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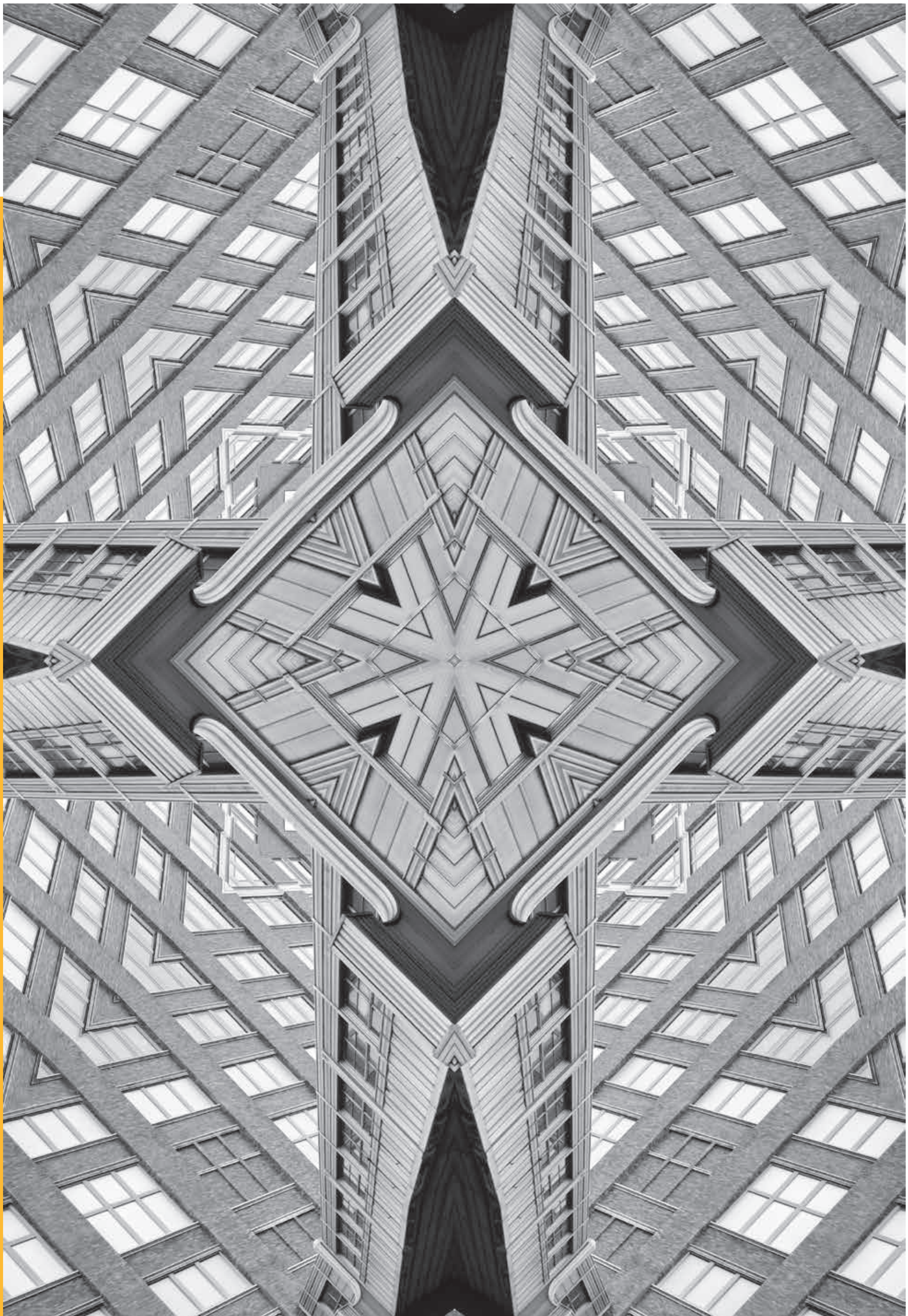

ISSUE NO. 335 OCTOBER 2021

The Imperatives of India's Climate Response

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Abstract

As the global climate crisis intensifies, nations are becoming more hard-pressed to formulate responses that will be acceptable to all stakeholders. In an effort to understand India's approach to addressing the challenges of climate change, this paper describes the natural circumstances that have historically shaped its responses. The paper also discusses the most crucial imperatives that have guided such actions and suggests that these will continue to play a dominant role in the future. The paper argues that any broad deviation from this course of action will not be sustainable as India's natural circumstances continue to influence its economy and public life.

Attribution: JM Mauskar and Sayanangshu Modak, "The Imperatives of India's Climate Response," *ORF Occasional Paper No. 335*, October 2021, Observer Research Foundation.

Introduction

The global climate has warmed significantly over the past few decades owing largely to anthropogenic factors, and the ramifications of the crisis will be witnessed across the world. Thus, the response also requires a global effort, albeit with some nations expected and able to do more than others. This paper discusses India's role in climate action, and underscores the circumstances and imperatives that will continue to guide India's response.

The paper outlines the natural circumstances[a] of geography and resource endowments and discusses India's historical response to them. It analyses the projected impacts of climate change on India and its responses thus far, through both domestic strategies and commitments to international instruments. The paper shows that India's climate action has been largely commensurate with the impact that global warming is having on the country. It finds that India's responses are shaped by its natural circumstances, and guided by its Constitution and civilisational ethos as well.

> Climate action requires global effort, albeit with some countries expected and able to do more than others.

a The term 'natural circumstances' refers to endowments of resources as well as climate and geology. 'Natural circumstances' and 'national circumstances' are not used interchangeably in this paper. 'National circumstances' encompass natural circumstances and other aspects like socioeconomic history, and cultural imperatives. 'National circumstances' was first mentioned in the UNFCCC (Article 4.1) and the Paris agreement (Article 2, sub-para 2).

India's Natural Circumstances: An Overview

In 2015, *The Economist* called India "a continent that is masquerading as a country."[1] Indeed, the country is enormous and highly diverse in its biogeophysical, socioeconomic, and political composition. Due to its vast expanse straddling two climatic zones – the equatorial and the temperate, as well as wide variations in topography and the strong influence of monsoonal circulations—the country's climate is varied—extremely hot and dry in the deserts, and severely cold in the high-altitude regions. India has six climatic zones: hot and dry (Western Rajasthan, parts of peninsular India); warm and humid (the coastal regions, northeast India); moderate (pockets of Karnataka, Maharashtra); cold and cloudy (much of Himalaya and pockets of central, southern and northeast India); cold and sunny (Ladakh and Aravalis); and composite (bulk of Indo-Gangetic plain and Central India).[2] India experiences six climatic regimes: Tropical wet; Tropical wet and dry; arid; semi-arid; humid sub-tropical; and mountain.[3] Temperatures can range from 51 deg C in Rajasthan, to -60 deg C in Ladakh.

Indeed, the Hindu Kush Himalaya (HKH) mountain range and the Tibetan Plateau is widely known as the 'Third Pole' because of their ice fields which has the largest freshwater reserve outside the polar regions. It presents seasonal and permanent frigid conditions in settlements at high altitudes like Lahaul and Spiti district, Himachal and the Union Territory of Ladakh. India also has one of the wettest places on Earth, while parts of the Thar desert may receive little or no rainfall for consecutive years.

The landforms are also highly varied and strategically located, creating distinct physiographic zones and influencing the agroecology of regions. India has seven physiographic zones (see also Figure 1).

1. The mountains of the north, comprising the Himalaya and other ranges, consist of marine sediments of calcareous origin, mostly limestone, which have been compressed and deformed by endogenic forces. They are among the youngest mountain ranges in the world.

2. The plains of North India were created by the deposition of sediments over millions of years by three main river systems – Indus, Ganga and Brahmaputra. The thickness of sediments can be from one to five kilometres.[4]

