

Global Warming

In the Indian Context

Nagraj Adve



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An Overview

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This text is based on conversations with many people from different states, chats with fellow-activists, public meetings, and talks. Among published material, I examined many of the state action plans on climate change, India's NDC, the recent landmark report on climatic changes in India from the Indian Institute of Tropical Meteorology and other government publications, EDGAR emissions data, IPCC reports, a few books, activist reports, and scientific papers. I have provided a few key references and sources of information at the end of the text, but left out citations to avoid making it overly academic.

It is mainly aimed at college and university students and teachers in towns and cities, other young people, activists, and anyone interested in a basic overview. Its broad purpose is to urge greater engagement, whether individual or collective, with climate change. The wonderful thing about engaging with climate change is that it connects with numerous issues, but which are often viewed in a fragmented manner. A few suggestions about what one could do, individually and collectively, are discussed at the end.

– Delhi, 3 October 2020

1

Understanding the science

What they told us in Gujarat

A few years ago, a group of us went to Gujarat to find out how climate change was affecting small farmers there. In villages in eastern Gujarat, they told us that the wheat and maize crops had been getting hit for some years during winter. Wheat and maize are important sources of nutrition for poor households in these and nearby regions. But because winters have been getting warmer, the dew (*os*) had lessened, or stopped entirely for the last few years. For those without wells—most of them poor households—dew is the only source of moisture for their crop. With less or no dew falling, either their crop dried up, or they were being forced to leave their lands fallow. In other villages in northern Gujarat, we were told of other effects: that it was not raining when it should, that lots of rain was falling in little time, etc.

When we asked them why the winters had been getting milder, the people's response there was interesting: "*Prakruti ki baat hai* (it has to do with Nature)." They did not consider it imaginable that human beings had the power to alter Nature on this scale. We do.

The Earth's *razai* is getting thicker

Whenever we burn coal, gas, and oil—the fossil fuels that are the engine of all modern societies, now and for the last 250 years—the carbon in those fuels combines with oxygen in the atmosphere to form carbon dioxide (CO₂). Like oxygen, it is invisible; nor can it be smelt. Unlike oxygen, carbon dioxide has the capacity to absorb and trap some of the invisible heat radiation emitted by the Earth. There are other gases that do this, such as methane (in natural gas) and nitrous oxide (from fertilizers), but carbon dioxide is the most important because it lasts for tens of thousands of years in the atmosphere.

Carbon dioxide though is not the villain; in fact, it is essential to life on Earth. Without carbon dioxide (and other greenhouses gases, including water vapour) being naturally present in the atmosphere, the Earth's average temperature would have been about minus 16 degrees Celsius (°C), and not habitable for humans.

But we have been adding to the amount of carbon dioxide, methane, and other gases in the atmosphere. We dig coal, oil, and gas out from under the Earth, and burn these fossil fuels to run factories, make cement, drive cars, generate electricity and light up our homes, make steel, run ACs, fly planes, transport goods, fight wars. Some of this is essential activity, some socially wasteful, and some extremely damaging. In such activity, the world as a whole emitted 38 billion tonnes (1 tonne = 1,000 kilos) of carbon dioxide from burning fossil fuels and cement production in 2019 (EDGAR data). Another five billion tonnes of carbon dioxide got added by cutting forests and from forest fires; when wood burns or rots, it emits CO₂.

The contribution of the other greenhouse gases, methane, nitrous oxide, etc, is calculated as an equivalent of carbon dioxide in their capacity to cause warming. Their share is about 10 billion tonnes of CO₂-equivalent. So, the total emissions of greenhouse gases worldwide currently add up to about 53 billion tonnes of CO₂eq. We keep adding more, year after year.

Our rate of carbon emissions is far more than the Earth’s natural capacity to absorb it. Since 2009, 29 per cent of all the carbon dioxide we have emitted has been absorbed by trees, soil, and grasslands. The oceans have taken up 23 per cent, making their waters more acidic. About 44 per cent has stayed in the atmosphere (scientists are unsure about the remaining 4 per cent). In 2019, carbon dioxide levels in the atmosphere averaged **409 parts per million (ppm)**. The pre-industrial average (11th–18th century) was 280 ppm. It was **315 ppm** when daily records first began to be maintained in March 1958 (Figure 1). It had not crossed 400 ppm for the last four million years. Atmospheric levels of all greenhouse gases measured have reached an alarming 496 ppm of CO₂eq, and rising by more than 3 ppm each year (NOAA data).

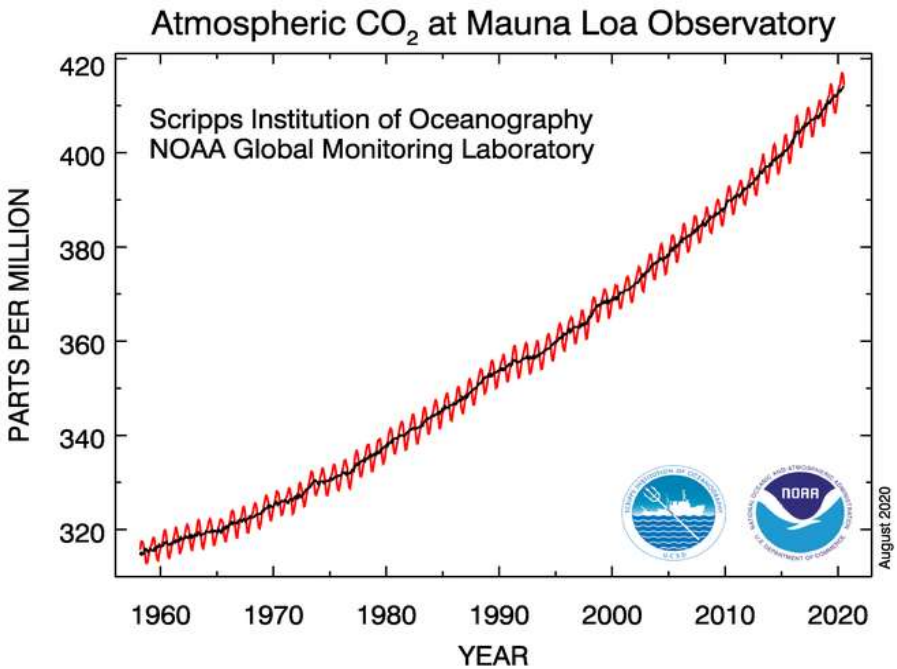


Fig. 1: Rise in atmospheric CO₂, March 1958–August 2020

Source: NOAA, <https://www.esrl.noaa.gov/gmd/ccgg/trends/mlo.html>

Carbon dioxide emitted anywhere spreads all over the Earth's atmosphere in about a year. Up there in the atmosphere, it acts like an invisible *razai*, or blanket. As we know, a blanket does not create its own warmth, it traps our body's heat. Similarly, greenhouse gases absorb some of the invisible, infrared heat radiation emitted by the Earth, and send it back towards the Earth's surface, hence cause global warming. Adding over fifty billion tonnes of greenhouse gases to the atmosphere each year is like adding layer after layer to the blankets we have already covered ourselves with, trapping even more heat.

The heat energy these greenhouse gases trap is staggering. It is equal to the energy of five Hiroshima nuclear bombs every second, 24 hours a day, 365 days a year for the last fifty years. So if you are a student who has just attended a 1 hour-long class, in that time greenhouse gases have trapped the energy equal to 18,000 Hiroshima bombs. Or 432,000 every single day.

Over ninety per cent of this massive heat goes into the oceans, because water has a high heat absorption capacity, and because a significant portion of the planet is ocean. What is left melts the glaciers and ice, warms the soils, etc.

How much warmer are we?

Global warming is measured by taking the air temperature just above the land and at the ocean's surface and seeing how it has changed over time. This is done at thousands of locations all over the globe, since 1880. **How much warmer has India become?** Average temperatures here have increased by about 0.7 degrees Celsius (°C) since 1901. We would have been much warmer but for air pollution (tiny aerosol pollutants) that is masking more warming.

The rate of warming has speeded up since 1981; our average temperature is rising by 0.17°C per decade. But temperatures are rising faster in some places, or during some seasons, more than others. For instance, the Himalaya is warming twice as fast. Northern India, where

l live, is warming by more than 0.5°C per decade during the pre-monsoon season, which is a staggering rate. And the surface temperature of the tropical Indian Ocean has risen by 1°C since 1951, mostly due to human activity.

What about **the world as a whole**? Scientists compare current average temperatures with the baseline average of 1880–1920, a reliable substitute for temperatures at the start of the Industrial Revolution. The Earth is currently, after accounting for short-term variability and natural fluctuations, **1.1°C warmer** than the pre-industrial average (Figure 2). The world is currently warming at 0.24°C a decade.

