



Climate action in Indian cities: an emerging new research area

Jan Beermann, Appukuttan Damodaran, Kirsten Jörgensen & Miranda A. Schreurs

To cite this article: Jan Beermann, Appukuttan Damodaran, Kirsten Jörgensen & Miranda A. Schreurs (2016) Climate action in Indian cities: an emerging new research area, Journal of Integrative Environmental Sciences, 13:1, 55-66, DOI: [10.1080/1943815X.2015.1130723](https://doi.org/10.1080/1943815X.2015.1130723)

To link to this article: <https://doi.org/10.1080/1943815X.2015.1130723>



Published online: 17 Jan 2016.



Submit your article to this journal [↗](#)



Article views: 1904



View Crossmark data [↗](#)



Citing articles: 3 View citing articles [↗](#)

Climate action in Indian cities: an emerging new research area

Jan Beermann^a, Appukuttan Damodaran^b, Kirsten Jörgensen^a and
Miranda A. Schreurs^a

^aEnvironmental Policy Research Centre, Freie Universität Berlin, Germany, Berlin; ^bIndian Institute of Management Bangalore, Bangalore, India

ARTICLE HISTORY

Received 30 June 2015 Accepted 8 December 2015

1. Introduction

India is the fourth largest emitter of greenhouse gases globally, following China, the United States, and the European Union. Although India still has a low per capita carbon level, due to its large population and growing economy, its share of global greenhouse gas emissions is rising. India is, thus, a particularly important country to examine in relation to climate change. This article investigates one particular aspect of India's climate policy: the role its cities play within its multi-tiered climate governance system. India is still a predominantly agricultural society with two-thirds of its population (about 850 million people) living in rural areas. Urbanization is, however, progressing; estimates are that India will add over 400 million urban dwellers between 2014 and 2050 bringing the urban population to over 800 million (United Nations, Department of Economic and Social Affairs, Population Division 2014).

This article aims to shed light on the challenges, capabilities and limitations of India's urban areas to deal with mitigating climate change. It complements the other articles in this special issue which focus on subnational state and provincial level climate policy. It takes as its starting point the academic multi-level climate governance debate and also looks at the role the co-benefit concept plays at the urban level. The article highlights key actors, drivers, and institutions of city climate action and considers how local climate policy and programs are enabled and constrained by India's federal political system. Finally, the role of international city partnerships in supporting climate activities is considered.

To explore the conditions shaping climate action in India's cities this article builds on a literature review and discussions held at an Indian-German expert meeting which took place in Bangalore in April 2015.

2. Cities and multi-level climate governance in India

Multi-level governance refers to processes linked to policy formulation, implementation, and monitoring, recognizing that these occur at various levels from the global to the national, the state, and the local. In this paper, a multi-level governance lens is used to analyze climate

policy governance. This type of approach recognizes that not only governmental actors, but also civil society and private actors play important roles in relation to climate policy and action.

National political frameworks condition the relationship between national, state, and local climate initiatives. They also influence the potential for horizontal and vertical diffusion of exemplary climate actions (Bulkeley and Betsill 2005, 2006; Alber and Kern 2008; Corfee-Morlot et al. 2009; Elander and Lundmark 2009; Kern and Bulkeley 2009; Bulkeley 2010, 2013). A local government's ability to introduce climate policies depends greatly on the country's institutional political set-up as well as the availability of resources, technical know-how, and political will. National climate policies are – if they exist – regarded as one supporting factor in city experimentation (Bulkeley 2010).

2.1. National actors and institutions

Major actors in India's national climate policy-making include the prime minister, a number of federal ministries, the parliament, expert groups, the business sector, civil society actors, research institutes and international organizations (Das 2012; Pulver 2012; Lele 2012). The Planning Commission, which was replaced in October 2010 by the National Institution for Transforming India (NITI Aayog), and the Financial Commission are important actors in the formulation and choice of policy alternatives as well as their implementation. There is general agreement among these actors on India's right to development. They also share the view that India should receive financial and technological assistance for climate mitigation and adaptation and that there should be a greater focus on enhancing global climate equity. There are, however, different views in India regarding what kind of contributions India can make and the speed at which change can happen.

The Indian government has long taken the position in the international climate change negotiations that the main responsibility for global warming lies with the developed countries of the North and that developed countries have a responsibility to provide developing countries like India with technological and financial assistance for climate change mitigation and adaptation. This stance is reflected in India's activities under the Kyoto Protocol, where India was second only to China in the number of Clean Development Mechanism projects initiated (UNEP 2015).