3. The Central Highlands between the plains of the North and Deccan Plateau.

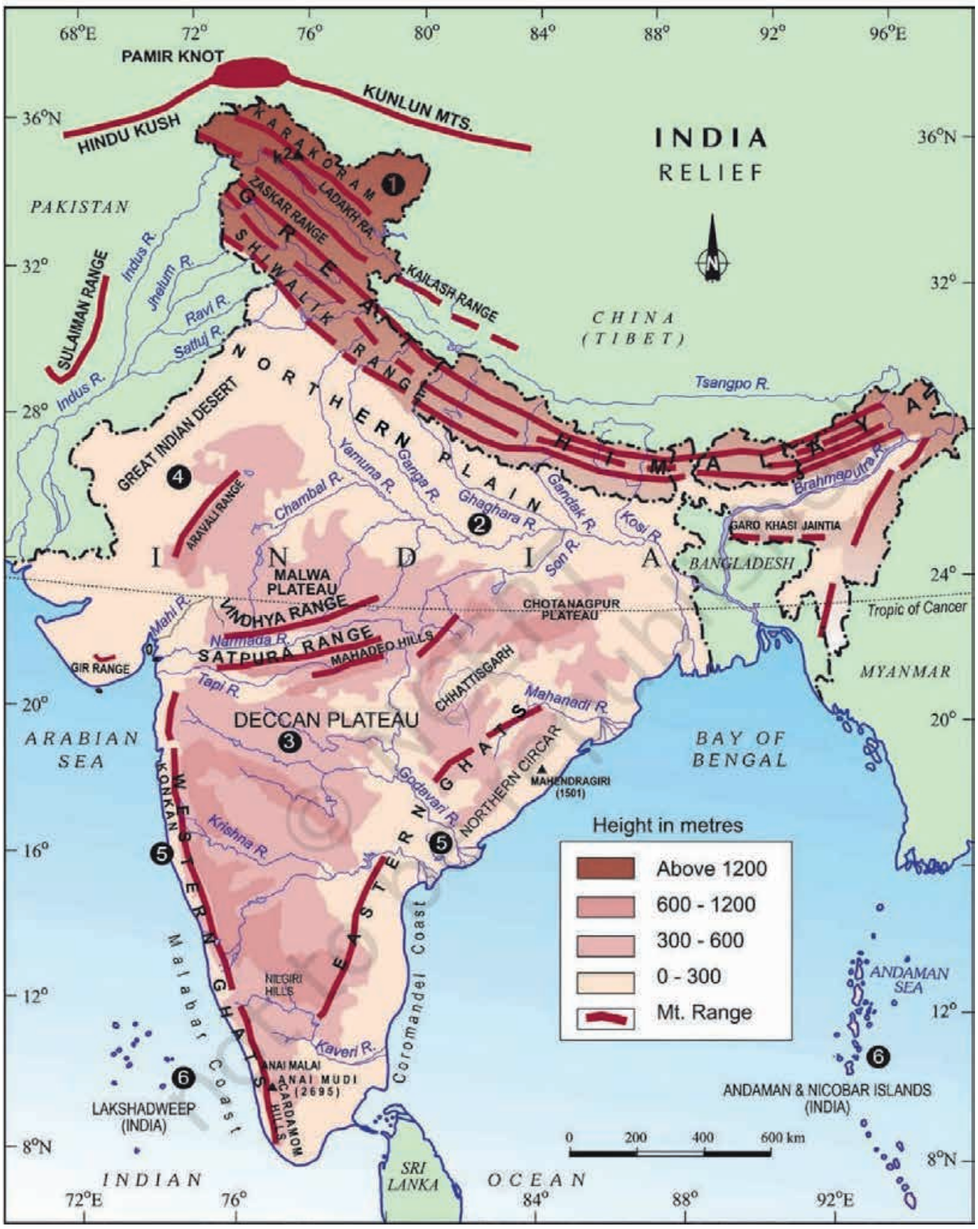
4. The Peninsular Plateaus comprising the Western and Eastern Ghats, Deccan Plateau (North and South), and Eastern Plateau. The Deccan volcanic province that records a massive accumulation of tholeiitic magmas in a relatively short period forming a thick igneous layer, is a significant geological feature in this zone.

5. The East Coast, 100-130-km wide.

6. The West Coast, narrower at 10-25 km.

7. The Lakshadeep Islands in the Arabian Sea and Andaman and Nicobar Island in the Bay of Bengal.

Figure 1: India's Relief Features



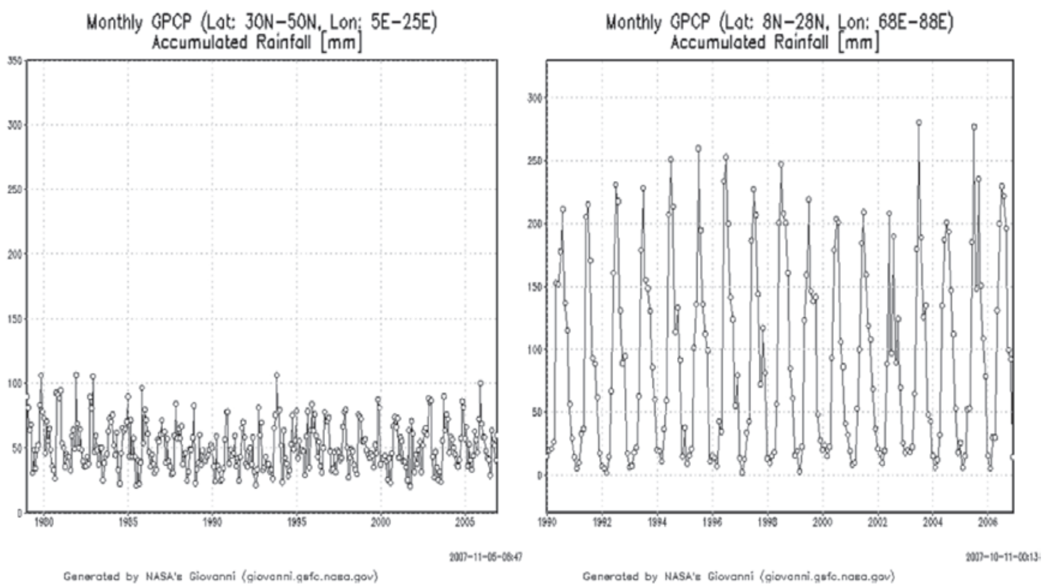
Source-NCERT[5]

India's Natural Circumstances: An Overview

The bulk of the precipitation in India is derived from the monsoon. The northwest of India also receives some precipitation from the Western Disturbances that originate from the Mediterranean Sea. The position of India near the tropic as well as the strategic location of the Himalaya forming a distinct arc along the country's frontier from north to east is key in creating a monsoonal climate. The thermal concept of Indian monsoon laying out the heating of the northern plains during summer and the formation of a permanent thermally induced low pressure as well as the shift of the Intertropical Convergence Zone to a position over the northern plains is well-known. During the prevalence of monsoonal circulation, the chain of high mountains blocks the equatorial maritime air masses from the south-west to crossover and, instead, forces them to curve to the north-west of India. Similarly, it prevents the cold air masses from the Tibetan Plateau in the northwest to enter South Asia during winter.

Within this highly skewed annual precipitation regime that largely consists of four months of monsoonal rains, the distribution of rains across space and time is also variable. Geographically, localised heavy rains are associated with orographic barriers while regionally they occur due to the shift of the monsoon trough. Temporally, there is also a very high interannual variability of rainfall associated with El Niño Southern Oscillation (ENSO) - modulating Indian monsoon, with less than normal rain during El Niño phases and more than normal rain during La Niña phases. The intra-annual variability occurs due to two main factors – the intensity of cyclones during monsoon and the number of monsoon break days. This may lead to regions experiencing a deficit of rainfall in the beginning, middle or end of the season. Cyclones mostly occur during the post-monsoon period and have been traditionally more frequent in the Bay of Bengal rim, affecting the eastern coast of India.

Figure 2
Interannual Variability of Rainfall: European region (left) and Indian Region (right)



Source : NASA GES DISC[6]

Concomitantly, variability of temperature and rainfall is an intrinsic part of the climate of India. The climate also influences the type and availability of natural capital such as forests, water, and soil. For example, the variability of temperature, rainfall and humidity has created five groups of forests – Moist tropical (west coast, east coast and eastern Himalaya); dry tropical (northern hilly regions and parts of south India); montane temperate (Northern middle Himalaya); montane sub-tropical (northeast India and the Western Ghats); and alpine (Himalayan region and TransHimalaya). India also has a wide variety of soil types that have also largely determined the predominant crop type of a region. Defined by the physiography and geology along with the prevalent climatic regime, the river channels also show a distinct character in terms of being perennial or not and their physical characteristics such as form or pattern. For instance, the Himalayan rivers are largely perennial, in contrast to the rivers of peninsular India. Similarly, the channel may have strong structural controls as in the case of a gorge with a high gradient or it may have more room to meander as in the case of floodplains.

India's Natural Circumstances: An Overview

The geological history of India is unique. India was part of the Gondwana supercontinent, sharing the landmass with Africa, Australia, and Antarctica. Around 120 million years ago, the Indian plate broke off and started migrating north; 50 million years ago, it rammed into the Eurasian plateau, thereby creating the Himalayas.[7] The Himalayas are perennially rising by more than 1 cm per year as a result of active tectonics.[8] Shallow-focus earthquakes in the region are common which, along with hazards caused by exogenous forces leading to flash floods and landslides, pose serious challenges for hydropower development despite the abundance of the hydrological gradient.

The geology of India is also extremely peculiar and a donnée in shaping the country's mineral resource endowments. The bulk of the valuable minerals are the products of processes predating the Palaeozoic age and are largely associated with igneous and metamorphic formations. Therefore, the large tract of alluvial plain in the north is largely devoid of minerals, while most of the economically valuable metallic minerals occur within the old crystalline rocks of the peninsular plateau. India has large endowments of Iron ore in the form of Haematite and magnetite. About 79 percent of haematite is found in the Eastern sector (Jharkhand, Chhattisgarh, and Odisha) while 93 percent of magnetite deposits occur in the Southern Sector (Andhra Pradesh and Tamil Nadu).[9] Another important mineral that aids in the preparation of steel is Manganese; India accounts for 8 percent of the global manganese ore reserves.[10] Deposits of Manganese are largely in Madhya Pradesh, Maharashtra, and Gujarat.

India also has widespread and substantial deposits of dolomites, limestone, and bauxite. In a report by the International Energy Association (IEA) in May 2021, a number of critical minerals have been identified which are required for rapid deployment in order to make energy transition.[11] Most of these critical minerals, like Copper, Lithium, Nickel, Cobalt, and Rare earths, are not found in viable quantities in India. However, the country has some reserves of chromium, silicon and manganese. The non-metallic minerals, such as mica, limestone, and dolomite, are available sufficiently, albeit in isolated pockets.

