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India and Climate Change: Evolving Ideas and Increasing Policy Engagement

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Abstract

India is a significant player in climate policy and politics. It has been vocal in international climate negotiations, but its role in these negotiations has changed over time. In an interactive relationship between domestic policy and international positions, India has increasingly become a testing ground for policies that internalize climate considerations into development. This article critically reviews the arc of climate policy and politics in India over time. It begins by examining changes in knowledge and ideas around climate change in India, particularly in the areas of ethics, climate impacts, India's energy transition, linkages with sustainability, and sequestration. The next section examines changes in politics, policy, and governance at both international and national scales. The article argues that shifts in ideas and knowledge of impacts, costs, and benefits of climate action and shifts in the global context are reflected and refracted through discourses in India's domestic and international policies.

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1. INTRODUCTION

India is a significant player in climate policy and politics. As a large low-income developing country, India houses a substantial share of the world's population that is vulnerable to climate impacts. As a fast-growing emerging economy, India plays a dual role with regard to emissions—as a minor contributor to past emissions, but a significant contributor to future emissions, albeit not on a per capita basis. In international negotiations, India has played an agenda-setting role on key concepts and ideas in the early years, and has gradually adopted a more elastic approach to the climate regime, although one that has been hotly debated internally. And as India has gradually internalized climate considerations in its domestic policies, it has become a testing ground for policies that seek to integrate climate considerations into development.

This article critically reviews the literature that describes the arc of climate policy and politics in India. The review is organized around two interlinked categories: (a) changes in knowledge and ideas around climate change, as well as (b) shifts in politics, policy and governance, both international and national.

2. CHANGES IN KNOWLEDGE AND IDEAS

When climate change emerged as a global concern in the 1990s, the issue was framed as a diplomatic problem for India, underpinned by a narrative around climate ethics rooted in India's minimal role in causing the accumulation of greenhouse gases (GHGs). This remains a strong theme, but this understanding has, over time, been complemented (but not replaced) by additional perspectives as knowledge and ideas around climate change have developed. These shifts are most notable around ethics, understandings of climate impacts, linkages to Indian debates around energy transition, linkages to broader ideas of sustainability, and implications of carbon sequestration for India's debates on forest policy, each of which are discussed further below.

2.1. Ethics

For more than two decades, climate change discussions in India have been inseparable from questions around ethics and conceptions of climate justice. In its early interventions in climate

negotiations, India argued that the cause of climate change is rooted in “*excessive levels of per capita emissions*” (1; emphasis in original) for which developed countries bore responsibility. An influential early nongovernmental framing by the research and advocacy organization Centre for Science and Environment (CSE) similarly placed responsibility for accumulation of GHGs on developed countries (2). CSE held that climate change is a problem of managing a global commons, as part of a critique of a study by a global research organization that, they suggested, inappropriately skewed the basis on which responsibility for climate change was allocated. They further argued that the developed world should be largely responsible for addressing the problem, because developed countries had far higher levels of historical emissions and had used up their share of the commons, which should be allotted to countries on a per capita basis.

This line of argumentation has shaped India’s climate position both internationally and domestically. Internationally, the focus on climate equity directly informs India’s longstanding emphasis in climate negotiations on the principle of “common but differentiated responsibility and respective capabilities” as the legal operationalization of climate equity (3, 4). Domestically, due to the centrality of equity, climate change has been constructed as predominantly a diplomatic issue, the goal being to ensure that developed countries take the lead in responding, with limited discussion of climate change as a salient factor in domestic development (5). In this narrative, although India should act on cleaning up its own environment, it should focus on domestic environmental compunctions rather than prioritize climate change under global pressure to do so. The slow dissolution of this wedge between climate change as a diplomatic versus a developmental issue best characterizes India’s changing role in global climate discussions. Below, we discuss three aspects of this shift, around the politics of metrics, reformulations of responsibility, and a growing awareness of India’s climate vulnerability.

First, the CSE report kicked off a two-decade-long struggle over the appropriate metrics for allocating climate responsibility—later labeled the burden-sharing debate (6). The choice of metrics was deeply political as it implied different responsibilities for the climate change problem and therefore for mitigation action and related financial contributions. As mentioned above, CSE’s initial framing focused on a per capita allocation of the commons—understood as the biosphere’s capacity to absorb GHGs—and therefore responsibility lay with countries that had emitted, over time, emissions in excess of the Earth’s absorptive capacity (2). In the intervening period, several other proposals for allocating responsibility have been put forward by governments and researchers, including the idea that countries should “contract and converge” in terms of per capita emissions, hybrid approaches that take into account countries’ capacity to address the problem, efforts to take into account basic needs of the poorest within countries rather than an allocation across countries, and efforts to frame allocation questions in terms of the stock of “carbon space” over time (6, 7). Although there are differences in outcomes across these approaches, India tends to be on the low end of the spectrum of responsibility allocation across a range of benchmarks because of its relatively low annual emissions over time and therefore historical emissions, and its low per capita emissions (**Figure 1**). Nonetheless, because India’s absolute emissions are growing rapidly, the country has increasingly been in the political spotlight at the United Nations Framework Convention on Climate Change (UNFCCC) negotiations.

In this context, two specific proposals are worth discussing further. In 2007, with climate change climbing up the geopolitical agenda, the then Prime Minister announced that India’s per capita emissions would never exceed those of developed countries (9, 10). This statement was significant, in that it reinforced a per capita metric, but entertained the idea of limits for India relative to other countries. Another significant proposal was introduced as India’s contribution to a collective research effort among the BASIC (Brazil, South Africa, India, and China) countries, which lent it some political heft. The proposal called for countries to be allotted a carbon budget

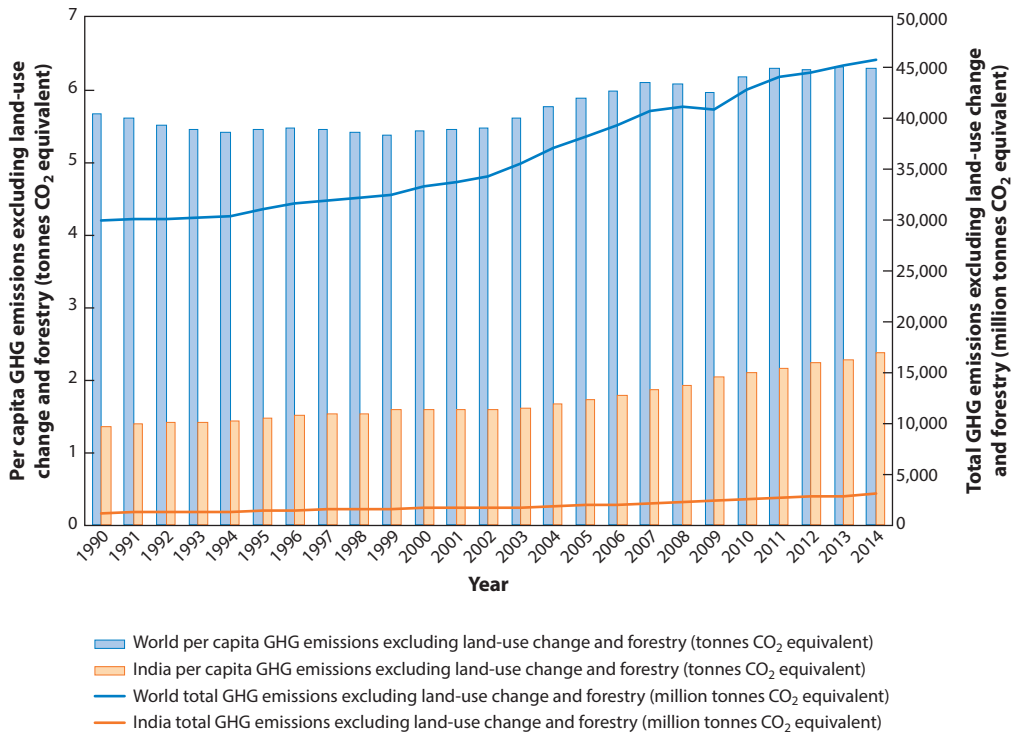


Figure 1

Total and per capita GHG emissions (excluding land-use change and forestry)—India compared with world average (1990–2014). Data from Reference 8.

based on a per capita allocation of a scientifically determined global carbon budget, using an optimization model that forces more rapid reduction by countries that have exceeded their budget (11, 12). Interestingly, the four BASIC countries produced somewhat divergent proposals. As these examples suggest, India has a track record of playing an active role in a metrics-based debate around climate equity, albeit one that seems as far from global closure two decades later as when the discussion began in the early 1990s.

