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Climate Change Governance in India: Mapping the Role of the Cities

Bhaskar Gogoi[1] and Jayanta Krishna Sarmah[2]

Department of Political Science[1]
Gauhati University, Guwahati 781 014, Assam, India

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ABSTRACT

Cities are at the forefront of climate action as never before: they concentrate risk but also provide opportunities to innovate. Situated at the crossroads of extensive urbanization, unequal development, and high climate vulnerability, Indian cities face an urgent imperative to governance to current and projected climate change impacts. While the poor and marginalised who live in multidimensional poverty and face acute deprivation bear the brunt of the consequences. Climate change not only exacerbates their existing inequalities, but also leads to disproportionate sharing of climate change risks, necessitating a shift from mere climate change mitigation to climate change adaptation and recognition that the involvement of all government levels, particularly local governments, has become a sine qua non for climate change adaptation to work because the impacts of climate change are manifestly local. This article argues that Indian urban local governments must occupy a definitive role in the Indian multi-lateral climate change governance framework. It argues that despite the important role played by urban local governments in combating climate change through adaptation strategies, multi-level governance framework is completely skewed in favour of the dominant and decisive role played by national and state governments. This article examines the role of Indian cities in climate change and scrutinizes the multi-level governance.

Key words: *Climate change, Local governments, Climate change governance, City, Climate change adaptation*

Introduction

Climate change has emerged as our generation's most significant and perplexing challenge. The Intergovernmental Panel on Climate Change's Special Report, Global Warming of 1.5 degrees Celsius (IPCC Special Report), warns that the world has already warmed by 1.0 degrees Celsius since pre-industrial levels, and that at the current rate of 0.2 degrees Celsius per decade, it will reach 1.5 degrees Celsius between 2030 and 2052. (IPCC, 2018). That report responds to the IPCC's request from the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) "to provide a Special Report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways contained in the Decision of the 21st Conference of Parties of the United Nations Framework Convention on Climate Change to adopt the Paris Agreement," and it addresses the UNFCCC Parties' request.

Leading scientists and experts on climate change have urged rapid action since the Earth is now in a state of emergency (Lenton *et al.,* 2019). According to a recent study, the melting of the Amundsen Sea Embayment, a glacial system in West Antarctica, is

([1]PhD Scholar, [2]Professor and HoD)

one of the major tipping points that our planet is rapidly nearing. The glacier's grounding line, which is where the ice, ocean, and bedrock converge, is in danger of permanent retreat. This might cause the rest of the West Antarctica ice sheet to collapse like dominoes, raising the sea level by three metres (Lenton *et al.,* 2019). According to the study, there is now no longer any time to intervene to stop these tipping points (Lenton *et al.,* 2019).

Our oceans have warmed steadily since the 1970s and have absorbed more than 90% of the extra heat in the climate system, according to the IPCC's Special Report on the Ocean and Cryosphere (IPCC, 2019). This has led to surface acidification, which has had a negative impact on warm-water coral reefs (IPCC, 2019). From the equator to the poles, ocean acidification has caused adjustments in the geographic range and seasonal activity of the main groups of marine animals, changing species composition and the development of marine ecosystems (IPCC, 2019). The increase in temperature, altered precipitation patterns, and frequency of extreme weather events brought on by climate change have already impacted food security (IPCC, 2019). Africa's pastoral systems are producing less livestock at decreasing rates of growth (IPCC, 2019).

Thus, the world has a very short window of opportunity to act effectively (Staden and Musco, 2010). Little focus appears to be given to locally driven adaptation because climate change is seen as a global issue (Sharma and Tomar, 2010). Local governments have become crucial players in the fight against climate change (Betsill and Bulkeley, 2007; IPCC, 2014). The Conference of Parties to the UNFCCC recognised how the climate change issue has changed through time at its 21st session in 2015. A global network of cities committed to constructing a low-carbon and sustainable future is being actively sought after by international organisations like C40 and Local Governments for Sustainability (ICLEI). Municipalities and local governments (urban areas) are becoming more visible and are becoming increasingly important in the dynamically shifting climate change negotiations (Bulkeley, 2015).

Climate Change Governance

All facets of society are represented in governance systems, including the State, MNCs, Civil Society, International Governmental Organizations, and Scientific Community. There are numerous institutions and people involved in the governance of climate change, thus it is not just about one particular player. For the purpose of developing and putting into practise effective climate policies, governance institutions at all levels- local, national, and international are required. A worldwide response is necessary to the problem of climate change. To put it briefly, the governance of the climate entails cooperation and teamwork among all different stakeholders in order to reach mutually agreeable decisions. When all the impacted interests jointly engage in face-to-face discourse, bringing their diverse viewpoints to the table to deliberate on the problems they face together, planning procedures are really collaborative (Innes and Booher, 2010). This diversity of viewpoints creates new opportunities for problem solving and the transfer of information and skills from one group to another, all while ensuring that the interests of the various groups are protected. Reduced adversarial interactions, redressed power and resource imbalances among stakeholders, and consensus-building are the ultimate goals of collaborative procedures (Innes and Booher, 2010). A solution can only be reached when all the persons involved make a decision jointly.