In energy resources, India has adequate coal deposits (9.5 percent of the global reserve), but very little petroleum (0.3 percent) and natural gas (1 percent).[12] Occurring mainly in two stratigraphic horizons – Permian sediments deposited in Intratectonic Gondwana basins and Early Tertiary in near-shore peri-cratonic basins and shelves. The Gondwana coal that occurs in the Eastern and Central parts of Peninsular India is of the bituminous type with moderate to High Ash content and low sulphur. The bulk of India's coal is of this type and is considered high-grade, concentrated in the Damodar, Godavari, Mahanadi and Sone River valleys, thus, largely confined to the eastern sector. The Tertiary coal found in North-eastern India has high

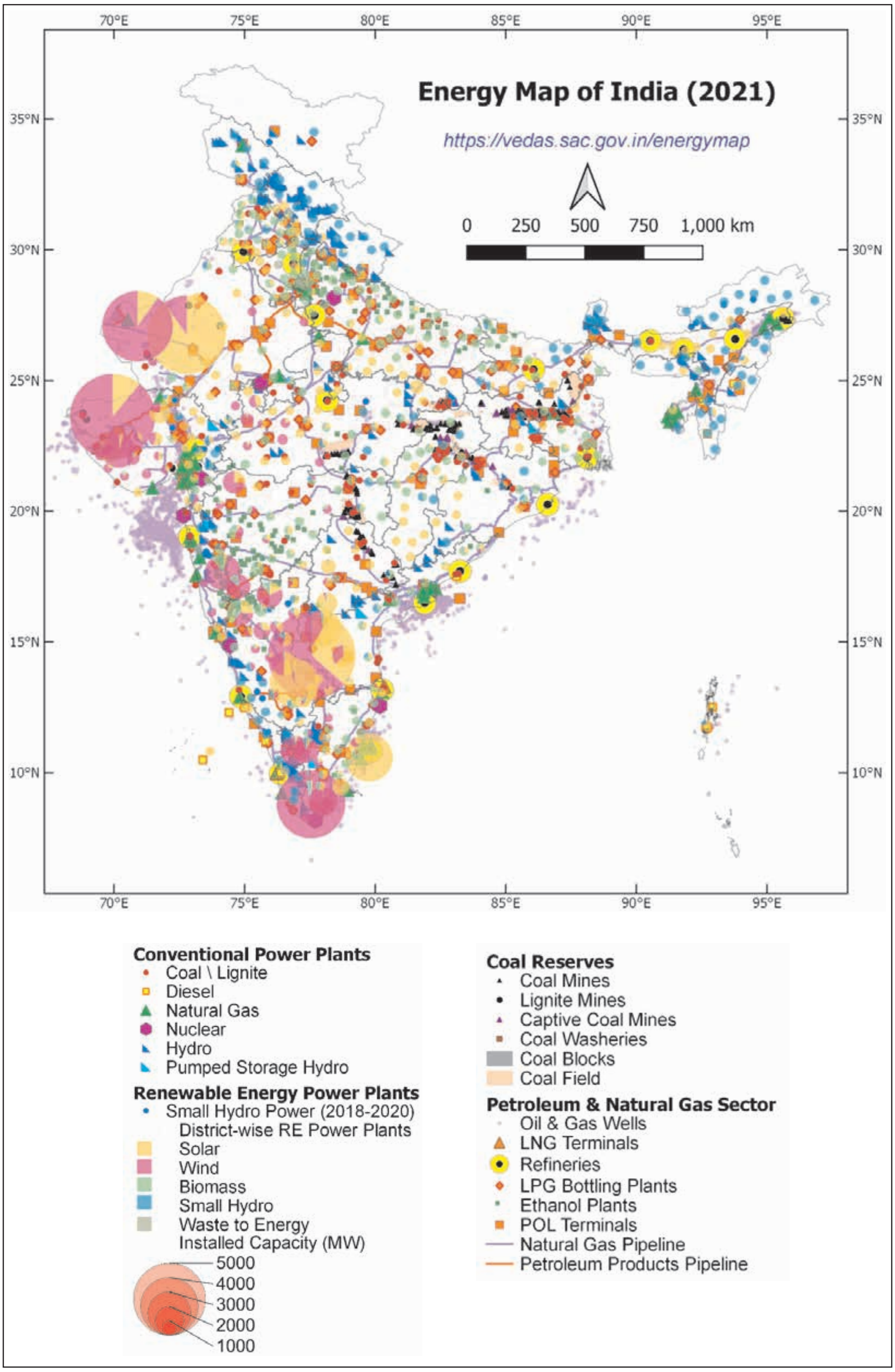
Sulphur content and ranges from strongly caking to non-caking. India also has the lignite variety of coal in Western and Southern India which is high in moisture and volatile matter and therefore, inferior in quality.

Crude petroleum occurs in sedimentary rocks of the tertiary period. The oil deposits are mostly scattered at the eastern and western frontiers of the country such as Digboi, Naharkatiya and Moran in Assam and the oilfields of Ankaleshwar, Kalol, Mehsana in Gujarat. Oil deposits were also discovered in 1973 at a location about 160 km off the Mumbai coast, which became Mumbai High. Natural Gas is obtained along with oil in all oilfields but exclusive reserves have also been identified which are scattered along the eastern coast as well as Tripura, Rajasthan and elsewhere. Despite India's large land surface area, its extractable hydrocarbon reserves remain meagre. Nearly 76 percent of the hydrocarbon discovered so far in India are in rocks of Tertiary age, 20 percent in Mesozoic, and the rest in older rocks. This is counterintuitive, as globally the finds of hydrocarbons shown a reversal of occurrence with a high probability of occurrence in the Mesozoic strata. Plausible reasons could be attributed to geological factors. For instance, the formation of the thick, impervious layer of igneous rocks over western and central India after the Mesozoic era could be concealing the hydrocarbon endowments and making extraction unfeasible.[13] Similarly, the thick layer of sediments in the Indo-Gangetic Plains makes the underlying geology largely unreachable. Further, with the Himalayan orogeny, it may have happened that the sedimentary oil-bearing column got largely exhumed and deformed due to the rapid movement of the Indian plate and the violent uplift event.[14] Thus, with severe limitations on conventional sources of fuel except for coal, India has been exploring non-conventional sources of energy such as nuclear since its independence.

India has a rather modest reserve of Uranium at 1,84,964 tonnes,[15] which constitutes only about 2 percent of the global availability of Uranium. Deposits of uranium are concentrated in four regions of India – Meghalaya, Singhbhum (Chotanagpur), Cuddapah basin (Andhra Pradesh/Telangana) and Rohil North Delhi fold belt. In contrast to the availability of Uranium, India has one of the highest thorium reserves in the world that mostly occurs as the mineral monazite in beach sand along the eastern and western coast. However, Uranium remains the mainstay of the nuclear energy industry since the technology to use it as a nuclear fuel is more developed.[16] However, India remains committed to study how to use Thorium as a nuclear fuel.[17] Thorium is also safer than Uranium and produces far less radioactive waste in volumetric terms during its use, while the waste is also less radioactive and comparatively short-lived.

The realisation of the above energy resource endowment into power generation is captured in Figure 3.

Figure 3: Energy Map of India



Source: VEDAS, NITI Aayog and ISRO[18]

India's Response to its Natural Circumstances

Ancient Era to 1947

Across the globe, societies have adapted to their environment's prevalent conditions of climate or water endowments. The emergence of the Indus Valley Civilisation along the fertile floodplains of the Indus and its tributaries with a distinctive regional culture, as against the sedentary farming cultures that predated it, is testimony to this harmonious relationship. The people of the Indus Valley Civilisation generated surplus grains that supported the urban dwellers. Rainwater harvesting was effectively practised during that time, which played a key role in the development of agriculture.[19] Monsoons have continued to remain important for the Indian population despite progress in expanding the irrigation coverage to delink the farmer's dependence on these seasonal rains.

Indeed, India has traditionally had three agricultural seasons and Kharif (summer crop) has remained the most important, constituting much of the net sown area in the country. Moreover, as the country was predominantly rain-fed for much of its history, distinct food geographies evolved based on the hydrometeorological specificities of the region. Therefore, coarse grains such as sorghum, millets, maize, and barley are equally part of the Indian platter as rice and wheat and have been grown in the semi-arid areas like Rajasthan, Karnataka, Madhya Pradesh, Telangana, and Odisha.

Since Indian society was largely adapted to floods, the damages from seasonal inundations in the floodplains could be kept at a minimum. For instance, in the floodplains of North Bihar, the *aghani* rice is grown in the land that is susceptible to flooding since it could withstand partial and temporary inundation provided that floods did not arrive without warning and the process of inundation was slow.[20] Similarly, in various parts of the flood-affected parts of the Ganga-Brahmaputra-Meghna basin, a number of indigenous strategies are applied—ranging from storing excess floodwaters in tanks to building houses on stilts, to altogether moving to safer heights and allowing the water to inundate the land for a bountiful-harvest in the post-monsoon season.[21] Floodplains were exceptionally productive due to the systemic wetting and drying. Therefore, floods were less of a concern except for the rare deluge. Land use change in the floodplains was limited, as was the growth of human settlements and agricultural land. Thus, the vulnerability was limited and adaptation could be achieved with locally procured resources and locally devised means. However, the story of another hydrological extreme – drought, is a different one.