Second, the notion that the concept of climate equity could be reduced only to disparities between countries in the global North and global South began to be challenged and complicated. In a resonant, if controversial, intervention, Greenpeace India asked if India was “hiding behind the poor” in seeking to stave off constraints on its emissions (13). The charge was that the high emissions of India’s growing wealthy population were camouflaged by the very low emissions of India’s poor, and that notions of equity should more properly include intracountry equity. The report directly challenged the firewall between international and domestic climate policy. For example, the importance of intracountry equity was also the basis of a critique of India’s carbon budget allocation proposal, which was issued as part of a joint publication by the BASIC group of countries (14). The debate was rife with methodological issues, such as the accuracy of the data on Indian consumption and alternative ways of estimating the relationship between consumption and emissions (15). However, the larger political question, on the salience of internal distributive questions to climate politics, had been made firmly.

Subsequently, a broader set of understandings of climate equity was increasingly articulated in the Indian discourse. Thus, the well-known journalist Bidwai argued that the Indian equity discussion overemphasized disparities between nations, that a North–South axis could not form the exclusive basis for discussions on climate equity, and that attention to intracountry equity questioned the validity of the Indian per capita position (16, 17). Another perspective held that an appropriate response to the hiding-behind-the-poor argument was to recalibrate the Indian debate from a focus on emissions allocation to the use of those emissions to meet the development needs of India’s poor (18). However, others focused on a “subaltern” view on climate change that called for learning lessons from the resilience practices of India’s poor, rather than trying to replicate the lifestyle of the rich (19). In a similar vein, a focus on community experiences of climate change, as articulated in public hearings held by a nongovernmental network, exposed a different aspect of India’s climate discourse, one removed from the stark binaries of the per capita North–South formulation (20).

An emergent theme in the literature was, therefore, a growing concern with the plight of the climate-vulnerable in India (5, 16, 21). Greater governmental attention to documenting potential climate impacts (22), and the growing availability of information on impacts (discussed in the next section), provided a burgeoning information base. Thus, despite the inequities of northern occupation of the carbon space, protecting India’s poor from climate impacts required India to also take seriously low-carbon measures and adaptation responses (21). That this perspective was seeping into the government is evidenced by a decision in 2009 to undertake state-level action plans on climate change, largely focused on adaptation concerns (23) (see Section 3.3, Domestic Policy and Governance). Ultimately, a somewhat unitary focus on North–South equity concerns shifted to a role for climate concerns—both mitigation and adaptation—albeit embedded within what Lele describes as an Indian tradition of broad-based environmentalism (24; see also Section 2.4, Sustainability).

2.2. Science and Analysis of Climate Change Impacts

An important, steady driver of shifts in Indian climate policy and governance has been growing awareness and scientific information about the nature and likely impacts of climate change. This section first summarizes the state of knowledge about climate change science and impacts in India. Next, it critically reviews the evolution of this field and identifies gaps in the literature. Finally, it assesses the influence of this knowledge on India’s international negotiating position and domestic policy.

Climate projections for India are based on regional climate models that are robust at predicting temperature change but are poor at simulating monsoon precipitation (25, 26). The monsoon continues to be significant for the Indian economy, with GDP dropping by 2–5% during drought years (27). But there is uncertainty over whether the monsoon will strengthen or weaken under the combined influence of long-term GHGs and short-lived pollutants (26). Extreme temperature and rainfall events are on the rise and likely to increase in the future (22, 28–30). Although attributing a specific extreme event to climate change is problematic, recent studies reckon that climate change had raised the likelihood of the June 2013 flooding in North India and increased rainfall by 60–90% (31, 32). However, the increase in tropical cyclone damage in Andhra Pradesh is due to economic and demographic factors rather than an actual increase in cyclone frequency or intensity (33).

A contentious scientific topic is the regional climate effect of black carbon from burning biomass, coal, and diesel in India. Although global studies have argued that black carbon is the second strongest contributor to global warming after carbon dioxide, Indian scientists have countered that ascertaining the precise contribution of black carbon on monsoon and agriculture is difficult,

and that the so-called Asian brown cloud deflects attention from the GHG emissions of developed countries (34). Undoubtedly, the air quality and health co-benefits of clean energy are worthwhile (35, 36), and India's Nationally Determined Contribution (NDC) talks about promoting LPG and cutting diesel subsidies, which will ameliorate black carbon impacts (37).

Himalayan glacier melt was a subject of controversy in the Intergovernmental Panel on Climate Change's (IPCC's) Fourth Assessment Report. Glaciers in the central and eastern Himalayas (although not the Karakoram) depend on summer monsoon snowfall and are sensitive to temperature rise. Models suggest substantial mass loss for these glaciers but not complete disappearance by the end of this century (38). Future trends in glacier retreat and downstream runoff, however, are hard to predict due to the paucity of onsite measurements and adequate time series data from satellite observations. In the Ganges basin, the contribution of snow and glacier melt to downstream water availability is only 10% on average, but 40% in the dry season (39). Future runoff in such watersheds is projected to increase but varies across precipitation scenarios (40), which has implications for drinking water supply, irrigation, and hydroelectricity generation. There are wide variations in runoff projections for other monsoon-dependent river basins in peninsular India (41).

In agriculture, climate change is likely to reduce irrigated rice yields by 10–15% and wheat yields by 22% by the end of the twenty-first century (42, 43). Pulses, key to India's nutritional security, are also vulnerable to temperature rise. Horticultural crops will be affected as well: Apple production has declined due to rise in winter temperature in the Himalayas (41). Forest vegetation is projected to change in 31% of modeled forest grids across the country, and specifically in 56% of grids in the Himalayas (41). In human settlements, there could be adverse impacts due to extreme events, heat stress, and climate-related diseases. Coastal areas are experiencing sea-level rise of approximately 1.3 mm per year on average (22, 44). Diarrhea incidence in North India is projected to rise by 13% by the 2040s (45), and the malaria transmission window is expected to expand in the North and Northeast (46).

The above literature constitutes a relatively linear approach to assessing physical impacts. Over the past two decades, climate impact and adaptation research in India has evolved toward a more nuanced exploration of human vulnerability, manifested differentially at the local scale in the context of multiple developmental challenges. There is growing acknowledgment that climate change is one of many stressors (along with economic globalization, urbanization, and migration) that affect all sectors (such as forests, water, agriculture, or fisheries). Moreover, climate adaptation is one of multiple and simultaneous concerns that face Indian citizens and policymakers. Consequently, one approach is to embed climate impacts in a multiple stressor and multiple objective framing (47).

One of the first studies to operationalize a methodology for the multiple-stressor approach combined mapping of indicators (of exposure, biophysical vulnerability, and socioeconomic adaptive capacity) and place-based case studies (48). This vulnerability mapping has been frequently used in research and state action plans to identify vulnerability “hotspots” and target adaptation interventions. It, however, produces static pictures of vulnerability rather than dynamic analyses of complex socio-ecological systems subject to multiple drivers. Moreover, case studies that nest local vulnerability within larger processes operating at global or regional scales are useful to identify the vulnerable and the factors that make them so, but their policy insights need not be generalizable. The involvement of affected communities is often restricted to providing data, and there are only a few examples of transdisciplinary research that shares science with affected communities as an opportunity for mutual learning, participatory modeling, and collectively identifying and prioritizing adaptation options (49–51). Although hydrological modeling is often devoid of sufficient ground realities of pre-existing human interventions and trends, a recent study provides a novel integrated approach to quantitatively model such interactions in rapidly urbanizing watersheds

(47). Finally, there is a need for transboundary assessments of river runoff and flood risk despite geopolitical conflicts and lack of data sharing.

In the context of international negotiations, it has been argued that a North–South gap in climate science and India’s limited engagement with the IPCC process initially weakened the country’s negotiating position (52, 53). Over time, however, climate science and impacts research have strengthened the country’s ethics-based negotiating position that those who contribute the least are the most at risk. The UNFCCC Conference of Parties (COP) 6 hosted by India in 2002 was dubbed the adaptation COP and adopted a Delhi Declaration on Climate Change and Sustainable Development (<http://unfccc.int/resource/docs/cop8/07a01.pdf>). The conceptualization of vulnerability as determined by underlying socioeconomic, ecological, and governance factors has implications for legal liability and loss and damage on the one hand, but on the other hand calls for policies that focus less on technical measures and more on social aspects, such as poverty reduction, livelihood diversification, protection of common property resources, and strengthening of collective action. This is reflected in India’s NDC, which claims that India spent 2.82% of its GDP on adaptation in 2009–2010, including “poverty alleviation, health improvement and disease control and risk management,” illustrating the blurred boundaries between adaptation and development in developing countries (37). Accordingly, the NDC identifies the need for adaptation finance of US\$ 206 billion (at 2014–2015 prices) between 2015 and 2030.

