically separated into considerations of housing and the economy (Kudva, 2009; Harvey, 1983). Informal settlements, often called slums, contain housing that is built outside of formally regulated markets (UN-Habitat 2003; Davis 2006). While conditions vary widely in slums (even within a single city), in general they tend to be overcrowded, have inadequate infrastructure and receive lower provisions of municipal services like electricity and piped water. The term "informal economy" was coined in the early 1970's in reference to the work conditions of peasants flooding cities from the countryside and is a "container concept" that, in part, describes a workforce that makes their living from a wide range of unskilled and low-paid casual jobs without claims to any form of security or protection (Breman, 1996, pp. 145-146; Davis, 2004). As Kudva (2007) points out, however, the "everyday lived experience of informality systematically vitiates" the separation of informality into separate spheres.

dissertation, the following sections situate my study in the context of India and Kolkata.

India's Urban Century & the Geography of Disaster

India is increasingly urban and increasingly at-risk from a range of environmental hazards.[3] Its urban population grew from just 63 million in 1950 to 363 million in 2010. By 2030, it will reach 600 million, more than that of the United States and Western Europe combined (GOI, 2010).[4]

Table 1.1: India's population 1950-2050

Year	Total Population (Millions)	Rural Population (Millions)	Urban Population (Millions)	% Rural	% Urban
1950	371.9	308.5	63.4	83	17
1960	446.0	366.0	79.9	82.1	17.9
1970	549.3	440.8	108.5	80.2	19.8
1980	688.6	529.5	159.0	76.9	23.1
1990	860.2	640.4	219.8	74.5	25.5
2000	1046.2	756.8	289.4	72.3	27.7
2010	1220.2	853.3	366.9	69.9	30.1
2020	1379.2	906.6	472.6	65.7	34.3
2030	1505.7	894.3	611.4	59.4	40.6
2040	1596.7	832.8	763.9	52.2	47.8
2050	1658.3	743.4	914.9	44.8	55.2

Source: United Nations Population Division, 2010

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[3] I agree with Pelling (2003) that the term "environmental hazard" is much preferable to "natural hazard" or "man-made hazard." In as complex a context as cities, the distinctions between the two categories are murky at best and misleading at worst. For the remainder of this dissertation, environmental hazard is used to categorize any event in the urban environment that has the potential to cause harm to people, households, or communities. Examples might include sudden onset hazards like earthquakes, fires, hurricanes, or industrial accidents, or slow onset hazards like droughts or climate change.
[4] By 2050, the UN estimates that India will have more than 875 million urban citizens, an astonishing growth of nearly 1400% in a single century. In 2010, India had 59 cities with populations larger than 750,000, and three of the world's ten largest metropolitan areas.

India is also one of the most disaster-affected countries in the world.[5] From 1950-

2009 it was exposed to only 5% of the disaster events worldwide but suffered 24%

of the fatalities and accounted for 34% of the total persons affected, either injured

or displaced by the disaster event.[6],[7]

Figure 1.1: Number of Disaster Events and Persons Affected by Disasters, 1950-2008, by Country
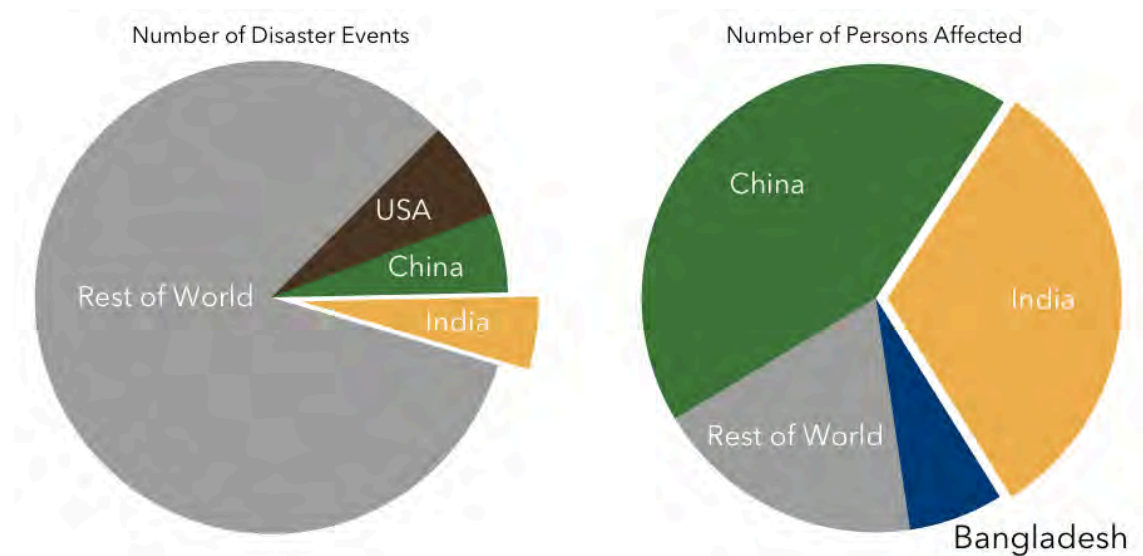
Sources: International Disasters Database, 2010

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[5] Most sources of information on disasters, like the International Disasters Database (IDD) (http://www.emdat.be/), do not disaggregate impacts into "rural" or "urban," so it is difficult to say exactly how much damage is done by urban disasters in India. This makes sense, because disasters often stretch across wide geographies and affect both urban and rural populations and thus defy easy classification. Anecdotal evidence, like the 2001 earthquake in Gujarat that devastated the cities of Bhuj and Bhachau and the 2005 Mumbai floods, point to an increasingly urban toll.

[6] In order for a disaster to be registered with the IDD, at least one of the following criteria must be met: 1) Ten or more people are reported killed; 2) One hundred or more people are reported affected; 3) There is a declaration of a state of emergency; or 4) There is a call for international assistance. While the IDD gives us a general sense of disaster trends, it likely underestimates the impact of environmental hazards on cities, especially in poorer communities, where "everyday disasters" do not meet the minimum criteria but take a large cumulative toll. See Bull-Kamanga et al., 2003 & Hardoy, Mitlin, & Satterthwaite, 2001.

[7] From 1978-2008, disasters in India accounted for more than 140,000 deaths and $45.5 billion dollars of damage. During the same period, disasters destroyed more than 27 million homes, including 1.7 million in 1999 when a cyclone struck the state of Orissa (Kapur, 2010, p. 15).

More than one-half of India's land mass is in moderate or severe seismic zones and one-third is prone to severe flooding or drought. The 7,800 kilometer (about 4,850 miles) coastline, where many of India's rapidly growing cities are located, is frequently exposed to a range of environmental hazards including erosion, landslides, tropical storms, cyclones, and flooding. Many of those same coastal cities, including Mumbai, Kolkata, and Chennai, are vulnerable to the effects of global climate change (McGranahan, Balk, & Anderson, 2007; Knutson et al., 2010).[8]

Beyond the immediate human and material costs, urban disasters pose a significant challenge to India's continued economic growth (Lewis, 1999). Urban populations contribute an ever larger share of India's GDP, up from 29% in 1951 to 60% in 2001. By 2011, it is estimated that 70% of GDP will be generated in urban areas. Urban populations also account for more than 90% of government revenues (ASSOCHAM, 2006; Kundu, 2003).

The Case: Kolkata, Queen of the East

Kolkata, the capital of the state of West Bengal and the third largest city in India, and Salt Lake, a new town within it, are the foci of this work.

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[8] For example, with a 2-4 degree increase in mean temperature, India can expect a 10-15% increase in monsoon precipitation, more frequent and severe precipitation events (like the one that caused the Mumbai floods of 2005), and increased intensity of cyclonic storms (Sharma & Tomar, 2010; Knutson et al., 2010). For a composite map of environmental hazards that typically affect the various regions of India, see http://www.preventionweb.net/files/3792_idn.pdf.

Figure 1.2: Kolkata's Location on the Subcontinent

Source: Natural Earth GIS

While much as been said in the planning literature about urbanization in India, recent attention has been focused largely on cities like Delhi, Mumbai, and the rapidly growing high-tech capitals of Bangalore and Hyderabad. Little has been written about Kolkata in the past 20 years, with some notable exceptions (e.g. Banerjee, 2005; Banerjee 2009; Roy, 2003a; Roy, 2003b; Chakravorty, 1996; Chakravorty, 2005; Mageli, 2004).

Table 1.2: Top 5 Urban Agglomerations in India by Population

Name	2001 Population (census)	2009 Population (estimate)
Mumbai	16,368,084	21,347,412
Delhi	12,791,458	18,639,762
Kolkata	13,216,546	15,414,859
Chennai	6,424,624	7,305,169
Bangalore	5,686,844	6,466,271

Sources: India Census, 2001; World Gazetteer, 2011

Within India's urban system, however, Kolkata is still a powerhouse. It is the political capital of West Bengal, India's fourth most populous state and third largest state economy (World Gazetteer).[9] As the largest city in East India it is the economic, political, and cultural center of a region with more than 220 million people. After Kolkata, whose population was 13.2 million in 2001, the next largest city in the region is Patna, with 1.7 million inhabitants, followed by Jamshedpur (1.1 million), Ranchi (.9 million) and Bhubaneswar (.6 million).

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[9] West Bengal's population in 2001 was approximately 80 million, and is estimated at more than 90 million today.

Figure 1.3: Relative Size of Cities in East India by Population (2001)

Source: Natural Earth GIS; India Census, 2001

Given its size and the important role it plays in the state and region, disasters

in Kolkata have broader import. Small disasters harm economic production and

access to the city's markets, stunt employment opportunities and the flow of

migration, and could potentially disrupt government functioning and provision of

services. A large disaster in the city could potentially cripple the entire region,

disrupting production networks and causing suffering well beyond the city or state border.

Kolkata's history and location make it an ideal place to study the tensions between urbanization and disaster risk. Agents of the British East India Company founded Kolkata on the eastern bank of the Hooghly River in 1690, less than 60 miles from the Bay of Bengal.[10] The location was advantageous for shipping and defense but less so from the perspective of climate and hazards. Typical of many deltaic river cities, Kolkata's geography leaves it regularly exposed to a wide range of environmental hazards. Floods, cyclones, heat waves, and malarial swamps and jungles have taken their toll on the city, and its rapid growth in the 20th century has created a host of man-made hazards, including poor sanitation and overcrowding, as well as air, water, and noise pollution.

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[10] Like others who have written about Kolkata or West Bengal in English, I struggle with the myriad ways standard Bengali words are transliterated; Hooghly, Hoogli, or Hugli? Chattopadhyay or Chatterjee? Throughout this dissertation, I have done my best to write names and places using the most popular English spellings, and if nothing else, to be consistent.

Figure 1.4: Location of Kolkata Metropolis in the Region
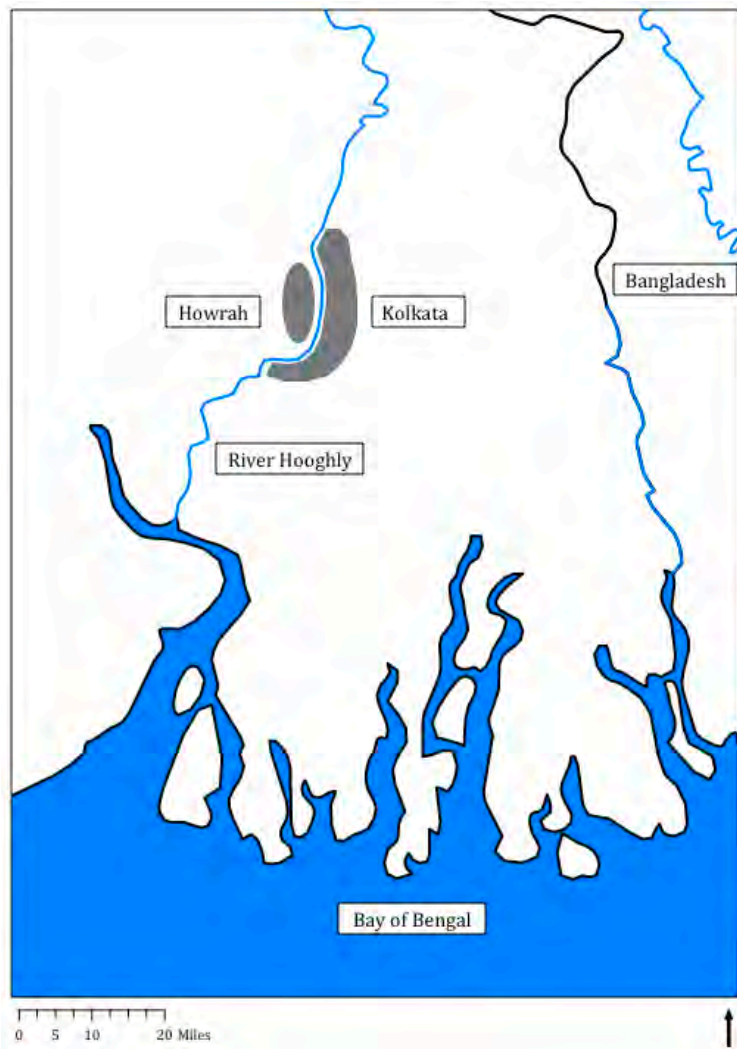
Source: Natural Earth GIS; Geoeye 2010

Kolkata is also one of the most vulnerable port cities in the world to the predicted effects of global climate change, including coastal flooding and elevated storm surges (Nicholls et al., 2008).[11] In 2010, the World Bank advised the West

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[11] The OECD report ranks vulnerability according to total population exposure. Following

Bengal government that climate change would push Kolkata to the "brink of civic disaster" (ECCWRD, 2010). Besides a rise in cyclonic storm intensity in the region, global climate change will cause a number of other potential hazards, including salt water intrusion (threatening regional agricultural production and ground water supply), more frequent and severe heat-waves, changes in precipitation patterns, and shifts in the geography and intensity of vector-borne diseases. The World Bank report argues that the effects of climate change will be most immediately and severely felt in the low-lying areas on the eastern fringe of the city, where most future development is being planned and where Salt Lake is located.

Like other major cities in India, Kolkata is rapidly changing as the country's population and economy booms. After a long period of stagnation, the city's economy is growing. With growth comes an insatiable appetite for land and development, and the city's footprint is rapidly expanding eastwards into the city and the region's flood plain. It is not just growth into flood plains that is important, however; it is also the character of that growth. Glittering malls, residential towers with private playgrounds and schools, and information technology parks are just some of the trappings of the new urban middle and upper classes, physical manifestations of Kolkata's transition from a moribund economy in the latter half of the 20th century to a new entrant in India's "reform economy during the second global period" (Chakravorty, 1996, p. 2). Alongside these modern and planned developments are thousands of slums and squatter settlements where more than 40% of Kolkata's population resides. The inhabitants of Kolkata's slums are vital to

Kolkata are Mumbai, Dhaka, and Guangzhou (p. 8).

the reform economy; as in other Indian cities and cities across the global South, the working poor in Kolkata are the backbone of the agriculture, manufacturing and service sectors of the urban economy. The growing economic and spatial divide between the modern elite and the labouring poor has profound implications for disaster risk.

Following in the footsteps of many of the most influential hazards researchers of the past several decades, I study disaster risk in Kolkata's eastern fringe as a component of everyday life, situating it in the broader patterns of the society in which it is embedded (Wisner, 2004). I go further, however, by focusing attention on two patterns that are typical of Indian cities as well as many cities in the global south and of new town developments in particular. First, while the informal sector is often treated as though it is separate from the city, and is thus excluded from the provision of infrastructure and civic amenities, it is in fact co-constitutive of the formal economy and co-locational with planned development. Second, planning is typically done from the perspective of the middle class and elite; because planning shapes the growth of cities over time, it creates a fractured urban landscape where the needs of households and communities in the informal sector are neglected. While planning's silence has been noted by many others, my work carefully maps and reveals patterns to provide the necessary empirical evidence.

I look closely at the relational nature of formal and informal sectors - both the economic relationships between low-income, casual, or informal workers and the people who employ them and the settlement patterns that emerge as the result of those relationships. I show how the informal workforce is central to the normal

functioning of new town developments but is routinely marginalized, both literally

and figuratively, as separate from, and outside of, the responsibilities of the

township's governance institutions. The resulting urban form is one of fractured

urbanism, where middle and upper class people inhabit the formal, planned, safe

spaces, but rely on a large number of poor and working class people who end up

living in hazardous slums and squatter settlements nearby. Similar to, and inspired

by, the work of Graham and Marvin, I show that this fracturing is acute in newer

townships and suburbs of Kolkata, where tropes of modernity and planning

necessarily lead to the expulsion of the poor beyond the boundaries of what is

modern and planned (Graham & Marvin, 2001).

I also examine the role that urban planning plays, and has played, in Kolkata's

development.[12] I argue that planning is a root cause of disaster vulnerability in the

city, for several reasons. Most importantly, planning has guided urban development

onto unsafe land in the urban periphery. For most of its history, Kolkata's physical

footprint reflected the natural geography of the region and the intrinsic role that

environmental hazards played in the life of its inhabitants. Urban growth happened

largely along the raised natural levee of the Hooghly, a "linear urbanized sprawl"

that stretched more than 60 kilometers (37 miles) from north to south, but rarely

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[12] By planning I am largely referring to the institutions and organizations that have statutory planning authority in the city and the urban agglomeration, as conferred by the Urban Development Department of the State of West Bengal; post-Independence, these would include the Calcutta Improvement Trust (CIT), the Calcutta Metropolitan Planning Organization (CMPO,) the Calcutta Metropolitan Development Authority (CMDA), and the current planning authorities, the Kolkata Metropolitan Development Authority (KMDA) and the Kolkata Municipal Corporation, as well as the planning authorities for municipalities in the Kolkata urban agglomeration. For detail on the history of the KMDA, see http://www.kmdaonline.org/html/about-us.html.

more than 4-6 kilometers (2.5 – 4 miles) in width (Chatterjee, 1990). Beginning in the 1960's, however, Kolkata's statutory planning organizations guided both by local political imperatives and expert consultant advice began pursuing a polycentric development strategy that encouraged eastwards development, towards the low-lying wetlands and marshes in the urban periphery. In doing so, they set Kolkata on a development path that continues today, as the city grows progressively into the regional flood plain.

A defining feature of the polycentric strategy was new town projects, residential, commercial, and industrial hubs located on previously undeveloped land. Kolkata's planning authorities made the infrastructure investments that were crucial for the viability of such developments and advanced the argument that modern technologies and engineering would effectively mitigate the environmental disadvantages of such eastward growth (S.K. Roy & K. Roy 1990, pp. 284-285). Unfortunately, planners failed to account for the needs of the poor, continuing a long tradition of exclusion of certain groups from the provision of infrastructure and civic amenities. While master plans have historically included limited, but separate, development programs for slums that already exist, they do not anticipate the needs of the low-income settlements that will necessarily accompany new, planned development. By ignoring, or paying only lip service to, the needs of the informal workforce and the dynamic processes by which slums arise, planning helps to create uneven geographies of risk. Thus, planned developments are largely safe from environmental hazards while accompanying low-income communities are left vulnerable.

The Dissertation's Structure

The general structure of the dissertation follows a traditional model, starting with a review of approaches to urban disasters and risk and then moving to the case study of Salt Lake, a mature new town development on Kolkata's eastern fringe, to provide evidence for the two central arguments of this dissertation: First, planning is a root cause of disaster risk because it shapes urban growth over time but tends to neglect poverty and informality, creating uneven geographies of risk. Second, despite the exclusion of informality in planning, the formal and informal sectors are co-constitutive of the broader urban fabric and are both locationally and economically interdependent.

The study of the social, political, and economic dimensions of disasters in the global South arose largely from studies of rural communities (e.g. Blaikie & Brookfield, 1987; Sen, 1983). In recent years a small but growing body of work has examined urban risk, though much of the attention is focused on the spectacle of urban disaster and subsequent attempts at recovery. Following this introduction, Chapter 2 looks at this urbanist and disaster literature and concentrates on the gaps that have emerged when theories of disaster risk are applied to cities of the global South. I describe the diversity and scale of environmental hazards that affect urban populations in poor cities and develop a typology of disaster that encompasses everyday, episodic, and catastrophic events. After a review of several theoretical models used by scholars to analyze disaster risk, I introduce Wisner et al.'s Pressure and Release (PAR) model of social vulnerability as the theoretical basis for and against which I develop my argument (Wisner et al., 2004). I find that the PAR's

treatment of urbanization is overly simplistic given the rich body of research on urbanization in the South. We know that informality in housing and the economy plays a key role in shaping Southern cities (e.g. Kudva & Beneria, 2005; Davis, 2004; Roy, 2003a). I explore this vast literature on informality to discuss how those economic, social, and material relationships that informality generates contribute to geographies of urban risk. As important, I show how planning, as an institution of urban governance, helps produce unsafe conditions at the local level.

Chapter 3 traces the history of urbanization and environmental hazards in Kolkata, beginning with Job Charnock and the British East India Company's arrival in 1690. The geography and climate of the region have long granted both riches and misery to the city's inhabitants. Kolkata was founded on a thin strip of high ground between the Hooghly River and marshlands leading to the Bay of Bengal, a swampy stretch of land that is regularly exposed to floods, storms, tropical heat, and a host of other environmental hazards (Barrett, 2004). Much of the history of urban planning in Kolkata is a history of crisis and response; from the Fever Hospital Commission report in 1840 to the founding of the Calcutta Metropolitan Planning Organization (CMPO) in 1960, periods of intensive planning have typically arisen in response to environmental crises. Yet, Kolkata "may suffer more from bad planning than from lack of planning" (Racine, 1990, p. 424). Planning has historically benefitted the elite, whether the Europeans in Kolkata during the colonial period or the middle and upper classes today, and so the impact of disasters tends to be highly uneven.

For most of its history, the city's spatial growth, both planned and unplanned, was confined to the high ground near the river. Soon after Independence, however,

the city began to grow east and south, into the previously unsettled marshes and wetlands in the region's flood plain. I document the history and trajectory of planned development in post-Independence Kolkata beginning with the creation of the CMPO, concentrating on eastwards growth and the development of new town projects in the urban periphery. These new towns will absorb a significant portion of Kolkata's formal growth over the next 50 years and are an important new phase in the city's evolving spatial structure (Chakravorty, 1996; Chakravorty, 2005).

Chapter 4 introduces the case of Salt Lake, one of the first and most successful new town projects in eastern India.[13] Salt Lake is a unique example of a mature new town project in the Kolkata urban agglomeration; the history and consequences of its growth offer valuable lessons about the outcomes of future townships in Kolkata's eastern fringe. After describing the history of Salt Lake's planning and development and the risks posed to the township by environmental hazards, I use the findings from a labour survey of 598 informal labourers working in the township to demonstrate the relational nature of the formal and informal sectors in Salt Lake and surrounding slums. While my survey data demonstrates that Salt Lake and its surrounding slums are economically and locationally interdependent, the question remains whether they are co-evolutionary; would the slums exist were it not for Salt Lake and other planned developments? I answer this question by documenting patterns of physical development in the Salt Lake area for the period of 1965-2010. As local level data on population and spatial growth are largely

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[13] Salt Lake was later renamed Bidhannagar, after the former Chief Minister of West Bengal Dr. Bidhan Chandra Roy, but the name Salt Lake is still in popular use today. Throughout this dissertation, I use the two names interchangeably.

unavailable or incomplete, especially when it comes to slums, I use remotely sensed imagery as an alternative source of information. My analysis shows that the growth of the Salt Lake township has been paralleled by the growth of slums, evidence that planned developments are key determinants of informal growth in Kolkata's eastern periphery.

The Salt Lake municipality imagines itself as a "modern, planned community," one that should be free from slums, shanties, and other visible signs of poverty. While the economy and operation of the township relies on the labouring poor, the municipality has evicted thousands of slum dwellers from within its borders. This logic of settlement has profound implications for disaster risk, especially as the city's planned development trajectory strikes further into the floodplains. Many informal and casual workers employed in Salt Lake have settled in informal settlements built on marginal land near the township. In Chapter 5, I shift my analysis to the micro-scale and document the unsafe conditions in the slums surrounding Salt Lake. I draw on an original survey of 414 households conducted in 2009-2010 to show that risk to environmental hazards is extremely high in these informal settlements. Because there is little emergency preparedness or disaster management capacity in Salt Lake or nearby municipalities, the vulnerability of individuals and households is largely driven by socioeconomic status, quality of housing and infrastructure, and service provision. I argue that Salt Lake has an economy and land-use pattern that is exemplary of fractured urbanism, where middle and upper-income residents live in the planned township with modern

infrastructure and amenities but rely on low-wage, informal sector workers who are forced to live in overcrowded and unserviced slums nearby.

Kolkata is on a track to develop more than a dozen new town projects over the next 30 years, townships that will eventually house several million people. My research concludes that new town development will be inevitably accompanied by slum growth unless planning and development paradigms shift substantially to incorporate the needs of low-income households and communities. In this fractured urban landscape, wealthier residents will remain relatively safe from environmental hazards while those who serve them will be increasingly at-risk. While the rich and the poor have always borne unequal environmental burdens in Kolkata and other Indian cities, new town projects represent a new stage in the evolving geography of risk in the city because of the hazardous land those townships occupy and because of the growing spatial divide between rich and poor that is demanded by residents of "modern" planned communities. While these findings are specific to new town projects like Salt Lake, they are broadly relevant to discussions of urbanization in India. In order for the Government of India's Disaster Management Act of 2005 to be effective, policy makers need to recognize that vulnerability and risk are not created solely at the micro-scale. Instead, they are the product of the social, political, economic, and institutional environments in which vulnerable households are embedded. Unless these structural causes of vulnerability and risk are addressed through appropriate planning and development policies, there will indeed be a "heavy price to pay" from future urban disasters.

CHAPTER 2: URBANIZATION AND ENVIRONMENTAL RISK

In the past 50 years the world has undergone a dramatic demographic shift, from predominantly rural to predominantly urban. Whereas just 29% of the global population lived in cities in 1950, more than 50% does today, and nearly 70% will by 2050. In real numbers, this means that the number of urban dwellers will nearly double by 2050, from 3.45 billion in 2010 to 6.29 billion in 2050. Nearly all of this growth (94%) will take place in the cities of the Global South (United Nations Population Division, 2010).[14]

Cities are often located in geographies of considerable economic advantage, especially in the areas of trade, transportation, and natural resource extraction. They are typically sited on rivers, coastlines, and lakes, near mountains, or in other locations that offer specific economic benefits. Of the five largest cities in the world (Tokyo, New York, Mexico City, Mumbai, and Sao Paulo), for instance, four are located on major bodies of water and all five grew historically as centers of shipping and trade.

Economic advantage, however, is often tempered by considerable environmental risk associated with urban locales (De Sherbinin, Schiller, & Pulsipher, 2007). Coastlines are often exposed to storms and storm surges, rivers to flooding and periods of drought, and mountainous areas to earthquakes and landslides. Some cities are at-risk of all of these hazards, and others. Indian cities are no exception. More than 68% of the country's landmass is prone to earthquakes, posing extreme risk to cities in states like Gujarat and across the Indian Himalayas.

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[14] In 1950, eight out of the ten largest cities in the world were located in the Global North. Today, that number had shrunk to just two (Tokyo and New York).

Several of India's largest metropolitan areas, including Kolkata, Mumbai, Delhi, and Chennai, are located on rivers or coasts and regularly experience floods, droughts, cyclones, and tsunamis. Indian cities are also highly at-risk from the effects of global climate change (McGranahan, 2007).

While worldwide statistics on disasters tend not to differentiate between urban and rural impacts, the evidence points towards an increasingly urban toll. The human and material impacts of the largest disasters of the past several years, including earthquakes in Japan, Haiti, and China, floods in Pakistan, and a massive heat wave in Russia, were felt largely in cities. In India alone, urban disasters claimed more than 64,400 lives and affected 660,000 from 2000-2009 (IFRC, 2010). This is not to say that disaster risk in rural communities is declining in importance; it is not. But until recently, urban risk has been a relatively understudied phenomenon, especially in the Global South (Mitchell, 1999; Pelling, 2003). Cities were seen as refuges from disaster, rather than sites of risk. Whereas the research on disasters in richer countries has historically been biased towards urban areas, the reverse is true in lower-income countries; as a funder at a major multi-lateral organization once told me, "disasters, by and large, affect rural populations." This rural bias is reflective in international development practice more generally as well (Marcus & Asmorowati, 2006).

Much of the early urban risk research views disasters as a one-off event; focused, theoretically informed case studies that are anchored around single hazards and bound by the recovery timeline of those places. A consequence of this single-case approach is that they tend to describe how cities are affected by

disasters rather than analyze the process of urbanization and how it shapes risk and vulnerability. Urban disaster studies, then, tend to be ahistoric and fixated upon a single natural hazard, with few attempts at describing how previous disaster events have influenced a city's urban form and how vulnerability is informed by past events and evolving institutions.[15]

In the past 10-15 years, this has begun to change, as cities have been increasingly described as sites of multiple and compounding vulnerabilities rather than safety and security (IFRC, 2010; e.g. Mitchell, 1999). At various times and places, however, both arguments have shown to be true. We also see dramatically different outcomes in high-income versus low-income cities. In 2010, massive earthquakes rocked Chile and Haiti, with tragically different results. Whereas the Chile earthquake caused moderate property damage and claimed the lives of several hundred people, more than 200,000 died in Port-au-Prince and several million more were rendered homeless. Whether the city is a site of safety or of risk varies widely based on institutional structures of planning and governance and on the person or household in question as well; even within the poorest city, the geography of disaster risk is highly uneven.

Here my primary area of interest is on the intersection of urbanization and disaster risk in the global South, which present a unique set of circumstances and challenges for hazards research. Rather than describing urban disasters generally, I analyze the common intra-urban distributions of disaster risk in large Southern cities such as Kolkata, my primary case (Chakravorty, 2005). In this chapter I lay out

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[15] There are some notable exceptions, of course. For example, see Oliver-Smith, 1986; Barry, 1998; Mustafa, 1998; Wisner, 2004b; Davis, 2005; Wisner & Pelling, 2009.

the conceptual framework I use to analyze the case. Following a brief overview of

the evolution of disaster studies and its theoretical foci, I identify significant gaps

that my work seeks to address. I review the recent literature on the physical, social,

and economic variables that shape household and community vulnerability and

describe how the dynamics of urbanization shape particular geographies of risk.

Within the urban landscape, I propose a simple typology for categorizing

environmental hazards, one that captures the full range of events that affect urban

populations including everyday, episodic, and catastrophic events. Third, I examine

disaster risk in the context of cities in the global South. Because geographies of risk

tend to mirror geographies of wealth and power in Southern cities, it is important to

ground our understanding of disaster in larger literatures of migration, urban

poverty, informality, and colonial development. Finally, I look at how the institution

of planning has worked in a contradictory fashion, both as a mechanism for

promoting urban disaster resilience and, at the same time, as a driver of inequitable

environmental conditions among different segments of the population.

The Genesis of Disaster Studies

There is a rich intellectual tradition of studying hazards and disasters, one

that stretches across many academic disciplines and fields of professional practice.[16]

Given the diverse background and expertise of the various academics, organizations,

and government agencies involved in the study of hazards and disasters, it comes as

no surprise that there is an "archipelago" effect in the field, a patchwork of

approaches arising in the various disciplines, sometimes with little or no

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[16] For recent reviews of hazards and disaster literatures, see Adger, 2006; Cutter, Emrich, Webb, & Morath, 2009; Gilbert, 1995; Olshansky, 2009; Smith, 2007; Kelman, 2007.

coordination between them (Hewitt, Kenneth 1983). This is despite a broad consensus that mitigating disaster requires a coherent and integrated approach (Kelman, 2008; Gopalakrishnan & Okada, 2007; Wisner, 2004a). There are some broad currents that have run through the field over the past 50-75 years, however, which show a broadening of concern from the study of hazards themselves to the study of risk, vulnerability and resilience.

Before I continue, some terms that I will use frequently need to be clarified. *Hazards* are threats that have the potential to cause harm, to people, places, or the things they value (Cutter et al., 2009). Hazards are described in relationship to people; an event is classified as a hazard "to the extent that it threatens losses we wish to avoid" (Hewitt, 1997, p. 25). *Risk* is the likelihood of a person, household, community or any other unit of analysis incurring harm due to a specified hazard event(s). Bound up in our understanding of risk is *vulnerability,* which Wisner et al. (2004) describe as "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a hazard" (Wisner, 2004a, p. 11). A simple way of conceptualizing the relationships between hazards, risk, and vulnerability is the following pseudo-equation:

R(isk) = H(azard) x V(vulnerability)

While risk is used primarily by outside observers to analyze potential disaster events, vulnerability is a prevailing condition or interrelated set of conditions experienced by people and communities. That is, while we can examine vulnerability independent from a specific hazard, we can only conceive of risk in

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relationship to vulnerability and its interaction with a specific hazard or set of

hazards. Whereas many scholars use vulnerability in reference to any "population,

system, or place," I prefer to follow Wisner et al. and reserve the word vulnerability

exclusively for referring to humans, whether as individuals, households, groups, or

communities. Places may be prone to disaster, locations may be hazardous, and

structures may be unsafe or fragile, but it is people who have agency and thus have

capacities as well as vulnerabilities.[17] Within this paradigm that focuses attention on

people and communities, *resilience* denotes the capacity of an individual or group to

adjust to threats, mitigate or avoid harm, or absorb and recover from the impacts of

a hazard(s) while staying within certain parameters of well being.[18]

     Disasters are the manifestations of risk, the outcomes of interactions between

hazard events and vulnerable populations. At its most basic level, disaster studies

examine this complex interaction of human populations with natural hazards

(earthquakes, floods, etc.), man-made hazards (industrial accidents, civil strife,

pollution, etc.), or combinations of both.[19] Most definitions of disaster rely on some

threshold measure of impact before the disaster label is affixed, whether it is the

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[17] Thanks to Ben Wisner for making this point clear to me.

[18] Though the vulnerability and resilience literatures are developing somewhat
independently of one another, I conceptualize the two concepts as on the same scale of
human condition relative to a potential hazard. This is different than the ways the term is
used by many in the global environmental change community, who see vulnerability and
resilience as separate, but linked, concepts and use resilience more broadly to refer to
systems, whether human or ecological (Cutter et al., 2008; Folke, 2006).

[19] What should be clear is that the term "natural disaster" is itself is misleading; whereas the
hazard event itself may be natural, it is only when it interacts with society and human
settlements that a disaster can result.

number of lives lost, property damaged, or requirements of the affected population from external assistance.[20]

The word disaster evolved from the Italian word *disastro*, which came from the Greek for "bad" (dis-) and "star" (-aster). Astrologically speaking, a disaster was described as an event happening under the malignant influence of an unlucky star ("Etymology of Disaster," 2011). In religious texts, disasters were often described as acts of God, divine retribution for the shortcomings of mankind. In the Hebrew bible Yahweh brought on a hailstorm to punish Egyptians because of the Pharaoh's treatment of the Israelites, one of the ten biblical plagues described in the book of Exodus. Following a particularly destructive cyclone in Kolkata in 1864, the British newspapers observed that:

> ...an Indian cyclone is an irresistible outburst of the destructive forces of nature before which man and man's works are *powerless as before the breath of the Almighty*, which can be encountered only by submission, or that resignation which while it lasts is so undistinguishable from paralysis ("The Recent Calcutta Cyclone," 1865, emphasis added).

While the tendency for divine attribution may have lessened over time, the predominant view of disasters well into the 20th century was that they were attributable to the forces of nature; sudden external events separate from society and human action. As such, the status quo prescriptions for disaster management dealt largely with the protection of human settlements from hazards, with dams, levees, and other engineering works, or with the provision of aid and relief following disaster events (Olshansky, 2009). Early disaster studies was thus highly

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[20] Stallings (1997) distinguishes between disaster and risk with two simple but important observations. First, whereas disaster refers to events in the past, risk is about the future. Second, whereas we can study disasters through both direct and indirect observation, studying risk involves a great deal more uncertainty; "the character of events is unknown in their important details."

technocratic and dominated by geo-scientists and engineers who focused on the prediction and management of hazard events (Mileti, 1999).

In 1942, Gilbert White published his doctoral thesis *Human Adjustment to Floods: A Geographical Approach to the Flood Problem in the United States,* which was subsequently published as a monograph in 1945. White's work represents a paradigm shift in the way disasters were researched and managed in the United States.[21] Rooted in, and helping to pioneer the human ecology perspective emerging at the University of Chicago in the early 20th century, White conceived of floods not as separate from society, but as defined and shaped by human activity (Mustafa, 2002). Thus, his approach has often been dubbed the "risk/hazards" model, differentiating between the hazard affect and sensitivity to that hazard (Turner et al., 2003a). White's work inspired a generation of scholars who struggled to understand why humans occupied hazard zones and what were the most appropriate adjustment measures that would help reduce the impact of natural events (Cutter, 2009, p. 4; Mileti, 1999, p. 18). He was one of the first scholars to emphasize the importance of both natural and social systems in determining disaster outcomes who made practical recommendations based on "working with nature rather than trying to control it" (Olshansky, 2009). White's work on risk perception and behavior was also quite influential. He described how many attempts to reduce the impact of natural hazards actually made people more vulnerable, because of the change in the way people perceived risk and ultimately, their behavior in relationship to natural systems. The classic example cited by

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[21] For example, the National Flood Insurance Program and its attendant land-use requirements were one result of his work (Olshansky, 2009).

Olshansky (2009) was White's observation that the building of levees increases flood damage because they change people's perception of risk and lead to more development in hazard-prone areas.

In 1970, large disasters in East Pakistan (modern day Bangladesh), Peru, and Biafra (Nigeria) collectively killed more than 1.5 million people and affected millions more. Reflecting on these events, a group of scholars from rural development, anthropology, geography, and other social sciences began to focus more of their attention on marginalization and the human drivers of vulnerability (Wisner, 2004, p. 42 and footnote 8). While the "physicalists" like White were still primarily concerned with human exposure to natural hazards, this new strand of research broadened our understanding of vulnerability in an attempt to understand why some groups suffer the impacts of disasters more than others (Gilbert, 1995).[22]

Crucially, they shifted the emphasis away from hazards or trigger events and instead concentrated on the political, economic, and social factors that shaped an individual's ability to cope with or recover from hazards. "Disaster is no longer experienced as a reaction," Gilbert wrote "the new paradigm considers that the causes of disaster are to be explained on structural as well as contextual grounds" (Gilbert, 1995, p. 235). Using an early version of a political ecology approach, they pivoted away from many of the psychological and sociological approaches to disaster that examined disasters as breaks from normalcy, including studies of mass panic, mental trauma, and the breakdowns in political and social institutions.

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[22] For some alternate readings of the history of disaster research, including a more detailed description of the evolution of the human ecology, behavioral, and hazards geography traditions, see (Hewitt, 1998; Mileti, 1999; Mustafa, 1998; Peek, Lori A. & Mileti, Dennis S., 2002; Quarantelli, 1995)

Instead, they described vulnerability as deeply rooted in conditions of everyday life and documented how the drivers of vulnerability were unevenly distributed across individuals, communities, and even countries (Emel & Peet, 1989; Hewitt, 1983).[23]

O'Keefe, Westgate, and Wisner's (1976) brief critique of hazards-centered approaches to understanding disaster was a landmark moment in this paradigm shift; it emphasized the need for hazards researchers to understand who is most vulnerable, and why (O'Keefe, Westgate & Wisner, 1976; Cutter et al., 2009, p. 4). The authors began by observing that the number of large disasters worldwide had increased substantially in the previous three decades and yet, there had been no major geological and climatological change that would affect the probability of extreme physical occurrences. The authors concluded that the explanation must lie in the "growing vulnerability of the population to extreme physical events" (O'Keefe et al., 1976, p. 566). They argued that in order for precautionary disaster planning to be successful, to alleviate the causes rather than the symptoms of disaster, we would first need to understand the marginalization process that leads to increased vulnerability. This approach resonated with broader discourses of international development that were more people-focused and considering basic needs approaches to poverty reduction and helped link disaster mitigation to wider scholarships on poverty reduction and resource management (e.g. Cuny, 1983).

While the study of natural and technological forces continues to occupy much of the research on hazards and disasters, especially in natural science, engineering,

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[23] Many of the disaster scholars from this period were concerned primarily with disaster in less developed countries, including land degradation in South America (Blaikie & Brookfield, 1987); drought in sub-Saharan Africa (Wisner, 2004a); earthquakes and floods in Peru (Oliver-Smith, Anthony, 1986) , famine in India (Sen, 1983), among many others.

and design fields, today vulnerability approaches are accepted as mainstream frameworks for analyzing risk, hazards, and disasters. Two features of vulnerability frameworks make them particularly effective as conceptual devices. First, they describe disasters not as discrete events but as cyclical phenomena that are informed by conditions prior to, during, and following the disaster event itself. In other words, they stretch the conceptual space around hazards to include previous disasters and their effects on conditions of vulnerability. This is especially important when describing urban disasters, where multiple hazards and stresses often interact. This is an important departure from the physicalists, who explained disasters using one-way linear explanations, discrete events that began with a natural hazard and ended with recovery and a "return to normalcy." In contrast, vulnerability approaches argue that social interaction with hazards is too complex for such bounded explanations (Pelling, 2003). Second, vulnerability approaches place hazards in the larger context of economic, political, and institutional forces that leave some households and groups more vulnerable than others. Mustafa (1998) argues that disasters are not accidental interruptions of ordinary life, but rather reflective of the places and societies in which they occur. "Discrete disaster events are merely symptomatic of systemic failure, not the cause of it (p. 291; Hewitt 1983).

Three Frameworks of Disaster Vulnerability

Cutter (2009) identifies three major vulnerability frameworks that have emerged in the past several decades. First is the pressure and release (PAR) model conceptualized by Wisner, Blaikie, Cannon, and Davis, first published in 1994 and

again in 2004. The PAR model traces the progression of vulnerability from "distant" or root causes, like lack of political power or particular economic systems, through dynamic pressures and the resultant unsafe conditions that vulnerable populations find themselves in at the time of hazard events (Wisner, 2004b, Chapter 2).[24] Vulnerable populations interact with environmental hazards, producing disaster. Cutter finds frameworks like the PAR model to be valuable for descriptive analysis but not for empirical testing (Cutter et al., 2009). She also criticizes the PAR model for failing to address the proximity of populations to sources of threats and for not describing the interaction of the social and natural systems that leads to the production of hazards, critiques that I will return to later in the chapter.

The "hazards in place" (HIP) model, formulated by Cutter in 1996, seeks to address these gaps and has been further refined by her and a number of colleagues since (e.g. Cutter et al., 2008; Cutter, Boruff, & Shirley, 2003). The HIP model is representative of a larger movement towards quantifying vulnerability and its constituent variables and then tracking them across time and place (e.g. Cutter, Burton, & Emrich, 2010; Cutter et al., 2009, p. 4). Such efforts find common cause with "vulnerability science," which is most often associated with research on hazards in the natural sciences and particularly in climate change science. The HIP model arose out of a frustration with frameworks of vulnerability that were "too diffuse to be of practical use" and is tied up in a desire to make such studies generalizable and more policy relevant (Cutter, 1996, p. 535). While the HIP model

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[24] The PAR model finds part of its intellectual lineage in the political ecology literature, particularly in the Blaikie and Brookfield's approach to regiona political ecology that proposed a chain of explanation for land degradation in less developed countries (Blaikie, 1985; Blaikie & Brookfield, 1987).

integrates the social dimensions of vulnerability and recognizes variation across different groups, it does not account for the root causes of vulnerability, the larger structural contexts within which vulnerability exists and is generated.

A third approach to vulnerability is the vulnerability/sustainability (VS) framework, first described by Turner and his colleagues in 2003 (Turner et al., 2003a; Turner et al., 2003b). The VS framework attempts to combine the social vulnerability considerations of approaches like the PAR model, but with greater attention paid to environmental (biophysical) systems and the production of hazards. It "provides…detail on the structure of the hazard's causal sequence" and examines the interaction of human systems with the natural environment in which they are embedded ("coupled human environmental systems"). Unlike the HIP model, the VS approach theorizes the impact of macro-level influences, like trends in political economy and global institutions, but only within the temporal scale of the population or system being analyzed. While the VS approach does separate vulnerability into exposure (the characteristics of hazards that impact target populations) and sensitivity (the social vulnerability or resilience of target populations or systems), the social dimensions of vulnerability are somewhat obscure.

The framework I find most useful is the Pressure and Release (PAR) model. While there is great merit in the HIP model's attempts at empirical testing and replicability, it has primarily been employed in the United States where regular, reliable, and geo-spatially organized data are widely available at a variety of policy-relevant scales (census tract, metropolitan statistical area, county, etc.). These

conditions do not apply in contexts like Kolkata, especially in regards to poor and marginalized communities. Indeed, data poverty is one of the strongest arguments for pursuing descriptive and qualitative analysis of vulnerability and risk in such contexts.[25] Cutter's own critique of her HIP model is that it largely ignores the root causes of vulnerability and does a much better job of describing the "what" rather than the "how" and "why." My research demonstrates that a thorough analysis of root causes is necessary if we are to understand the underlying dynamics of risk, which themselves are driving the conditions under which *future* populations will become vulnerable.[26] If our analysis of vulnerability is limited to in-situ examinations, how can we effectively mitigate the accumulation of risk among future populations? One of the greatest strengths of the PAR model and its modeling of the progression of vulnerability (see next section) is the ways in which empirically measured conditions at the local level can be linked back to underlying structural and institutional forces producing them.