Mapping the Cities in Climate Change Governance

Cities play a significant role in climate change. Cities use 78% of the world's energy and generate more than 60% of greenhouse gas emissions, according to UN Habitat. However, they only make up less than 2% of the Earth's surface (UNFCCC, 2021). Poor and low-income communities are more vulnerable to the effects of climate change, in part because many of them live on the margins of society, in unstable buildings, and in areas that are more prone to flooding, landslides, and earthquakes, but also because they lack the resources, emergency response systems, and capacity to deal with such events. This is particularly obvious in underdeveloped nations (Kumar, 2021). Cities play a crucial part in the governance framework for addressing the issue of climate change. The Joint Work Programme was formed by UN-Habitat, UNEP, the World Bank, and Cities Alliance to help cities in developing countries incorporate environmental considerations into urban policymaking (UNFCCC, 2011). If information exchange is promoted at all levels, the work that cities are now doing to address mitigation and adaptation can only strengthen and improve global policymaking negotiations. This involves greater research on cities and climate change locally and worldwide,

improved strategic thinking between national and municipal governments, and the gathering of aggregated data on the role of cities in climate change (Kumar, 2021).

Urban local bodies (ULBs) play a significant role in tackling climate change through adaptation strategies like generating income, providing affordable housing for marginalised communities, protecting ecosystems, and developing infrastructure that is climate resilient. Despite this, they are still constrained by a lack of funding and almost all of them are dependent on their national and state governments. The multi-level governance architecture in India is entirely biassed in favour of the national government's dominating and decisive role (Jorgensen *et al.*, 2015). Despite the 74th amendment to the Indian Constitution's provision, there is no decentralised power in Indian ULBs.

In this article, we examine the issue at hand and make the case that Indian urban local governments must play a clear role in the country's multilateral system for managing climate change. In the next part, we present three key arguments for why Indian cities should be given a prominent role in the politics of climate change. Then, in the section that follows, we give a brief review of India's multi-level governance system and highlight the myriad problems that local governments encounter under the country's current multilateral governance system. Finally, we propose a potential framework that cities might use to create an adaptation plan at the municipal level.

Materials and Methods

This article uses a desk-based review to identify and consider planned and implemented climate governance in Indian cities. To do this, we reviewed city-level master plans, climate resilience documents, Smart City Plans and state-level State Action Plans on Climate Change (SAPCCs), and sectoral reports of Indian cities with a million-plus population and small scale cities. These were supplemented by comprehensive searches for peer-reviewed literature for specific cities and gray literature from national and international climate governance.

Important climate change Stakeholders in India

Extreme Weather Conditions are severely Impacting Indian Cities

Many of the dangers associated with climate change on a global scale are concentrated in metropolitan areas, according to the IPCC's Fifth Assessment Report (IPCC, 2014). Climate change is already causing extreme weather events like floods and heat waves in Indian cities like Kanpur, Kolkata, and Chennai (UNISDR, 2012; Shaw *et al.*, 2010). Due to sea level rise, cities located along long stretches of coastline or significant rivers are constantly at danger of flooding (Beermann *et al.*, 2016). For instance, Kerala, India, saw its worst flood in 94 years in 2018. The weakening of the Indian monsoon and the moistening of the tropical troposphere, which are the main causes of the Kerala floods, have both been linked to climate change in studies (Hunt and Menon, 2020).

Similar to other susceptible cities, Mumbai is also at risk from many climate change-related hazards, including the threat of tropical cyclones, significant precipitation, and sea level rise (Dhiman *et al.*, 2019). Due to the socioeconomic disarray brought on by climate change-related floods, the city experiences