India's Response to its Natural Circumstances

As mentioned earlier, agricultural production in India has been intrinsically tied to the monsoons and the adequacy of rains. As such, the arid or semi-arid areas within the hinterland and in the rain-shadow of mountain ranges are less water-endowed. Life in these regions has thus evolved to accommodate the scarcity, be it the grains that were traditionally grown or the behavioural aspects of water use for various purposes. However, a crisis situation would still occur during the time of a meteorological drought.[b] This is linked with global and regional factors such as the ENSO phenomenon. At least 18 meteorological droughts occurred in India between 1870 and 2018; all the severe ones were due to ENSO.[22] Often, deficit rains for consecutive years increased the difficulty in the rural and agrarian landscape as there would be no respite from crippling food grain shortage, reduced fodder for animals, and shortage of drinking water and seeds. On the rare occasion of the transfer of these basic needs from neighbouring areas that had a surplus, people would be left with no option but to migrate. Thus, drought was feared more than floods, sometimes even in fertile regions like the Bengal delta.

The history of different regions of India is replete with the ancient wisdom of rainwater harvesting to reduce the impact of hydrological droughts even if a meteorological drought were to occur. In the arid parts of western Rajasthan, the task is done using saucer-shaped *Kunds* in privately owned land or land owned by caste groups. A kund with an area coverage of 100 m^2, and with an annual rainfall of 100 mm, could easily collect 10000 litres of water.[23] Similarly, *Khadins*, *Nadis*, *Talabs*, *Virdas*, *Bandha*, and *Johad* are all traditional ways of harvesting rainwater and increasing the infiltration of water for the replenishment of groundwater. In the water-endowed parts, the issue was effective transportation of water and local innovations were devised; in Meghalaya, for example, a network of bamboo pipes is used to transport water from perennial sources.[24] In the *apatani* system of Arunachal Pradesh, the irrigation system was designed in such a way as to tap into several small streams and springs through small and rudimentary structural interventions for wet rice cultivation along with fish farming.[25] Similarly, Ghuls of Western Himalaya, the Zabo and Cheo-ozihi of Nagaland, the Dongs and Garh/Dara of Brahmaputra valley, and the Ahar Pynes of Bihar are all traditional arrangements of adapting to the conditions of water endowments and optimising their use.

Throughout India's history, statecraft regarding the duties of Kings also mandated carrying out welfare activities. Pivotal to such activities were the

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b 'Meteorological drought' is defined based on the degree of dryness in comparison to 'normal' or average amount and the duration of the dry period. While meteorological droughts are caused by a deficit in rainfall, hydrological droughts are associated with the effects of such shortfalls on surface and subsurface water, determining their availability for humans and other constituents of the ecosystem.

construction and maintenance of structures for storing water for different uses. Thus, irrigation tanks, bunds and canals were constructed by the State to reduce the vagaries and uncertainties of water availability. Examples include the network of aqueducts and canals of Hampi under the Vijayanagara kingdom,[26] the indirect forms of human adjustment to water and climatic hazards under the Mughals through adjustments in land revenue policies, infrastructure development, administrative reform, human mobility, and landscape interpretation.[27] At times of drought or flood, land revenue remission (annewari) would be done, as well as providing crop/taccavi loans.

During the British era, the colonisers implemented measures to mitigate the vagaries of monsoon, with its successive cycles of floods, cyclones and droughts. The Indian Meteorological Department was set up in 1875 after a massive tropical cyclone in 1864 and two episodes of failures of rains in 1866 and 1871. The British enhanced irrigated areas through a network of canals, took measures for storage of grains and provision of relief to tackle droughts. They also put in place a network of railways and roads, meant basically for the military and other needs of the colonisers. Scientific mineral exploration was also initiated which, for example, led to the discovery of sizeable coal and iron ore reserves in Eastern India and significant oil reserves in Assam. Yet the health of the economy in general, and the farmers in particular, still depended on the vagaries of the Indian Monsoon when the British left in 1947.

The technology to harness the potential of India's mineral wealth and transport it over long distances arrived with the industrial age. However, the role and significance of minerals in shaping the economy and culture date back to ancient times. India has had an illustrious history of innovations and mastery with metallic minerals of various kinds, with uses largely localised. Ferrous metallurgy was particularly advanced, reaching its zenith in the first millennium AD. The Iron Pillar at Mehrauli, New Delhi, is a particularly good example of this advancement because it has withstood rusting and consequent corrosion for about 1600 years.[28] Similarly, the ingenious method of downward distillation of zinc vapour post-smelting to obtain zinc metal is also elaborated in the 13th-century text, *Rasa Rasaratnasamuccaya*.[29]

Until the middle of the 19th century both for fuel and lighting, firewood, wood charcoal, vegetable oil and biomass (straws and twigs) were used. Nothing was wasted, as cow dung patties were used as fuel for cooking in the Indo-Gangetic plains. The age of steam/industrialisation arguably got delayed in India due to the non-discovery of mineable/ viable coal reserves, let alone hydrocarbons, till the late 19th century.

Post-Independence

After Independence in 1947, India adopted a federal system of government, where power would be shared between the Union Government and the State Governments, with some centralising tendency. It also made sure that egalitarianism was an intrinsic part of India by including a chapter on fundamental rights in the Constitution. Articles 14, 15 and 16, in particular, relate to the rights to equality, against discrimination, and to equal opportunities. Owing to the humongous task of accommodating the demographic diversity while striving for social and economic justice at the same time, the framers of the Indian Constitution recognised the need for a set of principles to show India a general direction. Thus emerged the Directive Principles of State Policy (DPSP), whose aim is to establish the country as a welfare state. Article 39 (b) of the Indian Constitution provides that the ownership and material resources of the community are to be distributed in ways that will best serve the common good.[c]

This perhaps embodied the concept of "sustainable development" long before the term was institutionalised by the United Nations (UN) in the 1980s. In 1972, India was represented by its head of government at the first-ever UN Conference on the Human Environment in Stockholm.[30] Championing the cause of environmental protection, India's Prime Minister Indira Gandhi took the occasion of the conference to remark, "There are grave misgivings that the discussion on ecology may be designed to distract attention from the problems of war and poverty. We have to prove to the disinherited majority of the world that ecology and conservation will not work against their interest but will bring an improvement in their lives."[31] Subsequently, two additions were made to DPSP. In 1976, through the 42nd amendment to the Indian Constitution, Article 48A was added which directs the states to protect and improve the environment and safeguard the country's forests and wildlife. Article 51A was also added to prescribe that the fundamental duty of every citizen was to protect and improve the natural environment and have compassion for living creatures. Forest, as an item, was shifted from the state list to the concurrent list, enabling the union government to enact legislation regarding forests as well as wildlife.

The translation of constitutional imperatives into laws that looked to safeguard the environment also took place in the 1970s and 1980s. The first such law was the Water Prevention and Control of Pollution Act in 1974,

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c India aims to be an active and participative democracy. The seventh schedule of the Constitution delineates the allocation of powers and functions between the union government and states. The states exercise, for example, a degree of power with regard to law-making in the case of the subjects present in the concurrent list and state list of the Constitution.

followed by a similar one for Air in 1981. The Bhopal Gas Tragedy of 1984 made it more urgent to frame holistic laws that dealt with the environment. In 1986 the Environmental Protection Act (EPA) was passed, marking a shift from controlling pollution to protecting the environment. Thereafter, the EPA acted as the basis for various subordinate legislation for environmental impact assessment and coastal regulation, among other measures. The provisions of the EPA were framed in a manner that actions pursuant to international treaty commitments could also be taken thereunder, such as the Designated National Authority under the Montreal Protocol of the Vienna Convention on Ozone Depleting Substances.

In the 1990s, several Public Interest Litigations (PILs) were filed in High Courts and Supreme Courts that led to the passing of some fundamental and far-reaching directives for the control of air pollution, mining pollution, and deforestation. Parallel to this environment-related legislation, the Parliament enacted the Forest (Conservation) Act, 1980, no longer treating forests as resources to be exploited but as national endowments to be protected and conserved. Specialised tribunals were also set up, like the National Green Tribunal in 2010, that sought to apply natural law like "precautionary principle" or "polluter pays principle" to the national economy.

Social and economic development were also clear priorities for the newly constituted government after independence. Thus, the Soviet-style Five-Year Plans (FYPs) were initiated in 1951 as centralised and integrated national economic programmes. The long-term objectives were to increase the GDP and per capita income, raise employment levels, achieve self-sufficiency of commodities and food grains, promote social justice, reduce inequalities, and pursue modernisation. To achieve these objectives, three strands of development initiatives emerged: human development, industrial development, and development of infrastructure. While the first FYP sought to achieve self-sufficiency in food grains, the second one implemented the Nehru-Mahalanobis model of rapid industrialisation.[d] The subsequent six FYPs, until the liberalisation of the Indian economy in 1991, sought to strengthen agricultural growth and ensure economic stability while focusing on poverty eradication.

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d Prof. P.C. Mahalanobis, Indian statistician and adviser to Late Prime Minister Jawaharlal Nehru, was one-time member of the Planning Commission. He prepared a growth model with which he showed that to achieve a rapid long-term rate of growth it would be essential to devote a major part of the investment outlay to building basic heavy industries.