In the international negotiations, the Indian government has traditionally emphasized the fact that India's per capita carbon emissions (CO₂) are far lower than in any other of the major emitting economies. In fact, in 2013, India's per capita emissions amounted to about 1.7 tons CO₂/capita compared to 7.4 for China, 7.3 for the EU, and 16.6 for the United States. Still, India accounts for close to 6% of global CO₂ emissions, largely due to its population of about 1.28 billion in 2015.¹ By the early 2020s, India's population is expected to surpass China's population as the largest in the world and reach 1.7 billion by around 2050. India's economic growth rates are also strong, ranging from 5.1 to 7.4% during 2011–2014 (World Bank 2015). Due to its large and growing population plus its high economic growth rates, India's contribution to global greenhouse gas emissions is expected to grow significantly. CarbonBrief estimates that even if the country reaches its intended nationally determined contributions (INDC) that the Indian Government issued in preparation for the Paris climate negotiations in October 2015, India's emissions will grow by 90% of current levels by 2030 (Yeo and Evans 2015).

In 2007, the Indian government set up a high level advisory group on climate change (which was reconstituted in 2014) with the objectives to coordinate national action plans for assessment, adaptation, and mitigation of climate change; to advise the government on measures India can take; and, to facilitate inter-ministerial coordination. In 2008, the government issued India's first National Action Plan for Climate Change. The plan identifies eight core missions focusing on promoting solar energy, enhancing energy efficiency, sustainable habitats (e.g. energy conservation building codes, urban waste management and recycling, automobile fuel economy improvements, and public transportation), water security, sustaining the Himalayan Ecosystem, greening India through afforestation, sustainable agriculture, and strategic knowledge for climate change.

These missions must be implemented at sub-national levels of government requiring coordination across policy levels. The national government instructed each of India's states to develop action plans (see Jogesh and Dubash; Jørgensen et al. in this issue). It also needs to strengthen vertical governance coordination for the implementation of the INDC targets. The INDCs aim to lower emissions intensity of GDP by 33–35% by 2030 below 2005 levels and to increase the share of non-fossil fuels in the power mix to 40% of installed electric power capacity by 2030, plus to expand forest cover. Addressing these goals and action plans will require not only strong political leadership by the national government but also actions at the state and local levels. As a national institution the Financial Commission works at the interface between the center and the states, and is involved in the implementation of national targets at the subnational level.

2.2. Lacking empowerment of the city level

Already in the 1990s, efforts were made to effectively enhance the sharing of power between the national level and subnational levels of government. In the 73rd and 74th amendments to India's constitution in 1992, greater local governance powers in health and education were assigned to municipal governments. These included the right to raise revenues, pursue social justice policies and to direct economic development (Parikh 2014). However, cities' scope for taking action remains limited since the amendments of the constitution have not been effectively implemented. Urban development policies still belong to the realm of India's state governments, which then delegate responsibilities to local bodies. The powers of town and city governments vary across states and a significant decentralization of governance has not occurred. Therefore, cities' institutional and financial capacities remain weak (Sharma and Tomar 2010; Rao and Bird 2014).

In practice, the initiation of India's urban development policies is often conducted in a top-down manner, driven by national ministries (Urban Development, Housing, Urban Poverty Alleviation). The ministries provide guidelines and financial resources for state governments who are then expected to implement plans through their municipal bodies (Sharma and Tomar 2010; Doll et al. 2013). Studies on urban governance in the metropolitan areas of Delhi, Hyderabad, Kolkata and Mumbai show that state governments play a central role in urban reform processes. Urban areas are often "used as a showcase" of the state government's or the ruling party's policies (Ruet 2009, p. 275).

Within India's federalist structures, an additional governance challenge for cities is financial constraints, with local communities struggling to find the resources to act on a variety of issues, including climate change (Rao and Bird 2014).

2.3. The mobilizing role of non-governmental actors and the judiciary

Urban climate policy-making does not only involve governmental actors but also a wide variety of civil society and private players. While local and regional governments remain key actors in the development of effective urban climate strategies, climate action is increasingly shaped by various other actor groups at the state and city level, including the corporate sector, non-governmental organizations (NGOs), regional and transnational networks and international organizations (Bulkeley 2010; McKinsey Global Institute, 2010; Doll et al. 2013; OECD and Bloomberg Philantropies 2014). Castán Broto's and Bulkeley (2013) survey of 627 climate change initiatives in 100 cities worldwide reveals that globally, private and civil society actors account for about one quarter (24%) of urban climate action. In the 162 initiatives surveyed in Asia local non-state actors led as much as 39% of the urban climate experiments.