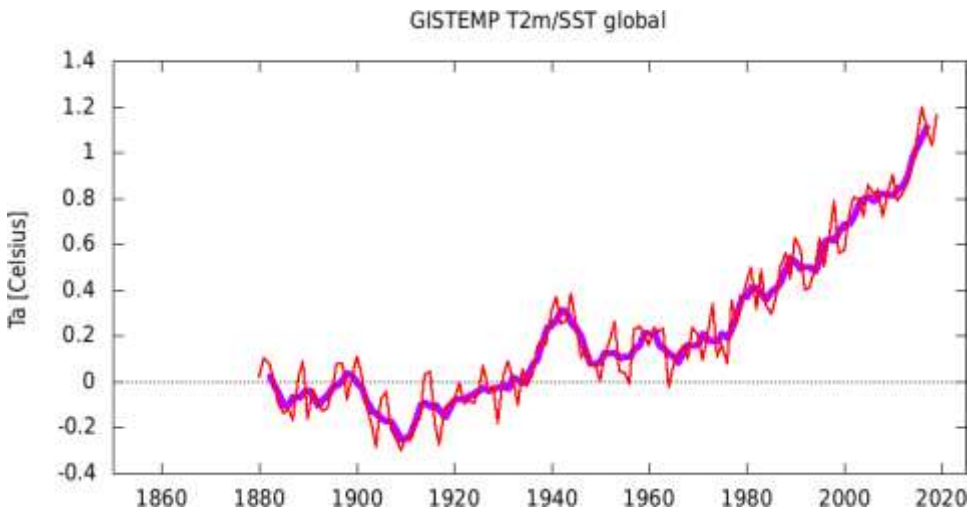


Fig. 2: Rise in global average temperature, 1880–2020

Source: World Meteorological Organization

However, like in India, some regions and ecosystems, such as the Arctic, North Africa, and southern Europe are warming a lot faster. These increases may not seem large, but planetary systems and many species are extremely sensitive to changes in temperature.

One crucial point here: all the warming does not happen as soon as carbon is sent into the atmosphere. There is a gap of many years between heat going into the oceans and the full surface warming this causes, which is yet to be felt.

A landmark IPCC report said in 2018 that this unavoidable, further warming would “likely be less than 0.5°C”, but this is over and above the current 1.1°C rise. And it could well be higher.

2

Roots of the problem

Who is responsible?

There are different ways of approaching this question. One is by **sector**. Including the heat and electricity used in each activity (indirect emissions), industry's share in annual CO₂ emissions worldwide is 31%, agriculture, deforestation, and forest fires 25%, buildings 19%, transport 15%, and energy 10% (IPCC data, figure 3). This sector-wise data implies that our interventions need to focus not just on coal/electricity, different systems need to change.

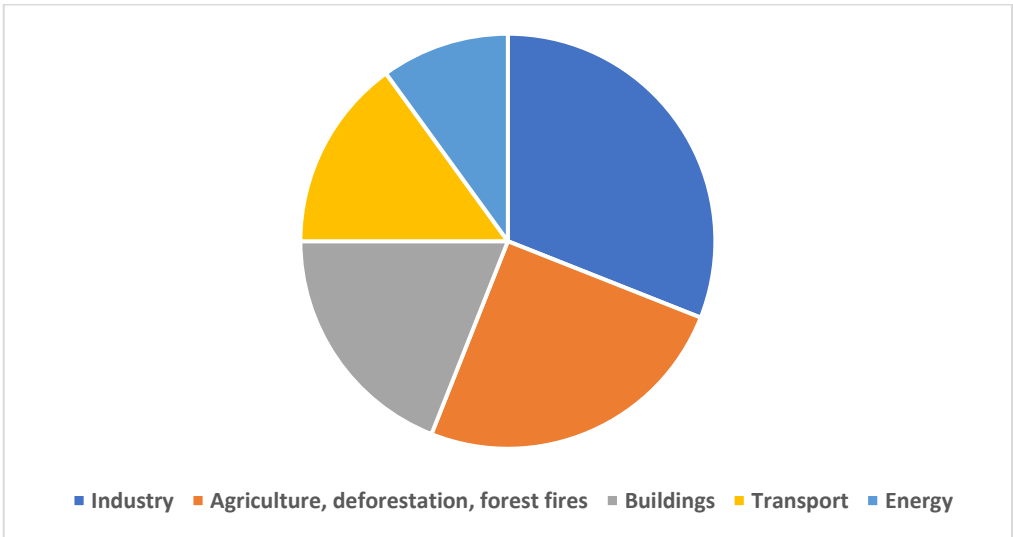


Fig. 3: Carbon dioxide emissions by sector, worldwide
Data source: IPCC (2014). Image: Nagraj Adve

Another approach is: which **areas** are emissions coming from? Only 30 per cent comes from rural areas. As much as 70 per cent comes from urban areas, which tend to have a lot of wasteful consumption by the better-off: air-conditioning, malls, etc. Cities also have a lot of structures, which though used by most people take a lot of resources and energy to build, such as Metros, flyovers, etc.

A third, very popular approach is to see which **nations** are responsible for how much emissions. Out of the total of 38 billion tonnes of carbon dioxide emitted in 2019, China (at about 11.5 billion tonnes) has leapt way past the United States (5.1 billion tonnes). India at 2.6 billion tonnes is a distant third, followed by Russia (1.8 billion tonnes), and Japan (1.2 billion tonnes). The EU's countries emitted 3.3 billion tonnes (Gt).

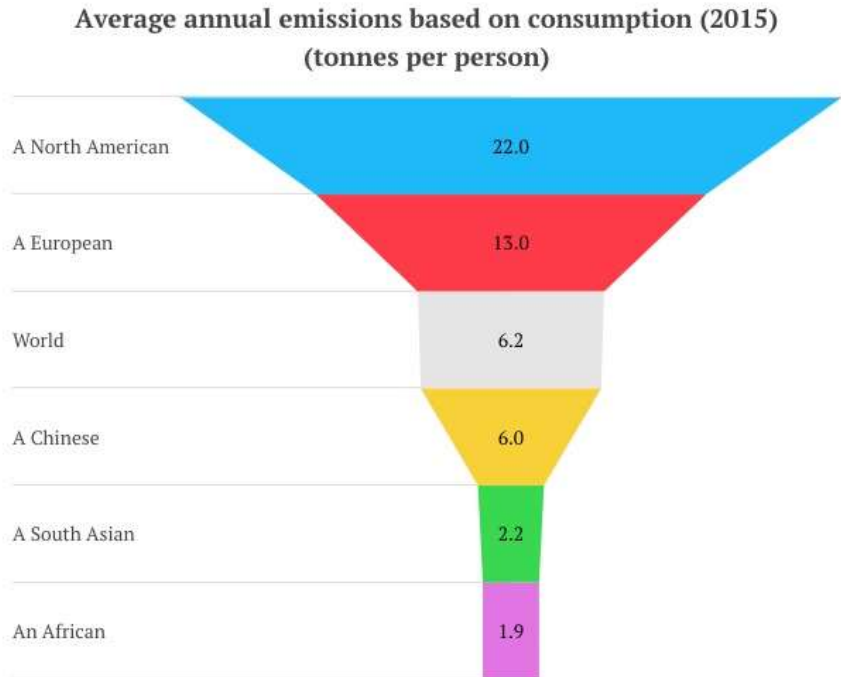


Fig. 4: Consumption-based greenhouse gas emissions, per capita
Data source: Chancel and Piketty (2015). Image: Rohit

Include methane and other gases, and India's total jumps to 3.7 billion tonnes of CO₂-equivalent (EDGAR data). Biomass burning in India, an essential energy source for poor households, contributes another 800 million tonnes of CO₂.

The US' emissions per person are a lot higher than China's or India's. It is even higher if one considers per capita emissions based on consumption (Figure 4). It is also higher if one were to consider the historical emissions of industrialized countries, what each country has emitted since the start of their industrialization.

Each of these frameworks would strengthen some of our demands, such as, say, that more public transport is necessary, or that rich, industrialized countries pay for the ecological damage they have caused. But they do not address issues at the heart of global warming. At the core of the problem are forces driving the modern capitalist economy, primarily the relentless quest for profits and growth. Also crucial are the growing differences in incomes, consumption, and wealth, in India and worldwide.

Underlying systemic drivers

The development of industrial capitalism powered by fossil fuels around the late 18th century marks a radical shift for what we are discussing, in multiple ways.

One, in the use of **energy sources**. Although coal was used in China and in London and a few other cities many centuries earlier, the scale of its use, with the spread of the industrial factory system in England in the late 18th century and the development of railways, was qualitatively different and massive. Emissions from oil began in 1870, and from gas in 1885. All these three fossil fuels—coal, oil, and gas—are very energy- and carbon-intensive.

Two, **maximizing profits**—from anything—became a primary driver. Corporations profit by using the cheapest sources of labour and raw materials. By making workers work for longer hours, and faster.

Companies also profit from exploiting Nature. They do so by gaining access and control over the common resources used by and meant for everybody, such as forests, coastlines, the seas, and rivers, and by land grabs.

It is not a coincidence that China became the biggest emitter of carbon dioxide in recent years. By the first decade of this century, manufacturing, urbanization, and other infrastructure had expanded massively in China, which has lots of coal and relatively cheap labour. By 2015, it was making a quarter of all the world's goods. Though this generated millions of stressful jobs, it came at a huge ecological cost, for Chinese people and for the world. But then corporations seek to *maximize* profit at any cost, the environment be damned.

