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Responding to climate change: What should Karnataka and India do?

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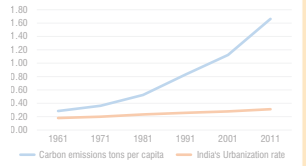

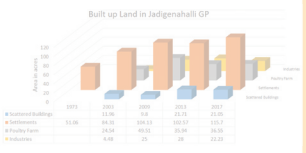

Introduction

The sixth annual assessment report of the Intergovernmental Panel on Climate Change (hereafter IPCCAR6) was released in August 2021. After assessing the technical, scientific and socio-economic information pertaining to climate change, IPCCAR6 concluded that earth's climate is getting warmer and that temperature in about a decade will probably go past the warning level. Issuing a 'code red for humanity', the report outlines the socio-economic implications for humans all over the planet.

IPCCAR6 points out that human influence has contributed to global warming, rapid and unprecedented changes in the atmosphere, ocean, cryosphere and biosphere in all regions across the globe resulting in hot extremes, marine heatwaves, heavy precipitation, agricultural and ecological droughts, intense tropical cyclones and reduction in ice cover. Many changes that are irreversible for centuries to millennia are taking place in the ocean, ice sheets and global sea level on account of the past and future greenhouse gas emissions. The report warns that global surface temperatures will continue to increase until at least the mid-century, unless there is a substantial reduction in carbon dioxide (CO_2) and other greenhouse gas emissions in the coming decades.

In view of the bleak picture painted by IPCCAR6 on climate change, the Institute for Social and Economic Change (ISEC), Bengaluru, organised a webinar on "Responding to climate change: What should Karnataka and India do?" on August 19, 2021. At this webinar, the faculty members who have undertaken research on climate change at ISEC presented issues in relation to climate change emerging from their long and diverse research experience on Karnataka and India, and provided suggestions on countering the ill-effects of climate change. This policy brief summarises the research and offers suggestions for addressing various aspects of climate change, including economic development, financing, relationship with urbanisation, effect on vulnerable groups and ecological regions.

Climate change: A disaster of and for economic development

Krishna Raj (2016) observes that a high carbon economy helped in achieving faster economic growth in recent decades; but carbon poses great threat to future economic development. IPCCAR6 projects that at the present rate of increase in greenhouse gases, the world will fail to limit the world's average temperature to less than 2^0C. This spells a catastrophe for the economic development and wellbeing of the people in India. The growth of a high carbon economy is linked to the neo-liberal economic policy of capitalism of mass production and consumption adopted by all countries of the world since 1980s. The economic cost of climate change is estimated to be around 5-10% of India's GDP annually (Krishna Raj, 2016).

Krishna Raj (2021) finds that realising a Low Carbon Economy is limited as the government aggressively pursues economic development with increasing promotion of foreign direct investment for undertaking economic activities to create jobs. In 2019, the total global climate finance was 579 billion USD, of which 44% was public finance while 56% was private finance. The concern is that about 93% of the total global climate finance was spent on mitigation activities while hardly 7% was spent on adaptation activities with potential to reduce greenhouse gases. While finance from the private sector flows mainly to transport and renewable energy, that from public sources goes to energy efficiency, adaptation, land use, and others, apart from transport and renewable energy. Committed to the Paris Agreement, India aims to reduce emission intensity of its economy by 33%-35% as compared to the 2005 level and increase the forest cover to reduce CO_2 levels equivalent to 2.5-3 billion tonnes by 2030. But while climate change targets demand the allocation of Rs 11 lakh crore, the actual climate finance was only Rs 1.37 lakh crore in 2018. Deficient climate finance may thus limit realising India's climate change targets.

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Global warming and vulnerable groups

Research on vulnerability to climate change is critical for designing local and national level policy as the socio-economic status of diverse communities will have a bearing on their adaptation to climate change. Global warming will adversely affect vulnerable groups - such as the elderly population, children and urban informal workers, especially women and those belonging to scheduled castes and scheduled tribes, who are unable to adapt to unexpected climate related events of flood, drought, heatwaves and landslides. IPCCAR6 warns that climate will adversely affect poor countries in general and vulnerable groups in particular.