Related to its ability to link across scales is the fact that the PAR model was developed largely from research and case studies in the global South and implicitly recognizes that the production of risk is both context specific and related to global forces that translate into local conditions. Models of vulnerability do not always translate well from the industrial North to the global South, where the dynamics of urbanization and human-environmental relationships have historically emerged somewhat differently. Most importantly, the PAR model recognizes the importance

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[25] In some studies where empirical models are tested using officially provided sources of information, I believe the authors may need healthier doses of skepticism about the reliability of the data employed (e.g. CCWRD, 2010; O'Brien et al., 2004).

[26] I also believe that understanding root causes of risk is critical for effective planning.

of historical institutions and trends that have a structural effect on household and community risk, something neither the HIP nor the VS frameworks address.

It is my argument that we cannot understand the production, distribution, and future trajectories of urban vulnerability in countries like India if we do not acknowledge the deep roots urban development has in a history of colonial exploitation, war, and institutions of planning and governance pre and post-Independence. To focus on the characteristics of vulnerability in-situ analyzes only the symptoms of these historical processes and outcomes and denies us the appropriate analytical lens by which to understand the structural forces that produce these geographies of risk in the first place. Without such a lens, it seems that hazards researchers would forever lurch from crisis to crisis, failing to address the root causes of those disaster events.

The PAR Model

Like Mustafa (1998) and Gaillard et al. (2007), I use the conceptual framework of the PAR model to examine disaster risk at the micro-scale within the context of larger urban dynamics. The PAR model theorizes disaster as the interplay between hazards, vulnerability, and risk (R = H x V).[27] Hazards and vulnerability apply pressure to an individual or community while the mitigation of vulnerability conditions and disaster preparedness releases the pressure and reduces risk. A disaster occurs when unsafe conditions are met with an environmental hazard and a

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[27] For example, all other factors being equal, a high-magnitude earthquake in a community with earthquake resistant buildings and infrastructure (low vulnerability) faces an equivalent amount of risk as a small earthquake in a community without resistant buildings.

significant number of vulnerable people experience loss, above some threshold of accounting (see next section).

The Pressure and Release (PAR) model proposes a chain of explanation for vulnerability at the individual and micro-scale, where root causes lead to dynamic pressures that result in unsafe conditions (Figure 2.1). Root causes are an interrelated set of processes and institutions within societies and the larger systems in which they are embedded. Root causes are theoretically the most distant from the vulnerability of a community and tend to be structural in nature, and create the conditions from which more immediate dynamic pressures emerge. Root causes are distant not just in a spatial sense, often arising from seats of political and economic power far from the sites of actual vulnerability, but also in a temporal sense, as historical events and conditions can continue to shape vulnerability in a given time and location. Root causes are also distant in that they may be "bound up with the cultural assumptions, ideology, beliefs and social relations in the actual lived existence of people concerned" that they remain invisible or often taken for granted (Wisner, 2004b, pp. 22-24). Root causes are often reflected in unequal distributions of power and resources as well as political systems, economic systems, and society's understanding of rights.

Figure 2.1: The Pressure and Release (PAR) Model
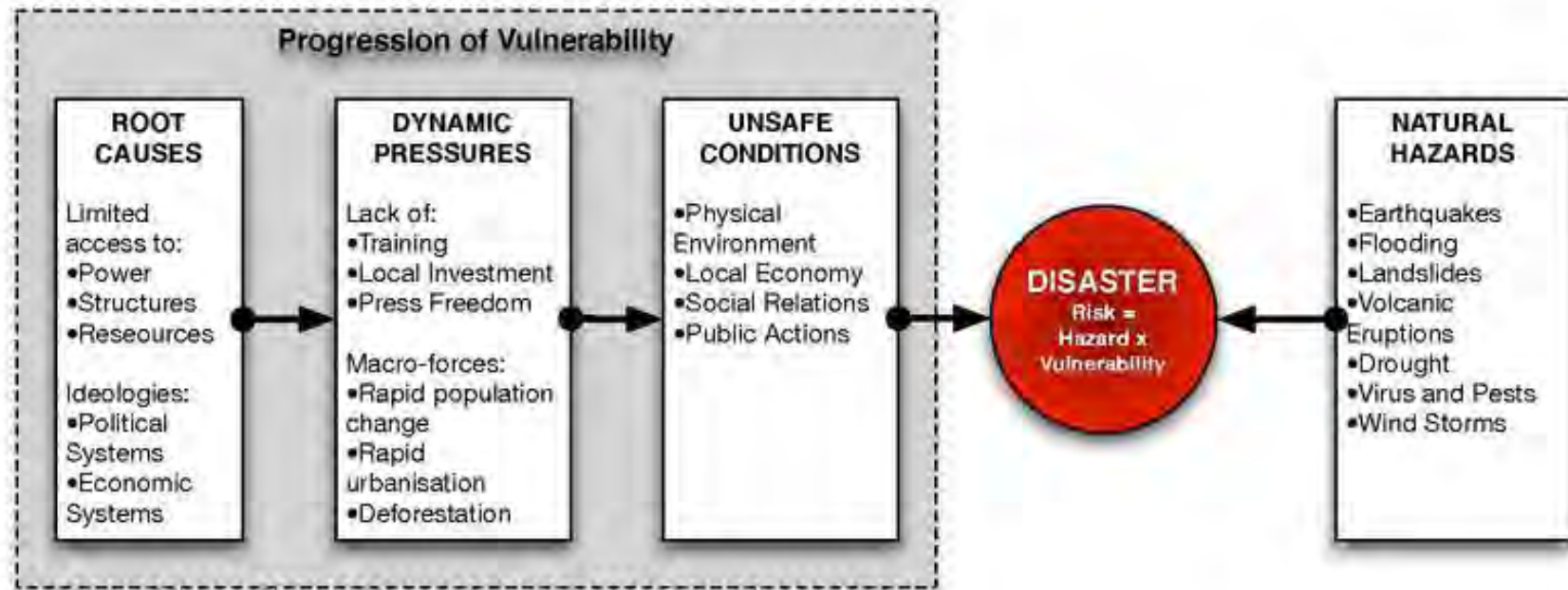
Source: Wisner, 2004a

Dynamic pressures translate the effects of root causes into specific unsafe conditions at the micro-scale. Dynamic pressures are often more contemporary and immediate manifestations of root causes and include active processes like rapid population growth and urbanization as well as critical weaknesses like the lack of a free press, shortcomings of local institutions, or poor regulatory structures (Wisner, 2004b, pp. 53-55). Because dynamic pressures translate root causes into specific unsafe conditions, they should be considered in relationship to the hazards that threaten people and groups.

Dynamic pressures create "unsafe conditions," the specific forms of vulnerability that are expressed when populations are met with a specific hazard or set of hazards. Unsafe conditions are the most immediate cause of vulnerability, both temporally and spatially. They include the physical environment in which a population lives or works, buildings and infrastructure, characteristics of the local economy and of the economic conditions of the population in question, the strength of local institutions (or the lack thereof), and the public measures taken to mitigate the effects of hazards.

Unsafe conditions also include the character of social relationships between vulnerable groups and larger political and economic systems. There has been considerable research done on the socioeconomic factors that tend to be correlated with vulnerability, sometimes referred to as social vulnerability (Cutter et al., 2003). Research findings generally reinforce the argument that the unevenness of disaster impacts mirror larger inequalities in society. Differences in disaster impacts have been attributed to class age, race, gender, caste and citizenship status, among other

factors (Douglas et al., 2008; Klinenberg, 2003; Peacock, Morrow, & Gladwin, 1997;

Sultana, 2010; Tierney, 2006). There is now evidence on the effects of these

socioeconomic factors on vulnerability at each stage of the disaster cycle: in levels of

disaster preparedness, the effectiveness of an individual or household's response to

natural hazards, and the ability of an individual or group to effectively recover

(Green, 2008; e.g. Green, Bates, & Smyth, 2007; Pennings & Grossman, 2008).

Because unsafe conditions are the most obvious forms of vulnerability in a

community, they are often the focus of hazards research and the target of mitigation

and risk-reduction policies and strategies. For example, the basic or rapid urban

needs assessments that document the conditions within cities of the Global South, a

staple in the process of designing development interventions and programming,

examines unsafe conditions (such as hazardous siting, poor building construction

and materials, lack of basic services) but rarely make the link back to the root causes

of such micro-scale vulnerability. As such, unsafe conditions are the most

documented and well-understood drivers of vulnerability in disaster studies, but the

processes by which unsafe conditions are created and maintained are less well

understood.

There are several limitations to the PAR framework, acknowledged by the

authors or raised in the literature subsequent to the framework's publication. While

I do not believe any are particularly damning to the framework's usefulness, I do

think it is important to acknowledge them in turn. First, the PAR model is rightly

criticized in that it does not adequately address the interplay between human and

natural systems in the production of the hazards themselves (Cutter et al., 2008;

Turner et al., 2003a). Blaikie et al. readily admit that the PAR model is an overly simplistic modeling of vulnerability and its intersection with the natural environment. The model downplays the role of the natural environment in the production of social vulnerabilities in order to emphasize the social causation of disasters. In reality, most individuals and communities are somewhat aware of their natural environment and nature plays a significant role in the production and maintenance of social frameworks. Likewise, human behavior plays a significant role in shaping hazards. This is a particularly important criticism when studying the dynamics of urban risk, where human activity continuously disrupts and reshapes the hazards profile of city and region.

Second, the concept of vulnerability cannot account for some of the behavior that is inextricably linked to the "relaxation of social and political boundaries" during disaster events, the type of psychosocial behavior that was widely studied by sociologists in the early 20th century. Short-term failures of economy, loss of basic utilities, food shortages, mass panic, or degradation of public health may result from disasters, regardless of structural vulnerabilities, especially when those hazards cause widespread and overwhelming damage. As the recent earthquake and nuclear crisis in Japan demonstrated, however, disasters may also bring about extraordinary levels of altruism, patriotism, or community cohesion.

Third, the vulnerability paradigm runs the risk of becoming ontologically messy, especially as it incorporates layers of context-specific qualitative and historical data. While a "grand theory" of disasters is unlikely, disaster studies does aim to generalize about outcomes, and increased numbers of variables, especially

those that are deeply rooted in history and context, make such generalizations difficult. I will return to this question of "generalizability" in the conclusion.

Finally, the vulnerability paradigm runs the risk of focusing too much on marginal and/or impoverished persons and communities, and on the structural forces that shape their experiences. It is generally agreed that poor communities suffer disproportionately during and after disasters (Beal & Fox, 2007; Blaikie, 1999; Bull-Kamanga et al., 2003; Davis, 2004). The PAR model, by focusing almost entirely on vulnerability and not on adaptive capacity or coping mechanisms inherent in any human with inherent capacities and a range of relationships, runs the risk of painting the poor and marginal as passive vessels of risk rather than as human actors with some degree of agency.[28] A related concern is that by focusing on the "funneling" of structural conditions into dynamic pressures and unsafe conditions, the PAR model paints a picture of vulnerability that cannot be mitigated without wholesale social, political, and economic revolution (Wisner, 2004b, pp. 14-15). I believe these concerns are overstated because the model is both dynamic and amenable to changes over time; as the later chapters in *At Risk* show, interventions at the local scale can have a dramatic "release" effect on vulnerability, even if structural conditions remain. I do acknowledge that the focus on the most

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[28] Since the publication of *At Risk*, a large and diverse literature on vulnerability and resilience has arisen, both in reference to environmental hazards as well as climate change and other examinations of human-environmental interactions. The role of adaptive capacity in vulnerability and resilience is now widely recognized; as Adger (2006) notes, in all its formulations "the key parameters of vulnerability are the stress to which a system is exposed, its sensitivity, and its adaptive capacity" (Adger, 2006, p. 269), a formulation also adopted by the Intergovernmental Panel on Climate Change's adaptation working group (O'Brien et al., 2004). In Wisner's more recent work, he modifies the pseudo-equation R=HxV to include an adaptive capacity variable. See (Wisner & Uitto, 2009).

vulnerable and their lack of resources and power does not adequately address the rational choices made by individuals that contribute to that person or household's location and prevailing conditions. I will return to this question of "acceptable risk" in the concluding chapter.

Vulnerability in the Urban Context Across the Global South

While the PAR model is a general framework for understanding the interplay of vulnerability, hazards, and risk, the primary focus in this study is a new town on Kolkata's periphery. Until recently, research on urban disaster risk in the Global South was relatively limited; vulnerability frameworks like the PAR model emerged largely from studies of rural development and the linkages between urbanization and disasters were under theorized (Hewitt, 1997). The importance of focusing on urban risk in the South is clear, for several reasons. First, the world is rapidly urbanizing and the vast share of urban growth over the next 50 years will take place in less and least-developed countries in Africa and Asia. Second, disasters disproportionately impact those countries. From 1950-2009, 35% of disaster events occurred in wealthy countries, but 94% of the fatalities were in poor countries. During the same period, of all persons affected by natural disasters 97% lived in the developing world (IDD, 2008). Clearly, the two trends are not unrelated. Urban populations in the Global South continue to grow and migrants continue to flow into cities that are often located in unsafe or hazardous geographies and unequipped to cope with the impacts of environmental hazards of varying sizes and degree

(Hardoy, Satterthwaite, & Miltin, 2002; Huq et al., 2007; Mitchell, 1999; Pelling, 2003, p. 4; Satterthwaite, Huq, Pelling, Reid, & Lanakao, 2008).[29]

Pelling (2003) argues that urban disasters are fundamentally different than rural ones, because of the constant and rapid interaction between the environment and the development process. Urban growth, especially at the pace and scale of which we are seeing today, is such that the nature of urban risk is being constantly redefined, as urbanization affects the environment and the environment affects urbanization, the "co-evolution" of urbanization and risk" (Adger 1999; Pelling, 2003, p. 6).[30] Cities are the foci of a range of human activities that are constantly re-shaping natural systems, but at the same time, cities themselves are very much a product of the larger natures in which they are embedded (Cronon, 1991; Peet & Watts, 1993; Harvey, 1996; Peet & Watts, 2004). The geographer Erik Swyngedouw describes cities as "cyborgs," part natural and part machine, each constitutive of the other (Swyngedouw, 2006). Cities were historically seen as separate from nature, a

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[29] Of the limited amount of research done on disasters and vulnerability in the cities of the Global South, most centers on "mega-cities" or national or state capitals (e.g. Mitchell, 1999; Nicholls, R. J., 1995; Wisner & Pelling, 2009). There is a dearth of research available on the accumulation of risk in small and medium-sized urban places. While there is a healthy debate over what constitutes a "small city," it is clear that these places house a significant portion of the world's urban population and will be responsible for a large portion of future urban growth (Bell & Jayne, 2009; Satterthwaite, 2006). What little research has been done shows that small cities may develop many of the risks associated with the urbanization process without the attendant increases in institutions and infrastructure that help make mega-cities resilient (Cross, 2001).

[30] Co-evolution is a useful conceptual device by which analyze urban risk, though its biological connotations may obscure the central role that people, institutions, governance, and planning play in negotiating the outcomes of human-environmental interactions. To put it another way, it is not a given or a predetermined outcome that cities tend to follow a spatial development pattern that places low-income and minority groups at greater risk than those with significant resources and power.

symbol of man's triumph over natural forces (Harvey, 2003).[31] Nature is controlled, paved over or relegated to carefully planned park and landscapes. Natural resources are produced in rural areas, transported into the city to be consumed, and transported out as waste, a linear metabolic understanding of the human-environmental interface (Marvin & Medd, 2006). Within the domains of urban theory and urban environmental history, however, while each perspective has addressed the components of a political ecological understanding of the city neither has explicitly explored the linkages between them.

Urban political ecologists have recently attempted to fill this void, concerning themselves both with the distribution and exploitation of natural resources in the urban context as well as the process of urbanization itself, the spatial, demographic, and social changes that occur as cities grow and change. As opposed to the environmental justice movement, embedded in a Rawlsian notion of distributive justice, urban political ecology has thus far been articulated as an extension of Marxist political ecology which maintains that uneven geographical and social conditions are the product of the capitalist forms of social organization of natural resources and resource flows (Heynen et al., 2006; Swyngedouw & Heynen, 2003). The small literature that urban political ecology comprises focuses exclusively on the capitalist city and how "the material conditions that comprise urban

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[31] This approach to cities has been rapidly and systematically dismantled in the past 10-20 years, as discourses on sustainability, resilience, landscape urbanism, etc. have reached something of a high water mark in planning and urban studies, as well as in academia, government, and the popular press writ-large. In particular, the popularity of the sustainability discourse and widespread concern with global climate change signals that the environment and management of environmental risk will be a key intellectual and political framing device for many years to come (Peet & Watts, 2004).

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environments are controlled, manipulated, and serve the interests of the elite at the expense of marginalized communities" (Heynen et al., 2006, p. 7). Focusing on uneven geographical processes in the production of urban environments is a way of contextualizing broader trends in socio-ecological urbanization (Harvey, 2006).

Unpacking Urbanization: The Accumulation of Disaster Risk

The PAR model is useful not just because of how it operationalizes vulnerability but because it is embedded in a larger body of work on urban political ecology, which allows us to link discussions of disaster risk with larger discourses on uneven spatial development in cities. With its roots in the traditions of political ecology, the PAR model is an appropriate lens through which to view the processes by which uneven geographies of risk and vulnerability emerge in cities like Kolkata.

One weakness in the PAR model is the undertheorized nature of urbanization processes. Wisner et al. describe rapid urbanization as a dynamic pressure that produces specific unsafe outcomes at the local level, but their treatment of urbanization is limited to understanding the in-migration process as one by which rural migrants move to overcrowded cities and are forced to occupy unsafe land, construct unsafe buildings, and/or work in unsafe environments. While this characterization captures one important dynamic of urbanization, I argue that it is far too narrow an understanding to fully explicate the urbanization process as a dynamic pressure affecting household and community vulnerability.[32] The

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[32] Current processes on migration are seeing significant shifts. Montgomery (2008) points out that contrary to the long-held belief that urbanization in poor countries is driven by migration from rural areas, upwards of 60 percent of urban growth in Asian, Africa, and Latin America can be ascribed to natural urban growth (the difference between urban birth and death rates) (Montgomery, 2008). This finding seems to hold true in my own research

trajectory and character of city growth is also mediated by governance institutions

like urban planning, which through their actions (or inaction) leave some groups of

citizens more vulnerable than others. That is, institutions like planning shape

urbanization, which in turn shapes geographies of disaster risk.

What makes cities unique sites for disasters? The answers to this question

are complex and myriad, and there is much about the dynamics of urban risk that

we do not know. Urbanization channels root causes of vulnerability into unsafe

conditions at the micro scale in a number of different ways. As this analysis of

vulnerability at different scales in Salt Lake will show, vulnerability is not a static

characteristic of urban populations but a condition that is intimately tied to the

pattern and character of city growth over time. That is, vulnerability refers to a long-

term process that includes "ongoing, chronic, underlying conditions" that lead to an

observed state (Kelman, 2009; Lewis, 1999; Oliver-Smith, 2010; Oliver-Smith,

1986). The conditions that are particular to cities range from population growth and

concentrations of economic activity to poverty and informality.[33]

Most important and perhaps most obvious is the rapid population growth in

cities, the details of which I provided earlier. Because many cities are located in

unsafe locations and are often exposed to multiple types of environmental hazards,

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in Kolkata, where most slum dwellers surveyed were born in the city rather than a rural
area or different state/country (see Chapter 6). So while Kolkata's growth over the past 50
years has been punctuated by periods of mass migrations, urbanization is an ongoing
process, and much of the current growth is due to natural growth.

[33] There is a small but growing literature on urban risk reduction in India, especially related
to flooding and climate change (e.g. Dahiya, 2003; Kilby, 2008; Nath, Roy, & Thingbaijam,
2008). Very few studies, however, have described either the uneven geographies of disaster
risk in Indian cities, or shown the linkages between historic institutions and processes and
the shape of contemporary urban vulnerabilities. There is also a significant body of work on
the role of globalization in migration, a process that I did not see as much in my work.

population growth places a larger number of people at-risk. Beyond this simple demographic explanation there are other important ways that population growth may drive vulnerability. Even in hazardous geographies, urban populations tend to settle first on the safest locations until land becomes too expensive or too crowded to support further growth. Only then do cities begin to expand into less safe areas like flood plains. As populations expand and cities grow, there is an ongoing and rapid transformation of both the urban and natural environment, which may alter the character, frequency, severity, or exposure characteristics of hazards. For example, in the past 50 years, deltaic cities like New Orleans and Kolkata have begun to encroach on wetlands and alluvial forests that traditionally act as buffers against hurricanes (cyclones) and associated storm surges. Such changes may quickly outpace traditional knowledge about the behavior of hazards and best approaches to mitigation. Finally, population growth may also outstrip a city's capacity to plan and provide infrastructure, especially in impoverished cities and communities. Once communities are settled in un-serviced or under-serviced settlements, it becomes much more difficult and expensive to provide the basic infrastructure and enforce the legal frameworks necessary for reducing disaster risk, such as drainage and building codes (Green, 2008).

Second, deep poverty is the most obvious condition that sets apart many cities especially in the global South and it tends to cut across and inform most other factors that contribute to vulnerability. There is a vast literature on urban poverty in the global South and a growing literature on the risks posed to the urban poor by environmental hazards (e.g. Amis, 1995; Benjamin, 2000; Rashid, 2000; Roy, 2003a;

Kudva & Beneria, 2005; Satterthwaite, 2001; Beall & Fox, 2007; Unger & Riley, 2007; Hardoy & Pandiella, 2009; Pandiella, 2009). Poverty, of course, is endemic in many cities of the global North as well, especially if we expand the scope of the term to include non-monetary factors like powerlessness and humiliation (Chambers, 1995). But few instances of material poverty in North America or Europe can match the levels of human deprivation produced in urban slums in Asia and Africa (Davis, 2004; UN-Habitat, 2003).

Poverty cuts across nearly every variable that contributes to vulnerability. Lack of financial resources constrains choices with respect to housing and housing location, healthcare, basic services, transportation, risk reduction activities (like stockpiling food, purchasing insurance, or evacuating ahead of hazard events), and so on. For local and state governments, poverty often implies resource constraints and diminished capacity. In Kolkata, for example, planners at the KMDA and KMC have defended their work by pointing out that development resources are inadequate for maintaining current dilapidated infrastructure, much less for providing new infrastructure for a rapidly expanding population; this position is not without its critics, of course (Basu, 1990; Bhattacharyya, 2010; Chaudhuri, 2010; KMDA, 2005; Racine, 1990). At a basic level, poverty challenges planning and planning interventions because it tends to focus development on the short-term, day-to-day basic needs of communities; in an environment of pressing needs and limited resources, it is more difficult for planners to advocate for long-term, structural approaches to environmental problems. While poverty is crucially important to our understanding of disaster risk and can amplify other

socioeconomic and physical characteristics that correlate with vulnerability, poverty and vulnerability are not entirely synonymous.

Third, informality in housing and the economy is a central feature of urbanization in the South. Globally, the numbers are staggering. The UN estimates that in 2001, more than 32 percent of the global urban population (924 million) lived in slums, urban settlements characterized by lack of basic services, insecurity of tenure, overcrowding, and inadequate housing, and/or locations on hazardous land. In major Indian cities slums house more than 40 percent of the urban population and represent some of the most at-risk communities in South Asia. Left unchecked, there will be more than two billion people living in slums by 2030, including several hundred million in India alone (UN-Habitat, 2003, p. XXV).

The informal economy, where work is neither protected nor regulated, is also central to the functioning of the Southern city. Broadly defined, the informal economy employs somewhere in the neighborhood of 80 percent of non-agricultural workers in Sub-Saharan Africa (when South Africa is excluded), 65 percent in Asia and 60 percent in Latin America (Becker, 2004). While studies of informality are typically separated into traditions that look at housing and the economy separately, in reality the "everyday lived experience of informality vitiates this separation" (Kudva, 2009).

Whereas earlier studies of informality assumed that Southern cities would follow the development trajectories of their Northern counterparts and eventually absorb informal settlements and work into the formal sectors, it seems clear now that informality is a core feature of contemporary urban growth in the South (Hart,

1973; Kudva & Beneria, 2005; Roy, 2005). Informality drives vulnerability in many important ways.

There is a growing literature that examines the risks posed to slum dwellers, many of whom live in precarious housing with only limited access to the infrastructure, services, and legal rights that promote resilience in formal settlements (e.g. Rashid, 2000; Hardoy, Mitlin, & Satterthwaite, 2001; Pelling, Maskrev, Ruiz, & Hall, 2004; Davis, 2006; Nchito, 2007; Murray, 2009). Slums are often located on marginal land that is frequently exposed to environmental hazards, like flood plains, canal banks, near train tracks and other transportation infrastructure, on garbage dumps, or on steep hillsides (Davis, 2006, pp. 123-128; Shatkin, 2004). The location of slums is often tied to income opportunities nearby, making vacant land of any sort a prime target for settlement. Without legal tenure and with the ever-present threat of eviction, many slum households do not invest their limited resources in making improvements that would make their home more hazard resistant, like using permanent building materials or self-improving nearby infrastructure (Werlin, 1999). While such studies are important for understanding the unsafe conditions prevalent in many slums, few have looked at the processes by which slums are established and grow. That is, we know more about the vulnerability of slum dwellers in-situ than we do about the dynamics of slum growth over time. This may be satisfactory for reducing risk among slum dwellers today, but limits us in our ability to plan for future unsafe development.

Studies that link informal work and disaster vulnerability are relatively limited and mostly center on informality as an indication of poverty and precarious

livelihood strategies, or on the lack of social safety nets inherent in casual work (Amis, 1995; Hardoy & Pandiella, 2009; Pelling, 2003). There is also a limited amount of research on how the nature of informal work itself can shape risk. For example, Pelling (2003) describes a landslide in the Philippines in 2000 that killed more than 300 people; the landslide itself was not made of mud or rocks, but rather garbage from a massive dump. The victims were inhabitants of a slum that had grown up on top of the dump, where residents earned their livelihoods as ragpickers, by sorting through refuse (Pelling, 2003, pp. 4-5). Hardoy and Satterthwaite (1991) describe similar linkages between informal work and environmental hazards. There is a need to further explicate the connections between informal work and unsafe conditions at the time of hazard events, and further, to look closely at the spatial development patterns that characterize urban economies with strong informal sectors.

Fifth, many cities in the South were founded or were occupied by colonial rulers and underwent a form of urban development that continues to influence the spatial structure, social organization, and governance of those spaces today. As King (1976) describes it, the colonial city is a "non-Western city resulting from contact with Western industrial colonialism;" colonialism is the establishment and maintenance, for an extended period of time, of rule over an alien people that is separate and subordinate to the ruling power (p. 18). As Kudva (2009) describes it, one thread of the colonial cities literature looks at the settlement, planning, and regulation of colonial urban spaces, while another focuses on the "production of particular built forms" like jute mills and associated workers housing in Kolkata (de

Haan, 1994; Chakravorty, 1996; Beattie, 2003; Chakravorty, 2005; Gooptu, 2005; Chattopadhyay, 2006; Legg, 2006; McFarlane, 2008; Kudva, 2009; Sundaram, 2010). There are clear linkages between the dynamics of colonial urban development and the production and geography of disaster risk in contemporary colonial cities. For example, informal housing in a city like Kolkata is not simply a reflection of a formal housing market that is unable to absorb the rapidly growing population, but rather a continuation of the deeply segregated spatial patterns of the colonial urban development process; the spaces where the colonial rulers once lived are now home to the urban elite, while the poor continue to occupy less desirable land with poor infrastructure and amenities (Gooptu, 2001; Davis, 2006). I will give further attention to the connections between colonialism, planning, and disaster risk in the next chapter.

Fifth, urbanization is not an organic process. It is shaped and conditioned, in part, by various economic, political, and social forces manifested in governance institutions like planning. Different groups have radically different abilities to make claims on and shape those institutions and as a result, urban development tends to be extremely uneven, especially in market economies (Sassen, 1991; Shatkin, 2004). This unevenness is evident in the social inequalities embedded in the spatial segregation between various groups. One of the institutions that is often central to shaping urban outcomes is planning. When urban planning is discussed in the disaster studies literature, especially in reference to the South, what is often described is the absence of planning (unchecked sprawl on the urban periphery) or planning practices that are "inappropriate" for reducing disaster impacts, like the

reconstruction of a disaster-affected community to the same standards it was pre-disaster (Burby et al., 1999; Pelling, 2003; Wamsler, 2006; Wisner, 2004a). What is rarely noted is how planning itself helps shape disaster risk, not as a weak or toothless institution but as a powerful tool wielded by urban elites to shape urban outcomes to their best interests. Just as urban development tends to be highly uneven, so too are the geographies of risk in Southern cities; further work needs to be done describing how these outcomes are interrelated.

Finally, many governments in the Global South emphasize disaster response rather than mitigation and risk reduction. This plays out in the urban context through a lack of appropriate planning, weak disaster management institutions, and few, if any, resources for risk reduction activities. In poor cities, disaster risk reduction tends to fall further down the list of prioritized concerns, given the widespread and pressing issues of poverty, informality, and environmental degradation. Fortunately, the emphasis is beginning to shift as researchers and international institutions like the UN and World Bank and non-governmental organizations have begun to recognize the linkages between disasters and development (Benson, Twigg, & Rossetto, 2007; Sanderson, 2000; Schipper & Pelling, 2006; Twigg, 2005; United Nations Human Settlements Programme, 2009; Wamsler, 2006; e.g. World Bank, 2010). Urban policy recommendations like those coming from the Cities Alliance and the United Nations International Strategy for Disaster Reduction (UN-ISDR) focus largely on resource allocation and appropriate planning mechanisms for disaster management activities, but thus far the results have been highly uneven at the local level (Global Network, 2009).

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A Typology of Urban Hazards: The Everyday, Episodic, and Catastrophic

In its original formulation, the PAR model emphasized natural hazards (see Figure 2.1). In reality, however, urban populations are at-risk from a wide variety of both man-made and natural hazards, which often interact and may occur at variety of different scales. Within cities, different groups have varying levels of vulnerability to hazards *as well as* different levels of exposure to them. Hence, geographies of urban risk tend to be highly uneven. In order for the PAR framework to explain how urbanization in the global South creates uneven geographies of risk at the local level, then, it needs to incorporate the full range environmental hazards that threaten urban populations. In the following section, I propose a simple typology of hazards that includes the full range of everyday, episodic, and catastrophic events that impact cities like Kolkata.

Central to any vulnerability framework, including the PAR, is the separation of incident from crisis; while a hazard event may trigger a disaster, it only does so when it comes into contact with a vulnerable population. While this is no great intellectual leap, it does break from common conventions. As Gilbert (1995) notes, it is easier for most people to say that a tornado destroyed a community than to say that the risks and vulnerabilities of a community were revealed during an extreme wind event (pp. 232-233).

Disaster, then, is a relative term; what constitutes a disaster varies significantly depending on the observer. In the news media and in popular discourse, disaster is usually shorthand for a natural or man-made hazard and its

immediate aftermath, isolated events characterized by spectacular natural phenomenon and widespread destruction: The Tohoku earthquake, the Bhopal industrial disaster, Hurricane Katrina, and so on. Television and print media reinforce this understanding, lending widespread coverage to sudden and catastrophic events that have the "capacity to astonish" (IFRC, 2005, p. 127). Yet, slow onset environmental disasters, like droughts or sea-level rise, cause significant damage but generally escape the news media and public's attentions (Middleton, 1998).[34]

For many scholars working in natural hazards research and emergency management, "disaster" marks the outcome of a hazard event reaching some threshold of impact on humans or human settlements. Cutter (2009), for example, defines disasters as "singular larger scale events that overwhelm local capacity" (p. 2). The International Disasters Database considers disasters as events where one or more of the following criteria are met: ten or more people are killed, one hundred or more people are affected, a state of emergency is declared, or there is a call for international assistance.[35] The main strength of threshold approaches is that there is a clear delineation between environmental problems, which routinely affect human health and well being, and disasters, a distinct category of events that have larger impacts. If every environmental hazard event that causes physical, economic, or social harm is counted as a disaster, the category itself may lose its analytical power and a distinct area of inquiry may be obscured.

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[34] For example, Wisner et al. (2004) show that meteorological, go-tectonic, and biological disasters accounted for less than 13% of reported disaster deaths from 1900-1990, while famine accounted for nearly 40% (Wisner, 2004a).
[35] See http://www.emdat.be/criteria-and-definition

The major drawback in this threshold approach is that it largely ignores small-scale events, those that have a relatively limited impact on individuals and households but have a large cumulative effect on communities and cities. These everyday hazards and disasters are prevalent in the cities of the global South and disproportionately impact low-income communities, especially the homeless and those living in slums and squatter settlements (Hardoy, J.E. & Satterthwaite, D., 1991; Hewitt, 1997; Bull-Kamanga et al., 2003; Davis, 2006). Because these highly localized hazards fall below the threshold for accounting and often occur in communities where reporting mechanisms are weak or non-existent, they often trigger "hidden disasters" that fail to appear in the international disaster data, which, in turn, underestimate the impact of environmental hazards on the urban poor.

By focusing on events that exceed minimum thresholds and tend to have broader impacts, urban hazards research runs the risk of ignoring small-scale events and obscuring the starkly uneven geographies of risk prevalent in most cities. That is, if managing disaster risk means reducing the number of medium and large scale disasters at a city scale, we can claim success even while small-scale disasters persistently and perniciously affect marginalized communities. The incentives for reducing risk are at the aggregate, which like most utilitarian approaches to management threatens to leave those at the margins worse-off. Not only do these everyday disasters have a deleterious effect on health and well-being, they play a role in the shaping the outcomes of larger disaster events (Bull-Kamanga et al., 2003).

We need an approach to understanding disaster that takes into account the full range environmental hazards that potentially impact urban communities. I propose a simple typology that takes into account the frequency, scale, and impact of hazard (Table 2.1).

Four characteristics of the typology are worth discussing. First, it is relative. How hazard events are categorized will depend largely on the scale at which it is deployed. For example, a flood that inundates an entire slum is catastrophic at the scale of the community, but possibly everyday when considered at the scale of the city. The relativity of the typology tends to work in this one direction - a catastrophic event at the scale of a city would rarely be anything less for a neighborhood, because neighborhoods tend to rely upon the economy, infrastructure, and institutions of the city in which it is embedded. At the same time, few events in history could be described as catastrophic at the global scale, save for some worldwide pandemics that have claimed significant portions of the global population. Second, the categories are necessarily fluid at the edges; what distinguishes an everyday from an episodic event is not an absolute measure, but rather is characterized by the context from within which the typology is deployed.

Table 2.1: Typology of hazards at the city scale

	Frequency	Scale & Exposure	Impact	Examples in Kolkata
Everyday	High probability, often caused by seasonal or routine events	Medium to large scale, although some may be of more limited scale (air pollution in some neighborhoods, for example)	Limited impact on people, property, or the environment	Monsoon rains; air, water, and noise pollution
Episodic	Medium probability, often caused by seasonal or routine events with unusual intensity or scale	Medium to large scale, most or all city residents are exposed	From limited to high impact, depending on the scale and severity of the event	Cyclone Aila; monsoon flooding (2000, 2001, 2008, 2011)
Catastrophic	Low probability	Large scale, generally affects entirety of city and beyond	Very high impact	Great Calcutta Cyclone (1865); famine (1943); monsoon floods (1978)

Third, there tends to be a direct relationship between the frequency and scale of an environmental hazard and the type of disaster it tends to produce; whereas routine hazards like monsoon rains occur with enough frequency and predictability that households have largely adapted to their effects, episodic and catastrophic disasters tend to be caused by less frequent and more severe hazard events. This is not always the case, however. For example, when multiple hazards impact a particular community over a period of time, they may have progressively greater impacts due to the increased vulnerability of affected households and communities. Finally, the typology does not distinguish between sudden and slow onset hazards, though this is a crucial distinction when thinking about public risk perception and policy responses (Cutter et al., 2009, p. 2). Whereas sudden onset events like floods and fires tend to appear quickly but last for relatively short periods of time, slow onset hazards like drought, sea-level rise, and water contamination tend to arise slowly and may be barely perceptible to the general public (Ibid). The negative impacts of slow onset hazards tend to accumulate over time and, unless mitigation or adaptation measures are taken, may eventually have widespread and devastating consequences.

In the next few pages, I explain each category of the typology in detail. I examine the categories using Kolkata as my point and scale of reference, and illustrate them using several of the city's past disaster events as examples.[36]

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[36] Kolkata is located in a tropical zone just north of the Tropic of Cancer and has three distinct seasons. Winter, or the cold season, lasts from mid-November until late February, and has an average daily temperatures of 20.4° Celsius (69° Fahrenheit)(Ghosh, 2005, pp. 45-46). The hot season, which begins in early March and lasts until mid-June, is warm and humid with average daily temperature of 31° C (88° F) and daytime highs reaching 38-42°C (100-108° F). The average humidity level during the hot season is 65-85%. The rainy season, or monsoon, begins usually in mid-June and lasts through September or early October. Average daily temperatures remain high

Everyday Hazards

First, *everyday* or *chronic hazards* are events that, when considered individually, tend to occur on a relatively limited scale or have relatively limited impact. Everyday hazards occur regularly and tend to be quite predictable. That is, they occur frequently enough that their geographies are relatively well understood. In Kolkata, examples include floods caused by pre-monsoon and monsoon rains, small fires in informal settlements and in older housing and commercial structures, noise, air, and water pollution, and others. Considered separately, these smaller environmental hazards cause relatively limited harm compared to larger events, or cause harm that is not easily quantified or measured (noise pollution, for example). Cumulatively, however, these everyday hazards carry enormous human, economic, and environmental costs, and represent an accumulation of risk with serious implications during larger hazard events (Bull-Kamanga et al., 2003).

The geography of disaster from everyday hazards is highly uneven and they tend to have the greatest impact on the urban poor, especially those living in slums, for several reasons. First, hazards that trigger everyday disasters tend to occur with frequency and regularity, and thus most households are able to adapt. For example, the monsoon rains in Kolkata routinely lead to flooding throughout the city. Because these floods are such predictable events, households and businesses are able to take simple measures to avoid harm; for example, many buildings have parking structures occupying the first floor, which

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during the monsoon season and relative humidity averages 80-85%. The city receives an average of 1600 mm (63") of rainfall per year. There is very little rainfall during the cold season, with monthly averages ranging between 5-31 millimeters (.2-1.2 inches). The average monthly rainfall rapidly increases towards the end of the hot season, as thunder and lightening storms called Nor'westers pass over the city. The vast majority of rainfall occurs during the monsoon, however; 82% (1316mm, or 51.8") of the yearly average falls from June-October.

allow floodwater to pass through without entering homes or businesses.[37] Another common adaptation measure for households at ground level is to leave the first several inches or feet of wall unfinished or free from plastering, so that minor floods do not ruin the walls. And, as expected, basements are nowhere to be found in low-lying cities like Kolkata. In many slums and squatter settlements, households cannot take even such minor adaptation measures. Most of the housing structures are built out of temporary materials and are usually one-story. Building features like elevated foundations are rare, because land-tenure is elusive and the settlements themselves are precarious, especially in squatter camps and newly established slums. Economic and social marginality also limits non-physical adaption measures. If a low-income household relies on daily wages to survive, it is unlikely that they would have the monetary resources to purchase insurance, stock up on food, water, and medical supplies, or take other adaptive actions. Second, everyday hazards are frequently mitigated by public infrastructure, like drains, covered sewers, and water treatment facilities. Slums, by definition, lack basic infrastructure that mitigates the impacts of chronic hazards. As such, much of the everyday environment should be construed as a hazard (Burton, Kates & White, 1993; Hardoy et al., 2001). Third, in the case of flooding, informal settlements are often found on marginal land that is used for the citywide management of hazards. In Kolkata, for example, slums are built along many of the city's drainage canals, where the drainage system deposits excess water during the rainy season.

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[37] Unless you are one of the domestic servants who tend to live in those parking structures, as drivers, guardsmen, maid servants often do. See Chapter 4.

Episodic Hazards

Second, *episodic* hazards are larger in scale and impact and often affect a larger segment of the population. These include unusually heavy monsoon rains, larger fires, and tropical storms, among others. For example, in the past 11 years Kolkata has seen widespread flooding in three different monsoons. In September of 1999, more than 35,000 people were rendered homeless and several were killed after several days of heavy rains deposited more than 330 mm of water in the city ("Rains Lash West Bengal," 1999). Most essential services in the city collapsed, including transportation, power, and communications ("Rain Strikes," 1999). Neighborhoods in the low-lying areas east and south of the core city were most affected; Lake Town, immediately north of Salt Lake, was still knee deep in water more than a week after the rains (Ghosh-Dastidar, 1999). In 2000, the city was again flooded, when the Hooghly breached its levees and inundated large parts of north and east Kolkata. Again, basic services were severely disrupted, and hundreds of thousands were left without safe drinking water for more than four days (Sarkar, 2000). The floodwaters reached all the way to the Kalighat Temple, the first time the famous landmark had flooded since 1978 (Gupta, 2000). In 2007, widespread flooding once again paralyzed the city, killing at least 11. Businesses, schools, and government offices were closed for more than five days, electricity and transportation services were severely disrupted, and an overflowing sewage system led to outbreaks of enteric disease ("Floods, Rising Death Toll," 2007; Majumdar, 2007).

Catastrophic Hazards

Finally, *catastrophic* hazards are characterized by their potential to cause widespread damage and suffering and overwhelm the capacity of most population groups

to cope. The disasters they trigger can cripple entire communities, cities, or regions, and in

a few cases (like the earthquake in Haiti in 2010), entire nations.[38] Catastrophic hazards

tend to be caused by low-probability, high impact events, those that are often least planned

for or that are most distant from the everyday experiences of city residents.[39]

Kolkatans are vulnerable to two types of catastrophic hazards. First, the monsoon

season occasionally brings huge volumes of precipitation to east India, which can cause

widespread and persistent flooding across the city, state, and region. In 1978, an

unprecedented monsoon rainfall caused catastrophic flooding across northern India.

Kolkata received 708 mm of rain from September 27th-29th, the heaviest recorded rain in

more than 100 years (Racine, 1990). Combined with tidal bores in an already-swollen

Hooghly River, the torrential rains overwhelmed the city's limited drainage infrastructure

and led to a complete inundation of the metropolitan area ("Calcutta Under Water," 1978).

The flood levels ranged from six inches near the natural levee of the riverbank to 10 feet in

the low-lying areas in the southwest and east. Chief Minister Jyoti Basu described the storm

as "catastrophic," a "natural calamity," and claimed that the flooding was the worst he had

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[38] Kolkata itself was nearly abandoned following a massive cyclone in 1737, a storm that wreaked havoc on the fledgling city. According to the General Letter from Bengal to the Court in December 1737, the storm "leveled most of the walls in the town, shattered and threw down many of the building and blew up the Bridges...the church steeple was overthrown. The storm also disrupted agricultural production in Bengal, which created famine conditions in the state for much of 1738. Following the storm, city officials feared that people would abandon Kolkata; the East India Company's administration went as far as to exempt city residents from ground rent and other taxes for much of the following year: "Inhabitant in as low and wretched condition by the Violent storm so that [we] remitted 'em part of the Arrears to prevent their Deserting of Towns" (quoted in Sen, 2000, p. 102).

[39] This is not always the case. Hurricane Katrina, which destroyed much of the city of New Orleans in 2005, made landfall as only a Category III storm and missed the city by at least 50 miles. It was not the "big one" that many had feared. The levee system was designed to withstand a more powerful storm but failed due to engineering faults and lack of maintenance. Several other hurricanes had threatened the city in the years prior to Katrina as well. In 2004, the approach of Hurricane Ivan prompted the evacuation of more than half of the city's residents.

seen in his lifetime ("Basu's Appeal," 1978). Large parts of the city were only navigable by boat, and the inability of busses, minis, and automobiles to ply the roads led to a complete work stoppage across the city ("A Second Coming," 1978). All major train lines leading into and out of the Calcutta were underwater, and track-switching circuitry were damaged, effectively cutting off the city from the region and country ("All Train Tracks," 1978; "No Rail Link," 1978). Critical utilities were also severely affected. Power plants, electrical infrastructure, and coal stocks were inundated, leading to blackouts across the state ("Power Situation Alarming," 1978). Telephone services were widely disrupted. Several of the city's largest hospitals were flooded, and were forced to turn away patients and flood victims ("Plight in City Hospitals," 1978). Ironically, the greatest crisis during the flood was a lack of potable water. Pumping stations and tubewells that provide drinking water to the city were under water, and large parts of the water supply were contaminated with overflow from drainage and outfall system, storm water mixed with sewage, industrial waste, and other hazardous materials ("Water Famine," 1978). By the third day of the flood, hundreds of thousands of people were lined up waiting for fresh water. On October 4th, a tidal bore caused the Hooghly River to break its banks, re-flooding large parts of the city ("Bore Floods Vast," 1978).

Bustees and slums seemed particularly hard-hit, though information on their experiences is relatively sparse. Newspaper reports from the southwestern parts of the city described chest deep water in bustees near Canal Circular Road, and more than 100,000 slum dweller stranded and in need of evacuation. After the storm had passed:

> ...the standing water was filthy. The half constructed roads turned into open gutters and the day's downpour sent water and human excreta from the gutters gushing in to the adjoining huts ("A Hell on Earth," 1978)

Outbreaks of gastro-enteritis and cholera were reported at many of the relief camps for Bangladeshi refugees that dotted the city; most of these camps were located in the low-lying areas of the eastern belt ("2000 Ailing in the City," 1978). All told, the flood of 1978 inundated more than 30,000 km^2 of land in West Bengal alone, killing several hundred people in Kolkata and injuring many thousands more. Given the paucity of information about the impacts on slums, these numbers surely underestimate the human costs, especially if we consider the health impacts that lasted for weeks and months after the storms.