Some of the surplus they extract is reinvested in the company to expand the business — buying new buildings, machines, computers. This accumulation, with the objective of making further profits, is a compulsion for all businesses. Because of competition, companies that do not do this would over time stagnate and close down, or be bought up by others. And because it is a compulsion, they can't stop trying to reinvest and expand. Maximizing profit, accumulation, and perpetually seeking growth are part of capitalism's DNA.

As a combined consequence of the qualities of fossil fuel energy and these tendencies of the capitalist system, the world economy, which grew at barely 0.1 per cent a year for well over a thousand years before 1700, has grown much faster since. Economic growth—calculated for a state, country, or the world as a whole—is a rise or fall in output, value of service, or income over a period, usually a year. Inching along for centuries before that, the world economy grew at 1.6% a year between 1700 and 2012, and in the last seventy years at over 3.5% a year (Piketty's data).

The world economy, which was 694 billion dollars in 1820, expanded to 49,000 billion dollars by 2019, 70 times as much. That is at constant prices for 1990. At current prices, the world's GDP was 88 trillion dollars in 2019 (World Bank data). It keeps ballooning, and in larger volumes.

Keeping in step, half of all carbon dioxide emissions since the mid-18th century has occurred just since 1986.

World economic growth is now expected to be sharply negative in 2020 due to the COVID-19 lockdowns and then grow again, perhaps at a slightly slower rate for a few years. Carbon emissions don't rise at the same rate as GDP; that depends on our energy mix of renewables and fossil fuels, and how efficiently our products and activity use energy. Over the past twenty-five years, CO₂ emissions for the world as a whole have risen 0.5 per cent for every one per cent rise in world GDP, that is, at half the rate of GDP growth. That improved in recent years as coal consumption slowed down in China, the US and other major economies use more gas, and the prices of renewables, particular solar power, fell sharply. Carbon dioxide emissions were flat for three years, raising illusions of a decarbonization of the world economy. But they rose again in 2017, and greenhouse gas emissions as a whole continued to rise throughout that period.

How will the global shutdown due to COVID-19 affect emissions? According to the Global Carbon Project team, "if some restrictions on economic activity remain worldwide until the end of 2020" (which is likely), CO₂ emissions will likely fall by about 7 per cent this year. It may well be higher. Though this dip is unprecedented, they will still be around 33 billion tonnes from burning fossil fuels and 38 billion tonnes including deforestation. As this is still far more than what the Earth can absorb, atmospheric levels will continue to rise. And I expect emissions will rise again from next year, in spurts.

In recent years, there have been shifts in world energy use, in electricity in particular. The expansion of solar and wind power has been impressive, helped by falling prices. Renewable energy, including hydropower, contributed 30% of electricity generated worldwide in 2019.

However, electricity is only one form of energy use. The share of new renewables, solar and wind, in total energy consumption is still small—just 4% worldwide in 2018, about 11% if one includes hydropower. This is

because the shift away from coal, oil, and gas in sectors other than electricity, such as transport, buildings, and industry, is at a very initial stage.

The science demands that annual greenhouse gas emissions should fall sharply, by 30 billion tonnes of CO₂-equivalent, for us to have a chance of avoiding dangerous levels of warming. Even in a COVID year with all the shutdowns, it will fall by not more than 5 billion tonnes of CO₂eq. **For greenhouse gas emissions to fall, it is not enough that renewable energy expands; the consumption of coal, oil, and gas use should reduce in absolute terms, not just as a share.** Coal consumption will flatten during and beyond COVID-19, but gas and oil consumption continue to grow each year. Worldwide economic growth, at 2.5% or thereabouts, would mean that greenhouse gas emissions will continue to rise in the foreseeable future, in spurts, particularly from the expanded use of oil and gas. This tells us how much we need to change the systems that consume fossil fuels.

To sum up, the roots of global warming lie in the inherent drivers of the world economy — maximizing profits and growth — and multiple inequalities. Those who see and discuss the issue only in nation-state terms or in other frameworks miss this underlying logic of the world economy. Most public meetings I attend are silent about it. We cannot hope to solve a problem if we have not defined it correctly in the first place.

These drivers have also contributed to a range of other ecological crises, both local (air and water pollution), and global, such as biodiversity loss, overfishing, deforestation, loss of species, resource depletion, plastic in the oceans, etc. An IBPES report released in May 2019 said that one million animal and plant species already face extinction worldwide, many within decades. Land degradation has occurred on 23 per cent of the global land surface. Urban areas have doubled since 1992. Plastic pollution has increased ten-fold since 1990. Wetlands have shrunk by 83 per cent since 1700. Though our main concern in this text is global warming, these extraordinarily grave environmental crises have common roots.

Unequal consumption, wealth, and emissions

How many gadgets does one use regularly at home? Does the house have an AC, more than one AC? Do we take a bus, the metro, or drive a car? Our carbon emissions depend on all of these things. When going out of town, do we take the train, or fly? Say, if you took a train from Delhi to Mumbai—1,384 kilometres—you would emit roughly 31 kilogrammes of carbon dioxide. In a plane, each passenger would emit over 150 kgs. And they would cause 13 times as much warming as someone taking the train, because planes emit condensation trails that trap heat.

All of this obviously depends on one's income and consumption. Differences of incomes and wealth in India have deepened over the last twenty-five years. There has been slight improvement in people's lives either due to government policy (for example, the expansion or upgradation of the village road network by over 600,000 kilometres since December 2000), or the spread of mobile phones, but this has been partial and unequal. The incomes and consumption of the better-off have risen sharply, and there's been an explosion in the wealth of the very rich: 1% of Indians own 58% of the country's wealth. However, most factory workers and security guards still earn Rs 8,000–9,000 a month. Most domestic workers take home Rs 5,000–6,000. Agricultural workers' earnings are seasonal. How much carbon dioxide can they possibly emit?

The fragile conditions in which people live and work became obvious to all with the desperate reverse migration home by millions of workers following the lockdown. The reasons are structural, not accidental, a consequence of years of contractualization and informalization of labour. It has been worsened by the Code of Industrial Relations and other labour laws passed by Parliament on 25 September. These condemnable laws attack working conditions, social security, and have made retrenchment and closure easier for establishments with less than 300 workers. All this creates the ground for even further inequalities in the future.

This deprivation and deepening inequality are reflected in energy access and use. Though the number of households with access to

electricity has risen in recent years, and there are fewer power cuts in many cities, yet tens of millions of people, including many in urban areas, don't have access to any electricity in their homes even now. Another tens of millions don't get it for many hours daily. This is despite the fact that India's electricity generation capacity has trebled over the past decade, to well over 3.5 lakh megawatts (372,693 MW as of 31 August 2020; Central Electricity Authority/CEA data).

Inequalities in emissions from current incomes and consumption are deepened by inequalities in emissions embodied in the products and property one owns. To take just two examples: in a car—which only a small proportion of India's population owns—3,500 kg of carbon dioxide is emitted just in making the aluminium that goes into the car, because the process is so energy-intensive. Or take a house. The larger or more *pucca* one's home, the higher the embodied emissions in it, because cement manufacture—like aluminium—is a huge source of carbon dioxide. And it has become common for the upper middle class or the rich in India to have at least two houses, one where they live and one more “in the hills”.

A nation-state framework of analysing global warming chooses to ignore these huge internal differences of income and wealth. Successive Indian governments have said, “India's per capita emissions are low”. It is hiding behind the poor. There is no one 'India'. In international negotiations, the government rightly argues for equity between nations. But the principle of equity should also apply within a nation, not only between nations. Greater equity implies that the rich in India should be made to consume less than they do, through higher income and wealth taxes, and a progressive carbon tax. That is one way there can be ecological space for the poor to improve their lives further. How we ensure that and yet generate decent work and employment for the millions of young people seeking jobs each year is a key question.

The deep inequality that runs through the causes of climate change also affects how its impacts are felt by people. This is discussed in the section that follows.

3

Global warming's impacts and urgency

Before we consider impacts in India and elsewhere, a few things are useful to keep in mind:

- Unlike most other forms of pollution, the source of carbon dioxide and where its effects are felt can be half a planet apart. The effects of carbon dioxide generated in the United States affects people in Orissa.
- A significant portion of carbon dioxide emitted today will remain in the atmosphere for centuries, influencing future climates.
- Impacts will worsen. Some of it is unavoidable. ***Our urgent intervention is needed to make sure that key ecosystems do not get irreversibly damaged, and that the situation does not spiral out of our control.***

Changes and impacts in India

Climate change adds on to all the other issues facing small and marginal farmers, the urban poor, and other communities—higher costs of seeds, fertilizers and other inputs; falling groundwater levels; insufficient income from small agriculture; landlessness among Dalits; takeover of common resources by industry; land alienation among Adivasis; land and other property not being in the woman's name; rising costs of health care in

urban areas, etc. Climate change impacts are both affected by and worsen the many inequalities in Indian society. Millions of better-off people also live in cities and towns on India's coasts and all over, and will face the effects of storm surges, sea level rise, flooding, and droughts. **But it is one of the worst violations of justice that those least responsible for global warming bear its burdens the most.**

The fall in economic activity due to the COVID lockdown does not reduce these and other climate impacts discussed below. In fact, whatever climatic impacts people face this year will be felt more severely by millions because of the stress from walking many kilometres home, the reduced access to incomes, food, and nutrition, the disruptions faced by farmers, and the loss of livelihoods being faced by tens of millions of others.

