Urban Sustainability in India: Evolution, Challenges and Opportunities

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Background

The word "urban," as per the Census of India, refers to settlements with a minimum population of 5000, with a density of 400 persons per square km, and with at least 75 percent of the male working population engaged in non-agricultural activities. According to this definition, there are a total of 7935 urban settlements in India, which account for 31.2 percent of its total population (i.e., 377.1 million out of 1.2 billion) and 63 percent of its national economic output (Mishra 2015).

India has been urbanizing at a steady but moderate pace. The average annual growth rate of the urban population in India was 2.4 percent in 2015, which is lower than some of India's neighboring countries in South Asia, such as Bangladesh (3.4 percent) and Nepal (3.2 percent), but comparable to emerging global economies such as China (2.7 percent) (Urban Population Growth (Annual %) 2015). Despite having a lower share of urbanization compared to many developed and developing countries, India houses about 10 percent share of the world's urban population (Urban Population (India) 2015) and (Urban Population Growth (Annual %) 2015), and a few of the largest and most populated cities of the world. However, beyond the large cities, there exist a large number of small towns that constitute a substantial share of India's total urban population (Census of India 2011). Thus, the story of India's emerging urbanization is as much about its small, non-descript

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towns spread across a large rural canvas, as much as it is about its large cities like Mumbai, Delhi, Kolkata, Bangalore, and Chennai.

Cities, by their very necessity, are supposed to be efficient by exploiting the flow of natural and human resources and information. Brendan O'Flaherty, in his book *City Economics*, argues that cities could persist, only if their advantages offset the disadvantages. The very notion of cities is of a space that is able to, through an exploitative role, provide a competitive advantage. Thus, there would be tensions between the ideas and practices of sustainability and the creation and use of urban spaces. One would therefore expect, from time to time, the emergence of questions and challenges regarding environmental, social, and economic justice. These questions become even more pronounced in places with severe environmental problems, especially remarkable in developing countries like India. The country has big stakes in its cities to achieve a high level of economic growth and, at the same time, is committed to global agendas such as the Sustainable Development Goals (SDGs), the New Urban Agenda of HABITAT-III, and the Paris Agreement on climate change.

In independent India's policy discourse post 1947, the formal recognition of urban as an important sector started with the eighth five-year plan (FYP), during 1992–97(refer Fig. 36.1). Until then, urban was dealt with through centrally driven programs, mainly focusing on basic infrastructure provision and the creation of a few new cities as capital towns. Urban sustainability, in its true sense, was not a conscious political discourse, yet. The 74th Constitutional Amendment Act (CAA), in 1993, paved the way for the empowerment of Urban Local Bodies (ULBs) to manage their own functions, including planning for their respective jurisdictions. Although the implementation of the 74th CAA in its true essence has been a debated subject in India, this landmark reform has actually been a catalyst for a number of flagship urban sector programs that Indian cities observed in later years. The Jawaharlal Nehru National Urban Renewal Mission (JnNURM) was among the first of such flagship programs. Despite various limitations, JnNURM managed to bring urban local governments to the center of dialogues while planning the cities' infrastructure requirements. References to sustainability, in the JnNURM, were mostly related to financial sustainability, at a time when private finance in public infrastructure creation was seen as a potential, in an otherwise dismal urban finance scenario.

The second generation of urban development programs were started post 2010. These programs (Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation [AMRUT], Housing for All, Heritage City Development, and Augmentation Yojana [HRIDAY], among others), together,
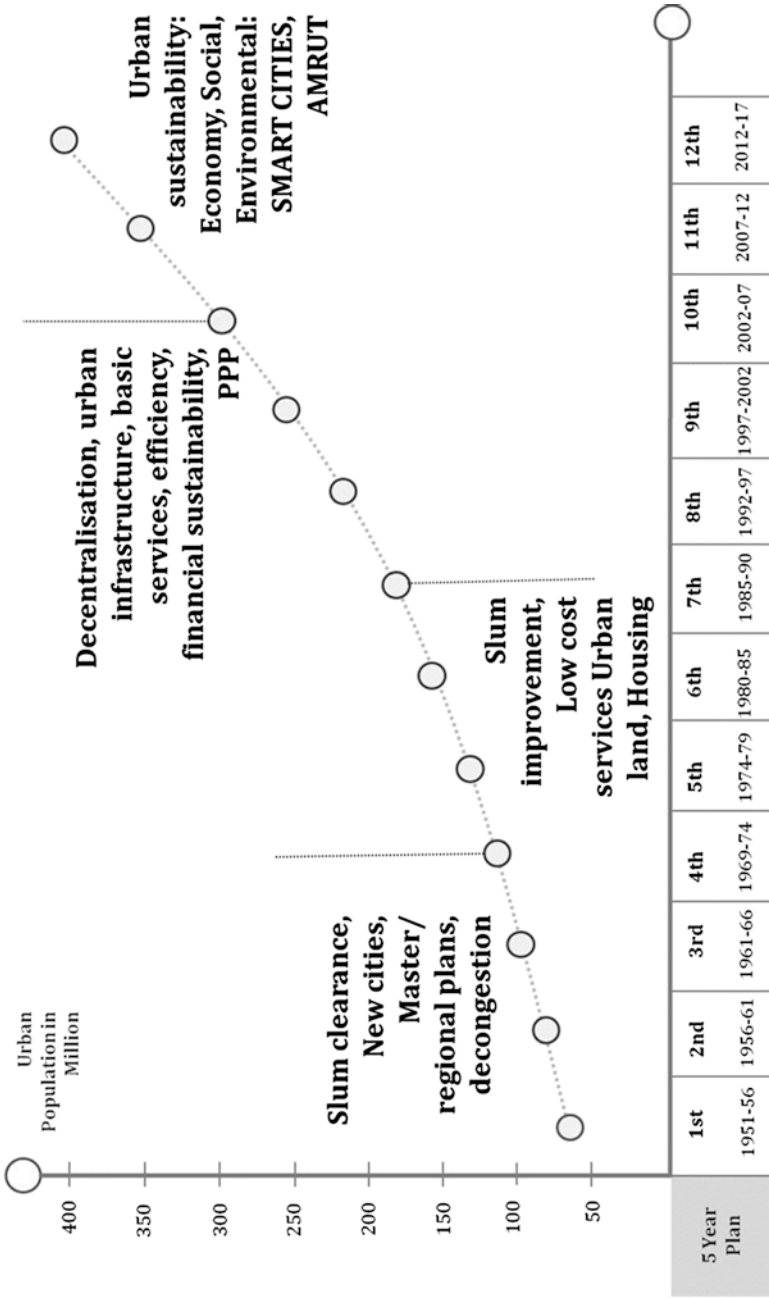
Fig. 36.1 Evolution of India's urban sector programs since 1951 (Source: Analysis done by the author from five-year plan documents released by erstwhile Planning Commission of India)