Second, the city is at-risk from tropical cyclones, low-probability events that have the potential to cause widespread damage and loss of life. Cyclonic storms in the Bay of Bengal tend to "spin off" west and north towards Orissa and Bihar, or east towards Bangladesh, but the occasional storm will bear down directly on Kolkata. In 2009, Cyclone Aila missed the city by more than 200 miles, but still caused severe flooding, widespread tree loss, wind damage, and seriously disrupted regional transportation and trade ("Dazed by Aila," 2009; Kulkarni, 2009).

The last time a major cyclone directly struck the city was on October 5th, 1864. As is the case with many tropical storms that affect Kolkata, the Great Calcutta Cyclone came at the end of the rainy season, when the rivers were already swollen with water. The storm, now referred to as the Great Calcutta Cyclone, had wind speeds estimated at 140 miles per hour and created a storm surge of over 34 feet at Diamond Harbour. By the time the surge reached Kolkata it was still 26-28 feet and easily topped the banks of the Hooghly (Barrett, 2004; Gastrell & Blanford, 1866). The storm waters engulfed the city and nearby regions, creating a flood that extended for more than 8 miles from the river (*Papers Relating to the*

Cyclone, 1865). On October 6th, the day following the storm, Montague Massey wrote in his

diary that:

> It seemed at first sight as if the town had suffered from the effects of a bombardment. As I slowly wended my way along the various streets and across the Maidan, I was confronted on all sides with striking evidence of the frightful ruin that had overtaken the city.

Of particular concern to the British was the impact of the cyclone on shipping. Later in his

account, Massey describes the scene at the river:

> The sight that there greeted me was truly appalling and beggared description. Of the whole of that grand and superb array of vessels which had been seen the day before gracefully riding safely at their moorings…one alone was left, all of the others having been violently torn adrift and swept clean away to the four winds of heaven (quoted in Barrett, 2004, pp. 416-417).

According to The New York Times, more than 180 shipping vessels were severely damaged

or destroyed, causing "great excitement" at Lloyd's, the London based insurance company

("India, China, and Japan," 1864).

While the storm did considerable damage to European homes, businesses, and

churches, it devastated the makeshift huts that predominated the "Black Town" and nearby

colonial estates. By one count, 92 European dwellings were destroyed, compared to 89,440

"native" dwellings (Gastrell & Blanford, 1866). In a widely published British account of the

storm, the author describes the wind and water striking the town like a locomotive, and

that the "vast assemblage of native huts" were "of course all down" following the storm

("The Calcutta Cyclone," 1865; "The Recent Calcutta Cyclone," 1865). All told, the Great

Calcutta Cyclone killed at least 60,000 city residents, and probably many more, making it

one of the deadliest cyclones in the history of India and South Asia.

Kolkata is more at-risk today from cyclones than ever before; while the city has

been spared in several "near misses" in the past hundred years, the urban agglomeration

continues to grow further towards the low-lying areas in the flood plain. It is only a matter of time before it is struck again.

I would like to make a few additional comments about the utility of the typology as a whole for understanding the linkages between urbanization and disaster risk. When we broaden our view of hazards and disasters beyond single events and towards a longer time horizon, we see that there are clear linkages between everyday, episodic, and catastrophic events. Repeated small disasters may create cascades of vulnerability over time, an accumulation of risk that Robert Chambers refers to as the "ratchet effect" (Bull-Kamanga et al., 2003; Chambers, 1995). This is particularly evident among the poor, who often experience a "vicious circle" between disaster and poverty. Episodic or catastrophic disasters may impair households and communities to such a degree that they are newly at-risk from everyday hazards; a case in point is Haiti, where hundreds of thousands who were left homeless after the earthquake in 2010 now live in makeshift settlements and are far more vulnerable seasonal rains and minor flooding.

The scale at which we employ the typology is vitally important because the wider our scope of analysis, the greater the likelihood is that we will obscure the uneven impact of hazards on different groups of people. If our unit of analysis is the city, for example, classifying certain disasters as everyday or episodic obscures the potentially catastrophic impacts of those hazards on vulnerable communities. Comparing disasters at the national or international level further decreases our ability to observe the terrain of impacts on people and communities. For example, while regional or international studies of climate change often make comparisons between countries or between groupings of countries (e.g. developed, less developed, least developed), such analyses obscure the extremely uneven

impact of disasters on marginal group within those countries (e.g. McGranahan et al., 2007; O'Brien et al., 2004; Revi, 2008). The appropriate scale at which to study hazards and disasters will vary depending on the research questions at hand, but we should acknowledge the trade-offs as change our lens from local to global, or vice-versa.

Finally, including everyday events in a continuum of hazards contradicts the professional orthodoxy in urban development and disaster management. As Bull-Kamanga et al. (2003) describe, urban development specialists and organizations tend to concentrate on life-, health- or livelihood-threatening risks that are constantly present or common in the urban environment; and disaster specialists concentrate on life- or health-threatening risks from occasional or exceptional disaster events (p. 194). Many critical observers have pointed out that this is an arbitrary distinction, that disaster risk reduction should be "mainstreamed" into development practice, and development implications should be considered in disaster planning and recovery (Anderson & Woodrow, 1989; Benson et al., 2007; Cuny, 1983; Gopalakrishnan & Okada, 2007; Schipper & Pelling, 2006; Twigg, 2005). Doing so would help close the gap between "disaster people" and "development people" (Christoplos, Mitchell & Lilijelund, 2001; Wamsler, 2006).

In the following chapters, I use the PAR framework to explain how urbanization leads to uneven geographies of risk to everyday, episodic, and catastrophic hazards in Southern cities, with Kolkata as my case. I do so by following the "chain of explanation" of vulnerability, beginning with the underlying or "root" causes of colonial development and elite led planning and working towards unsafe conditions the local level (Wisner, 2004b, p. 52).

CHAPTER 3: COLONIAL DEVELOPMENT, PLANNING AND THE ROOTS OF DISASTER RISK

> Less than two centuries ago, the site of the present city of Calcutta presented the ordinary aspect of a rural district in the delta of Lower Bengal - a flat, rice-swamp interspersed with patches of jungle, with a few scattered villages on the river-bank. Few would have ventured to predict that here would shortly arise a 'City of Palaces'; that in spite of morasses, malaria, hurricanes, and the difficult navigation of a treacherous river, Calcutta would in the nineteenth century be an emporium of trade of the first magnitude, and Capital of an Empire in the East (CMDA, 1977, quoting the Report on the Census of Calcutta 1876).

Kolkata's past and future histories are intimately tied to its geography and climate, and especially to its river. It sits just 60 km (37 miles) upstream from the Bay of Bengal on the banks of the Hooghly, a 160-mile distributary of the mighty Ganges; the river forms the westernmost edge of the world's largest delta, the Ganges-Brahmaputra (or Sunderbans) Delta. The city is virtually surrounded on three sides by water, with the river to the west, the Bay of Bengal to the south, and a series of salt-water tidal lakes and low-lying wetlands to the east.[40] The Hooghly has been the source of vast riches and misery for the city's inhabitants. Along with Dhaka, Kolkata is the principal seaport in the region and has been a gateway for trade in eastern India for more than 300 years. At the height of its economic activity in the mid-19th century, Kolkata and its ports accounted for 65 percent of goods shipped in and out of India.

Kolkata's location has also made it one of the most hazard prone cities in Asia. Kolkata is a "typical riverine city surrounded by marshes, tidal creeks, mangrove swamps, and wetlands" (Ghosh, 1999, pp. 2-3). Its low-lying geography and tropical climate makes it prone to flooding during the monsoon season and tropical cyclones (hurricanes) originating in the Bay of Bengal are a constant and deadly threat. The effects of global

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[40] The Sunderbans, the world's largest mangrove forest, lie further to the east and south and is a natural buffer against the cyclonic storms originating in the Bay of Bengal.

climate change will likely make matters worse; the predicted rise in sea level rise and increased cyclonic storm activity will threaten large portions of the city's population (OECD, 2007; World Bank, 2010).

Of the many possible narratives of Kolkata's urban history, one of the most compelling is that of risk management: how the city's hazardous location shaped growth and how past planning and development decisions continue to influence geographies of risk today. In the following chapter I unpack this narrative, beginning with the arrival of the British. I concentrate on planning, one of the key urban governance institutions that shapes city growth over time. Prior to formal planning efforts, settlement patterns in Kolkata reflected the needs of the elite; landowner estates and colonial mansions surrounded by the thatch hutments of servants and the labouring class. Once formal planning commenced, it followed a similar logic, primarily benefitting the ruling classes while excluding the poor and the ruled. Given the city's geography and climate, the primary concerns for the various planning committees in early Kolkata were drainage, sanitation, and public health. The infrastructure investments they made, however, were largely in the European parts of the capital. Once the British departed, native elites continued these trends of exclusion and neglect. Today, planning is done largely for the middle and upper classes and fails to incorporate the needs of the informal sector, where the majority of the urban poor live and work. This is reflected in Kolkata's patterns of growth in the latter part of the 20th century and in its plans for eastwards growth over the next 30 years.

A City in the Swamp: Charnock's Landing

Most English language histories of Kolkata begin with Job Charnock, the chief agent of the East India Company in Bengal, "a block of rough British manhood," who landed on

banks of the Hooghly on August 24, 1690, after negotiating for a trading license with the

Mughal emperor Aurangzeb (Cotton, 1909; Dutta, 2003; Moorhouse, 1971). Charnock did

not technically found Kolkata; he and his men settled amidst a collection of three villages,

in an area that had been populated by humans for hundreds of years (Sen, 2000, p. 6). In all

practical respects, however, the modern city of Kolkata can trace its origins back to

Charnock's landing. As Sen (2000) describes it, "Calcutta was not the creation of the

English. But as a city it certainly was manufactured by them" (p. 45).[41]

Charnock and the East India Company were primarily interested in establishing a

defensible foothold for trade in Bengal. Charles Robert Wilson (1895) wrote:

> The experience of more than half a century had convinced the English that their
> trade in Bengal would never prosper without a fortified settlement at its centre. In
> 1686 they set about discovering a spot suitable for such fortification. After repeated
> trials Charnock came to the conclusion that the required spot was Sutanuti, and here
> out of deference to his views and in spite of much adverse criticism, the foundation-
> stone of the British Empire in India was at last laid. And Charnock chose not only
> deliberately, but wisely. Calcutta was the fit place for the English purpose from two
> distinct points of view. Not only was it strategically safe, but it was an excellent
> commercial center (p. 13).

Kolkata's location on the eastern side of the river was a key strategic advantage; in

order to attack the settlement, enemies would need to cross the Hooghly because the Bay of

Bengal and vast marshlands, jungles, and salt lakes afforded natural protective barriers to

the north, south, and east. The land around the village of Sutanuti, where Charnock

established a fort and factory, was slightly elevated and offered a clear vantage point and

firing position on ships advancing along the river. Sir Charles Stuart-Williams, Chairman of

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[41] The British were not the first Europeans to colonize portions of Bengal near where Kolkata now
stands; some of the city's present-day suburbs, like Chinsurah, Hooghly, and Chandernagore, were
already "thriving markets patronised by the Portuguese, the Dutch, and French" by the time Job
Charnock landed (Munsi, Sunil K., 1990). The Portuguese founded several settlements in the region
in the 16th century, including the Hooghly township in 1537, only 40 kilometers north of Kolkata.
The Dutch established a factory in Chinsurah in 1623.

the Port Trust in 1928, wrote in the Journal of the Royal Society of Arts that the 'site could

not be bettered' in terms of defense (Racine, 1990).

Kolkata's location on the Hooghly was also ideal for shipping and export. It offered the

best anchorage for sea-faring ships in the region, far enough upstream to protect them

from the rough winds and waters in the lower reaches of the delta. Kolkata's ports (and

later, railroads) connected the British Empire to the vast agricultural and mineral wealth of

the Indian hinterlands. Racine (1990) writes that: "From the beginning the city owes

everything to the river. The Hooghly represented an axis of penetration into the riches of

Bengal of the seventeenth century and beyond that into the heart of the Moghul Empire…"

(p. 27). Banerjee (1980) adds "the city was strategically located from the point of view of

British trade with the Far East and Australia as well as of the Ganga-Brahamputra basin

with abundance of paddy, saltpetre, salt, fine textile and indigo and later jute, tea, and

mineral wealth of Bengal, Bihar, and Orissa" (p. 90).

As ideal as the location was for commerce and defense, the climate and geography of

the region were incredibly hard on its early inhabitants:

> The surroundings, from the beginning, were hardly better. Ninety kilometers from
> the sea, Calcutta's riverbed is only six metres above sea level and nearby, very close
> to the river, the lowlands begin. These lowlands include marshes transformed into
> lakes by heavy rains, stagnant *bhils*, moribund streamlets no longer linked to the
> river, an unhealthy region where malaria and cholera killed masses of people up to
> the nineteenth century. Too much water, in this depressed, badly drained site in a
> metropolis still today inundated after each heavy monsoon shower (Racine, 1990, p.
> 63).

Captain Alexander Hamilton, a frequent visitor to the city in the 18th century, wrote, "a

more unhealthful place could not be chosen on all the river" (Deb, 1905). Calcutta was

"little better than an un-drained swamp, in the immediate vicinity of a malarias jungle"

(Busteed, 1904, pp. 157-159). Rudyard Kipling, the great cheerleader of British colonialism,

lent voice to Calcutta in "The Song of Cities," capturing the tension between the wealth and

misery that the river offered:

> Me the Sea-captain loved, the River built,
> Wealth sought and Kings adventured life to hold.
> Hail, England! I am Asia – power on silt,
> Death in my hands – but Gold! (Kipling & Washington, 2007)

Kolkata's geography and climate are typical of many deltaic river cities, as are its

struggles with flooding and hydrological hazards. The Hooghly's waters carry enormous

amounts of rich soil from the Himalayan Mountains to the north, and over the course of

thousands of years the deposition of silt built up the land where Kolkata now sits. There is

a narrow band of relatively high ground along the banks of the Hooghly, a natural levee

that extends 2-5 kilometers (1-3 miles) outwards, before the elevation drops off towards

the flood plain in the east. Charnock and the earliest settlers of Kolkata built on this natural

levee, choosing the eastern side of the river because it was more easily defended. What

they did not know, however, was that the geography of the larger region slopes downwards

from west to east and north to south, from the high banks of the river towards the wetlands

and marshes and, eventually, the Bay of Bengal. Charnock effectively founded Kolkata in a

flood plain and, with regards to environmental hazards, on the "wrong side" of the river.

Kolkata's twin city Howrah, which sits on the banks of the Hooghly opposite to Kolkata,

suffers from far fewer flood problems.[42]

The Early Colonial Period

From the late 17th to the mid-19th century, Kolkata grew from a small colonial fort and

trading outpost to the capital of the British Empire in India, one of the largest and most

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[42] The oldest parts of Kolkata, along the banks of the Hooghly and near Fort William and the
Maidan, are approximately 6 meters (18 feet) above mean sea level MSL, while newer suburbs
along the eastern and southern fringe lay as low as .25 meters (1 foot) above MSL (Sarkar, 2000).

economically vibrant cities in Asia. It was described as the citadel of the British in India and

a gateway from India to London and world at large (Munsi, 1990, p. 40). The earliest

decades of Kolkata's history were marked by military conflict, including the defeat of the

British at the hands of the Nawab of Bengal, Siraj ud-Daulah, in 1756. The British

recaptured Fort Williams and the city the following year, and with the defeat of Siraj ud-

Daulah's forces at the Battle of Plassey, effectively established the British East India

Company's control over most of Bengal. In 1773, during the administration of Lord North,

the supremacy of the Bengal presidency over Madras and Bombay was for the first time

recognized and Kolkata formally became the capital of British India (Ibid., p. 36).

From 1698 to 1901, the total land area of Kolkata grew from 1,861 to 20,547 acres,

while the population grew from several thousand to nearly a million:

Table 3.1: Kolkata's expansion, 1698-1921

Year	Area	Population	Source(s)
1698	1861 acres	....	Wilson, *Early Annals* I, p. 286
1746	5,472 bighas and 1/2 cottah	....	Holwell, *Tracts*, 3rd ed., p. 209
1762	6,057 bighas and 13 cottahs	....	Long, *Selections*, no. 581
1794	4,997 acres	....	A.K. Ray, *A Short History of Calcutta*, p. 58
1821	4,997 acres	179,917	Assessors estimate
1831	4,997 acres	187,081	Captain Steel's estimate
1837	4,997 acres	229,714	Captain Birch's estimate
1840	4,997 acres	361,369	Simm's estimate
1866	4,997 acres	377,921	Dowlean's Census
1876	5,037 acres	429,535	Beverley's Census
1881	5,037 acres	433,219	Census of 1881
1891	20,547 acres	681,560	Census of 1891
1901	20,547 acres	847,796	Census of 1901
1911	20,547 acres	896,067	Census of 1911
1921	20,547 acres	907,851	Census of 1921

Source: Nair, 1990

Kolkata, the "Queen of the East," was at the center of British India, a territory that stretched from modern-day Bangladesh to Pakistan. Three of the four largest mining, plantation and manufacturing industry agglomerations in colonial India were concentrated in East India, with Kolkata as their trading hub: jute, coal and tea (Goswami, 1990, p. 88). In 1856-1857, Bengal and Calcutta contributed more than 44% of total revenue in British India (Sinha, 1990, pp. 31-33). By the end of the 19th century, Kolkata and its nearby ports handled more than 50% of cargo moving in and out of country.

Kolkata was, at various times, called the Second City of the Empire, the City of Palaces, the City of Dreadful Nights, and The Black Hole of the Empire.[43] Its various monikers are evidence that the city has always been one of contradictory extremes; rich and poor, ruler and ruled, splendor and squalor. Kolkata was typical of colonial urban development, where investments in planning and infrastructure were extremely uneven between European residents and local populations (e.g. Zerah, 2008; King, 1976). The British areas of the city, or the "White Town," were as richly appointed as any European capital, resplendent with colonial mansions, wide, paved streets, and carefully kept gardens. The "Black Town," where the vast majority of Indians lived, was largely unplanned and un-serviced, and suffered from poor drainage, lack of sanitation, and generally abysmal living conditions.[44]

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[43] The Black Hole refers to an incident following the defeat of the British at the hands of the Nawab of Bengal, Siraj ud-Daulah in 1756. According to one prisoner's account, more than 120 British died from suffocation after being confined in a small room in Fort William. Modern historians believe that this number is greatly exaggerated (Macfarlane, 1975). In any event, "Black Hole" later took on additional meaning in the period following the Great Bengal famine and the Partition, when Kolkata was a worldwide symbol for poverty and dysfunction, a "metaphor for urban disaster" (Chattopadhyay, 2005, p. 3). For a fascinating lecture on the history of the Black Hole incident by Partha Chaterjee, see http://shc.stanford.edu/intellectual-life/video-podcasts/detail/black-hole-empire.

[44] Sen (2000) notes that other colonial centers developed in similar ways. He cites a description of Madras [Chennai] from 1813, describing the city as "divided into two parts, the Fort or White Town,

In terms of physical size and population, the Black Town was much larger than its European counterpart; compared to the "insignificant planned area," which was relatively well-serviced, "the larger part of the city suffered from open drains, seasonally flooded hutments, scarce supply of drinking water, and crowded trams" (Banerjee, 1980, p. 98).

Lord Valentia, after a visit to Kolkata in 1803, wrote:

> The town of Calcutta is at present well worth of being the seat of our Indian government, both from its size and from the magnificent buildings which decorate the part of it inhabited by Europeans...the Black Town is as complete a contrast to this as can be well conceived. Its streets are narrow and dirty, the houses of two stories, occasionally brick but generally mud and thatched, perfectly resembling the cabins of the poorest class in Ireland (Quoted in Sen, 2000, p. 15).

Sen (2000) places the dividing line at the Esplanade, arguing that it "became the imposed buffer that separated the residence of the rulers from the ghettos of the ruled" (p. 16). Yet the dividing lines between the Europeans and those they ruled was not as clear as Sen describes.[45] In 1766 a Mrs. Kindersley complained about the proximity of hutments to European dwellings:

> ...the appearance of the best houses is spoiled by the little straw huts, and such sort of incumbrances, which are built up by the servants for themselves to sleep in; so that all the English part of town, which is the largest, is a confusion of very superb and very shoddy houses, dead walls, straw huts, warehouses, and I know not what (Quoted in Chaterjee, 1990, p. 133).

As Munsi (1975) points out:

> Poverty and splendor lie so close to each other in Calcutta...slums were needed for the servicing of the mansions and their occupants, or how else could the rich get servants, cooks, darwans, chowkidars, cleaners, gardeners, dhobis and the rest? Labour was abundant and cheap and it paid to keep slums within the city, in fact nearer to the mansions (p. 111).

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and the Black Town..." (Sen, R., 2000). King (1976) documents similar development patterns in colonial Delhi.

[45] Chattopadhyay (2005) challenges the idea of the "dual city," arguing that racial divisions were "neither complete nor static" and that the everday use of space blurred the distinction between the various ethnic quarters of the city (see Chapter 2).

So, while the bulk of the Indian population were kept separate from the European quarters,

servant classes tended to reside on the estate of their employers or very nearby.[46]

Mukherjee (1990) argues that the houses of the White Town were "emblematic of the

British dominance" in Kolkata, and that the number of servants employed was indicative of

status. He relays an amusing account from 1775, where Alexander Acrabie, the Sherriff of

Calcutta describes the servants in his household:

> My own Establishment consists of a Sircar, a Broker and Interpreter, - a Jemmadar
> [steward, head servant] who stands at my Door, receives messages, announces
> Visitors, and also runs by the side of my palanquin to clear the way. I am preceded in
> all my Peregrinations by two Peons or running Footmen and as many Hircarahs
> [harkaras] or Messengers…Eight Bearers for my Palanquin complete my Train…Mr.
> Francis keeps five [horses] and according to the cursed fashion of this idle country,
> has ten fellows to look after them, besides a coachman to keep the whole in order.
> He has moreover twelve Palanquin Bearers, for no reason that I can learn except his
> being a Councillor – four Peons, four Hircarahs, two Chubdars [chobdars, staff
> bearers] who carry silver staves, two Jemmadars. These are without Doors – Within,
> a Head Sircar, or Banyan or Broker or Agent… . House keeping comprador and his
> mate go to market, two cooleys bring home what he buys – Consomar [khansama]
> takes charge of it. Cook and two Mates dress it. Baker in the house. Butler and
> assistant take charge of Liquor, Abdar and his Mate cool them. Two Side Board Men
> wait at Table. House – two Metrannes [sweeper-women] to clean it, two watchman
> to guard it, a Durwan to keep the Door. Tailor, Washermen and Ironing Man for each
> Person. Mashalgees, Torch Bearers of F[rancis] 4, M[acrabie] 2, L[ivins] 1, C[ollings]
> 1. We make a flaming funeral appearance. Two Mallies or Gardeners, Cow and
> poultry feeder and Pork man…

In total, Sherriff Acrabie and his household of four employed 110 servants, most of who

would have lived on the premises or nearby (pp. 46-48).

These logics of work and service dependency, and their resulting logics of settlement,

were not confined to the European parts of Kolkata (Chattopadhyay, 2005). Similar

patterns of work and settlement played out in the Native Town, where baro baris (big

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[46] There are interesting parallels between the logic of settlement of wealthy households and their
servants and the settlement patterns of migrant workers in the jute industry, who tend to live near
mills. See de Haan (1997) and Gooptu (2001).

houses) owned by wealthy zamindars and Bengali elite were edged by hutments housing

servants and domestic laborers. Baltazard Solvyns, a Dutch journeyman artist who

published a 12-part account of daily life in the Black Town in 1799, wrote:

> Besides their [balconies] use in keeping out the rays of the sun from the interior
> apartments, they serve as a place of repose to the indolent Hindoo, where he enjoys
> a cooler air and sleeps away the heat of the day, while his servants give a gentle
> motion to the air around him, with large fans called *pankas.* Here too he indulges in
> the phlegmatic pleasure of smoking the hooka and frequently receives his visits"
> (quoted in Hardgrave, 1990).

For its first 60 years or more, Kolkata developed haphazardly in this manner, largely

unplanned but for a few structuring elements including Fort William, markets and bazaars,

and major thoroughfares like Esplanade Avenue. There was, however, a clear logic of work

and service dependency; it was a city of staggering contrasts. In 1766, a Mrs. Kindersley

described the unplanned nature of the early city, White or Black:

> ...[Calcutta] is so irregular that it looks as if all the houses had been thrown up in the
> air, and fallen down again by accident as they now stand. People keep constantly
> building; and everyone who can procure a piece of ground to build a house upon,
> consults his own taste and convenience without any regard to the beauty or
> regularity of the town (Quoted in Chaterjee, 1990, p. 133).

Though taxes were levied on some businesses and residents, these revenues passed to the

coffers of the colonial administration - there was no institution or body that had the

interest or authority to provide municipal infrastructure, planning, or services (Sen, 2000).

According to M. Chatterjee (1990), "planned settlement was not a priority for either the

foreign traders or their native associates or beneficiaries; they viewed the city solely as a

place for commercial gain by the quickest means" (p. 133). The East India Company,

primarily concerned with maximizing revenue, was "oblivious to the necessities of public

expenditure" (*Britain in India,* 2006, p. Vii). And so large parts of Kolkata grew "filthy and

unhealthy" through much of the 18th century, while the city administration busied itself

mostly with the collection of ground rents and town duties (Sen, 2000). The zamindar, who was formally entrusted with municipal administration and had the formal authority to repair roads and drains, was given precious little resources to affect change.[47]

When disease spread beyond the Black Town and began to endanger the European portions of the city, the colonial administration took notice. British records show that in the mid-18th century, ship captains routinely lost more than 25% of their crews in Calcutta, owing to a range of communicable diseases including "night fog, scurvy, bilious fevers, colic, putrid fevers, and fluxes." A cholera epidemic struck in 1762, greatly affecting both the Indian and European populations; according to British records, more than 50,000 'blacks' and 800 Europeans perished (Ray, 1902, p. 149). Similar outbreaks of smallpox, cholera, and other enteric diseases garnered Kolkata the reputation as one of the least healthful cities in the empire.

Till the late 18th century, there had been no formal planning efforts in the city, beyond piecemeal investments in infrastructure and public works. Because early Kolkata was primarily a site for resource extraction and exploitation, a home for colonial rulers, transient sailors, footloose industrialists, soldiers, and Indians under colonial rule, it "turned out to be nobody's city - not of the administrators, the industrialists, the businessmen and even the common citizens" (Munsi, 1990, p. 17). More accurately, perhaps, was that it was everyone's city, but no one felt responsible for it. Certainly not the British, who ruled but were not invested in the well-being of the vast majority of the city's inhabitants.

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[47] The responsibility for municipal administration was transferred from the zamindar to the Justices of the Peace in 1793 (*Britain in India,* 2006).

While periodic edicts were issued with regards to the sanitary conditions in Kolkata, it was the Marquis of Wellesley, the Governor General of India from 1798-1805, who ushered in the first planning efforts in the city's history.[48] Wellesley was the first imperial Governor who imagined his role as more than the protector of commercial interests in Kolkata; commenting on the city's general state of disrepair, he argued that India should be ruled "from a palace, not from a country house" (M. Chatterjee, 1990, p. 134). In his Minutes of June 16, 1803, where Wellesley laid out the case an orderly development of Kolkata and laid the groundwork for planning and development in the city in the 19th century, the Governor honed in on the poor drainage conditions in the city:

> The defects of the climate of Calcutta during the latter part of the rainy seasons may, indeed, be ascribed in great measure to the state of the drains and the watercourse…in their present state, they neither answer the purpose of cleansing the Town nor of discharging the annual inundations occasioned by the rise of the river or by the excessive fall of rain during the South-West monsoon…the health of the town would be considerably improved by the improvement of the mode of drainage…improvements that would ameliorate the climate (*Calcutta Municipal Gazette,* 1945; *Britain in India,* 2006, pp. 10-12).

Thus, from the outset, planning in Kolkata has focused on overcoming the "natural deficiencies" of the city's environment, to manage the range of environmental hazards that caused harm to city residents.

As Anthony King argues, colonial cities were sites for the realization of technologies of power for the control of populations, of which planning was a prime example (King, 1976). The emergence of planning as a way to improve sanitary and environmental conditions in Kolkata mirrored similar trends in England.[49] In Kolkata, a central concern to manage the

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[48] For example, a charter issued by George III in 1793 mandated that the streets should be cleaned and repaired, "for the health, security, comfort and convenience of the inhabitants…" (Munsi, 1990, p. 47).
[49] There was a near constant circulation of architects, engineers, planners, and other officials

spread of disease from the "native" portions of the town where diseases were thought to originate to European quarters (Beattie, 2003).

The Start of Formal Planning - The Lottery Committee

The English residents of Kolkata were hostile to any proposal for increased taxes for civic improvements. In the late 18th century, a popular means for raising money for projects was the commission of lotteries; proceeds from such events funded town improvements and the construction of several of Kolkata's most famous imperial buildings.[50] In compliance with Wellesley's directives, the Town Improvement Committee was established in 1806. In lieu of raising taxes, however, the Town Improvement Committee instead sanctioned a series of lotteries, and thereby became known as the Lottery Committee (M. Chatterjee, 1990). The committee set out to reconstruct Kolkata into a "modern" town, one that would be "suitable for the long stay of Englishman" (Ray, 1902, p. 164-165). Over the course of 30 years, the Lottery Committee gave Kolkata its "first taste of town planning," in accordance with the trends in contemporary Europe (M. Chatterjee, 1990, p. 136). While the ambitions of the committee were often tempered by the availability of revenues, they did make significant investments. Of the many infrastructure improvements carried out, the most notable were the completion of a central north-south roadway that stretched the length of the city and included Cornwallis Street, College Street, and Wellington Street, improvements to the Maidan and a series of public tanks (pukurs) that served as park and recreation areas (Deb, 1905, 48). Besides new roads, which were built largely for purposes of trade, most of the other city improvements were confined to the European parts of town

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concerned with city management between Britain and Indian cities, not just Kolkata. See Chattopadhyay (2006) and McFarlane (2008a).

[50] Between 1806 and 1817, 17 lotteries were held in Kolkata (*Britain in India,* 2006, p. xi). Lottery funds were used to build such landmark buildings as the Town Hall and the Free School.

(Das, 2006). The Lottery Committee was dissolved in 1836 when its methods for fund-raising became unpopular in Britain. It was replaced soon after by the Fever Hospital Committee (Racine, 1990).

Fever Hospital Committee

The Fever Hospital and Municipal Improvements Committee was established in 1840, based on the recommendations of Sir James Ronald Martin, a surgeon and public health scholar. The Committee released its main report in 1847 and refuted a common view that by virtue of its location and climate, "Calcutta was beyond the aid of sanitary science" (M. Chatterjee, 1990, p. 138). Martin, like Wellesley before him, drew sharp distinctions between the "native" and European parts of the city, and acknowledged the geographical advantages of the British settlements, as they were "windward during the S.W. Monsoons" and less prone to climatic "accidents" (Martin, 1837, p. 18). Nevertheless, Martin drew connections between the sanitary conditions in the "native" settlements and the health of the European residents, as he and other health professionals believed that various germs travelled from the former to the latter via trade, transportation, and in the winds. In the context of scientific understanding of disease at that time, even projects like road widening were linked to health. Writing about improvements to the roads in the Black Town, Martin argued that street-widening would "effect the two greatest improvements of all as respects the salubrity of the city, free exposure to the sun, to rarify and elevate the vapours, and to the winds to dilute and dissipate them." The natives, he wrote, "have yet to learn…that the sweet sensations connected with cleanly habits and pure air, are some of the most precious gifts of civilization" (Beattie, 2003; Martin, 1837, pp. 23-24).

Like the Lottery Committee, the Fever Hospital Committee recognized that inadequate drainage was a central driver of adverse climatic conditions in the city and recommended that an underground drainage system be installed. Also like the Lottery Committee, the Fever Hospital report focused almost entirely on the improvement of drainage conditions in the British areas of the town. From the beginning, the objective of the Committee was to get rid of "endemic insanitation [sic]" that had become a constant threat to the health of the British residents and informed the Calcutta Corporation that "the death rate was maximum among the British and this was due to the undrained condition of the city" (Kundu, 1994, p. 2).

Despite these dire warnings from Lord Wellesley and the Fever Hospital, it wasn't until the late 19th century that the first underground drainage system was installed in Kolkata (Nath & Majumdar, 1990). The system was designed by William Clark, chief engineer of the Calcutta Corporation, and was built between 1860-1875, and was the first underground sewerage system in all of India (Banerjee, 1980). The Clark Scheme called for the installation of brick lined sewers beneath many of the city's major throughways, which carried sewage and storm water to pumping stations and eventually out of the city via drainage canals (Nath & Majumdar, 1990). The scheme was expanded to reach several European suburban areas between 1891-1906. In total, it brought 20 square miles of the city under sewerage, almost entirely in the central business and administration area and in the European suburbs (Kundu, 1994).[51]

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[51] Clark's brick-lined sewers are still the only underground drainage system in much of Kolkata today. Due to heavy siltation and the burdens of time, many parts of the system are virtually non-functional. Each year sections of the system collapse, causing cave-ins in many of the city's major streets (for recent examples, see Ganguly (2010) and "Road Caves in Near Raj Bhavan" (2010). Even light rains cause flooding through large portions of the city, because the sewers are only working at

The Calcutta Improvement Trust

Though notable improvements were made to the city based on recommendations from the various committees in the 19th century, they were not carried out according to an overall plan or long-term vision for the city. Goode (1916) wrote that improvements were made but that the "disjointed, irregular pattern which the growing town had taken on was not undone and rewoven according to a plan" (quoted in M. Chatterjee, 1990, p. 138).

Like most of the organized planning efforts that preceded it, the CIT came about largely in response to crisis; an outbreak of plague in the mid-1890's was the impetus for the Trust, though it wasn't until 1912 (after the British transferred the capital from Calcutta to Delhi) that it actually formed (Munsi, 1975; Rothschild, 1906).[52] The CIT was modeled on the experiences of the Bombay Improvement Act of 1898; the object was for the "improvement and expansion of Calcutta in an orderly manner" in areas related to "health, 'defective ventilation', conservancy, and the provision of building sites" (Chaterjee, 1990, p. 139). The CIT, under the leadership of E.P. Richards, produced the first planning document on Kolkata in 1914 (Richards, 1914). The plan recognized for the first time the importance of the Kolkata's suburbs and larger region in the healthy functioning of the city, and presented a more complete account of the deficiencies in housing in infrastructure across the entire city, in European and non-European areas (Chaterjee, 1990). Over the next 40 years, the CIT completed hundreds of projects, including the planning and

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20-30% of their capacity and the outfall channels they empty into are also heavily silted (KMDA, 2005; Nath & Majumdar, 1990). Currently there is a multi-crore effort underway to de-silt and repair portions of the sewerage system, by installing fiber-glass linings in the tunnels. This Jawaharlal Nehru National Urban Renewal Mission (JNNURM) funded project has faced several major delays, however, including an investigation of corruption in the tendering process.
[52] The Trust was formed based on the enactment of the Calcutta Improvement Act of 1911, which came into force on January 2nd, 1912 (Chaterjee, 1990).

development of several residential suburbs, including the present day neighborhoods of Southern Avenue and Dhakuria Lakes.[53] Like other planning efforts before it, however, the CIT was never able to marshal adequate resources to close the enormous infrastructure gap in the core city, or to keep pace with the rapid population growth in the KUA in the early 20th century.

Planning in Post-Independence Kolkata

By 1947, the year of Indian Independence from Great Britain, Kolkata and its twin city of Howrah had grown as a pair of linear cities, stretching 50 miles from Kalyani in the northwest to Uluberia in the southwest. Taken as a whole, Kolkata had "grown in spite of itself...haphazardly, unsystematically, without a suitable structure or coordination of the forces of growth" (CMDA, 1977, p. 14).

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[53] Though the Trust was made mostly irrelevant by the creation of the CMPO and was brought under the control of the Calcutta Municipal Development Authority (CMDA) in 1989, it still technically exists today. The KIT owns at least 11 market complexes, 3 auditoriums, a number of housing complexes, and employs more than 875 planners, engineers, and draftsmen. Over the years, however, the KMDA has taken over all core functions of the KIT, and funding has slowly been withdrawn by the state government (Chaterjee, 1990, p. 144; "KIT Dies a Natural Death," 2010).

Figure 3.1: Linear Growth in the KUA, 1793-1947
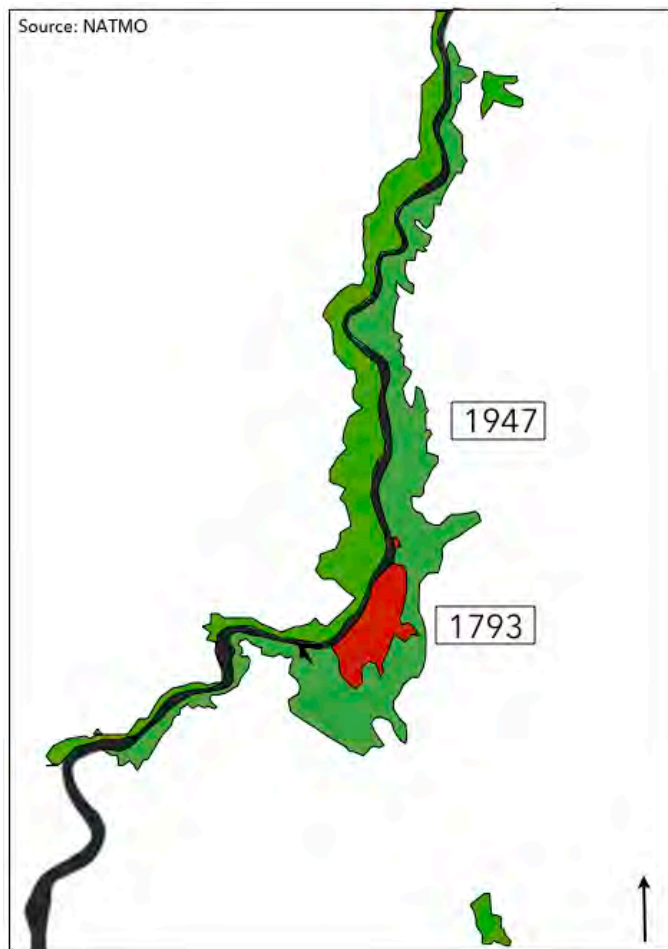
Source: NATMO; Geoeye 2010

Two factors were most important in shaping Kolkata's linear urban form. First, the major

industries in the city relied on easy access to the river. It was the best access point to the

deep-water ports further to the south, and to and from the vast hinterland of Bengal. Once

the jute industry began to transfer mills from England to Bengal in the late 19th and early

20th century, companies established a "chain of mills along both river banks, to take care of

water transport" (CMDA, 1977, p. 15). Major road and rail infrastructure, limited by the

same geography, largely followed routes close to and parallel to the river.

More important is the particular geography and climate of the region. Given that

Kolkata was established "precariously on the edge of a deltaic swamp," the best land for

development is alongside the river, on the natural levees that extend no further than two

miles in either direction (Murphey, 1964, p. 241). To the east are a series of marshes and

Salt Lakes, and to the south is the Bay of Bengal. Thus, by 1960, Kolkata's total population

of over six million was contained in an area of only 137 square miles.

Along with the transfer of the British capital to Delhi, 1912 also marked the beginning

of a long economic decline in Kolkata. Kolkata's decline, relative to the colonial period, can

be explained by a number of interrelated political, economic, environmental, and historical

factors (Racine, 1990). First, as the political center of gravity shifted from Kolkata to Delhi,

so too did the attendant benefits of being an imperial capital. More important, Kolkata was

the site of fierce, and often violent, nationalistic conflicts in the period leading up to and

following Independence. Second, the Freight Equalization Policy of 1956 standardized the

prices for coal, steel, cement, and other items nationwide, which destroyed West Bengal

and Kolkata's locational advantage with regards to natural resources and wholesale trading

(Chakravorty, 2005; World Bank, 2009, 257). Soon after, global demand for jute (burlap,)

one of West Bengal's most important export products, dried up, with devastating

consequences for the city and region. While tea, rice, coal, and iron ore still dominate the

regional economy, there were more than 100 jute mills employing tens of thousands of

laborers in the KUA at the time of partition, a number that has fallen by more than 50%

today (Goswami, 1990).[54] Kolkata's dominance in shipping was also diminished by the

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[54] According to the statistics published by the Office of the Jute Commissioner in the Ministry of
Textiles, Government of India. Retrieved online on December 12th, 2010 from
http://jutecomm.gov.in.

ongoing siltation of the Hooghly and her main port at Diamond Harbor, the same geologic

processes that formed the Gangetic Delta (the continuous transportation of rich alluvial

soils from the Himalayas to the plains below). The silting of the river required extensive

dredging that made ship borne transportation more expensive and hazardous, and as a

result, the center of trade slowly shifted from Kolkata to other ports in the East India.[55]

Third, Kolkata and Bengal went through several periods of crisis in the mid-20th

century. From 1943-1944, Bengal experienced one of the worst famines in human history

(for an overview, see Sen, 1983). More than three million persons died during the famine,

many on the streets of Kolkata, as waves of rural migrants came to the city searching for

food (Goswami, 1990). Communal riots between Hindus and Muslims rocked Kolkata in

August of 1946, with thousands left dead and many more injured (Markovits, 2007). Soon

after, in 1947, Britain announced plans for the partition of India, including the division of

Bengal into the India controlled, predominantly Hindu state of West Bengal and the

Pakistani controlled, predominantly Muslim state of East Bengal. For Kolkata, partition was

the "unkindest cut of all," as the city was "deprived of her resource region on the other side

of the new border" and as "millions of refugees poured in from erstwhile East Pakistan" (M.

Chatterjee, 1990 pp. 142-143). Racine describes the cruelty of the Bengal partition:

> Bengal and the delta are cut in two by an absurd and bloody border, an economical
> heresy. In 1947, more than 140,000 km[2], the major and most fertile part of the
> Delta, became foreign territory, and for nearly 25 years enemy territory. Whereas
> Calcutta lost an essential component of its hinterland and most of the jute fields
> which fed its factories, West Bengal bent, over the years, under the weight of
> 3,000,000 refugees, fleeing in the years between 1946 and 1956 from what had
> become East Pakistan, with a large number of them settling for good in the [Kolkata
> urban] agglomeration (Racine,1990, p. 56).

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[55] From 1950-1971, Kolkata's share of port traffic, measured In gross weight of cargo handled, fell
from 39.6% (1950-1951) to 11.5% (1970-1971) (Racine, 1990, p. 84). During the same period,
Kolkata also lost ground to Mumbai, Delhi, and Chennai as the centre of Indian finance.

Official estimates put the number of refugees to West Bengal between 1946 and 1961 at 3.3 million, with at least 1 million remaining in Kolkata permanently (CMDA, 1977, pp. 20-21 and Tables 19-20). The period leading up to, and following the Bangladesh Liberation War of 1971 saw upwards of 10 million more refugees take shelter in Kolkata and nearby suburbs, with another million staying permanently. During partition and after the Bangladesh war, the vast majority of these new migrants to the city settled in squalid squatter colonies and slums along the eastern fringes of the city, from Kalyani and Barrackpur in the north through Dumdum, Tollyganj, and down to Sonarpur in the south (P. Chatterjee, 1990, p. 27).[56] Kolkata was also then, as it continues to be today, the main catchment area for migrants from several adjacent and impoverished states, including Orissa, Bihar, and eastern Uttar Pradesh. With such an enormous flow of rural migrants into the city, soon slums and squatter settlements took up every piece of vacant land in the city and on its fringe.

While similar waves of migration (primarily Punjabi) and slum growth occurred in Delhi, migrant colonies there eventually flourished. In Kolkata, however, massive influxes of refugees combined with the severe economic downturn and tensions between various political and ethnic groups brought Kolkata to the point of civic collapse.[57] By 1951, the

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[56] Beginning in the mid-1960's, many refugees also settled in camps on the western edges of Howrah, across the river from Kolkata.

[57] It was during this period that Kolkata gained a reputation in India and around the world as an economic, social, and political basket case, and became a reference point for western descriptions of "3rd world cities," with all the negative connotations that label was meant to convey. Home to Mother Teresea's Missionaries of Charity, the city evoked (at least among some western observers) images of "multitude, misery, dilapidation, violence…Calcutta, an urban monster, a city of hell" (Racine, 1990, p. XXXXV). The French sociologist Claude Levi-Strauss visited Kolkata in the mid-1950's and said it was "the urban phenomenon, reduced to its ultimate expression, and derided the city as the "home of everything in the world worth hating" (Dutta, 2003). In 1968, the New York

population density of the Calcutta Metropolitan Area (CMA) was the highest in India. In the

104 km^2 area of the core city, there was an average density of 5,351 houses and 30,276

persons per km^2. In the most densely populated wards of North Kolkata, population

densities reached an unfathomable level of over 100,000 persons per km^2. This, despite the

fact that the city was largely made up of 1-4 story buildings, with very few high-rises.

Within the core city, the rapid increase in population drove new development to the lowest

lying and poorly drained areas along the eastern fringe, including Tangra, Topsia, and

Kasba, directly adjacent to the "pestilent marshes" of the Salt Lakes (CMDA, 1977, p. 16).

Growth was especially rapid in the outlying areas; from 1941-1951, the population

increased 47 percent in Barrackpur, 63 percent in Behala, and almost 120 percent in

Dumdum, compared to 20 percent in Kolkata (Goswami, 1990, pp. 92-93). The aging

infrastructure, already wholly inadequate for the majority of the city's population, was

unable to support the new demands placed on it. One of the most immediate and troubling

consequences of the city's rapid growth was the outbreak of disease, especially cholera, in

the slums and refugee camps in the 1950's.