In India urban development and environment networks often involve actors from within the city as well as external actors, coming from international agencies or foreign countries. What these actor coalitions look like, the degree of influence of international agencies, the forms participation takes, and the influence of various social groups, however, varies considerably across India's cities (Lama-Rewal and Ruet 2009). An interesting case where civil society actors and the courts played a key role is the introduction of compressed natural gas (CNG) in Delhi's public transportation fleet. In the mid-1980s, Delhi's air pollution was severe. It gained the attention of the media, a private litigator, the National Environmental Engineering Research Institute and in the 1990s, the Delhi-based Centre for Environmental Sciences (Rajamani 2007). In 1998, India's Supreme Court mandated the use of CNG in public transportation vehicles, and instructed the Delhi government to take action. The city's entire public transportation fleet was forced to meet the new technical standard by 2001 (Goyal and Sidhartha 2003). The court set deadlines for governmental reporting and forced political action with its rulings.

2.4. Emerging climate change action in Indian cities: initiation, learning and emulation

India has roughly 50 cities with a population of one million or more, the largest being Mumbai (12.4 million), Delhi (11 million), Chennai (8.6 million), and Bangalore (8.5 million) (Census Organization of India 2011). Many of India's cities are highly vulnerable to sea level rise as they are situated along India's extensive coastline or along major rivers. Already, Indian cities are feeling the impacts of extreme weather events, including heat waves and floods (Shaw et al. 2010).

Due to the overwhelming challenges – including rapid population growth, overburdened infrastructure, poverty, and income inequality – it is not surprising that sustainable development and climate action usually are not prominent on the political agenda in Indian cities. However, in recent years urban activities have grown in these areas. Examples include New Delhi, which launched India's first city-level climate change agenda covering the years of 2009–2012, Hyderabad's sustainable transportation strategy and waste management

initiatives in Kolkata, Mumbai and Surat (Sharma and Tomar 2010; Doll and Balaban 2013; Gouldson et al. 2014; Kapshe et al. 2013; Puppim de Oliveira 2013; Puppim de Oliveira et al. 2013a; Bulkeley and Caston 2013).

Bi-lateral and transnational city collaboration can lead to climate initiation and learning. This process includes exchanging experiences, promoting learning, supporting the diffusion of policies and the formulation of joint GHG reduction targets, and lobbying for influence in international and regional climate negotiations (Bulkeley 2010). In India, the national government has supported domestic urban collaboration already since 2007 when it introduced the Indian Peer Experience and Reflected Learning (PEARL) program to actively support city exchange and learning, especially in the area of urban infrastructure development. A total of 167 Indian cities were sub-divided into six groups according to their size, socio-economic profile and geographical location (Mega Cities, Industrial Cities, Mixed Economy Cities, Cultural Cities, Cities of Environmental Importance and North East Cities) to facilitate partnerships between cities with similar interests. The exchange of knowledge takes place via the PEARL website.² Several dozen best practice examples have been uploaded by the National Institute of Urban Affairs that coordinates the initiative. From a global perspective this program is rather unique as Campbell (2012) emphasizes in his study of trans-local learning worldwide: "Only a handful of nations have focused on horizontal exchange as a matter of policy. India is a bellwether" (p. 209).

Similarly India's Smart City governance approach is geared towards diffusion by learning and emulation as it aims at the development of a best practice "replicable model for sustainable and inclusive cities", which "will act like a light house" and be adopted by other Indian cities.³ In 2014, the Government of India launched the Smart Cities Mission, a technology oriented approach to the promotion of sustainable and inclusive cities. This Mission aims at enabling cities to apply technology and information to ecologically modernize and improve infrastructure and services. In an illustrative list six areas are distinguished in which smart solutions can be applied: E-Governance and Citizen Services, Waste Management, Water Management, Energy Management, Urban Mobility, and Others.⁴ The focus of the Smart Cities Mission is first on the provision of core infrastructure, such as water and electricity supply, sanitation and waste management, urban mobility and public transport, affordable housing, especially for the poor, robust IT connectivity and digitalization. Its second focus is on aspects concerning politics such as good governance, especially e-Governance and citizen participation, and its third focus area is policy goals, such as sustainable environment, safety and security of citizens, particularly women, children and elderly, and health and education.⁵

