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Urban India and Climate Change*

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> One of the defining parameters for delivering India's sustainable development agenda will be the development path chosen by urban India.
>
> —*Economic Survey of India, 2017–18*
> (Department of Economic Affairs 2018)

Cities globally are increasingly positioned as sites of climate action, placing new importance on India's urban transition. The United Nations' (UN) 2015 Sustainable Development Goals (SDGs) include an explicit goal on cities, and the 2015 Paris Climate Agreement promotes climate outcomes in national development contexts, carving out a role for cities. India is especially relevant to this discussion as it is projected to undertake the largest urban transition globally in the next few decades. In this chapter, we reflect on the implications of

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India's urbanization for the country's energy and climate debates. We start with describing the uniqueness of India's current urban moment, synthesize the growing literature on how urban centres are responding to climate change, and discuss how emerging climate mitigation and adaptation actions can be mainstreamed into urban development.

India's Current Urban Moment

About 400-million additional people are projected to live in Indian urban settlements by 2050, a doubling in four decades from 2014 (United Nations Division of Economic and Social Affairs [UN DESA] 2014). Urban India already contributes to 63 per cent of the country's gross domestic product (GDP) and the proportion is set to increase further (High Powered Expert Committee [HPEC] 2011). To support this population and economic growth, estimates indicate that two-thirds of India's built environment will be constructed between 2010 and 2030 (Kumar et al. 2010). Transitions of such scale place extraordinary pressures on infrastructure and resources, with little doubt that urbanization will be a central determinant of India's future development.

India's urban concentrations are characterized by a set of complex features and a wide spectrum of urban form. This includes megacities such as the National Capital Region (NCR), Greater Mumbai, and Bangalore, to the many more small and medium-sized cities. Yet, across scale and density, welfare conditions remain dire. Official poverty rates hover around 15 per cent (Government of India [GoI] 2011) and one in six residents lives in officially designated slums. Also, 16 per cent of urban residents remain without water and 28 per cent are without toilets and adequate drainage. For those with access to services, quality remains low (HPEC 2011). The health of the local environment, that is, air, water, and land, is dire. The most polluted cities in the world are now in India, with limited prospects for progress (World Health Organization [WHO] 2016). As urban populations grow, the demand for basic services will rise, increasing the concerns of inclusivity and the burden on already-stretched resources and infrastructures.

Further, a distinctive feature of India's wave of substantial urbanization is that it comes at a time of global momentum on climate

change, as is exemplified by the Paris Agreement of 2015. This burden was less relevant for countries which significantly urbanized in the 2000s, when there was less imperative, though increasing pressures, for developing countries to mitigate their greenhouse gas (GHG) emissions (see Chapter 7 in this volume). As per India's Paris contribution, the country will urbanize while reducing the economy's energy intensity and fossil-fuel share of electricity (GoI 2015). By this measure, it can be argued that India is set to undertake potentially the first large-scale, climate-conscious urbanization.

Urbanization is salient to India's climate contribution for a variety of reasons. One, as the country urbanizes, rising income levels and greater access to basic services will lead to significant future urban energy demand, particularly from transport, residential, and industrial end use (ICLEI- South Asia 2009). Second, urban India is prone to a multitude of climate risks, such as coastal surges and cyclones (Sridhar 2016), uneven precipitation causing water stress (Kumar, Geneletti, and Nagendra 2016), heat waves and temperature increase (Dholakia, Mishra, and Garg 2015), and higher incidence of diseases such as malaria (Sahay 2017). These multiple risks are 'interlinked and growing' (Revi et al. 2016), and compound multiple local stressors of population growth, land use change, and industrialization (Lele et al. 2018). Climate change also compounds social vulnerabilities; thus, those without adequate shelter, drainage, and water, and with social disadvantages, in urban areas will be the most affected (Hughes 2013; Rumbach 2018; Yenneti et al. 2016). Finally, urban networks of streets, transport, and buildings, most of which are yet to be built, will endure for decades and condition consumption, waste, and social and environmental vulnerability for the long term.

Managing urban India's climate mitigation and adaptation efforts successfully will require responding to multiple and simultaneous challenges of providing services and livelihoods to many, while preserving the local environment and its increasing managing climate impacts.