The reason vulnerable groups are adversely affected due to climate change is because of their unfavourable socio-economic conditions (such as low income, lack of assets, low education), which are the determining factors in the event of loss and damage due to weather related events. The frequency of climate related events is also expected to increase in the next two or three decades. Further, millions of people will be pushed into poverty and inequality, food insecurity, water scarcity, conflict, migration and unemployment which are the major socio-economic aspects accentuating an unfavourable response to climate change in India. For the vulnerable groups who live below poverty line, climate change is another burden for their lives and livelihoods.

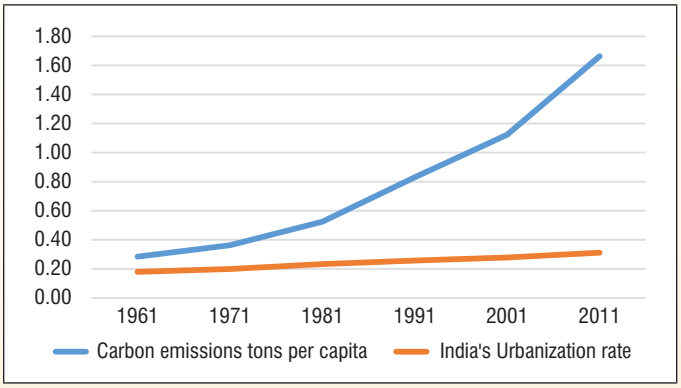
Karnataka is one of the most vulnerable states to climate change. Balasubramanian et al (2019) found that 65% of sample households in four Karnataka districts were highly vulnerable, 30% moderately vulnerable and 5% were less vulnerable to climate change and weather related events. It was found that climate change affected the income and livelihood of the vulnerable groups on account of declining wage rates and rising food prices. Due to climate extreme events, monthly wage loss was estimated to be between Rs 10,000 to 15,000 on account of the loss of employment. Nearly 69% of the vulnerable households reported a rise of Rs. 500 to Rs. 1,250 in food prices after the climate change related disasters. Persons from over 57% of the households reported migration to nearby cities in search of employment. About 65% needed emergency help to recover from vulnerability to climate change in Karnataka.

Carbon emissions, climate change and urbanisation

Sridhar (2018) raises questions on two aspects of urbanisation from the viewpoint of climate change and carbon emissions: 'While cities are blamed for climate change, is urbanisation leading to carbon emissions in India? Are cities to be blamed for depleting agricultural income?'

Figure 1, which presents the trends in urbanisation rate and carbon emissions per capita for India during 1961-2011, shows that urbanisation was increasing very slowly while carbon emissions were rising quite steeply implying that urbanisation was not the cause. McCarney (2009) found that Palo Alto, California, USA, was the world's most carbon emitting city at 11 tons per capita, while the least was Sao Paolo, Brazil, at 1.9 tons per capita. In India, Ramachandra et al (2015) reported that the maximum carbon emitting city was Chennai at 4.79 tons per capita. So, at least based on these data, carbon emissions in Indian cities, with many of them being devoid of power, are way below that of cities in the West.

Figure 1: Urbanization and Carbon Emissions, India, 1961-2011



Sources: Central Statistical Office, World Bank, and author's analysis

Using time series data for India over 1960-2011 from the World Development Indicators, Sridhar (2018) presents evidence on the causes of carbon emissions, correcting for stationarity, and finds that urbanisation has no significant effect on carbon emissions per capita or carbon emissions per sq km of land area. Rather the percentage of electricity from fossil fuels such as coal had a positive effect on both measures of carbon emissions, in addition to GDP.

As supporting evidence to the positive relationship between electricity consumption and carbon emissions, Paul et al (2012) report that Kalaburagi in Karnataka is the highest consumer of electricity at 957 KW hrs per household (compared with 207 KW hrs per household for all India). In vehicle congestion, another risk factor for carbon emission in cities, Paul et al (2012) report that Hubli-Dharwad is the highest at 474 vehicles per KM of road. Naturally, they find that Hubli-Dharwad and Kalaburagi are the worst in poor air quality, measured as violation of Respiratory Suspended Particulate Matter (RSPM) over the permissible levels.

Using district level for India, Sridhar (2016) also finds that climate change indicators such as rainfall, extreme temperature differences, and urbanisation do not affect agricultural per capita income. In some specifications, Sridhar (2016) finds that urbanisation leads to increased agricultural income, possibly due to remittances. Coastal districts experience decreased agricultural income, plausible due to their salinity.

Hence based on this research, urbanisation does not appear to directly worsen climate change or unfavourably affect agricultural income.