Indian cities are also increasingly active in joining international city partnerships in the areas of sustainable and low carbon development. Several Indian cities have established partnerships with cities from the Global North that go beyond the traditional twinning focus on cultural and individual citizen exchange. Pune (India) and Bremen (Germany) have collaborated in a multiplicity of environmental projects, amongst others in the areas of biogas and waste management, since the 1970s. Ahmedabad has partnered with Valladolid, Spain in the development of a comprehensive program for ecological heritage preservation. Another example is the partnership among Guntur (India), Bologna (Italy) and Vaxjö (Sweden) in implementing ecoBUDGET, a city-level environmental management system. Indian cities also engage in South-South city partnerships, as demonstrated by Coimbatore which has exchanged knowledge and experiences in renewable energy and energy efficiency strategies with the cities of Ekurhuleni (South Africa) and Yogyakarta (Indonesia) as part of the

“Local Renewables Model Communities Network”, facilitated by the city network ICLEI-Local Governments for Sustainability.

A major driver for Indian cities engaging in international cooperation is the urgent need for innovative and sustainable solutions to address problems tied to energy, water and transport infrastructures. Urbanization and industrialization have led to a rapid growth in energy and water consumption, the quantities of solid waste and sewage and the use of individual and public transport. Many cities suffer from regular power cuts due to a fragile and overburdened energy infrastructure. Drinking water often is unsafe for human consumption. City managers also have to deal with overflowing waste management systems and congested streets. Mukhopadhyay and Revi (2012) argue that due to pressures stemming from development and expansion, Indian cities are open towards learning from other cities. A major challenge, however, remains the lack of independent and accessible documentation on sustainable and climate governance experiences that would allow Indian cities to learn from their peers (Sharma and Tomar 2010).

A further barrier Indian cities face when establishing formalized city partnerships or international partnership projects is their strong dependence on national and state level governments for approval and financial support. Even if partners have access to central and state government institutions and receive consent for joint projects, the approval procedure is often associated with considerable time delays and budget constraints (Beermann 2014).

3. Co-benefits as drivers of cities' climate actions

Climate policy can provide several economic and environmental co-benefits, such as clean air, local and regional environmental improvements, employment and technological developments (Kousky and Schneider 2003; Rabe et al. 2006; Betsill and Rabe 2009). Suggesting its powerful appeal, the co-benefit approach has been promoted by a wide variety of international organizations, national, state, and local governments, climate research organizations and consultancy commissions (e.g. IPCC 2001; OECD 2003; MOEJ 2008).

The OECD (2010) argues that cities can deliver “cost-effective policy responses to climate change,” and that they are centers of innovation that “can advance clean energy systems, sustainable transportation, spatial development and waste management strategies to reduce greenhouse gases” (p. 3). It is at the local level that many creative policy ideas have been developed: “The existence of a myriad of local co-benefits gives rise to the opportunity to craft policy that addresses multiple concerns simultaneously” (Kousky and Schneider 2003, p. 369). The IPCC’s reports point out that city climate action can provide various co-benefits, especially for developing countries (IPCC 2014). Investment in low-carbon, climate-resilient urban infrastructure can be cost effective and provide various positive side effects such as reducing traffic congestion and local air pollution (Dubash et al. 2013, Gouldson et al. 2014, Gouldson et al. 2015).

Governmental actors are confronted by many policy demands and must contend with conflicting policy objectives promoted by actors with different interests. The climate policy discourse in India is still dominated by the development-first paradigm (Dubash 2013; Dubash et al. 2013; Fisher 2013; Thaker and Leiserowitz 2014). Climate change issues are typically subordinated to the prerogatives of economic development and poverty reduction. Yet the threatening scenario of climate change, which impacts many economic sectors and hampers human livelihoods, has become increasingly apparent. Therefore a co-benefit

approach, which seeks win-win solutions, could bridge at least some conflicting policy objectives and help advance India's climate policy (Dubash et al. 2013). Co-benefit-based actions that provide for both development and climate mitigation are in fact becoming a more significant driver of domestic climate policies (Dubash 2013; Dubash et al. 2013, Indian Council for Research on International Economic Relations 2015).

Areas in which co-benefits may be applied are energy access and security, employment, new green markets, clean air, and water and waste management, all of which have the potential to bridge the gap between necessary climate mitigation efforts and the need to boost economic growth and poverty eradication.