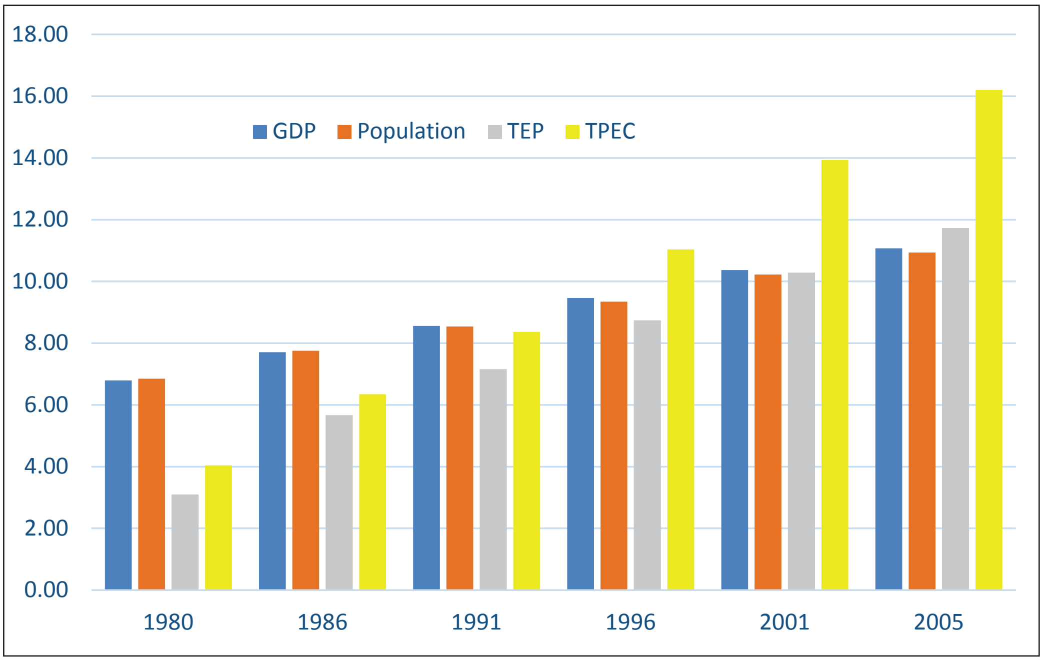
Under the first five-year plan, multi-purpose river valley development projects were initiated to augment surface water and transport it efficiently to increase the irrigation coverage of the country. This was imperative for the development of the agricultural sector, and brought key co-benefits like flood-control and hydropower generation. The Bhakra-Nangal multipurpose dam and the subsequent Indira Gandhi Canal, Damodar valley project, and Hirakud Dam Project, were all implemented during this period. The nation continued to face acute food grain shortages and was dependent on food grain imports, mainly from the United States (US).[32] This changed with the advent of the Green Revolution in the late 1960s. A crucial input that helped the Green Revolution succeed was the timely, adequate and assured supply of water. This was ensured by the proliferation of borewells which helped to add 11 million hectares to the net irrigated area, even as the area irrigated by surface water expanded only by 3 million hectares during the same period.[33] Despite all these efforts, 51 percent of the net sown area remains rain-fed,[34] the concerned farmers and the local economy continuing to be exposed to the impacts of temporal and spatial monsoon variability. The serious water stress is compounded by the ever-increasing requirement of water for human use, mostly in urban areas; industrial use and the discharge of untreated wastewater; and a decline in water quality whenever the annual rainfall is inadequate.

In the pre-liberalisation phase, India also grappled with the challenges of energy insecurity. Coal resources being concentrated in the eastern part of the country, shipping coal to thermal power plants located all over the country, imposed transport costs. Further, importing coal/ oil freely was problematic at that time due to various factors including foreign exchange shortage and port capacity constraints. From the early decades of Independence, therefore, hydropower, nuclear power and solar/ wind energy were sought to be promoted as much as the scarce financial resources permitted. However, nuclear power development was constrained due to the limited availability of technology and fissile materials. Solar power generation also suffered from the low efficiency of solar cells and grid-related constraints. Similarly, large hydropower projects were beset by public resistance due to land-related issues and high upfront capital costs. The Oil Crisis of the early 1970s was a wake-up call when serious energy security concerns, vis-a-vis hydrocarbon, became evident. It resulted in the management of demand through organisations like the Petroleum Conservation Research Association (PCRA), which promoted energy efficiency and higher taxation.

In 1991 and through the subsequent FYP (1992-97), the country entered a new phase of economic growth through fiscal and economic reforms, including liberalisation. As the share of the industrial and service sectors in the economy increased, energy production had to keep pace with the high demand and consumption of energy (see Figure 4). This demand, in turn, was primarily driven by energy-intensive sectors with low energy-efficiency like power generation, steel, cement, refineries, chemicals, fertilisers, and transport. The growth rate of Total Primary Energy Consumption (TPEC) outstripped GDP growth rate, and the gap between TPEC and Total Energy Production (TEP) widened towards the beginning of the 2000s (see Figure 4). The demand and consumption of coal and hydrocarbons also increased manifold during this phase. According to estimates, oil imports tripled within a decade, from 500 Kb/d in 1990 to 1.54 Mb/d in 2000. Coal imports also tripled and the share of domestic coal consumption met by imports rose from under 4 percent to 8.3 percent.[35]

Figure 4

Growth in GDP (in 10^8 Rupees), Population (in 10^8 people), Total Energy Production (in 10^{15} BTU), Total Primary Energy Consumption (in 10^{15} BTU)



Source: Sahu (2008)[36]

Soon enough, concern for energy security grew and the Indian government took initiatives towards the diversification of energy sources along with regulatory mechanisms like increased efficiency and enhanced conservation. These circumstances made it imperative for the government to actively seek ways of decoupling energy consumption from economic growth, even as it looked for alternatives such as renewable energy.[e] India's primary energy intensity of GDP has also declined consistently since the 1990s. The Energy Conservation Act 2001 was enacted under which the Bureau of Energy Efficiency (BEE) was set up. A new Electricity Act was enacted in 2003, which among other reforms permitted the stipulation of renewable energy purchase obligations on the distribution companies or discoms.

Furthermore, energy conservation rose with the launch of the government programme in 2006 to provide standards and labels on energy-saving and cost-saving potential of 21 selected appliances of different brands. This was followed by the Energy Conservation Building Codes in 2007 (ECBC), Agriculture Demand Side Management (DSM) in 2010, and Municipal DSM in 2015 that targeted various sectors.[37] India has also taken strides in developing the renewable energy sector, especially solar. The expansion of renewable energy has been a key thrust of successive governments.

At the turn of the 21st century, India was struck by three massive disasters: the Odisha super cyclone (1999); Gujarat earthquake (2001); and the Indian Ocean tsunami (2004). This propelled the political leadership across party lines to recast the weak disaster management system that was in place. Parliament enacted the Disaster Management Act in 2005 as a foundational legislation that lays a comprehensive framework enabling governing bodies to be created at the national, state, district and other local levels to discharge assigned tasks and responsibilities towards the management of disasters. At the apex level, the National Disaster Management Authority (NDMA) was constituted to formulate policies and approve the national plan for disaster management. The states were no longer the final authority in formulating their respective plans and had to follow the broad guidelines laid out by NDMA.[38] This coordinated, structured approach was a marked departure from pre-2004.[f]

It is well-established that population levels and growth rates are key drivers of the consumption of energy and other resources. India's population has steadily risen while the decadal population growth rate continues to decline—from 24.8

e India was one of the first countries in the world to have a full-fledged ministry dedicated to renewable energy.

f The Disaster Management Act covers disasters such as cyclones and tsunamis, as well as those with slow onset like floods, droughts, famine, and disease outbreaks.

percent during 1961–71 to 21.3 percent from 1991 to 2001, and 17.6 percent, 2001–2011. Today India has a potentially massive demographic dividend: it has a huge youthful population who are aspirational and who could benefit from the rapid economic growth of the kind that has been experienced in the last three decades.

At the same time, India remains largely rural; in the rural districts, essential infrastructure needed to achieve aspirations remain inadequate. Deep penetration of technology and cellular connectivity has only enabled the juxtaposition of these two grossly unequal faces of growth. Thus, India faces both challenges and opportunities in terms of managing its youthful population while sustaining on the path of poverty alleviation and steady economic growth, with social and economic justice for all.

To be sure, India has achieved remarkable progress since independence. Many of the development indicators had improved by the time the country adopted a National Action Plan on Climate Change (NAPCC) in 2008. However, it still has a long way to go (see Table 1).