cover over 500 cities and urban settlements in India. Around this time, most of the mission statements and program guidelines had started mentioning "sustainability" as a goal, reflecting a more cautious approach in response to an intensified global agenda focusing on sustainability. However, these programs also reflected visibly different importance of diverse aspects of urban sustainability. Generally, one could observe more importance towards enhancing economic competitiveness of cities and financial sustainability of the ULBs.

Providing for the urban poor has always been a major focus of India's urban development programs which contributes towards the social equity pillar of sustainable development. However, the approach adopted for addressing the urban poor's conditions through urban development programs has been a contested issue with limited success on the ground.

Indian urbanization is constantly evolving at the intersection of growing population, changing economic and lifestyle pursuits, constrained resources, worsening environment, and a fast-evolving technology space. The status of Indian cities is a reflection of the interaction, as well as contestation among these forces, over space and time.

In the following sections, I present the emerging character of India's urbanization. This is followed by an overview of the performance of Indian cities, across a range of key quality of life and urban sustainability parameters, accompanied by anecdotes of sustainable initiatives that are slowly enabling change, on the ground, in Indian cities.

Case Study

India's Urbanization: A Spatial Phenomena Dominated by Large Cities and the Silent Emergence of Small Towns

Till the beginning of this century, Indian urbanization was primarily dominated and driven by million-plus cities, which also included three megacities with ten million-plus population in their urban agglomeration. The 2011 census results reaffirm the dominance of the million-plus cities (refer Fig. 36.2). However, what is emerging as a slightly different trend is the growth differential within different parts of large urban agglomerations (UA), and emergence of census towns as major shareholders (30 percent) in the total urban population. Between 2001 and 2011, population growth in core city areas under municipal jurisdictions has slowed down considerably. On the other hand, census towns and villages at the peripheries of the city and within the UA area,
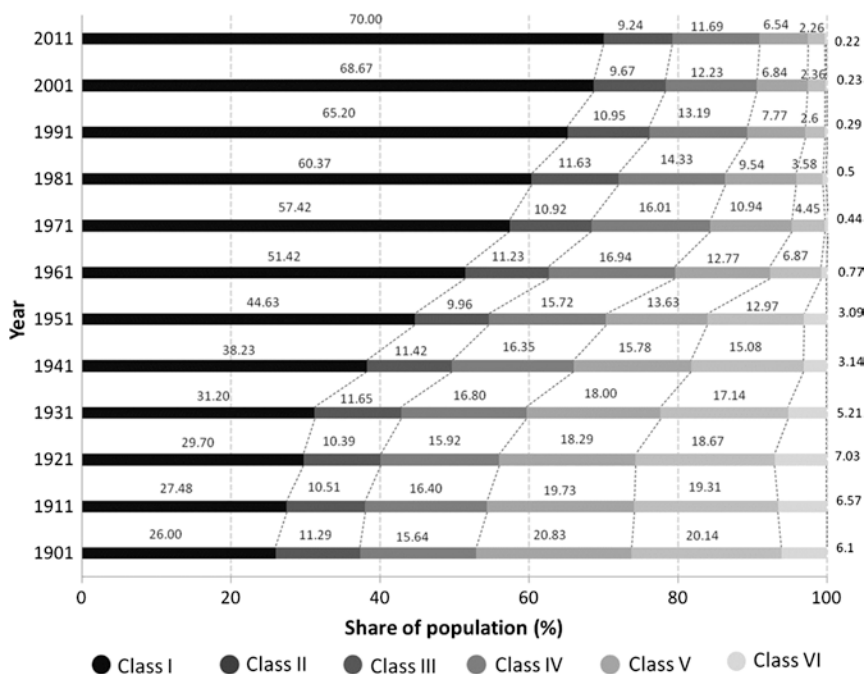
Fig. 36.2 Distribution of urban population across various size classes of towns in India (Source: Analysis done with data sourced from Census of India)

termed as Outgrowths, have experienced increased growth momentum. Greater Mumbai, the largest UA in India, has experienced a population decline in one of its urban districts in the core city area (Census of India 2011).

Another type of shift from rural to urban is silently taking place in some census towns located away from a large city and its immediate hinterland. These towns are experiencing rapid changes in economic activities, resulting in a spillover of urbanization into surrounding villages. A number of such towns play extremely important roles in the value chain of a global economy, but remain deprived of infrastructure and facilities comparable to their economic contribution. One important contributor to the emergence of smaller towns and their rapidly changing character is the development of industrial corridors running in long stretches across districts and states. Post 2011, at least five major industrial corridors have been conceptualized and are being developed in various parts of India. Integrated townships alongside these corridors have also been planned with the hope of creating new-age industrial settlements. However, such fully functional townships are yet to become a reality. On the other hand, land acquisition and redevelopment mechanisms have become important determinants for the success of such projects, many of which have seen severe disputes between landowners and various other stakeholder groups.

The remaining census towns which are neither periurban, nor display any significant economic activity, exhibit characteristics of villages where agriculture does not appear to be a viable option anymore. At this point, one should go back to the definition of urban in India, which does not include the status of infrastructure as one of the criteria. At the same time, notions of urban type of infrastructure continue to play a determining role in defining Outgrowths outside large cities[1] (Census of India 2011). This ambiguity is pronounced in new census towns which are devoid of adequate infrastructure and governance. The definition is also oblivious of the changing nature of rural outputs, which are becoming less and less dependent on agriculture (Mishra 2015), and the role of women in the economy.