Urban Approaches to Climate Change

Over the past decade, cities have emerged as potential champions in addressing climate change as they offer the advantage of operational ease through implementable projects, even when national

governments are less willing to respond to climate change (Fisher 2014). In this section, we map the evolution of India's urban climate responses and the related literature, and describe the characteristics that mark these efforts.

Evolution of Urban India's Climate Responses

The earliest Indian urban climate concerns were around vulnerability to climate stresses and disaster risks. This resulted in adaptation efforts which were easier to motivate as their benefits accrue locally, compared with the more dispersed benefits of GHG mitigation (Sharma and Tomar 2010). Early climate adaptation efforts in India were primarily dominated by two international networks: Rockefeller Foundation's Asian Cities Climate Change Resilience Network (ACCCRN); and the UN-sponsored ICLEI–Local Governments for Sustainability (Beermann et al. 2016; Fisher 2014; Hackenbroch and Woiwode 2016). The focus of these networks differed geographically, depending on local climate vulnerabilities and risks and related infrastructure deficits (Joerin et al. 2014; Sharma, Singh, and Singh 2014; Yenneti et al. 2016). In Ahmedabad, heat stress led to a call for action (Knowlton et al. 2014), while Surat (Blok 2016; Chu 2016) and Kochi (Sowmya, John, and Shrivasthava 2015) addressed the risk of sea-level rise and flooding. Water was also a recurrent focus, with efforts in Indore addressing scarcity and in Gorakhpur, waterlogging (Bahadur and Tanner 2014a).

Adaptation efforts also sought to address the complex interdependencies of urban development with climate change (Bahadur and Tanner 2014b; WS Atkins 2014). The focus on alleviating multiple risks (Kumar, Geneletti, and Nagendra 2016; Parikh, Sandal, and Jindal 2016) resulted in city departments promoting cross-cutting solutions, such as the redevelopment of green spaces, urban agriculture, and lakes (Govindarajulu 2014; Hackenbroch and Woiwode 2016; Revi et al. 2016). In Chennai, the focus on flood management explicitly focused on interdependencies between urban planning, coastal management, and real estate growth (Rajagopalan 2017). Meanwhile, in Delhi, the climate plan received criticism for not highlighting the outcomes for vulnerable groups (Hughes 2013).

Over time, the early emphasis on adaptation broadened to include GHG mitigation, consistent with the changing international climate context and India's 2009 (Copenhagen) and 2015 (Paris) pledges of economy-wide carbon intensity targets, and the increasing affordability of energy efficient and renewable technologies. The salience of urban India to national mitigation efforts also became more pronounced with accelerating energy consumption, and associated emissions, even though starting from a low base. Subsequently, urban centres came to be seen as sites for the deployment of technologically and politically feasible energy-efficient and low-carbon end-use options. National policies and schemes were started to promote various alternatives for urban areas; for example, the National Mission on Sustainable Habitat, the Smart Cities Mission, the Solar City Programme, and Green Urban Transport Mission, all have rolled out climate-friendly features, such as rooftop solar plants, public transport, bike lanes, and Energy Conservation Building Code (Hackenbroch and Woiwode 2016; Rajasekar, Chakraborty, and Bhat 2018). These are complemented by large-scale energy efficiency schemes for subsidized light-emitting diode (LED) bulbs and efficient appliances. Taken collectively, these efforts signal the larger trend of the growing climate mitigation and adaptation actions in India's urban areas.

Characteristics of Urban India's Climate Responses

In order to better understand the nature of India's urban climate responses, we describe the key characteristics that mark the range of efforts made across Indian cities: the use of local development priorities as an entry point to climate actions; the role of non-state actors in promoting climate-relevant outcomes; and the proclivity for discrete project-based activities.

The formulation of urban climate mitigation and adaptation responses has been based on linking climate change with immediate and local development needs (Aggarwal 2013; Beermann et al. 2016; Sethi and Puppim de Oliveira 2018; Sharma and Tomar 2010). This is partly because Indian city leadership has little choice but to put development first, with critical gaps in the provision of housing, transit, sanitation, safety, jobs, water, and energy infrastructure. In

addition, using development as an entry point for climate efforts is an artefact of the low awareness, and low political priority, of climate change within city governments (Fisher 2014; Sharma, Singh, and Singh 2014) as, unlike national and state governments, there is no formal mandate for cities to produce action plans on climate change (Revi 2008; Sethi and Mohapatra 2013). Of 59 city plans, an analysis found that only 10 per cent have climate-relevant strategies and 30 per cent exhibit awareness (Kumar and Geneletti 2015: 215). The focus, instead, has been on addressing more immediate and pressing developmental needs, which city governments have institutional and electoral incentives to meet (Bahadur and Tanner 2014b; Rajasekar, Chakraborty, and Bhat 2018).