In 1959, after tracing a worldwide outbreak of cholera back to Kolkata, the World

Health Organization (WHO) sent a research team led by Abe Wholman to evaluate the

situation (M. Chaterjee, 1990, p. 143). "There is hardly any aspect of community

development that is keeping pace with the growth of Calcutta's population or with the

migrants of its hinterlands," the team wrote in their 1960 report.

Times declared Kolkata to be "choking to death as a result of overcrowding and neglect" ("A Sinister
Urban Crisis," 1968). Later, in 1985, Rajiv Gandhi famously described Kolkata a "dying city," a
comment that sparked outrage in West Bengal and reinforced a stereotype that the city continues
to struggle to live down. As Banerjee (1990) so aptly puts it,"Perhaps no other city in India has
received so many epithets as those earned by Calcutta" (p. 351).

Overcrowding, degradation of housing, health hazards, primitive water supplies, lack of space for new industries, traffic bottlenecks, power shortages, a still unsolved refugee problem are all increasing the costs of moving goods and of providing the many services that a growing industrial region demands of its metropolis (WHO, 1960).

The WHO report, which "sounded the alarm" regarding the situation in Kolkata to the international community, recommended urgent steps to arrest the deterioration of the city, most especially in the areas of water, sanitation, and drainage (Kundu, 1994, p. 12). With the support of the U.S. based Ford Foundation, the government of West Bengal established the Calcutta Metropolitan Planning Organization (CMPO) in 1961, and signed an agreement with the WHO in 1962 to produce a master plan for rehabilitating and improving the water supply and sanitation systems in the city.[58]

The goals of the CMPO were lofty, centered not only on the immediate crisis but also on the long-term health of the city. According to the organization itself, in the CMPO:

...for the first time, the comprehensive technical skills of modern urban planning [were] brought to bear to determine the co-ordinated and systematic actions that [were] necessary both to provide emergency relief in situations of acute urban crisis arising from the inadequacy of services and facilities, and to lay the foundations for the long-term social and economic progress of the city and its immense hinterland (CMPO, 1966, p. 3).

Crucially, the CMPO recognized for the first time the scope of planning should extend beyond the core city and extend across the entire urban agglomeration, a 460 square mile area stretched lineally along the Hooghly that included 2 municipal corporations (Kolkata and Howrah), 33 municipalities, and 37 non-municipal urban areas (CMDA, 1977).

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[58] It is widely believed that the Ford Foundation was pressed into the service of West Bengal by President John F. Kennedy, who met with the Chief Minister of West Bengal and was warned that if Kolkata failed, east India might easily "go to the Communists" (Banerjee, 2009; see Racine, 1990, Appendix). This is an area of politics and planning I would like to explore in my future research.

In 1966, the CMPO published two planning documents of note. First was the Calcutta Metropolitan District (CMD) Plan for Urbanization, led by Ford Foundation consultant Allan Jacobs (Jacobs, 2011). The plan consciously took into account the historical development patterns in the city, specifically the entire linear agglomeration on both sides of the river, while proposing specific land-use patterns for future growth (M. Chaterjee, 1990). The Plan for Urbanization laid out in great detail a proposed future land-use plan for the city, along with proposals for investments in major roadway infrastructure (see Figure 3.2).

Later that same year, the CMPO published the Basic Development Plan (BDP) to much fanfare and international attention.[59] The BDP had a different vision than the Plan for Urbanization; instead of focusing on expansion along the entire lineal city, it proposed a more vague "two-centre" strategy for development. The plan called for growth around the Metropolitan Centre, comprised of the existing commercial and industrial cores in Kolkata and Howrah, as well as in the previously established but sparsely inhabited Kalyani Township, 40 kilometers (25 miles) to the north. The idea was to develop a series of "counter-magnet" cities at the edges of the urban agglomeration and in the larger region, with Kalyani-Banshberia as a "secondary core" to the over-crowded metropolitan centre. Eventually, central Kolkata and Kalyani would mark the poles of a "single transmetro city system."[60]

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[59] Banerjee (2009) writes that the plan was judged as a "major innovation in international planning" (p. 203).

[60] The plan also called for planning and development in the Asansol-Durgapur and Haldia areas, as regional counter-magnets to the KUA (CMDA, 1977, Map 4). Ultimately, the Kalyani development failed to achieve development as a viable secondary core. See Chapter 4.

Figure 3.2: CMD Plan for Urbanization (1966)
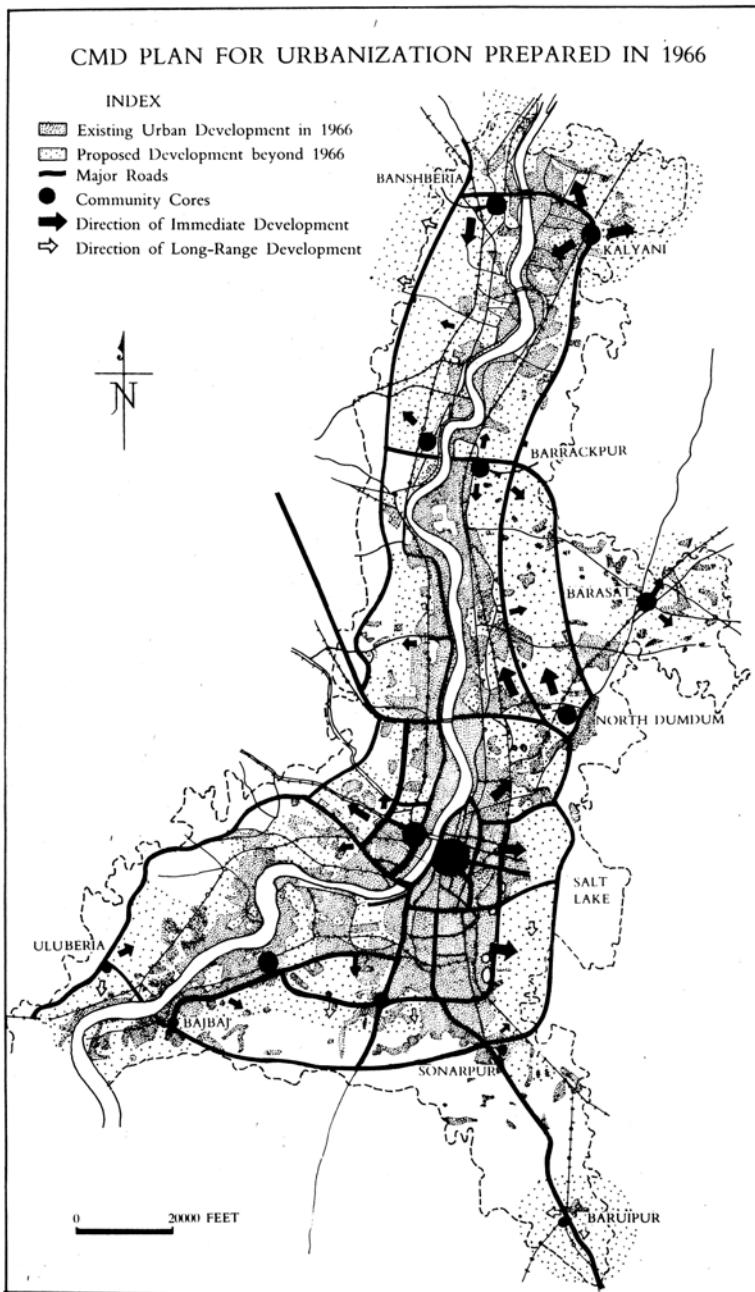
Source: M. Chatterjee, 1990

The differences between the Plan for Urbanization and the BDP were significant, and revealed serious disagreements between different members of the CMPO staff about what the proper development trajectory of the region should be. Whereas the Plan for

Urbanization offered up a distinct physical vision for the future city, the BDP was more of an economic and policy-based document that was a "blueprint for economic development" (Banerjee, 2009).

Figure 3.3: The Basic Development Plan's "Two Centre" Strategy
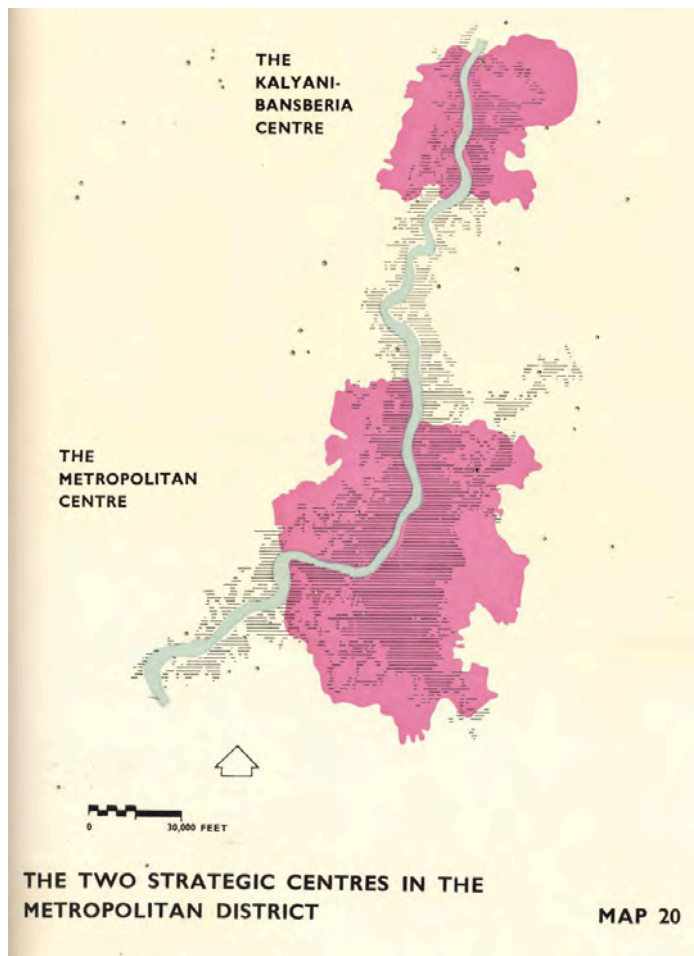
Source: BDP, 1966, Map 20

Both plans, however, supported key infrastructure investments, especially major roadways but also drainage and water supply, that would support an eastwards and westwards expansion of the linear cities (both Howrah and Kolkata), maintaining the basic form that had emerged along the river but guiding future growth outwards towards the

lower-lying marshlands and salt lakes to the east, west, and south of the existing urban

agglomeration.

Both plans also recognized the challenges posed by Kolkata's riverine geography; the

BDP observes the unique footprint of the KUA:

> The extreme lineal form of the conurbation presents a marked contrast to the forms of urban development found in many other river cities. In both London and Paris, for example, growth has tended to radiate outwards in all directions from a strong and long-established centre on the river. This has not happened in Calcutta, because of the confining and constricting nature of the topography (CMDA, 1977, p. 15).

Yet, the plan also touted the ability of "modern technology" to "overcome many of the

obstacles to development presented by Calcutta's physical situation":

> This has been amply demonstrated elsewhere in the world - notably in the Netherlands - and the Salt Lake Reclamation Project is already a major example of what can be achieved in the Metropolitan District (Ibid).

The BDP acknowledges that the physical geography of the region had constrained physical

growth:

> With the great increase in population over the past decades, the area of developed land has expanded, but very slowly. The physical limits of the two major cities, Calcutta and Howrah, have been forced outwards through acute population pressure and consequent increasing demand for space for residency and industry. *But, precisely because of the severe physical difficulties of developing in the low-lying lands on the fringes of the cities, and because of the absence of the systematic provision of transportation and utilities for new development areas, the physical expansion has not kept pace with the growth of the population. In the past forty years or so...population densities have increased dramatically in the core cities of Calcutta and Howrah, and in the CMD as a whole* (CMDA, 1977, p. 15; emphasis added).

Besides the obvious environmental and social challenges created by such extreme

population densities and land shortages, the BDP also argued that the lack of developable

land was "injurious to...economic growth" in the metropolitan region (CMDA, 1977, p. 17).

While the Plan for Urbanization was never fully incorporated into the BDP, and while

most of the economic and social plans and programs in the BDP were never implemented

due to a dearth of funds and statutory authority, the plans did help guide "systematic provision" of infrastructure to the areas on the eastern (and to a lesser extent, western) fringe of the region, including the Eastern Metropolitan Bypass, new drainage canals and covered sewers, and an expansion of the city's piped water supply system (S.K. Roy & K. Roy, 1990, p.282).

Given the CMPO's limitations as a statutory body, the Government of West Bengal decided to establish a body for centralized administration of [urban] investment programmes in the KUA. Accordingly, the Calcutta Metropolitan Development Authority (CMDA) was created in 1970 (Ibid., p. 284). The CMDA (renamed the Kolkata Municipal Development Authority, or KMDA, in 2001) became the "apex body for urban development and planning" in the CUA, a role that has only recently begun to diminish with the transfer of planning authority to municipalities following decentralization reforms in the early 1990's (M. Chaterjee, 1990).[61]

In 1976, the CMDA's Directorate of Planning published the Development Perspective Plan (DPP), based on Monidip Chaterjee's work at the CMPO. The DPP disposed of the "two-centre" strategy adopted by the BDP and instead proposed a polycentric growth strategy that would strive to achieve a balanced distribution of population across the entire urban agglomeration. Crucially, the Development Perspective Plan "emphasized the east-west spatial growth to be provided with road connections as well as river connections at several points" (S.K. Roy & K. Roy, 1990, p. 296). The CMDA published the *Perspective Plan and*

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[61] The West Bengal Municipal Act of 1993 gave municipalities the power and responsibility to impose taxes and fees, maintain roadways, drainage, and sewerage infrastructure, regulate buildings, and a host of other functions.

Action Programme for the CMD in 1981, further elaborating the infrastructure and investments needed for multi-centered growth.

No post-Independence plan for Kolkata have come to fruition in its entirety, whether due to lack of resources, lack of authority, the absence of political will, or the tendency of the real-estate industry to guide development , with planning struggling to play catch up (Kundu, 1994; Racine, 1990; S.K. Roy & K. Roy, 1990). Yet, several critical components of the post-Independence plans did get implemented, including the infrastructure necessary for east-west expansion. By 2001, the city had grown substantially into the lower-lying land to the east and west, areas that were geographically unsuitable for development just 50 years earlier (Figure 3.4).

In 2001, the population of the KUA was approximately 15 million. By 2050, it is expected to reach at least 30 million. In 2005, the KMDA published *Vision 2025*, the current perspective plan for managing this future growth (KMDA, 2005). By and large *Vision 2025* continues the trajectory of east-west development established in the BDP and DPP. It proposes another major highway, the Eastern Expressway, which would ring the city further east of the EMB. As the failure of the Kalyani project demonstrated, transportation linkages between the core and periphery are vitally important to promoting a polycentric development strategy. Besides the Eastern Expressway, *Vision 2025* also relies on the expansion of the underground railroad system (the Metro), which will eventually link downtown Kolkata with peripheral settlements in the eastern part of the city, including the Salt Lake and Rajarhat new town projects.

Figure 3.4: Spatial Growth in the KUA , 1793-2000
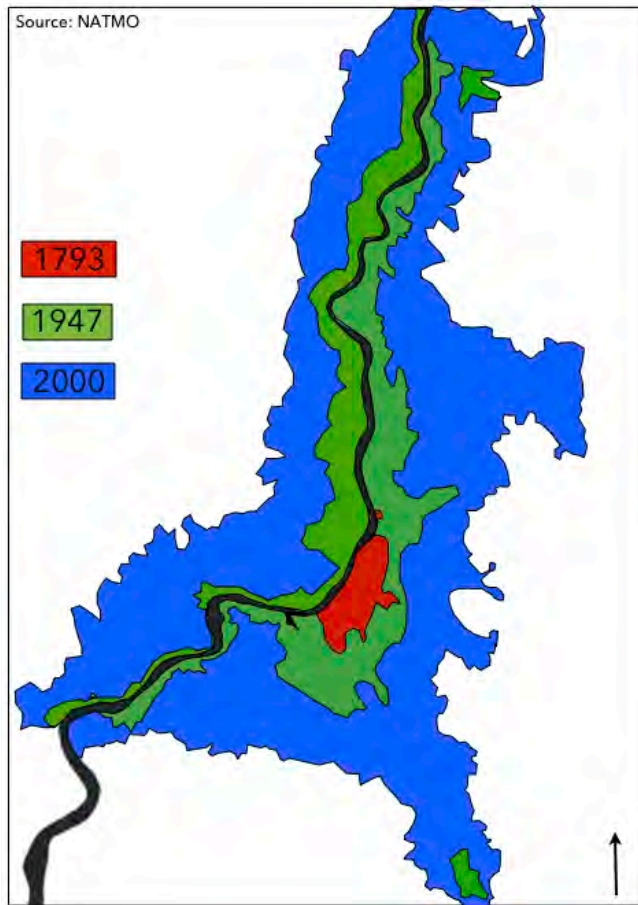
Sources: NATMO; Geoeye, 2010

The plan also calls for the construction of at least 15 new town projects as well as 4 new industrial centers in the urban periphery, further into the marshes, salt lakes, and regional flood plain:

Figure 3.5: Proposed new towns, industrial centers, and expressway infrastructures
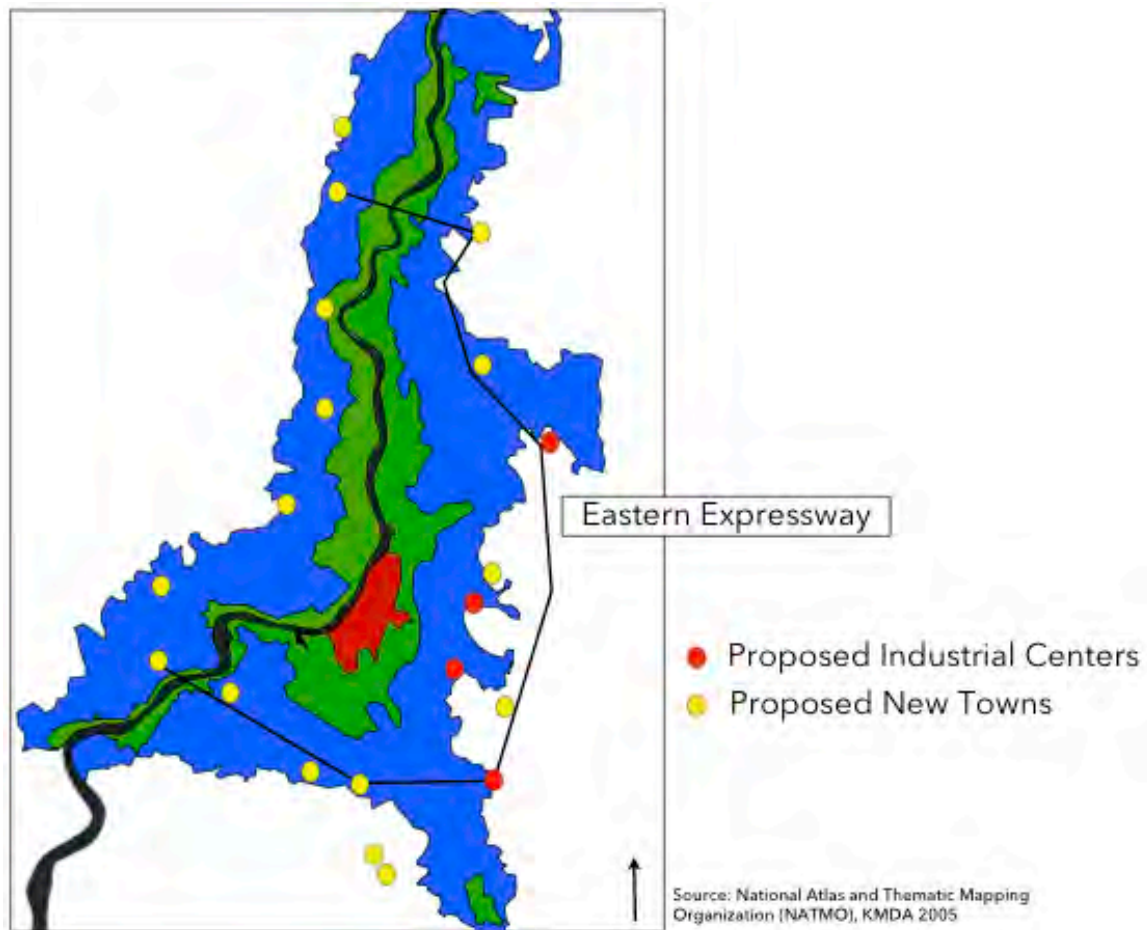
Sources: NATMO; KMDA, 2005

Kolkata and West Bengal have a relatively long history of new town planning. From

Kalyani and East Calcutta to Patuli and Salt Lake, new town projects have been a popular

form of development in the KUA since Independence. Yet, the *Vision 2025* plan represents

an acceleration in the pace and scale of new town development; the new town projects

proposed there will eventually house between 5-10 million people, many times more than

the previous projects combined. While they are just a part of the overall growth strategy

for the city, they are the central strategy for planned development in the urban periphery.[62]

Sanjoy Chakravorty describes them as the "most significant new spatial component of

Kolkata" (Chakravorty, 2005). Given their proposed location in the flood plain in the urban

periphery, the ways in which these new towns are planned and developed will play an

important role in shaping the future city. I will explore these questions in greater detail in

the following chapters by looking at the history and growth of Salt Lake, the only mature

new town project in Kolkata's eastern periphery.

Planning as a Root Cause of Disaster Risk

Like many colonial port cities, Kolkata was founded in a commercially advantageous

location that also happened to be one of the "least desirable or even repulsive urban sites

anywhere in the world" (Murphey, 1964, p. 242). Geography alone, however, does not

explain risk. I would like to end this chapter by highlighting three different ways that

planning shaped, and continues to shape, urbanization and geographies of risk in Kolkata.

First, and most important, planning has historically excluded the poor. In the colonial

city, planning was done primarily to protect the health and welfare of European residents

and their "supportive native compradore classes" (Kundu, 1994, p. 2). Even when planning

efforts were targeted towards lower classes, they generally benefitted the colonizers in

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[62] There are several reasons why new town projects tend to be built in the urban periphery, or why the urban periphery is attractive to real-estate developers and investors. First, due to population density and the high price of land, the cheapest and least controversial areas to assemble land are in rural or peri-urban areas, especially given the restrictions imposed by the Urban Land Ceiling Act of 1976. This is not to say that such projects are uncontroversial; witness the political uproar over the construction of the Patuli township and the assemblage of land in Nandigram for a major manufacturing plant. Second, even if land were available and affordable in the urban core, the law in West Bengal is extremely tenant-friendly and makes eviction difficult and expensive. There is also a widespread rent-stabilization law (the Rent Control Act) that keeps prices for many units in the city the same as they were in the 1950's, giving tenants enormous financial incentive to fight development . These kinds of things combine to help make greenfield development attractive to developers and investors (Racine, 1990).

some regard. For example, the city administration banned thatched roofs on *katcha* huts in 1837, to guard against fires. The impetus for the ban, however, was to reduce the risks posed to Europeans; fires in native huts were a distinct threat to the colonial mansions they tended to cluster around (Banerjee, 1990). The CIT represented a transition from planning for the benefit of colonial rulers to planning largely for the benefit of the wealthier classes. Whereas the main objective of civic improvement in the colonial period had been to secure improve the environmental conditions for Europeans, planning during the CIT period and post-independence, led by elite Indians and foreigners, largely focused on the needs of the middle and upper classes. Chakraborty (1990) points out that while the CIT did a "commendable service" improving the city for native Indians, in stark contrast to previous planning efforts, it did so in large part by expelling the poor among them, to clear room for development that largely benefited the middle and upper classes (Chakraborty, 1990, p. 2). For example, while the Trust created numerable schemes for constructing housing complexes for different occupational groups, it restricted its programs for the poor to the building of sanitary huts (latrines) (Mitra, 1990, p. 153). Without the construction of rehabilitation housing, many of the slum dwellers displaced by KIT projects were largely pushed to unoccupied, unserviced, and flood-prone land in the urban periphery.

Following independence, planning continued this pattern of exclusion, albeit in slightly different ways. Choudhury (1990) argues that planners and developers have struggled to eliminate the contrast between the original White and Black towns in the city, to "break through the tangled mass of unplanned growth to the north and east of the planned and fortified European settlement." The city's growth, they argue, has been hamstrung from the outset by the "basic contradiction of colonialism" (p. 157).

Contributing to this struggle is the socio-spatial reordering that occurred after the British left the city; this period largely saw a continuation of colonial era spatial development patterns, as middle and upper class Indians took over areas of the city that were formerly held by the British and Europeans, and low-income workers (especially migrants) took over the unplanned areas of the city (Chakravorty, 2005). Thus, the uneven development that once separated the White and Black towns now breaks along class, caste, and religious lines, and planning itself continues to work on behalf of the urban economic, political, and social elite.

This settlement logic is imbued in post-Independence planning and development as well. Contemporary plans, beginning with the BDP in 1966, tend to exclude the poor in two ways. Perhaps most common is the separation of poverty and informality from the main body of plans, relegating the needs of low-income groups to specialized development programs and treating those groups as separate from city itself. Examples abound: the Bustee Improvement Programmes that accompanied the BDP in 1966 and continued through much of the 1970's and 1980's (with financial support from the World Bank and the Asian Development Bank), the Calcutta Slum Improvement Programme, and the BMC Slum Infrastructure Improvement Plan, to name a few. These development programs tend to focus on the "weaker sections of society" by recommending investments in slum infrastructure, housing, or in land tenure agreements for low-income and migrant households.

The KMDA and other planning bodies also tend to focus on small and medium scale projects like Sector V, New Town Rajarhat, or Sunrise City (figure 3.6). Given the

ineffectiveness of city-wide plans like the BDP or Vision 2025, these smaller projects tend

to anchor trajectories of urban development.[63]

Figure 3.6: Layout Map for Sunrise City IT Park

Source: KMDA 2011

Over the course of my field research, I did not see a single small or medium scale

development plan that included housing or amenities for low-income workers, though they

are a vital part of a functioning economy in those places.

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[63] Based on my conversations with academics and officials outside of the various planning bodies, documents like Vision 2025 or the KMC's Kolkata Metropolitan Area development plan have little practical effect outside of spatial planning and infrastructure investment (as opposed to sections on economic development, historic preservation, and so on). Santosh Ghosh, the Exeutive Director of the Centre for Built Environment, told me "what they are doing is not planning. Have you read that plan [Vision 2025]? Different departments wrote those things and then stapled them together…one hand does not know what the other is doing" (Santosh Ghosh, personal communication, December 10th, 2009).

In either case, the poor continue to be excluded from planning. Separate development plans for slums and bustees, even when successful, deal only with growth that has already occurred, to try and remedy the failure of *past* plans to cope with informality; they do not anticipate the needs of the poor in future development. The same is true for spatial development plans that are concerned solely with the needs of those working and living in the formal sector, despite the wide range of vital jobs and services performed by "informals" (Bayat, 2004). As such, planners misunderstand the co-constitutive nature of formal and informal development, a topic I discuss extensively in the following chapters. The resulting logic of settlement, where the middle and upper classes live in planned settlements surrounded by slums or squatter camps that house the working poor, recreates colonial urban forms. Today, as before, Kolkata is a city of multi-storied buildings and squalid slums, of palaces and hovels (Munsi, 1990).

Second, planning in post-Independence Kolkata has played a central role in shaping the trajectory of urban growth into the flood plains to the east and west of the lineal core. As discussed in the BDP, up until Independence, Kolkata's spatial growth was largely constrained by the topography and climate of the region. For the first 250 years of its history, the "largest unplanned city in the world" hewed closely to the river, on the natural levee that represents the safest developable land in the region. Areas outside the linear sprawl, like the European suburbs to the south of metropolitan core, were made possible only because of the planning and infrastructure investments made there. Only with the advent of modern planning did the city begin to expand in to the floodplain that its population had historically avoided. The trajectory of Kolkata's growth post-1947 was not inevitable; it was determined through strategic investments in the infrastructure necessary

for previously uninhabitable land to be built up, including transportation, water, sewerage, and drainage.

A third and related issue is that Kolkata's exclusionary and incremental planning virtually guarantees continued development further into the flood plains. Kundu (1994) argues that the "decision to set up Salt lake City on the eastern fringe of the Calcutta metropolis seems to have set up an eastward expansionary thrust that produced a chain effect in terms of more expansion in that direction" (p. 58).[64] While Kundu was referring to the formal development that has accompanied Salt Lake's growth, we must also consider the growth of slums. As I show in the next two chapters, formal and informal development is deeply interrelated, economically and locationally. The growth of Salt Lake has been accompanied by the growth of dozens of slums and squatter settlements nearby, where much of Salt Lake's informal work force live.

The same outcome will likely accompany new town projects proposed in *Vision 2025*. In the absence of a comprehensive and enforceable land-use plan for the urban agglomeration, piecemeal development will tend to attract further development, formal and informal, along the same spatial trajectories. From the perspective of risk and risk management, this future is troubling; what was once land too inhospitable for development will become the core city, while the boundaries of the KUA will push further and further into the unsafe land in the urban periphery. Those living in formal developments may be able to mitigate the effects of environmental hazards, while those living in slums will likely not.

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[64] The growth of neighborhoods in the vicinity of Salt Lake supports this argument; from 1971, when the first house in Salt Lake was built, to 2001, the population of South Dumdum grew by 140%, from 158,200 to 392,150. North Dumdum grew by 290%, 64,000 to 220,032 (India Census, 1971-2001).

CHAPTER 4: URBANIZATION AND NEW TOWN DEVELOPMENT
THE CASE OF SALT LAKE

As Kolkata's urban development trajectory turns eastwards, new town projects are a key feature of future planned growth. There is one mature new town development in the city's periphery, a township called Bidhannagar (or more popularly, Salt Lake). This chapter examines Salt Lake as a case study in urbanization, a dynamic process that shapes disaster risk at the local level.

Figure 4.1: Bidhannagar (Salt Lake) in the Kolkata Urban Agglomeration
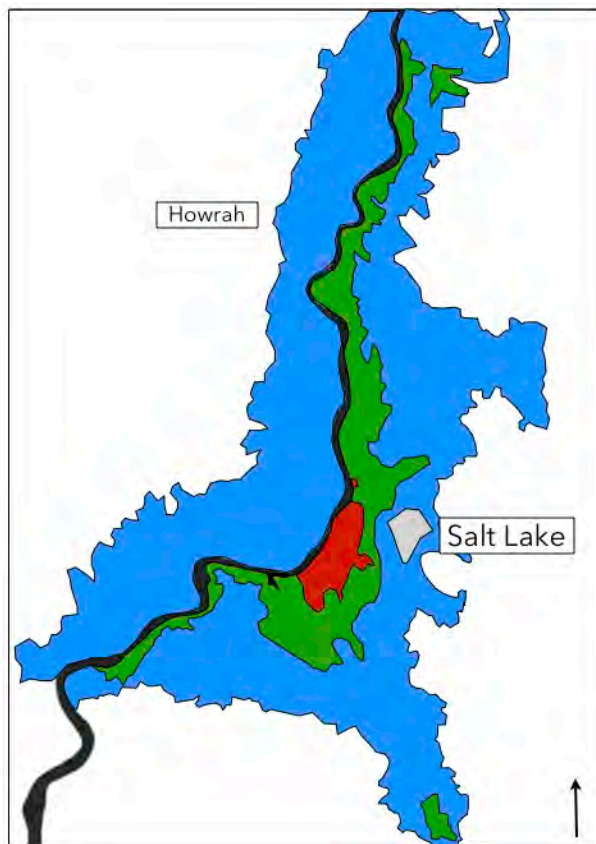
Sources: NATMO; KMDA, 2005; Geoeye 2010

Salt Lake was planned and built in the 1960's and has since grown into an enclave for the wealthy, currently home to more than a quarter million people. Its history offers valuable lessons about the likely outcomes of future planned development in Kolkata's eastern fringe. Unlike other scholars, I examine not just the growth of the Salt Lake township itself but its impact on the development of the surrounding area as well (ETH Studio Basel, 2008; Toskovic, 2009). I discard the notion of Salt Lake as a political unit defined by its planned boundaries and instead analyze it as a component of the larger urban fabric. In order to do this, I interviewed dozens of public officials, organizational leaders, and ordinary residents, and conducted a labor survey of 598 low-income and informal workers in the township. My research shows that informal workers are critical to the functioning of the Salt Lake economy but are excluded from living in the township itself and, as a result, reside in slums and squatter settlements nearby. This logic of settlement, a vestige of colonial development and rooted in a modernist planning ideal, creates an uneven geography of risk between the rich and the poor that shapes the outcomes of disaster events.

"Dr. Roy's Wonderland" – The Salt Lake Township

In 1948, Dr. Bidhan Chandra Roy became the second Chief Minister of the state of West Bengal.[65] He inherited a city in crisis; the British partition of Bengal had led to millions of refugees crossing the border from newly created East Pakistan into West Bengal, many of whom took refuge in Kolkata.[66] This sudden influx of refugees coincided with an acute housing shortage in the city and resulted in a proliferation of slums, squatter

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[65] Dr. Roy was preceded by Prafulla Chandra Ghosh, who served as West Bengal's first Chief Minister from August, 1947 till August, 1948.
[66] East Pakistan broke off from Pakistan in 1971 and became the independent country of Bangladesh.

camps, and "pavement dwellers," homeless families forced to settle on any scrap of available open space.

On a diplomatic trip to the Netherlands in 1949, Dr. Roy saw how the Dutch were able to build cities along the Rhine River despite severe geographical challenges similar to those in Kolkata (Government of West Bengal, 1981). With this newfound inspiration, he returned home and proposed that Calcutta should build a new township called "Salt Lake," on land that would be recovered from the vast wetland areas to the east of the city, referred to today as the East Kolkata Wetlands (EKW).[67]

In 1951, Dr. Roy invited a Dutch engineering firm, NEDECO, to create a strategy for reclaiming the low-lying land. The Bengal government and NEDECO struck on a clever way to recover marshland. Conventional approaches, like the "cut and fill" method where land would be dug up from other areas and deposited in the Salt Lakes, would be impossible because of the sheer volume of material that would be required.[68] Instead, NEDECO coordinated their plans with the state's efforts to dredge parts of the Hooghly River. The dredged materials would be mixed with water and piped from the river to the wetlands, a process called hydraulic filling. As the water drained off to nearby canals, the solid material would settle and eventually raise the land to an acceptable elevation.

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[67] According to the Ramsar Convention, the intergovernmental treaty governing the conservation and management of more than 1900 wetlands of "international significance," a wetland is an "area of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres." See www.ramsar.org.

[68] Earlier plans to reclaim the Salt Lakes using the cut and fill method, like the Gurner Committee Plan of 1943 (developed by the Calcutta Improvement Trust), had to be dropped because of an insufficient amount of filling material available near to Kolkata. See Chattopadhyaya (1990), pp. 94-95.

At the time, the East Kolkata Wetlands were made up of the Northern and Southern Salt Lakes (Chatterjea, 1990). The Northern Salt Lakes, which covered approximately 20 square miles, were proximate to populated areas like Ultadanga and Beliaghata and were closer to the city's core. They were also relatively close to Sealdah Station, a major train terminal, and the Bow Bazaar trade area. For these reasons, engineers and planners decided to site the township there, arguing that its proximity would allow it to quickly and successfully integrate into the larger city.

Figure 4.2: Proposed Site of the Salt Lake Reclamation Project (1962)
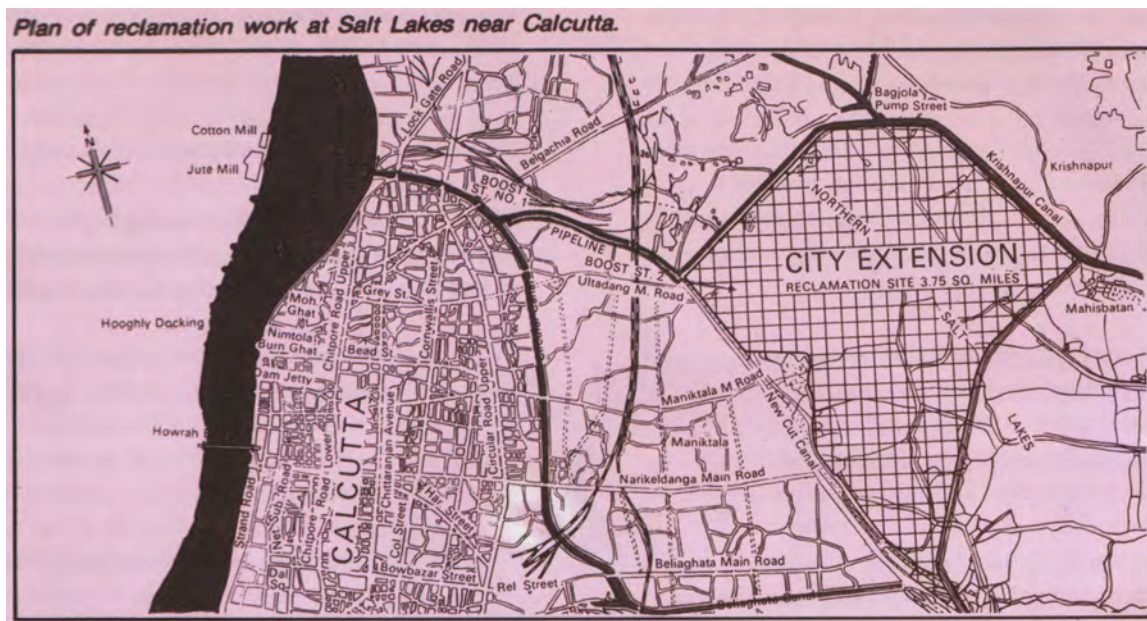
Source: Toskovic, 2009

State officials hoped to avoid the difficulties that plagued Kalyani, another satellite township in West Bengal that was built in 1950. Kalyani was built 45 km (28 miles) north of Kolkata on the banks of the Hooghly and was meant to balance the growth of Kolkata. Another brainchild of Chief Minister Roy, Kalyani was planned to act as a "counter magnet" development that would eventually house more than a half million people and become a

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second urban core in the Kolkata urban agglomeration. The township was "created at great expense and to resounding failure," primarily because of its distance from, and inadequate transportation linkages with, the core of the city (Chakravorty, 2005, p. 10).

Locating Salt Lake in the northern portion of the EKW would avoid such problems. The center of the township would be just 7.5 kilometers (4.7 miles) from BBD Bagh (formerly called Dalhousie Square), the nerve center of state and local government, while the Eastern Metropolitan Bypass would link the township to both the airport and the core areas of the city. The state assembled approximately 10 square kilometers (4 square miles) of land in the northern Salt Lakes for reclamation and development. The area was extremely low-lying, however; its elevation ranged from one meter (three feet) below sea level to just one meter above. Nearby areas that were two meters or more above sea-level routinely suffered from waterlogging (flooding) and large portions of the salt lakes were persistently under water (Chatterjea, 1990).

In 1962, the State of West Bengal hired a Yugoslavian engineering firm, Messrs. Invest Import (MII), to carry out the hydraulic filling scheme. More than 1 billion cubic feet of filling materials were eventually piped in, raising the land to 3.5 meters (11 feet) above sea level (M. Chatterjee, 1990). The Estimates Committee, who advertised the global tender for the Salt Lake reclamation project and recommended that the West Bengal government award the tender to the Yugoslav firm, justified their choice of a non-Indian firm by arguing that the Yugoslavians were "experts in the line of hydraulic filling" (Estimate Committee, 1966). They also argued that an Indian firm would be entrusted to conduct the town planning for Salt Lake, a better utilization of indigenous skill. Indian planners would have "better knowledge of the climate and social environment of the land and are expected to

draw up designs of town-planning to suit the needs and requirements of the Indian

people." The Indian planning form was never hired; in addition to overseeing the land

reclamation project, MII also provided a young city planner named Dobrivoje Toskovic to

develop a master plan for the new township.[69]

Chief Minister Roy's primary goal for the Salt Lake township was to provide

accommodation to "houseless" families from the lower and middle classes. Dr. Roy

imagined the township as a "wonderland," a self-contained cynosure of multi-storied

housing, parks, markets, businesses, and all the other amenities necessary for economic

and social self-sufficiency. He instructed Toskovich to plan a city that would house 400,000

lower and middle-class citizens, a model development with "all the amenities and facilities

of a modern, planned town" (Chattopadhyaya, 1990).

Toskovic set out to create a "humane and healthy environment," which would operate

"just like a garden city" (Toskovic, personal communication, March 9, 2010). He was

heavily influenced by the work of modernist architects and planners like Le Corbusier and

Lucio Costa; his chief inspirations when designing Salt Lake were the planned communities

of Chandigarh (India), Brasilia (Brazil), and Rawalpindi (Pakistan), all of which imagined

land as being a blank slate, a tabula rasa for urban development. He saw the Salt Lake

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[69] It is not entirely clear why Indian planning firms were not contracted to plan the Salt Lake township. Based on my interviews with planners familiar with the Salt Lake reclamation process, including Toskovic, the Salt Lake plan was a component of the Yugoslav firm's bid for the hydraulic filling tender. A senior planner [Santosh Ghosh] who worked for the CMPO during this period told me that the engineering work was the main focus of the proposal, that Toskovic's services were included as a bonus - "they [the state of West Bengal] paid for the engineering, and got a free plan as well" (Ghosh, personal communication, December 10th, 2009). One possible explanation was the perceived lack of skilled planners who were willing to work in Kolkata; the Ford Foundation team that advised the CMPO for a decade beginning in the early 1960's voiced a similar complaint, and eventually paid for a number of young Indian professionals to travel to Europe and the United States and earn their graduate degrees in planning.

project as an opportunity for Kolkata to begin anew, to abandon the disorder of the old city and embrace the amenities that planned communities could offer. "Today = Anarchy," he wrote prominently in his notes.

> The road is choked with traffic. The servants' quarters are now shops which encroach on the pavement. The house becomes a block of flats. Each part has developed separately producing chaos (Toskovic, 2009).

His sketch of "The problem" illustrates his concerns:

Figure 4.3: "The Problem"
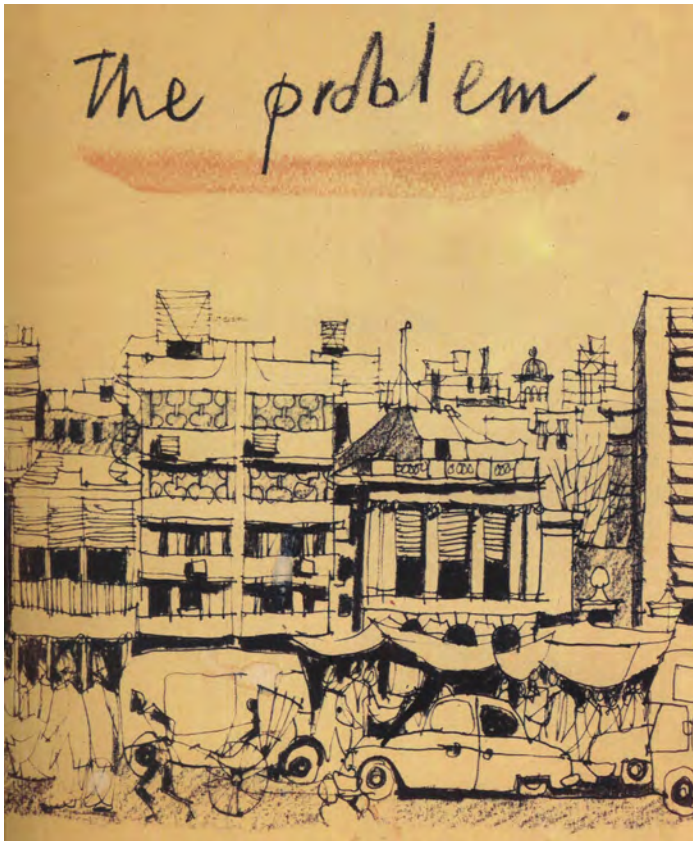
Source: Toskovic, 2009

High-rise buildings are closely packed together, while cars, rickshaws, and people share the crowded street. The merchandise from shops spill out onto the sidewalk, which is filled with hawkers and endless pedestrians. The solution was to start over, to plan using a

"clean sheet" in the urban periphery and away from the "entanglement" of the core city.[70]

As Holston (1989) wrote about master planning in Brasilia: "to be different, an imagined utopia must negate the prevailing order" (p. 79). As the master plans for Brasilia attempted to dehistoricize the city from Brazil, so to did Toskovic's plans for the Salt Lake township attempt to negate the history of the larger metropolis in which it was to be embedded.

Given the high density of urbanization along the levee of the Hooghly, and the prohibitive cost of assembling and developing land in the core city, the clean sheet would necessarily need to be built in the peri-urban fringe.

Figure 4.4: "The Clean Sheet"
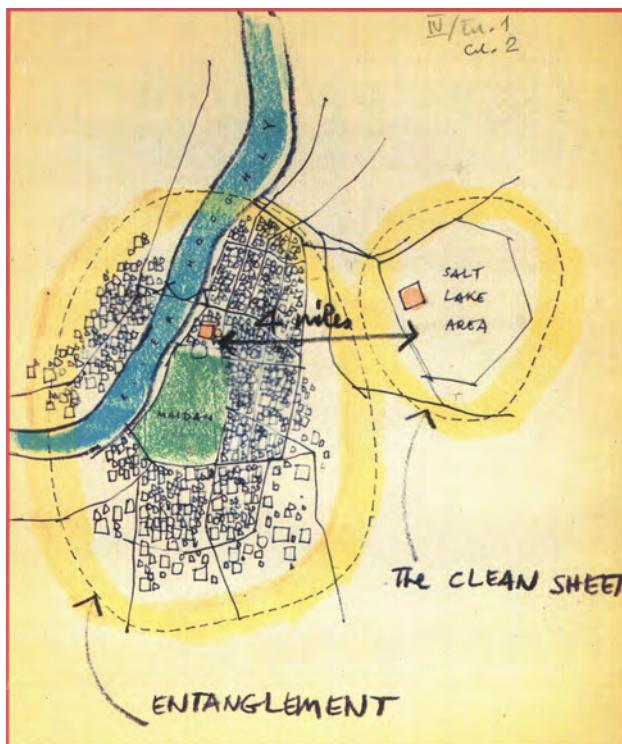
Source: Toskovic, 2009

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[70] Toskovic was certainly not alone; Dr. Roy's motivation for building the township was deeply rooted in a desire to begin anew, to offer the amenities of a planned settlement that would thereby "bypass the city's ills - poor infrastructure, slums, and poverty" (Chakravorty, 2005).