Domestically, growing analysis of climate change impacts and greater attention to climate prediction have improved awareness among policymakers and the public about the stakes to India of climate change. Strengthening climate change research capacity in the country has become a priority. The Ministry of Earth Sciences, created in 2006, is mandated to improving forecasting efforts. The Indian Institute of Tropical Meteorology recently developed the first Indian climate model to contribute to the IPCC (54). The Indian Network for Climate Change Assessment (INCCA) was created by the Government of India in 2010 as a network of 125 scientific institutions (22, 55)—partly to formalize the teams that worked on the first National Communication and partly as a domestic counterpart to the IPCC after the Himalayan glacier controversy. It published an assessment of four sectors (agriculture, water resources, ecosystems and biodiversity, and human health) in four “hotspots”—the Himalayas, Western Ghats, coastal areas, and the Northeast. The INCCA process, however, is a loose network of sectorally isolated studies, without much interdisciplinary research. Some sectors and issues are less well studied, e.g., fisheries, biodiversity, migration, energy, and regional projections of sea-level rise.

These assessments have strengthened the scientific base for domestic policy making, including within the various national missions and the various state action plans on climate change (see Section 3.3, Domestic Policy and Governance), but some challenges remain. First is the issue of scale: Adaptation measures are planned and implemented at administrative scales such as state and district, which do not correspond to relevant physical boundaries such as catchment or agroecological zone (56, 57).

Second, the uncertainties inherent in climate models, particularly when downscaled for administrative areas, are rarely acknowledged in state action plans, and there is scant capacity to act on probabilistic forecasts. Ahmedabad city’s heat action plan is an uncommon attempt to design an early warning system based on probabilistic forecasts (58).

Third, as rapidly growing Indian cities concentrate people and assets in risky locations, urban resilience has become a topic of great interest, particularly in the aftermath of flooding in the megacities of Mumbai, Chennai, and Bengaluru. But very little power is vested with urban governments (59); urban spatial planning does not integrate climate change risks (60), and siloed institutions prevent the operationalization of an adaptive governance approach that responds to underlying socio-ecological dynamics (61).

Finally, although adaptation is often examined in terms of concrete technical adaptation measures, in practice it often requires grappling with the pattern of development itself, which requires a systems approach to adaptation challenges. For instance, although concern over damaging extreme events (such as hailstorms, flash floods, cloudbursts, and lightning strikes) has brought greater attention to early warning systems and mobile-based climate services, disaster risk reduction may require rethinking development decisions that shape vulnerabilities in cities, coastal areas, and mountains. In agriculture, crop simulation models suggest adopting new cultivars and modifying agricultural practices (62). But in adopting these, small and marginal farmers are constrained by the lack of timely credit, labor, irrigation, seeds, market access, insurance, and by the high cost of cultivation (63). To address these challenges requires systems thinking in policy, such as by recognition of the water-energy-food nexus, incentivizing varieties such as millets that are robust to climate impacts, and ensuring that varieties ill-suited to local contexts—such as rice cultivation in semiarid zones—are avoided. In addition to scientific knowledge and technical interventions, India's larger development choices need to internalize the intertwined nature of climate and other social and environmental risks.

2.3. Energy Transitions

Energy, which accounts for 69% of India's GHG emissions, is a particularly salient dimension of India's development choices from a climate perspective (63). That India's energy and economic situation is fast changing is indisputable. Between 2006 and 2016, the country's annual primary energy consumption almost doubled, from 414 Million Tons of Oil Equivalent (MTOE) to 724 MTOE, bringing tangible declines in poverty levels (64, 65). However, 400 million people still lack access to electricity, and average per capita consumption remains well below global levels (64). Additional energy use is thereby necessary for India's development, which has traditionally been met by fossil fuels, and more recently with increasing renewable-based power. In this section, we describe India's ongoing energy transition and reflect on the analytical base and challenges of identifying development pathways that balance India's energy needs with their GHG implications.

Tackling energy concerns has long been at the heart of India's development planning. In the early 2000s, the country's energy needs grew significantly as the economy liberalized but was also laden with a domestic narrative of limited energy resources. Concerns over energy security and the subsequent constraints to growth led to the formation of the Integrated Energy Policy (IEP) in 2006. The IEP presented different scenarios for India to maintain its energy supply, particularly in response to the previously overstated assumptions about the availability of domestic coal (66). Energy security has remained central to India's policy discourse since, with a discussion of climate change gaining ground from 2007, as India began engaging with issues of global energy governance. India's early position at the international climate arena emphasized its energy and development priorities. But this position increasingly came under pressure, necessitating explicit analytical links between India's energy security concerns and their global climate implications (67). The urgency to develop robust analytical projections to assist policy making has been reiterated through the years, especially in the lead up to the 2009 Copenhagen Summit, during the preparation of the official Low Carbon Strategies for Inclusive Growth (LCSIG) report in 2009–2014, and while formulating India's nationally determined climate contribution for the 2015 Paris Agreement (37, 68, 69).

The task of projecting future development pathways with different technology choices has been undertaken by various researchers since 2006. These studies can be broadly categorized by their differences in methodology and model types, national or global origins, and objectives and assumptions. From a methodological standpoint, studies project future scenarios based on

different model types. The linkages between technology choices and the macroeconomy are examined by studies using top-down general equilibrium models, such as the government's LCSIG study (69, 70). Bottom-up studies, on the other hand, are more technology detailed and suitable to examining energy subsectors (64, 71–75). Projections from Integrated Assessment Models reflect on future technology choices based on system-wide assessments of physical and socio-economic variables, and their interactions between sectors (76, 77). In terms of study origins and scope, the analysis can be at either the national or global level. National studies enable focus on national energy systems and domestic political objectives (69, 70, 72, 73, 78). Global studies, with India- or South-Asia-specific projections, enable multi-country and regional comparisons, with mitigation potentials usually based on global-scale carbon price or burden sharing optimizations (79–82). A third categorization of the different modeling studies is centered on their framing, which guides scenario construction. Some studies are framed primarily around development futures such as the direct provision of services to the poor, generating jobs through manufacturing, providing full energy access, maintaining high GDP rates, among others, from which energy implications are indirectly derived (64, 69, 73). Others are more conventionally focused on carbon-related outcomes such as decarbonization, low-carbon policies, energy security, and clean energy (72, 74, 76).

Even as the number of studies on India grows, using them to understand the balance between India's energy needs and its low-carbon transition is difficult. The pace, scale, and scope of India's socio-economic transitions, along with the rapidly changing energy technology opportunities, make credible modeling and projection efforts a challenge. Part of the challenge is the uncertainties around yet-to-be chosen patterns of infrastructure and energy production, which will lock in long-term consumption patterns. At present, it is unclear which techno-social choices will determine electricity provision to 300 million people and clean cooking fuels to 800 million, or meet the large employment needs in a fast-urbanizing context (79, 83, 84). This uncertainty, in turn, has led to studies using disparate macroeconomic assumptions, often with different baselines about current policies. Interpreting future Indian energy trends and their associated GHG emissions is thereby difficult. A synthesis of recent modeling studies finds that India's 2030 CO₂ projections range from a 9% to a 169% increase from 2012 levels (85). In addition to varying projections of energy use and emissions, the swiftly changing domestic context makes climate mitigation costs difficult to estimate (69, 78). The government's assessment, based on India's Paris pledge, puts a price tag of \$2.5 trillion (2014–2015 prices) on implementing by 2030 the measures in the pledge; however, it does not provide much clarity on the analytical basis for this estimation (37).