Studies of Kolkata, India's third largest and most densely populated city, reveal various potentials for economically beneficial climate mitigation actions, including increasing energy efficiency and developing renewable energy (Gouldson et al. 2014, 2015). The studies point to the potential to simultaneously strengthen the city's economic competitiveness, energy security and carbon intensity. The authors found strong economic co-benefits for investments in low carbon measures. According to their survey, Kolkata could reduce its annual carbon emissions in the commercial, domestic, industry, transport and waste sectors by 21% by 2025. The investments would pay back after 3.9 years through annual savings and generate savings for the lifetime of the measures. Moreover, if the returns were reinvested in low-carbon measures, Kolkata could reduce its carbon emissions by even 36% relative to the business as usual scenario of the city. However, implementation challenges and the need for various investment options both in the form of commercially attractive projects, and development assistance have constrained the realization of projects. Gouldson et al. (2014) underline the importance of governmental action, but they also emphasize the challenge of formulating and implementing socially desirable, equitable, inclusive and sustainable pathways towards a low carbon economy and society.

Significant potential for co-benefits from the use of low carbon, clean power generation technologies may arise not only in urban areas but also in the peri-urban villages that surround India's megacities. Research has shown that co-benefits may arise in the form of additional employment, output stability and agriculture stabilization (Damodaran 2012). In the case of the peri-urban village of Mundur, which has suffered from the loss of common lands to landfills for waste coming from the city of Bangalore, programs to promote waste reduction in Bangalore coupled with reclamation and greening of the common lands could enhance opportunities for simultaneously addressing biodiversity conservation, providing "green lungs" for Bangalore, and reducing the metropolitan's carbon footprint (Damodaran 2014).

The co-benefit approach has been integrated into a number of important policy documents, such as India's National Action Plan for Climate Change and various documents published by India's previous Planning Commission. Several studies have examined co-benefits in relation to the Delhi metro (Doll and Balaban 2013), greenhouse gas mitigation action in the Hyderabad transportation sector; the introduction of the natural gas-fuelled public transportation busses in Delhi; project improving solid waste management in Kolkata and Mumbai, plus a waste management improvement scheme in Surat (Doll et al. 2013; Puppim de Oliveira et al. 2013a).

Doll et al. 2013 emphasize a number of conditions which they found to be conducive to the effectiveness of the projects they studied, such as the balancing of interests, the existence of strong civil society actors, and support from private partners and international

organizations. Their recommendations address possible ways local governments can foster progress and institutional changes. The projects they looked at typically involved more than one governmental level, a number of different governmental departments and policy areas, various public and private financial sources and a significant number of stakeholder groups. They found the creation of a special purpose jurisdiction to be helpful, as was set up for the Delhi Metro Project. The special purpose jurisdiction facilitated and improved coordination across governmental levels and stakeholder groups (Puppim de Oliveira 2013; Doll et al. 2013). Local governmental institutions can empower local stakeholders and citizens and stimulate innovative urban planning processes.

The understanding of sustainable development and the focus of policy differ considerably between India and western industrialized countries, especially at the city level. European cities' strategies for sustainable and low carbon development often focus on environmental aspects, whereas in Indian cities, economic and social development is typically prioritized over environmental aspects (Ghosh 2014). These findings underline the importance of pursuing environmental and socio-economic co-benefits in cooperative projects between Indian and Western cities.

More research will be required to better understand city-level climate action within multi-level climate governance systems in India and other developing countries. The number of studies on climate action in cities of the global south is increasing (e.g. Kousky and Schneider 2003; Dhakal 2009; Revi 2008; Qi et al. 2008; Aylett 2011; Hardoy and Romero Lankao 2011; Kithia 2011; Beermann 2014), but is still limited in comparison to the large number of publications on urban climate action in the industrialized countries (e.g. Bulkeley and Betsill 2003; Kousky and Schneider 2003; Schreurs 2008, 2009; Bulkeley 2010; Krause 2011; Bulkeley and Betsill 2013). Recent studies also show the potential to study urban climate governance in an international comparative perspective, including cities from both the Global South and North (Bulkeley and Castán 2013; Bulkeley and Caston 2013; Castán Broto and Bulkeley 2013).

With regard to India additional research is required on Indian cities' climate mitigation and adaptation potentials, cities' interlinkages within India's multi-level climate governance framework, plus ways to facilitate financial and social co-benefits in urban climate action within the Indian federal context.

4. Conclusion

This article has examined multi-level climate governance in India, with a special focus on Indian cities. It has shown that urban climate governance in India is driven by actors and institutions at multiple levels of government, including the national, state and local levels. Although cities' ability to act is constrained by institutional, jurisdictional, fiscal, and other factors, there is growing awareness of the importance of urban climate action and research. Also important to understand are the horizontal ties among and between Indian cities as well as between Indian cities and cities in other countries. Indian cities are increasingly involved in various urban networks and they are entering into bilateral collaborations. These urban networks can provide cities with support and can stimulate action through the sharing of ideas and experiences.