In terms of spatial distribution, the southern states of India, and some of the northern and eastern states show higher levels of urbanization. In most of the states that have noted a high urban population growth rate during the decade 2001–11, a large number of new census towns have contributed to the rate of urbanization (Bhagat 2011). Also higher urbanization in states could also be correlated to higher levels of economic advancement.

Sustainability and Indian Cities: An Historical Legacy of Urban Form and Function

Sustainability of cities is in many ways a function of sustainable urban lifestyles. The culture the Indian subcontinent has been of making more with less. Though changing rapidly with the rise of an affluent Indian middle class, the frugal legacy still puts Indians ahead of most other countries in environmentally sustainable consumption.[2] India, as well as much of South Asia, has traditionally followed a more resource efficient trajectory. The region has always had the challenge of meeting expectations of a large population base with limited land and other geological resources. Indian cities had grown as mixed-use dense settlements promoting walkability, lesser motorized trip length, and safer and vibrant public spaces. Traditional Indian neighborhoods had followed design principles that optimized the use of space, sunlight, and coping mechanisms against adverse climatic conditions, by using vernacular construction materials and urban planning principles (Sanyal et al. 2010). For instance, ancient cities of the Indus Valley contained urban centers and appear to have been well-planned with organized infrastructure, architecture, and systems of governance.

Judicious and planned use of life-sustaining natural resources such as water has been an integral part of traditional Indian urban settlements as could be seen from *Kere*s (lakes) in southern Indian states to *Bauli*s (stepwells) in northern and western parts of the country. The vibrancy and variety in Indian cities as centers of activity are difficult to match.

India as a country and its cities continue to maintain a lower per capita consumption of resources. India has a smaller ecological footprint (EF) compared to countries of similar size in terms of population and economy. Considering that the urban sector contributes to more than 60 percent of the national economy, India's urban areas are more resource efficient than most of its developed country counterparts. However, this aspect of urban sustainability of modern Indian cities is partially a result of suboptimal quality of life standards. The following sections transect India's present urban centers for their sustainability in some key quality of life indicators set against four key sustainability principles.

Apart from a summary of performance of cities, this chapter highlights some positive changes that are taking place mostly driven by a more engaged citizenry and civil society. These positive stories are yet to scale and are mostly exceptions rather than the rule. However, these are the lighthouses for driving India's urban story towards a more sustainable pathway.

Sustainability of Twenty-First-Century Indian Cities: The Emerging Picture

The measurements of urban sustainability are built around the three pillars of sustainable development (i.e., social equity, ecological conservation, and economic growth). More recently, few city sustainability indices have represented these three pillars under people, planet, and profit, inspired by the Sustainable Development Goals (SDGs).

This chapter assesses sustainability of India's urbanization anchored by four key principles emerging from the SDGs: well-being, equity, efficiency, and foresight (or resilience) (Bhattacharya et al. 2015). The discussions in the following sections reflect the status of all three pillars of sustainability in terms of their outcome, and not necessarily the intent of various interventions the cities have been subjected to. The data to discuss sustainability have been sourced from a variety of studies done by different institutions and thus not necessarily synchronized over space and time. However, this chapter attempts to include data for major cities in India along comparable timelines.

Well-Being and Equity Through the Lens of Urban Quality of Life in India

Well-being of a city could be summarized as the average quality of life of its citizens. Expression of citizen rights in a city in a given political framework could also indicate well-being of a city. However, the general impression could camouflage exceptions and outliers that also co-exist in a city system that provide critical insights in understanding of urban equity. In other words, a well-being status against a certain parameter is not necessarily a reflection of distribution of the same across various social and geographic locations. The latter requires disaggregated analysis of data, and many times, in the absence of the data, anecdotes provide valuable proxies. This section discusses urban India's performance in quality of air and water and access to critical urban services, both in terms of average numbers and through a dipstick or snapshot assessment of the status of those who are less privileged.

Quality of Urban Environment: Air and Water

In 2014, 37 Indian cities appeared in the list of top 100 polluted cities in the world published by the World Health Organization (WHO). According to the National Air Quality Monitoring Index (NAQI) which monitors 43 cities across India, under the National Air Quality Monitoring Program (NAQMP), a large number of the Indian cities did not meet India's National Air Quality (NAQ) norms during 2015–16, despite the latter setting a higher limit compared to WHO standards ("NAQI status of Indian cities" 2015). A recent study indicated that pollution levels across all 168 cities monitored under the study (including the NAQMP cities) are above the WHO standards. The report also suggests that air pollution causes 1.2 million deaths in India annually and costs the economy about three percent of the national ("Airpocalypse: Assessment of Air Pollution in Indian Cities." 2017). One could say that a large share of this life and economic loss is contributed and borne by cities in India. Those most vulnerable to impacts of air pollution include populations that are the most exposed to large amounts of air pollutants. These include those living along roadsides and spending long hours outdoors ("Air Pollution Nitrogen Dioxide," n.d.). This also includes homeless populations in cities, a large number of whom are migrant laborers. The

transport sector is one of the major contributors to air pollution in Indian cities (13–22 percent).

Water quality in Indian cities has two separate dimensions: quality of supplied water and the quality of both surface and groundwater in the natural urban ecosystems. The former is not always a shadow of the latter as many Indian cities such as Bangalore source large volumes of water from distant sources for supply within the city. According to the Central Pollution Control Board (CPCB), in India, most of the rivers passing through or close to cities are polluted heavily in the downstream due to large-scale water abstraction and discharge of untreated or partially treated industrial effluents and sewerage (Aggarwal 2016). The Ganga, one of the most urbanized and largest river basins in India, is also one of the world's most polluted rivers, with 17 cities located, respectively, on its banks ("Pollution Assessment: River Ganga" 2013).

