Human Face of Climate Change
From Risk to Resilience in India Cities

Social Vulnerability in Informal Settlements

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Abstract

India is expected to be 40% urban by 2030. Cities contribute to 60% of the national GDP currently. By 2030, this number is expected to reach 75-80%.[1] Rapid urbanization and economic growth, however, is being accompanied by a growing population of urban poor living a marginal existence in informal settlements within Indian cities.[2] India has also been ranked as the sixth most climate change-vulnerable country by the Climate Risk Index 2018.[3] Urban poor are struggling to cope with climate change induced impacts that add to the stresses that they already face; their socio-economic conditions limit their ability to cope with, and adapt, to climatic changes.

This paper investigates climate change impacts within informal settlements in three Indian cities - Delhi, Agra and Panaji. It draws attention to the stories of individuals living in informal settlements in these three cities and the ways in which the impacts of climate change aggravates their daily lives. Further, it shows how vulnerability within these settlements is shaped by a range of social conditions – access to decent work and livelihoods; structural and social issues of caste, ethnicity and gender; and slow erosions of social solidarity and networks. Displaced from drought and failing crop cycles, rural migrants to Delhi are dual victims of climate change, living in illegal, underserved settlements, exposed to intense heat waves and water scarcity. In Agra, socially excluded temporary households along the Yamuna river basin are facing progressive urban decay and are at a risk of displacement were the river to change its course. Rising sea level and urbanization have compromised the livelihoods of fisher folk in coastal communities in Panaji.

1 Introduction

Rapid urbanization and climate vulnerabilities in India

India is rapidly urbanizing and is expected to move from a 34% urban population in 2018 to 40% by 2030. It is estimated that 400 million urban dwellers will be added between 2014 and 2050 bringing the urban population to over 800 million.[4] This increase in urban population is both due to natural population growth and rural to urban migration. With the shift of the Indian economy from the primary to tertiary sector, an increasing number of rural people are migrating to cities in hope of better work opportunities and quality of life. Economic trends further reflect continued urban growth: Indian cities contribute to 60% of the national GDP currently; by 2030, this number is expected to reach 75-80%.[5]

Increasing urbanization and economic development is however accompanied by growing populations of urban poor living in informal settlements in Indian cities.[6] According to the 2011 census, 65.5 million Indians live in such households— some Indian cities such as Mumbai, Delhi and Agra have over 50% of their populations living in informal settlements. The lack of provision of housing and basic services at a pace that meets the rapid population growth resulted in development of these informal settlements with wider ramifications on health, safety and well-being of their residents. Residents in informal settlements also tend to be the most vulnerable to climate change effects because they live along riverbanks, on sensitive slopes, polluted grounds, low-lying coastal waterfronts in unstable structures without adequate services.

India has also been ranked as the sixth most vulnerable country to climate change by the Climate Risk Index 2018. "It is expected that impacts will include a general increase in temperatures by 2–4°C, an increase of 7–20% in annual precipitation with increased intensity, alongside increases in riverine flooding, cyclones, storm surges, and sea-level rise."[7] 360 million people will be exposed to extreme heat in 142 Indian cities by 2050. The most harshly impacted will be the most socially vulnerable: residents of informal settlements.

Informal settlements most often exist outside the purview of the State formal system of laws and regulations that are meant to ensure resilient systems, structures, and households. They lack implementation of land-use, building bylaws and urban services and infrastructure. As a consequence, many households are devoid of basic infrastructure and services that should be provided in urban contexts such as stable electricity connections, clean water supply, household provisions for sanitation, paved roads, sewage and drainage facilities. Many of these settlements are prone to natural hazards, eviction and eventual relocation. Residents cannot afford formal housing in the city and most live on illegally occupied land. In many cases land tenure or acquisition is unrecorded or lacking documentation. Vulnerability of informal settlements is however not just physical: residents typically have unstable livelihoods and are marginalized because of structural social conditions including identity, caste or ethnicity.

"Social vulnerability as the lack of capability of individuals, groups or communities to cope with and adapt to any external stress placed on their livelihoods and well-being."