Table 1

A comparison of India (post-independence) and India before the adoption of National Action Plan on Climate Change (NAPCC)

Indicators	India (post-independence)	India (in 2007-2008)
Per capita annual income	**INR 11,570**[39] **or $ 231.4** (Based on 2011-12 prices) World Average GDP per capita (for 1950, in 2011 prices): **$ 3700**	**INR 35,430**[40] **or $787** (Based on 2004-05 prices) World Average GDP per capita (Current US$): **9428.52**
Per Capita Electricity Consumption ($) (kWh)	**16**[41]	**561.248**[42] World Average: **2843.6**[43]

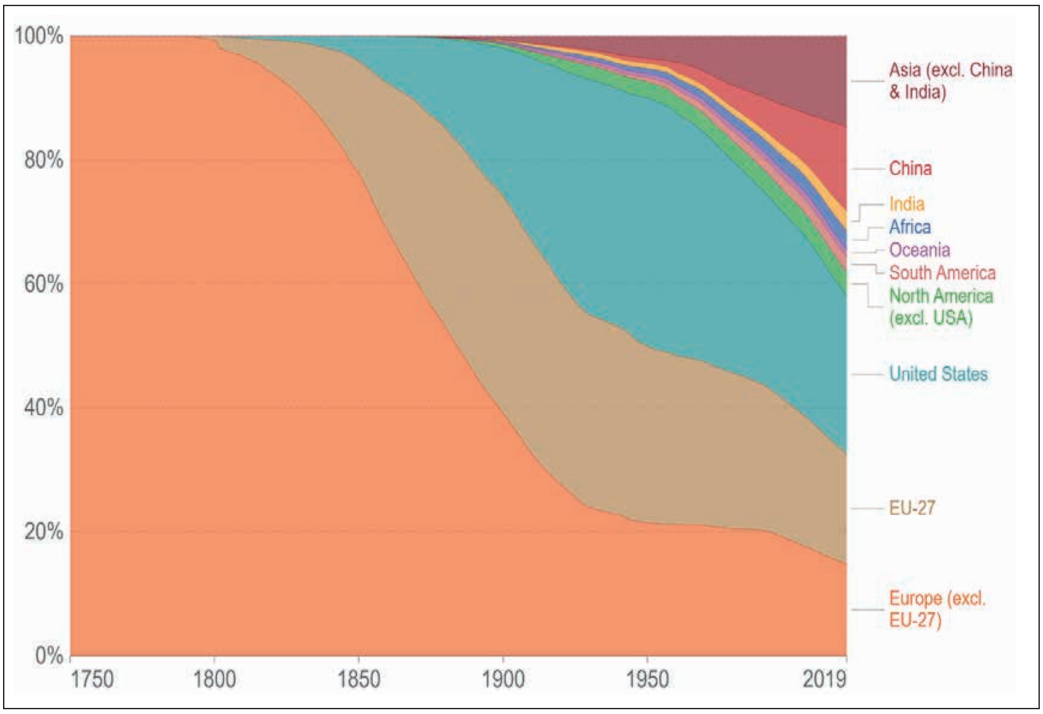
Food grain production (in million tonnes)	**50.8** (in 1950-51)[44]	**230.78** (2007-2008)[45]
Net Irrigated Area (in million hectares)	**20.9**[46] (17.60 % of total agricultural land)	**63.2**[47] (34.65 % of total agricultural land)
Length of road (all types – in km)	**3,99,942**[48]	**40,16,401**[49]
Life expectancy	**32 years** (As per census of 1951)[50]	**67 years** (As per census of 2011)[51]
Literacy rate	**18.32%** As per census of 1951)[52]	**72.98%** (As per census of 2011)[53]
Estimate of Poverty	Poverty Ratio (percent) in 1973-1974: **54.9**[54]	Poverty Ratio (percent) in 2004-05: **27.5**[55]
Percentage of Women in Total Labour Force (Note that the definition changed in the 1971 Census and therefore, the number of women recorded as full-time workers (main) was reduced.)	**28.98**[56] (in 1951)	**24.37**[57] (in 2008)

Weather and climate are two different but related terms: Weather indicates the short-term conditions of the atmosphere while climate is the average daily weather at a certain location for an extended period of over 30 years. In the climate change discourse, what is referred to is the changes in the measures of climate, including precipitation, temperature, and wind pattern over a long period. Actions or events at all scales—local, regional, or global—can lead to climate change. For instance, actions like land-use change, urbanisation, and reduction in tree cover can have a local climate impact while cataclysmic events will have a more global impact, like the K-T event that resulted from a 10-km-wide asteroid colliding with the earth and creating a nuclear winter subsequently, wiping out 70 percent of all species.[58] Climate change, in the current context, is due to anthropogenic factors, –or an increasing concentration of greenhouse gasses in the atmosphere because of human activities leading to an increase of temperature globally.

Unlike cataclysmic events of the past, the current anthropogenic global warming due to Green House Gas (GHG) emissions is a relatively slow process, with each GHG having a different lifecycle before it ceases to remain in the usual form. For instance, water vapour (1 to 10 days), methane (112+ years) is relatively short-lived than Carbon Dioxide (100-300 years), and Nitrous Oxide (120+ years). Of these GHGs, it is the CO_2 (Carbon Dioxide) which is the most significant GHG, based on its lifetime and larger quantum than other GHGs (280 parts per million in pre-industrial times compared to parts per billion magnitudes of other gases in the atmosphere) coupled with its relative global warming potential. Thus, the present discourse of Climate Change needs to be pegged on the accumulated stock of GHGs, and not the annual flow.

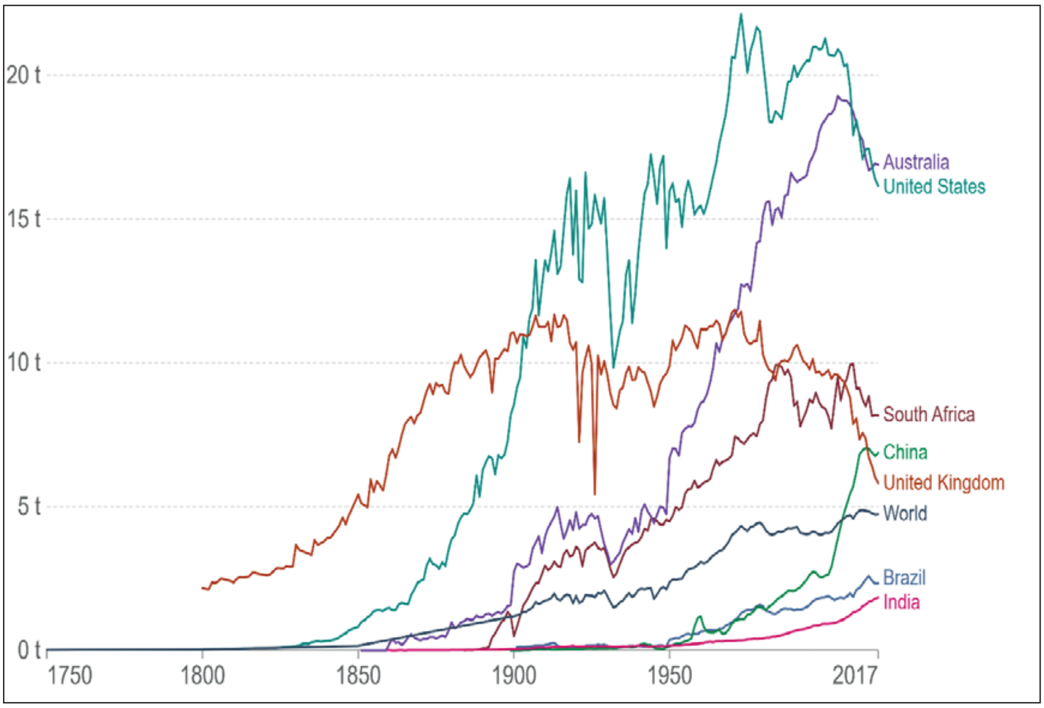
As illustrated in Figure 5, in the year 1900, almost the entirety of accumulated CO_2 emissions till then was from Europe (80 percent) and the US (20 percent). This was because only they had meaningful access to coal and oil. By 1950, 95 percent of the accumulated stock of CO_2 was still divided between Europe (50 percent) and the US (45 percent). In 1990, when a climate change UN treaty was being negotiated, the developed world accounted for around 80 percent of the accumulated CO_2. The latest estimates (2019) show about 60 percent of CO_2 stock being due to both Europe (35 percent) and the US (25 percent), with China accounting for 12 percent and India 4 percent. Since the Human Development Index (HDI) is connected with the per capita energy use, which in turn is linked with GHG emissions, it is interesting also to note that the global average of per capita GHG emission for the year 2017 is around 4.73T, with the US at 16.16T and UK 5.82T, while China is 6.86T and India 1.84T, the figures were far more skewed in 1990.[59] (See Figures 5 and 6).

Figure 5: Cumulative CO_2 emissions by region (calculated from fossil fuels and cement production only - land use change not included)



Source: Our World in Data[60]

Figure 6
Per capita GHG emissions (emissions from land use change are not taken into account)



Source: Our World in Data.[61]

The Intergovernmental Panel on Climate Change (IPCC) was set up in 1988 by the UN Environment Programme (UNEP) and the World Meteorological Organisation (WMO) to review and make recommendations regarding the physical science, the impacts and the response to climate change. The IPCC has so far submitted Five Assessment Reports and work on the sixth is ongoing; the Report of Working Group I on Physical Science Basis was submitted in August 2021.[g]

The successive IPCC reports have found that owing to temperature rise due to rising GHG, mainly carbon dioxide levels in the atmosphere, climate change is intensifying the water cycle. This in turn would bring more intense rainfall and

g Global Circulation Models (GCMs) form the core of IPCC's scientific assessments, which are predominantly based on published peer-reviewed literature.

associated flooding in some regions, as well as more intense droughts in others. The coastal areas will continue to experience sea-level rise throughout the 21st century and amplify permafrost thawing and the loss of seasonal snow cover in high mountains and across the tundra regions. The melting of glaciers and ice sheets and the loss of summer Arctic ice would also continue.