Drinking water demand, for many cities in India, is met by groundwater. According to a CPCB report published in 2011, which studied 28 cities across India, most of the cities have been found to have groundwater quality issues such as being contaminated with sewerage water, unchecked extraction, reduction in groundwater recharge due to increased built-up areas, and concentration of some minerals beyond permissible limits ("Ground Water Scenario in Major Cities of India" 2011).

While access to drinking water in urban India has improved considerably, the quality of drinking water supplied by civic authorities is a concern for citizens. A small study in a poor urban pocket in Delhi, in 2013, revealed that about 42 percent of households were receiving contaminated water. As a consequence, 24 percent of children suffered from diarrhea, and 11 percent of households experienced death of an infant (Varma 2014). Overall, there are signs that the quality of drinking water in cities, from all sources, suffers from water quality problems, with the urban poor mostly bearing the brunt, through loss of working days and sometimes life.

Two large-scale government programs to restore the glory of India's two mightiest rivers—the Ganges and the Brahmaputra—have been initiated by the government of India. Happening in parallel is a community initiative to clean the Adyar River, passing through the city of Chennai, and make it free of pollution received from the city. The initiative also included greening of some of the islands on the river.

Access to Services: Housing

The housing situation in Indian cities can be described as predominantly being a demand-supply problem. There is both under-supply and over-supply, depending on housing for different income groups. According to the Technical Group on Urban Housing Shortage 2012–17, there was a shortage of 18.78 million houses in urban India in 2012. Out of this, about 96 percent (18 million) of the shortage was in the low-income group (LIG) and economically weaker sections (EWS), whereas 80 percent (15 million) of this shortage was constituted by means of congested houses. Here, one should note a quick comparison with the slum population in India which is 13.7 million, according to the Census of India 2011.

In this context, it is important to look at the issue of urban equity with respect to Indian slums, which often represent as bleak areas of deprivation. Even though the inadequacy of shelter and the incidence of poverty are not confined to slums only, these pockets undoubtedly exhibit sub-standard quality of life conditions. However, the mere presence of slums cannot be the sole statement of urban inequity. First, there is little agreement on what could be labeled as a slum, and there are political economy considerations behind these decisions. There are poor urban pockets under severe distress that might not be included in official slum figures because of reasons, such as the legal status of the land occupied by them. Second, slums could be, arguably, an indication of more inclusive cities in a given geo-political context where cities do not close their doors to migrants and refugees. In such cases, slums emerge as a result of an inadequate system to cater to the demands of these inhabitants seeking a place in the large city. However, there are serious issues relating to distribution of wealth, infrastructure, and natural resources, and thus, slums do present the most interesting case to be studied while discussing urban equity.

Access to Services: Transport

Indian mega cities score low compared to their global and Asian counterparts in the walkability index ("Walkability in Indian Cities" 2011). Between 1951 and 2011, the share of buses among total motor vehicles has come down from 11 percent to 1.1 percent ("Review of Urban Transport in India" 2014). Out of 468 cities with more than 1 lakh population, only 61 cities have a formal bus transport system (Gadepalli 2016). Among the mega cities, only Mumbai

and Kolkata have full-fledged suburban rail systems connecting different parts of the city. It is estimated that in several megacities in India such as Delhi, Mumbai, Kolkata, and Bangalore, buses which are generally one to two percent of the total number of vehicles on the road are used to meet 33–62 percent of the total vehicular trip demand. Importantly, non-motorized transports (NMT), especially walking, constitutes a substantial portion of total mode share (48–55 percent) in Indian cities. However, this does not necessarily indicate good walkability conditions in cities, and merely demonstrates a compulsion of commuters with less access to affordable public transport.

With more private vehicles, traffic congestion in Indian cities is a concern that is catching global attention and is proving to be detrimental to competitiveness of Indian cities as investment destinations. Studies show that in most Indian cities, both large and small, travel speeds are slower than in cities like Singapore, London, Melbourne, and Sydney. ("Review of Urban Transport in India" 2014)

> "Whitefield Rising" is a platform for citizens living in an upcoming locality, one of the information technology hubs in Bangalore. It is trying to make a change in the civic infrastructure and services situation in their locality (such as condition of roads, footpaths, water, and sanitation) by focused group discussions, seeking expert help, interacting with the government/municipal bodies, and implementing solutions.

Access to Services: Water and Sanitation

According to the Joint Monitoring Program 2015 Report for the Millennium Development Goals (MDGs), most South Asian countries, including India, made substantial progress towards increasing access to drinking water and sanitation facilities. According to the World Bank statistics, about 97 percent of the urban population in India had access to improved sources of water, and about 63 percent had improved sanitation facilities in 2015. These figures indicate an increase of about four percent and eight percent from 2001, respectively, for water and sanitation sector. However, several other studies have indicated a more moderate access situation for these two critical basic services in urban India while acknowledging the enhanced policy focus in the national domain. Access for urban poor remains lower than national averages (refer to Fig. 36.3).
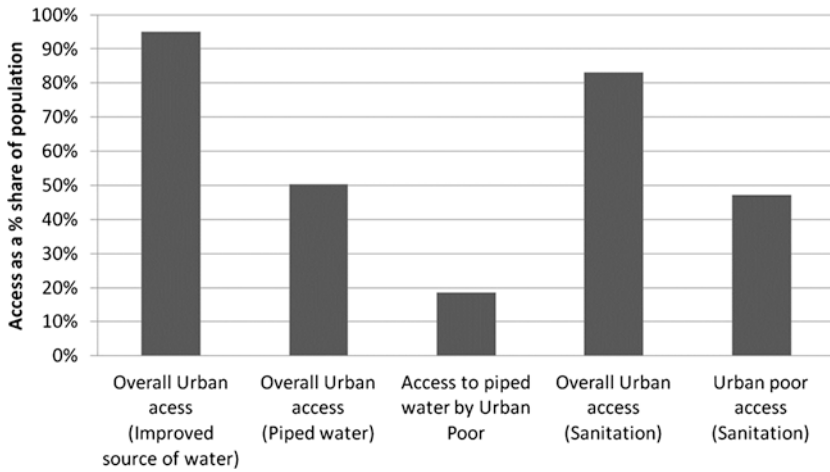
Fig. 36.3 A summary picture of urban India's access to water and sanitation (Source: Analysis done by the author from Water Sanitation Scenario in Urban India document, by the Health of the Urban Poor (HUP) Program and Population Foundation of India, submitted to the UN India Water Development Report 2012)