The factors, or rather mechanisms, that can explain the emergence, success and failure of urban climate initiatives, action and frameworks, remain important research areas. In

particular, the potential for simultaneously addressing climate change and economic and social co-benefits in the ongoing transformation of India's cities deserves further attention.

Notes

1. http://edgar.jrc.ec.europa.eu/overview.php?v=CO2ts_pc1990-2013.
2. <http://pearl.niuu.org/>
3. <http://smartcities.gov.in/writereaddata/What%20is%20Smart%20City.pdf>
4. <http://smartcities.gov.in/writereaddata/SmartCityGuidelines.pdf>
5. <http://smartcities.gov.in/writereaddata/What%20is%20Smart%20City.pdf>

Disclosure statement

No potential conflict of interest was reported by the authors.

References

- Alber G, Kern K. 2008. Governing climate change in cities: modes of urban climate governance in multi-level systems. OECD Conference Proceedings; 2008 Oct 9–10; Milan, Italy.
- Aylett A. 2011. Changing perceptions of climate mitigation among competing priorities. The case of Durban, South Africa. [Internet]. Case Study prepared for the Cities and Climate Change: Global Report on Human Settlements. [cited 2015 Jun 26]. Available from: <http://www.unhabitat.org/grhs/201>
- Beermann J. 2014. Urban partnerships in low-carbon development: opportunities and challenges of an emerging trend in global climate politics. URBE – Rev Bras Gestão Urbana. 6(541):170–183.
- Betsill M, Rabe B. 2009. Climate change and multilevel governance: the evolving state and local roles. In: Mazmanian K, Kraft ME, editors. *Toward sustainable communities: transition and transformations in environmental policy*. 2nd ed. Cambridge (MA): MIT Press. p. 201–225.
- Bulkeley H, Betsill MM. 2013. Revisiting the urban politics of climate change. *Environ Polit*. 22(1):136–154.
- Bulkeley H, Castán BV. 2013. Government by experiment? Global cities and the governing of climate change. *Trans Inst Br Geog*. 38(3):361–375.
- Bulkeley H, Caston BV. 2013. Urban governance and climate change experiments. In: Mieg H, Topfer K, editors. *Institutional and social innovation for sustainable urban development*. Routledge; p. 72–87.
- Bulkeley H. 2010. Cities and the governing of climate change. *Annu Rev Environ Resourc*. 35(1):229–253.
- Bulkeley H, Betsill MM. 2005. Rethinking sustainable cities: multilevel governance and the 'urban' politics of climate change. *Environ Polit*. 14(1):42–63.
- Bulkeley H, Betsill MM. 2003. *Cities and climate change: urban sustainability and global environmental governance*. London: Routledge.
- Campbell T. 2012. *Beyond smart cities: how cities network, learn and innovate*. Abingdon: Earthscan.
- Castán Broto V, Bulkeley H. 2013. A survey of urban climate change experiments in 100 cities. *Global Environ change*. 23(1):92–102.
- Census Organisation of India. 2011. Available from: <http://www.census2011.co.in>
- Corfee-Morlot J, Kamal-Chaoui L, Donovan MG, Cochran I, Robert A, Teasdale P. 2009. Cities, climate change and multilevel governance. OECD environmental working papers N° 14. OECD publishing.
- Damodaran A. 2014. Peri-urban villages of Bangalore, India: reclaiming the commons to cope with climate stress. Paper presented at Conference on Sustainability 2014: Future Urban Developments at Different Scales; 2014 May 9–10; KIT, Karlsruhe, Germany.
- Damodaran A. 2012. The economics of coping strategies and financing adaptation action in India's semi-arid ecosystems. *Int J Clim Change Strategies Manage*. 4(4):386–403.
- Das T. 2012. Climate change and the private sector. In: Dubash, NK, editor. *Handbook of climate change and India Development, politics, and governance*. Abingdon: Earthscan; p. 246–253.