Impact of climate change on agriculture and water sectors

With 60 per cent of India's population depending on agriculture and the climate change affecting agriculture and water resources, water scarcity, which is very high in India due to drastic reduction in the per capita water availability to 1486 cubic meters, will limit economic growth in India and cost the economy in terms of pollution control, water recycling, and drinking water purification. Against this background, Krishna Raj (2020) shows contrasting ways of Bengaluru and New York addressing climate change and urban water supply. Bengaluru is likely to face an acute drinking water shortage with the reduction in water availability in the Cauvery river basin, mainly due to variation in precipitation levels. New York, on the other hand, increased per capita availability of drinking water despite a growing population due to its

long-term climate action plan and by securing and conserving Catskill and Delaware watersheds.

Climate change and vulnerable ecological regions

Prioritising ecosystems vulnerable to changing climate - such as the biological bridges, landscapes dominated by agriculture in the Western Ghats, the Eastern Ghats, the Himalayas etc., studies done by Nautiyal (Nautiyal et al., 2016 and Nautiyal 2021a) highlighted the issues related to climate change and its impacts on socio-ecological systems in some of the landscapes in India. Two such ecologically important biological bridges in Karnataka are the BR Hills and the MM Hills ranges which connect the Western Ghats to the Eastern Ghats. Nautiyal (2021b) concludes that due to the biotic and abiotic stresses, the societies in both the regions are deprived of the resources which are required to sustain their livelihoods. For example, the contribution from non-timber forest products sector to household income declined from 50% about couple of years back to 4-5% in recent times. Such a shift in their income source impacted the sustainability of the resource flow from the natural to man-made ecosystems. He also finds an adverse impact of climate change on crop productivity, vegetation changes, resource availability, resource flow and thermal heat changes in the Western Ghats region of Karnataka resulting in an increase in precipitation in some of the areas of Western Ghats by 3.8 mm per year (high intensity rains in shorter time) with increase in local temperature. This has negatively impacted the production of the major crops in the region.

The minimum air temperature is also constantly rising from 1994 to 2020 which is around 1^{0}C. Increase in urbanisation and industrial activities are the most important factors influencing land surface temperature and air temperatures in the Himalayan region, resulting in a massive glacier ice melt. IPCCAR6 indicates that the cities are warmer than the surrounding areas due to urban heat island (UHI) effect, although the report points out that, due to inadequate data, the relationship between cities and carbon emissions cannot be firmly established. Nonetheless, the urban heat island alters the water cycle and increases surface runoff intensity, thus impacting the urban ecology. A strong correlation between the level of emission in urban environment and emergence of UHI is found (Nautiyal, 2021c).

Climate change and peri-urban vulnerability

Peri urban areas, located immediately adjacent to urban areas, are vulnerable to climate change risks given extensive damage to the peri-urban environments and rapid changes in peripheries with the increasing urbanisation and expansion of city limits. Urban and peri-urban sustainability and safety are therefore of growing concern. The exponential increase in population growth in Bengaluru region has resulted in an increasing demand for land in Bangalore Rural district, resulting in change in land use from agriculture to non-agricultural activities, leading to decrease in vegetation, waterbodies and reduction in groundwater table.

Hosakote taluk, a peri-urban area and one of the landscapes in the semi-arid tropical regions of Karnataka, depends only on groundwater for drinking, cultivation and industrial purposes. Groundwater levels declined as the abstraction has been a continuous phenomenon and overexploitation of groundwater has occurred to the extent of 223.5% on account of quest for potable water in the deeper zones

Old structure (Kalyani) at Jadigenahalli Gram Panchayat

House damages due to landslide in Kodagu

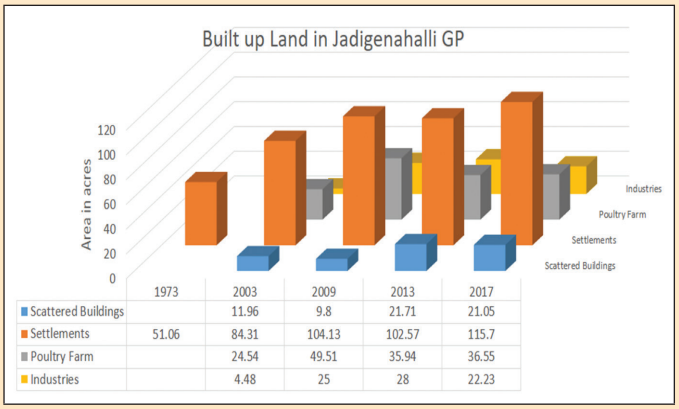
and farmers' desire to test their fortunes even at greater depths.