1. Less rain, more variability

The most widely-felt climatic change across India in recent years has been to rainfall patterns, with increased variability. According to a landmark report by the Indian Institute of Tropical Meteorology (IITM), Pune of June 2020, the southwest monsoon (June–September, from which India gets 75 per cent of its total annual rainfall) has reduced by 6 per cent since the 1950s. The decreasing trend is particularly severe in Kerala, the Western Ghats, Madhya Pradesh, Chhattisgarh, Uttar Pradesh, and parts of the northeastern states.

Even as it has lessened, the distribution of rainfall within this monsoon season has gone haywire. There are more frequent and longer dry spells. Moderate rainfall (50–100 mm/day) has decreased over much of the country. At the same time, extreme rainfall events (more than 150 mm/day) have been getting both more frequent, and three times as frequent over very wide areas, right from Gujarat to the Orissa coast, as compared to the early 1950s. No wonder farmers say that nowadays it does not rain for many days and then a lot of rain falls in a few hours or a couple of days! They say they first noticed these changes in rainfall 15–20 years ago, but it has worsened over the last 7–8 years.

A number of human factors, one must bear in mind, contribute to the reduction and increased variability in rainfall, such as deforestation and increased pollutant particles in the atmosphere. However, a key common cause of many of these changes is the warming waters of the Indian Ocean, the western Indian Ocean in particular. It is warming even more than India's landmass. This has reduced the temperature difference between India's landmass and the sea, which is weakening our monsoon in many regions. Ironically, a warmer ocean is also contributing to widespread extreme rainfall over the Western Ghats and central India because excess moisture is transported at times.

All of this is causing widespread damage to Indian agriculture and water supply. Nowadays, it often rains when it should not and does not rain when it should. Farmers sow crops expecting rains that don't arrive or come late. Or there is intense rain at the time of harvesting, which affects the standing crops and fodder. "The damage to paddy is at least 40 per cent," said an old farmer when this happened repeatedly in my village Adve in southern Karnataka. More intense rain also damages the topsoil. It causes flooding, and adversely affects people's access to water. Crop loss and damage due to unseasonal rains and large hailstones has become common.

Every season in the past few years has been affected: kharif, rabi, kharif, rabi. If it is drought in one season, it is unseasonal rains in another, intense rains in a third. Farmers are being constantly forced to react. Essential crops in India are still extremely rain-dependent: for instance, half the land under rice and wheat is dependent entirely on rainfall. Small and marginal farmers, those in dryland, rain-fed areas and without access to groundwater, poorer households mostly, bear the brunt of this. Often, they tend to be from Dalit or underprivileged caste households, or Adivasi communities. And when agriculture gets hit on a huge scale, agricultural workers too suffer loss of earnings. At such times, scant attention is paid to them with no concept of their being compensated.

2. Deadly heat

Over the last fifty years, heat waves in India have become more intense, frequent, and last for longer. It is caused partly by a warmer tropical Indian Ocean and drier soils. This makes the soils even drier, has affected the yields of key crops such as wheat and fruits, stresses cows, buffaloes, and other livestock, and damages forests. It has also worsened water problems in many places. Night-time temperatures are also less cool than they used to be, hence offering little relief to working people from the daytime heat. Coping with too much heat adds to the stress that urban people face.

The elderly, the very young, and working people are particularly vulnerable to greater heat stress. Workers having to labour in stifling conditions, 12–14 hours a day in industrial areas, is common across India. Those in other occupations are also vulnerable: urban construction workers (often women), agricultural labourers, road-building labourers, miners, and those who sell goods in pushcarts, or work outdoors in cities. *“Kya karein, paapi pet ka sawaal hai,”* some rickshaw pullers told me during an intense Delhi summer. In 2015, over 2,500 excess people died in India in a deadly heat wave worsened by global warming. This deadly impact is going to become more frequent, widespread, and lethal because of extreme heat and humidity in the future.

3. Sea level rise and other coastal effects

Sea surface temperatures of the tropical Indian Ocean have risen by 1°C since 1951. Any water that is warmed tends to expand and rise. Sea level rise along India’s coasts has accelerated to 3.3 mm/year over the past 30 years because of this and due to accelerated melting of the great ice sheets on Greenland and Antarctica.

Relative sea level rise in the West Bengal Sunderbans, which includes other factors, is much higher. It has meant a slow erosion of people’s lands, villages, homes, and salination of wells and fields. “We used to have

12 *bighas*”, a farmer told us. “Six have been swallowed by the water.” People repeatedly have had to shift inland, and tens of thousands of people have had to migrate in a search for a livelihood.

No occurrence brought home to me the reality of sea level rise more than the fate of a primary school on Sagar island in the Sunderbans. When a group of us visited four years ago, classes were on in full swing. A few hundred metres from the school stretched a mud embankment, broken in parts. And beyond that, the Bay of Bengal. Later, a senior teacher sent photographs of the school building. It had been completely destroyed by the advancing waters. Multiple factors are responsible, but there is a lesson this school teaches us, for what is unfolding in the Sunderbans today will occur along thousands of kilometres of our coasts tomorrow.

Global warming has other coastal effects. Some fisherpersons in southern Karnataka told me, “Our going out to sea has become more uncertain because there is no clear pattern of rainfall and storms any more. Sea currents are changing in unexpected ways. Wind direction has become unpredictable.” The space to do post-catch work, often done by fisherwomen, shrinks as the sea encroaches.

As it is, numerous ports, ultra-mega power coal plants, and other projects on the coast in Gujarat, Andhra Pradesh, Tamil Nadu, and elsewhere are damaging traditional occupations, and polluting agriculture, water bodies and local ecosystems. Now climate change adds to this damage. Rising sea surface temperatures is causing stronger storm surges. The salt water that comes in with storms, and that which seeps into the groundwater harms coastal agriculture and drinking water sources. Tens of millions of people practice agriculture, fishing, and other livelihoods in fertile, biodiverse stretches along over 7,500 kilometres of India’s coasts. They are all vulnerable as global warming’s effects intensify.

4. Extreme events

On 27 July 2005, 974 mm of rain fell in a single day in Mumbai. Lakhs of people had to wade several kilometres through chest-high water. Well over a thousand people died in the floods, mostly poor residents of North Bombay, as their houses and shanties on slopes collapsed. Some people drowned in their cars as waters rose above them. This is now happening periodically, bringing that great city to a halt. In late June 2019, more than the entire month's rain fell in two days. I have had a few conversations with people in Bombay about it; they get anxious every time it rains very heavily because it reminds them of what happened in 2005.

In June 2013, a very wide region of Uttarakhand was hit by intense rains, that too for three days. The devastating floods that followed may well prove to be India's worst climate change disaster. The extreme rain burst the wall (moraine) of a mountain lake, Chorabari Taal, just above Kedarnath. Its surging waters rushed downhill, destroying that town and villages below, submerging thousands of tourists, villagers, and workers. The National Disaster Management Authority said 11,000 people may have died. But the death toll could be even higher – the precise number of those who died will never be known – partly because there were so many Nepali and Indian migrant workers from elsewhere on duty then, at the height of the tourist season.

In Uttarkashi, Rudraprayag, Chamoli and Pithoragarh districts, and beyond, homes were swept away, the standing crop destroyed, fields submerged in river water or mud and debris, animals on which locals depend for manure and milk, drowned. Tourism—on which lakhs of locals and migrant workers depend for jobs and earnings—was hit. Children's schools were damaged. Women in particular were badly affected as they nurture households, cook food, get fodder.

Rainstorms, which occur over very wide areas and contribute to flooding, have increased in frequency and duration (by 15 days) since the early 1950s. These are caused by warmer seas, and more moisture due to a warmer landmass. Extreme rainfall events are happening regularly

nowadays—Uttarakhand in 2013, Srinagar in September 2014, Chennai in December 2015. Kerala in August 2018, which received over 40 per cent more than normal rainfall from June to mid-August; 350 people died, with landslides in Idukki and Wayanad districts and numerous towns flooded and homes extensively damaged (Figure 5).



Fig. 5: Flooding in Kerala, 2018

Source: Reuters

In every case, the societal impacts of intense rains are made worse by chaotic ‘development’ fuelled by the drive for profit—the builders’ lobby in Mumbai, run-of-the-river projects in Uttarakhand, and buildings shrinking the Pallikaranai wetlands in Chennai. In cities and towns in India, wetlands and water bodies are being shrunk and built upon. It is reasonable to ask, “Who is this development really benefiting?”

5. Spreading droughts

Droughts have increased in duration, area, and intensity since the early-1950s, in central India and southern peninsular India in particular, among other regions. Two key reasons are warmer temperatures due to global warming, and excessive warming of the Indian Ocean. Warming also causes already dry regions to get even less rainfall. But droughts are now happening in regions known for good rains, including parts of the North East.