Although the results of analysis remain murky, empirically, there are two trends that are guiding the likely future of India's energy sector. First, successive governments have signaled a strong policy direction in favor of accelerated renewable energy adoption, which is reflected in falling renewable energy prices between 2014 and 2017. A target of 20 Gigawatts (GW) of renewable energy by 2022 set in 2010 as part of the National Solar Mission, was subsequently enhanced 175 GW by 2022 (86). Moreover, since 2010, India has had in place a cess (an earmarked tax) on coal, although it was recently repealed as part of a broad tax reform. In its Paris NDC pledge, India packaged these into a larger statement that by 2030, 40% of India's electricity generation capacity would be based on fossil-fuel-free sources (37), which, as analysts have noted, are likely to be well exceeded if the 2022 pledges are met (87). The marketplace responded with dramatically dropping renewable energy generation prices for wind and solar, with the cost of solar electricity plummeting from 17.91 INR/KWh (0.356 USD/kWh in 2010) to 2.44 INR/KWh (0.038 USD/kWh) in 2017 (88, 89). Renewable energy capacity addition in 2016–2017 almost matched that year's addition from thermal power (89), stemming from well-structured reverse auctions (90, 91). Although some studies raise questions about the sustainability of these low prices, risks from overaggressive bids

(92, 93), and grid-integration challenges (89, 94), the renewables price trend is firmly in the direction of cost competitiveness with coal-based electricity.

A second trend, related to falling renewable energy costs, is the diminishing interest in coal from the government and private sector. The recent draft National Electricity Plan and other complementary studies estimate lower thermal power requirements than the government's 2015 pronouncement of 1.5 BT of coal by 2019 (95–97). The declining attractiveness of coal investments is also a function of recent low-coal plant load factors, stranded coal assets in 2016–2017, and unrest over their environmental impacts (84, 98). A further reason for potentially lower future coal use is the lower than previously expected growth in electricity demand. The Government's Electric Power Survey lowered its projection of India's electricity generation needs in 2026–2027 by 24.4%, from 2,710 TWh in its 2012 edition to 2,047 TWh in the 2017 edition (99). Although the magnitude of future demand has yet to be shaped, it is likely that the adoption of efficiency measures and off-grid electricity will result in lower actual demand than studies project (100, 101).

In sum, India's energy future is significant for global climate mitigation, but India's development transitions make it analytically difficult to have clarity on its likely energy, and consequently emissions, trajectory. Projections vary from India's growth path being fueled by large amounts of carbon-intensive coal (64, 84, 102), or alternatively, India making large strides in renewable energy toward a lower-carbon future than business-as-usual (BAU) (103); however, in all cases the per capita carbon projections for India remain well below global averages (85). As the literature increasingly suggests, it is likely that the eventual destination of India's energy sector will be determined by development choices that the country makes, which will have implications for future electricity demand and the pace of the transition from coal to renewables.

2.4. Sustainability

An area on which energy modeling studies are relatively silent is the overlap—the synergies or trade-offs—between alternative energy choices and the environmental sustainability of India's development path. More specifically, the implications of alternative energy choices for local environmental outcomes concerning air quality, land use, water use, and biodiversity, as well as for social sustainability, including provision of livelihoods, housing and migration, and income distribution, are an emergent research agenda. This agenda carries political implications, since the political cost of mitigation is reduced if there are substantial socio-environmental and economic co-benefits, and conversely co-costs imply reduced acceptance of these actions. In this section, we discuss the gradual mainstreaming of the co-benefits or multiple-objectives approach in India's environmental discourse, and summarize the evidence on synergies and trade-offs between socio-environmental outcomes and climate-friendly development actions. This trend is aligned with the international context, particularly the new Sustainable Development Goals (SDGs), which, also, focus on the interrelatedness of economic development, well-being, social justice, and the local and global environment and well-being.

Traditionally, the linking of development priorities with socio-environmental considerations has not been the norm in India policy making, and particularly not with climate change, which acts as a threat multiplier to sustainability risks. At the same time, the Indian National Action Plan on Climate Change, formally at least, calls for a co-benefits approach where the linkages with development and the environment are explicitly considered (68). The approach also features prominently in the country's Twelfth Five Year Plan and LCSIG report (69). Conceptually, the approach is useful to India's stance on climate change, as it emphasizes the complementarities between low-carbon development and socio-environmental goals. For example, public transport and energy efficiency are likely to bring gains for urban liveability and local air pollution, thereby serving

multiple economic, environmental, and social objectives simultaneously. From a climate change standpoint, these actions enable India to not compromise on development goals and yet also make a global climate mitigation contribution. However, following this approach requires understanding the trade-offs and synergies between these different objectives, and especially between GHG reduction and regional or local environmental concerns. So far, analysis that accounts for these interactions, and informs political choices, is rather limited and for the most part, the rhetoric has been one of “win-wins.”

Although global models provide strong evidence of substantial complementarities between climate mitigation and reduced air pollution for the South Asia region (104), Indian studies have traditionally paid only partial attention to such linkages. Furthermore, the literature on how to implement multiple objective-based development policies is thin (105), with the exception of a few sector- and state-specific studies (106). More recently, however, there is acknowledgment that decisions regarding India’s transitions in urbanization, demography, and infrastructure are salient to the long-term fate of important local priorities—such as air quality and public health, livelihood opportunities, food, and nutrition patterns. A growing research base is beginning to examine how these locally relevant socio-environmental dimensions of energy and low-carbon decisions interact.

The literature on the synergies across India’s multiple development objectives is mainly in the areas of low-carbon urban development, clean cooking fuels, and renewable energy investments. In particular, urban co-benefits are found when climate mitigation initiatives are embedded at the local level, across the key urban sectors of waste management, transport, buildings, and industry (107). Mitigation options from low-carbon urban development are found to offer significant social benefits in public health (108), and urban green spaces are suggested as a cost-effective measure for climate adaptation, with benefits for urban biodiversity, disaster risk management, and ecosystem services (109).

In analyses of sustainable low-carbon transport, the co-benefits of improved air quality and energy security are found to be high (110), with nonmotorized transport resulting in better urban public health (111). Studies that examine the move toward clean cooking find gains in health and welfare for the vulnerable sections of society (112). The transition from solid fuels to LPG cooking is further found to reduce pressures on forests and achieve modest climate benefits, although with uncertainties regarding the extent of nonrenewable biomass harvesting (113). Studies that consider the impact on livelihoods show that renewable energy technologies provide green jobs along with a wider set of socioeconomic and environmental co-benefits (114). Livelihoods, food and water production, and rural development are also examined in the context of large-scale biofuel production (115, 116).

The evidence of potential trade-offs, however, is largely examined between renewable investments and biodiversity, the preservation of local forests versus grazing land use, and the local environmental and biodiversity impacts of coal plants (117). The literature includes trade-offs (and synergies) between solar energy and the impacts on agricultural land and water resources, with ways to maximize the efficiency of land and water use (118). Other studies consider the trade-offs from integrating mitigation and adaptation strategies in agriculture and forestry (119), and the interdependence among the water, energy, and food nexus (120).

In the context of a changing climate, and the international policy discourse, there is a push to rethink the utility of conventional growth models and instead focus on the trade-offs and synergies across pressing simultaneous development goals (121, 122). The SDGs are important to this, as they promote a much broader conception of development and sustainability within which climate actions can also be framed, and which goes beyond increasing economic and technological growth. Institutionally, however, such an approach presents a more sophisticated, and potentially more

complicated, policy response that requires moving beyond traditional sectoral approaches toward greater policy coherence (see Section 3.3, Domestic Policy and Governance).

2.5. Sequestration

The forest sector has been an important part of India's position in climate change negotiations, particularly from a mitigation perspective. Unlike other forested tropical countries, however, where the challenge has been one of halting or slowing down deforestation, Indian negotiators and some scientists argued early on that there are no net carbon emissions from India's forests (123). Subsequent official estimates have claimed that Indian forests are in fact net sinks of carbon (124–126), and several analysts claim that they have the potential to sequester much more (127).

On this basis, India has pushed for an expansion of the REDD (Reducing Emissions from Deforestation and Degradation) program to a REDD+ program that rewards not just reductions in deforestation but also increases in sequestered carbon. With the adoption of REDD+ at the COP15 in Bali (128), the Indian government's actions focused on efforts toward "REDD-readiness" (129), in anticipation of large-scale international funding.¹ An important component requirement for REDD is reliable monitoring, reporting, and verification (MRV). The international negotiations only led to draft agreements on MRV processes by 2013 (131, p. 22); the Indian government claims to have a robust top-down forest-monitoring system (132) to build this on. Other studies have argued that community-based monitoring would be cheaper (133). However, hardly any REDD+ projects have actually gotten under way; only one in Meghalaya (134) garnered payments in the voluntary carbon market. At the same time, the push for REDD+ attracted much criticism for its inattention to ecological trade-offs with biodiversity and other forest ecosystem services and the likely adverse impacts on ongoing efforts to decentralize forest governance (129, 135).