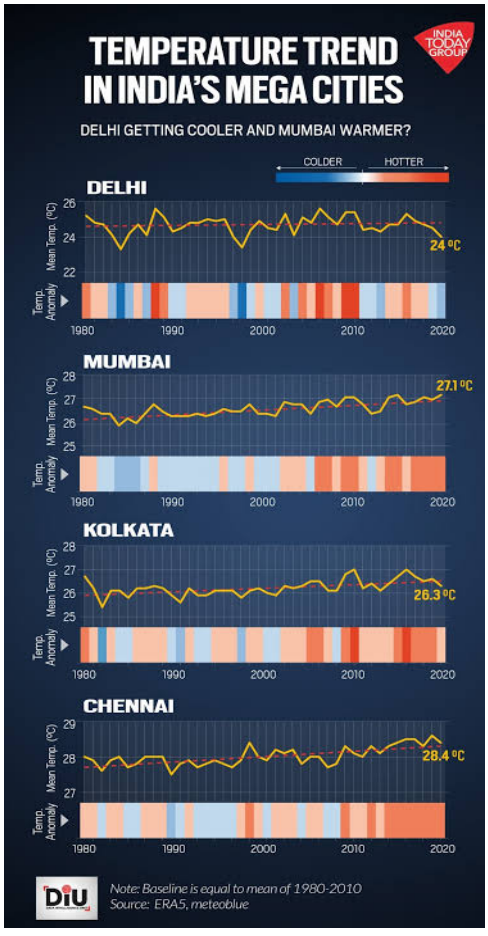

Photo courtesy: India Today

significant economic losses every year (Dhiman *et al.,* 2019). Similar to other regions, the Kolkata City region frequently floods due to high precipitation brought on by strong storm surges (Dhiman *et al.,* 2019). The monsoon season also frequently results in flooding in some places, including Gorakhpur in Uttar Pradesh. More than one million people are affected by these floods, the majority of whom are impoverished and marginalised (Gupta *et al.,* 2013).

The above picture shows the temperature increasing in different Indian cities. The IPCC's fifth assessment report has marked certain cities on the east coast of India as the regions of maximum climate vulnerability (IPCC, 2014). Extreme weatherevents are expected to disproportionately impact thepeople living in these cities (IPCC, 2014).

Most coastal cities in India, including Mumbai, Kolkata, Chennai, Kochi, and Vishakhapatnam, heavily rely on their developed infrastructure, which includes rail and road corridors, transportation and communication networks, industrial zones and parks, and maritime and port capabilities. This infrastructure is not climate resilient despite being essential for the growth of the national economy. These coastal cities are frequently victims of cyclones, storm surges, and floods due to rising greenhouse gas (GHG) emissions, primarily from economic activity (OECD, 2010; Roy, 2019).

The situation is exacerbated for poor urban dwellers in cities that are still disproportionately vulnerable to climate change (IPCC, 2018). They have poor quality and unsafe housing, insufficient infrastructure, and a lack of healthcare and emergency services (IPCC, 2018). According to the IPCC Special Report, global warming of 1.5 degrees Celsius will have a greater negative impact on the poor, even if the effects on the rest of the population are limited (IPCC, 2018). According to the ominous report, by the mid-to-late twenty-first century, climate change will act as a poverty multiplier, making poor people poorer (IPCC, 2018). This is problematic for many Indian cities because slums house more than a quarter of their population, and infrastructure and basic services are inadequate to match the unprecedented scale of urbanisation (MoHUA, 2015).

City Adaptation Actions to Limiting Global Warming to 1.5°C

The IPCC has identified four critical systems for mitigating global warming: energy, infrastructure, land and ecosystems, and industry (De Coninck *et al.,* 2018). The transformation and development of these systems over the next few decades will determine the success of efforts to limit global warming to 1.5 degrees Celsius (De Coninck *et al.,* 2018). Transformational changes in these systems are required, but such changes cannot be achieved at a single level of government or organisation (De Coninck *et al.,* 2018). They must represent the conclusion of efforts from numerous parties, including international organisations, countries, cities, and local areas. Cities are significant stakeholders because, through urban planning and urban transition, they can have an impact on energy systems (De Coninck *et al.*, 2018). According to IPCC AR 5 (2014), "cities are built of complex interdependent systems that can be used to enhance climate change adaptation through effective local governments backed by collaborative multi-level governance. This may allow for synergies between protecting ecological services, creating livelihoods, and investing in and maintaining infrastructure" (IPCC, 2014).

Similarly, the IPCC Special Report concluded with high confidence that a transition in energy, land, urban and infrastructure (including transportation and buildings), and industrial systems is required to limit global warming to 1.50 degrees Celsius (IPCC, 2018). The substructure upon which such transitions must be made is urbanisation. To put it another way, any transitions in these four identified systems must be founded on urban expertise and a multilateral governance framework.

More over half of the world's population lives in cities. Over the next three decades, an additional 70 million people are anticipated to relocate to urban areas worldwide each year. This movement will unavoidably lead to a significant amount of urban infrastructure and building reconstruction (IPCC, 2018). For cities to construct necessary and economically advantageous infrastructure, including buildings, early policy involvement is required (IPCC, 2018). This will impact upcoming emissions (IPCC, 2018). For instance, in order to achieve the goals of keeping global warming to 1.5°C in 2050, building stock emissions must be decreased by 80–90% from current levels (IPCC, 2018).