Fig. 6: This was once a lake!

Source: Nagraj Adve

Global warming contributes to intensified droughts in interior regions. Some parts of Bundelkhand in central India (straddling Uttar Pradesh and Madhya Pradesh) have been experiencing droughts for most of the last twenty years. When a team of ours visited Bundelkhand some years ago, we saw a complete collapse of agriculture. Large lakes had

dried up for the first time (Figure 6), lakhs of agricultural workers, small farmers, and poor women were migrating with their entire families. Livestock were being abandoned to a dusty death because of lack of water and fodder. Survey teams led by Swaraj Abhiyan that visited Bundelkhand more recently found the same grim conditions prevailing.

Women face the brunt of this. We found old women unable to use the few functioning handpumps because the water levels had plummeted. Patriarchy induces them to eat less when food supply gets hit. Because underprivileged women do all kinds of work inside and outside the house—procuring water, as marginal farmers, getting fodder and wood, as agricultural workers, as construction workers—they are the single largest social group and the worst to be hit by the climate crisis in India.

6. Across the Himalayan ecosystem

The Hindu Kush Himalayan region—which includes Tibet and Nepal—has warmed by 1.24°C during 1951–2014, about twice as much as India’s average rise over the same period. The temperature rise is higher in the Himalayas because as snow melts, the darker surface absorbs more heat. The rise is even sharper in winters; warmer, shorter winters are being felt all over India but in particular at higher altitudes.

This is causing a change in snowfall patterns, in Kashmir, Ladakh, and Himachal Pradesh, and reduced snow at mid- to high altitudes. Precipitation is happening less as snow and more as rain. Or it snows at the wrong time in the season. “There is a lot of reporting in Kashmir about global warming when we get less snow or erratic rain,” a professor of political science at the University of Kashmir told me a couple of years ago. “Students, and others, are very aware of the problem. They see afforestation as the way forward”.

Small glaciers are disappearing, and large glaciers melting, both high up and below at their snout. Less snow gravely impacts mountain people’s access to water for drinking during the summer months, and irrigation. Springs, on which locals depend for drinking, other domestic uses, and

irrigation, are drying out. Forest fires are increasing. “Our agriculture, social activities, and entire knowledge systems were often determined and regulated by regular climate patterns,” a resident of Chamoli in Uttarakhand said at a public hearing. “But now we are losing all sense of climate ... Because of little snowfall, numerous water sources in the region have dried up. This has depleted soil fertility.”

Other species are affected too. Oak trees, apple trees, vegetables, reptiles, butterflies, birds and other fauna all try to adapt by climbing higher up mountain slopes, looking for temperatures to which they are accustomed. Meadows are shrinking, and alpine species face a risk of extinction. Many alpine plants and other species are already near mountain tops; how much further can they go?

7. Impacts on health

Many factors affect health; to isolate climate change is neither easy nor necessary. But climate change could have a range of direct and indirect effects. The poor face reduced access to food and nutrition. This could happen either directly in rural areas when their crops get adversely impacted, or indirectly in urban areas because of the temporary spikes in food prices. This reduced food intake is also hitting the urban poor in numerous places.

Malaria is spreading wider, to new areas, to higher altitudes, or at different times of year because of a changing climate. Dengue fever and chikangunya, transmitted by a virus through the *Aedes Aegypti* mosquito, has tripled in recent years in India due to warmer temperatures, erratic rainfall, and greater humidity.

The increase in the number, area, and duration of heat waves, mentioned above, is causing acute heat stress and deaths, particularly of the poor and aged, the homeless, and those who work outdoors for long hours. Recent studies have revealed that chronic kidney disease (CKD) is becoming more widespread and rampant, particularly among working people, due to excessive heat and humidity. One of the deadliest global

warming impacts in future will be large areas across India, indeed across South Asia, becoming uninhabitable. It will become so hot and humid; this combination will interfere with our bodies' capacity to lose heat. A certain death will be guaranteed for even the very fit who remain outdoors for six hours, and even in the shade.

8. Other impacts in urban areas

Besides many of the impacts narrated above, one serious issue for urban people is having to cope with longer and more frequent heat waves, which kills hundreds of people each year. Studies have shown that excess heat affects the urban poor excessively, because of their cramped homes, congested localities, and materials used.

Also, water problems at both ends: by flooding during extreme rainfall, and by droughts. The huge drought in parts of Maharashtra in 2016 resulted in the people of Latur town being supplied water by trains! These droughts are accentuating the already unequal distribution of, and access to, water in any Indian city.

Cyclone Fani, fuelled by a warmer Indian Ocean, hit Orissa in early May 2019 (Figure 7). Innumerable lives were saved due to prior warning and timely intervention by the state government. Yet, the severity with which water and electricity networks in Bhubaneswar and other towns were damaged reveals another way how vulnerable urban residents in India, particularly the urban poor, are to the impacts of global warming. Basti residents in poorer parts of Bhubaneswar got no water for several days after the cyclone hit, and they came out on the streets and blocked roads demanding water.



Fig. 7: Cyclone Fani's devastation in Orissa, 2019

Source: *The Conversation*

It is to me deeply worrying that these impacts in India described above have happened with barely 1.1°C of average warming worldwide, and 0.7°C in India. These climate impacts are going to ***intensify*** and ***will happen simultaneously***. Sea level rise in one place, drought in another, flooding close by, intense rains It will hit food security, access to water, livelihoods, lands, health, etc of people everywhere. Are we displaying the urgency the situation warrants?

Impacts beyond India

- **Sea levels** are rising by an average of 4.8 mm/year, 2016–2020.
- **'Extreme events' spreading** all over the world in the last decade:
 - 2010:** floods in Pakistan and a heat wave in Russia
 - 2013:** heat waves in Argentina
 - 2014:** fires in California; droughts in parts of Jordan, Lebanon, Israel, and Palestine; blizzard kills 43, including 21 trekkers in Nepal
 - 2016:** extreme rains in Wuhan, China

2018: severe drought in Cape Town

2019: intense heat and wildfires devastated large parts of Australia

2020: 90 wildfires across 10 states of the western United States kills at least 35; they are still raging as I write this

- **Extreme heat**, in barely 0.1 per cent of the globe in the 1950s, now spreads over 10 per cent of the globe. About 125 million more people are exposed to heatwaves now than 20 years ago.
- **The Arctic** is warming at twice the global rate and is frequently several degrees above normal, affecting climates in Europe and North America. Thick, 5-year old ice is 90 per cent less in area now than in 1979.
- The gigantic **Antarctic ice sheet** is losing 199 billion tonnes of ice a year (which is partly why sea levels are rising faster).
- Powerful rains, and consequently landslides and floods, in parts of **Pakistan's mountains** that did not face such rain earlier.
- Of the 800 **Himalayan glaciers** being monitored in China, India and other countries, 95 per cent are melting. Melting is happening at over 20,000 feet altitude.
- **Droughts**, influenced by warm sea surface temperatures in the western Indian Ocean, have affected millions of poor people in Somalia, Zimbabwe, and other parts of Africa over the past 4 years
- **Food production** is getting hit in some of the poorest countries, and China.
- **Oceans** have warmed to a depth of 2,000 metres, and even lower. There are now heat waves in the oceans that are becoming more frequent, longer and more intense

Impacts on other species

Species in India

As ocean waters have become warmer, mackerel, oil sardines, and other fish species have moved north along both coasts. Earlier found up to Malabar in Kerala, mackerel have moved 650 kilometres north and can

now be found off Gujarat. In the Bay of Bengal, earlier only up to Andhra, they are now found in Orissa's waters. Sardines have reached Bengal. A similar shift of location northwards is happening with river fish in the Ganga.

- Migration of species to higher altitudes in the North Indian mountains, such as oak and apple trees, animal species, and vegetables.

- Early or erratic flowering of many plants and trees, such as of mango in Orissa, Andhra Pradesh, and Karnataka, rhododendrons across the Himalayas, saffron in Kashmir.

- change in the timing of spawning of certain fish due to higher sea surface temperatures.

- Coral bleaching happens soon as sea water temperatures cross 31°C. Bleaching due to higher sea surface temperatures has occurred every summer off the Tamil Nadu coast since 2005.

- Slow death on a large scale of cows and other livestock in times of drought; they also face greater heat stress and consequent illnesses.

Species worldwide

A survey of over 800 published papers covering hundreds of species showed similar effects:

- Species are moving northward, or away from the Equator, towards the poles, towards more suitable temperatures.
- The annual migration of birds is happening earlier.
- As it gets warmer, mountain species are moving upwards, but some mountain frog species have gone extinct having nowhere higher to climb.
- Some birds are laying their first eggs earlier.
- Disruption in timing between lifecycles of predators and prey, and of insect pollinators with flowering plants.
- Scientists now believe that up to 40–70 per cent of all species could become extinct because of heat waves, droughts, more acidic oceans, having nowhere further to climb at the top of mountain slopes, and other effects of global warming.