- Dhakal S. 2009. Urban energy use and carbon emissions from cities in China and policy implications. *Energy Policy*. 37(11):4208–4219.
- Doll CN, Balaban O. 2013. A methodology for evaluating environmental co-benefits in the transport sector: application to the Delhi metro. *J Clean Prod*. 58:61–73.
- Doll CN, Dreyfus M, Ahmad S, Balaban O. 2013. Institutional framework for urban development with co-benefits: the Indian experience. *J Clean Prod*. 58:121–129.
- Dubash NK, Raghunandan D, Sant G, Sreenivas A. 2013. Indian climate change policy: exploring a co-benefits based approach. *Econ Polit Wkly*. 22(22):47–61.
- Dubash NK. 2013. The politics of climate change in India: narratives of equity and cobenefits. *WIREs Clim Change*. 4(3):191–201.
- Elander GE, Lundmark M. 2009. Multilevel governance, networking cities, and the geography of climate-change mitigation: two Swedish examples. *Environ Plann C*. 27(1):59–74.
- Fisher DR. 2013. Understanding the relationship between subnational and national climate change politics in the United States: toward a theory of boomerang federalism. *Environ Plann C*. 31(5): 769–784.
- Ghosh B. 2014. Sustainability appraisal of emerging trajectories in solar photovoltaic and urban mobility systems in India and Thailand [master's thesis]. [Internet]. Eindhoven University of Technology. [cited 2015 Jun 26]. Available from: <http://repository.tue.nl/780502>.
- Gouldson A, Kerr N, McAnulla F, Hall S, Colenbrander SA, Roy J, Sarkar S, Chakravarty D, Ganguly D. 2014. The economics of low carbon cities. Kolkata: Centre for Low Carbon Futures, Leeds.
- Gouldson A, Colenbrander S, Sudmant A, McAnulla F, Kerr N, Sakai P, Hall S. 2015. Exploring the economic case for climate action in cities. *Global Environ Change*. 35:93–105.
- Goyal P, Sidhartha. 2003. Present scenario of air quality in Delhi: a case study of CNG implementation. *Atmos Environ*. 37(38):5423–5431.
- Hardoy J, Romero Lankao P. 2011. Latin American cities and climate change: challenges and options for mitigation and adaptation responses. *Curr Opin Environ Sustain*. 3(3):158–163.
- Indian Council for Research on International Economic Relations. 2015. Reimagining India's urban future. A framework for securing high-growth, low-carbon, climate-resilient urban development in India. New Delhi: Indian Council for Research on International Economic Relations.
- IPCC. 2014. Climate change 2014: contribution of working groups I, II and III to the fifth assessment report of the intergovernmental panel on climate change. Geneva: IPCC.
- IPCC. 2007. Climate change 2007: impacts, adaptation and vulnerability working group II contribution to the intergovernmental panel on climate change fourth assessment report summary for policymakers. Geneva: IPCC.
- IPCC. 2001. Climate change 2001: synthesis report. A contribution of working groups I,II, and III to the third assessment report of the intergovernmental panel on climate change. Watson, RT, the Core Writing Team, editors. Cambridge: Cambridge University Press.
- Kapshe M, Kuriakose PN, Srivastava G, Surjan A. 2013. Analysing the co-benefits: case of municipal sewage management at Surat, India. *J Clean Prod*. 58:51–60.
- Kern K, Bulkeley H. 2009. Cities, Europeanization and multi-level governance: governing climate change through transnational municipal networks. *JCMS J Common Mark Stud*. 47(2):309–332.
- Kithiia J. 2011. Climate change risk responses in east African cities: need, barriers and opportunities. *Curr Opin Environ Sustain*. 3(3):176–180.
- Kousky C, Schneider SH. 2003. Global climate policy: will cities lead the way? *Clim Policy*. 3(4):359–372.
- Krause RM. 2011. Policy innovation, intergovernmental relations, and the adoption of climate protection initiatives by U.S. cities. *J Urban Aff*. 33(1):45–60.
- Lama-Rewal ST, Ruet J, editors. 2009. Governing India's metropolises. London: Routledge.
- Lele S. 2012. Climate change and the Indian environmental movement. In: Dubash NK, editor. Handbook of climate change and India: development, politics, and governance. Abingdon: Earthscan; p. 208–217.
- McKinsey Global Institute. MGI_India's_urban_awakening: building inclusive cities, sustaining economic growth [Internet]. 2010. McKinsey & Company; [cited 2015 May 11].
- Dezember MM. 2008. India: emerging leadership on climate change: an overview concerning India's domestic laws, and the instruments and measures of climate change mitigation. Washington (DC): Heinrich Böll Foundation.