The statistics however leaves scope for scrutiny in terms of the access conditions they indicate, as well as the quality of the facility to which citizens have access. For example, the census of India measures access in terms of physical distance of the facility for households. However, it does not capture aspects such as reliability, time, location, and design of the facility, which can render a facility inaccessible despite being located within the normative physical distance. Moreover, since most of the burden of water provision for households is on women, and women are the group which suffers most due to absence of sanitation facilities, lack of proper access conditions has significant impact on women, resulting in more hours of unpaid care work, loss of economic opportunities, and sometimes exposure to violence (Bhattacharya et al. 2016).

Public toilets in Trichy, a tier-II city in the state of Tamil Nadu in India, are being managed by women self-help groups (SHGs) with support from a number of donors and NGOs. Apart from positively impacting health indicators in the city, with more sustainable financial returns compared to ULB-managed toilets, the project has been an example of social empowerment, especially for women.

Efficiency

The word efficiency can have different connotations when described in relation to cities. Most commonly, it is used in connection with production of economic value vis-a-vis use of resources, or efficiency of urban services, in terms of leakage and unaccounted losses. In this section I examine efficiency from three broad perspectives: one, as a wider function of ecological systems within which cities sustain themselves, that is, its use of resources vis-a-vis its availability expressed by ecological footprint (EF); two, functional efficiency of urban service delivery; and three, economic sustainability of urban local bodies.

Ecological Footprint of India's Urbanization

At a country level, India accounts for approximately 7.1 percent of the global total EF and 4.9 percent of world's total bio-capacity ("Species and Spaces, People and Places" 2014). India's EF is the third largest in the world after the USA and China. However, India has historically had a lower per capita EF (ranked 135 globally with 0.9 global Ha/cap) compared to developed countries; it is also lower than countries with comparable economies and population size, such as China (approximately 2.2 global Ha/cap), as per 2002 data. However, there is an increasing gap between per capita EF and available bio-capacity of India. Notably, built-up areas contribute to six percent of the total ecological footprint of India ("Species and Spaces, People and Places" 2014)

While there is no reliable assessment of EF of Indian cities, which is considered as a good comprehensive measure to assess ecological sustainability, studies for other cities show that generally, a compact city form with higher population density could be directly related to lower EF.[3] However, looking beyond per capita numbers, the larger picture raises tough questions for overall ecological consequences that India's urbanization is creating, given its bio-capacity.

There is increasing evidence that rapid urbanization of cities in India has not only resulted in significant change in land use but also negatively impacted natural ecosystem and biodiversity ("Impact of Urbanisation on Biodiversity" 2012). It is estimated that the average EF of India's urban middle class would increase in the long run, owing to growth in population and consumption (Rajashekariah 2014).

In the absence of a comparable statistics on EF of Indian cities in recent times, we look at some specific parameters that contribute to overall ecological footprint of cities and, thus, can give an idea about the trajectory in which

cities are growing, or rather what sort of ecological and environmental compromises and consequences they are creating, both within and outside the physical urban jurisdictions.

Souring Water for Urban India

Almost all the megacities and many of tier-I and tier-II cities have started facing water crisis especially during hotter seasons. The demand-supply gap ranges anywhere between 70 percent and 17 percent (Dash 2013). A number of large Indian cities meet their water demand from sources located far away. This creates sustainability issues on multiple fronts. First, sourcing water from far distance is generally accompanied by high transmission and distribution losses as well as high cost of transportation and high consumption of energy. Second, dependency on faraway sources is subject to high external variables and thus become unreliable in the long term. Third, it raises a larger question of social equity and environmental justice regarding the distribution of life-sustaining natural resources. Fourth, sourcing water from faraway sources has been related to a more complex behavioral aspect of both citizens and civic agencies that start neglecting nearby water bodies, which are no longer used as sources of water for the city and its citizens. Cities that use their own groundwater are fast depleting their dynamic water reserve as groundwater extraction is far higher than its recharge, as a result of blocked drainage channels and decreases in permeable surfaces. A report prepared by Mihir Shah, former member of the erstwhile Planning Commission of India and an eminent expert on urban water systems, noted that as cities grow, engulfing peripheral areas into their municipal boundaries, and become denser, their dependence on external sources of water grows, along with increased inequality of supply and poor infrastructure conditions in the peripheries (Shah 2016).

A gated residential community towards southeastern part of Bangalore has managed to achieve water sustainability for its own needs using the Integrated Urban Water Management approach.

The 800-year-old Nizamuddin Baoli, the only surviving stepwell in Delhi, was restored by an NGO that worked closely with the community. The project included creation of parks and open spaces, especially for women and children. In fact, at the time of writing this chapter, Vijayapura, an ancient city in southern India, has started drawing water from its ancient *Bawadis* (huge open wells) built during the fifteenth to seventeenth century after successful restoration.

Managing Waste from Urban India

Waste, both municipal solid waste (MSW) and solid and liquid waste from the city's sanitation, are not only important aspects in maintaining a city's aesthetics and liveability but can also lead to grave consequences for the well-being of citizens, the peri-urban areas, and the larger ecological systems surrounding the city. The average per capita MSW generated from Indian cities ranges anywhere between 0.36 and 0.55 kg per day; the bigger the city size, the higher the number. This is in general lower than cities in the developed countries, owing to the average Indian lifestyle which has lower consumption levels compared to developed countries. Evidence shows that collection efficiency of MSW in some of the Indian cities could be as low as 20 percent and as high as 100 percent. However, the major problem lies in handling of solid waste after collection. Most of the cities rely on landfills to dispose MSW, and most of the time these landfill sites are located outside the city. While landfills do pose a serious threat of polluting local ecosystems, especially water resources, studies show that landfills are going to be unsustainable in the long run owing to the area of land needed to accommodate the amount of waste generated from an increasing urban population, in an increasingly landlocked urban future. Considering that only a minimal share of MSW is treated (about 13 percent as estimated in 2011) and an even smaller amount is recycled for reuse, it also contributes to the increasing EF of cities (Joshi et al. 2016).