Defining Social Vulnerability

Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and the lack of capacity to adapt. Certainly, sensitivity to climate impacts has tangible physical aspects like quality and location of housing. However, social dimensions such as access to, and control over, economic, social and institutional resources; wealth; social status; and gender, amongst others are equally critical and often not accounted for in explanations of adaptive capacities and resilience.[8] In this paper, we focus on the human dimension of vulnerability: including socio-economic class; access to social networks; education, knowledge, and skills; and political power and agency.[9]

Decades of hazard and climate change-related research has drawn on differential impacts of hazards owing to social and structural factors underlying vulnerability. For example, Füssel defined 'social vulnerability as the lack of capability of individuals, groups or communities to cope with and adapt to any external stress placed on their livelihoods and well-being.'[10] Schellnhuber et al. proposed the term 'differential social vulnerability,' which they define as 'the varying degree of adverse effects that different individuals and social groups in one location may suffer from the climate stressors they are exposed to.'[11] Within these vulnerable groups, members also have coping mechanisms such as strong social networks that help them withstand the negative effects of disruptive shocks like extreme weather events. "More needs to be known about these mechanisms to understand whether they can be multiplied and used to increase the resilience of people at risk from disasters."[12]

Cities in a Comparative Framework

	Delhi	Agra	Panaji
Scale	**Area: 1,484 km² (Union Territory) Population: 16,787,941** Delhi's urban area now called Central National Capital Region (CNCR) has an estimated population of 26 million people, making it the world's second-largest urban area.	**Area: 87km² (Metropolitan Area) Population: 1,760,285** Agra is one of the most populous cities in Uttar Pradesh, and the 24th most populous in India.	**Area: 76.3km² (Metropolitan Area) Population: 114,759** Delhi's urban area now called Central National Capital Region (CNCR) has an estimated population of 26 million people, making it the world's second-largest urban area.
Informal Settlement Population	76.3% urban population living in unplanned settlements	56% of urban population	N/A
Major Urbanization Factors	In-migration and natural growth. Majority rural migrants. 2,172, 760 migrants in NCT Delhi since 1991-2001, 68.7% from rural India.	Local migration for jobs with tourism rise. 32.2% growth rate in a decade.	In-migration for tourism and construction labor. Tourism intake. Additional floating population of 639,177 tourists. 5x the actual city population.
Problems Faced	Quality of life, lack of urban services and their management. No legal address or identification. Heat waves, vector-borne diseases.	Working conditions and fading livelihoods. Access to clean water and sanitation, water scarcity. Open defecation and sewage. Long term- displacement.	Prone to flooding, and sea level rise. Threatened traditional livelihoods. Outdated urban services. Eroding beaches and affected coastal commons.
Climate Threats	Heat island effect, depleting groundwater, flooding during monsoons and unseasonal weather events.	Changing intensity and flow of river, river-flooding, extreme weather events.	Flooding and sea level rise, inundation in low lying areas with subsidence of land, extreme weather events.

"These settlements are unauthorized colonies that cropped up without state approval, or villages engulfed by expanding urban boundaries."

Delhi

More than half of Delhi's population lives in informal settlements.[13] These settlements are unauthorized colonies that cropped up without state approval, or villages engulfed by expanding urban boundaries. The selected case study settlements of Hauz Rani and Khirki in Delhi are urban villages of complex morphologies. The two informal residential settlements are clustered around some green spaces and historical monuments in the affluent South Delhi region. Both Hauz Rani and Khirki are a mix of different coexisting settlement types- planned residential neighborhoods, unauthorized colonies, urban village typology, Jhuggi-Jhopris,[14] etc. While much of the population in the area shares homogenous socioeconomic characteristics, some areas of Khirki Village and its extension have more diverse occupants ranging from middle-class households to temporary housing. Hauz Rani, on the other hand, is a predominantly Muslim settlement — densely packed and with limited access to urban services.

Unauthorized and unregulated urban villages such as Hauz Rani and Khirki — surrounded by dense urban growth — are experiencing intense heat island effect and depletion and contamination of groundwater. The immediate impacts are felt on health and availability of potable water, or through the flooding during monsoons and unseasonal storms. In the long-term, extremely dense informal clusters would be untenable as demographic pressures drive up the built up areas compounding heat stress during peak summers.

Agra

Agra is a tourism hotspot owing to the presence of Taj Mahal, a UNESCO World Heritage Site. It also has 417 informal settlements making up for about 56% of the urban population, of which about 50 settlements lie along the 'buffer' zone of Yamuna river basin within the municipal limits of the city. The selected case study of Katra Wazir Khan is one such trans-Yamuna informal settlement along the riverbed. Like other informal settlements in Agra, Katra Wazir Khan and Tajganj have a concentration of small-scale and household industries, while large scale industries lie on west of the Yamuna river. Most residents are employed as informal laborers in manufacturing units for electric and mechanical goods, textile, foundries, transportation and logistics services. There are also livelihoods dependent on traditional skills of making local handicrafts, marble carving and inlay work and leather goods. A significant section of the urban poor work in the thriving tourism industry in the city.