Globally, changes to the oceans would include warming and marine heatwaves, ocean acidification and reduced oxygen levels, all of which have the potential to adversely impact marine ecosystems and the populations that are dependent on them. In the urban areas, it is expected that some of the impacts would further amplify such as the effect of heat due to urban 'heat islands', urban flooding, and sea-level rise in coastal cities.[62, 63] According to the Working Group I Report of the Sixth Assessment Cycle of the Intergovernmental Panel on Climate Change (IPCC), human activities have caused a warming of 1.1 °C since 1850-1990, and when averaged over the next 20 years, global temperature is expected to reach or exceed 1.5 °C of warming.[64]

The impacts will be faced across all sectors. Water-related mortality, infectious diseases, and respiratory illnesses will be some of the health hazards while changes in crop yields and irrigation demand will impact the agriculture sector. Similarly, water supply and water quality will also be affected. Loss of habitats and biodiversity will also be a challenge. The forest composition along with its geographic range, health and productivity are also likely to change. The cryosphere will experience a recession or complete melting of glaciers and the coastal parts will encounter erosion of beaches and inundation due to sea-level rise and storm surges. It is expected that much higher expenditures would be required to protect coastal communities in the years to come.[65]

Two Working Groups (WG) of IPCC deal with the response to climate change, WG II with Adaptation and WG III with Mitigation. Climate mitigation means a reduction in the atmospheric GHG concentration through reduced emissions;[h] or through absorption of existing GHGs.[i] Adaptation, meanwhile, means sustainably countering the economy-wide adverse impacts, be it water management, agriculture sector, poverty eradication, disaster management, forestry & eco-system, gender disparities or health sector.[j] Adaptation measures need to be locally oriented while mitigation measures can have a wider span.

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h By, among others, higher energy efficiency, use of renewable/ nuclear/ hydrogen/ non-carbon sources of energy, fuel switch like using natural gas instead of coal, lifestyle changes, and taxation.

i By methods such as afforestation, carbon capture, and storage, among others.

j In other words, climate adaptation is the development of resilience to hazards, shocks or stresses caused by climate change.

In 1990, the UN took up the negotiations of a treaty on Climate Change in light of the First Assessment Report of IPCC. The UN Framework Convention on Climate Change (UNFCCC) was adopted in 1992 in Rio de Janeiro with the objective of stabilisation of GHG concentration to prevent dangerous interference with the climate system. In light of the science on GHGs, the first Principle adopted by the UNFCCC, in Article 3.1 was that the Parties will protect the climate system for the benefit of present and future generations based on equity and in accordance with their Common but Differentiated Responsibilities and Respective Capabilities (CBDR & RC). The principles also provided that precautionary measures be taken cost-effectively, Sustainable Development is a Right, and measures to combat climate change should not be a means to discriminate or restrict international trade. In Article 4.1 on Commitments, it is envisaged that besides CBDR, the Parties would take into account their national and regional development priorities, objectives and circumstances in their actions. Article 4.2(a) a soft target of the peaking of GHG emissions by 2000 for the Developed Countries and subsequent paras 3, 4 & 5 of this Article 4 relate to provision of finance, technology and capacity building by them to the developing countries. (UNFCCC – Articles 3, 4, 7(2b,2c) 22(2)).[66]

Some years later, in 1997, the Kyoto Protocol under the UNFCCC was agreed in light of the 1995 Second Assessment Report of the IPCC. It provided for legally binding targets for the developed countries and also a Clean Development Mechanism (CDM) for mitigation, cooperation between the Developed and Developing Countries involving financial and technical support. The US, after rejection by its Senate, did not ratify the Kyoto Protocol; Australia did likewise. This adversely affected the Protocol right as it was just beginning to be enforced.[k]

The Fourth IPCC Assessment Report of 2007 focused on the need to restrict global warming to 2 deg C and consequently at the Bali Conference of Parties (COP) it was agreed on Para 1(b) of the relevant decision[67] inter alia that all countries will take differentiated mitigation action. Before the Copenhagen Conference of Parties (CoP) in 2009, many countries submitted their Pledges for Climate Mitigation, which were formally anchored during the Cancun CoP of 2010. At the 2011 Durban CoP, negotiations were started for a universal treaty post-2020 under the Convention with a view to finalising it by the 2015 CoP. As a measure to provide mutual reassurance, at the Warsaw CoP in 2013, the Parties agreed to submit Intended Nationally Determined Contributions in 2015 well ahead of the CoP meeting, meaning also that a "top-down" target setting, as agreed in the UNFCCC or its Kyoto Protocol, was no longer on the table.

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k The first Commitments period, 2008-2012, started late because the Protocol came into force only in 2005 after its ratification by the Russian Federation. And just before its Second Period (2012-2020) began, Japan and Canada also opted out. The CDM had started well but failed due to a lack of demand.

The Fifth Assessment Report of the IPCC submitted in parts between 2013-14 provided the latest scientific underpinning, especially the serious consequences of a global temperature rise, to the negotiating process for the post-2020 treaty to be agreed at the Paris CoP in 2015. The Paris Agreement (PA) aims to strengthen the global response to the threat of climate change, in the context of sustainable development and poverty eradication with a temperature goal of well below 2 Degrees Celsius and aspiration of 1.5 Degrees. The PA will be implemented to reflect equity and CBDR & RC, in the light of different national circumstances.[l,m ,68,69]

In the successive CoPs held between 2016 to 2019 after Paris, the Paris Agreement Work Plan was agreed on except for some issues. These include the market and non-market mechanisms, which would replace or enlarge CDM. PAWP was expected to be finalised at the Glasgow CoP in 2020 but because of the Covid-19 pandemic, the Glasgow CoP was postponed to 2021. While the Paris Agreement came into force from 4 November 2016, the NDCs thereunder began to be implemented from 1 January 2021, overshadowed by the pandemic.

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l In the PA there is also bindingness to undertake and report climate actions but not to achieve the results, in continuation of the 'bottoms up' trend of submitting INDCs. New provisions have been introduced in the PA regarding Transparency, Global Stock Take (keeping the 'top down' option alive) and Compliance. Paras 22 and 24 of the Decision Text to which the PA is annexed provides that the INDCs submitted already need not be resubmitted though they could be clarified or elaborated.

m The nature of the PA, that is whether it is a new climate treaty or under the UNFCCC, is no longer in doubt after its ratification in 2016 by President Obama, opting-out in 2017 by President Trump and re-ratification in 2021 by President Biden, all acting under their respective Presidential power relating to an implementation agreement; ; rather than involving the Senate as was done for substantive treaties like the UNCLOS, the Vienna Convention on Ozone Depleting Substances & its Montreal Protocol, or the UNFCCC and its KP.

Owing to the country's massive size, diversity, and other natural circumstances discussed in this paper, almost all the impacts outlined earlier are applicable in some part of the country or the other. The UNFCCC, in its articles 12 & 10, envisages submission and consideration of National Communications (NATCOM) by the Parties containing *inter alia* inventory of emissions by sources and removal by sinks, steps taken to implement the UNFCCC, and any other relevant information. So far, India has submitted two NATCOMs. In the Cancun CoP of 2010, the Parties agreed, in addition, to submit Biennial Update Reports (BUR) to their NATCOMs and India has submitted three such BURs.

A 2020 report of the Ministry of Earth Sciences provides the latest, detailed assessment of climate change in the Indian region. India is expected to experience a temperature rise of approximately 4.7 °C and 5.5 °C relating to corresponding temperatures in the recent past (average of 1976-2005) under RCP 8.5 scenario, the worst-case one. Thus, heat stress will amplify, particularly over the Indo-Gangetic and Indus River basin. The heat content in the tropical Indian Ocean is also projected to rise. As far as precipitation is concerned, the regional models for the Indian Region project an increase in variability of precipitation with a substantial increase in daily precipitation extremes along with an increase of the mean. Climate models also indicate that increased variability of monsoon precipitation and increased water vapour demand will lead to a high likelihood of droughts becoming more frequent and intense, as well as expansive in area, under RCP 8.5. In the case of sea-level rise, the Indian scenario is even worse, with a projected rise of 300 mm relative to the average (1986-2005) under RCP 4.5, a conservative scenario; the global mean is approximately 180mm.

Salinity ingress and high storm surges during tropical cyclones are already a concern, especially on the East coast. Climate models for India further project increasing intensity of tropical cyclones in the Northern Indian Ocean while there is going to be a marked decrease in snowfall in the Hindu Kush Himalaya even as the annual precipitation is likely to increase.[70] All these changes will further impact human systems and the economy in ways that have already been discussed in the earlier sections of this paper.

Therefore, in this era of even greater climate uncertainty, India is faced with the twin challenges of sustaining its economic growth and eradicating poverty while adapting to the imminent threats of climate change and contributing to the global mitigation efforts. India's second NATCOM to the UNFCC of 2012, supplemented by successive BURs, sought to list these impacts while emphasising that India's large population directly depends upon climate-sensitive sectors like agriculture and forestry and therefore the country has much to be concerned about. Furthermore, India's national development goals span various systems like habitats, health, energy, and infrastructure investments, which would be adversely impacted by climate change.[71]

India's climate response, while based on the UNFCCC and its Paris Agreement, is in accordance with modern India's response to its natural climate variability. It is also based on its Constitutional and cultural ethos, as outlined in relevant sections of this paper.