Gradually, the policy emphasis appears to have shifted away from garnering external funds to using internal funds for sequestration (129). In its NDCs for the Paris COP21 agreement in 2015, India committed to sequester an additional 2.5 to 3 billion tonnes of CO₂eq in its forest sector by 2030 (136), probably on the basis of a massive USD 6 billion compensatory afforestation fund (CAMPA) that had accumulated (137). This sequestration pledge has been the subject of much public debate (137–139). Common to debates on this pledge and the earlier REDD+-related claims are three questions around which this section is organized: the accuracy of biophysical estimates on which sequestration is based, the trade-offs involved in undertaking sequestration, and questions of social and legal feasibility.

First, how accurate are the biophysical estimates on which claims of current net sequestration, and therefore the technical feasibility of the NDC, are based? There is a divergence between academic and official estimates of current rates of carbon sequestration in India's forest sector in recent years. Official estimates range from +68 MtCO₂eq/year in 2005–2007 (124) to +203 for year 2000 (125) and +200 for year 2010 (126). But some academic studies estimate net sequestration to be negative, from –185 MtCO₂/year in 2005–2007 (140) to –198 MtCO₂/year during 2005–2013 (141).² The reasons for this divergence may be several. First, there are differences in the definition of forest cover. Official estimates include all tree cover (including monocultural plantations in forest lands as well as horticultural crops in private lands), which results in a rising "forest cover" trend, and only natural tree cover shows a declining trend (141). Second, official estimates have

¹One official estimate was of USD 3 billion over three decades (130).

²The academic estimates exclude changes in soil carbon, but these are anyway estimated to be negative in official estimates, thus their inclusion would only increase the divergence.

given estimates of sequestration due to growth in forests that remained forests (FL-FL) and addition in carbon due to conversion of nonforest to forest (L-FL). But they appear not to measure the carbon emissions from forest-to-nonforest (FL-L) transitions, which are nonzero. Third, there is variation within official estimates themselves. The Forest Survey of India data show declining growing stock for most of 2003 to 2013, in spite of stable or increasing forest cover, but India's official national communications on climate change surprisingly show a positive trend in carbon stock (125, 126).

The ambitious pledge appears to be driven by the optimistic estimates of current net sequestration. Indeed, if India is already sequestering forest carbon at the rate of 200 MtCO₂eq/year, then it just needs to maintain this rate to meet the sequestration pledge of 2.5 GtCO₂eq over 15 years. However, if India's forests currently are net emitters due to ongoing degradation, then reversing that process and further meeting this target would require fast-growing monoculture plantations and draconian protection measures.

Second, what are the biophysical trade-offs involved in undertaking carbon sequestration on this scale? Monoculture plantations for carbon come with trade-offs. Conceptually, trade-offs between carbon sequestration, biodiversity conservation, hydrological regulation, and benefits in the form of timber and nontimber forest products are obvious (142, 143). Empirically, limited studies are available on the extent of these trade-offs for different socio-ecological contexts in India (see, e.g., 144, 145). However, that current forest cover estimates are really tree cover estimates that hide the decline in natural forests (and hence *inter alia* in biodiversity) has been repeatedly pointed out (146). Nevertheless, the Green Indian Mission (GIM), which is the key strategy for achieving the sequestration pledge, "does not entertain the possibility of tradeoffs" between "carbon and noncarbon benefits of forests, such as biodiversity" (129). Alternatively, if one assumes that carbon sequestration will only be taken up to the extent and in a manner that does not harm other forest use and nonuse benefits, then the projected net sequestration may be unrealistic.

Third, is it socially and legally feasible to meet this commitment; alternatively, what might be the social and governance consequences if the Indian state attempts to meet these commitments? Given the trade-offs between using forests for carbon sequestration versus harvesting forest products for local livelihoods, the question of what forests are for and who decides this becomes crucial. Forest governance, which deals with these questions, is currently in a state of flux in India (147), with the Joint Forest Management (JFM) program failing to engender meaningful participation even by official assessments (148). The Forest Rights Act (FRA) of 2006, a landmark legislation that offers communities the right to manage their forests, albeit implemented rather slowly (149), can potentially create more meaningful devolution of forest governance. The GIM plan and other official reports make assumptions of a smooth transition from JFM to FRA (150). But in reality, nonacceptance by the forest bureaucracy of the FRA-based devolution of rights (151) is leading to conflict between local communities and CAMPA-funded afforestation activities in many locations (<http://landconflictwatch.org/node/498/67/all/all/all/all>). Recentralization of governance is the most likely outcome if carbon-centric forestry is prioritized (129). Resolving the governance issue will be crucial to improving the synergies and reducing trade-offs between carbon sequestration, local livelihoods, and conservation, as well as for seeing lasting impacts on the ground.

In sum, the official Indian stance has consistently been that Indian forests are sequestering carbon and can sequester more. Some academic studies are beginning to question the biophysical basis of this claim, but no resolution has been reached. Similarly, critiques of the sequestration pledge for being carbon-centric and recentralizing forest governance have not been openly discussed. More open debate about sequestration estimates is certainly needed (152), but it needs to

be coupled with more interdisciplinary analyses of the socio-technical issues involved in positing forests as carbon sinks, so as to bring some convergence between different stakeholders in this sector.

3. SHIFTS IN POLITICS, POLICY, AND GOVERNANCE

The sum effect of the changes in ideas and knowledge described above was to complicate what began as a straightforward and compelling Indian narrative around climate change that limited its scope to being a diplomatic challenge alone. Introducing internal distributional questions as part of climate ethics and considering implications of climate science for Indian impacts forced exploration of climate change as part of India's development debate. The analytical challenges of understanding linkages between climate change and energy transition, forest carbon sequestration, and local environmental and social considerations have spawned an emergent literature on these themes.

In this section, we begin by exploring how the growing public debates on climate-development links were reflected in Indian political debates around climate change. This, in turn, led to shifts in official policies both in international positions and then in domestic policy at multiple levels of governance. As the discussion makes clear, these were by no means clearly separable, and, indeed, were often mutually reinforcing.

3.1. Politics

Over time, a more variegated Indian climate politics emerged from changes in ideas around ethics, new information and ideas around climate impacts, and the relationship between mitigation and sustainable development. Stylized descriptions of Indian climate politics at the time of the 2009 Copenhagen COP suggested three coexisting and contending perspectives: (a) growth-first realists who downplayed climate concerns as part of a geostrategic game, advocating stonewalling of international commitments; (b) sustainable-development-focused realists, who took climate change and local environmental concerns seriously, but were skeptical of a just international agreement based on the history of the equity debate; and (c) sustainable-development-focused internationalists who saw India's interests lying in stimulating-enhanced international cooperation on climate change, including through enhanced Indian action (5, 18, 153). In an example of the last category, Bidwai launched a detailed criticism of India's domestic energy policy and approach to negotiations. However, examples of all three strains were evident, including in rare Parliamentary debates before and after the Copenhagen negotiations, where themes of historic inequities, vulnerability, and co-benefits were all aired in a robust debate on the principles that should guide India's negotiating position (154).

Political diversity was mirrored by growing diversity in media representations in the English language press. Thus, news articles from 2002–2007 were summarized as reinforcing a “risk-responsibility divide” framed in postcolonial language (155). By 2009–2010, the narrative had broadened to include discussion of growing emissions from developing economies, discussion of the role of China, and some discussion of climate impacts even while narratives of North–South polarization remained powerful (156). Regrettably, more recent analysis is unavailable.

Notably, in a telling reminder of the failure to understand perceptions across a North–South divide, the persistence of these views in the Indian media were somewhat uncritically dismissed by some international interlocutors as “hackneyed and arguably unproductive” (157). More useful was an unpacking of perceptions of climate politics among Indian officials, which showed how categories of “north” and “south” are “discursively reproduced” through such reportage, but also

that important material conditions—limited resources, greater vulnerability, and data on relative levels of cumulative emissions—are harnessed to this process (158). The slow unwinding of this circle of reproduction, emerged through what Atteridge et al. (159) usefully describe as a “two-level game,” with domestic and international policy developments in India enabling shifts in the other, drawing on changing ideational and material shifts. Below, we discuss each, with attention to the interactions across both levels.