Most informal settlements in Agra are not connected to basic sanitation and municipal services. The absence of individual or public toilet facilities leads to unsanitary practices of open defecation. 43% of temporary households in Agra face acute water shortage without access to individual water supply connections. Sewer lines are choked and untreated sewage along the river basin like Katra Wazir Khan directly flows into the river. At the same time, surface water from the river is a major source for the city. This water is severely contaminated and unfit for drinking, exposing the residents to multiple health risks.

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"Coastal communities, which depend on coastal ecosystems for resources and livelihoods, are especially vulnerable to the impacts of climate change."

For informal settlements of migrant communities settled along the Yamuna river basin in Agra, the short and the medium-term impacts include - variation in the intensity of flow of the Yamuna every season; flooding of the buffer zone in Agra because of emergency release of water during extreme precipitation; tributary drainage channels carrying untreated wastewater from the city toward informal settlements; and stagnation of untreated wastewater at times of high water level in the river. In the long term, upstream management of the river will have local consequences. In the absence of a river basin development controls regime, large populations that chose the riverbank for habitation will be subject to displacement, relocation or progressive deterioration of environmental services.

Panaji

Given Goa's role as a prime tourist destination, the state capital Panaji is a rapidly urbanizing city bound by the Mandovi River and the Arabian Sea on an estuary of 812 hectares. The city is located within an undulating topography of varying urban density, surrounded by an intricate system of wetlands, tidal marshes and cultivated paddy fields interconnected by canals, inland lakes, bays, lagoons and creeks governed by regular tides. The selected case study - a coastal settlement called Caranzalem village lies between Miramar and Dona Paula, south of Panaji city center. A dense fishing village, most inhabitants are long term residents: traditional fishermen and others with

livelihoods dependent on coastal commons. The state government's vested interests in tourism, changing coastal regulations, sand and coal mining, and rampant illegal activities are detrimental to the livelihoods of such peri-urban informal settlements.

Climate change induced threats in the city of Panaji and in Goa more generally include sea level rise, flooding due to changes in rainfall patterns and intensity, and coastal erosion of beaches. Panaji is prone to sudden flooding due to heavy rains, often leading to disruption in urban services. Coastal communities, which depend on coastal ecosystems for resources and livelihoods, are especially vulnerable to the impacts of climate change involving: the loss of beach-space and coastal commons, loss of livelihoods; flooding of settlements; deteriorating health and living conditions; and eventually displacement. The watersheds of the Mandovi river basin around Panaji are both unique and highly vulnerable to climate impacts.[15] Rapid urbanization has affected drainage in the coastal estuarine agro-system of Khazan lands around Panaji and reduced the resilience of communities.

2 Social Vulnerabilities

At a time when national climate change policy directives increasingly focus on climate change mitigation and structural solutions for resilience, it is critical to understand the forces and address the systems that allow social vulnerability to persist. Evidence states that efforts to reduce social vulnerability go hand in hand with sustainable development and improvements in quality of life.[16] The research work on Resilient Cities strives to identify the key variables and mechanisms of social vulnerability. In the subsequent section, we explore some of dimensions of social vulnerability field assessments in informal settlements of Delhi, Agra and Panaji - three Indian cities with different characteristics, yet similar challenges.

Livelihoods

Informal employment accounts for 81% of the urban workforce in India.[17] Casualisation of labor is now seen as directly linked to poverty and employment status.[18] Livelihoods of people in informal settlements are linked to low literacy and skill levels. There is a high incidence of school dropouts among children in Agra informal settlements, trapping them in a future of low wage unskilled jobs and the cycle of urban poverty. Inhabitants work on low, irregular wages, on informal terms, creating economic vulnerabilities which subsequently make them more vulnerable to impacts than others. An economically vulnerable household or individual is unable to afford the means to adapt and build resilience to climate change.