Manasi and Raju (2020) find that there is no water in most of the tanks which only collect local runoff duringthe rainy season and store water temporarily. Most of them are silted although a few are desilted. A detailed inventory in a Grama Panchayat (Jadigenahalli). revealed 480 groundwater withdrawal structures.

The study analyses the land use changes and pressure on groundwater (in terms of the number of structures and their spatial distribution) in Jadigenehalli Gram Panchayat area located in the peri-urban area of Bengaluru city. The numbers of borewells and defunct borewells have increased over the years. The depth of bore wells ranges from less than 500 to more than 1500 feet.

Figure 2 shows that the built-up area has increased during the period 1973 to 2017.

Figure 2: Changes in built-up area in Jadigenahalli Grama Panchayat



	1973	2003	2009	2013	2017
Scattered Buildings		11.96	9.8	21.71	21.05
Settlements	51.06	84.31	104.13	102.57	115.7
Poultry Farm		24.54	49.51	35.94	36.55
Industries		4.48	25	28	22.23

Policy suggestions

The government needs to mobilise adequate financial resources for the mitigation of greenhouse gases by 2030 as well as for adaptation. It should focus on adaptation to climate change rather than on mitigation. The budgetary allocation on adaptation to climate change should be substantially increased as this will enhance the capacity of people to adapt to climate change. The government also needs to utilise funds allocated to existing schemes to undertake measures to conserve land and water, and contribute to groundwater recharge.

Given that households belonging to disadvantaged groups will face the brunt of climate change, the following are needed: i) distribution of resources such as finance and technology, with special focus on direct cash transfers to affected communities based on the loss and damages due to climate change, ii) innovative social protection schemes especially to vulnerable groups for adaptation to climate change; iii) a strong climate policy at the state level to reduce vulnerability to climate change in future; and iv) resort to decentralised governance - be it

protection of environment or socio-economic development of groups, for coping and mitigation in all the regions.

In order to reduce carbon emissions, there is a need to promote energy efficiency, and cities must depend on renewable sources of energy, and reduce vehicular congestion and emissions by encouraging public transport. Cities should provide public transport, especially metro rail services and increase the fleet of electric vehicles. More research and data are required to assess the effect of urbanisation on climate change and vice-versa.

To reduce the UHI effect, the carbon footprint in the cities and megacities should be reduced immediately by: a) adopting city-specific approach considering the growth pattern, terrain, climate and building density; b) providing incentives for green building and adopting regulatory norms for high-end residential developers to develop energy-efficient infrastructure; c) introducing mandatory in-built solar PVs (Photovoltaic system- solar modules which consist of a number of solar cells to generate electricity) in cities getting a good amount of solar radiation; and d) planning decentralised but integrated urban energy systems based on wind and solar energy (based on climate and topography) for the cities with rapid future growth. Strong coordination is required among the line departments and research disciplines for coming up with useful and doable solutions to cope with climate uncertainties. The emphasis should be on developing region-specific circular economy models in the state, keeping its all diverse agro-climatic regions in view.

The following are to be initiated to address climate change concerns in Bengaluru, peri-urban areas and its hinterlands: a) Form Local Planning Authorities (LPAs) for regulation, coordination of urban development and land conversion for non-agriculture purposes; b) Ban cultivation and propagation of eucalyptus trees by amending the Karnataka Tree Preservation Act 1976 as this will help given the ill effects of extensive eucalyptus plantations; c) Support and promote the efforts of farmers in adopting to drip and sprinkler irrigation of crops; d) Reuse waste water from the lakes as this is an innovative local solution; and e) Preserve cultural practices and traditions such as conservation of medicinal plants, sacred forests and sacred ponds; f) Ensure drinking water availability by improving watersheds of Cauvery River Basin; and g) individual houses must conserve rain water and recharge groundwater acquifers, especially in Bengaluru as the water crisis is going to be serious in the future.

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Old Openwell (currently not in use) at Jadigenahalli Gram Panchayat

Borewell drilled in Tank bed at Jadigenahalli Gram Panchayat

Disused borewell located in scrubland at Jadigenahalli Gram Panchayat

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