By this nature, and also because of the relative centralization of Indian urban governance, city climate action often depends on state and national-level mandates and directives (Aggarwal 2013; Beermann et al. 2016; Sharma, Singh, and Singh 2014; Sharma and Tomar 2010). At the local level, there are a host of actors that implement schemes and master plans, such as the city government and the district urban development authority, and in larger urban areas, dedicated parastatal bodies are in charge of housing, transport, electricity, and water, but operate independently of the municipal government. The development decisions taken locally are shaped by the priorities of these various agencies and multiple influential actors (Bahadur and Tanner 2014a; Fisher 2014). Climate planning within this architecture is thereby often merged with national and state schemes, which ensures funds and meets local concerns. For example, in a green housing programme, the Rajkot Municipal Corporation's primary objective was to address a growing demand for low-income housing built under the central government's Housing for All programme, but the city engineers incorporated climate-adaptive elements, such as rainwater harvesting and passive cooling and ventilation, on these sites, which led to additional, climate-friendly benefits (Bhardwaj and Khosla 2017).

Such formulation of climate action has led to a growing literature on climate and local development linkages. In Delhi and Kolkata, studies proposed low-carbon residences by improving end-use efficiency, and also through rooftop solar and waste-to-energy plants (Farzaneh et al. 2014) that link both affordable and pro-poor

low-carbon projects (Colenbrander et al. 2016). In Indore and Gorakhpur, non-state actors leading climate projects had to also focus on local realities of immediate and known problems, such as garbage collection, while coping with governance in silos (Bahadur and Tanner 2014a). Local goals, however, are not always welfare or development oriented. Instead, outcomes can be influenced by powerful local lobbies: in the case of Surat, for example, well-organized entrepreneurial communities lobbied to direct adaptation activity to an industrial area at risk to sea-level rise (Blok 2016; Chu 2016).

Along with development benefits, studies are also increasingly examining health benefits of mitigation. In Surat, a waste-to-energy plant reduced carbon emissions and water pollution, accruing local health benefits (Kapshe et al. 2013; Puppim de Oliveira and Doll 2016). An India-wide study found that increase in electricity, modern cooking fuels, and clean water lowers short-term morbidity for 2.4 million people, with only modest increase in GHG emissions (Ahmad, Pachauri, and Creutzig 2017). A range of mitigation studies focus on transport and on finding incentives to increase public transit (Maitra and Sadhukhan 2013) to enhance safety, health, and air quality and reduce GHG emissions (Ahmad, Pachauri, and Creutzig 2017; Guttikunda 2008; Pathak and Shukla 2016). The Delhi Metro was evaluated for its benefit to transiting passengers and its co-benefits to air pollution and carbon mitigation (Doll and Balaban 2013; Puppim de Oliveira and Doll 2016), but also with some equity trade-offs as it disproportionately displaced the poor (Doll et al. 2013). In general, finding linkages between climate and development goals—whether politically or technically motivated—has become a key feature of urban climate responses in India.

The implementation of such urban climate efforts is a product of the collaborations between various actors at the local level. In particular, there has been a dominance of non-state actors, especially international ones, who operate in partnership with the local government. Non-state actors plug gaps of state capacity, data, and finances (Sethi and Mohapatra 2013; Sharma, Singh, and Singh 2014), and range from international donors with large climate change portfolios, global city networks such as C40 and Rockefeller Foundation's '100 Resilient Cities', consultants, and research groups, to local lobbies, private sector associations, universities, and non-governmental

organizations (NGOs) (Alankar 2015; Boyd and Ghosh 2013; Bulkeley and Castán Broto 2014; Cook and Chu 2018; Revi 2008). In these collaborations, local city actors are found to 'bundle' (Aggarwal 2013) and 'steer' (Cook and Chu 2018) partners and financing to achieve national and local climate and development actions (Padigala and Kraleti 2014)