Early policy interventions by Indian urban local governments could concentrate on improving the design of non-structural building components and designing future structures with thermal insulation and reusable materials. The Malaysian government has launched a scheme called the Low Carbon City

Framework whereby local governments are asked to identify low-carbon townships (Sahni and Singh, 2014). Local governments in Indian cities may also concentrate on municipal trash management, compact, pedestrianised cities and towns, and minimising carbon-intensive transportation. Reduce, reuse, and recycle are the "3Rs" of trash management, and Project SUNYA, run by ICLEI - Local Governments for Sustainability, encourages city councils to embrace them. The Indian cities of Shimla and Coimbatore have successfully carried out this programme (Mehra, 2019). To achieve low-carbon cities, waste management and reduced production are crucial factors (IPCC, 2014).

Many industrial parks are linked to urban areas via a variety of dependencies such as water, waste managing, and materials. Local governments in cities can aid industrial transitions by replacing high-carbon-intensity goods with renewable and reprocessed materials (IPCC, 2014).

Concerns of Vulnerable Groups

Urban regions offer many socioeconomic chances for employment and money generation, but they are also progressively becoming riskier places to live, particularly for city dwellers with low incomes (Agarwal, 2008; Olsson *et al.*, 2014). They always intersect with social, economic, political and environmental risks and rising levels of inequality. They have far greater negative impacts on poor people living in disadvantaged regions (Barbier and Hochard, 2018). Exposure to environmental risk and hazard results from both physical activities (such as infrastructure, urban planning, and transportation) that produce these hazards and human actions that create vulnerabilities (for example, lifestyle choices and ingesting patterns). Depending on the socio-spatial structure of the city or cities, these concerns collectively have diverse effects in various areas.

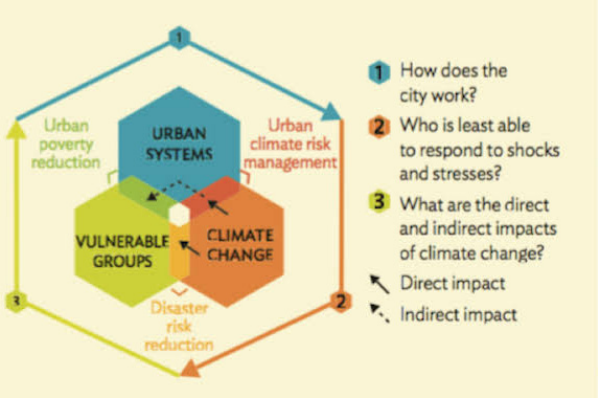

Photo courtesy: Asian Development Bank

The Indian urban poor face a dual whammy of climate change hazards because these hazards are not only catalysed by Indian urbanisation problems (Revi, 2008) but they also interrelate, as mentioned, with other socio-economic, political and environmental hazards that are intrinsic in Indian society. For example, women in India bear anuneven burden of climate change due to the prevalent social inequalities and prescribed social and economic roles (Rao *et al.*, 2019). On the other hand, migrants, for example, settle in areas that were previously unsafe (prone to flooding and landslides, for example) or create the possibility of a man-made disaster (environmental degradation, slum fires, health hazards). A flood or a cyclone does not discriminate between residents and affects everyone in its path, so urban vulnerabilities do not only affect low-income residents.

Prioritising Adaptation over Mitigation

To begin with, implementing adaptation policies does not imply "giving up" on climate change mitigation policies. In fact, for maximum benefit, adaptation must be adopted alongside mitigation policies and, to the greatest extent possible, integrated with mitigation efforts (Grafakos *et al.*, 2018). However, if co-adoption is not possible for two important reasons, adaptation must take precedence over mitigation. First, while mitigation helps to avoid or limit future climate change by reducing the accumulation of GHGs in the atmosphere, it does little to mitigate the effects of GHGs that have already been emitted and are in the atmosphere (OECD, 2009). This is problematic because, while it will mitigate the long-term effects of climate change, it will have little effect on the emissions already emitted in previous decades as a result of the continued use of fossil fuels. Since 1751, the world has emitted over 1.5 trillion tonnes of CO_2, and these emissions are responsible for nearly all of the warming (Ritchie and Roser, 2020).

Second, mitigation necessitates difficult policy decisions such as technological advancements, carbon emission trading, and an energy tax. It would also entail funding for climate-resilient infrastructure. GHG emissions will likely continue to rise for some time before levelling off. Difficult policy decisions and technological advancements will not produce immediate results (IPCC, 2014).