- [MOEJ] Ministry of the Environment Japan. 2008. The co-benefits approach for GHG emission reduction projects. Tokyo; [cited 2015 Dec 28]. Available from: <https://www.env.go.jp/en/earth/ets/icbaghserp081127.pdf>
- Mukhopadhyay P, Revi A. 2012. Climate change and urbanization in India. In: Dubash NK, editor. A handbook of climate change and India Development, politics, and governance. Abingdon: Earthscan. p. 303–316.
- OECD. 2003. The forgotten benefits of climate change mitigation: innovation, technological leapfrogging [Internet]. Working Party on Global and Structural Policies; [cited 2015 Jun 26]. Available from: <http://www.oecd.org/env/cc/19524534.pdf>
- OECD. 2010. Cities and climate change. Paris: OECD Publishing.
- OECD, Bloomberg Philanthropies. 2014. Cities and climate change: policy perspectives [Internet]. OECD Publishing; [cited 2015 Jun 26]. Available from: <http://www.oecd.org/env/cc/Cities-and-climate-change-2014-Policy-Perspectives-Final-web.pdf>
- Parikh S. 2014. India: from political federalism and fiscal centralization to greater subnational autonomy. In: Halberstam D, Reimann M, editors. Federalism and legal unification: a comparative empirical investigation of twenty systems. Dordrecht: Springer Netherlands. p. 255–265.
- Pulver S. 2012. Corporate responses to climate change. In: Dubash NK, editor. Handbook of climate change and India Development, politics, and governance. Abingdon: Earthscan; p. 254–265.
- Puppim de Oliveira JA. 2013. Learning how to align climate, environmental and development objectives in cities: lessons from the implementation of climate co-benefits initiatives in urban Asia. *J Clean Prod.* 58:7–14.
- Puppim de Oliveira JA, Doll C.N., Suwa A. 2013a. Urban development with climate co-benefits: aligning climate, environmental and other development goals in cities. Tokyo: United Nations University, UNU-IAS Policy Report.
- Rabe BG, Roman M, Dobelis AN. 2006. State competition as a source driving climate change mitigation. *N.Y.U. Environ Law J.* 14:1–53.
- Rajamani L. 2007. Public interest environmental litigation in india: exploring issues of access, participation, equity, effectiveness and sustainability. *J Environ Law.* 19(3):293–321.
- Rao G, Bird R. 2014. Governance and fiscal federalism. In: Ahluwalia IJ, Kanbur R, Mohanty PK, editors. *Urbanisation in India: challenges, opportunities and the way forward.* 1st ed. New Delhi: Sage India. p. 203–230.
- Revi A. 2008. Climate change risk: an adaptation and mitigation agenda for Indian cities. *Environ Urban.* 20(1):207–229.
- Ruet J. 2009. Thinking the Delhi, Hyderabad, Kolkata, and Mumbai experience: emerging modes of urban governance and state intervention. In: Ruet J, Twa Lama-Rewal S, editors. *Governing India's metropolises.* London: Routledge. p. 270–303.
- Ruet J, Twa Lama-Rewal S, editors. 2009. *Governing India's metropolises.* London: Routledge.
- Schreurs MA. 2008. From the bottom up local and subnational climate change politics. *J Environ Dev.* 17(4):343–355.
- Schreurs MA. 2009. Multi-level governance and global climate change in east Asia. *Asian Econ Policy Rev.* 5:88–105.
- Sharma D, Tomar S. 2010. Mainstreaming climate change adaptation in Indian cities. *Environ Urban.* 22(2):451–465.
- Shaw R, Chakrabarti PGD, Gupta M. 2010: India city profile climate and disaster resilience: selected examples; consultation report. Geneva: International Strategy for Disaster Reduction.
- Thaker J, Leiserowitz A. 2014. Shifting discourses of climate change in India. *Clim Change.* 123(2): 107–119.
- United Nations, Department of Economic and Social Affairs, Population Division. 2014. World urbanization prospects: The 2014 revision, Highlights (ST/ESA/SER.A/352); [cited 2015 Dec 28]. Available from: <http://esa.un.org/unpd/wup/highlights/wup2014-highlights.pdf>
- [UNEP] United Nations Environment Programme. 2015. Centre on energy, climate, and sustainable development. CDM Projects by Host Region. Available from: <http://www.cdmpipeline.org/cdm-projects-region.htm>

World Bank. 2015. GDP Growth. Annual (%). Available from: <http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>

Qi Y, Ma L, Zhang H, Li H. 2008. Translating a global issue into local priority: China's local government response to climate change. *J Environ Dev.* 17(4):379–400.

Yeo S, Evans S. 2015. Analysis: India's climate pledge suggests significant emissions growth up to 2030. *Carbon Brief*; [cited 2015 Dec 28]. Available from: <http://www.carbonbrief.org/indias-indc>