Fecal sludge management (FSM) is another aspect that has been posing challenges to health and well-being in cities and degrading the larger environment and ecosystem, especially water systems. It also affects various aspects of human development, especially with different marginalized groups in cities facing varying types and degrees of vulnerability. A Fecal Sludge (FS) Flow diagram, constructed for Indian cities, shows that about 81 percent of FS goes untreated and is directly disposed (Rohilla et al. 2016). This further pollutes water bodies and river systems carrying traces of pollutants downstream far beyond city limits. Vrishabhavathy, an ancient river originating right from the center of the city of Bangalore, has turned into a drain loaded with untreated sewage, toxic chemicals from industries, and garbage. Many of the rivers passing through cities eventually meet a similar fate. They emerge again, reminding citizens and civic authorities about their otherwise forgotten might and intrinsically nested relation with the city, only during the time of urban floods.

Notably, India has spent approximately USD 5000 million, for the Ganga Action Plan (GAP), over the last few decades, to restore one of its largest rivers, the Ganges, to its past glory, by cleansing the waste flowing through its

water. However, in the absence of a robust planning and mechanism for controlling the sources of waste, much of what is contributed by the city's sewerage systems and industrial waste, the GAP has remained largely ineffective.

A wetland towards east of the city of Kolkata sprawls over 125 sq. km. and receives about 1000 mld of sewerage from the city. The wetland, part of which is used for fish cultivation and provides livelihood to thousands of farmers and fishermen, treats the sewerage completely organically without any cost to the city government. Having the status of a Ramsar sites, one of the 26 such in India, the wetland however has not escaped threats of encroachments from the fast growing real estate industry—an increasing concern.

A number of citizen-led initiatives to restore lakes in Bangalore, the once coveted garden city of India, have started gaining momentum and are showing results on the ground. These initiatives are pushing civic authorities to take action to restore the man-made lake system of Bangalore, which has diminished from 262 lakes in 1960 to only 81 in 2017.

Energy Demand and Emissions

India is projected to be the largest contributor to the rise in global energy demand by 2040, although the projected per capita demand would still be 40 percent lower than the world average ("India Energy Outlook (World Energy Outlook Special Report)" 2015). A major share of this demand will be from Indian cities. Currently, about one quarter of the energy demand in India is met by renewable sources—the rest is met by fossil fuels. Considering that India is just entering into a more industrialized and urbanized future, the energy demand from cities is likely to grow substantially. Nevertheless, the country is committed to reducing the energy intensity of its economy by 20–25 percent by 2020, and thus new and renewable sources of energy are receiving increased policy focus.

Literature suggests that most of India's emissions will come from its urban agglomerations, negatively impacting the environment and its rural population (Sanyal et al. 2010). In 2015, a study published by the Indian Institute of Sciences presented a sector-wise assessment of carbon footprints of seven major cities in India (Fig. 36.4).

Transportation and domestic sectors were found to be the two biggest contributors of emissions in these cities.
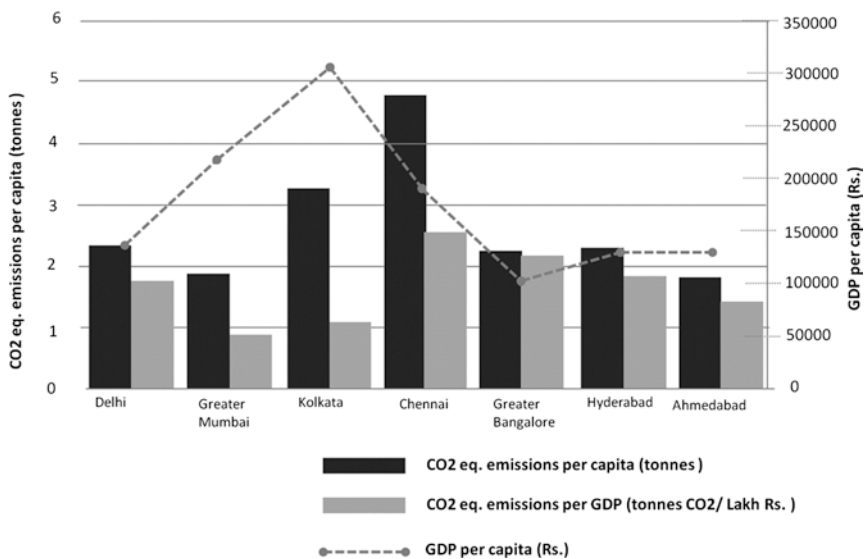
Fig. 36.4 CO_2 eq. emissions per capita, GDP per capita, and CO_2 equivalent emissions per unit of GDP for different cities (Ramachandra et al. 2014)

Electric Vehicles (EV) for Indian Cities

India's National Urban Transport Policy has set forward-looking policy directions by advocating for land-use and transport integration, emphasizing on moving people rather than vehicles, and also pushed cities to think about EV as the viable mode of clean and efficient public and private transport. A number of Indian states (such as Himachal Pradesh) and cities (such as Bengaluru) have carried viability studies of EV as an option and started procurement of vehicles.

Efficiency of Urban Service Delivery

An important aspect of efficient urban service delivery lies in non-revenue services. While a portion of this could be attributed to transmission and distribution (T&D) losses, a large part could also be due to non-collection of charges for services provided. While the first is largely due to quality of infrastructure and technical matters, the latter is a direct function of the efficiency of urban governance mechanisms.