In Agra, traditional crafts is one such source of livelihood where people from informal settlements — mostly migrants — live and work in unfavorable conditions in small factories in shoemaking and stonework exposed to toxic fumes and dust particles. In a tight, poorly-ventilated room in Kans Gate, Gokulpura, 34 years-old Sanjay sits with five other men ploughing away with a hand drill for 14 hours every day. They sit on the floor, sweaty faces masked by rags to avoid breathing in the white dust floating through the room. Climate change threats worsen their conditions. He recollects when two years ago their local bore well dried up. Water is crucial in the carving process. They are now forced to walk a kilometer to get water from the closest government tap. In addition, they buy bottled water for drinking, increasing their expenses from an already meagre wage. Sanjay mentions that groundwater has been quickly depleting in Agra over time. The bore wells are dug deeper and deeper every year.

Labor Chowk in Delhi presents a similar scenario where migrant residents from nearby informal settlements are hired as daily manual labor in construction work and thus exposed to heat waves in harsh working environments. This situation is also felt by workers in the platform economy i.e taxi and autorickshaw drivers. With a low-wage rate and no job security or regular contracts, these groups have a high incidence of poverty.

Traditional fishermen live in unplanned settlements along shores in Goa. Their livelihood is intricately linked to threatened natural resources and marine ecosystems which they depend on as a source of livelihoods. Devi Nayak, a 54 year old woman who sells fish in Goa exclaims that the catch has become lesser over the last few decades. She is not sure if this is because of overfishing or climate change. In the case of agricultural livelihoods supported by ecologically-dependent Khazan lands, urbanization has affected drainage in the unique, coastal, estuarine agro-system of Khazans around Panaji and reduced the resilience of dependent communities.

Many households living in informal clusters do not have the means to provide for the family on a regular basis. Traditional craftsmen in Agra are often left unemployed and face periods of starvation during the hotter months when tourism-based livelihoods are impacted. Many restaurants and other tourism-run businesses, including export houses, lay off staff in these months. Tourism is sensitive to climate change, as are livelihoods associated to tourism; small businesses, restaurants and cafes in Agra or beach shacks in Panaji are at risk.

Identity

Informal settlement residents often don't have identification or legal address proof. Many find themselves excluded from formal systems of support and access to services, like not being able to open a bank account or having a legal address - on which access to many government schemes often depends.

Pradha Mantra, age 45, makes a living by selling steel utensils and wooden artifacts along the Press Enclave Road in front of Max Hospital, on the periphery of Hauz Rani. She has lived by the roadside in a kutcha house of brick walls, under a roof of salvaged materials, for over a decade. She has been unable to secure an official address for her house due to lack of formal identification papers. This consequently means no access to any urban service or incentive schemes for the poor. Many people in informal clusters and poor households face the same lack of proper identification or a valid address; they have no legitimate way to seek access to state support or urban services, thus restricting their adaptive

capacity to build resilience. Climate change could drive more migration to urban centres. This will put even more pressure on services and housing, potentially multiplying informal settlements and undocumented citizens.

Gender

Gender plays a critical role in individual vulnerability, with women typically more likely to be negatively affected by the impacts of climate change and access to power and resources than men.[19] The socio-cultural prejudices, traditions and norms that emphasize the male role in a household render women excluded or dependent: they are unable to seek financial security and independence, secure a job and are excluded from decision-making. For example, in the case of Muslim-dominated Hauz Rani, there is a limited presence of females in public spaces.

For Pradha from Hauz Rani, the closest source of water was an open tap in front of the Max hospital, but even that has been closed up to prevent misuse. Now she must get water from a distant park which is quite laborious. She and her daughters have to go to far off places to defecate in the open on due lack of public amenities nearby. Water stress only aggravates the situation. Similarly, Anar Devi from a river side settlement in Agra is forced to travel further and further every year for her goats to be able to find grass patches and clean water to feed. Urbanization, encroachments and depleting clean sources of water mean the women of the household have to walk more to source water and find places for defecation. This means more exposure to extreme heat and higher chances of heat strokes as average summer temperatures rise with global warming. The stress to source potable water and adapt to extreme weather events for young girls potentially also mean increase in female school — dropouts and early withdrawal from education.[20]

"Women commonly face higher risks and greater

burdens from the impacts of climate change in situations of poverty, and the majority of the world's poor are women."[21] Women and children in informal settlements are also left exposed to unsanitary, unsafe unhygienic practices of open defecation as noticed widely in Katra Wazir Khan or in the Jhuggi Jhopris of Hauz Rani.[22] Women's unequal participation in decision-making processes and labour markets compound the inequalities and often prevent women from being able to contribute to climate-related planning, policy-making and implementation.