3.2. India in Global Climate Debates

India’s role in global climate debates has evolved over time, shaped by both shifting domestic understandings of climate change and a growing recognition of climate change as an important component of India’s foreign policy narrative and stance. However, there has also been a remarkable consistency to the country’s underlying approach to climate negotiations. This story of continuity and change is best understood through three periods: early years of negotiation, negotiating global pressures for greater developing country commitments around the Copenhagen negotiations of 2009, and the resolution at Paris in 2015. In addition, this section briefly touches on the negotiation processes outside the UNFCCC, on aviation, and on hydrofluorocarbons (HFCs), which have also assumed importance.

Building on this conceptual stance, India played an active role in the early days of the climate negotiations, working to shape the Framework Convention around its understanding of climate ethics. Central to this effort was the expansion of the idea of “common responsibilities” to address climate change, as articulated in the first IPCC report, to “common but differentiated” responsibilities (160). Moreover, India played a role in ensuring the negotiations took place under the auspices of the United Nations General Assembly, rather than a specialized agency, thereby ensuring that the numerical strength of developing countries and the principle of formal equality for all countries could be maintained (161). India further elaborated the notion of differentiated responsibility in the early days of the negotiations to ensure that any commitments by developing countries would depend on provision of finance and technology from wealthier countries that had greater responsibility for the problem (1, 4). As negotiations progressed toward formulation of the Kyoto Protocol, India was able to mobilize a larger coalition of developing countries—notably also including vulnerable small island states pressing for a legal protocol—around an approach centered on the idea of differentiated responsibility, placing primary obligation to take action on the developed world (160).

Having successfully enshrined differentiated responsibility as a key principle of climate negotiations, much of the subsequent two decades were spent defending this notion, and, on occasion, being forced into tactical withdrawals. During the 2000s, India and other developing countries were confronted with the question of whether and how, in a post-Kyoto phase of negotiations, they would take on greater obligations than they had under the first phase. In echoes of early conceptual battles over how responsibility was to be allocated, there was active discussion of whether the stock of emissions contributed by each country was salient, which would prioritize the past, or the flow of annual emissions would be the main metric, which would place developing countries’ present and future emissions under scrutiny (4).

This was also a period when India was increasingly invited to the high table of global politics and began feeling pressure to demonstrate responsible engagement. Thus, in 2007, then Prime Minister Manmohan Singh pledged at a G8+5 meeting in Heiligendamm that India’s per capita emissions would never exceed the average of developed country per capita emissions (4). Although this pledge was not meaningful in practical terms, it did open the door a crack to some form of obligation by India. In 2009, at a meeting of the Major Economies Forum at L’Aquila, India signed

a joint statement committing to a two-degree warming target. This process culminated in 2009, with India's pledge at the Copenhagen meeting that the emissions intensity (or emissions per unit GDP) would decrease from 20% to 25% below 2005 levels by 2020.

This period also saw considerable domestic ferment on climate policy, as the next section discusses in more detail. This shift from a dogged posture of domestic insulation from climate concerns to more active domestic engagement could potentially be explained as the result of the political class partially displacing what had been largely bureaucratic control over India's agenda as the issue moved up the global political ladder (159). Certainly, India took several domestic steps that signaled seriousness in intent on addressing climate change in the late 2000s, notably formulating a National Action Plan on Climate Change in 2008 with several associated National Missions (68).

Several commentators noted the moment around and after the 2009 Copenhagen climate talks as a moment of transition in Indian climate policy, despite considerable continuity with past positions. Although some emphasized the former, highlighting a shift toward an internationalist stance and one imbued with greater flexibility and "value-creating elements" (153, 162), others were more cautious, emphasizing the substantial role of personality politics in the form of the then Minister of Environment and Forests, and the persistence of longstanding narratives around equity and differentiated responsibility (5). This shift, whether understood as lasting and substantial, or indicative and rather more contingent, has been explained as the result of a series of factors: growing awareness of climate impacts and vulnerability (5, 162), the growing appreciation of potential co-benefits of climate mitigation action, particularly in a context of scarce domestic energy (5, 159, 162), and a heightened concern with geopolitical perceptions of India's role in global cooperation (4, 5, 159). Others argue that India's change goes beyond shifts in strategy to forge a new climate "identity" shaped by a composite of India's development concerns, geopolitical aspiration, a desire to present an alternative to a dominant "Northern" perspective, and a struggle to deal with resource constraints (163).

India's negotiation alliances also shifted during this period. Although India had historically worked to hold together the G-77 + China as a large negotiating bloc of all developing countries, from the Copenhagen negotiations of 2009 and beyond India operated more closely as part of the BASIC group of large emerging economies most under pressure to take on additional obligations (4, 10). The emergence of this bloc has created a powerful new political force in climate negotiations. But the stresses of keeping the alliance together have also placed pressure on national positions, notably in 2012 at Durban where India was somewhat at odds with other BASIC countries on the legal nature of the agreement going forward (164, 165). Indeed, as its BASIC allies have signaled growing willingness to take on legal obligations, India has, in parallel, worked closely with another diverse group of 24 countries spanning Saudi Arabia, the Philippines, Venezuela, and China, more closely rooted in the G-77, which has tended to focus on the early Indian agenda of preserving differentiated responsibility. These diverse alliances strategically speak to different aspects of Indian interests and approaches to negotiating a climate agreement.

By the time of the Paris Agreement in 2015, India's room for maneuver was diminished due to global shifts. However, the emergent global consensus on the form and content of a global agreement had also changed sufficiently to accommodate the rearticulated version of India's interests. Thus, on India's key issue of differentiated responsibility, a joint statement by the United States and China prior to the Paris Agreement redefined differentiation by adding the modifier "in light of changing national circumstances," creating a more dynamic notion of differentiation. India had little choice but to accept this new formulation, which likely shaped the articulation of differentiation in the Paris Agreement (166). At the same time, although India remained opposed to a legally binding agreement, the ultimate form of the Paris Agreement—which combined a legally binding

form but nonlegally binding obligations of conduct in the form of sovereignty-preserving “nationally determined contributions”—addressed at least some of India’s substantive concerns (165).

Opinions on whether India’s interests were well served at Paris vary. From one perspective, India’s interests as a vulnerable country are served because the Paris Agreement puts in place at least some mechanism for global cooperation, notably through transparency-based mechanisms for ratcheting up pledges, and the voluntary nature allows India to calibrate its pledges based on development consideration (167). From another perspective, by failing to enforce binding limits on countries consistent with explicit equity metrics, the Paris Agreement constitutes a setback for developing countries (168) even described as “climate apartheid” (169).

Finally, India’s participation in non-UNFCCC negotiations, around aviation emissions and HFCs, signals some continuation with older negotiating approaches in the former and an intriguing new direction on the latter. A key issue for India in aviation emissions negotiations was the operationalization of differentiation: whether the emissions-offsetting mechanism would account for the different pace of growth of the airlines industry in emerging versus developing countries (166, 170) ultimately resolved through a phased approach over time. On HFC emissions (the Kigali Amendment to the Montreal Protocol), India somewhat unusually offered to undertake deeper reductions conditional on developed countries taking more aggressive measures and, in a departure from past approaches, argued for and won a threefold categorization of country commitments, with China notably in an interim category and India in a category permitting somewhat later action (166, 171). This signals a substantial departure from a historical adherence to strict developed and developing country boundaries in climate negotiations.

3.3. Domestic Policy and Governance

From an earlier focus on climate as a diplomatic problem, the last decade has seen a proliferation of domestic policy changes and new governance arrangements. These domestic efforts have frequently been stimulated by international pressures, ideas, and networks, in further evidence of the close link between the two levels of governance. Moreover, while policy changes began at the national scale, they rapidly diffused to states and cities. Consequently, in India as elsewhere, climate change is increasingly a challenge of multilevel governance that requires integration across scales, and across multiple sets of actors—governmental and increasingly nongovernmental (172).

Perhaps the most significant single stimulus to national climate policy making was the 2008 National Action Plan on Climate Change (NAPCC). The NAPCC was widely viewed as India’s response to international pressures (159). However, the NAPCC pulled off a delicate political balancing act between global pressures and equity-and-differentiation-focused national positions by framing India’s climate approach as guided by the pursuit of co-benefits. In a reversal of the then prevailing understanding of this concept, co-benefits were measures that achieved national development objectives that also, and implicitly secondarily, yielded climate gains. For example, perhaps the most significant national objective that promised climate co-benefits, at least when promoted through renewable energy, was energy security, at a time when there was considerable concern about assuring energy to fuel India’s rising growth rate (5).