These collaborations were either informally structured, as in Delhi (Hughes and Romero-Lankao 2014), or institutionalized, as in the case of Surat (Chu, Anguelovski, and Roberts 2017). In the latter, the city government, local chamber of commerce, education institutions, and technical consultants, backed by an international donor, set up the Surat Climate Change Trust to coordinate and direct climate change activity in the city. Set up as a trust, the organization could operate independently of national and state government procedure and even acquire funds from external organizations (Chu 2016; Karanth and Archer 2014). The ICLEI network helped Indian cities embed policy ideas, or at least seed them for the future, through techniques such as generating data inventories (Fisher 2014). In this way, climate mitigation and adaption actions in cities are the result of a negotiated relationship between state and non-state actors. Studies find that the influence in determining these actions lies mainly with city governments, donors, and influential political and industrial lobbies, often at the exclusion of actors representing vulnerable groups (Hughes 2013). Donor-driven activities have also been critiqued for their globally oriented climate motivations and outcomes-based approach, as opposed to being driven by local needs (Khosla, Sagar, and Mathur 2017).

Most urban climate responses, as a result, take the form of projects, which are implementable and aim to provide evidence of outcomes and benefits. These projects tend to be ad hoc, experimental, technical (Boyd and Ghosh 2013; Hackenbroch and Woiwode 2016), and focus on 'win-win' solutions (Fisher 2014). The activities are discrete and map on to existing needs and institutional frameworks of city governments, which are often largely sectoral. The limited nature of this response is partly because of governance and capacity constraints of operating in a centralized policymaking system, especially for small to medium cities. Surat's more institutionalized approach to coordinate actions with a trust is an anomaly (Chu 2016). In the more

typical case of Mumbai, climate experiments engaged separately with the waste sector, real estate, transport networks, coastal regulations, and state pollution policies, but with little effort at coordination (Boyd and Ghosh 2013).

In the final section of this chapter, we build on this early experience of urban approaches to climate change to frame what a structured and coordinated approach to Indian urban climate policy could be.

Towards a Climate-Conscious Indian Urbanization

Responses by Indian cities to climate change are still nascent, but there is little incentive to build on this action. Most cities therefore do not mention, let alone adequately address, climate change in their development plans (Kumar and Geneletti 2015). If the approaches so far are indicative, the future trajectory of urban responses to climate change in India will be shaped by how local development and climate goals will be linked and prioritized. While a range of Indian cities are beginning to embark on identifying such linkages, a strategic understanding of interacting climate and development priorities, across governance levels, is yet to be developed. A solely project-based approach is insufficient as cities are not culminations of sites and projects but entail complex systems, interacting infrastructures, and socio-technical systems. Given the magnitude of change that Indian cities will face in the coming years, and their impending challenges of inclusivity and vulnerability, this section outlines the considerations by which climate actions can be mainstreamed in urban areas.

Structural Changes and Lock-in

Most of urban India is yet to be built. This particular aspect of cities offers, perhaps counter-intuitively, a potential advantage. Decisions about urban form are still open, and once made will lock-in energy and carbon consumption patterns for the long term. How cities are built over the next decade will condition how most Indians live until the end of the century: in the choice of building types; in how they expend energy; in the amount of distance travelled, and the ways in which distances are covered. These choices will have material consequences for air, water, congestion, energy, and climate change,

amongst others. So far though, curtailing urban sprawl and planning for strategic densification is not yet on the policy radar.

Similarly, for adaptation, infrastructure that accounts for climate risks will need to address the current deficit for vulnerable groups, and also alleviate local climate risks such as flooding, heat islands, water security, and air pollution. While more climate-specific infrastructures such as levees, rainwater harvesting systems, and passive cooling buildings will also be required, it is important to stress that Indian cities are especially vulnerable to climate risks as they have not yet extended basic infrastructures such as storm drainage, municipal water supply networks, wastewater systems, public shade, and shelter to all. Ensuring these basic infrastructures are in place during the impending transition is essential in adapting urban India to climate change.