For these reasons, climate change is likely to continue on an upward trend for several decades. Too much emphasis on mitigation strategies would result in more misery and increase the vulnerability of the urban poor because mitigation strategies would fail to address these already "locked-in" emissions. As a result, we require adaptation strategies that include taking deliberate actions to mitigate the negative effects of climate change (IPCC, 2014). According to the IPCC, adaptation is "adjustment in human natural systems in response to actual or anticipated climate stimuli or their effects that mitigate harm or exploit beneficial opportunities" (IPCC, 2014). Further, it has described mitigation activities as follows:

activities that aim to reduce GHG emissions, directly or indirectly, by avoiding or capturing GHGs before they are emitted to the atmosphere or sequestering those already in the atmosphere by enhancing"sinks" such as forests. Such activities may entail, for example, changes to behavior patterns or technology development and diffusion (IPCC, 2014).

As related to mitigation, per the IPCC explanation, adaptation directly includes measures that respond to both pragmatic and expected climate change.

Towards Transformative Adaptation

The opportunity for social reform presented by climate change adaptation is excellent. Our comprehension of this will be aided by Freire's critique of adaptability. According to Freire, "adaptation is hostage to being limited to efforts to live better inside, rather than seek change to, the social and political systems that influence life chances" (Pelling, 2011). Similar to this, people often choose to cope with poverty by concealing their desires, dreams, and aspirations rather than making an effort to change the systems that limit their ability to succeed in life (Pelling, 2011). We can comprehend connections between adaptation and social and political reform if we read this criticism in conjunction with the IPCC's description of climate change. In light of these criticisms, we can define climate change adaptation as considering and making adjustments to the behaviours and institutions that create risk (Pelling, 2011). The term "transformative adaptation" refers to this as opposed to "incremental adaptation," which aims to preserve current institutional systems, development trajectories, and practises (Revi *et al*., 2014). Our institutional structures, priorities, and norms will be able to undergo significant changes thanks to transformative adaptation (Bahadur and Tanner, 2014).

As argued above, the urban poor in India face varying degrees of climate change hazards. Following natural disasters like floods are vulnerabilities brought on by urbanisation. These hazards ultimately have an impact on nearby social, political, and environmental risks. As a result, India is constantly in need of revolutionary adaptation. By supporting pro-poor and sustainable modes of development and tackling the core causes of poverty, encouraging transformative adaptation in India's cities would not only make our cities resilient to the threats posed by climate change, but will also protect our urban poor from additional vulnerabilities.It will allow us to effect "changes to entrenched systems maintained and protected by powerful interests" in the words of O'Brien (Bahadur and Tanner, 2014, p. 208).

Adaptation Addresses Needs of Local Development

Adaptation action addresses the immediate need for local development (Khosla and Bhardwaj, 2019). Indian climate change strategy has traditionally combined adaptation and mitigation efforts while connecting them to urgent local development demands (Khosla and Bhardwaj, 2019). Due to the word "co-benefits" being used in the National Action Plan on Climate Change, this connection has always existed in Indian national climate politics (Dubash, 2013). Our 12th Five Year Plan and National Action Plan on Climate Change both incorporate policies that not only advance economic growth but also mitigate climate change.

The IPCC's 2014 report on climate change has identified a number of important criteria that are critical in determining the ability of cities all over the world to adapt. The availability of risk-reducing infrastructure in cities, such as sanitary facilities, drainage systems, and all-weather roads, as well as inexpensive and conveniently placed housing, food security measures, and, most significantly, healthcare and emergency services. Local governments' institutional capacity for gradual and transformative adaptation, as well as their capability to integrate adaptation policies into local regulatory frameworks, are additional critical factors (IPCC, 2014). Cities without the risk-reducing infrastructure and services are less prepared to take adaptation action (Revi *et al*., 2014).

Therefore, a city's ability to supply its residents with the bare minimum of basic infrastructure, such as decent housing and sanitary facilities, is ultimately what determines whether or not an urban centre will be able to adapt. Urban planning, sanitation conservation, public health, and other duties fall under the purview of municipal governments, according to the 12th schedule of the Indian Constitution. Because of this, the upshot of adaptive tactics at the local level will typically be improved local development.

Local Level Matters for Adaptation

Local communities are the ideal places to realise the benefits of adaptation: First, despite being a worldwide occurrence, climate change has clearly local effects. Risks from global climate change, such as more frequent heat waves and rain, mix with other geographic, economic, social, and environmental elements to cause relatively localised events that have an impact on local livelihoods (IPCC, 2014). Second, regional differences exist in both vulnerabilities to and capacities for adapting to climate change. They are the outcome of interactions between a variety of local characteristics, including economics, infrastructure, gender, and political engagement. These and other regional elements decide how negatively climate change affects the local population (IPCC, 2014). Third, local levels are the most appropriate for evaluating the effectiveness of adaptive strategies. Adaptive measures must be taken in response to the anticipated or actual experience of climate change since the adverse consequences of climate change are influenced by many local intervening factors that produce distinct vulnerabilities for different locations (IPCC, 2014).