The NAPCC was sprawling, comprising eight national missions that potentially impacted a wide swathe of India’s development efforts, ranging from solar and energy efficiency adoption, to improved urban habitat and water management. One tangible and immediate impact of the NAPCC and its missions was the broadening of the formal institutional structure for climate governance to embrace sectoral line ministries, the Planning Commission (later modified and re-labeled NITI Aayog), the Ministry of Finance, and, as we discuss below, state-level governance mechanisms as represented in **Figure 2** (173). However, this breadth was not matched by a

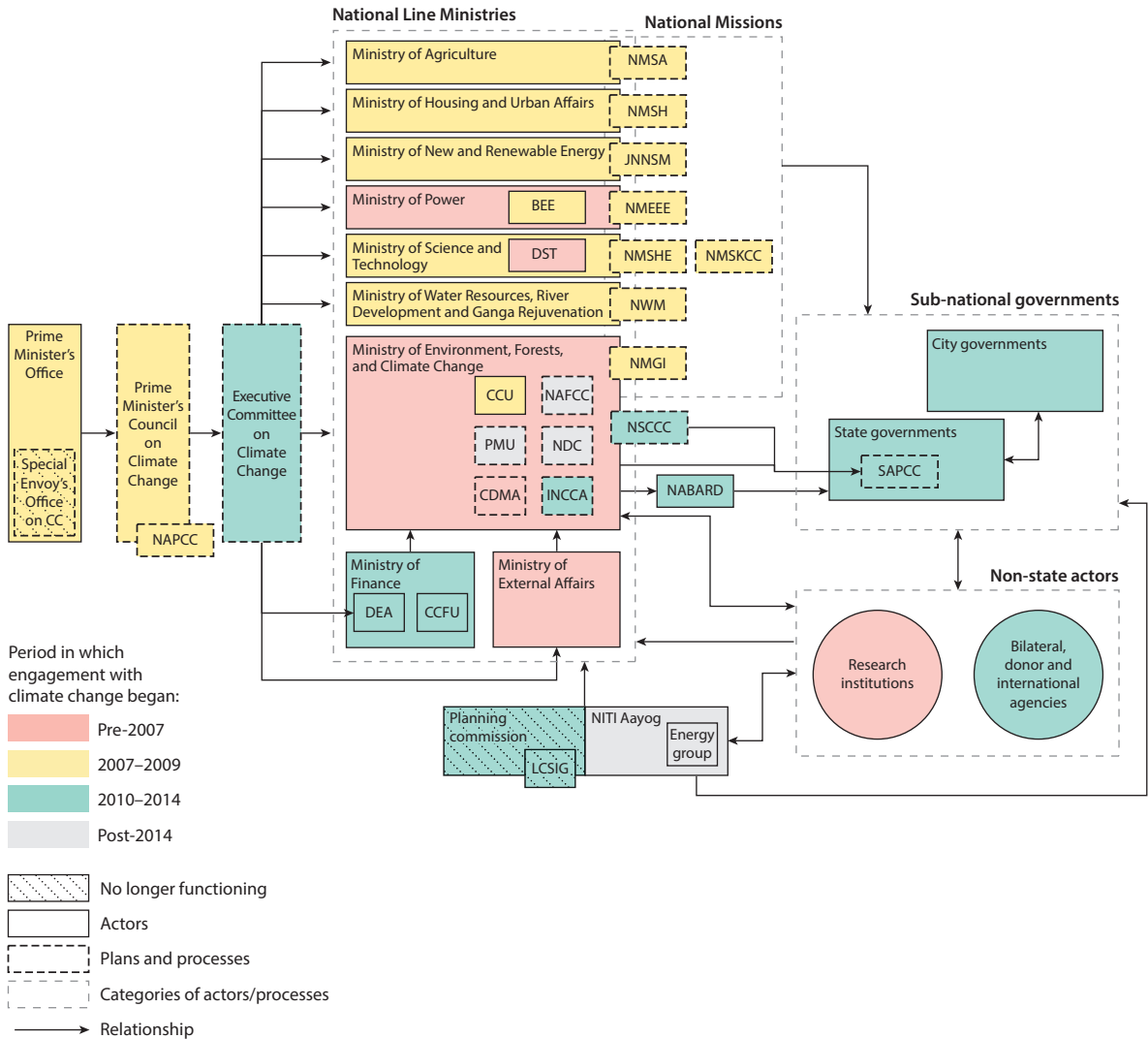


Figure 2

The Institutional Structure of India's Climate Governance (as on March 2018). Abbreviations: BEE, Bureau of Energy Efficiency; CC, Climate Change; CCFU, Climate Change Finance Unit; CCU, Climate Change Unit; CDMA, Clean Development Mechanism Authority; DEA, Department of Economic Affairs; DST, Department of Science and Technology; INCCA, Indian Network on Climate Change Assessment; JNNSM, Jawaharlal Nehru National Solar Mission; LCSIG, Expert Group on Low Carbon Strategies for Inclusive Growth; NABARD, National Bank for Agriculture and Rural Development; NAFCC, National Adaptation Fund on Climate Change; NAPCC, National Action Plan on Climate Change; NDC, Nationally Determined Contribution; NMEEE, National Mission on Enhanced Energy Efficiency; NMGI, National Mission for Green India; NMSA, National Mission for Sustainable Agriculture; NMSH, National Mission on Sustainable Habitat; NMSHE, National Mission for Sustaining the Himalayan Ecosystem; NMSKCC, National Mission on Strategic Knowledge for Climate Change; NSCCC, National Steering Committee on Climate Change; NWM, National Water Mission; PMU, Project Management Unit; SAPCC, State Action Plan on Climate Change.

commensurate increase in the depth of capacity, nor was the form of institutionalization well matched with the particular need of a co-benefits-based linkage between climate and development that required seeking synergy between the two.

Given the importance and breadth of the NAPCC, there are remarkably few studies of its implementation. One early study of the NAPCC process (rather than outcomes) does note that the mission aims are frequently general in nature and defy easy accountability, and that there is limited synergy across missions (174). However, in some cases, such as the energy efficiency mission, the objectives were more clearly laid out and the NAPCC process was able to generate new institutional opportunities that were material to realization of tangible gains, in this case in terms of programs for energy efficiency and outcomes.

Although the NAPCC machinery remains active, the Paris process has led to India's submission of a Nationally Determined Contribution (NDC) (37), although it is too early to assess its impact on policy or institutional change. The NDC included three concrete pledges against which outcomes could be monitored, along with several more aspirational statements such as improved adaptation and building capacity. The most overarching of these was, in an extension to the Copenhagen pledge, to increase the emissions intensity of India's economy to 33–35% below 2005 levels by 2030 (37). Although there is considerable variation in projections of India's emissions, one synthesis of existing studies suggests that policies in place in 2015 are consistent with this trajectory (85). Indeed, India's emissions trajectory has shown a consistent downward trend in recent years, with its emissions intensity converging with the global average (Figure 3).

A second pledge suggests that by 2030 40% of India's electricity generation capacity will come from non-fossil-fuel sources, which, as discussed in Section 2.3, Energy Transitions, is likely to be met if domestic targets on renewable energy promotion are realized. The third pledge, as discussed in Section 2.5, Sequestration, aims at sequestering an “additional” 2.5 to 3 billion tonnes of CO₂eq

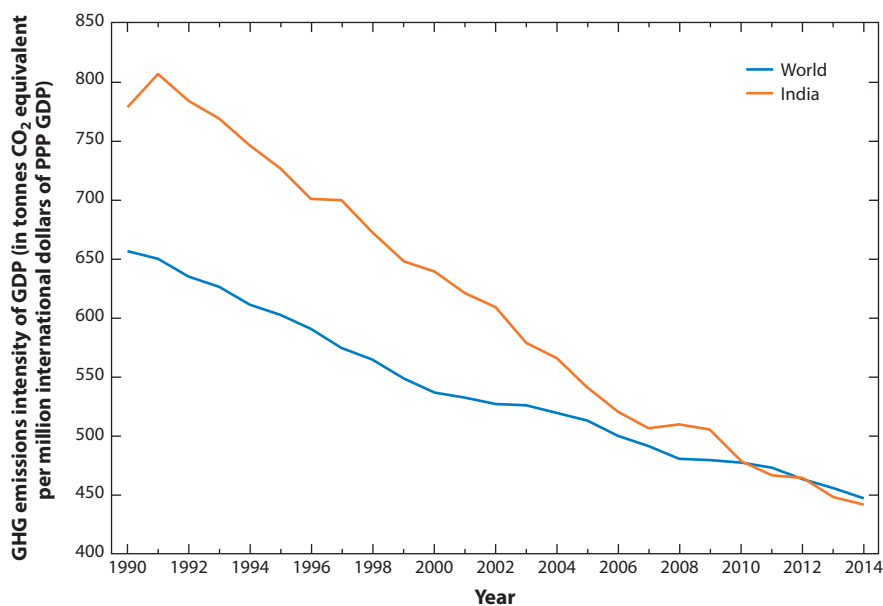


Figure 3

GHG emissions intensity of GDP. India compared with world average (1990–2014). Data from Reference 8.

in the forest sector by 2030. Tracking and accounting progress toward these pledges is likely to inform future scholarly literature.