The sceptical view

There are still those who say that the Earth may be warming, but it is not significant; or, that humans are not primarily responsible, it's part of the Earth's natural cycles; or, that it has happened before, so what's the big deal? Mercifully, their number has reduced over the last few years as climate change's more intense effects become more frequent and obvious.

To say it has happened before naturally is true but what matters is the pace at which current changes are happening, and why.

Human civilization itself evolved over the last 10,000 years and we are pushing changes that have not happened for millions of years, outside human experience. Ecosystems are able to adapt only when things change slowly. Changes are now happening much faster than ecosystems and species can cope with.

Some people were questioning the basic science because Earth surface warming slowed down for some years after 1998. This happened because most of the excess heat being trapped by greenhouse gases was going into the deeper oceans. This lull in rising surface temperatures ended dramatically, with 2014, 2015, and 2016 successively breaking records as the hottest years ever, since instruments began comprehensively recording temperatures in 1880. This year, 2020, will end up being very close to the warmest year ever recorded, 2016.

If we send more carbon dioxide and other greenhouse gases into the atmosphere every year, they will trap more heat. This basic physics of global warming has been well established for well over a hundred years.

The urgency of action

The window for us to intervene is closing fast. That is what makes global warming unlike any other issue we may grapple with. There are multiple reasons underlying this claim.

Key ecosystems, such as the Arctic, are tipping over into new states from which they will not recover for the foreseeable future.

Two, with greater warming, extreme events such as the floods in Kerala and Uttarakhand will occur more frequently. People will barely recover from one catastrophic event for another to hit them.

Three, central to understanding the urgency of tackling global warming is that the Earth system is a complex system. The crux of any complex system is that its elements are interconnected, and that the whole is more than the sum of its parts. The effects of changes in one element of the system could be amplified on the others through feedback loops, sometimes in unexpected, non-linear ways that directly or indirectly cause further warming.

The most immediate is the melting of Arctic summer sea ice. In mid-September this year, Arctic sea ice shrank to 3.74 million sq km, its second-lowest ever. Less ice, in the Arctic or elsewhere, results in less sunlight being reflected by the darker surface that remains. This is causing greater regional and planetary warming. In a second feedback, a melting permafrost, spread over a quarter the landmass of the northern Hemisphere, is releasing the methane underneath, which traps even more heat. Both feedbacks have already been happening for years.

The world's ecosystems are connected. Less ice in the Arctic can contribute to greater forest dieback in North America—which causes more carbon to be emitted—more ice melt in Greenland, and the slowing of key ocean currents. These changing ocean currents in the Atlantic could contribute to droughts in the Amazon and further ice loss in East and West Antarctica. So, changes at one end of the planet would damage ecosystems at the other end (Figure 8).

RAISING THE ALARM

Evidence that tipping points are under way has mounted in the past decade. Domino effects have also been proposed.

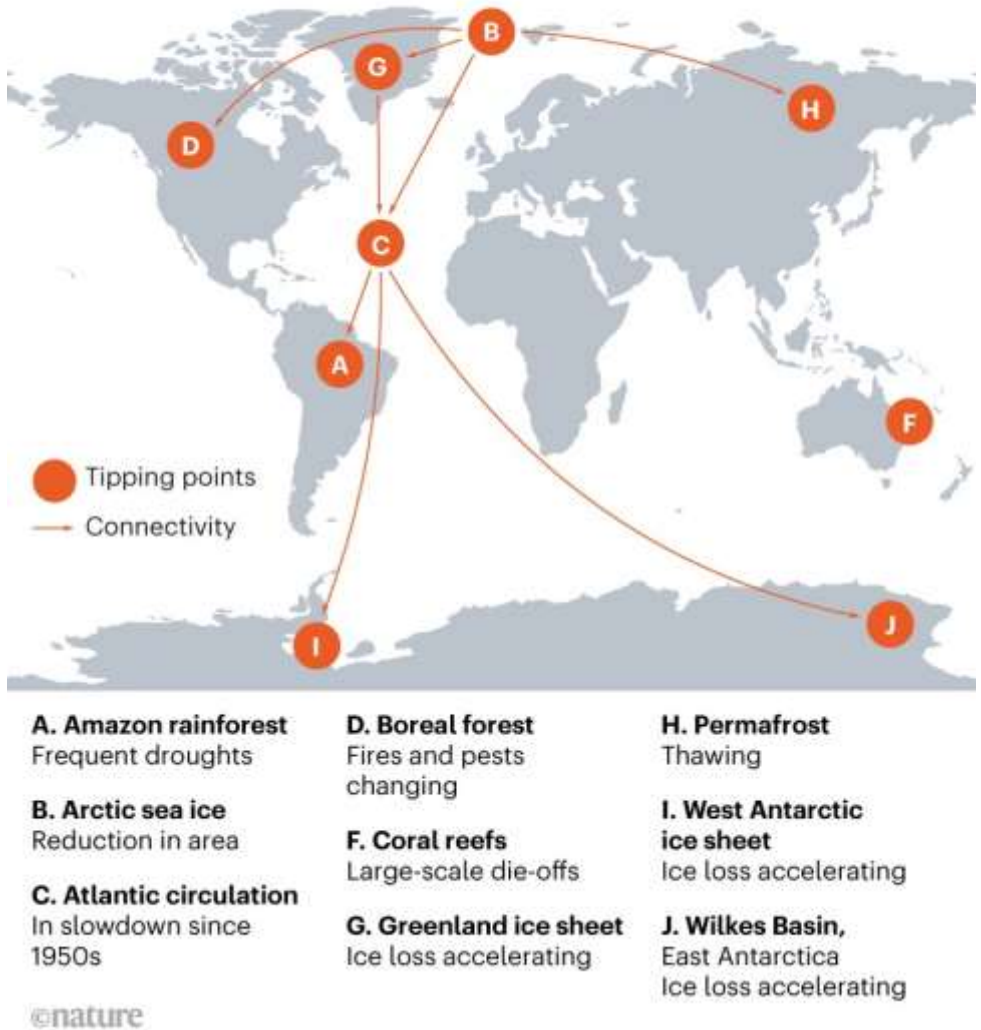


Fig. 8: Many Earth's systems face tipping points and are interconnected

Source: *Nature*/Lenton et al (2019)

After a point, climate change becomes increasingly difficult to control as these changes in ecosystems begin to feed on each other, the one amplifying the other, the two worsening a third. *The urgency to tackle global warming comes from the fact that **these feedbacks will happen together on a scale that makes it impossible for humans to prevent extreme warming, of a kind civilization has never experienced.***

The scientific community has been providing robust, grave warnings for many years. It is now up to political and economic elites, policy makers, unions and other organizations in civil society, and the climate justice movement in general to ensure that we rapidly change the transport, electricity, industrial, agricultural, and other systems in equitable ways, and the development trajectory in general, to ensure that we prevent reaching extremely dangerous levels of warming or the planet tipping into states beyond our control. It is to this action that we now turn. The urgency has never been greater.

4

Fiddling while the planet burns

What are the governments doing?

The Indian government

Given the urgency and complexity of these problems, not enough and not quickly enough.

India's National Action Plan on Climate Change (NAPCC) has eight missions—solar energy, water, sustainable agriculture, enhanced energy efficiency, sustainable habitat, the Himalayan ecosystem, Green India, and strategic knowledge. Two of these—with improved energy efficiency and the expansion of solar power—have made significant progress. With most other missions, it's largely been business-as-usual. In specific sectors water, agriculture, energy—and viewed overall, the likely intention and certainly the main outcome of policy measures for several years now has been the greater presence of, and profit-making by private industry.

State Action Plans on Climate Change (SAPCCs) have been drafted in 33 states and union territories. In most states, they are statements of intended development pathways. Hence it is unfortunate that in most states they were done with little consultation with people, unions, or local organizations. The Madhya Pradesh SAPCC was one welcome exception, in the numerous consultations the state government organized then before drafting it. The process of revising the SAPCCs is currently underway in many states. A few NGOs have been engaging with this process, but it needs many more organizations to intervene to ensure that the process is more democratic and the policy document more people-friendly, both in letter and its implementation.

India's Nationally Determined Contribution (NDC), the main national-level policy document, has **three key commitments**, all to be met by 2030: one, India will “reduce the emissions intensity of its GDP by 33 to 35 per cent by 2030 from 2005 levels”. That is, not less in absolute terms, but reduced emissions per unit of GDP. Two, 40 per cent of our installed electricity capacity will be from non-fossil fuel energy sources. And three, the government pledged to create an additional carbon sink of 2.5–3 billion tonnes of CO₂-equivalent through additional forest and tree cover.

Reducing emissions (**mitigation**) is indeed the most important aspect of climate change. However, the NDC's first commitment is too modest: it merely continues on the same declining emissions intensity trajectory as the decade prior to it. And as of 31 August 2020, our electricity capacity from non-fossil fuels — which includes large hydropower, wind, solar, biopower, nuclear, and small hydropower — had already reached 38 per cent (141,272 MW out of 372,693 MW total capacity), ten years ahead of time. This is a reflection of our recent renewables' expansion, but more so of the fact that our second commitment target is too low.