Current Indian Multi-Level Governance Model

Constitutional Framework of the Urban Local Bodies

The Parliament passed the 74th Amendment Act, 1992, which went into force on June 1st, 1993. It amended the Constitution to include Articles 243-P to 243-ZG as Part IX-A. The amendment put Article 40 of the Constitution into effect. Part IV's article 40, which is titled "Directive Principles of State Policy," commands the states to organise village panchayats (self-governing administrative bodies in rural regions) and give them the necessary authority and powers to carry out their self-government functions (74th Amendment Act, 1992). The Seventh Schedule's List II lists the subjects for which the states have sole legislative authority. In order to accomplish the goals of the 74th Amendment, List II was changed, and Entry No. 5 (Local Government) was added. As required by Article 246 of the Constitution, this allowed the state governments to pass the necessary laws pertaining to municipalities (74th Amendment Act, 1992).

Insufficient Funds and Lack of Financial Autonomy

Although the 74th Amendment shows a goal to empower ULBs through economic and political decentralisation, it makes no provisions about their revenue assignments, which is why it does not resonate with many people (Gandhi and Pethe, 2017). While giving the ULBs new responsibilities, the Constitution neglects to specify the sources from which they can obtain the necessary funds (Das and Chattopadhyay, 2018). Therefore, it is the responsibility of the state governments to adopt laws and rules governing the financing of ULBs. According to List II (State List) in the Seventh Schedule of the Constitution, local government is a state subject.

Despite the 74th Amendment's requirement that state governments set up a state finance commission (SFC) every five years to examine and suggest ways to improve the financial stability of the municipalities, this has continued to be the case (NCRWC, 2001). This obligatory provision has, however, been reduced to a purely nominal obligation due to a lack of political will among state governments. For instance, in all the big cities, at least a year passes between the SFC's formation and the submission of its report to the Ministry of Panchayati Raj (Chakraborty *et al.*, 2018). The time between the formation of SFCs and the submission of their findings is two years for the cities of Assam, Karnataka, Kerala, Punjab, Rajasthan, Sikkim, Tamil Nadu, and West Bengal, and much longer for other cities (Chakraborty *et al.*, 2018). In Andhra Pradesh, an SFC was established in 2004, and it delivered its final report to the Panchayati Raj Ministry in 2009. In December 2013, the Bihar SFC was founded, and in December 2016, the Ministry received its report (Chakraborty *et al.*, 2018). In Haryana, the SFC was established in April 2010 and its report was submitted in 2014. (Chakraborty *et al.*, 2018). The state administrations have not even attempted to put the "Action Taken Report" in the state legislature table for the cities of Haryana, Goa, Gujarat, Uttarakhand, and Bihar.

In India, the ULBs' sources of income can be divided into three groups: I the ULBs' internal sources of income, such as taxes on real estate, entertainment, advertising, professions and trades, and charges like fees and fines; (ii) intergovernmental transfers; and (iii) external sources of income, such as borrowings (Sharma, 2020). The difficulties associated in ULBs are lack of capacity building and the absence of clear political authority.

Global Cities in Climate Change

The examples of certain cities that have successfully incorporated climate change agendas into their local development policies and practises are examined in this section.

United States of America

Climate change has caused the United States to warm by 2.6 degrees Fahrenheit (1.4 degrees Celsius) since 1970. Because of climate change, the climate of the United States is changing in a variety of ways across the country. From 2010 to 2019, the United States had its hottest decade on record. Extreme weather events, invasive species, floods, and droughts are on the rise. The effects of climate change on tropical cyclones and sea level rise affect regions of the country.

Major cities in the United States have enacted 61 major building, energy, and transportation policies, as well as launched 79 new climate programmes and initiatives, putting them on track to reduce their emissions by 32% by 2025. This actually exceeds the targets set by world leaders in the Paris Agreement. These cities have passed 61 major building, energy, and transportation policies and launched 79 new climate programmes and initiatives, putting them on track to reduce their emissions by 32% by 2025. This actually exceeds the targets set by world leaders in the Paris Agreement. Boston plans to cut single-occupancy vehicle trips in half by 2030. To encourage people to use public transportation again, the city launched a pilot programme offering preloaded transit and bike passes to 1,000 residents in five of the pandemic's hardest hit neighbourhoods.