Inspired by the modernist ideals of zoned areas, Toskovic imagined that the new township would have clearly separated spaces for living, working, traveling, and relaxing, instead of the density and mixed use that characterized the old city (McFarlane, 2008b). For instance, he describes his planned pedestrian walkways as "free from motor cars and shaded by buildings, with access to banks, clubs, restaurants. Immediate access to park [sic]" (Toskovic, Dobrivoje, 2009, p. 19). His conceptual drawings focus heavily on green space, imagining both a city surrounded by a green belt and a large central park around which the township would be organized. Toskovic also appreciated the importance of building a strong link between BBD Bagh and the core of the township; his sketches clearly conceptualize the areas as deeply interrelated.

Toskovic's master plan called for a series of residential and commercial super blocks surrounding a central park. Super blocks would be separated by divided arterial thoroughfares that would then exit the township at several points. While some super blocks would contain only government offices or commercial real estate, most would be residential with hundreds of houses and/or apartment buildings, as well as small parks, sports facilities, and central markets. These markets would be interspersed throughout the township and would contain a wide variety of shops and vendors, so that the daily needs of residents would be within short walking distance of their homes. More important, they would contribute to Toskovic's vision of a separation between uses; whereas in the central city, merchandise and vendors spilled out into the sidewalks and roadways, in Salt Lake they would be neatly contained within designated market buildings. Toskovic's plan called for 30% of the residential plots to be set aside for single family homes, while 70% of plots

were designated for apartment buildings or housing cooperatives, to fit the budgets of

middle-class families (Toskovic, personal communication, March 9, 2010).

Figure 4.5: General Plan for "New Calcutta" (Salt Lake)
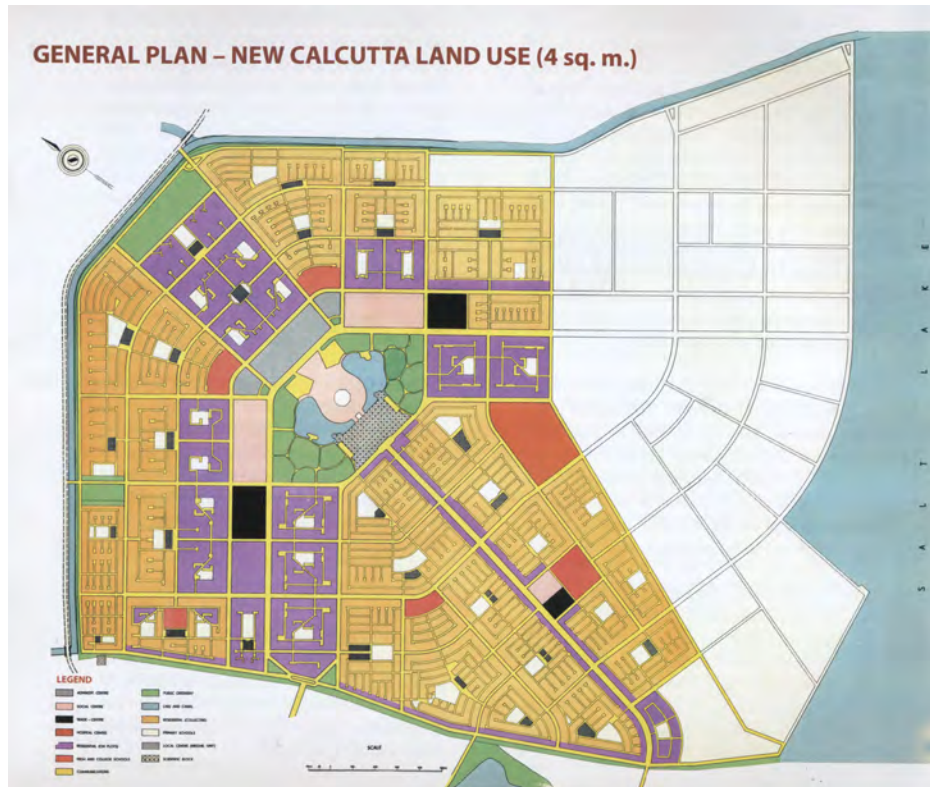
Source: Toskovic, 2009

Today, Salt Lake contains 74 superblocks, divided into 5 sectors. The township was

opened to development in stages and the sector boundaries correspond to the order of

development. Sectors I-III were opened during the period 1965-1969, and are the focus of

my study. Sector IV is a small area on the southeast of the township, now mostly taken up

by Nicco Park, East India's first amusement park, as well as rehabilitation housing for

residents from southern Dattabad displaced during the construction of the Salt Lake

Stadium and the Hyatt Regency Hotel. Sector V was opened for development in the mid-1990's and is considered the information technology (IT) hub of Kolkata.[71]

Superblocks are separated by divided roadways and are assigned two-letter identifiers (AA block, AB block, etc.) While some commercial and government superblocks contain single buildings or clusters of buildings, most are residential or mixed use and are further divided by collector streets. Most residential and mixed-use blocks contain at least one small park, a central market, and amenities like sports fields, schools or community centers.

Figure 4.6: Typical Salt Lake Block
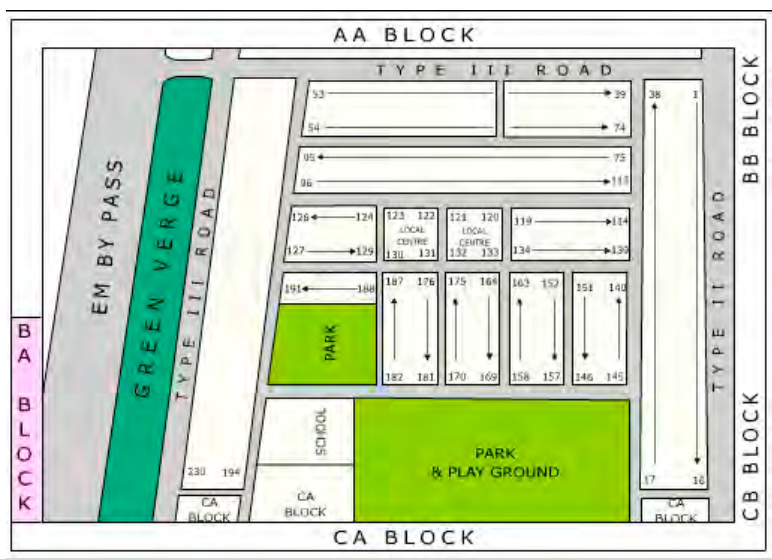
Source: Click Salt Lake, 2011

Reclamation work commenced on April 16, 1962, and the first private house in the township was occupied in 1970 (Chatterjea, 1990; Chattopadhyaya, Haraprasad, 1990). The population has grown rapidly since, from 10,000 in 1981 to 100,000 in 1991 to

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[71] I did not include Sector V in my study, for two reasons. First, it was only opened for development in the past 15 years and is underdeveloped relative to the rest of Salt Lake. Second, Sector V broke away from the Bidhannagar Municipality in 2006 and formed a new municipal area called Naba-Diganta (BMC, 2007).

approximately 276,000 in 2011. The BMC estimates that by 2030, the population will reach

500,000 (BMC, 2007; KMDA, 2005). This is in addition to a large commuter population that

works in the many office buildings and government compounds throughout the township.

The state government recently approved a measure to allow an additional floor to be built

on most structures in the township which could help spur the population past 600,000

("Salt Lake Houses," 2010).

Though the State of West Bengal owns the land, Salt Lake is now its own municipality

with an elected municipal government and its own planning and development offices. A

divided highway (EM bypass) borders the township on the west and drainage canals

border it on the north and east. At the southern end is Salt Lake Stadium, a 120,000-seat

sports arena completed in 1984, while a large park and *mela* ground dominates the center.

City Centre, a high-end shopping mall and cinema complex, is the major commercial

attraction in Salt Lake and several other retail malls and luxury hotels are opening

nearby.[72] Salt Lake has a distinct character compared to the rest of Kolkata; visitors often

remark how they feel like they are in a completely different city, or as one friend put it, on a

different planet. There is a palpable sense that the township is striving to meet the image of

the "sanitized, formal, master-planned spaces of the planners' and policymakers'

imagination," a common aspiration for developments in Southern cities (Kudva, 2009).

From a demographic perspective, Salt Lake is different than the township that the

Chief Minister and Toskovic envisioned.[73] Whereas Dr. Roy had imagined a place for middle

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[72] For example, a 5-start Hyatt Hotel was recently completed near Salt Lake, one of the largest
luxury hotels in the city.
[73] The failed promise of Salt Lake providing housing to the middle class is still noted today. While
living in Kolkata, I made regular trips to the American Center Library. During my visits, I would
make small talk with one of the Bengali security guards who monitored the entrance. When I told

and working-class people, today it is an enclave of wealth and prestige, a "VIP" address where many of the city's most powerful and wealthy families live. Instead of the 70/30 split of residential land-use between multi-unit and single family structures described in the original master plan, today the ratio is almost exactly reversed, with the majority of plots containing well-appointed houses rather than apartment flats (Saha, 2008). Though the processes by which landowners were able to change the zoning of their plots are somewhat murky, most of the evidence points towards political patronage and dubious leaseholder transactions ("The Salt Lake Fiddle," 2010). In the 1980's, then Chief Minister of West Bengal Jyoti Basu moved his personal residence to the township and, soon after, many state officials followed suit. According to some long time residents, Basu treated state-owned land in the township as "political bucks (currency)," and that many of the plots were converted to single family through their patronage to the ruling CPI(M) government.

Once an individual becomes a leaseholder in the township (all land is owned by the state), he is only legally able to transfer the control of his plot land to his offspring, to prevent land speculation and escalating prices. Again, residents told me that this law was easily flouted by well-connected leaseholders. When a lease is taken over by an individual who is clearly not related to the original owner, the new leaseholder will "still always have the appropriate documents," according to a long-time resident and neighborhood association leader. By his account, and others, counterfeit documentation is readily available through the municipal and state government for a person with the right connections and resources.

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him that I was doing research on Salt Lake, he told me how his father is still bitter because Salt Lake was "meant to be a place for us, for average Bengalis," but that "today, it is for the rich only."

Neither the original Toskovic plan nor the current land-use plan for Salt Lake makes land or housing available to the poor. When I asked Toskovic about this, he told me that his plan had always targeted middle-class citizens, and that for low income housing it "depends on the Government decision to find an adequate area where this kind of construction is adequate to [sic] paying capacity of these people." Rabial Mallick, Director of the Institute for Development Education and Action in Kolkata, asked the planners of Salt Lake why they did not build housing for low-income people, to which they replied that there was "widespread concern" that housing poor people in the township would depress real-estate prices in the vicinity (Rabial Mallick, personal communication, November 14th, 2009). Speaking anonymously with a reporter from the Kolkata Mirror newspaper, a resident of EE block in Salt Lake voiced additional concerns about living in proximity to poor people: "It's time we take our morning walks in clean air and our children grew up without hearing the slang that is freely used by slum dwellers. I came to Salt Lake and purchased a flat in this township for the reason that my children grow up in a healthy atmosphere" (Biswas, 2009).

Salt Lake Today

I moved to Salt Lake in 2009, to a 3-story home near the western edge of the township. The house was divided into three apartments; the top floor was the vacation home of the owner, a Bengal-born professor living in Germany. The ground floor was occupied by his brother, Mr. Banerjee, his wife, their two children and spouses, and six grandchildren. In many ways, my study of Salt Lake began there; they took me in with a hospitality that lived up to the city's reputation. As I struggled to establish the outlines of my study, I spent many hours drinking tea and chatting with Mr. Banerjee, a retired

engineer who was endlessly helpful answering my questions about the township. I sometimes accompanied him on his daily errands; to the market, the pharmacist, morning walks in the park and nightly walks around the neighborhood. I met a great number of his friends in Salt Lake, mostly retired men who had once (like himself) worked in the West Bengal government and who had built homes in Salt Lake when it first opened for development. I joined the Salt Lake chapter of the Rotary Club and attended their twice-monthly meetings, usually a short discussion of the various projects and events the Club was planning followed by snacks and several rounds of drinks.

These friendships were enormously important to the progress of my research, on a number of levels. The collective knowledge they shared with me about the history and development of the township was invaluable. Most of them are akin to "homesteaders;" they moved to Salt Lake when it was still largely a vacant expanse of marshland, mostly occupied by refugees from the Bangladesh Liberation War and the huge number of casual laborers employed to help build the township. As such, they knew more about the history and politics of the township than any published record I have found. As mostly middle and upper class retired bureaucrats, they had extensive connections in the municipal and state government. Whereas I had previously struggled to secure face-time with local officials, Mr. Banerjee and his acquaintances were more than willing to fix appointments and to accompany me to meetings. Within weeks of my first Rotary meeting, I was in the home of the Chairman of the Bidhannagar Municipality, sipping chai and discussing my research project with him. He instructed the urban planning staff at the BMC to meet with me and share the township's most recent development plans and electronic maps and graciously

arranged for me to meet with other important officials in the city and township, including

fellow party members at the KMDA and KMC.[74]

I also made friends with a number of local business owners and young professionals,

who offered a different perspective on the township than Mr. Banerjee and his generation.

For many years Salt Lake had a reputation as a sleepy suburb, away from the action of the

city and mostly a place for older people. In the past decade, however, more young people

have begun to move to the township, especially after Sector V was opened in the late

1990's. Sector V was strategically developed as a site for Kolkata's burgeoning high-tech

industry, and businesses there (including Indian giants InfoSys and Wipro) employ

thousands of young professionals who have settled in Salt Lake and nearby Rajarhat. As a

result, several brand new nightclubs and restaurants have recently opened that cater to

this new, youthful population.

When I first arrived in Salt Lake, I had intended to study how flooding and other

natural hazards affected the township itself. Toskovic was certainly concerned with

flooding when he drew up his master plan; "the geography of the township," he observed,

"was full of problems." To cope, he relied on "modern technical principles" that would

ensure "proper drainage and storm-water management" (Toskovic, personal

communication, March 11, 2010). I was skeptical, given the city's track record with

infrastructure improvements and maintenance and expected to find that the township was

frequently inundated during the monsoon and tropical storms. What I found instead was

that the township was relatively safe from most environmental hazards that routinely

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[74] For the remainder of my field research, the chairman's endorsement helped smooth over any tensions that arose with party workers, police, or government officials.

affect the city. I interviewed more than a dozen residents who had lived in the township since the 1970's, and most could only recall two or three times the township experienced widespread floods that affected people's homes; once in 1978, during some of the worst flooding in West Bengal's history, and (less severely) in 1999 and 2006. "During the monsoons waterlogging is there," said Satyajit Das Gupta, a leader at a local NGO "...but only in the roadways and around some of these open areas [referring to a large open area and taxi stand across the street]" (Das Gupta, personal communication, February 4, 2010).

A review of the back issues of the Salt Lake Telegraph (SLT) confirms these accounts.[75] The SLT is a weekly section in the largest English newspaper in Kolkata and the only newspaper written exclusively about the Salt Lake township.[76] Since the newspaper began publishing in September 2005, only a handful of articles make reference to flooding, and almost always in reference to the waterlogging of streets, sidewalks, and open spaces (e.g. Sarkar, 2008).[77] A 2008 survey of the top 10 civic concerns in the township did not include flooding or emergency management, although mosquitoes and airborne insects ranked #5 ("Vox Populi," 2008).[78] Even the 2006 flood that inundated dozens of houses near the Kestopur canal was decidedly man-made. The Telegraph reports that the floods were caused by sand bags errantly left in the canal during the dry season, which impeded

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[75] The contents of the Salt Lake Telegraph give some immediate clues about the township's demographics and wealth; there are regular columns on financial management, gardening, consumer electronics, and dog ownership.

[76] The SLT archives are not online; in order to access them, I had to travel to the Telegraph's main office and take handwritten notes, since cameras were not allowed inside the building and photocopiers were not available.

[77] Standing water does cause an occasional public health crisis in the township, as the mosquitoes, flies, and other insects proliferate in stagnant water and then spread disease. For example, the township has faced several outbreaks of malaria and dengue fever in the past decade, including a particularly severe outbreak in 2005 ("Sleeping with the Enemy," 2005).

[78] The top 3 concerns were water supply, road maintenance, and park maintenance, respectively.

its flow and caused it to break its banks during a particularly heavy downpour ("Sandbags in Canal," 2009). The BMC's Draft Development Plan for 2007-2012 describes the drainage problem in the planned township as "nominal" (BMC, 2007, p. 214).

There are a number of reasons why Salt Lake and its residents are largely resilient to environmental hazards, both physical and socioeconomic. As Biswajiban Majumder, the chairman of the Salt Lake Municipality, pointed out, the township has "proper planning and infrastructure," including an underground sewerage and storm water management system (Majumder, personal communication, December 7, 2009).[79] The township is also elevated 3.5 meters (11 feet) above the surrounding area, which naturally drains water away from Salt Lake and into the canals on the northern and eastern borders. The buildings, both residential and commercial, are overwhelmingly made from permanent (pucca) materials, including brick, concrete, steel, and asbestos, in marked contrast to shantytowns that ring the township. Permanent buildings are generally more resilient to the heavy rains and high winds that accompany storms, as well as to fires, earthquakes, and other natural hazards that sometimes affect the city. The streets in Salt Lake are wide and (relative to Kolkata generally) well maintained, and can accommodate both storm water runoff as well as allow easy passage of emergency vehicles to several nearby hospitals.[80] The township's many trees and parks help to reduce air temperature by as much as 2-3 degrees Celsius (3.6-7.2 degrees Fahrenheit) compared to downtown Kolkata, reducing the impact of heat-waves, and also act as "lungs" that absorb some of the smog and air pollution that often blankets

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[79] Though the drainage infrastructure in Salt Lake is currently performing adequately, years of neglect has left many of the pipes silted and performing below drainage capacity. See BMC (2007).
[80] Salt Lake has significantly better road infrastructure than Kolkata generally. Roadways cover just 6-8% of surface area in the Kolkata Metropolitan District, which has led to enormous problems with traffic and congestion. By comparison, roadways in Salt Lake cover 23% of the township (Chatterjea, 1990).

the city (Ghose, Paul, & Banerjee, 2005).[81] Given these physical factors, as well as the socio-economic status of the vast majority of Salt Lake's inhabitants, residents of the township are generally resilient to both the everyday and episodic disasters.[82]

It is true that Salt Lake, examined strictly within its physical boundaries and focusing only on the people who reside in the planned portion of the municipality, is relatively safe from environmental hazards. The township is not an island, however. Rather, it is deeply embedded in the larger fabric of Kolkata.[83] Besides its master planned urban form, gridded blocks, wide streets, centralized marketplaces, and other features that set it apart from the rest of the city, Salt Lake is also remarkable for its (nearly) complete lack of slums and squatter camps.[84] These informal settlements, sometimes called *bustees*, house between 35-50% of Kolkata's population (Kundu, 2003), yet only tiny pockets of informal housing exist in the township. Salt Lake is also free of pavement dwellers - those individuals and

[81] Because the economy of Salt Lake, Rajarhat, and the nearby wetlands revolve around government services, IT, and aquaculture/pisiculture, air pollution is generally lower in other parts of the city.
[82] Though its drainage infrastructure and well-constructed buildings help reduce some of the risks associated with a catastrophic cyclone, its residents are still extremely vulnerable to such an event. If a cyclone similar to the Great Calcutta Cyclone of 1864 struck the city, Salt Lake's location in the flood plain, its limited transportation connectivity, shortage of fresh water supplies, proximity to outflow canals, and aging population would likely lead to immense human and economic losses, both during the storm and in its aftermath.
[83] An important issue that I am leaving unanswered here is whether Salt Lake, and development in the eastern fringe of Kolkata generally, affects the drainage of the rest of the city. A great number of environmentalists have argued that the construction of the EM Bypass, Salt Lake, Rajarhat, Patuli, and other developments are creating a less permeable eastern "rim" that interferes with the natural drainage patterns of the region, effectively trapping storm water in the city and making a bad drainage situation even worse. Kundu (1994) describes some of the debates that occurred during the planning of Salt Lake, and organizations like the South Asia Forum for the Environment (SAFE) continue to advocate for restricting development in the eastern fringe (Kundu, 1994).
[84] Chakravorty (1996) claims that "Salt Lake has no slums" (p. 10). This is not entirely true. Dattabad is technically within the boundaries of the Bidhannagar municipality, though local politicians and residents go to great lengths to distinguish between the planned and unplanned areas of the municipality (see Chapter 6). Excluding Dattabad, there are still small pockets of slum growth in the township, especially on vacant lots, in public parks, and within the Salt Lake stadium complex. For example, there is a small group of ragpickers who squat on land opposite of Unnayan Bhavan (a government office complex). These slums areas are slowly being eradicated relative to the rest of Kolkata, Salt Lake is remarkably slum free.

families who haven't yet found or cannot afford a home in the slums, and who sleep on sidewalks, footpaths, landings, bus stops, or any other spare piece of ground that might be occupied in the city (usually with a fee or service paid to the local party, police, or politician). Without *bustees* and pavement dwellers, Salt Lake lacks some of the most omnipresent physical markers of poverty in Kolkata, unmistakable components of the larger urban system.

A Slum-Free Salt Lake

Within the administrative boundaries of the Bidhannagar municipality are three distinct areas: the planned township of Salt Lake; Dattabad, a recognized slum; and a wetland area of 21 square kilometers to the east of the planned township, absorbed into the municipality in 1995.[85] There is a tension between what the Bidhannagar municipality is and what its residents and administration imagines it to be. In its promotional literature, the BMC advertises itself as a modern and prestigious township:

> Being a planned city, Bidhannagar offers many facilities usually not available in many of the other older Indian cities. It has clean and well-maintained roads and sanitation, tree-clad boulevards, relatively pollution free environment, its own swimming pool…the Bidhannagar Municipality has carved out a distinguished position in the Municipal Map of the state of West Bengal…Unique and exclusive as it is, this Municipality has become a model to follow in the eyes of others.[86]

Yet the inclusion of Dattabad and the "added area" of the wetlands, where several thousand subsistence farmers, fisherfolk, and rural poor live, means that the Bidhannagar

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[85] The official development map of the Bidannagar Municipality, provided to me by one of the BMC's staff planners, indicates that the land where the Dattabad slum sits is "vacant. This is curious, because the Dattabad settlement predates the Salt Lake township itself (Chapter 5). The BMC draft development plan (2007-2012) clearly describes Dattabad as an area of concern and as a site for investment, so it is not clear why the settlement was left off the map. Leaving slums off of official development maps is common incities in India and the Global South. One possible explanation is that through intentional "unmapping" of slums, development authorities can evade responsibility for them and legitimate their own claims to those lands when economically or politically expedient (Roy 2003a).

[86] From the Bidhannagar Municipality website, http://bidhannagarmunicipality.in. Accessed on March 8th, 2011.

municipality encompasses a diverse range of settlements, from the homes of urban elite to those of the urban and rural poor. This diversity is recognized, if begrudgingly, in BMC development plans:

> Bidhannagar, the most important satellite township of the city of Kolkata is situated in the eastern fringe of the city. The town Bidhannagar has a remarkable feature. It was basically a planned township with residents from the middle class, upper-middle class & upper class of the society. But with the inclusion of the added area in its eastern side, it now happens to be a city with residents from all strata of the society. This added area is inhabited mostly by the economically weaker section of people (BMC, 2007, pp. 13-14).

The DDP goes to similar lengths to distinguish the planned township from the Dattabad slums:

> The planned township enjoys an organized growth due to zoning of land-use whereas the added areas are sprawled with unorganized growth. The slums of Dattabad on the fringe of the planned township along the E.M. [sic] Bye Pass are diametrically opposed to the planned township, densely populated with deplorable living condition (BMC, 2007, p. 12).

Though the Dattabad slum was established prior to Salt Lake and housed many of the workers who helped build the drainage and road network in the township, and though it is home to a great many of the service workers who labor in the township, its status as a slum is seen as a blight on the township. "Without proper planning of the settlement of Dattabad, the planned township of Bidhannagar Municipal area remains in an unfinished & unorganized state. But this proposal cannot be fulfilled by the ULB [Urban Local Body] itself without the intervention of the State Government" (BMC 2007, 27).

Outside of official development plans, however, the BMC rarely mentions Dattabad or other added areas. This rhetorical distinction between the planned township and the remainder of the municipality was reflected in nearly all the conversations I had with municipal officials and residents of the formal areas. In general, Salt Lake was used in reference to the township - if I had questions about Duttabad or the added areas in the wetlands, I would have to specifically introduce them into the conversation. In a discussion

about my research project and about the Duttabad slum, the chairman of the BMC told me that he was "not the most appropriate person to discuss these issues with" because he had not spent time in the slum himself. The location of our interview, the Chairman's office in the BMC headquarters in Salt Lake, was less than a kilometer from Dattabad. Pointing to my companion, a member of the Salt Lake Rotary Club and community activist, he said "this man has walked among those people…he will help you in these matters" (Majumder, personal communication, December 7th, 2009).

I had similar experiences speaking with planners and engineers in the state government. An architect-cum-planner in the Department of Urban Development had a difficult time understanding my questions about differences in infrastructure across the municipality, because I was referring to the Salt Lake township and the added areas simultaneously. "Salt Lake is planned, finished" he said. "Flooding is not a concern because Bidhannagar was built with sufficient drainage facilities" (Sen, personal communication, January 6th 2010). When I pointed out that the Duttabad area had very poor drainage, he was visibly annoyed. "Duttabad is an unplanned area," he argued. "We cannot be held accountable for what we did not do."

The tendency of planners, policy makers, and residents of Salt Lake to imagine Bidhannagar as simply the planned township, as a "unique and exclusive" community, has real and practical consequences. The most obvious are the ongoing campaigns by the BMC to rid the planned township of slums, shanties, and certain types of informal businesses. In 2007, the BMC carried out a "mini-operation Sunshine" to evict slum dwellers and hawkers

from street corners, vacant lots, and canal banks across the township.[87] In July 2007, the

BMC demolished more than 2,000 shanties that had been built on the side of the

Krishnapur (Kestopur) canal, displacing more than 8,000 people (Chakraborty, 2007).

Many of the evicted families took up residence on the opposite side of the canal, while the

Salt Lake side was fenced and will eventually be converted into a park. Debashish Roy, an

official in the department of urban development in the BMC, worries that those who have

taken up residence across the canal may damage the newly constructed fence. "Their very

presence is threatening," he told the Salt Lake Telegraph (Chakraborty, 2009a). Much of the

rhetoric around these evictions centered on the "anti-social" activities that supposedly

occur in slums; "The place is a den of criminals," complained a local resident, referring to

the shanties on the side of the canal ("Robbery at SA 150," 2007).[88] Reviewing newspaper

coverage of the evictions in both 2007 and 2009, there was little, if any, acknowledgement

that the majority of evicted slum dwellers earned their livelihoods in Salt Lake. The Salt

Lake Telegraph did quote one shanty dweller who was evicted from the township side of

the Krishnapur canal, only to resettle on the opposite side. My husband is a construction

worker, if we leave this place it will be difficult for him to get a job," she said. "I am working

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[87] Operation Sunshine was a campaign by the Left Front-led government in 1996-1997 to evict thousands of hawkers from the streets and pavements around Kolkata. See (Crossette, 1997; Roy, 2003b). Though the conflict between hawkers and the city government had been brewing for many years, the immediate impetus for Operation Sunshine was a visit by British Prime Minister John Major ("Calcutta Gets Major Facelift," 1997).

[88] Whenever crimes occur in Salt Lake, suspicion immediately falls on the slums and lower-income neighborhoods surrounding the township. After a break in at a home in the AJ block in 2010, nearby communities of Lake Town, Dakshindari, and Bangur were blamed because they are, according to the local English language newspaper, "all havens for criminals." This was only after the most immediate suspects were ruled out - the homeowners had "faith in both maids who work[ed] in the house ("Lakhs Looted," 2010).

as a maid servant in the nearby blocks, we will be jobless if we switch to some other area"
(Chakraborty, 2009a).

The same month, several hundred food and chai stalls were also demolished by local
police and municipal workers because they had "become a nuisance to Salt Lake residents."
These evictions were often justified based on the incompatibility of informal housing and
activities with the character of Salt Lake. After the canal and hawker evictions in 2007, a
staff member at the Urban Development Department said that "hawkers interfere with the
planned nature of the township" (Chakraborty, Sucheta, 2008). The following month
another 200 shanties were destroyed, and inhabitants evicted, from Sector V, the IT hub in
the township. The eviction was carried out as part of a "beautification drive." "The shanties
clash with the image of a tech township, so we decided to do away with them" said Subrata
Sen, the vice-Chairman of the Nabadiganta Industrial Township Authority, which is housed
in the BMC offices in Salt Lake ("Eviction in Sector V," 2007).

In 2009, an effort was undertaken to destroy several bamboo bridges stretching from
the Salt Lake township to nearby slums and neighborhoods. These informally constructed
bridges are preferred by rickshaw pullers and other laborers who use bicycles and carts for
transport because they are even with the ground, unlike the permanent bridges, which
require users to climb stairs (see Figure 6.1). Commenting on the removal of the bridges,
BMC chairman Biswajiban Majumdar commented that "Salt Lake is a planned city and we
cannot allow such illegal bridges here" (Chakraborty, 2009b).

Figure 4.7: Informal bridge over the Kestopur Canal

Source: Author's photograph, 2010

Majumdar used a similar argument to justify the removal of several small pockets of slum dwellers from vacant lots in Salt Lake in 2009: "There is no scope for shanties and slums in Salt Lake," said the BMC chairman. When asked about the fate of slum dwellers who were about to be made homeless, Majumdar argued that "they are not homeless. Many of them have their houses and lands in the village" (Biswas, 2009).[89] According to Nandagopal Bhattacherjee, member, chairman-in-council, BMC, the shanties and slums were "disfiguring the township with filth and an unhealthy sub-human lifestyle that is inappropriate for its citizenry."

The Relational Qualities of Informality

Yet, there are a great number of poor people working in Salt Lake on a day-to-day basis. Construction workers, street vendors, chai-wallahs (tea sellers), vegetable sellers,

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[89] According to our survey, only 22.2% of households in slums near Salt Lake own land in West Bengal or another state in India; the vast majority did not (see below).

shoe shiners, rickshaw pullers, maids, and a host of other low-income and informal workers make their living in the planned township. Living in Salt Lake and spending time with families and workers there, I saw how important low-income labor was to the daily lives of Salt Lake's residents, businesses, and government offices. I grew to appreciate just how dependent the residents of Salt Lake are on the people that serve them and alternatively, how dependent low-income labourers are on the work they find in Salt Lake. For example, one of the most immediate relationships for middle and upper-income homeowners in Salt Lake (and Kolkata, generally) is with maids and other household servants (Ray & Qayum, 2009). Every middle-class family I met employed at least one household servant and most employed several. For example, the landlord's brother, Mr. Banerjee, employed two maid-servants, one cook, one driver, and a regular washerman (dhobi,) and had easy access (via his mobile phone) to an array of other workers, including plumbers, construction helpers, and *matador* drivers.[90] Beyond the household, a dizzying array of low-income workers keep Salt Lake functioning, from barbers and shoe-shiners to construction workers and gardeners.[91]

From conversations with domestic workers in my own house and others on my block, I knew that most lived in Dattabad, a sprawling slum that occupies several acres of land on the western edge of Salt Lake. Dattabad stretches from the DA block in the north to the Salt Lake Stadium in the south, a distance of just over 1.5 kilometers, and houses somewhere between 25,000-50,000 people. The northernmost portion of the slum was less than a

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[90] Matadors are small trucks that are used to transport larger items like furniture.
[91] Chakravorty, writing in 1996, found that the biggest and most persistent complaint among Salt Lake residents was "concerns [over] the difficulty of obtaining affordable and reliable domestic servants, the old bourgeois complaint that 'good help is hard to find'" (p. 10). Based on my research, things have certainly changed in the 15 years since Chakravorty was writing; while employers sometimes complained about the reliability of workers, there seemed to be a sufficient supply.

quarter mile from my flat, an abrupt departure from the tree-lined streets and gated houses

of Salt Lake. Its winding footpaths are lined with makeshift housing of thatch, tin, and

plastic, interspersed with more permanent structures made of bricks and bamboo. Open

sewer ditches crisscross the settlement, connecting to large salt water ponds that are the

last relic of the township's formerly marshy ecology. Water standpipes dot the settlement,

where dozens of women and children queue each morning. The footpaths connecting

Dattabad to the planned areas of Salt Lake are some of the busiest intersections in the

township, as thousands of maid-servants, rickshaw pullers, construction workers, and

other low-wage labourers stream back and forth.

Figure 4.8: Salt Lake and Dattabad

Source: Author's photographs, 2010

To understand how the dynamic process of urbanization, and new town development in particular, shapes the geography of risk in the city, these informal workers need to be taken into account, for at least two reasons. First, while most informal workers do not reside within the township itself, they are critical to its functioning. From transportation and food delivery to building trades and security, informal workers are the backbone of the service economy in Salt Lake. Second, based on the many studies of the laboring poor in India and other developing cities, and based on my own conversations with housekeepers and laborers in my household and neighborhood, it is unlikely that settlements like Dattabad would exist without Salt Lake and its labor market (e.g. Castells & Portes, 1989; Davis, 2004; Kudva & Beneria, 2005; Mukhopadhyay & Dutt, 1993; Pelling et al., 2004; UN-Habitat, 2003). That is to say, without the formal planned township it is unlikely that slums like Dattabad would arise or have as large a population as they do today.

To gain a more systematic understanding of the informal workforce in Salt Lake I designed a short survey instrument around the themes of work, housing, and transportation. With the help of a translator, I administered the survey to 598 workers

from across the township.[92] The survey results provide powerful quantitative evidence that

confirms the rhythm of work and living in Salt Lake just described; informal workers

provide a wide variety of essential services, for very little pay, and tend to live in slums and

squatter settlements near the township.

Our sample was comprised of 598 adult workers, more than two thirds of whom

(394) were male. This does not necessarily mean that more men are employed in informal

occupations in Salt Lake than women; based on our survey methodology, occupational

groups that were male-dominated were more easily accessible because they tended to

work outdoors and often times away from employers or were independent (for example,

rickshaw pullers, chai sellers, or barbers.) Women workers tended to be concentrated in

household and domestic service, though some chai, food, and snack stands had female

employees, as did some construction sites.[93]

The respondents represented 44 different occupations, which can be divided into the

following categories: food and beverage (199), domestic workers (183), other services

(56), construction and building (44), non-food vendors and buyers (40), municipal hires[94]

(33), transportation (27) and miscellaneous other (16).

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[92] For a detailed description of the survey's methodology, see Appendix A.

[93] One of the shortcomings of the survey instrument was that it does not ask for the respondent's age; I eliminated the question in order to keep the survey instrument as streamlined as possible, not recognizing how interesting that demographic information would have been for analyzing mobility, earning, and housing geography.

[94] Municipal hires were not regular employees of the municipality or city. Rather, they were day-labourers who were mostly employed under a West Bengal "urban job guarantee porgramme," modeled on the Mahatma Gandhi National Rural Employment scheme. The programme guaranteed 100 rupees ($2.10) per day for work and was targeted at unemployed urbanites. Most of those we interviewed were engaged in heavy road work, Metro construction labor (site clean up, hauling, etc.), or park maintenance. The employment scheme was devised in the run up to the municipal and assembly elections and was funded by the CPI(M) controlled State Finance Ministry.

Table 4.1: Occupations by Category[95]

Category	Count	Percent
Food & Beverage	199	33.3%
Domestic Workers	183	30.6%
Other Services	56	9.4%
Construction and Building	44	7.4%
Non-Food Vendors & Buyers	40	6.7%
Municipal Workers	33	5.5%
Transportation	27	4.5%
Misc. Others	16	2.7%
Total	598	100.0%

Source: Rumbach Salt Lake Labour Survey, 2009-2010

The workers we interviewed tended to live relatively close to Salt Lake, which was reflected in their means of transportation to work and their commuting times. The most common mode of travel from home to work was on-foot; excluding those workers who live in the homes of their employers, 28.8% walked to work. Twenty one percent used a van rickshaw, while 13.5% rode a bicycle and 11.5% rode a bus. Less than 4% of respondents traveled to work by train.[96] Commuting times, on average, were less than one hour (See Figure 4.9). Again, excluding in-home domestic workers, 95.3% of respondents (486) had less than a one-hour commute each way, while 50.2% (256) traveled less than 30 minutes. Almost 20% of respondents (101) lived within a 15-minute commute of their workplace.[97]

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[95] For a complete list of occupations represented, see Appendix D.

[96] The nearest train station to Salt Lake is Bidhan Nagar station on the eastern edge of Ultadanga, approximately 1/2 kilometer from the northwestern most block and 2.5 kilometers from Central Park. Ultadanga Crossing, also nearby, is one of the busiest transportation hubs in Kolkata, for those traveling by bus, taxi, rickshaw, and automobile.

[97] These findings complement Roy's (2003) ethnography of poor women who travel very long distances to work as maid servants in South Kolkata. I suspect, although I did not do research on the question, that many of the women who are live-in maid servants might be from villages or settlements in rural areas in North and South-24 Parganas (Roy, 2003a).

Figure 4.9: Time to Travel From Home to Work (one-way)
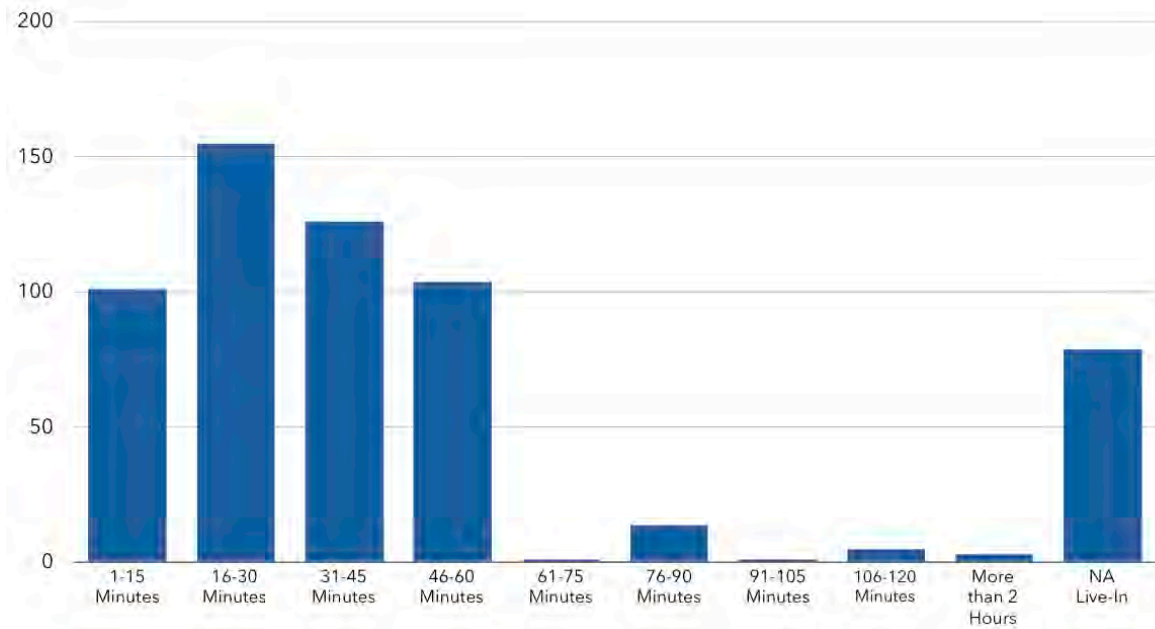
Source: Rumbach Salt Lake Labour Survey, 2010

Nearly all of the respondents were low-income, with most earning between 1,500 ($33) and 4,000 ($89) rupees per month (see Table 4.2).[98] Ten percent of respondents (60) earned less than 1,500 rupees per month, while 58.2% earned less than 3,000 rs/month ($67). Only 5.3% earned more than 4,000 rs/m, and none earned more than 5,000 rs/m ($111).[99] Virtually all of the workers we interviewed (96%) worked seven days a week.

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[98] Survey questions about income are notoriously unreliable because respondents may underestimate, or overestimate, their income, have variable income from day to day, week to week, or month to month, may receive non-monetary benefits in exchange for labor, or for a host of other reasons give inaccurate responses. We used income as simply a guidepost in our survey, and limited the scope of the question to the respondents immediate occupation. That is, if we were interviewing a maid servant, we asked him/her how much they made for the job they were working at that time, not a combination of incomes from all of their jobs, or an estimation of total household income.

[99] At the time of the survey, approximately 45 rupees = $1.

Table 4.2: Monthly Income

Income (Rs)	Count	Percent
Less than 1,000	34	5.7%
1,000 - 2,000	81	13.5%
2,000 - 3,000	233	39.0%
3,000 - 4,000	218	36.5%
More than 4,000	32	5.4%
Total	598	100%

Source: Rumbach Salt Lake Labour Survey, 2010

We also asked survey respondents about their living arrangements; the vast majority lived either in the place of their employment or in an informal settlement/slum. Of the 597 who responded, 9% (54) were maid servants, drivers, or chowkidars (guards) who lived on the premises of their employers. Two percent (12) were dhobis or chai/food stall owners and workers who lived in their stalls or stands, usually a small wooden or thatch structure. Of the remaining respondents (531), 94.4% (501) reported living in a slum or squatter settlement.[100][101] When we mapped the location of these slums, a clear spatial pattern emerged:

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[100] Just 5.6% (30) of all respondents lived in formal housing.

[101] What does, and does not, constitute an informal settlement is sometimes tricky because of the wide range of settlement types, many of which blur the line between formal and informal. On the eastern fringe of Kolkata, however, the separation is more distinct than in other parts of the city. We approached the question as follows. First, we asked the respondent where they lived. Many of the settlements, like Dattabad or Sree Krishna Pally, are well-known and recognized slums without any formal housing within their boundaries. If the name was ambiguous (i.e. Kestopur, a nearby neighborhood with both informal and formal development), we asked a series of follow up questions, about the type of housing they lived in, the services they received, and the ownership of their house/land. In all cases but one we were able to reach a satisfactory answer.

Figure 4.10: Location of Respondent's Homes
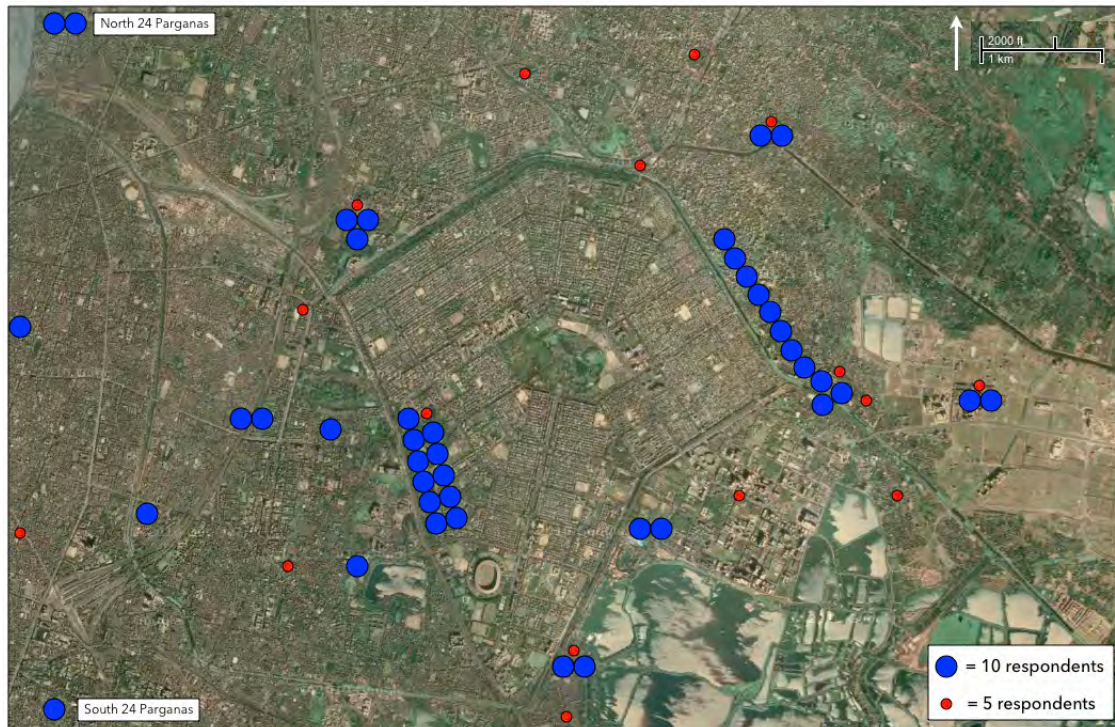
Source: Rumbach Salt Lake Labour Survey, 2010; Geoeye, 2010

The majority of respondents live in one of two major slums: Dattabad, discussed

earlier, and Kestopur, an area on the northeastern and eastern edge of Salt Lake that has

both slums and formal housing developments. Many of the remaining respondents live in

settlements to the west, north, and east of Salt Lake, mostly within a 2km radius. Relatively

few live in areas that are more than 2km away; the largest number live in the mostly rural

districts of North-24 Parganas (22) and South-24 Parganas (4), and a handful live in the

North Calcutta area around College Street (4).