This modesty in official targets is encouraged by the short-sighted nationalist view – one that I have heard from college students, but which also prevails across the political spectrum – that developed countries are responsible for the problem, so why are we being asked to do more or act with greater urgency? True, they are, and given their high per capita

emissions, and even higher consumption emissions discussed earlier, it is indeed imperative, and just, that rich, developed countries cut their emissions very sharply. But a key reason why India should set and follow more ambitious targets is that our people are already being massively hit by climate change, and will be far more.

India's NDC extends over ten years, until 2030. Only countries with 5-year NDCs are required to submit revised ones in 2020. But it is likely India will submit a slight upgraded NDC. One can only hope that the pledges therein will be truly and unconditionally ambitious. We also need to push for more urgent global action. The future for India, in its absence, looks bleak: by the late decades of this century, India will experience an average temperature rise of more than 4°C, heat waves will be 3–4 times as frequent and twice as long, sea level rise will engulf our coasts, and much else, says the recent IITM report referred to earlier.

India's NDC does have some welcome mitigation measures. Among these are an expansion of rooftop solar photovoltaic connected to the electricity grid, and an expansion of mass transit public transport. Solar power capacity is pledged to grow to 100 gigawatts (GW) by 2022, as part of an overall renewable energy (RE) expansion to 175 GW over the next few years (currently 88 GW, not counting hydropower). In September 2019, Prime Minister Modi, in a speech at the United Nations, announced a new RE target of 450 GW by 2030.

These are part of the second key commitment in India's NDC. The progress so far, though below targets, has been impressive. Our solar capacity is currently 35,739 MW, and wind 37,999 MW (as of 31 August 2020; CEA data). But there is a catch: unless it is on rooftops (currently just 5 per cent of total capacity), even solar power can be potentially problematic: roughly five acres of land are needed for generating every one megawatt of solar power. The NDC document mentions 25 solar parks, which will take over lots of agricultural land. It is only at very high altitudes in Ladakh, where a huge solar project is planned, that land is less an issue.

Electricity forms only a part of India's total energy use (indeed, energy use anywhere). Coal, oil, and gas still comprised 92% of India's commercial energy consumption overall (that is, not counting biomass) in 2018, hydropower 4%, renewables a mere 3%, and nuclear 1%. So, notwithstanding the recent renewables expansion, India still depends overwhelmingly on fossil fuels.

In fact, one key problem with India's NDC and energy policy in general is the grabbing of energy from all possible areas and forms: a massive expansion of nuclear power (which it calls "environmentally benign") to an impossibly high 63,000 MW by 2032, from 6,780 MW currently; large hydropower to nearly 100 GW; and even more coal, oil, and gas. This indiscriminate expansion is largely aimed at meeting the energy demands and pleasures of the privileged in an increasingly unequal society.

The third pledge—to sequester an additional 2.5–3 billion tonnes of CO₂eq by 2030—seems to be based on inflated estimates by the Indian government that our forests and trees take up 300 million tonnes of carbon dioxide a year (and thereby reduce atmospheric CO₂ by that much). There is no accepted figure of how much carbon India's forests are taking up, or even a consensus that they are at all. The government also says that our forest and tree cover has increased from 24.01% to 24.39% of our total area between 2013 and 2017. We should treat all these official claims with some caution. Old, natural forests in different parts of India have been under threat from three ongoing social–economic processes: greater urbanization; the spread of agriculture, including in hilly areas; and—the most contested—mining, road-building, and the establishment of thermal power and other industrial projects in hilly, predominantly Adivasi areas, which has led to bitter resistance there.

Important to the well-being of forests, and hence their capacity to sequester carbon, is people's control over their resources, and individual and community rights to forest land. This has been a source of bitter contestation following the passing of the hard-won Forest Rights Act (FRA). Over a decade later, only a tiny proportion of community forest resources areas has been recognised as such.

It remains to be seen what implications the government's pledge of sequestering additional carbon dioxide has for the struggle over who controls the forests — the State, private companies, or local communities. The expanded commercialization of forests that the commodification of carbon allows may well make this political terrain filled with intensified tensions in the years ahead.

Regarding helping people cope with climate impacts or preparing for them (**adaptation**), the 2011 government scheme National Innovations in Climate Resilient Agriculture (NICRA) identified 151 climate-vulnerable villages across states for a range of interventions. These include moisture conservation techniques such as mulching, construction of farm ponds, introducing short-duration crop varieties, drought-tolerant varieties, etc. However, a recent analysis finds it is hampered by low participation and is understaffed.

Thousands of wells and ponds have been dug under the MGNREGA, which boosts adaptation, whether or not that was the intention. This important government scheme remains underfunded when it could help crucially in times of drought, flooding, and heat stress, and now to address the widespread unemployment following the COVID shutdown. Studies about heat-coping hybrids, saline-resistant crops, and other relevant research are being carried out in agricultural research institutes; it needs to reach farmers everywhere quicker and wider. Krishi Vikas Kendras are understaffed, agricultural extension services are being withdrawn, just when they are needed the most, as neoliberalism dictates that welfare and state support be squeezed.

At the state level, there have been limited efforts towards building capacities of different bodies, and providing assistance in accessing finance. Pilot projects across different states include climate-resilient livestock production in Punjab, assessing climate risk and vulnerability across 12 Himalayan states, and heat action plans across 13 states in varied stages of implementation. Cyclone preparedness has improved

commendably since the super cyclone of October 1999 that killed 10,000, in terms of tracking impending cyclones, warning people about it, and evacuating people in large numbers. Hence loss of life has reduced sharply, as we saw with Cyclones Fani and Amphan. But the huge damage to homes, electricity and water supply, and other infrastructure continues because of fragile housing and other multiple social deprivations.

But clearly, a lot more needs to be done and with greater urgency. Repeated recent disasters reveal how poorly prepared the governments are, with rare exceptions, despite having a state action plan in place. When disaster struck, like in the Chennai and Kashmir floods, it is the people who came together and helped each other. Kerala was an exception, with the state government, civil society organizations, and people working in much better synchrony during the 2018 floods. What's more, the broader development trajectories and policy choices by various state governments worsen the effects of climate change. Economic and social equity is central for people to adapt and cope with climate change in a more resilient manner.

In general, the economic policies of the last 30 years—cheap flights, easy finance for cars, malls in cities, easy access to ACs, fridges, TVs and other consumer durables, reduced income and wealth taxes on the rich, meagre social sector spending—cause and reflect the deepening inequalities of incomes and wealth. There is a view that the issue of climate change ought not to interfere with India's right to develop. However, we also need to reflect more on how unequal that development has been. And how damaging. So many of our cities are among the most polluted in the world, causing early or higher death rates of the elderly and of those with respiratory problems, and hurting everybody's quality of life.

Successive governments continue to hide behind the poor by saying that India has "very low per capita emissions", while grabbing energy from everywhere, and causing displacement of the poor on a huge scale. The current government has been an ecological, social disaster. It is a matter of the gravest concern that governments, at the states and Centre, have

sought use the lockdown period to push through regulations harmful to people’s control over land and resources [the EIA 2020 amendment], and people’s health and the environment [by inviting commercial industry into 41 coal blocks], among others areas like workers’ rights and the law. This would not just adversely affect many local communities and damage local environments, it will also increase emissions and damage carbon sinks like wetlands and forests, which have global implications.

Other governments elsewhere

So far, international action has little to show for its most important part – emissions reduction. According to IPCC/WMO’s *United in Science 2020* report, annual carbon dioxide emissions today are “62 per cent higher than [when] international climate negotiations began in 1990”.

Yet, the nature of the problem is such that urgent and coordinated global action in the international arena is essential. For 25 years, governments have been meeting annually at a Conference of the Parties (COP) to discuss chiefly four key areas: emission cuts, adaptation measures, financial help, and technology transfers to developing countries to help them reduce emissions or adapt. The most significant in recent years was the 21st COP, in Paris in December 2015.

In 1997, at the Kyoto COP, most developed countries agreed to cut emissions by a tiny 5.2 per cent by 2012 over their 1990 levels, less than what the science demanded. But since developing countries, including China and India, were not required to sign on, and the US Congress did not ratify the Kyoto Protocol, some of the world’s largest emitters were not covered by it. And not just were the target cuts feeble, the Kyoto Protocol opened the way for corporations to profit from the crisis, via the Clean Development Mechanism (CDM) and Reducing Emissions from Deforestation and forest Degradation (REDD). They are now trying to expand this profit-making via REDD+. This is hardly surprising; capital will try to profit from *anything*. As we discussed, it’s part of its DNA.

We are currently at the end of the second phase of the Kyoto Protocol's commitment period (2013–2020). The third phase, covered by the Paris Agreement, starts in 2021. As part of that, each country was to submit its Intended Nationally Determined Contribution to the United Nations. China pledged to cut its emissions intensity by 60–65 per cent by 2030. The United States had pledged to reduce its emissions—absolute, not relative—by 26–28 per cent by 2025, over its 2005 levels. But this is just a 3 per cent reduction over its Kyoto Protocol's 1990 baseline.