As Columbus, Ohio, works to reduce emissions by 45 percent by 2030, promote environmental goals to help the city improve residents' lives. Denver's climate and economic development offices are collaborating to ensure that their residents are first in line and well-prepared for jobs in this expanding industry. The city awarded six organisations $2.1 million in contracts last fall to provide outreach, education, up-skilling, re-skilling, apprenticeships, and on-the-job training for clean-energy jobs. Honolulu is speeding up the development of clean, affordable transportation options for more of its residents. Another city, Indianapolis, has created a framework for capacity building in order to deliver climate action. It will assist the city in staying on track to meet its climate goals.

Pittsburgh, a city, has amended its budget to make room for climate action. Parking reform is a key component of San Diego's climate action efforts. San Joso, California collaborated with Latino and Vietnamese communities to develop a decarbonization strategy that addresses workforce training, financing, and tenant protections in order to reduce building emissions.

Denmark

Denmark is the most populous Nordic country and, after Finland, the second to develop an adaptation strategy (Goodsite *et al.,* 2013). The country is extremely vulnerable to sea-level rise, and it faces a number of climate-change-related hazards, including hot weather, rising sea levels, more heat waves, and heavy precipitation (Goodsite *et al.,* 2013). Climate change policy in Denmark is overseen by the Ministry of Climate, Energy, and Building (MCEB). Although the MCEB is primarily concerned with mitigation, it is also involved in adaptation efforts across various sectors and government agencies (Goodsite *et al.,* 2013). Denmark recognises the significance of local-level adaptation and is actively assisting municipalities in developing action plans.

It made climate adaptation a priority for local governments in its 2008 adaptation strategy (Jensen *et al.,* 2016). The strategy provided local governments with a variety of options for preparing for future climate change (Jensen *et al*., 2016). It urged local governments, for example, to harmonise their road regulations and rail standards to account for expected climatic changes, as well as to develop road drainage systems that can handle increased precipitation (The Danish Government, 2008). It also provided for the incorporation of climate change into planning and development, allowing public authorities, citizens, and businesses to determine when climate change must be considered. It described the sectors most vulnerable to the effects of climate change (The Danish Government, 2008, pp. 8-9), such as coastal management, water supply,

energy supply, and building and construction.

The Ministry of Environment established a Climate Change Adaptation Squad in 2012 to ensure that all municipalities have adaptation action plans in place by the end of 2013. (Goodsite *et al.,* 2013). Copenhagen, Denmark's capital and largest city, is working hard to "incorporate adaptation into all aspects of the city's development, with the idea that adaptation and the development of an attractive and green major city are two sides of the same coin" (Goodsite *et al.,* 2013).

Australia

Australia is vulnerable to extreme weather events such as bushfires, heat waves, rising ocean temperatures, changing rainfall patterns, and sea level rise (Pearce *et al.,* 2018). Its three largest cities, Melbourne, Sydney, and Brisbane, account for 49 percent of the country's total population and are located along the coast. Adaptation actions in these three cities are of particular concern. Melbourne has emerged as the leader in climate change adaptation among the three (CCASR, 2017). Since 2007, the city has conducted comprehensive assessments of the future risks posed by climate change.It is actively promoting its local governments, which are "at the heart of adaptation action" (CCASR, 2017), according to its most recent Climate Change Adaptation Strategy Refresh 2017. In collaboration with the Victorian Centre for Climate Change Adaptation Research, the city created a best practise adaptation model for its local governments (Department of Environment, Land, Water and Planning, 2016). The municipal authorities in Sydney are in charge of climate change adaptation in both the city and the surrounding areas. As part of its "Environmental Action 2016-2021: Strategy and Action Plan" (The City of Sydney, 2017), the emphasis is on low-carbon, water-sensitive, climate-resilient, zero-waste, green, and cool measures.

Results and Discussion

Framework for Adapting to Climate Change in Indian Cities

Adaptation is a major component of several national policies and plans in India. The National Action Plan on Climate Change (NAPCC), for example, is an Indian policy instrument for mitigating and adapting to climate change. It was released on June 30, 2008, and it has eight broad objectives (NAPCC, 2008); however, its primary focus is on promoting development and achieving a high rate of economic growth (Pandve, 2009). The eight missions are simply a means to an end of achieving development and growth through the use of low-carbon energy (Pandve, 2009). NAPCC is a policy instrument that lacks a detailed strategy for carrying out its missions (Pandve, 2009 and Rosencranz *et al*., 2010). None of its eight missions directly address climate change adaptation; instead, they focus on development goals that also address climate change. As a critical area of engagement for Indian cities, the National Mission on Sustainable Habitat addresses adaptation and mitigation interventions (MOHUA, 2008).

Table 1 shows the vulnerable cities of India, which are facing growing climate risk frequently. For instance, most of the Indian cities has executed the adaptation plan and action. For example, Ahmedabad, Heat Action Plan has developed in 2013 by the Ahmedabad Municipal Corporation (AMC). Mumbai has launched the coastal zone management plan to countering growing climate risk.