The results of our labor survey are evidence of two of the relational qualities of the

formal and informal sectors. First, they are economically interdependent. The vast majority

of informal workers in Salt Lake work in essential services and trades; they are not just

performing survival activities at the margins of society, excess human capital in a city with

too many people and too few jobs (Davis, 2004). Instead, they are playing many of the same roles that the laboring poor have played in wealthy neighborhoods in Kolkata since its inception; as servants, manual labor, human transportation, and urban metabolic functionaries (food delivery, waste removal, etc.). It is difficult to imagine Salt Lake functioning without them - they are instrumental to daily life in the township.[102] Second, the formal and the informal are also co-locational; there is a spatial dimension to their economic interdependence. Research on informal housing has long shown that proximity to livelihood opportunities is a crucial factor determining the location of slum growth (e.g. UN-Habitat, 2003). The case of Salt Lake and its informal labor force supports these arguments. The work pays extremely low wages, requires long working hours, and offers few days off. Many in the labor force, especially women, have additional responsibilities in their households. Thus, the nature of the employment favors a pattern of settlement that enables workers to quickly, and cheaply, transport themselves to work while maintaining their familial, religious, and community obligations (Ray & Qayum, 2009; Roy, 2003a). The effects of urbanization are not contained within the physical borders of planned communities; rather, the labor market in Salt Lake is a key determinant of slum growth in the surrounding area.

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[102] Chakravorty (1995) argued that it was technologically feasible for households in new towns to eliminate the need for many informal sector workers through capital-labor substitution, like the purchase of domestic appliances, and predicted that many of them would do so. The results of our survey in Salt Lake indicate that this is not the case.

CHAPTER 5: A FRACTURED URBANISM

In the preceding chapters I showed how urbanization, a dynamic pressure in the PAR model, is not an organic process but is shaped, in part, by urban governance institutions like planning. I used a case study of Salt Lake as an example of planned urbanization that follows a logic of settlement that neglects the needs of low-income workers and excludes them from living in the township itself, though they are an integral part of the local economy. This chapter documents the unsafe conditions that result from Salt Lake's planned development. Unsafe conditions are the final stage in the progression of vulnerability in the PAR model and are the "specific forms in which the vulnerability of a population is expressed in time and space in conjunction with a hazard" (Wisner et al., 2005, pp. 55-56). They are the manifestation of more distant causes of vulnerability at a single point in time and in a specific place.

The chapter is divided into two sections. First, I summarize the findings of an original survey of households in the slums surrounding Salt Lake. The survey documents the unsafe conditions in those slums and the risks posed to slum households by everyday, episodic, and catastrophic disaster events. Second, I characterize the uneven geography of risk between the township and its nearby slums as fractured urbanism, a pattern of urban development that has profound implications for managing disaster risk (Coutard, 2008; Douglass & Huang, 2007; Graham & Marvin, 2001). Based on the evidence from Salt Lake, now a mature township, future new town development in the eastern fringe will likely leave hundreds of thousands of low-income individuals at-risk.

Household Survey (2010)

In the last chapter I described how residents of Salt Lake are resilient to most environmental hazards because of their socioeconomic status and the infrastructure, housing, and amenities in the township. What about the inhabitants of the surrounding slums, where large portions of the Salt Lake workforce live? How do low-income households living and working in the informal sector fare during hazard events? To answer these questions I designed and administered a household survey of slums within Salt Lake's laborshed.[103] I partnered with Prantik Jana Vikash Samity (PJVS), a local non-governmental organization (NGO), and surveyed 414 households over the course of six months, January through June of 2010.[104] We collected demographic and socio-economic information as well as data on employment, housing, land tenure, infrastructure and services.[105] Collectively, these data represent a study of baseline conditions of vulnerability, risk, and resilience at the local level.

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[103] Prantik is one of the few NGOs working in the informal settlements around Salt Lake and is primarily concerned with education and child health. I worked with a team of three Prantik employees, all of whom have extensive experience with urban poverty research and survey methods. They offered invaluable feedback on preliminary drafts of the survey instrument and were the primary enumerators of the survey. (I usually would accompany one of the enumerators during field visits, be we generally had two enumerators working simultaneously in different parts of the survey area).

[104] The survey was conducted in three phases. After designing the survey instrument and workshopping it with the enumerators and selected local officials, we conducted two pilot surveys in January 2011. Each pilot survey included 20 households; after each pilot, we had lengthy discussions about the instrument's performance and made necessary changes in the question structure, ordering, content, and language. Once we were satisfied, we began the full survey in mid-February 2010. The pilot survey data is not included in the results.

[105] There is precious little household data from informal settlements in Kolkata, especially in the newer slums on the eastern fringe of the city. Besides limited studies by academic researchers and NGOs, the most recent household data on slums that I was able to locate was published by the CMDA in 1991, almost 20 years ago (Chakrabarti & Halder, 1991). The most recent study of Kolkata's homeless populations, the so-called pavement dwellers, was published in 1975 (Mukherjee, 1975).

We surveyed households across six settlements that were broadly representative of the slums surrounding the township.[106]

Table 5.1: Survey Settlement Sample Sizes

Settlement	Settlement Size (Estimated)	Sample	Percent of Total
Duttabad	25,000	201	48.5%
Sree Krishna Pally	1,500	32	7.7%
Salt Lake II (Netaji Nagar)	2,000	50	12.1%
Naya Patti (Nazrul Colony)	3,500	79	19.1%
Kestopur (Mission Bazaar and Satorupa Pally)	1,400	52	12.6%
Total	33,400	414	100%

Source: Rumbach Salt Lake Household Survey, 2010

Community Profiles - Dattabad

Duttabad is the largest slum within the territorial boundaries of the Bidhannagar Municipal Corporation (BMC) and is referred to as an "added area" of the township.[107] It is the largest informal settlement in our survey region in terms of physical size as well as population. It is located on the western side of the Salt Lake township, bordered by the EM bypass to the west, DA block to the north, the Labony housing estate to the east, and the Salt Lake stadium to the south. For the purposes of our survey, we divided Dattabad into

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[106] For a detailed description of the survey methodology, including settlement selection and sampling procedures, see Appendix B.

[107] Besides published sources and field visit observations, this profile is based on interviews with four Dattabad residents: Prankrishan Santra (aged 70); Asit Sarda (62); Haripada Makal (75); and Ashok Sinha (52).

three regions: north, central, and south. The settlement is home to approximately 4,000-5,000 households and a total population of 20,000-25,000.[108]

Dattabad was established in the 1950's as a resettlement colony for families displaced by the reclamation of the Salt Lake wetlands. Most of these original families were fisherfolk; some residents can trace their family history in the area back several hundred years to when Dattabad was a rural village on the banks of the salt water ponds that gave the township its name. The original settlers of Dattabad often held *pattas* (leases) on lands and creeks, but these were made null and void after the Government of West Bengal acquired their land for the Salt Lake township development. One person we interviewed remembered that local functionaries from the then ruling party, the Indian National Congress, played a central role in providing assistance to residents displaced by the Salt Lake project and settled many of them in the area that is now Dattabad. Today, the settlement falls under the jurisdiction of the Bidhannagar Municipality.

Dattabad has seen several periods of rapid population growth due to migration or influxes of refugees. These include the period leading up to and following the Bangladesh Liberation War (1971) and in the aftermath of widespread flooding across the state of West Bengal in 1978, 1981, and 1990.[109] In the past decade, Dattabad has seen a new influx of

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[108] The population of Duttabad is a politically charged question. Because the settlement has long been considered a stronghold of the CPI(M), it is in the party's interest to inflate the population statistics so that, come election time, the total votes from the settlement seem plausible. At the same time, it is in the Trinamool Congress's interest to underestimate the population. The numbers presented here are based on interviews with residents, a visual survey of the entire slum area, and estimations of average household size and numbers of households living within structures. Two trends make me skeptical of any estimation of Dattabad's population, including our own: first, the population is growing rapidly and second, the buildings are being further and further subdivided to accommodate growth.

[109] In the period leading up to, and immediately following the Liberation War, Salt Lake was the site of the largest refugee camp in India. The refugees became instrumental in the construction of the township's infrastructure (Galbraith, John Kenneth, 1971; Rangan, Kasturi, 1972).

migrants from neighboring states, like Bihar, Orissa, and Jharkhand, as the economic

opportunities in the informal sector near Salt Lake continue to improve. According to the

BMC, whereas "proper" Salt Lake is mostly middle and upper less and revolves around

government employment, in Dattabad "men folk usually to [sic] manual work like pulling

rickshaws where womenfolk are engaged in domestic services" (BMC, 2007, p. 12).

The Dattabad slum is diverse in its infrastructure and housing stock. Some of the

oldest parts of the slum feature permanent housing, paved walking paths, constant supplies

of electricity, and indoor plumbing. For most of the residents however, conditions are quite

poor; by the BMC's own account there is "a scarcity of water, insufficient open drains, lack

of proper sanitation system [sic]" (BMC, 2007, pp. 12-14).

Figure 5.1: Household survey settlements relative to Salt Lake

Sources: ETH Studio Basel, 2010; Geoeye, 2010

Naya Patty (Nazrul Colony)

Naya Patty (alternatively, Nayapatti) is a medium sized slum directly to the east of Salt Lake. It is bordered by the Kestopur canal on the north and east, the Technopolis Building and Sector V to the south, and Salt Lake's AL block to the west. Naya Patty has both formal and informal development within its borders; due to its close proximity to Salt Lake, Sector V, and New Town Rajarhat, it is one of the fastest developing areas in east Kolkata. Within Naya Patty is the Nazrul Colony, a settlement with approximately 500 households, although there are significant numbers of squatters who live scattered throughout the same area; the borders of the Colony, and of Naya Patty generally, vary according to whom we interviewed.[110]

Like other settlements in and around Salt Lake, Naya Patty was largely settled by refugees from East Pakistan following Partition and during the Bangladesh Liberation War. The Government of West Bengal created settlement camps along the Kestopur canal during the refugee crisis and, while most refugees returned to Bangladesh after independence, some stayed to take advantage of the work opportunities in Salt Lake, Dum Dum, and other nearby areas. All indications are that the population is growing, but evictions are a major concern in the settlement; with the formal areas of Salt Lake, Rajarhat, and Sector V growing quickly, the land where Naya Patty is situated is becoming increasingly desirable.

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[110] Besides published sources and field visit observations, this profile is based on interviews with three residents of Naya Patty: 1) Sunirmal Das (aged 65), 2) Prayat Roy (34), and 3) Ashok Mondal (67).

Kestopur - Satorupa Pally

Satorupa Pally is a small slum with a total of 150 households (900 people) on the bank of the Kestopur canal, opposite from the AF block in Salt Lake.[111] Satorupa Pally is one of the many small slums and squatter camps that collectively make up the "Kestopur" area, which includes both formal and informal settlements and stretches along the Kestopur canal north and northeast of the Salt Lake township.

Sartorupa Pally was originally founded by internally displaced persons following the great floods of 1978. The space for the settlement had to be carved out of a dense jungle area and wetlands area that used to abut the canal. Muslim families originally founded the settlement, though the religious composition has since changed. The settlement has grown rapidly in the past several years, especially after Cyclone Aila devastated much of the southern portions of West Bengal in 2009. Satorupa Pally falls under the jurisdiction of the Rajarhat Gopalpur (Vidhan Sabha) constituency.

Kestopur - Mission Bazaar

Mission Bazaar is another small slum that is directly adjacent to Satorupa Pally. Mission Bazaar is home to approximately 120 families (500 people).[112] The settlement was founded between 1942 and 1947 as Christian converts moved to the area to be near to a Catholic Mission that was being built. Many of the families in the settlement trace their

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[111] Besides published sources and field observations, this profile is based on interviews with three residents of Satorupa Pally: 1)Sekh Abdul (aged 65); 2) Sekh Tamizuddin (34) and 3) Pankaj Das (42).

[112] Besides published sources and field observations, this profile is based on interviews with three residents of Mission Bazaar: 1) Narendra Nath Das (aged 67); 2) Ashutosh Bairgi (65); and 3)Subhdra Mondal (34).

origins back to the settlement's founding. The population of Mission Bazaar is growing, but mostly because of family size (generational growth) and because of "forced occupation" by benefactors of local political parties. It falls under the jurisdiction of the Rajarhat Gopalpur (Vidhan Sabha) constituency.

Salt Lake II (Gull Math)

Salt Lake Two, or Gull Math, is a settlement of approximately 500 household (2,000 people) located just west of the CA and DA blocks of Salt Lake, across the EMB. The settlement is bordered by the EMB on the east, Purbasa Estates to the South, and the Bagmari Muslim Burial Grounds to the West. A portion of the settlement is built along Bagmari Burial Ground road, with small shanties erected on the three feet of space between the cemetery wall and the edge of the roadway.

Salt Lake II got its name from the history of settlement in the slum; it began as a resettlement colony during the Bangladesh Liberation War, but really grew during the great floods of 1978 as rural migrants poured into the city. Since "Salt Lake" was being built immediately opposite the settlement, it became known as "Salt Lake II." According to residents, the settlement is growing rapidly today because CPI(M) functionaries are encouraging migration from nearby villages to take advantage of work opportunities available in Salt Lake, Sector V, and other nearby neighborhoods. It falls under the jurisdiction of the KMC.

Srikrishna Pally

Srikrishna Pally is a small settlement bordering Salt Lake to the northwest, bordered by VIP road to the north, the HUDCO housing estate to the south, the EM Bypass to the east,

and the Bidhannagar rail station to the west.[113] The settlement is home to 300-350 households with a total population of approximately 1,500. The population is growing but the settlement is constrained geographically, as it is built on extremely marginal land between major roadway and canal infrastructure.

Srikrishna Pally began as a refugee settlement during following Indian independence and the Bangladesh Liberation War. According to long-time residents, the settlement was set up under a rehabilitation scheme designed by the Department of Refugee Relief and Rehabilitation of the Government of West Bengal and residents were historically referred to as the "Refugee Group of 998." Today, it falls under the jurisdiction of the Kolkata Municipal Corporation (KMC).

Survey Results – Demographics

We surveyed a total of 414 households representing 1,967 individuals.[114] We interviewed more women (229) than men (185), but the balance among all individuals represented (1,967) was fairly equal, 50.2% male and 49.8% female. The average household was made up of 4.8 persons (with a median of 4); the largest had 14 members, while the smallest had just 1.[115] Our survey population was quite young; the median age of all individuals was 26. The oldest individual was 90 and the youngest was just 1 month.

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[113] This community profile is based on interviews with three residents of Srikrishna Pally: 1) Sudhanya Mondal, the Secretary of the Local Committee of the CPI(M) (aged 65-70); 2) Dhiren Biswas; and 3)Gouranga Biswas (51).

[114] Of the 414 survey respondents, 52.7% reported being head of the household while 44.9% were not. Ten respondents (2.4%) chose not classify themselves. The vast majority of surveys were conducted in Bengali/Bangla (404), with the remaining conducted in Hindi (9) or English (1).

[115] A household is a "group of people normally living together and taking food from a common kitchen" (National Sample Survey Organization et al., 2003). Members of households need not be related to one another.

More than 88% of survey households were Hindu (365), while 11% were Muslim (45) and 1% were Christian. The mix of household religions varied significantly by settlement; whereas Dattabad, Sree Krishna Pally, and Naya Patty were almost entirely Hindu, both Salt Lake II and Satorupa Pally had substantial Muslim populations (see below). True to its history, the Kestopur Mission Bazaar settlement had the highest proportion of Christian respondents.

Table 5.2: Respondent's Religion

	Hindu	Muslim	Christian	Total
Dattabad	197	4	0	201
Naya Patti	78	0	1	79
Salt Lake 2	33	17	0	50
Satorupa Pally	20	24	0	44
Sree Krishna Pally	32	0	0	32
Mission Bazaar	5	0	3	8
Total	365	45	4	414

Source: Rumbach Salt Lake Household Survey, 2010

There is an oft-repeated belief amongst city officials that most slum dwellers migrate from rural areas. We found this to be untrue; a great majority of individuals represented in our survey were born in the slums. More than 53% (1,042) were born in the structure the household occupied at the time of the survey, while 7% (137) were born in the same settlement. Only 20.8% (409) migrated from a rural area and an additional 8% (155) were born in Bangladesh.

Income and Employment

Income may be the single largest determinant of vulnerability and resilience at a household level (Wisner, Ben & Uitto, Juha, 2009). While vulnerability and poverty are by no means synonymous, poverty is a driver of vulnerability for many households because it constrains choices; about housing, housing location, education, health, insurance, and any number of other variables that ultimately affect vulnerability. Individuals and families with relatively large incomes and savings typically have the ability to reduce risk in multiple different ways, e.g. by insuring homes and possessions, having the flexibility in work and work hours to evacuate ahead of storms, investing in at-home risk-reduction measures like better housing materials and emergency stores of food and water, accessing emergency medical care, recovery from disasters and damage using immediately available savings and/or credit, and so on.[116] Although money is only one type of capital that is important for disaster resilience, it is particularly important in urban settings where most households do not have access to natural resources, land, or other types of natural capital (Wisner et al., 2004, p. 96).

The vast majority of survey households were low-income; 52% earned less than 5,000 rupees per month combined (~$108), and 96% earned less than 10,000 rs/month. A small number, around 6%, earned less than 3,000 rupees ($67) per month, and 4% earned more than 10,000 rs. Nearly 60% (247) of households reported having some form of savings. Through follow-up interviews, we learned that savings took many forms. Some of

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[116] According to official estimates from the GOI Planning Commission, 25.7% of urban dwellers in India lived below the poverty line in 2005-2006. It is widely believed that these estimates drastically underestimate the level of real poverty in cities, especially in bigger cities like Kolkata, because of the relatively high cost of food, housing, and services (GOI, 2010, p. 9).

the respondents had accounts with local banks while others kept jewelry or cash in their homes. In the Sree Krishna Pally settlement households have formed self-help groups under the guidance of their local member of the West Bengal Legislative Assembly. These self-help groups will allow members to avail themselves of a slum improvement scheme (Valmiki Ambedkar Abasan Yojuna) that will subsidize construction of new housing units and provide land with clear title to slum dwellers below the poverty line.

Researchers have long questioned the efficacy of income related questions in surveys, especially for households engaged in informal or irregular work. A proxy question for income is household expenditures; how much does a household spend on goods or services in a given week or month? We asked survey households to rank their weekly household expenditures by category (food, housing, education, transportation, and health care). More than 99% of respondents (411) ranked food as their largest expenditure.[117] Low-income households where food is the major monthly expenditure are extremely vulnerable to fluctuations in price, especially on staple items like rice, cereals, flour, dal (lentils), and cooking oil. Price increases often occur soon after disaster events because of crop destruction, disruptions in transportation networks, and hoarding by households and merchants (Sen, 1983). Even a relatively small increase in the price of food can increase the malnutrition rate amongst the urban poor.

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[117] After food, expenditures were more diverse. Forty percent (168) of respondents ranked education as their second largest expense after food, while 35%(144) said housing. Transportation (50) and health care (47) were also ranked 2nd by 11-12% of respondents.

Table 5.3: Expenditure Categories

	Highest Expenditure	2nd Highest Expenditure	3rd highest Expenditure
Food	411	3	0
Housing	1	144	126
Education	1	168	71
Transportation	0	50	84
Health Care	0	47	123
No response	1	2	10

Source: Rumbach Salt Lake Household Survey, 2010

The Government of India provides subsidized staple foods to low income families through a ration card system, a program designed to improve food security and public health (Planning Commission, 2005, pp. 365-379). Ration cards are also used in post-disaster scenarios as a mechanism for distributing emergency aid. More than 69% (1259) of those eligible in our survey (five years or older) possessed a ration card, while 30.7% (557) did not.

Employment is not important simply because of the income it generates, however; the nature of work is also central to vulnerability and resilience (Adger, 2003; Chambers, 1995). Employment in the informal sector is linked to vulnerability because of low wages but also because of the lack of protections afforded by the state. Sudden and unexpected shocks like environmental hazards impact those in the informal sector especially hard because their employment is not guaranteed and they are not protected by the state entitlement programs enjoyed by many in the formal sector (Sanderson, 2000). Work in

the informal sector is also unregulated and often takes place in hazardous locations or under unsafe conditions.

Of the 1,967 individuals represented in the survey, 911 (46.3%) were employed in the week prior to their participation in the survey.[118] The majority (57.8%) were engaged in casual or unskilled occupations like household domestic work, rickshaw driving, or construction. More than 20% (186) were self-employed, most commonly as hawkers, buyers, or food/beverage vendors. Another 13.3% were engaged in regular employment as unskilled workers, most frequently in manufacturing, construction, or municipal employment. Just 1.4% (13) of all respondents were regular, skilled employees. The labor profile of survey households is markedly different then many of the industrial slums found in Kolkata and other Indian cities, where small-scale manufacturing and household enterprises dominate the local economy (Kudva, 2009). In Kolkata, for example, the Kumortoli area is well known for its crafts men and women who create thousands of ornate idols for the city's many Pujas, most famously the Durga Puja.

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[118] Of the remaining 1,056 individuals, 469 were students, 379 were unemployed, 117 were under the age of 3, and the rest were unpaid family employees, sick or handicapped, or retired.

Table 5.4: Household Member's Main Activity in Past 7 Days

Category	Count	Percentage
Unemployed	379	19.3%
Self-Employed	186	9.5%
Employer	17	0.9%
Regular employee (skilled)	13	0.7%
Regular employee (unskilled)	121	6.2%
Casual employee (skilled)	47	2.4%
Casual employee (unskilled)	527	26.8%
Unpaid Family Employee	35	1.8%
Student / apprentice	469	23.8%
Pensioner	0	0.0%
Sick/handicapped	23	1.2%
Other	3	0.2%
N/A (under 3 years old)	117	5.9%
Missing	30	1.5%
Total	**1967**	**100%**

Source: Rumbach Salt Lake Household Survey, 2010

Employment in the slums surrounding Salt Lake, however, is concentrated in services

(domestic work, construction, transportation, food service) as well as in small enterprises

that cater to other slum residents, like food stalls, vegetable sales, or bicycle repair. A small

sampling of the various occupations of household members demonstrates the importance

of the service economy:[119]

> Household #5: (1) Maid servant, (2) maid servant
> Household #10: (1) Cycle rickshaw puller
> Household #15: (1) Cycle repair shop worker, (2) day laborer, (3) day laborer
> Household #20: (1) Carpenter, (2) maid servant
> Household #25: (1) Owner of auto-rickshaw, (2) driver of same rickshaw
> Household #30: (1) Contractor, private tutor, (2) bulb factory worker
> Household #35: (1) Driver
> Household #40: (1) Rental income, (2) fish pond fishing

Not surprisingly, the survey results also show a clear economic relationship between

survey households and the Salt Lake labour market. While 12.5% of workers earned their

livelihoods inside the informal settlement itself, 51.6% worked exclusively in Salt Lake and

another 16.2% earned at least part of their income in the township. Less than 20% of all

workers earned an income outside of the settlement but not at all in Salt Lake.

Table 5.5: Location of Household Member's Work Activity

Category	Count	Percentage
Inside this settlement	113	12.5%
Outside this settlement, Salt Lake	468	51.6%
Outside this settlement, not Salt Lake	152	16.8%
Multiple locations, INCLUDING Salt Lake	147	16.2%
Multiple locations, EXCLUDING Salt Lake	27	3.0%
Total	907	100.0%

Source: Rumbach Salt Lake Household Survey, 2010

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[119] These households are each from the Dattabad settlement and are ordered by income (highest income occupation first, followed by second, third, etc.)

Housing

Housing is central to people's interactions with environmental hazards and is a key component of disaster risk at the micro-scale. Housing encompasses both the physical space within which households live as well as the financial and legal relationship they have with the homeowner, land owner, and/or state. Housing built from permanent materials on safe land and with clear tenure tends to increase disaster resilience, while poorly built structures in hazardous geographies and with insecure tenure does the opposite.

Housing conditions varied widely across survey households and settlements, but in general most households lived in cramped and crowded conditions in temporary or semi-permanent structures. The median household shared a single room, usually a 9-16 square meter space used for cooking, eating, and sleeping. The average number of persons per room was four, with the highest ratio in Salt Lake II and Naya Patti (4.9 and 4.8, respectively) and the lowest in Dattabad (3.5). Crowded conditions in slums help spread diseases, including tuberculosis, influenza, and cholera. This is especially worrisome in the aftermath of everyday or episodic floods (Hardoy & Satterthwaite, 1991).

Building materials and the quality of construction are also important determinants of risk (Green, 2008). Well-built structures can withstand many of the everyday and episodic hazards that affect coastal cities like Kolkata, including heavy rains, tropical storms, high winds, and lightning. Buildings with permanent and raised foundations can mitigate the effects of minor flooding and well-built roofs and walls keep rainwater from entering. Well built structures also perform relatively better than temporary ones during catastrophic events like cyclones, though even permanent and well constructed buildings can easily

collapse under such conditions (UN-Habitat, 2003). Structures made from permanent materials are also more fire resistant than those made from wood, paper, or thatch.

The construction materials used to build houses, hutments, or shacks in the survey settlements may be broadly divided into *katcha* (temporary) and *pucca* (permanent), depending on the building materials used for the foundations, walls, and roof. Structures themselves may be entirely katcha, semi-pucca, or pucca, depending on the mix of materials used. A semi-pucca structure has *either* the walls or roof made of pucca materials, but not both (NSSO et al., 2003).[120] Over time, housing structures in slums tend to become more permanent, especially as households secure tenure or land rights. This is true across cities in the global South, and has historically been true in Kolkata. According to Jean Racine (1990):

> …gradually, the *kaccha* became *pakka* or *semi-pakka*. The owner of the huts, paying a fixed rent to the owner of the land, improved the dwelling in order to get a better rent from it. Those who could afford paid, while others left for *bustees* away from the centre. To improve the houses and to change the *kaccha* - light and fragile - into *pakka* - solid and strong - meant replacing clay with bricks and thatched roofs with tiled roofs, even of low-quality (Racine, 1990, p. 313).

The housing structures we surveyed were predominantly temporary (katcha) or semi-permanent (semi-pucca). Less than 36% of structures had pucca walls (148), the most common materials being concrete and stabilized bricks. Of the 264 housing structures with katcha walls (64.1%), the most common materials used were thatch, plastic, and unburnt bricks.[121] Slightly less than 60% of housing structures surveyed had pucca roofs, with tiles

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[120] Pucca and katcha are categories used by the National Sample Survey Organisation (NSSO) and the Indian Census. According to the NSSO, a pucca wall is one made of burnt bricks, GI sheets or other metal sheets, stone, cement or concrete. A pucca roof is made of tiles, slate, shingle, corrugated iron, zinc, or other metal sheets, asbestos cement sheets, bricks, lime and stone, stone, and RBC/RCC, or concrete. For photographs of different housing materials found in survey communities, see Appendix.
[121] Two surveys were missing information on housing construction materials.

as the predominant material (52.9%). The tiles themselves were often of very cheap quality, however, and attached to bamboo pole frames, making them prone to damage from heavy winds (see figure 5.2). Of the 40.8% of structures with katcha roofs, the most common materials used were plastic and thatch. Most housing structures surveyed had pucca flooring, the most common materials being cement screed (44.5%) and concrete (34.5%). Approximately 20% of the housing structures had katcha flooring, the most common material being dirt (19.2%) or bamboo.

Figure 5.2 – Semi-pucca housing structure in the Nayapatti settlement

Source: Author's photograph (2010)

Tenure and ownership of housing is another important factor that influences the permanency of structures and the quality of materials used for construction. Households

with insecure tenure tend to be hesitant to upgrade their homes or local infrastructure, because those investments might be lost at the whim of a city or state government that suddenly evicts them (Pelling, 2003; Davis, 2004). Of the 414 households surveyed, 121 (29%) were tenants, meaning they paid rent for their housing, the land it is built upon, or both. Almost all (117) tenant households were located in Dattabad.[122] Of the remaining households, the vast majority reported that they owned the structure they resided in but were occupying land without paying rent. Security of tenure is questionable under such circumstances, even with the patronage of local political party offices and functionaries.[123] As the area around Salt Lake and Rajarhat continues to develop, the largely government-owned land that the survey settlements occupy will become more valuable, increasing the pressure on the city and state to evict squatters.[124]

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[122] The median price per month for rent was 400 rupees (~$8.80). The highest rent was 1,500 rs/month ($33), while the lowest was 45 rs/month ($1).

[123] The importance of vote-banking and party politics in the state seems to have two oppositional, but important, impacts on slums. On the one hand, the power of leftist populist rhetoric in West Bengal and the numerical importance of slum voters has protected many Kolkata bustees from the wholesale demolition and evictions being carried out in Delhi, Mumbai, and other major cities. This is not to say that evictions are not happening in Kolkata - clearly, they are (Das Gupta, 2003; Roy, 2003a). But given that the meteoric rise of the Trinamool Congress and its leader, Mamata Banerjee is due in large part to her stance against the activities of Operation Sunshine and the more recent evictions in Nandigram and Patuli, it is clear that pro-poor politics still carry considerable clout in West Bengal. On the other hand, political patronage only extends so far and the political system has become deeply corrupt. While incremental improvements are sometimes made, like the paving of a footpath or installation of additional water taps, none of the informants we talked to expected major changes to the overall living conditions in the slums. Despite the lofty promises that emerge in the run-up to elections, most are never fulfilled. As Chaudhuri (2010) describes these promises, which are "all so rosy and ready on paper," as "pipe dreams for the non-shouting, powerless landless and marginalised" (Chaudhuri, 2010, p. 22).

[124] This process is already playing out in parts of northern Dattabad due to an expansion of the Metro rail service. The new east-west line connecting Howrah to Sector V and the airport is scheduled to run through Dattabad and Salt Lake. Construction has been delayed because of the resistance of Dattabad residents to eviction and relocation.

Services

The availability and reliability of basic services like electricity, water, and sanitation, are important contributors to risk or resilience at the household level. Electricity is a basic urban development indicator and is important for household and community risk reduction. Warnings about cyclones, tropical storms, and unusually heavy monsoon rains are transmitted quickly on television and the radio. Households without electricity are forced to rely on word of mouth warnings, which are less reliable than direct communication via electronic media. Across all settlements, 70.5% of households had access to electricity. Electricity service was extremely uneven across settlements, however; while 97% of households in Dattabad had access, only 9% of households in Naya Patti did. The means of electricity access is also relevant for discussions of disaster risk. Based on our observations in the field, many households with electrical hookups relied on illegal hookups, informal wiring that "pirates" electricity from transmission lines (see figure 5.3). These hookups are extremely unsafe; they are the frequent cause of fires and, especially during heavy rains or floods, deadly electrocutions.

Figure 5.3: Illegal electrical hookup

Source: Author's photograph (2010)

Access to clean, potable water is essential for everyday health and is crucial in the aftermath of episodic or catastrophic disaster events. A large majority of households in our survey have access to piped water provided by their municipality. Across all settlements, 85% of respondents used piped water as their primary or secondary source for drinking water.[125] In general, households access water at stand pipes or hand pumps scattered throughout the settlements, filling buckets, jerry cans, or earthenware pots and carrying them back to the household. Stand posts serve as few as 20 and as many as 200 households

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[125] There was significant variation across the survey settlements in terms of the balance of primary and secondary sources for drinking water. In the Kestopur settlements (Mission Bazaar and Satorupa Pally), the majority of households accessed water using hand-pumped bore hole wells. In Mission Bazaar, there is no piped water and 100% of respondents used bore hole pumps. In Satorupa Pally, just 30% of households used piped water, while 75% reported using hand pumps as their primary or secondary source. In Dattabad, where small ponds dot the settlement, 99% of households access piped water, but over 30% also reported using open water sources for drinking water. Almost all households (98%) in Salt Lake II use piped water, but 10% also use water trucks or water delivery services. When we probed on this answer, several respondents told us that water trucks deliver supplies during the frequent water shortages that plague the KMC or are sometimes more convenient than queuing at stand pipes, where long waits and sporadic delivery make collection a long and tedious process.

each, according to studies by the BMC (BMC 2007).[126] Across all survey settlements, we heard complaints about the reliability of water supplies, especially during the hot summer months.

Sanitation services are extremely important for disaster management, especially in flood-prone cities like Kolkata. Waste management systems that store sewage on-site or discharge it to nearby ponds or canals post a significant public health risks, especially during rains and flood events. Fecal material in flood-waters and contamination of drinking water sources, such as open water bodies, are some of the leading causes of disease following minor or major flood events (e.g. Schwartz et al., 2006). The diseases range from enteric infections, like cholera, E-coli, and salmonella, to skin and eye infections (Du, FitzGerald, Clark, & Hou, 2010). Children are particularly vulnerable as the sites where they play can easily be contaminated with fecal matter, and their bodies are less able to cope with the effects of many enteric diseases, especially diarrhea.

Less than 10% of survey households had access to a private toilet, nearly all of which were located in Dattabad. More than 80% of households in Dattabad and virtually 100% of households in other survey settlements relied on toilets outside of homes. Most toilets are within a five-minute walk from houses, but a substantial number of respondents had to walk further:

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[126] Looking back, I regret not asking some more specific questions about drinking water and water access. Two questions would have been useful to include: first, how long is the average wait time for access to water taps? And second, how often are there water shortages in the settlement? During qualitative interviews and while doing research for the community profiles, these issues were raised many times, and would have been important data points to collect.

Table 5.6: Time to walk from house to latrine (one-way)

Time (one-way)	Count	Percentage
Less than 1 minute	57	13.8%
1-5 minutes	190	45.9%
6-10 minutes	91	22.0%
11-20 minutes	14	3.4%
More than 20 minutes	17	4.1%
Not sure	6	1.4%
Not applicable	37	8.9%
Missing	2	0.5%
Total	414	100%

Source: Rumbach Salt Lake Household Survey, 2010

Only 23% of toilets/latrines deposit the waste into the municipal system. Most rely on open bodies of water (31.4%), septic storage tanks (30.2%), pits (27.3%), or open drains (3.1%).

Figure 5.4: Canal and Pit Latrines

Source: Author's photographs, 2010

Infrastructure and Flooding

Drainage infrastructure is essential for reducing disaster risk in flood prone cities like

Kolkata. Whereas the Salt Lake township has an underground sewerage system that

performs relatively well even during heavy monsoon rains, the informal settlements in our

survey varied widely in both the presence and performance of drainage systems. Of all

households surveyed, only 38.6% (160) reported having a drain outside their homes, while

61.4% did not. Of the 160 respondents with drains outside their homes, only 20% (32)

reported that the drains worked "most or all of the time," while 56% (89) worked "some of

the time" and 24% (38) worked "rarely or not at all." Where drainage infrastructure did

exist in the survey settlements, it was almost always open: hand-dug trenches, concrete

lined gutters, canals, etc. For example, the BMC describes the drainage infrastructure in

Dattabad:

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> There is a Gutter channel running between the unplanned areas and the planned township. The household and latrine effluents from the nearby houses along with [sic] the runoff water during the monsoon, passes through this Gutter channel. Except this Gutter Channel, there is no other remarkable drainage feature in the area. (BMC 2007, p. 57)

While open drains are generally preferable to no drainage infrastructure, they do suffer from several serious defects. For example, open drains are susceptible to clogging (from garbage, invasive plants, siltation, etc.,) and without regular maintenance can quickly become ineffective. Stagnant water in clogged drainage systems can contribute to infectious disease outbreaks because it is a breeding ground for mosquitoes and other insects. Open drains can also overflow during flood events, even minor ones; if those drains carry raw sewage, gray water, garbage, industrial runoff, or other hazardous materials, overflowing may have serious public health impacts.

Figure 5.5: Open drains - Duttabad

Source: Author's Photograph, 2010

Due to inadequate drainage and a flood-prone geography, survey households experience frequent flooding during the monsoon. Seventeen percent (72) of survey

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households reported that the road or footpath outside their home would always flood. Another 45.2% (187) said that the road/footpath would flood sometimes, and 14.7% (61) said rarely. Only 22.7% (94) reported that the road/footpath never flooded during the monsoon. When asked "during the monsoon, does your home flood?," 17% (70) reported that their homes always flooded. Another 51.2% (212) said that their homes sometimes flooded and 13.5% (56) said yes, but rarely. Only 18.4% (76) said "never."[127]

Figure 5.6: Frequency of homes flooding during rain
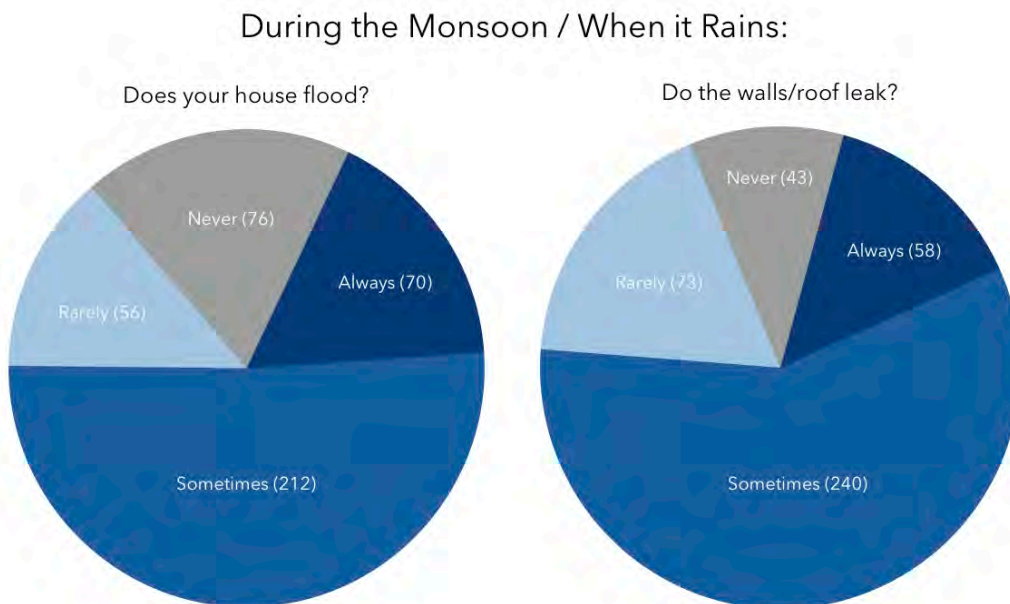
Source: Rumbach Salt Lake Household Survey, 2010

The likelihood of homes flooding during the monsoon varied substantially by settlement (see Table 5.6). It is not surprising that settlements like Salt Lake II, Dattabad, and Satorupa Pally routinely flood. Unlike the Salt Lake township, they are lower-lying and are in the flood plain for the greater Kolkata region. What is surprising, however, is that

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[127] For the purposes of our survey, flooding was defined as an event where water enters the housing structure from the ground up. This is distinct from water entering the home through the walls/roof, which is more of a reflection of the quality of housing materials and construction than the presence or performance of drainage systems.

fewer households reported flooding in Naya Patti and Mission Bazaar, though they have poorer infrastructure overall. The most logical explanation for this finding lies in the location of the settlements themselves. Both Naya Patti and Mission Bazaar are built near the Krishnapur (Kestopur) canal, and many of the homes are directly adjacent, or above, the canal itself. Everyday or episodic floods would largely pass by, or under, those housing structures and into the canal. What is troubling, however, is the possibility of a catastrophic flood event where the canal itself tops its banks. In that situation, it is hard to imagine that any of the structures in those settlements would escape significant damage or destruction.

As with housing, infrastructure in slums tends to improve incrementally over time, with piecemeal investments made by the local community, NGOs, and/or the state and local government. In Kolkata, and West Bengal generally, the NGO sector is considered relatively weak compared to other states in India. This weakness was reflected in our survey results. When asked, "in the past 5 years, have there been improvements made in this slum (roads, drainage, schools, health care, etc.)," more than 70% (292) said yes. When asked "who was responsible for the improvements made," more than 99% gave credit to the government.

Table 5.7: Response to question "During the monsoon, does your house flood?"

Response	All		Dattabad		Sree Krishna Pally		Salt Lake II		Naya Patti		Mission Bazaar		Satorupa Pally	
Yes, always	70	16.9%	45	22.4%	2	6.3%	5	10.0%	7	8.9%	1	12.5%	10	22.7%
Yes, sometimes	212	51.2%	98	48.8%	19	59.4%	42	84.0%	25	31.6%	1	12.5%	27	61.4%
Yes, but rarely	56	13.5%	34	16.9%	4	12.5%	2	4.0%	6	7.6%	3	37.5%	7	15.9%
Never	76	18.4%	24	11.9%	7	21.9%	1	2.0%	41	51.9%	3	37.5%	0	0.0%
Missing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Total	414		201		32		50		79		8		44	

Source: Rumbach Salt Lake Household Survey, 2010

This is markedly different than in other studies of slum upgrading and improvements, where NGOs and community mobilization played the key role (e.g. Pelling, 2003; Shatkin, 2000).[128]

Figure 5.7: Housing Structures on the Kestopur Canal

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[128] Uncovering the reasons for a weak NGO sector in Kolkata is beyond the scope of my dissertation. A few interesting theories emerged, however, in my conversations with NGO leaders and local residents. First, and most important, is the "omnipresence of providers of political patronage" and "the need to play to the tune of…vote bank politics" (Das Gupta, personal communication, March 23rd, 2010). There are few, if any, aspects of life in Kolkata that are not mediated in some way through party politics, including in the slums. Local parties act as intermediaries for a host of services and government schemes, delivering housing, health care, and other amenities in exchange for party loyalty. The same logic extends to slum improvements; the most intense development activity in Kolkata's bustees tends to happen just ahead of municipal and state elections, as the political parties try to court voters ("Left Focuses on Urban Poor," 2010). For example, After a major fire broke out in the Ultadanga slum near Salt Lake in January 2010, just ahead of the municipal elections, the political parties scrambled to outdo one another with promises of rehabilitation for victims. For several weeks, representatives of the CPI(M) and TC argued back and forth over who would provide the best rehabilitation scheme, improving on each others promises ("Fire at Ultadanga," 2010). Second, the strength of party politics has led to a "co-optation" of NGOs and CBOs that are able to access funds from the central government or international donors. As one NGO leader told me, "the very minute I get funding I will have 10 party goons outside my door, wanting to run the show."

Source: Author's Photographs, 2010

A Fractured Urbanism

Our survey results demonstrate a wide range of unsafe conditions in the slums surrounding Salt Lake and paint a clear picture household and community disaster risk. Workers are predominantly low-income and earn their livelihoods in the informal sector, where they are afforded neither security nor legal protections. The settlements lack basic infrastructure and households have uneven or insufficient access to basic services like electricity, sanitation, and clean water. The housing structures are poorly built from mostly temporary or semi-permanent materials and are extraordinarily overcrowded. Many are located in hazardous geographies near roadways, sewage canals, or stagnant ponds.

By virtue of these unsafe conditions, households are at-risk of a wide range of everyday, episodic, and catastrophic disasters. Everyday disasters are common in slum settlements (Davis, 2004; Bull-Kamanga et al., 2003; Hardoy & Satterthwaite, 1991). Poor drainage, sanitation, and waste management combine to cause a range

of health problems, especially during heavy rains or minor floods. Living alongside major roadways dramatically increases the incidence of injury and death to pedestrians from automobile and truck traffic (Badami, 2009). The common practice of cooking over charcoal stoves make fires a constant threat, one that is exacerbated by the density of housing structures and the use of katcha materials like thatch and bamboo. The common (and often illegal) electrical connections to high voltage lines overhead make electrocution one of the most common, and least discussed, hazards in informal settlements. Poverty cuts across our entire analysis of risk, because poor households have a far more limited range of options for reducing risk or managing the impacts of hazards (Adelekan, 2010; Douglas et al., 2008; Hardoy & Pandiella, 2009; Murray, 2009; Rashid, 2000; UN-Habitat, 2003; Wisner, 2004a).[129]

Many of the same factors that make households at-risk to everyday disasters put them at greater risk from the episodic and catastrophic events that periodically threaten the city. A major flood, similar to 1978, or a cyclone of the size and trajectory of the 1864 storm, would have devastating consequences for the informal settlements surrounding Salt Lake. Slum households, most without access to private

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[129] One of my top priorities for future research is to conduct follow-up interviews that focus exclusively on household and community management of hazards. In partnership with PJVS, I had intended to do individual and household ethnographies of flooding, but ran into unexpected research roadblocks as the municipal elections approached. Essentially, as the campaign season heated up, we found it increasingly difficult to work in the slums because of the influx of party loyalists who loudly (and sometimes aggressively) questioned our motives. Luckily for us, these issues arose at the very tail end of our survey effort and were were able to complete our work to produce an adequate data set. Consulting with community leaders and staff at PJVS, we decided that it would be best to do follow up work at a later date, rather than risk (however unlikely) the safety of the enumerators or interview participants.

transportation or the economic resources to quickly evacuate, would find themselves trapped on low-lying land between the river and the marshes, taking shelter in poorly constructed houses built near the canals that carry storm water away from the rest of the city. The likelihood of katcha or semi-pucca housing surviving a cyclone is slim, given the high winds, lashing rains, and flying debris that is characteristic of such storms.