Nonetheless, it is interesting that a large amount of non-revenue water (NRW), besides the T&D loss, actually caters to sections of the population who otherwise are not included in the formal service delivery net, such as migrant laborers working in informal sectors. The informal sector in India absorbs about 70 percent of the urban working population, with an average annual growth rate (4 percent) higher than the formal economy (2.5 percent). It would be

interesting to estimate the economic gain generated by this informal economy, which benefits from NRW, as opposed to the loss incurred on account of the same. Another argument is that a large part of the T&D loss actually goes back to the ecosystem through groundwater recharge, although not in the most efficient manner. Many Indian cities have been aiming for 24×7 water supply for which minimizing T&D loss is a prerequisite.

> About 30 percent of the total water drawn from the Cauvery River for Karnataka is lost in transmission, and about 20 percent of total water supplied to the city of Bangalore is accounted as NRW. On the other hand, some reports suggest that the 24×7 water supply scheme in the city of Nagpur, one of the first ever in India implemented through public-private partnership mode, is actually turning to be more inequitable to different localities and sections of citizens.

Economic Efficiency of Urban Local Governments

Urban India contributes approximately 60 percent to the national economy (in gross domestic product terms). However, there exists a substantial backlog in basic urban infrastructure provisions, which is estimated to be around USD 250 billion as per the estimates of the High Powered Expert Committee on urban infrastructure. This implies that more investment is needed from public and private sources.

Self-sustainability of ULBs continues to be a challenge even with increased interest from the private sector to engage with cities, by means of investment and expertise. A number of assets and infrastructure built with private sector assistance or even through support from state or central governments are turning out to be dead investments in the long run, as the ULBs are not able to sustain financial sources for operation and maintenance of the assets. A credit rating of Indian cities published in 2017 reveals that only 94 out of 500 cities included in the Smart Cities Mission and AMRUT have obtained ratings, which is necessary for securing different modes of financial self-reliance such as the issuance of municipal bonds ("Press Information Bureau Government of India Ministry of Urban Development" 2017).

> In 2016, the citizens and civil society of Bhopal, a tier-II city in India, managed to create enough pressure on the local government to put on hold the plan for a high-end area development plan and instead initiate actions towards preparing a strategic plan for integrating the city's natural elements into the urban development process. Around the same time, civil society-led protests compelled civic authorities in Bengaluru to drop a high-investment flyover construction plan, which was not a viable solution for the city's traffic problems. Following the success of this movement, civil society groups have launched an online platform named *Niga* (vigil) to enable the citizens and communities be vigilant over decisions made by civic authorities.

Resilience

Resilience in urban systems can be described as a combination of foresight and coping mechanisms. In their fifth assessment report, the Intergovernmental Panel on Climate Change (IPCC) has mentioned six major categories of climate change threats to cities and urban areas, which are drought, increased precipitation, rising sea levels and storm surges, inland and coastal flooding, heat stress, increased aridity, water scarcity, and air pollution (Revi et al. 2014). South Asia is regarded as one of the most vulnerable regions to impacts of climate change. Evidence shows that South Asian countries, including India, are more prone to natural disasters compared to the rest of the world.[4] The vulnerability of these areas is compounded by the region's low human and economic development indices compared to developed countries. Cities, which signify concentration of population and economy, naturally incur substantial loss of human and economic resources. Indian cities, some of which are among the most populated ones in the world, tend to show vulnerability especially in the wake of extreme natural events such as heavy precipitations, resulting into urban floods, which are becoming more frequent. India figures among top five countries in Asia and the Pacific in economic damage and fatalities ranking with significant impact of disasters in urban areas. Naturally, building urban resilience is emerging as one of the top priorities of the region. Incidents of urban flooding in the recent past in Indian megacities, such as Mumbai and Chennai, expose significant fault lines in the city's spatial growth management strategies and disaster response mechanisms. Urban floods in Chennai, caused by heavy rainfall, over short periods of time in November 2015, were estimated to have led to losses worth USD 2.2 billion, apart from loss of lives. While one cannot control natural events, the reason behind such severe impacts of the floods was largely anthropogenic. One common feature that could be seen in almost all urban flooding incidents in India is unscientific spatial planning of built infrastructure and lack of enforcement of laws. In all cases, built spaces encroached upon prime natural contours or were chocked by garbage. While innovative disaster assessment techniques and data gathering tools are increasingly being used, such cutting-edge efforts are yet to be largely mainstreamed in formal city governance mechanisms.

Chennai was better prepared after the 2015 floods by taking proactive measures to create a stronger flood monitoring and response mechanism.

There are a number of indigenous flood modeling efforts done by national- and state-level disaster management authorities and premier technology institutes in India which are better designed to capture contextual variations of cities in India.

Lessons Learned

Indian cities continue to create paradoxical examples of inclusion through informality[5] and efficiency through rather compromised quality of life standards. As economic output of urbanization increases, we see tougher contestations in cities and their adjoining peri-urban areas, over questions of well-being, equity, efficiency, and resilience. The contestations take different forms depending on power structures such as citizen vs. citizen, citizen vs. business groups, or citizens vs. government. A part of the struggles for efficiency and equity seen in Indian cities is inherent to the fact that India is stressed for natural landmass resources compared to its large population. Nevertheless, at the same time, these struggles and tensions could be perceived as a feature of the ongoing urbanizing trajectory that Indian cities are experiencing. Thus, it would be inadequate to apply lessons from more urbanized contexts and expect them to work. Western cities experienced peak urbanization when there was no internet and when the world did not start to stare at a 2° C global temperature rise scenario. India and other south Asian cities are currently in an unusual phase in an atypical period which demands unique and carefully crafted strategies and responses. We are also at a stage wherein the characteristics of future Indian cities are not easy to predict. They may develop along their current trajectories or result in alternative urban paradigms that embrace ecosystems limiting traditional growth, or perhaps along some other path.

Going back in time, the idea of collaborating with nature can be seen in most ancient Indian cities, until engineering skills and investments started overpowering natural constraints. Modernization has put Indian cities on the global map in an increasingly open economic paradigm but at the same time brought consequences that urban governance mechanisms were not prepared for. At this juncture, a new genre of initiatives focusing on cities has come forth with the hope of transforming India's urban face.