In addition, the Ministry of Housing and Urban Affairs launched another flagship scheme, the

Table 1. Climate vulnerable cities in India

City	State/Union Territory	Vulnerability
Mumbai	Maharashtra	Floods, Temperature rise
Delhi	Delhi	Heatwaves
Chennai	Tamil Nadu	Floods
Bengaluru	Karnataka	Floods, High Temperature
Puri	Odisha	Cyclones
Guwahati	Assam	Landslides, Floods, Erosion
Imphal	Manipur	High Temperature, Deficit Rainfall
Kolkata	West Bengal	Floods
Ahmedabad	Gujarat	Heatwaves
Indore	Madhya Pradesh	Heatwaves, Heavy precipitation

Jawaharlal Nehru National Urban Renewal Mission, in 2005. Its goal was to accelerate planned development of some identified cities and encourage urban infrastructure reforms, but in its current phase, it fails to address climate change adaptation, risk mitigation, or vulnerability assessment for urban areas (Sharma and Tomar, 2010).

The following framework, adapted from a UNFCCC strategy, could guide the steps in the development of a municipal-level adaptation strategy in Indian cities. It consists of four steps: assessment of climate change impacts and vulnerability; planning for adaptation; implementing targeted adaptation actions; and monitoring and evaluating adaptation interventions (UNFCCC, 2011).

The first step is to determine whether and how much climate change will affect us. This evaluation is carried out for natural systems (water supplies, agricultural productivity) as well as various aspects of human society (social well-being, economic activities) (UNFCCC, 2011). If it is determined that climate change poses significant risks and that adaptation is required to manage those risks, then additional assessments are conducted to inform the subsequent adaptation process. For example, as part of the Asian Cities Climate Change Resilience Network climate resilience strategy programme, a detailed vulnerability analysis was conducted in Surat, Indore, Guwahati, and Gorakhpur (Sharma *et al.*, 2014).

The second step is to identify and evaluate the various possible adaptation activities before selecting the best option from the available alternatives. This avoids duplication of activities and ensures that adaptation activities are adequately integrated into government policies. Adaptation planning must include "community-based adaptation," which allows for local participation in adaptation planning and activities (Archer *et al.*, 2014). All efforts should be made to involve various stakeholders, as this will aid in the identification of vulnerable sectors as well as existing and potential adaptation initiatives.

The third step is implementing adaption actions and it comes after assessment and planning. This can be accomplished successfully by integrating adaptation initiatives into district and rural level development programmes (UNFCCC, 2011). There is not just one implementation strategy that works best.

The last step is to monitor and evaluate the adaptation strategy's capacity to reduce climate threats' susceptibility for various groups and natural resources. Monitoring is required to document the advancement made in carrying out the specific adaption measures in respect to its goals. Monitoring should be carried out during the implementation phase, during the duration of the adaptation action, and occasionally even after that (Lamhauge *et al.*, 2012; UNFCCC, 2011). Monitoring yields information and knowledge that can be used to improve adaptation efforts.

Conclusion

Climate change is both a local and a global problem, and requires action at all levels, including the city level, if it is to be addressed effectively. Municipal governments need to identify adaptation issues at the local level. Strong linkages between the local, national, regional and global levels are essential if cities are to receive the support they need, in particular through adequate funding, to be able to carry out the climate change activities assigned to them. The climate change adaptation framework for cities necessitates the launch of a comprehensive intervention that includes urban development and growth as well as environmental safety and sustainability. This will necessitate re-directing investments toward adaptation planning, necessitating a link between various levels of institutional intervention.

Indian cities municipal governments are neither the well-equipped nor the most effective organisations. Many people lack the resources and ability to guarantee basic services in their community. As a result, it is likely that initial bureaucratic and political constraints will prevent an accurate assessment of the costs of adaptation and the mainstreaming of some adaptive acts into municipal functions.

Startlingly, none of the three levels of the Indian government seem to comprehend the importance of locally led climate adaptation. City governments have been sluggish to develop adaptation strategies, and the state and federal governments have been slow to set up supportive institutions, despite the abundance of studies emphasising the advantages of locally driven adaptation. India's municipal governments have been institutionally vacant due to a lack of political commitment on the side of Indian governments to carry out their constitutional obligations.

National governments should step up and en-

courage local governments to start planning for adaptation. By bringing adaptive planning to one or more cities and thereafter expanding it to other cities, state governments might play a crucial role. Other local governments would become interested in the planning framework after it had been used and proven, and they would decide to adopt it in their own cities. It will bring the favourable framework for climate governance in Indian cities.

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Conflict of Interest

None.

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