Caste

Some social groups amongst the urban poor are more at risk because of the discrimination they face on grounds of caste, class or identity. While caste plays less of a role in the daily lives of the upper and middle classes in cities, there is evidence that it still plays a major role in the employment, education and living conditions of the lower income groups.[23] The general composition of the majority of informal settlements comprises of scheduled tribes (ST), scheduled castes (SC), and other backward classes (OBC), from the

weaker sections of society. Among the informal population in Agra, 87% belong to the OBC and SC divisions.[24] Maximum number of child laborers belong to the SC and OBC communities, as well.

Pradha Mantra stresses that the lack of a caste certificate means they are unable to avail any government support for themselves. Indeed, their jhuggi shelter (slum dwelling) is not recognized legally and as a result there is a bleak chance of ever being able to connect to the legal municipal services or avail any other government-aided benefits.

Community and Cohesion

Social cohesion within the community is a strong resilience tool in informal settlements. Migrants, people from weaker sections of society, women headed households, and other minority communities are often socially excluded. Without a community base to rely on, there is no cohesion. Limited social mobility leaves them unable to seek support. There is no job security, insurance or savings to tap into. This incoherence of a community identity means that adaptive measures are informed solely by individual capabilities.

In the case of Hauz Rani, migrants are often economically vulnerable and lack social support and kinship – this makes coping an individual struggle. 50 year old Rahit is originally from a village near Sitapur in Uttar Pradesh. For many like Rahit, the impact of climate change on agriculture is already being felt. "Crops don't grow well in this heat," he says, "they use much more water to irrigate. I moved here because my family wasn't making enough money anymore in farming." Climate impacts on agriculture are exacerbating migration to urban areas, as well as rendering informal settlements and rural migrants within the cities as increasingly vulnerable. Rahit and those that share the same fate— the landless, small or marginal farmers with limited skill, capital and social networks— are perhaps the most vulnerable groups to climate change in India. Without a solid community base to rely on, there is no cohesion for migrants.

Limited social mobility leaves them unable to seek support. There is no job security or savings to tap into. There are no labor unions and any adaptive measures are dependent on individual capabilities.

On the other hand, interviews with local households revealed that Muslim residents of Hauz Rani pool together resources to confront the neighborhood's issues, instead of putting faith in the authorities to help them. Common faith, the mosque and integrated community shape the cohesion here, aiding a bit in neighborhood adaptive measures. Left to rely on their own means, older slum communities often came together to seek solutions to better their conditions. This was demonstrated in the Agra settlements where neighbors would pool together money to solve issues of water shortage. 'Adaptation is about how people respond to and live with their increased exposure to climate-related risks and stresses on their livelihoods'.[25] People draw upon available physical, economic, political, and cultural resources, including their social relations.

3 Conclusion

At national and state climate action policy levels in India, there is very little emphasis on everyday challenges that vulnerable communities face due to changing climate conditions. Urban resilience does not figure in the policies – either in climate specific or other urban development policies and initiatives. The limited discussion on cities and climate change is restricted to structural and infrastructural measures. Issues of equity, poverty eradication and community empowerment that shape access to infrastructure are not addressed.

Urban climate resilience must not be limited to strengthening infrastructure and implementing hard solutions. It must encompass and prioritise protecting the most vulnerable communities to the effects of climate change, and addressing the underlying factors and issues that increase the structural vulnerability of certain populations. Policies can both empower or systematically exclude marginalized groups, and may reinforce existing inequalities or increase threats to their well-being and livelihoods. "Transformative social policy that addresses aspects of redistribution, enhances productive capacity and social cohesion and reshapes institutions in line with the principles of good governance, equity and empowerment can significantly reduce vulnerability to climate change."[26]

An effective policy framework should bring forth the importance of, and the need to, introduce urban climate resilience into informal settlements; draw out a structure of the institutions and regulations needed to implement the same; and identify windows for financing these actions. A policy framework for urban climate resilience, which keeps in mind the disproportionate vulnerability and differential abilities of different social groups, would help take significant steps towards sustainable development of cities. Resilient planning would include preparing urban systems, built environment and social fabrics, to withstand these changes and associated impacts.

As climate change impacts are unevenly distributed among individuals and communities, due to differential exposures and vulnerabilities, there is a need to assess adaptive capacity at a local scale and situate them within state and national governance frameworks.

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