India's urban development started receiving focus not very long ago. There is visible effort in measuring outcomes instead of outputs along with a slow shift in perspective of what we consider as symbols of prosperity. More importantly, a more concerned and better-informed discourse is slowly gathering momentum emphasizing a more holistic approach towards planning for ecosystem-based services which can create a viable win-win model in the long run.

One must also remember that at present, India's megacities highly influence average numbers because of the sheer number of the population that resides in them. However, megacities are reaching their carrying capacity fast.

Thus, the future urban population of India, which is projected to double by 2050, will mostly reside in tier-II and tier-III cities. In tier-II and tier-III cities, the problems have not reached a complex stage as much as they have in megacities, which appear to be resistant to solutions. There is an urgent need to focus on these cities, and intense research is needed on census towns, peri-urban areas, and their transformations.

Despite unsatisfactory average performance, Indian cities exhibit tremendous coping mechanisms to sustainability challenges. The future lies in learning from anecdotes and finding the right entry point in the established institutional mechanisms to scale up successes. India's demographic position is to its advantage with the age-pyramid bulging below the 20 years age group and thus ensuring a continuing work participation over the next three to four decades. India also has a more stable domestic environment congenial to stable economic growth compared to many of its South Asian counterparts. We also see the emerging of an increasingly aware and concerned citizenry that is turning the otherwise theoretical discourse of sustainable development to more real-life, tangible actions. The future looks somewhat hopeful.

Challenges and Barriers

Sustainability is not an easy or simple goal, especially in developing countries that are sharing the responsibility of reducing global carbon footprint while being positioned far below their developed country counterparts in prosperity and quality of life standards. Continuous contestations in urban spaces show the struggle to seek justice in the face of conflicting goals that are handled through hurried responses. Formidable challenges exist in a number of areas, and these ought to serve as a guide in the formulation of the next phase of urban development programs in India.

- *Scalability and Replicability*: India is a large and diverse country with many agro-ecological zones and different social and political forces at play in different parts of the country. Nevertheless, replication and scaling up are a must, and this needs learning from both success and failure. Indian cities also need to learn better from each other and from developing countries in similar contexts, before looking for solutions from Western countries. There exist smaller stories of success, which show immense possibility. The key is in collective effort and an efficient governance mechanism supporting the same.

- *Data Preparedness and the Problem of Evidence-based Policy-Making*: India, like many other developing countries, suffers from poor data syndrome. Meaningful data is key to transitioning from an output-oriented discourse to a more outcome-oriented discourse. Lack of disaggregated evidence also limits opportunities that could emerge by comparing intersections of different sectors. Synchronization between sectoral programs under various ministries, in data, scale, time, and fiscal management, is critical to achieving a universal agenda like sustainable urban development. The hope is that India's commitment towards the SDGs will galvanize actions towards this, a substantial part of which is expected to be crowd-sourced with critical involvement of civil society and think tanks.
- *Capacity of Urban Institutions Affecting Good Governance Agenda*: There is substantial capacity constraint, especially at ULBs level to carry out reform agendas, especially the e-governance schemes and to respond to growing demand from increasingly aware citizenry. The fast-changing technology space is generating additional requirement for adequate training and capacity building in ULBs and across urban sector institutions. While the new-age programs focused significantly on citizen engagement, translating the same into an effective coalition of actors for the city's benefit has not been possible through these programs. It is interesting that approaches (such as various open data initiatives) are coming into existence outside the ambit of formal programs and gathering enough weight to influence decision-making.
- *Thinking Beyond Cities and Linking Villages to Sustainable Urbanization*: Cities, in order to be true engines of growth, need to lead to the development of a region. Little evidence exists on livelihood generation by cities beyond the formal sectors. A substantial gap remains in the understanding of peri-urban dynamics and how these areas in transition relate to the city, the inflow-outflow pattern in terms of natural resources, economic opportunities, migration, and vulnerability. The urban-peri-urban-rural relationship is stronger than what is recognized in present urban governance mechanisms. Cities are living off their fringes and the rural areas both adjacent and away from them. It is high time that the capacity of rural local bodies be given as much importance while advocating for capacity building of urban local bodies, especially in rapidly urbanizing contexts.

Finally, the importance of asking the right question and creating conversations around sustainability issues cannot be undermined as cities embrace technology-driven solutions and operate on tools and platforms. Fundamental and exploratory research, with multi-disciplinary approaches, can lead to

enhanced understanding of the pattern of urbanization in India and related sustainability issues. There is little disagreement that the future generation of urban and rural sector programs need to be built on a much better under-standing of urban dynamics in order to convincingly argue for cities as engines of growth.

Notes

1. OGs—outgrowths are defined as enumeration blocks with viable boundaries, such as villages, which are physically contiguous to a town and possesses urban features in terms of infrastructure and amenities.
2. According to 2014 National Geographic/GlobeScan Consumer Greendex which is a scientifically derived sustainable consumption index of actual con-sumer behavior and material lifestyles across 18 countries, Indians are the top-scoring environmentally sustainable consumers.
3. Studies measuring ecological footprint of Atlanta, Dubai, Vancouver, Berlin, Dubai, London, and Barcelona show that Atlanta and Dubai have the highest EF compared to other five cities, which either have a compact urban form or high population density or both. Refer to http://assets.wwfindia.org/down-loads/urbanisation_report.pdf originally sourced from www.citymayors.com.
4. A 2015 UNESCAP report shows South and Southwest Asia was the most affected sub-region in the world in terms of number of natural disasters that hit them and the amount of loss of life and economy.
5. While urban poverty is an important aspect contributing to informalities in Indian cities, researchers have argued that informalities in India's urban plan-ning regime are marked by "state of deregulation, ambiguity, and exception." Roy, Ananya; Research Article: Planning Theory "why India Cannot Plan its Cities: Informality, Insurgence and the Idiom of Urbanisation," SAGE publi-cation (http://journals.sagepub.com/doi/abs/10.1177/1473095208099299).

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