As urban spaces provide a physical setting for shaping preferences and practices, lock-in effects are not easily reversed and the cost of switching infrastructures and behaviours can be prohibitively high. The current ability of India's cities to determine their urban form is a distinctive window of opportunity to choose alternative development pathways that do not compromise on quality of life, and yet also internalize long-term climate responses. This opportunity, however, will only be as useful as the decisions that cities make within the next 5–10 years.

Multiple Objective-Based Planning

City officials have multiple objectives, including urban development goals—such as water, waste, energy, mobility, and land use—and climate change, which are interrelated and vary in salience for different political actors and constituencies (Bhardwaj and Khosla 2017, 2018; Pathak et al. 2015; Sethi and Puppim de Oliveira 2018). Climate change impacts and solutions are embedded in these interconnected goals, and an increasing set of examples, as previously described, demonstrate how national policy and city initiatives are incorporating climate action into urban planning. These initiatives are primarily driven by the synergy between city development and climate goals, which serves as an effective and politically viable entry point for city climate action. However, the decisions are more

complicated when cities need to make a trade-off between climate and development.

A potential methodological tool to evaluate the linkages between different urban objectives systematically is to use a multiple objectives framework. The framework draws from the literature on co-benefits and provides a structure to assess multiple and simultaneous urban priorities, which can be economic, environmental, social, or governance based, and subsequently identify the synergies and trade-offs across them (Khosla et al. 2015). Cities can use the framework to identify schemes, technologies, plans, and projects which can potentially achieve both development and climate concerns. Alternatively, they can also make explicit the trade-offs that policy decisions inevitably lead to and provide a more transparent and rigorous basis for doing so. Recent tools, such as the multidimensional urban liveability index proposed by the Ministry of Urban Development (MoUD) and the cross-sectoral focus of the Smart Cities Mission's visioning process, indicate a policy shift aimed at understanding the multi-objective needs of India's urbanity (MoUD 2017). However, a more structured multiple objectives approach can help cities push beyond their conventional piecemeal actions and create strategic and systemic links between climate change and urban goals.

Institutionalizing Urban Climate Responses

Redirecting urbanization from existing energy and carbon-intensive pathways will require an institutional structure that is able to leverage interactions across sectors, as opposed to the current compartmentalized project-based approach. However, Indian cities have little incentive and are under-equipped in terms of technical or financial capacity to reap such systemic benefits, particularly with respect to climate change. Most urban bodies have limited their focus on discrete projects which are ad hoc and rarely coordinated (Hughes and Romero-Lankao 2014), instead of a strategic integration of climate adaptation and mitigation agendas (Boyd and Ghosh 2013; Chu, Anguelovski, and Roberts 2017). Coordination between these projects is made further difficult by the multi-level nature of urban governance and sector-specific silos within which decisions are made, often leading to conflicting actions (Bahadur and Tanner 2014a;

Bhardwaj and Khosla 2018; Kumar and Geneletti 2015; Revi et al. 2016; Sharma and Tomar 2010).

The sharing of best practices and recent city-level schemes, such as in Surat, are beginning to encourage integration. National programmes such as the Transit Oriented Development Policy, Green Urban Mobility Scheme, and aforementioned Smart Cities Mission, and Liveability Index for Cities, attempt to promote coordination and cooperation across departments, particularly to align urban action with national objectives. A more successful institutional architecture would involve the creation of spaces for such cross-sectoral strategizing and coordination, and working across governance levels to enhance the role of urban governments (Bhardwaj and Khosla 2017; Doll et al. 2013; Revi et al. 2016; Sethi and Mohapatra 2013).

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In conclusion, this chapter reflects on India's urban responses to climate change in light of the larger urbanization trend taking place in the country. We synthesize the growing research on this issue and describe the narratives that mark these actions. While the synthesized literature often suggests the need for more local responses to climate change, regional considerations also enter play. For example, Delhi's climate change plan stands out with its proposed coordination with upstream states, Haryana and Himachal Pradesh, to ensure water sharing and security (Aggarwal 2013). A city's air pollution problem is also as much a challenge of addressing local concerns, such as transit and waste management, as the agricultural practice in upwind states. A strategic and coordinated approach that acknowledges such unbounded urban challenges, and the window of opportunity to lock-in lower consumption and sustainable infrastructures, could be an important shaper of India's low-carbon development path.

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