India has been engaging in adaptation to the existing climate variability, which was much higher than that prevailing in most parts of the world. Successive governments in India have prioritised the enhancement of the country's overall adaptive capacity. This is in recognition of the fact that inadequate preparedness will derail India's aspirations for sustainable and equitable development and poverty eradication. India's domestic circumstances would indicate that most of the projected climate impacts arising basically from increased variabilities of temperature and rainfall are already being tackled; except for some novel impacts like a glacial retreat and sea-level rise.

While the strengthening of coastal areas against storm surges and sea-level rise is practicable, there are no easy solutions for the accelerated glacier retreat, some retreat already having taken place as part of the natural cycle over the last two centuries. Since climate change is riddled with unknowns, India now needs in a time-bound manner to eradicate poverty, climate-proof its economy, and enhance the adaptive capacities of people, communities and institutions. Achieving all this will need to be underpinned by focused local-level studies since climate adaptation planning and execution will have to be made locally.

For climate change mitigation, India has been making decisions based on its natural endowments—for example, trying to substitute oil and natural gas with solar/wind/nuclear and hydro energy, and stressing on energy efficiency thereby partly decoupling its economic growth from GHG emissions. The developed world has reduced its carbon emissions basically by switching from coal to oil and natural gas: the US exploited shale oil and gas; the EU, Russian natural gas; France took recourse to nuclear power; and Norway, to hydropower.

These options have not been practicable for India, with its large import dependence on hydrocarbons and coal being its primary energy source. Wind energy has limited potential; nuclear energy has problems in fuel availability; and hydro projects carry social and seismic stability issues. India is therefore left with solar energy, forestry, and bio-energy as the three possible alternatives. However, solar power suffers from the intermittency problem. There is no output when it is dark or overcast and battery storage at grid-scale is yet to take off. Bioenergy is costly and needs diversions from the food chain. Lastly, for baseload, there is no ready alternative presently except for coal or nuclear power.

Carbon mitigation for steel and cement industries, both vital for India, is not practical anywhere globally and Carbon Capture and Storage (CCS) is yet to succeed globally. What is most important is that despite the provisions of climate treaties, the setting up of organisations such as the Green Climate Fund (GCF), and pious declarations of intent, no meaningful flow of climate finance or climate technology has taken place. The Indian energy transition is sought to be carried out based on its stressed resources. Thus, India's mitigation efforts need to successfully tackle these constraints and uncertainties without crimping its agenda for equitable development.

After the UNFCCC came into force on 21 March 1994, India continued to play a role in setting up the relevant institutions, rulemaking, as well as the finalisation of the Kyoto Protocol in 1997. After Kyoto Protocol came into force on 16 February 2005, India participated actively in the CDM, gaining the highest number of Carbon Emission Reduction Units (CERs), next only to China. Over those years, from 1992 to 2007, India pursued its sustainable development agenda, including energy efficiency and non-conventional energy.

Consequent upon agreement to the Bali Action Plan of December 2007, envisaging all countries to take climate action under the principle of equity and CBDR, India announced its National Action Plan on Climate Change (NAPCC) in June 2008. The plan encapsulates India's development outlook based on its unique resource endowments, the overriding priority of economic and social development, and its adherence to a civilisational legacy that places high value on the environment and for maintaining ecological balance. The NAPCC comprises eight national missions of which two—solar energy and enhanced energy efficiency—were related to mitigation; one mission about forests (green India) was for both adaptation and mitigation; four missions, sustainable habitat, water, Himalayan ecosystem, agriculture-related to adaptation and there was one overarching mission about strategic knowledge for climate change.

The NAPCC was guided by the following principles: protecting the poor through inclusive, sustainable and climate-sensitive development; objectives of national growth and poverty alleviation; demand-side management; extensive and accelerated deployment of technology for adaptation and mitigation; innovative market, regulatory and voluntary mechanisms for sustainable development; unique linkages with civil society, Local Government Units (LGUs), and Public-Private Partnerships (PPPs). The Technical document annexed to NAPCC spelt out other priority areas such as advanced technologies, disaster management, health sector, and coastal areas protection. The Technical document also listed climate finance and technology issues and the need to enhance the implementation of the UNFCCC. The choice of the NAPCC Missions and other priority areas is in accordance with the natural circumstances outlined earlier in this paper.[72]

Although the NAPCC was publicly announced and implemented thereafter, the first international announcement regarding climate mitigation was formally made by India in November 2009, just before the CoP 15, in the form of the Copenhagen Pledge which was thereafter submitted to UNFCCC in January 2010. In its Pledge, India proposed voluntarily to reduce the emission intensity of its GDP by 20-25 percent by 2020 in comparison to the 2005 level. The Pledge was to be subject to relevant national legislation and policies as well the UNFCCC, particularly its Article 4.7 which stipulates that economic and social development, and poverty eradication are the overriding priorities. It is relevant that the emissions from the agriculture sector would not form part of the emission intensity assessment. The Copenhagen Pledge of India reflects its intent to contribute to global mitigation efforts while protecting its vulnerable agriculture sector and pursuing its national priorities.[73]

As has been noted earlier, for mutual reassurance, it was decided that INDCs would be submitted well before the Paris CoP—i.e., before the contents or binding nature of the proposed Agreement were known. India submitted its INDCs on 2 October 2015. India's INDCs were premised clearly on a "best efforts" basis and not on any specific temperature goal or shared vision which were still, to begin with, under negotiation. Indeed, amongst the G-20 nations, India is the only one whose NDC meets the requirements of the 2 deg-C goal subsequently agreed at Paris.[74]

The propagation of a sustainable way of living based on conservation and moderation, as well as the adoption of a climate-friendly and cleaner path to economic growth, preceded the three mitigation contributions. The emission intensity reduction contribution is a progression to the Copenhagen Pledge of 2008. A subsequent explanation in the INDC document states that there is no binding need for any sectoral action, including the agriculture sector. The contribution relating the electric power installed capacity mentions non-fossil fuel-based resources, thus keeping the door open for nuclear and hydro energy should future climate impacts so require. Moreover, the help through the transfer of technology and international finance is listed, being an essential factor for the implementation of this contribution. The forestry contribution comes just after the adaptation contribution listing various vulnerable sectors, including disaster management which was less prominent in the NAPCC of 2008. Fund mobilisation and capacity building, together with cutting-edge research, are the last two contributions. Eight priority areas have also been listed after the NDCs, of which climate-resilient infrastructure and enhancing climate resilience are noteworthy. The INDC document also promises that its implementation will be protective of vulnerable sectors and segments of society.

The last significant communication that India made to the UFCCC was on 2 October 2016 when it formally ratified the Paris Agreement. India's Declaration is given below in full, encapsulating as it does, the Country's domestic imperatives and understanding of the international climate scenario:

Declaration:

"*The Government of India declares its understanding that, as per its national laws; keeping in view its development agenda, particularly the eradication of poverty and provision of basic needs for all its citizens, coupled with its commitment to following the low carbon path to progress, and on the assumption of unencumbered availability of cleaner sources of energy and technologies and financial resources from around the world; and based on a fair and ambitious assessment of global commitment to combating climate change, it is ratifying the Paris Agreement*."[75]

This section closes with a look at how India has implemented its Climate Change promises. India's emission intensity of GDP has reduced by 24 percent between 2005 and 2016 and the country is well on-track to meet its Copenhagen Pledge. Going beyond its NAPCC, India is implementing one of the largest renewable energy expansion programmes in the world, with a target of achieving 175 GW of renewable energy capacity by 2022 and the overall target pegged at 450 GW. The shift to renewables is particularly captured in the increase in installed capacity of solar energy – an increase by 14 times from 2.63 GW in March 2014 to 36.91 GW in November 2020.[76] Energy efficiency is also on the rise, as is the forest cover in the country. Much progress has been made since the formulation of NAPCC, and India's GDP per capita (current US$) has risen substantially – from $ 998.522 in 2008 to $ 1900.707 in 2020.[77] India's electric power consumption (Kwh per capita) has also increased from 561.248 (in 2008) to 804.51 (2014).[n],[78]

On the international front, India has co-launched the International Solar Alliance along with France at the Paris CoP on 30 November 2015.[79] During the UN Climate Action Summit of 23 September 2019, India also launched the Coalition for Disaster Resilient Infrastructure (CDRI) – a partnership of national governments, UN agencies and programmes, multilateral financial institutions and mechanisms for development, the private sector, and knowledge institutions.[80] In November 2020, the Apex committee to Implement Paris Agreement (AIPA), was set up under Sec 3(3) of the Environment Protection Act 1986 amongst others for implementing NDC of the Paris Agreement.[81]

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n The global average for GDP per capita and electric power consumption is 10,925.728 (2020) and 3131.68 (2014), respectively.

Conclusion

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Thus, India has demonstrated its intention to convert the climate challenges, which are mostly a product of its natural circumstances, to opportunities. India has embarked on the path of climate action based upon its domestic imperatives and civilisational ethos, in accordance with its treaty obligations. While it may be assumed that India will continue to take strides in that direction, any broad deviations would be unsustainable in the long run considering how India's natural circumstances continue to play a dominant role in its economy and public life.

> India is intent in converting its climate challenges, which are mostly a product of its natural circumstances, to opportunities.

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