Compare these to the risks faced by residents of Salt Lake and it becomes clear that the geography of risk between the township and its slums is highly uneven. In and of itself, uneven risk between rich and poor is not unusual; the same pattern of development has taken place in Kolkata since the colonial period. Though the rhetoric used by the leaders and residents of Salt Lake is wrapped up in the language of the new, the planned, and the modern, in reality the township is reproducing the same pattern of uneven development that has characterized the city since Job Charnock made landfall. Just as the "black town" developed in an unserviced and hazardous way, so have the slums that house the labor that keeps Salt Lake working. The Salt Lake case demonstrates that new towns are not the "modern" cities that Chakravorty (2005) predicted, where residents would adopt household labor saving devices (like vacuums, dishwashers, etc.) in exchange for servants. Instead, residents and administrators are pursuing the look and feel of a modern city by pushing slums beyond the physical borders of the township, while reaping the benefits of cheap and plentiful human labor for maintaining a certain quality of life. While they continue to pursue the "wonderland" imagined by Toskovic and the utopian master planners who inspired him, they run into the same

central contradiction of utopia that Holston (1989) identified in Brasilia; the "substance" of Salt Lake, the people, households, businesses, and institutions located there, bring with them many of the traditions and histories that the utopia was meant to reject. While the residents of Salt Lake have attempted to remove poverty from sight and earshot, they have maintained the same economic structure and labor relationships through which slums grow and flourish. As a result, a distinct pattern of spatial development is occurring, where slums grow up close enough to the township to satisfy the voracious demand for low-income wage labour, but far enough away so that township residents can enjoy the promise of the modern city, one that is "clean, spacious, and free from visible poverty" (Chakravorty, 2005).

I describe this logic of settlement as fractured urbanism, where the middle and upper classes inhabit the formal, serviced, and safe spaces but depend on low-income workers who are forced to inhabit unserviced and unsafe land in the periphery. Fractured urbanism is a play off of Graham and Stephen's influential work *Splintering Urbanism* (2001), which argues that the "unbundling" of infrastructure networks and the bypassing of low-income and poor communities is splintering the material and social landscapes of cities (Coutard, 2008; Douglass & Huang, 2007). I prefer the term "fractured" because it paints a picture of an urban fabric made up of co-constitutive parts, despite the fractures and fissures that divide them. While Salt Lake is epitomizes the "premium, networked" spaces that Graham and Stephen describe, its well-being is still intimately linked to the non-networked spaces surrounding it. The same is true for workers in the informal sector; their lives and livelihoods rely on the employment opportunities afforded them by those

in the premium spaces. Because these spaces are both economically and spatially co-constitutive, fractured urban development has major implications for disaster risk, a discussion I turn to in the next chapter.

CHAPTER 6: CONCLUSION

In May of 2011, a political coalition led by the All India Trinamool Congress

(TMC) won a landslide victory in the West Bengal Assembly poll, capturing 227

seats in the 294 seat legislature and control over the state bureaucracy.[130] The

TMC's election made international news because it marked the end of the longest

democratically elected Communist government in the world; the Left Front, a

political coalition led by the Communist Party of India (Marxist), had enjoyed

uninterrupted rule over West Bengal for more than 34 years. For many, the election

of the Trinamool Congress and its populist leader, Mamata Banerjee, marked a

symbolic break from the past, a new beginning in a city beset by economic, political,

and environmental woes. Chief Minister Banerjee wasted no time putting forward a

grand vision for Kolkata, promising that under TMC rule, the city would soon

resemble London, a green city with modern amenities, efficient services, and a

vibrant economy.[131]

The rhetoric of the TMC reflects shifting attitudes towards cities at the

national level. India has historically neglected urban areas, in public policy as well as

the allocation of public funds. Vyjayanthi Rao argues that the city is the ultimate

symbol of modernity in western society, but in India it is the nation-state itself that

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[130] Though the Left Front had controlled the state assembly for more than 30 years, control over the Kolkata and the Kolkata Municipal Corporation had changed hands several times in the preceding decades. In 1995, the Congress Party won control over the municipality from the Left Front, followed by a victory for the TMC in 2000. In 2005, the CPI(M) led Left Front regained control from Trinamool, only to lose it again in 2010.
[131] Lofty campaign rhetoric aside, the TMC does seem focused on improving conditions in the city. Banerjee substantially increased the development budget for 2012, with a 24% increase in funding for the state planning commission, much of it targeted towards infrastructure improvements in Kolkata (Bangaaliana, 2011).

is considered the "ultimate arbiter of issues of citizenship, justice, and belonging."
As a result, cities like Kolkata have had, at best, an "ambivalent place as a site of
modernity" and that urbanization may be viewed as an "inappropriate trajectory for
Indian modernity" (Rao, 2006, pp. 225-226). It was only in the Seventh Fifth Year
Plan (1985-1990) that the problems of haphazard urban development, urban
poverty, and slums were first explicitly addressed (Selja 2008). The Eleventh Fifth
Year Plan (2007-2012) recognizes the central role that cities play in economic
development and argues that the future economic prosperity of the nation depends
on "making Indian cities much more livable, inclusive, bankable, and competitive."
In other words, sustainable urbanization is at the top of the national development
agenda (Government of India, 2007).

A core component of the sustainable urban development is the mitigation of
environmental hazards (Satterthwaite, 1999; Wisner, 2003; UN-Habitat, 2009). In
other words, one of the central planning and urban development challenges facing
the new Trinamool administration is disaster risk management. The goal of this
dissertation has been to explore the straightforward but difficult question: how does
urbanization shape disaster risk in the global South? Using a mixed methods
research design and an in-depth case study of Kolkata, I have shown how urban
development, guided by governance institutions like planning, leads to uneven
geographies of risk at the local level. In this brief concluding chapter, I summarize
my findings and the contributions they make to the hazards research and planning
literatures. I also discuss some of the implications my findings have for planning and
disaster management practice in Kolkata and India.

Like many cities in India and across the world, Kolkata is increasingly at-risk from environmental hazards. While the city's location and climate have always made it prone to environmental hazards, in the past several decades the urban footprint has expanded beyond the safest land near the river and towards the hazardous floodplains to the east and south.[132] The geography of disaster risk in the city, however, is extremely uneven, with vulnerability concentrated in slums and squatter settlements in the urban periphery. Using the Pressure and Release model of disaster vulnerability, I construct a "chain of explanation" from the unsafe conditions at the scale of the household and slum to more distant socio-economic, political, historical, and institutional forces.

Kolkata's development trajectory is guided by elite driven planning with its origins in colonial approaches to urban governance, where ruling interests guided formal development while poor and "native" groups were left to settle in marginal or un-serviced areas outside of the urban core. This same logic of settlement informed the creation of Salt Lake, a new town development in Kolkata's eastern periphery. Salt Lake's planning and development illustrates the chain of vulnerability and is a case study in how planned urbanization can lead to unsafe conditions for marginalized groups. Salt Lake is home to mostly middle and upper

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[132] Two factors could further increase the frequency and severity of hazard events for residents in the eastern periphery. First, global climate change will likely cause more frequent and intense tropical storms and cyclones, elevated storm surges, more intense rainfall during the monsoon season, and a host of other environmental impacts (World Bank 2010). Second, the city's continued growth eastwards will do further damage to the East Kolkata Wetlands, a natural buffer against tropical storms and storm surges, increasing the likelihood of future cyclones impacting the city (Ghosh, 2005; Amrita Chatterjee and Dipayan Dey, personal communication, April 4, 2010).

class residents, but daily life in the township requires a large number of informal and low-wage workers. Through interviews and an original survey of low-income labourers, I show that the poor are excluded from living in the township itself and instead settle in slums and squatter camps nearby. The Bidhannagar Municipal Corporation (BMC) imagines Salt Lake as a "modern township" that is free from the encumbrances of the older city. As a result, the BMC not only fails to plan for slum dwellers and squatters who have settled within its borders, but also actively seeks to expel them beyond its physical boundaries.[133]

This pattern of urbanization is common in Southern cities, where planning is often unwilling or unable to incorporate the needs of the informal sector. As a result, I describe urbanization as a dynamic pressure that leads to unsafe conditions at the household or local level; in the case of Salt Lake, the rapid growth of slums on un-serviced and hazardous land surrounding the township. I document these unsafe conditions using data from an original survey of households in these informal

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[133] In Kolkata and other cities with cultures of spatial, rather than comprehensive, planning, the success or failures of planning are affixed within the spatial boundaries of the developments themselves. When I asked Dobrivoje Toskovic, the planner who designed Salt Lake, about the larger environmental and social critiques of the project, he became defensive, saying "of course nothing is ideal." He then suggested a different standard by which to judge his work: "The main question is: are people living in Salt Lake satisfied or not?" (D. Toskovic, personal communication, March 18, 2010). Toskovic made a similar argument after visiting Salt Lake in 2007, 40 years after the township was initially conceived:

> I realized that the concept of Salt Lake City and its implementation is accepted and that the inhabitants of this New city are satisfied, which for the Author represents the highest reward" (Toskovic, 2009).

He felt that the city had developed the way he imagined: "It has grown into a lovely garden city, just as I had planned." During our interview, I asked him if he had visited Dattabad during his tour of the city; he had not, as it was "not part of the Salt Lake township."

settlements. Within the framework of the PAR, households living in these slums are at-risk of disaster. By virtue of their location in a low-lying flood plain, they are exposed to a wide range of environmental hazards, from everyday events like monsoon flooding and water pollution to catastrophic cyclones and tropical storms. Poverty, lack of basic infrastructure and services, poor housing construction, weak disaster management institutions, and a host of other factors make them vulnerable to those hazards.[134]

New town developments are a central feature of the city's future development, but are also representative of the urbanization process generally. As the only mature new town development in the KUA, Salt Lake lends us important evidence about the likely outcomes of future developments. New town projects like Rajarhat, a high tech township coming up alongside Salt Lake, along with luxury residential towers and other private residential enclaves, will eventually house several million people in Kolkata's periphery.[135][136] Unless Kolkata and West

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[134] Like Wisner et al. (2004), I run the risk of portraying informal and low-income workers as passive victims lacking in agency or self-determination with regards to disaster risk by emphasizing the historical, structural, and institutional drivers of vulnerability. This is certainly not the case. In reality, slums like Dattabad and Kestopur are some of the most desirable destinations for low-income laborers in Kolkata, given the healthy labor markets in Salt Lake, Rajarhat, and other nearby municipalities. Households also engage in a range of small scale risk-reducing activities. Examples of the activities we observed during our household survey and associated field visits and inteviews included upgrades in housing structures and/or materials, elevation of furniture and bedding, temporary evacuation of housing structures during heavy monsoon rains, small-scale improvements to drainage infrastructure such as hand-dug trenches outside of hutments, and pressuring local political parties to improve drainage infrastructure in frequently flood-stricken areas. This raises the important question of acceptable risk; how much risk are low-income households will to accept in exchange for employment and income? This is a topic I would like to explore in my future research on India.

[135] New Town Rajarhat was renamed Jyoti Basu Nagar in 2010.

[136] An important dimension of new town planning and development that I have not discussed here is the linkages projects like Rajarhat and larger processes of globalization,

Bengal's approach to planning and development changes, we should expect to find similar geographies of risk emerge as those around Salt Lake. While it is true that Kolkata's poor have always suffered disproportionately from environmental hazards, new town projects will continue, and in many ways accelerate, these trends.[137] Salt Lake, and new town projects generally, are different than traditional development in the city. For one, new town projects are being planned and developed on low-lying land in the region's flood plain. Even if the same vulnerabilities that exist in other slums persist near new town projects, their location in the flood plain substantially increases the frequency and intensity of hazards that households and communities are exposed to. Within the planned townships themselves, planners and administrators manage increased exposure to hazards by investing in risk-reducing infrastructure and services, like separated storm-water managements systems, elevated land and building foundations,

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especially in the IT sector. As Shatkin (2004) argues, the "fundamental insight of the growing literature on the relationship between globalisation of cities, spatial change, and social inequality has been that urban development in market economies Is inherently uneven" (Shatkin, 2004, p. 2471). Technological innovations like the internet allow global industries, especially the IT sector, "to take advantage of technological innovations in telecommunications and transport to lower the cost of production by seeking cheaper land, labour and natural resources in increasingly peripheral locations..." Within peripheral locations like India, footloose IT companies and professionals demand modern amenities and gravitate towards high-tech cities and enclaves, most notably Bangalore and Mumbai. The exclusion of the poor from enclaves like Salt Lake, Rajarhat, and other parts of Kolkata, then, is linked to a larger desire to be "world class" communities that can attract global industry, with all the modern amenities and services professionals expect but without the visible signs of poverty traditionally found in the Indian metropolis.

[137] Although my study is focused largely on accumulation of risk in informal settlements, Kolkata's growth trajectory has implications for disaster risk in formal developments as well. Of particular concern are catastrophic hazards, like a major cyclone or unusually heavy monsoon rains, which could easily overwhelm drainage infrastructure and cause severe damage and flooding. Given the lack of storm warning systems, emergency evacuation routes, or disaster management institutions in general, a catastrophic hazard could cause widespread loss of life and property damage in both formal and informal settlements.

updated building codes, backup water and electricity supplies, and so on.[138]Poor

communities, however, are pushed beyond the boundaries of the townships, leaving

them in slums and squatter camps in adjacent municipalities, which often have far

fewer resources with which to manage risk.

Based on this evidence, I make several arguments that advance our

understanding of urbanization and disaster risk in the global South. Most important,

planning should be described as a root cause of vulnerability or resilience. Planning

may be quite distant from actual disaster events, spatially or temporally, but

influences both the trajectory and character of urban development. Rather than

treating urbanization simply as rapid population growth, I show how urban

governance institutions like planning and the settlement logics they employ shape

geographies of disaster risk within the city. In the case of Salt Lake, planning and

governance institutions neglect the needs of the informal workforce and actively

exclude them from the township. Salt Lake's dependence on low-income and

informal labor, on the one hand, and the township's exclusion of the poor, on the

other, results in a fractured urban landscape with highly uneven levels of risk to

everyday, episodic, and catastrophic hazards.

This expands the concept of urbanization as a dynamic pressure in the PAR

model and demonstrates how the process of urbanization, guided by planning and

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[138] Because of the decentralization of local government in West Bengal, new towns are being spun off as separate municipalities with their own responsibilities for taxation and service provision. In May of 2011, the TMC led government proposed bringing Salt Lake, Rajarhat, and several other municipalities in the KUA under the control of the KMC. As of July 2011, it is unclear whether this proposal will eventually become law, given the skepticism voiced by leaders in those municipalities.

other governance institutions, helps shape conditions at the ground level. It also helps to explain the variations in disaster risk between cities that have different approaches to urban development, even with similar climates, geographies and levels of economic development.[139]

My findings also highlight the relational qualities of informality, a distinguishing feature of urbanization in the South. Whereas informality is often compartmentalized as a separate area of inquiry and policy, I demonstrate the co-constitutive nature of formal and informal urban growth. Although large portions of economic activity and housing in Southern cities are located in the informal sector, informality is often excluded from the planning schemes that govern development. My study shows that in the context of new town developments like Salt Lake, the formal and the informal are locationally and economically interdependent, together comprising the larger urban fabric. Informal workers in Salt Lake settle in hazardous slums surrounding the township for a host of practical reasons, including lowered transportation costs and to cope with the time demands inherent in low-wage labor. They are vital to the functioning of the township but excluded from the infrastructure and services necessary for reducing risk to an acceptable level. If planners in Kolkata and other Indian cities hope to reduce the risk of disaster for future developments, it is crucial that they recognize this interdependence. Simply documenting the unsafe conditions of slums and proposing infrastructure

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[139] Dhaka is located less than 250 km (150 miles) from Kolkata with a similar climate and geography but is considered to have stronger disaster management institutions and is better equipped to manage environmental hazards. The two cities are natural cases for comparison of the effects of different historical, socio-political, economic, and institutional contexts on geographies of risk, a project I hope to take up in the near future.

improvements is not enough; they must also focus on formal development processes that will inevitably lead to informal growth.

These findings reveal some of the weaknesses in theoretical frameworks that analyze vulnerability in-situ, like the HIP model. If conditions of vulnerability and risk in the slums near Salt Lake were examined without a corresponding understanding of their role in the Salt Lake economy, the socio-economic and political conditions that lead to the exclusion of informality in planning and public policy, and the roles that institutions like planning play in shaping urban development, then the resulting policies would be targeted towards the symptoms of urban risk rather than the underlying causes of it. Such policies may be useful for improving conditions in already vulnerable communities, but would do little to mitigate the future growth of at-risk settlements.

Disaster Management and the Geography of Urban Risk

Until recently, disaster management has not been a priority of the Indian government, despite the disproportionate impacts of disasters on the country's population. The Tenth Five Year Plan (2002-2007) recognized disaster management as a development issue for the first time and argued that environmental hazards pose a significant threat to state, regional, and national development processes. The Plan also acknowledged that hazards had "never been adequately factored into our planning." (Planning Commission, 2002; 2008). Crucially, the Plan recognized that state and center governments in India had traditionally *reacted* to disasters as they happened rather than reducing impacts through planning." By and large, we have

taken the approach that these events are transient in nature and, therefore, can be addressed as and when they arise" (Ibid., p. 7).

The Disaster Management Act of 2005 (DMA), passed in the aftermath of the Gujarat earthquake, created legal requirements for the implementation of disaster management plans at the national and state level and codified the shift in priorities from disaster relief to disaster mitigation and preparedness. There is considerable interest at the local, state, and national level for planning and development policies that achieve the twin goals of continuing economic growth and reducing risk to urban environmental hazards.[140]

The implementation of the DMA has far varied considerably from state-to-state, however. In West Bengal, the Department of Disaster Management did prepare a state-level disaster management plan in 2008 but it remains in draft format almost three years later.[141] Based on interviews with more than two dozen government officials, NGO leaders, and academic researchers, it is fair to say that the state plan has not had any significant impact on planning or policy in the city. None of the city officials I spoke with had heard of the state plan, and just one was even aware of the DMA itself.

My research demonstrates the disconnect between the ambitions of the Disaster Management Act and the governance institutions that shape city growth. In

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[140] For example, see the proceedings of the Second India Disaster Management Congress 2010, online at http://nidm.gov.in/idmc2/home.asp.

[141] To call it a plan is somewhat charitable. From a public policy or planning perspective, the report does not seem to have much utlility, largely consisting of tables of data on past disaster events (without sourcing information) and vague recommendations ("all warning systems should be used"). I attempted to schedule a meeting with officials at the Department of Disaster Management for more than a year to discuss the plan, but was unsuccessful.

order for the DMA to be effective at the city level, it must expand the mandate for

urban risk reduction beyond disaster management departments and into the offices

where city management policies are formulated and implemented. International

efforts like the United Nations International Strategy for Disaster Reduction's

"Making Cities Resilient" campaign may be a useful bridge between national level

policies like the DMA and city government.[142] The effectiveness of such campaigns

will rest largely on whether city, state, and national governments are willing to

acknowledge the root causes of disaster risk and work towards fundamental

economic and social reforms, however. If their attention continues to focus on the

outcomes of fractured urbanism rather than its source, then such agreements will

do little to reduce disaster impacts in the long term.

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[142] For an overview of the UN-ISDR campaign, see
http://www.unisdr.org/english/campaigns/campaign2010-2011/.

APPENDIX A: METHODS

Hazards research is an interdisciplinary endeavor that stretches across nearly every academic field and area of study. As a result, there is a tendency for reductionism towards disciplinary expertise: in the earth sciences, towards studies of hazards, their characteristics and occurrence; in architecture, towards the performance of the built environment during hazard events and improvements in landscape and design; in sociology, towards the study of social systems and the vulnerability of various groups; and so on. While this tendency towards disciplinary explanations is understandable given the terrain of academia, it is less than satisfactory for informing public policy. If tragedies like the Indian Ocean Tsunami or Hurricane Katrina have taught us anything, it is that disasters are "wicked" problems that can only be understood, and addressed, holistically (Rittel & Weber 1973).

In my account of Salt Lake and the geographies of risk that new town developments engender, I argue that states of vulnerability should be understood as products of history and the vestiges of historical institutions as well as current social, political, economic, and institutional contexts in which people and communities are embedded. Inspired by King (1976), Holston (1989), and Green (2008), among others, my research design incorporated multiple types of qualitative and quantitative data that combine to paint a more complete portrait of Salt Lake and its surrounding slums. I gathered these data while living in Kolkata from 2009-2010, with frequent visits to peri-urban communities east of the city. Like Roy (2003), my initial research aspirations were tempered by the data limitations in

West Bengal and Kolkata, especially related to urban poverty and informality at the local level. To my knowledge, there is no accurate account of the location, size, and characteristics of informal settlements in the eastern periphery. What data we do have is largely out of date or, in the case of some organizations and agencies, extremely limited in scope.[143] As a result, I worked to generate my own primary data, primarily through two surveys as well as archival research, satellite imagery and geospatial analysis, and semi-structured interviews. The following appendix provides greater detail about my data collection efforts.

Library and Archival Research

To understand how contemporary geographies of disaster risk in Kolkata are rooted in planning and colonial development, I made extensive use of libraries and historical archives in India and the United States. The National Library in Kolkata was especially important for my study; their holdings include many out-of-print volumes on the city's history and development post-Independence, in addition to invaluable historical records from the British colonial period. The library at the Centre for Studies of Social Science, Calcutta contains many historic and contemporary planning documents and government reports, including compendia of published materials from the CMDA, KMDA, KMC, and the Urban Development Department. The archives at the Centre for Built Environment in Kolkata hold substantial number of documents related to planning and urban development in West Bengal. I also benefitted from the excellent South Asia collections at Cornell University, the University of Chicago, University of California Berkeley, and

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[143] For examle, PJVS has done several baseline surveys of socio-economic conditions in slums near Salt Lake, but their efforts are limited to just three settlements.

Columbia University. I made frequent visits to archives in Kolkata and Delhi, including the National Library's newspaper and periodical archive, the State Archives of West Bengal, the National Atlas and Thematic Mapping Organization archive and the National Archives of India. I was able to access several United Nations and World Health Organization reports from the mid 20th-century by contacting organizational librarians and requesting specific items. I also visited the Ford Foundation archives in New York City, where records of the foundation's involvement in the Bustee Improvement Scheme (1965) and Basic Development Plan (1966) are kept.

One major drawback of my archival research is my lack of Bengali language training. While there are many important resources on the history of Kolkata and West Bengal written in English , my historical and archival work would have improved if I were able to review the rich archive of Bengali language newspapers and scholarship available in Kolkata.

Salt Lake Labour Survey (2009-2010)

To gain a more systematic understanding of the informal workforce in Salt Lake I designed a short survey instrument around the themes of work, housing, and transportation. With the help of a translator, I administered the survey to workers from across the township.   The survey area was comprised of 53 blocks, spread equally across sectors I-III.[144] Along with my research assistant/translator, I

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[144] I excluded 21 blocks from the survey, for varying reasons. Some blocks contained private educational institutions or government offices that were closed to the public. For example, Block DE is largely comprised of Indira Bhavan, the long-time home of ex-Chief Minister Jyoti Basu, and KA block is almost entirely taken up by Salt Lake stadium. Other blocks were

interviewed a total of 598 informal workers in a 7-week period from February-

March of 2010. Our survey instrument contained nine questions related to work,

mobility, and housing.[145] The average interview lasted approximately 7-10 minutes,

although we often held longer informal discussions afterwards.

Developing a sampling strategy for informal workers is a difficult task; there

are no lists, censuses, employment records, or registrations that tells us how many

workers there are or what full range of activities they are engaged in.[146] In the

absence of that data, it was impossible to create an accurate sampling frame.

Instead, I relied on those several months of observations about daily life for

residents of Salt Lake and the workers that supported them. I drew up preliminary

lists of all occupational categories I had observed and during our survey we made a

conscious effort to balance the numbers of respondents from different occupational

groups. We conducted the surveys at three different times, on every day but Sunday:

from 7-10 a.m., 11 a.m.-2 p.m., and 5-7 p.m. The total number of surveys

administered during each time period was roughly equal. Our method of identifying

potential interviewees varied; we set out to complete 1-2 blocks per day and 10-20

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dominated by a single commercial establishment or landmark, such as the Salt Lake
Stadium or City Centre Mall complex.

[145] A copy of the survey instrument can be found in Appendix B. We piloted the survey
instrument twice in January 2010. The first pilot was with 20 respondents, after which we
made minor changes, and piloted again with an additional 15 respondents. After making
final changes, we began the full survey in February.

[146] There is some very limited data on individual occupational groups in Salt Lake. For
example, the cycle rickshaw union, Citu, puts the total number of rickshaw drivers in the
township at 3,750, operating through 90 stands throughout the township (Chakraborty,
2010). They also point out that many rickshaw pullers illegally enter and operate in the
township on a daily basis.

surveys per block. We approached potential survey respondents in a number of

different locations:

Streets: We initiated many of our interviews on the street, meeting workers
who were coming to or going from work, engaged in work (pulling fruit carts,
pedaling rickshaws, doing construction, etc.), or running errands for their
employers.

Transportation hubs: During peak travel times, we focused much of our
attention on transportation hubs like bus stops, rickshaw stands, canal bridges
and footpaths.

Food stalls and Chai stands: Many of our interviews began with
conversations near the chai and food stalls that tend to be clustered at major
intersections and outside of government buildings.

Markets: Markets were a convenient venue for speaking with casual laborers
like vegetable, fruit, and meat sellers, rickshaw pullers (who congregate
outside,) and domestic servants running errands for their employers.

Parks: We met several of our interview subjects in local parks and
fairgrounds, where many domestic servants go to rest and socialize during
breaks or between shifts.

We did not keep careful records on the survey refusal rate, but it was low - less

than 10%. Most refusals were related to work - some maid-servants, gardeners,

chowkidars (watchmen), drivers, and other domestic servants were too busy to

participate in the survey, or were hesitant to complete the questionnaire within ear

or eyeshot of their employers. In fact, we often had the opposite problem; in public

places where we were conducting interviews we would often draw a small crowd of

interested workers, many of whom wished to be surveyed as well. Since

occupational groups tended to cluster together (rickshaw pullers at rickshaw

stands, for example), we often had to decline their participation in order to keep a

balance of occupations in the sample.

Following the survey effort, I entered the data into a custom built database designed in Microsoft Outlook. After completing data entry, I reviewed 15% of the database records against the original survey forms to check for accuracy. I then exported the database into Microsoft Excel for data analysis and generation of descriptive statistics.

Household Survey (2010)

To document the unsafe conditions in the slums and squatter camps around Salt Lake, I designed a household survey to baseline data on work, education, services, and expenditures as well as a series of questions on risk, vulnerability, and resilience.[147] I partnered with Prantik Jana Vikash Samity (PJVS), a non-governmental organization (NGO) based in Salt Lake, who translated the survey instrument and helped to administer it. Over the course of six months (January - June 2010), we surveyed 414 families from across the six settlements, representing 1,967 individuals.[148]

We defined our survey population as households in slums within the Salt Lake laborshed. To determine a sampling frame, we first made a list of all the informal settlements mentioned in the Salt Lake Labour Survey (see Chapter 4).[149] Different

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[147] A copy of the survey instrument can be found in Appendix D.

[148] The survey was conducted in three phases. After designing the survey instrument and workshopping it with the enumerators and selected local officials, we conducted two pilot surveys in January 2011. Each pilot survey included 20 households; after each survey pilot, we had lengthy discussions about the instrument's performance and made necessary changes in the question structure, ordering, content, and language. Once we were satisfied with the changes, we began the full survey in mid-February 2010. The pilot survey data is not included in the results.

[149] There are obvious shortcomings with this approach, as there are more informal settlements in the Salt Lake laborshed than those we identified in our labor survey. There is no accurate or comprehensive list of bustees in Kolkata, and because of the near constant cycle of slum evictions, the geography of informality is constantly shifting. Thus, I make no

agencies and organizations in India define slums in different ways. The Slum Act

(1956) defines slums as "those areas where buildings are in any respect unfit for

human habitation." The Central Statistics Organization defines them as areas

"having 25 or more katcha structures, mostly of temporary nature, or 50 or more

households residing mostly in katcha structures huddled together or inhabited by

persons with practically no private latrine and inadequate public latrine and water

facilities" (UN-Habitat, 2003). For our survey, we followed the National Sample

Survey Organisation (NSSO), which defines a slum as:

> ...a compact settlement with a collection of poorly built tenements, mostly of temporary
> nature, crowded together usually with inadequate sanitary and drinking water facilities in
> unhygienic conditions (NSSO & Government of India, 2003, p. H-1).

In order to qualify as a slum, more than 20 households had to be located in that

settlement. A *squatter settlement*, on the other hand, is a settlement that has all the

characteristics of a slum but less than 20 households.

A total of 35 slums were named in our survey of informal workers in Salt Lake,

from Sealdah (once) to Duttabad (113) and Keshtopur (116). We did preliminary

site visits to many of these informal settlements to get an overall sense of size and

composition. We were able to condense the list by more than a half because many of

the settlements had overlapping names or could be grouped together because they

were individual areas of functionally larger settlements. We also eliminated

communities in North-24 Parganas, the district immediately north of Kolkata,

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claim that these results are representative of bustee populations around Salt Lake. I do,
however, claim that they are descriptive of those populations, and the results tend to
corroborate other types of evidence I have gathered.

because of the logistical challenges posed by distance.[150] We grouped the remaining

settlements by size (large, medium, small) and location relative to Salt Lake

township (west, north, east). Finally, we selected a group of six settlements that

were broadly representative of the overall group: Dattabad, Naya Patty, Keshtopur

(Satorupa Pally), Keshtopur (Mission Bazaar), and Salt Lake II (Gull Math).[151]

Sampling Method

At the beginning of our survey effort we established a goal of 400 households

for our total sample, across five settlements. Based on this number we used our

settlement population estimates to apportion the total number of surveys per

settlement. Once the target number of surveys for each slum was established we

relied on site visits and key-informant interviews to estimate the total number of

households in the settlement. With the help of community members, we also drew

rough maps of the settlements marking roads, footpaths, and major landmarks. We

later adjusted these drawings using high-resolution satellite imagery as base

maps.[152]

We surveyed on everyday of the week except Sunday and primarily in the

morning (7 a.m. – 10 a.m.) and evening (7 p.m. – 9 p.m.) when heads of households

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[150] Many of the informal workers traveling from North-24 Parganas (22 total) were engaged in vegetable and fruit sales; according to interviews with several of these workers selling produce at the CA market in Salt Lake, they would leave their communities very early and travel by train in order to reach the Salt Lake markets by morning. Roy (2003) focuses on women commuters who ride the trains from South-24 Parganas into the southeastern parts of the city, often to find work as maid servants and as vegetable sellers.

[151] A map showing the location of these settlements relative to Salt Lake is available in Chapter 5, figure 5.2.

[152] Given the density of housing structures, roads and footpaths were typically not visible on satellite images. These images were crucial, however, for fixing absolute distances, and orienting the maps to major landmarks outside the slums.

were likely to be present and to avoid the suffocating heat of the mid-day. We used a systematic sampling approach to choose survey households. First, we divided the estimated number of households by the total number of surveys to be administered (N). Next, we randomly chose a number between 1-10 as the starting household for the survey in each settlement (K). We then sampled every Nth household according to the doorways on housing structures, beginning with door K. For example, if the settlement size was 1000, and we wanted to conduct 100 surveys, we would sample every 10th household (1000/100) starting with house K (K, K+10, K+20, etc.). If an adult member of the household was not present or declined to take part in the survey, the survey enumerator would then attempt to survey the household living to the immediate right of the original household. If this household was not present or declined, he would then attempt to survey the household to the immediate left of the original household. This pattern was repeated (moving further from the original household) till a willing respondent was found.

Several weaknesses in our sampling methods should be acknowledged. First, despite our best efforts to estimate the total number of households prior to beginning our survey, we were often forced to revise these estimates once we began surveying, especially in two of the larger slums (Dattabad and Naya Patti). Second, and related to the first, we found that in some parts of slums housing structures were being further and further subdivided to accommodate new migrants and growing families. Some of these subdivided structures, however, had only a single doorway, and the longer-established households tended to live in this "first position" near the doorway. Thus, it is likely that our survey oversampled these

long-established households and under-sampled those living in inner-hutment

partitions. Third, we surveyed only houses, hutments, shacks, and other structures

that were primarily residential. We did not include storefronts, commercial spaces,

chai shops, dhobi stands, and other structures where some labourers sleep. Based

on conversations with workers at these locations, many of them tend to be newly

arrived or migrant workers, often times men who are supporting families in rural

areas. Again, we likely under-sampled this population.

Our survey team met weekly to discuss any outstanding issues with the

sampling, survey administration, or the survey instrument and to check the survey

forms for completeness. Following the survey effort, I entered the data into a custom

built database designed in Microsoft Outlook. After completing data entry, I

reviewed 15% of the database records against the original survey forms to check for

accuracy. I then exported the database into Microsoft Excel for data analysis to

generate descriptive statistics. I also used the Outlook custom query tool to build

specific data requests, again exporting the results into Excel.

Using Remotely Sensed Imagery for Urban Analysis

One of the great challenges of doing research on cities in the global South is

data poverty; information on population, employment, housing, land-use, migration,

etc. at the local level is often not available, and when it is, it may be incomplete or

outdated. In some instances, the local government does not have the financial or

institutional capacity to regularly collect data. In others, the data may be collected

but is closely guarded by those who possess it. In a few instances data may be made

available to government outsiders but should be viewed suspiciously due to a lack of

transparency about collection methods; after all, data is a source of power for those who have it, or those who are able to create narratives based on it.[153] The issue of data poverty is compounded by rapid growth and development. Information quickly becomes obsolete, and one-off studies can only hope to create a snapshot of conditions and context. Data poverty is especially challenging for research on the informal sectors. The informal economy is, by definition, outside the regulatory structure of the state, and thus resists being systematically counted.

Kolkata is no exception. During my first few months in the city, I spent many hours in libraries, archives and in municipal and state offices trying to access the most recent and up-to-date information on growth and development, especially on the eastern fringe. Much of the publicly available data is outdated and much of the recent data held by public organizations (like the KMC or the KMDA) is not available to the public. Data poverty is particularly acute with regards to slums and squatter settlements; other than a few organizations that carry out primary research and

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[153] One example from my field work: for several months I was trying to determine the total population of Dattabad. Speaking with government officials from the BMC, all of whom were part of the CPI(M), they told me that the population had swelled since 2001 (the date of the last census) and may have reached more than 45,000. Speaking with community leaders from Dattabad and with fieldworkers from PJVS, they estimated the population to be much lower, perhaps 25,000. What could account for the discrepancy? Counting the population is enormously difficult, of course; everyone agreed that Dattabad's population was rapidly growing, and that housing units were being further and further subdivided to shelter new families and workers. But only during the municipal elections did I realize another potential reason for the discrepancy. Dattabad has traditionally been a stronghold for the CPI(M) in the BMC and the township was poised to flip to Trinamool Congress control. Accusations were running rampant that the CPI(M) was temporarily bringing in voters from outside of Kolkata and housing them in Dattabad. So, it would make sense that the local CPI(M) government would want to overestimate population statistics ahead of the election, so that when election day came around, a surge in the voting population in the settlement would seem plausible. This anecdote is based mostly on rumors and accusations, of course, but it illuminates how any data gathered by the government might be viewed with suspicion in a city where patronage and party politics infiltrates every aspect of daily life.

keep records on the settlements they work in, very little up-to-date data exists or is

available (Kundu, 2003; Roy, 2003a).

Geospatial data of Kolkata is especially difficult to come by. The National Atlas

and Thematic Mapping Organization (NATMO) maintains a modest catalogue of

maps of Kolkata, including a land-use map produced in the 1990's, but they are only

available on paper and do not have meta-data to describe the methods by which

they were produced.[154] To my knowledge, there is no publicly available electronic

map of Kolkata that is complete and georeferenced, though it is the 7th largest city in

the world. The best available public resource is Google Maps. Scholars often resort

to hand-drawn maps of the city or rely on historic maps that do not reflect the

dynamic urban growth that is taking place on the eastern and southern fringe (see

Chakravorty, 1996/2005; Chen, Wang & Kundu, 2009; Roy, 2003a). Recently,

NATMO has developed a GIS database and map atlas of the city that shows

individual buildings, parks, infrastructure, etc., but it is only available in book

format. I met personally with the Director of NATMO several times, who made it

clear that the database would not be made available to researchers or the public,

due to considerations of "cost and copyright."

Approaches to Remote Sensing of Urban Change

One promising source of information on the dynamics of urban growth and

development is remotely sensed data, including aerial photography, light detection

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[154] One of my contacts, a former professor and high-level bureaucrat, advised me that the land-use maps were not particularly accurate, and the process of creating them was less than ideal. For example, we were dissing a recently produced land-use map published by NATMO and he told me that everyone who entered the office was asked to help identify landmarks and the uses of buildings in neighborhoods with which they were familiar, rather than carrying out a more systematic field survey effort.

and ranging (LIDAR), and satellite imagery. Remote sensing (RS) simply means that

there is no contact between the source of information and the device that is

acquiring it; remotely sensed data imagery everything from photographs to human

vision (Lillesand, Kiefer & Chipman 2008). With the advent of commercial and free

imagery services like Google Earth, remote sensing increasingly refers to data

collected by satellites. Remote sensing provides a largely untapped data source for

urban analysis in the South and holds particular promise in contexts of data poverty.

Aerial photographs and satellite imagery archives now cover a period of nearly 50

years, and high-resolution imagery is becoming increasingly common. Not only can

remote sensing be used for making observations about urban agglomerations at

multiple points in time, it may also prove valuable for observing or predicting trends

in urbanization and spatial growth (Small, 2005).

Unlike many environmental features that can be observed using low-

resolution RS imagery, the urban environment requires high-resolution imagery,

less than 10 meters per pixel spatial resolution, to distinguish between basic

features like buildings and roadways.[155] Though medium-resolution imagery (15-

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[155] There are several drawbacks to using high-resolution satellite imagery, especially for historical research. The imagery has relatively small temporal range when compared to other sources of historical data. While some high-resolution military imagery is beginning to be declassified, commercially available imagery only came to the market in the late 1980's. High-resolution images may also have a low "return rate" compared to other detection systems; because high-resolution satellites capture images in relatively narrower "swath" than lower resolution systems, they are not nearly as synoptic in their coverage. For instance, the IKONOS satellite, which has a ground resolution of one meter in the panchromatic band, has a swath of 11 kilometers; the camera only captures images that are 11 kilometers in width. By way of comparison, the Landsat 7 satellite, with a ground resolution of 15 meters in the panchromatic band, has a swath of 185 kilometers, and the moderate-resolution imaging spectroradiometer (MODIS), with ground resolutions ranging between 250-1000 meters, has a swath of 2330 kilometers (Jacobsen, 2005). Revisit times between imagery acquisition, depending on the camera angle, may range from several

30m per pixel) has been used to observe human settlement patterns and document urban change (e.g. Small 2005, Ryznar & Wagner 2001), the availability of high-resolution imagery has opened up a world of possibilities for urban analysis (Miller & Small 2003, Monkkonen 2008.) Given that such imagery only became commercially available in the late 1980's with the launch of the SPOT satellite, the use of RS data for urban analysis is a relatively new and emerging area of inquiry. There are several approaches that researchers have used to attempt and classify urban land use and land cover (LULC), identify features in the urban environment, or detect changes in the urban LULC and footprint over time.

Pixel-based classification systems, which are widely used in many other types of remote sensing studies, attempt to assign pixels to various classes of identification based on their spectral signatures (Hurskainen & Pellikka 2009; Lillesand et al. 2006). Several studies have had success mapping urbanization writ-large using pixel-based approaches, distinguishing between "urban" and "not urban" on a medium or large scale (e.g. Mundia & Aniya 2005; Ryznar & Wagner 2001). Pixel based approaches alone are inadequate for classifying objects within the urban environment, however, for several reasons. First, many of the features of cities are spectrally similar, such as concrete rooftops and pavement, and thus require additional external interpretation and contextual information. Second, pixels do not

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weeks to more than a year. Based on prevailing weather conditions (cloud cover,) this means that relatively clear images of any urban agglomeration might only be available every few years, a low-temporal resolution for capturing the nuanced dynamics of urban change. High-resolution imagery may also be prohibitively expensive, especially archival imagery. For example, a single high resolution scene (60km x 60km) from the SPOT imagery archive costs more than $2,000.

capture the spatial relationships of objects that are so critical for understanding an urban environment; unlike natural systems, the routine and regular ordering of city features is a characteristic that could (and should) be exploited to perform more accurate and effective classifications. Third, urban objects of the same type might display entirely different spectral signatures. For example, in the informal settlements in Kolkata, roofing materials may be plastic, thatch, concrete, tin, asbestos, or any number of materials combined (Mason & Baltsavias 1997).

A second approach incorporates shape, texture, distance, and other contextual information into an analysis of spectral characteristics to understand cities as a series of objects that have spatial relationships to one another. This object-oriented approach relies on powerful algorithms that "learn" from user input and contextual classification to eventually carry out automated classification schemes. For example, Hoffman (2001) uses image segmentation at multiple, nested scales to identify like objects. Other studies have used object-oriented approaches to classify residential land-use types (Stow et al. 2007; Herold, Liu and Clark 2003), do an unsupervised classification of slums across city-regions (Filho and Sobreira) and are able to extract features from even medium resolution Landsat imagery (Wong et al. 2003). While object-oriented approaches hold great promise for urban analysis, their chief drawback is that the proprietary software (e-Cognition) used in most studies is prohibitively expensive for research purposes.

Visual interpretation is the simplest method for interpreting and extracting useful information from remotely sensed data. Visual interpretation is the "science and art of observing images with the objective of identifying different objects and

judging their significance" (Jensen, 2007). As Hurskainen and Pellikka (2007) point

out, visual interpretation is the oldest method of RS data analysis but is still very

relevant for urban analysis when other methods fail or are not effective. Even in

sophisticated object-oriented approaches, visual interpretation is still required to

impart the kinds of contextual information needed to "train" the algorithm for

further unsupervised work. The downsides of visual interpretation are several; it is

laborious, costly and may leave too much discretion to the interpreter, who may

lack experience (p. 2). Nevertheless, when doing analysis on as small a scale as a city

or neighborhood, visual interpretation is currently the most effective and accurate

approach to analyzing high-resolution imagery. Throughout this dissertation, I have

used visual interpretation as my primary approach to interpreting RS data.[156]

Data and Methods

For my field research and in the subsequent analysis contained in this

dissertation, I use remotely sensed imagery in a variety of different ways. The data

used consists of four high-resolution satellite image datasets of the Kolkata

metropolitan area, with a temporal range of 45 years (1965-2010):

1. The first data set was acquired by the KH-7 reconnaissance satellite between
    1965-1967 (May 1st, 1965; April 24th, 1966; and February 6th, 1967). The
    KH-7, also known as the Gambit, was the United State's first high-resolution
    surveillance satellite. It was designed as a space vehicle that would launch
    into orbit, acquire imagery using onboard sensors, and then return to earth
    with the undeveloped film on board. The Gambit program flew 28 missions
    from 1963-1967, acquiring more than 80,000 images with ground
    resolutions ranging from .6 - 1.3 meters (2 - 4 feet) (National Archives,
    2002). The imagery from the Gambit missions was declassified in 2002, and

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[156] When necessary, I have also done some light pixel-based analysis. For instance, to
distinguish the edges of water bodies from structures built on their banks, I found it useful
to spectrally identify water using ENVI, to confirm that my visual interpretation was
accurate.

is made available by the United States Geological Survey and the National Archives through the Earth Resources Observation and Science (EROS) Center.[157]

2. The second data set was acquired by the IKONOS earth observation satellite on December 4th, 2000. The image has a spatial resolution of one meter in the panchromatic band and four meters in the multi-spectral bands (red, blue, green, and near infrared).[158]

3. The third data set is a mosaic of two images acquired by the IKONOS satellite on September 28th, 2002 and November 26th, 2002. The image has a spatial resolution of one meter in the panchromatic band and 4 meters in the multi-spectral bands (red, blue, green, and near infrared).

4. The fourth data set is a mosaic of two images acquired by the Worldview 2 earth observation satellite, acquired on January 27th, 2010 and February 15th, 2010. The image has a spatial resolution of .5 meter in the panchromatic band and 1.8 meters in the multi-spectral bands (red, blue, green, and near infrared.)

I geo-registered each image using ITT ENVI software, using the Worldview 2 (WV2) dataset as a base image.[159] Following are details of the steps I took in the geo-registration process:

- **IKONOS 2000:** I opened both the WV2 panchromatic band and the IKONOS 2000 panchromatic band in ENVI, with the former as a base image and the latter as the warp image. Next, I set 18 ground control points across the images, with an RMS error of 2.13. I used easily identifiable features for control points, such as traffic circles, corners of buildings, and roadway intersections. Third, I warped the IKONOS 2000 image using the RST (rotation, stretch, and translation) Warp Method, a linear transformation, with cubic-convolution re-sampling.

- **IKONOS 2002:** I followed the same procedure for the IKONOS 2002 image as I did for the IKONOS 2000 image, using 21 control points with a RMS error of 1.88.

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[157] The EROS Center has also made available imagery from the KH-9 satellite, which acquired imagery until 1980. Both sets of data may be accessed online at http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/Declassified_Satellite_Imagery_-_2.

[158] This image set was acquired through a grant from the GeoEye foundation.

[159] The WV2 image was prepared and orthorectified by GeoEye, a private provider of geospatial data and services.

- **KH-7:** I followed the same procedure for the KH-7 image as I did for the IKONOS images, using 15 control points with a RMS error of 11.57.[160]

I also used ENVI to sharpen a WV2 multispectral image (1.8 meter resolution) using the panchromatic band (.5 meter resolution) with the Gram-Schmidt spectral sharpening tool and nearest neighbor (NN) re-sampling. Once the data sets were geo-registered to the WV2 imagery, I saved them as JPEG 2000 format files using lossless compression and brought them into a geographic information systems (GIS) environment using ESRI's ArcGIS software. The images were projected in WGS 84 / UTM Zone 45N.