There is a larger literature, if somewhat scattered and disconnected, on subnational climate action at the level of both states and cities. For much of the literature, unsurprisingly, the starting point is an exploration of the linkage between local development objectives and climate change, using the language of mainstreaming or co-benefits—whether based on adaptation or mitigation. The articulation of the benefits, or objectives, illustrated the multilevel nature of climate planning. Thus, although state actions started with a national nudge, they rapidly took on a local flavor, as with attention within climate plans to coal-fired power in Odisha or desertification in Rajasthan (159). Moreover, there was frequently an easy equivalence assumed between climate plans and state-sustainable development plans, due to limited scientific input into assessing how broad climate impacts would translate locally and therefore a thin conceptualization of the development climate link (175). Thus, Aggarwal found that state planning in Delhi was driven by an effort to leverage perceived climate funding opportunities to address short-term development agendas through “strategic bundling” (176), and climate mitigation funds were used as a way to bring attention to high theft and loss levels in Odisha’s power sector (175). In some cases, however, where central government guidance was strong, as in renewable energy promotion, state plans followed a top-down approach, but even here, there was space for state-level experimentation with alternative policies (177). Moreover, as a study of climate mitigation in the buildings sector suggests, even though central schemes are in place, they rely not just on vertical linkages to states, but also on horizontal linkages between firms, NGOs, and local government actors to enable flows of knowledge, finance, and technology (178).

The literature also highlights the importance of the processes through which climate planning occurs, and the related role of networks and the potential for both reinforcement as well as disruption of existing power relations. In the context of clean energy, governance arrangements shape access to bureaucratic authority and finance, which suggests attention not only to technical dimensions of energy governance but also to the shifting balance of power across coalitions of actors.

These themes come through in a particularly textured manner in the literature on city climate planning, much of which is based on a single multi-city effort, the Asian Cities Climate Change Resilience Network. An insightful study of Indore and Gorakhpur highlights the tension between project narratives of preparing for surprises, shocks and systems thinking with local realities of immediate and known problems such as garbage collection, and the reality of compartmentalized governance (179). However, the effort to mediate these tensions can create new institutional spaces, which also carry the potential to disrupt existing networks of power and shift agendas. Similarly, climate planning in Surat requires the cocreation of implementable options—such as urban public health and climate resilience, or promotion of cool-roofs and passive ventilation—through the mediation of international narratives around climate resilience, local institutional arrangements, and existing urban actors (180). Drawing on a different set of cases based on the work of the South Asia chapter of the global network ICLEI, Fisher highlights the importance of this network as an agent of “policy mobilities” by embedding policy ideas, or at least seeding them for the future, through techniques such as generating data or building inventories (181).

4. CONCLUSIONS

As this review suggests, there is now a substantial literature exploring how climate change is likely to impact India, and how India has engaged with this emergent global challenge politically and in policy formulation. Notably this literature goes far beyond a limited focus on international

negotiations, a topic that tended to dominate previous material. This shift reflects the gradual deepening of engagement with climate change in India, particularly in terms of domestic policy efforts to address adaptation concerns and explore linkages between energy and forest policy and mitigation. This linkage has productively taken the form of understanding how climate impacts are one of multiple stressors impacting India, and, also, that India seeks to address multiple and simultaneous development objectives, including but by no means limited to climate change mitigation and adaptation. A particularly rich emergent literature examines how these linkages play out at the subnational level. Internationally, India has sought ways of engagement with the emergent international regime even while retaining its historical emphasis on concerns of equity and differentiation among countries. In practice, it has broadened its forms of engagement, submitting international pledges at Copenhagen and Paris, shaped by a combination of irresistible global forces, a growing realization of its own climate vulnerabilities, and, crucially, an engagement with the idea that climate mitigation and development need not always be in conflict.

Despite the increasing depth of the literature, several areas remain that are weakly understood and require greater and closer attention by researchers. Research on impacts and adaptation has tended to reinforce a divide between natural and social science, with a need for enhanced work on understanding how multiple natural and social stressors interact to cause vulnerability. In addition, as the literature on state climate planning suggests, the link between research and policy formulation in this area remains weak. And the biophysical, social, and governance implications of the ambitious sequestration pledge in the forest sector remain *prima facie* controversial but understudied.

While the literature and policy framing rests heavily on a co-benefits narrative, which has more recently been reformulated into a more neutral multiple-objectives framework, careful empirical evidence on the existence of synergies and trade-offs across competing objectives remains limited. If climate policy is to be mainstreamed into development efforts, more systematic and rigorous efforts at analyzing and categorizing these linkages are necessary.

On the policy front, analysis of how international pledges are internalized into policy making, the extent to which they shape policy, and an accounting of their impacts all remain understudied. Although there is a growing subnational literature, and particularly one on actions in cities, it tends to be focused on a relatively small number of cases that are stimulated by international networks. With regard to international policy formulation, greater attention to how climate change interacts with other foreign policy objectives and the broadening of the diplomatic sphere beyond the UNFCCC are important areas for future attention.

India's deepening engagement with climate change, both conceptually and as a policy challenge, is welcome. However, given the overhang of immediate development challenges, climate change can only be salient to politics and governance if a robust analytical framework is developed to integrate climate considerations alongside and interwoven with pressing development challenges. Developing this integration is the pressing challenge for the next generation of research. Meeting this challenge is likely to provide a useful set of concepts and tools for many other countries that similarly seek a way to engage climate considerations while maintaining a focus on their domestic challenges.

SUMMARY POINTS

1. Shifting ideas and knowledge on climate change in India have been shaped by, but also shape, the country's climate politics and policy landscape, leading to substantial changes in both over time.

2. The notion of climate equity remains central to Indian climate politics, but its meaning has broadened over time, to include not only disparities among nations, but also disparities within India and the impacts of climate change on vulnerable populations.
3. Initial steps by the government to focus scientific attention on topics such as the monsoon, impacts on agriculture, black carbon, and glacial melt have contributed to public and policymaker awareness of climate change.
4. India's energy future is critical to understanding India's contribution to global greenhouse gas mitigation, but uncertainties in the country's development trajectories yield a wide range of projections, strongly shaped by the future mix of coal versus renewable energy and the nature of energy demand.
5. Social and environmental co-benefits across developmental and mitigation objectives is a key concept in India's climate policy making and climate research; the prevalence of co-benefits affects political willingness to take action, given widespread co-benefits can reduce the effective costs of mitigation action.
6. Understanding India's substantial forest sequestration pledge is complicated by uncertainty on biophysical estimates of current net sequestration, the social and environmental trade-offs inherent in enhanced sequestration, and social and legal complexities involved in implementing this pledge given the complexities of forest governance in India.
7. India's approach to global climate debates demonstrates considerable continuity, focused on principles of equity and differentiated responsibility backed by Southern solidarity, while also showing signs of change, particularly through a willingness to adopt a nationally determined role in mitigation and a heightened concern for geopolitical perceptions.
8. India has become a testing ground for policies that seek to integrate climate considerations into development policies, with a growing, if limited, framework of climate institutions and efforts to design and implement co-benefits-based national missions in areas such as energy, urban development, and water, and state and city plans focused on resilience and energy efficiency.

FUTURE ISSUES

1. How widespread and substantial are both synergies and trade-offs across pressing Indian developmental concerns such as job creation, energy security, energy access, local environmental quality, and climate mitigation?
2. What factors on both demand and supply sides are likely to shape India's energy future, and with what implications for India's contribution to global mitigation efforts?
3. What are the obstacles to implementation of India's forest sequestration pledge given the existing governance structure of forests in India?
4. What institutional forms of climate governance best enable mainstreaming of climate considerations into developmental planning and policy making?

5. What mix of factors—such as knowledge of impacts, awareness of co-benefits, considerations of equity, and geopolitical objectives—are likely to shape domestic climate politics in India in the future?
6. What role will climate change play in shaping India's foreign policy and strategic outlook in the future?

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

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