Remotely Sensed Data in My Dissertation

RS data has proved useful for a number of practical research and analysis tasks. During the course of my field research I used imagery to confirm the geographical extents of survey areas, produce rough estimates of numbers of shelters to inform preliminary sampling strategies, orient survey enumerators, and

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[160] I was unable to reduce the error through additional ground points. When I linked the image displays and visually compared the resulting image sets, they matched closely enough to satisfy the needs of this project. Several characteristics of the imagery may be responsible for the high registration error, given that the KH-7 imagery was not orthorectified like the Geoeye reference data set. One possibility is relief displacement due to the topography of the land and built environment. This seems somewhat unlikely since the topography of Salt Lake area is extremely flat and uniform. I did use several control points based on buildings, water tanks, or other elevated structures, but these objects are less than 30m in height. These elevated structures would cause some displacement but likely not enough to create such high error statistics. Other possible sources of error are tilt displacement and scale differences, both related to the differences in the viewing angle of the KH-7 and Geoeye sensors. In general, both tilt displacement and scale differences are greater at higher viewing angles and greater distances from nadir. For oblique views, the scale and tilt displacement varies across the image. Because the KH-7 imagery was not orthorectified, these scale differences would not have been corrected, which would be consistent with the large errors generated using the linear stretch transformation.

a host of other small tasks.[161] I also used imagery as an accurate and geo-referenced

base image for creating maps, measuring distances, and identifying major

landmarks and other points of reference whilst in the field. Comparing historic

imagery of the area around Salt Lake to contemporary images also allowed me to

verify findings from my interviews, surveys, and other research methods. For

instance, imagery analysis confirmed that the settlements in my survey were largely

established in the aftermath of the Bangladeshi Liberation War, with the exception

of Dattabad, which predated the township (see Chapter 4).

An area where I see great promise for RS analysis is in the detection and

delineation of urban slums and slum growth. Recent studies have attempted to

classify informal settlements using RS data. Stow et al. (2007) set out to determine

whether image segmentation and hierarchical classification of a Quickbird image of

Accra, Ghana could delineate residential land-uses and determine socio-economic

status of various neighborhood sized objects. They employed two different object-

based classification strategies. The first strategy relied on the spatial frequency

characteristics of multi-spectral data for pixels within neighborhood-sized

segments. The second strategy looked at the proportions of Vegetation-Impervious-

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[161] During the course of our household survey, I was surprised to learn that my
enumerators, who have an almost encyclopedic knowledge of informal settlements in the
Salt Lake area, had a very difficult time describing those settlements in a geographically
accurate way. We worked together on multiple occasions to produce basemaps and sketch
survey areas; often time these maps would be strikingly inaccurate, and my enumerators
struggled to orient themselves once accurate base-maps were produced. I was equally
struck by the inaccuracy of official maps with reference to informal settlements, even those
that have existed for decades. The survey enumerators, while unable to locate a slum from
an unfamiliar "birds eye" perspective, had a deep knowledge of the institutions,
infrastructure, walking paths, businesses, local leadership, and many other particulars of
the settlements that does not appear in any official record. Clearly, there is great potential
for merging these two worlds of knowledge and expertise.

Soil (VIS) sub-objects within neighborhoods, on the assumption that higher income

neighborhoods would have a higher ratio of landscape vegetation to soils and

impervious services, versus low-income neighborhoods.[162] Both strategies yielded

residential land-use maps with similar overall accuracy (75%) but the distribution

and patterns of general land-use types were different, and the authors found that

the V-I-S strategy showed a closer agreement with a map generated using census

indicators of slums. Thus, they find that the primary remotely sensed indicator of

residential socio-economic status in Accra is the presence of landscape vegetation.

Sliuzas and Kuffer (2008) take a different approach by combining

government data with high-resolution imagery to devise a typology of "poverty

areas" that could be correlated with broader socio-economic indicators such as

deprivation indices. They use Indian census classifications that demarcate different

types of informal settlements and then use visual interpretation of IKONOS imagery

of those areas. Their analysis results in a series of physical indictors that are helpful

in distinguishing between settlement types, such as building sizes, built-up density,

and structure of settlement layouts. Unfortunately, their study is preliminary and

lacks any on-the-ground research or contextual data that would help them to verify

census categorization. Given the ongoing processes of slum demolition,

rehabilitation, and/or regularization, relying on 10-year census cycles for

understanding the dynamics of slum growth seems untenable.

I mapped the growth of the five informal settlements included in my

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[162] The authors use Ridd's (1995) VIS urban land-cover system. In both classification
methods, they used multispectral data for image classification tests and panchromatic data
for visual validation (5168).

household survey using the RS data described earlier. I took a similar approach as

Sliuzas and Kuffer by focusing on areas I knew to be informal in order to develop a

series of indicators that will be useful in future classification efforts. I focused on the

visual distinctions between formal development in Salt Lake and the informal

developments that surround it. Keeping in mind the heterogeneity of informal

settlements, I was still able to identify five characteristics visual in high-resolution

RS images that distinguish informal settlements in the survey area, based on field

observations and photographs:

- **Building Materials:** The quality and material of housing stock varied significantly between formal and informal settlements, with formal developments being comprised largely of pucca structures while informal settlements were made up mostly of katcha or semi-pucca ones. While such stark differences generally hold true on the peri-urban interface of east Kolkata, it is worth noting that in core urban areas (like Howrah), slum structures would be far less distinguishable based on materials, because they have been built up and improved over time.

- **Building Density and Size:** Informal settlements around Salt lake tend to be dense and overcrowded with many small structures packed tightly together and negligible open space. Though Salt Lake is also quite dense, it has larger and taller buildings with more space between structures and more open spaces like parks and gardens.

- **Vegetation:** Dense informal settlements would be less likely to have areas of vegetation than formal developments, which might be distinguished by lawns, gardens, or parks. While there might be some agricultural production in informal communities in the peri-urban fringe, due to the value of land in the metropolitan area I would not expect any (detectable) agricultural activities in the city's denser slums.

- **Roads, Footpaths, and other Infrastructure:** The layout and materials of roads and pathways differ substantially across development types. In Salt Lake, streets are wide, paved, and arranged in regular patterns. Informal settlements like Duttabad, on the other hand, tend to be located near paved roads but are arranged along narrow thoroughfares and footpaths. These roads and footpaths are not usually arranged in a regular pattern, making informal settlements a challenge to navigate (for outsiders, at least,) and visually distinctive from above. In many ways, the comparison between

Salt Lake and nearby formal areas and the slums is an ideal case, from a visual interpretation standpoint. Most parts of Kolkata lack the regular gridding of streets and alleyways that characterize Salt Lake and new developments and make them so immediately distinguishable from above.

- **Settlement size and location:** Compared to famous slums like Dharavi and Kibera, which house millions of people and stretch for miles, most slums near Salt Lake are relatively small and located on marginal land. For example, Salt Lake II directly abuts the wall of a large cemetery, with portions contained in the three feet of space between the wall and the roadway, where a dense line of hutments has risen.

The following maps show informal growth from 1965-2010 based on the above criteria and within the boundaries of the survey settlements:

Dattabad - Informal Settlement Footprint

1965

2010

Data Sources: Worldview 2, acquired January 27, 2010
and KH-1 Gambit, acquired May 1, 1965
Datum: WGS 84 Projection: UTM Zone 45N

0   135   270   540 Meters

0   130   260   520 Meters

Kestopur (Satorupa Pally) - Informal Settlement Footprint
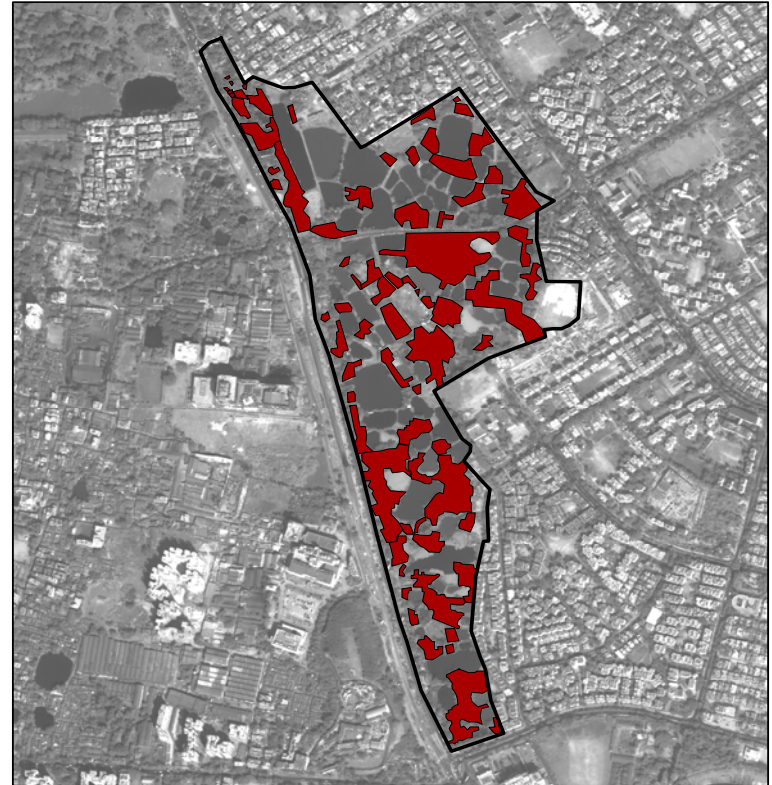
1965

2010

0   20   40   80 Meters

Data Sources: Worldview 2, acquired January 27, 2010
and KH-1 Gambit, acquired May 1, 1965
Datum: WGS 84 Projection: UTM Zone 45N

0   15   30   60 Meters

Naya Patty - Informal Settlement Footprint

1965

2010

Data Sources: Worldview 2, acquired January 27, 2010
and KH-1 Gambit, acquired May 1, 1965
Datum: WGS 84 Projection: UTM Zone 45N

0   65   130   260 Meters

0   65   130   260 Meters

Salt Lake II - Informal Settlement Footprint

1965

2010

Data Source(s): Worldview 2, acquired January 27, 2010
and KH-1 Gambit, acquired May 1, 1965
Datum: WGS 84 Projection: UTM Zone 45N

0   45   90   180 Meters

0   45   90   180 Meters

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Sree Krishna Pally - Informal Settlement Footprint

1965

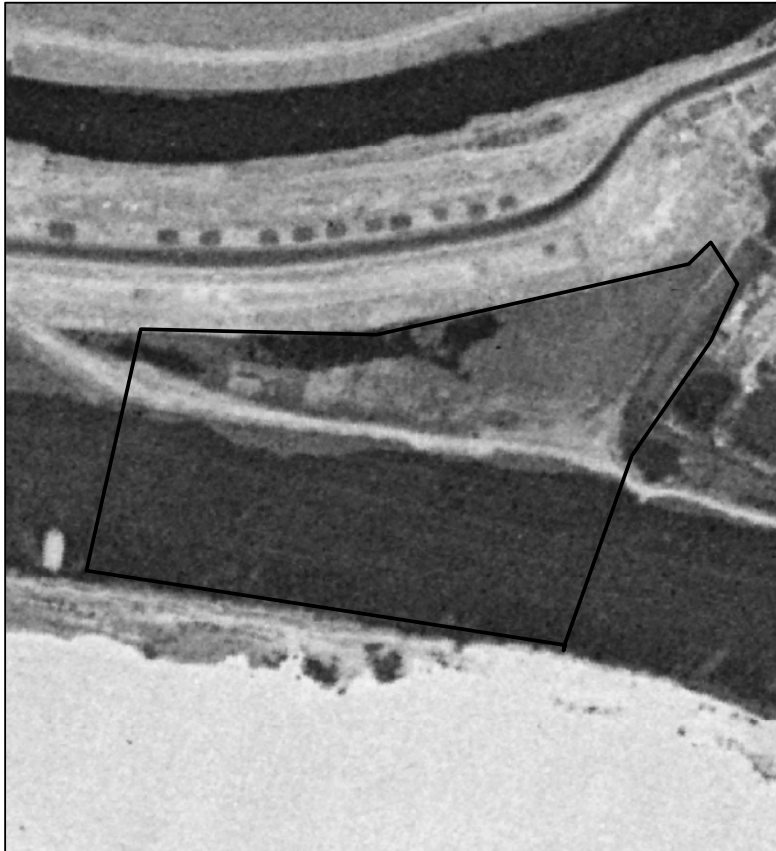2010

Data Sources: Worldview 2, acquired January 27, 2010
and KH-1 Gambit, acquired May 1, 1965
Datum: WGS 84 Projection: UTM Zone 45N

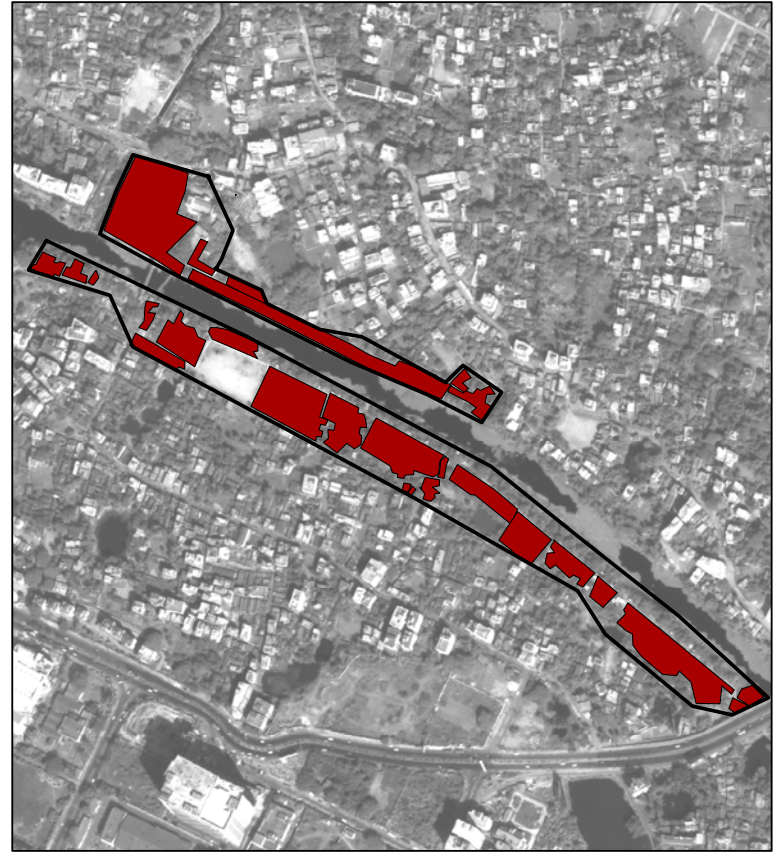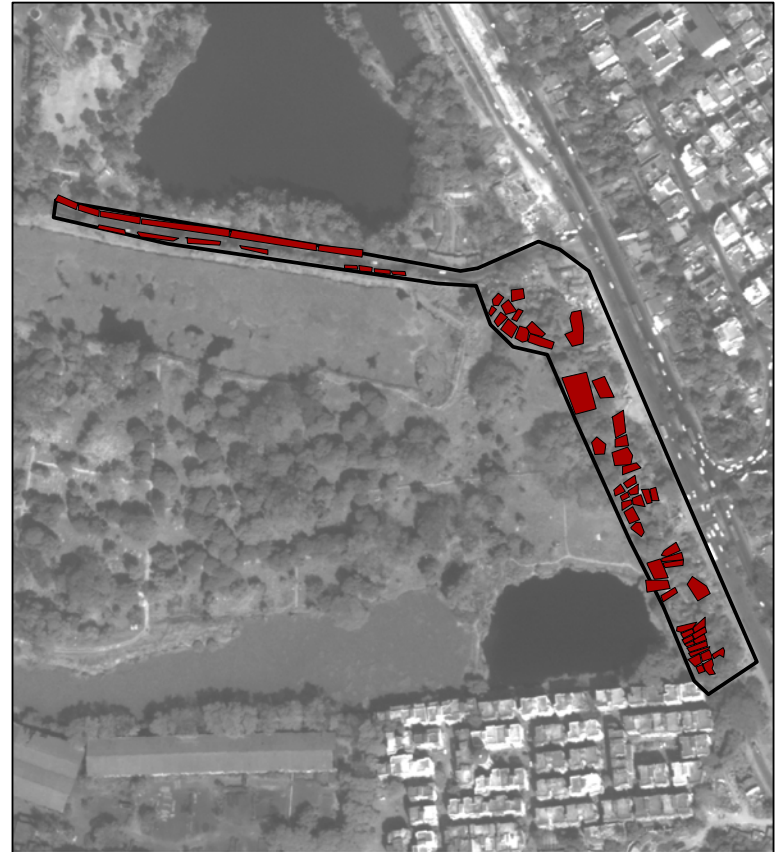0   30   60   120 Meters

0   30   60   120 Meters

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The findings displayed in these maps come with several caveats. Most important, it is not entirely clear whether some settlements or clusters of buildings are informal or rural. That is, while the building footprints in Dattabad and parts of Naya Patty in 1965 appear similar to the informal settlements observed in 2010, calling them "informal" might be misleading. Dattabad, for example, was for many years a fishing village, though by 1965 it had begun to integrate into the urban fabric of South Dum Dum and Kolkata. The separation of building footprints across the settlement indicates that it may have had more in common with a rural fishing village than an urban slum, though the building sizes, irregularity, lack of infrastructure, and other indicators remain consistent with informal growth. This highlights one of the central difficulties with using RS data for historical analysis; without the ability to ground truth finding, and in areas like Duttabad where very few historic records were kept, it is difficult to reach conclusions with a high degree of confidence. In this case, the findings would be bolstered through additional field interviews and archival research, which I plan to pursue during my next round of field visits.

Many of the physical features of informal settlements are not visible from above, even with high-resolution images. These include surface drains, drainage infrastructure, water taps and most internal footpaths and roadways. This makes mapping or understanding the spatial logic of the settlement themselves difficult, making careful field observations even more important (Meinel et al., 1998.) Mapping settlement footprints is also made difficult because of tree canopies, which obscure the view of hutments and other informal buildings. This was most

problematic when analyzing images of Salt Lake II and Duttabad. Third, some building types are difficult to distinguish, especially in the panchromatic KH-7 image. A long, rectangular roof feature could be the top of a long hutment, commonly built in these areas. It could also be the roof of an open storage shed or temporary building, which might have housed workers or equipment engaged in the dredging and filling process underway in Salt Lake. In either case, a more diverse set of imagery data would help to distinguish features as temporary or permanent.

Remote sensing holds great promise as a method and data source for urban analysis. Used appropriately in conjunction with other sources of data, RS could help to alleviate the problems caused by data poverty in cities like Kolkata. The trend towards higher resolution imagery provided for free by services like Google Earth could help to open new avenues for research and action. As part of my future research on new town development and geographies of risk, I hope to track the development of Rajarhat, a township coming up directly adjacent to Salt Lake. Rajarhat was founded just over a decade ago and will develop slowly over the next 20 years. With regular high-resolution images of the township and its surrounding area, remote sensing analysis will help to show the ongoing dynamics of formal and informal urban growth across time.

APPENDIX B: SALT LAKE LABOUR SURVEY – INSTRUMENT

Can you please give us three minutes of your time to complete a quick survey? We are doing a research project on workers in Salt Lake and where they live. It will help us better understand how the city is growing.

Date: Time:	Survey Block:
RESPONDENT #	
Sex of Respondent	☐ **Male** ☐ **Female**
Occupation(s)	
Do you work primarily in this block?	☐ **Yes** ☐ **Multiple blocks** **List** _____
How many days per week do you work in Salt Lake?	
What is your average monthly income?	
Where do you live?	**Intersection / Neighborhood** _____ **Map Grid #**
Residence in a slum area?	☐ **Yes** ☐ **No**
How do you Travel to work? (check all that apply)	☐ **Bus** ☐ **Rickshaw** ☐ **Bicycle** ☐ **On Foot** ☐ **Train** ☐ **Other** _____
How long does it take you to travel from home to work?	

Thank you very much for giving us the information!

APPENDIX C: COMPLETE LIST OF OCCUPATIONS FOUND IN THE SALT LAKE LABOUR SURVEY (2009-2010)

Auto-Rickshaw Driver
Bamboo Seller
Barber
Bicycle Repairman
Carpenter
Cement Bag Filler
Chai Wallah (tea seller)
Shoe Cobbler
Coconut Water Seller
Cycle-Rickshaw Puller
Dhobi (washerman)
Electronics Recycling
Fish Seller
Food Stall Worker
Fruit Seller
Fertilizer Seller
Home Gardener
House Servant
Kati Roll Maker
Key Maker
Kulfi (frozen dessert) Seller
Maid Servant

Matador (small truck) Driver
Mason
Mason's Assistant
Mattress Maker / Seller
Painter
Pan Seller
Pandal Maker
Paper Buyer
Personal Driver
Personal Shopper
Rag Picker
Road Worker
Security Guard
Shoe Shiner
Snacks Seller
Sugarcane Juice Seller
Tailor
Taxi Driver
Tree Seller
Utensils Seller
Vegetable Seller

APPENDIX D: SALT LAKE HOUSEHOLD SURVEY - INSTRUMENT

KOLKATA ENVIRONMENTAL HAZARDS BASELINE SURVEY

Survey Identification # ☐   Date:

Research Assistant Name: Time:

Household Identification Information

Settlement Name……………………………………………………………………..

Introduction

Introduction and Consent

Hello / Good Morning / Afternoon! My name is………..I am conducting a study of flooding in Kolkata, and your household has been randomly selected for interview. We would very much appreciate your help in filling out our questionnaire. It should take approximately 30 minutes of your time.

We are gathering information on the types of houses, delivery of services, and experiences with flooding in this area and in your household. Could you please let us know who the head of household is? [If yes] Would you be willing to answer our questions?

Confidentiality: We will not reveal your name or where you live to anyone, under any circumstances. No one will be able to identify you or any members of your household, or your address from our report.

Taking part in this survey is completely voluntary. If you decide not to take part it will not affect your current or future relationship with Prantik or the researchers. If you decide to take part, you are free to withdraw at any time. If at any time you feel uncomfortalbe, please tell us and we will stop the interview.

Would you like to continue with the survey?

[IF SURVEY IS REFUSED, PLEASE PUT EXPLANATION ABOVE AND BEGIN NEW SURVEY AT DOOR/STRUCTURE TO THE RIGHT OF THE ORIGINAL DOOR/STRUCTURE, AS PER SAMPLING PROTOCOL]

Module 1: Household Composition and Demographics

Sex of Respondent: Male ＿＿ Female ＿＿

Head of Household (Circle) YES / NO or Family Member # ＿＿ (refer to family table)

Religion [ASK AND MARK ACCORDINGLY]:

Hindu [ ]   Muslim [ ]   Christian [ ]

Other (specify)………………………………

Caste (if Hindu)……………………………………………………………………

Q 1:   How many persons are there in your household? (Household: people who usually live here and share meals)

………………………….persons

Q 2:   Please help us to fill out the following tables about everyone in your household:

HH #	First Name	Relation to Head of Household (i.e. spouse, son, cousin)	What is the sex of [name]? Male or Female?	How old is [name]?	What is the school attendance status of [name]? In school (Formal).......1 In school (Informal).....2 Left school................3 Never attended School....................4	What is the highest level of education attained by [name]? None.....................................1 Primary incomplete....................2 Primary complete....................3 Secondary incomplete...............4 Secondary complete.................5 Incomplete Certificate...............6 Diploma incomplete Certificate.....7 Diploma Complete Certificate......8 Diploma Incomplete Degree.........9 Completed Degree or above........10	Where did [name] live before moving into this house? Born in this home...............1 Other house/apt in this settlement.........................2 Other informal settlement in Kolkata............................3 Other non-slum settlement in Kolkata............................4 Other city in India................................5 Rural area in India................................6 Other country (specify)............................7
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

220

HH#	What has been [name]'s main activity during the past 7 days? Unemployed…………………1 Self-Employed…………………2 Employer……………………3 Regular employee (skilled)…….4 Regular employee (unskilled)….5 Casual employee (skilled)………6 Casual employee (unskilled)……7 Unpaid family employee……….8 Student / apprentice……………9 Pensioner…………………10 Sick/handicapped……………11 Other (specify below)…………12	Where does the main activity take place? Inside this settlement……………1 Outside this settlement……SPECIFY Both……..SPECIFY Specify which area respondent does activity: Salt Lake, Lake Town, etc.	Does [Name] have a Ration Card? Yes…………………..1 No…………………..2	Does [Name] have a Voter Card? Yes…………………..1 No…………………..2
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

The next series of questions are on when you arrived in Kolkata and how you use your house.

Q 3:   How long have you lived in this settlement?

    1.   Less than 6 months   5.   5 - 10 years
2.   6 months – 1 year   6.   10 - 20 years
3.   1 – 2 years   7. More than 20 years
4.   2 – 5 years

Q 4:   How long has your household been occupying this house / room / structure?

    1.   Less than 6 months   5.   5 - 10 years
2.   6 months – 1 year   6.   10 - 20 years
3.   1 – 2 years   7. More than 20 years
4.   2 – 5 years

Q 5:   How many rooms does your household have?

………………………………………. rooms

Q 6:   Do you use part of your home for any of the following purposes? [CIRCLE ALL THAT APPLY]

1. Shop / Commercial   4. Rental
2. Household Industry   5. Not Applicable
    3. Office

6. Other (specify) ……………………………………………………

Module 2: Services (Electricity, Water & Sanitation)

The next series of questions is about your household's access to infrastructure services, like water and sanitation.

Q 7:   What are the sources of lighting in the house, starting with the source used most?

[CIRCLE ALL THAT APPLY AND RANK ACCORDING TO RESPONSE]

1. Electricity   5. Candle Wax
2. Gas   6. Firewood
3. Kerosene (lantern)   7. Battery
4. Paraffin (candle or lantern)   8. Solar

9. Other (specify)…………………………………………..

Q 8:   What is the source of your drinking water for your household?

[CIRCLE ALL THAT APPLY AND RANK ACCORDING TO RESPONSE]

1. Tap / Piped Water   5. Gravity Flow Scheme
2. Bore Hole / Hand Pump   6. Open Water Sources
3. Protected (covered) Well/Spring   7. Water Truck/Vendor
Unprotected Well/Spring   8. Rain Water

9. Other (specify)……………………………………

Q 9:   How long does it usually take you to walk from your house, one way, to your primary drinking water source?

1.   Less than one minute   4. 11 – 20 minutes
2.   1 – 5 minutes   5. More than 20 minutes
3.   6 – 10 minutes   6. Not sure

Q 10:   For those who DO NOT have piped water in their home or access to a private well, in the last one week (7 days) how much did you spend PER DAY on water from all sources?

Rs / day…………………………………………

Sanitation Facilities and Services

Q 11:   Where is the toilet / latrine that members of your household use?

1.   Inside home / Private toilet [go to Q 13]
2.   Outside home
3.   No facility [go to Q 13]

Q 12:   How long does it take you to walk (one way) from your house to the toilet/latrine?

1.   Less than one minute   4.   11 – 20 minutes
2.   1 – 5 minutes   5.   More than 20 minutes
3.   6 – 10 minutes   6.   Not sure

Q 13: Where does the sewage go?

Municipal treatment   5. Water Body (canal, lake, etc.)
Septic Tank   6. Soak Pit
Open Drain   7. Do not know
Pit Latrine

8. Other, specify……………………………………

Grey Water – Used Kitchen, Laundry or Bath Water

Q 14: How do you dispose of your grey water?

1. Goes into a closed drain   4. Into a water body (i.e. canal)
2. Goes into an open drain   5. Goes into a pit latrine
3. Onto the road, pavement, or ground   6. Do not know

7. Other (specify)……………………………………………………..

Solid Waste / Rubbish

Q 15:   What is the most common way YOUR household disposes of solid waste / rubbish?

        1. Burning   4. City Collection
Pit   5. Private Collection
Heap   6. Dump into water body (canal, lake)

7. Other (specify)………………………………………………………………

Q 16:   How often is your solid waste / garbage collected?

More than once per week   4. Once per month
Once per week   5. There is no regular pattern
More than once per month   6. Never

7. Other (specify)…………………………………..

Q 17:   How much do you pay for refuse collection per week?

Rs / week… ……………………………………….

        [IF DO NOT PAY, MARK 0. IF NOT KNOW, MARK 99]

Drainage

Q 18:   Is there a drain outside your house?

Yes
No (Go to Q20)

Q 19:   Does the drain work properly?

Yes, most/all of the time   3. No, rarely or not at all
Yes, some of the time

Q 20:   During the monsoon, does your home flood?

Yes, always   3. Yes, but rarely
Yes, sometimes   4. No, never

Q 21: When it rains, does water come in through your roof or walls?

        1. Yes, always   3. Yes, but rarely
        2. Yes, sometimes   4. No, never

Q 22: During the monsoon, does the road/footpath outside your home get waterlogged?

1. Yes, always   3. Yes, but rarely
        2. Yes, sometimes   4. No, never

Module Three: Land Tenure and Ownership

The next series of questions are on the ownership of this land and housing unit, and the costs of living here.

Q 23:   Do you own this property? [property = land and/or house]

Own both land and structure [go to Q28]
Own the structure but not the land [go to Q25]
Land but not structure
Tenant

Q 24:   What type of tenancy agreement do you have with the owner of this structure?

Written formal agreement   3. No agreement
Verbal agreement

Q 25:   What is the total cash rent you pay (not including water or other utilities)?

…………………………………Rs/month

Q 26:   Has your rent been increased / reduced within the past year?

Increased   3. No change
Reduced [go to Q 28]   4. Don't know

Q 27:   Why was the rent increased?

For no reason
Result of improvements to the neighborhood
Periodic increases
Improvement in tenant income / lifestyle
Improvements to the housing structure
Market prices increasing

Other (specify)………………………………………

Module Four: Income

This next series of questions is on the income of everyone in your household, and what items your household spends money on.

Q 28:   What was your total household CASH income last month (include all sources as well as money received from remittances)

Less than 3,000   4. 10,000 – 20,000
3,000 – 5,000   5. More than 20,000
5,000 – 10,000   6. Don't know / No answer

Q 29:   What are your household's largest sources of income [by occupation]?

	Household Member #	Occupation
Largest Income		
2nd Largest Income		
3rd Largest Income		
4th Largest Income		

Q 30: Does your household own land outside of Kolkata?

    1. Yes, in West Bengal
    2. Yes, in another state in India
    3. No, household does not own land

Q 31:   Does any member of this household have savings or a bank account?

1. Yes   2. No

Q 32:   Does any member of this household currently have a loan? [Circle all that apply]

No loans   4. Self-Help Group
Loan from bank   5. Loan from relative or friend
Micro-Credit NGO   6. Loan from informal lender

7. Other (specify)………………………………………………………………

Q 33:   Over the last 12 months, did you SEND gifts or money [remittances] to support persons in your family, extended family or friends (or any people who do not usually live with you)?

1. Yes   2. No [go to Q 35]

Q 34:   Where does that person or people live? [Circle all that apply]

In Kolkata   3. Rural West Bengal
In another city in West Bengal   4. In another state (specify)

5. Other (specify)………………………………………………………..

Q 35:   Over the last 12 months, did you RECEIVE gifts or money [remittances] from your extended family or friends (any people who do not usually live with you)?

1. Yes   2. No [go to Q 37]

Q 36:   Where does that person or people live? [Circle all that apply]

In Kolkata   3. Rural West Bengal
In another city in West Bengal   4. In another state (specify)
5. From Abroad

6. Other (specify)………………………………………………………..

Q 37:   What do you spend your income on?

Please rank the following categories of household expenditures, starting with the category that your household spends most on. Please divide your expenditures for food, transportation, services (water, sanitation, telephones, etc.), education, housing, and healthcare.

[RANK THE FOLLOWING CATEGORIES FROM 1-5, 1 BEING THE CATEGORY THE HOUSEHOLD SPENDS THE MOST ON, 5 BEING THE LEAST.]

1. Food…………………………..   2. Transportation………………

Housing……………………..   5. Health Care………………...

Education……………………

Telephones

Q 38:   Does your household have access to a telephone? (Circle all that apply)

Mobile
Landline
No access to a telephone

Infrastructure Improvements

Q 39: In the past five (5) years, have there been improvements made in this slum? (i.e. road paving, toilet installation, drainage improvements, piped water supply, school construction, etc.)

Yes
No [Go to: conclusion]
Don't know / no answer [go to Q 41]

Q 40: If yes, who was responsible for the improvements made?

Government
NGOs
Community members
Other (specify) _____

Conclusion: This concludes our questionnaire. Thank you for inviting us into your home, and taking time out of your day to assist us in our study!

Module Five: Physical Observations

[THE FOLLOWING INFORMATION SHOULD BE RECORDED AFTER THE INTERVIEW HAS CONCLUDED. INFORM THE RESPONDENT THAT YOU NEED TO MAKE SOME QUICK OBSERVATIONS ABOUT THE HOUSING STRUCTURE]

Q 41:   What materials have been used for the construction of the dwelling?

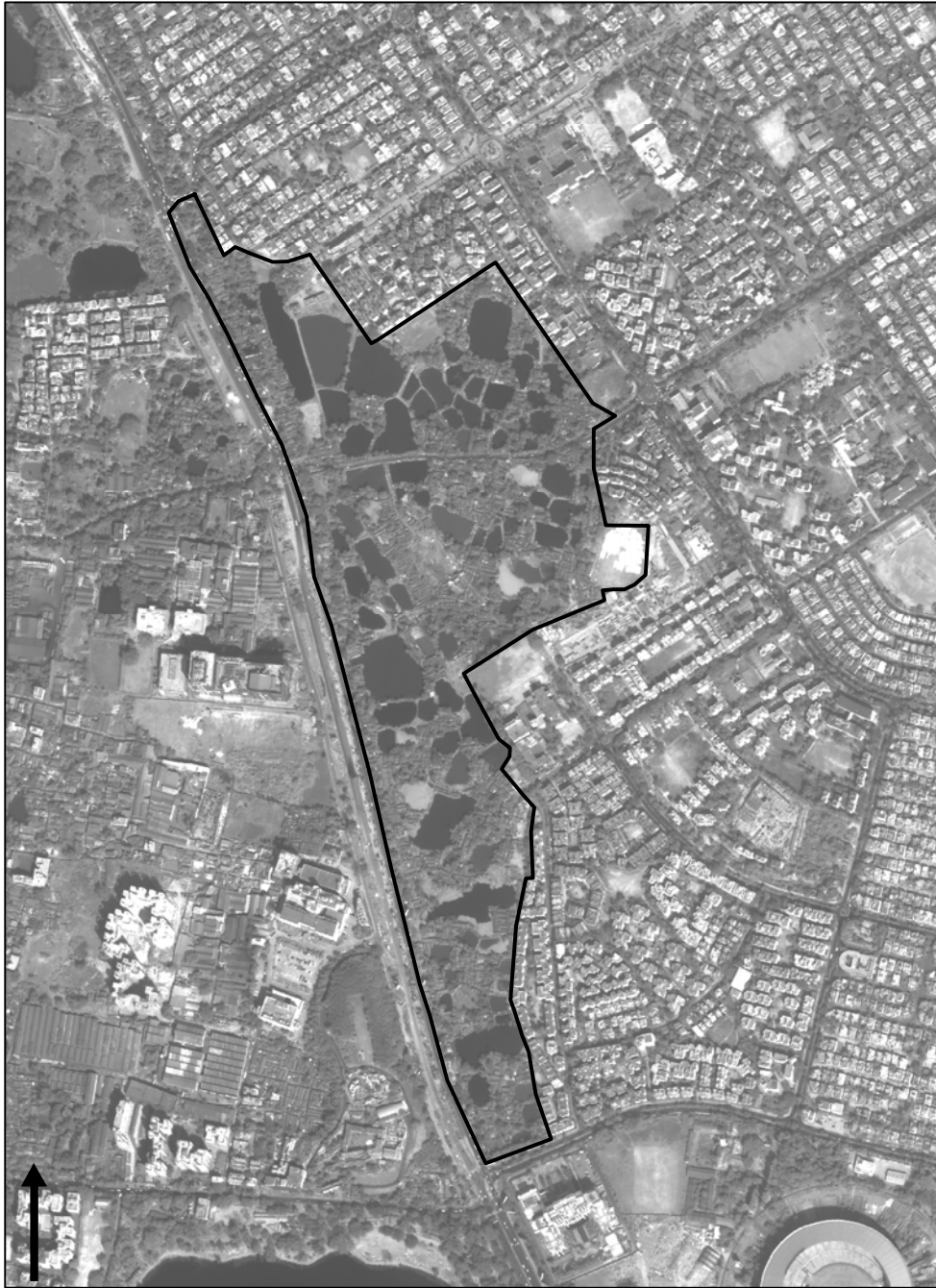| A: External Walls	B. Roof	C. Flooring
Concrete Cement Blocks Thatch Stabilised bricks Unburnt brick with cement Unburnt bricks with mud Wood Mud and pole Plastic Other (Specify)	Iron sheets Tiles Asbestos Concrete Tin Thatch Plastic Other	Concrete Brick Stone Cement Screed Rammed Earth Wood Other

Time of Survey Completion:

Q 42: Language(s) survey was conducted in……………………………………………

APPENDIX E: SALT LAKE HOUSEHOLD SURVEY - SETTLEMENT LOCATIONS

Kestopur - Satorupa Pally
(1,200)

Sree Krishna Pally
(1,500)

Salt Lake City
(275,000)

Salt Lake II
(2,000)

Naya Patty
(3,500)

Dattabad
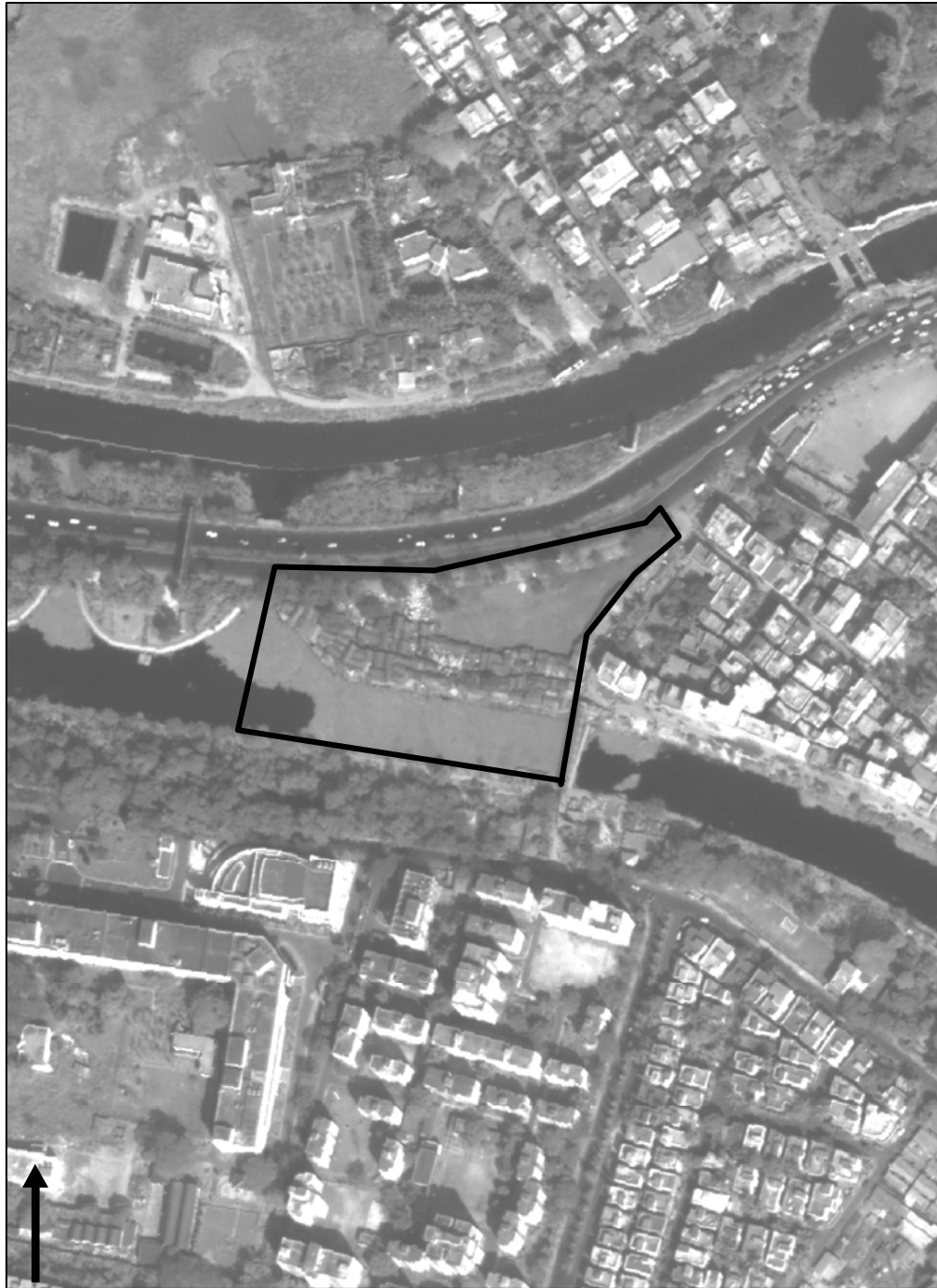(25,000)

Dattabad Settlement - Location

Data Source(s): Worldview 2, acquired January 27, 2010.
Datum: WGS 84
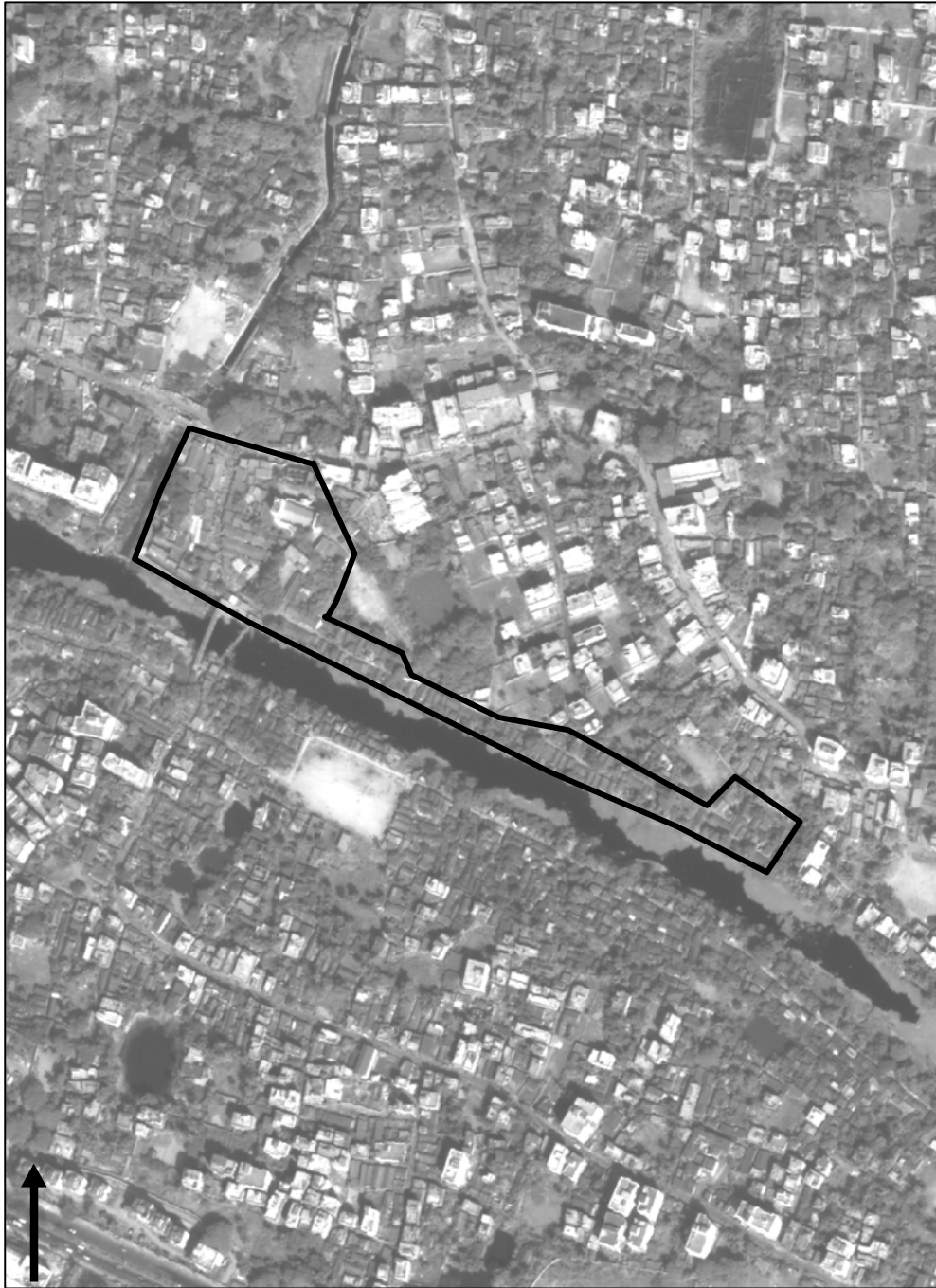Projection: UTM Zone 45N

0   125   250   500 Meters

Kestopur (Satorupa Pally) - Location

Data Source(s): Worldview 2, acquired January 27, 2010.
Datum: WGS 84
Projection: UTM Zone 45N

| 0 | 37.5 | 75 | | 150 Meters |

Naya Patty - Location

Data Source(s): Worldview 2, acquired January 27, 2010.
Datum: WGS 84
Projection: UTM Zone 45N

0   50   100   200 Meters

Salt Lake II - Location

Data Source(s): Worldview 2, acquired January 27, 2010.
Datum: WGS 84
Projection: UTM Zone 45N

0   50   100   200 Meters

Sree Krishna Pally - Location

0   40   80   160 Meters

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