On 22 September, President Xi Jinping announced that China would peak its annual CO₂ emissions before 2030, and two, become carbon-neutral by 2060. A country aiming to become carbon neutral implies it will emit only as much as its carbon sinks [forests and lands] can take in, and — more ambiguously — pay companies to reduce emissions beyond its borders.

Such enhanced pledges from many countries are due in 2020, but in the context of the pandemic, one can't say when they will be submitted; only a handful had at the time of writing this.

Given the urgency discussed earlier, international commitments need to be far more ambitious. The Paris Agreement mentions limiting warming to “well below 2°C above pre-industrial levels, and pursuing efforts to limit the temperature increase to 1.5°C”. This may be a victory of sorts for all those who have for years pushed for thresholds below 2°C. However, the Paris Agreement has adopted a fragmented approach that disregards what the science is telling us about total reductions needed. It has effectively no mechanism to ensure that its own targets are met. Crucially, the present pledges of emission cuts by *all* countries, *even if* they are met, will lead to an average warming of 3°C. It will be disastrous on a colossal scale; human civilization has no experience of those temperatures.

There are rare exceptions among governments. Some of the small island nations, facing the threat of sea level rise, have been pressurizing big governments to act. Pressured by indigenous peoples who form over half its population, the Bolivian government passed the Law of the Rights

of Mother Earth in 2010. It recognised that all living things have rights, including the right to biodiversity without genetic manipulation, the right to water to sustain life, and the right to restoration of ecosystems damaged by human activity. Ecuador put in its Constitution that Nature too has rights just as humans do. In February 2019, Cuba included the fight against climate change in its Constitution, “which threatens the survival of the human species”.

There have been innumerable appeals by writers, activists, and numerous organizations worldwide that key countries move towards a ‘green’, renewables-led recovery out of COVID-19 and the economic recession the world has slumped into. Whether a green recovery actually happens is debatable, and China is the key player in that process.

In general, I would urge all readers to keep an eye on what China does. It consumes half the world’s coal and produces and consumes a significant proportion of other commodities. It has continued to push coal strongly after emerging from COVID-19. What China does is extremely significant for climate change and increasingly a lot else globally.

The political landscape in recent years has not been encouraging. Brazil now has an elected right-wing government hostile to climate change. Russia’s economy continues to be heavily reliant on oil and gas exports. In the United States, President Donald Trump’s administration has sought to open up more coal mining areas, and formally withdrew from the Paris Agreement, a setback to mitigation efforts, within the US and internationally.

But it is the systemic drivers mentioned earlier—the constant efforts to maximize profits and growth—that are the more serious, underlying problem than Trump. Most governments bat for national elites. They are unable to question the systemic issues of capitalism or class. To expect that government elites would show us the way out, in the absence of people’s pressure from below, would be to put our faith in the wrong hands.

So, what *can* we do? It is to this key question that we now turn.

5

What *can* we do?

Work together, on different things, at all levels, and with urgency. Global warming touches on so many areas of life that it enables us to engage through whatever we find meaningful or interests us.

There is a view, ideological in its essence, that technology will solve the problem. To expect that a solution will come from technology alone is not just unrealistic, but also foolhardy, because it encourages us to sit back and do nothing. Technology has its place. For example, we do need to expand rooftop solar power, and improved energy efficiencies of various kinds. But the way forward is social, political change, combined with appropriate technologies, not technology in isolation.

What follows are some suggestions of ways forward, largely in urban contexts in India. They are obviously by no means exhaustive. However, the urgency of global warming does not allow us the luxury of time.

Individual efforts

The market is taking over the minds of many people. Not just in the obvious symptom of unnecessary consumption—gadgets become a way we present ourselves—but also in influencing our interactions with other people and with the natural world. Resisting this mental loss of freedom is both an essential first step and a constant battle.

Regarding specific individual measures, try to identify your largest carbon-emitting activity and minimize it. This suggestion applies *only* to the well-off. It's usually flying. If this applies to you, minimise flying to essential situations and emergencies. In addition, reduce the consumption of your electricity units, by say, 10 per cent quickly. Minimize the use of energy-guzzling gadgets like ACs; use buses and other public transport, buy local produce, etc. These individual lifestyle choices need favourable public policies that enable them, such as cycle paths, bus transport that is safer for women, etc.

At the household level, for those who can afford it, measures that help include installing rooftop solar panels and rainwater harvesting. Rooftop solar panels connected to the electricity grid is possible in some cities. Growing vegetables in your veranda if you have one, or on the terrace of your house or housing complex is not just healthier, it also reduces your food's carbon footprint. Urban agriculture is practised in Delhi, Bangalore and a few other cities in India but is largely restricted to the well-off. Finally, eat less meat if you are well-off and can meet your nutritional needs from other food.

Collective ways forward

Individual actions, though relevant, are not sufficient. The usefulness of individual action is exaggerated by elites and the media. They ask us to turn off our lights on Earth Day for one hour, or change our light bulbs; we think we have done enough. We then tend to avoid questioning the systemic issues at the root of global warming and a range of other ecological problems. Social and political change usually happens collectively, when many people realise that something is wrong and needs to be changed or improved, and come together to do something about it.

How can I get involved in collective action, you may ask? Fridays for Future, Extinction Rebellion, and other youth organizations are mushrooming in many towns. College students can form youth clubs, discussed below. Better-off residents can mobilise their resident welfare

associations (RWAs) to instal solar panels and water harvesting in their building complexes. Or you can join existing collectives such as student bodies, unions, or women’s organizations.

1. Work needed in your community or town

What would you like your town or city to be like? Any city in which we live has a number of issues that connect with global warming, both in reducing emissions or adapting to climate change, but need to be addressed keeping greater equity in focus. Cities are responsible for 70 per cent of greenhouse gas emissions in India and globally, and a large part of carbon emissions in cities come from three sources: energy use/electricity, air conditioning in particular; transport; and construction.

Student groups and other organizations can collectively pressurize the government to ensure two key measures regarding electricity use – steep tariff rates for high-end consumers, and that a greater share of a city [or state’s] electricity consumption comes from solar and wind. For more, see point 2 below.

Around **public transport**, in Delhi, some organizations have demanded that the number of public buses be expanded significantly. That bus corridors—which reserve one-third the road space for public buses and emergency vehicles—be built. Bengaluru for instance introduced a ‘bus priority lane’ in November 2019 that works well. We should be pushing for a public transport system that stops focusing on car users alone, and be meant for all, including cyclists, pedestrians, and bus users. Following COVID-19, many cities such as Bogota, Paris, and London have laid out cycle paths over many kilometres to enable people to travel safely.

In Mumbai, there is an ongoing citizens’ campaign (called ‘Aamchi Mumbai, Aamchi BEST’) for the past three years against the privatization of its famous BEST bus service, and supporting bus workers’ rights. They demand that fares need to be low for buses to be accessible to all, and that there be more buses with a wider reach in different parts of the city.

Many more buses are needed so people can travel safely during this age of COVID. We need free, safe, and reliable buses, the Sustainability Urban Mobility Network demands. Access to metros ought to be made universal through cheap monthly passes, like in Mumbai's trains. And to reduce the use of private cars [and hence emissions], a feeble, infrequent odd-even plan is not enough. Local governments should be approached to introduce congestion charges, car-free zones, and better last mile connectivity to homes.

Regarding **construction**, measures that would help include the use of appropriate materials, and enforcing building regulations. But more broadly what is essential is urban planning which ensures that people's travel between home and work is within a few kilometres, and affordable public housing for the poor to protect them from climate change's worst impacts, as we saw with Cyclone Fani.

Now about adaptation. All towns in India need a publicly transparent, **comprehensive heat action plan** to cope with growing heat stress which is killing people. A number of towns—such as Ahmedabad and Surat—across 13 states have such plans. Important aspects of such heat plans are providing widely, freely available water in mobile vans; setting up cooling areas; training medical personnel; and having early warning systems in place.

Water is a key area of intervention in a climate-changed context. Work around water is possible at four levels. Reviving or preserving traditional or older water bodies in your locality—bavadis/stepwells, ponds, lakes, older canals, streams. But as a first step, we need to know where they are. Identifying such water bodies is something students can do in urban areas, and farmers' and other organizations elsewhere. Or you can do along with others in your locality or community. Two, pressurizing local authorities to create the infrastructure for **rainwater harvesting** along roads and public places, and making dugholes for recharging rainwater into the ground, which helps falling groundwater levels. Along with this, an **equitable distribution** of water, so that every single person or household can access a minimum daily volume for a decent living.

Regenerating traditional water bodies, building new water harvesting structures, planting trees, cleaning existing water bodies, re-laying the water distribution network more equitably have multiple benefits: improving the groundwater situation, reducing waste, using less energy, and ensuring water for all. It has the added benefit of creating jobs on a large scale so unions and workers would be interested.

Finally, the deluge in Chennai in December 2015 and Mumbai in June 2005 tells us how encroachments on wetlands, floodplains of rivers, and water bodies prove disastrous in the long run, and should be opposed in every town as India urbanizes. Such as the campaign to preserve the Ennore Creek and wetlands in Chennai. All of this suggests we need to pressurize both the municipal authorities, and elected politicians who are supposed to represent our interests.

2. Demanding renewable, less harmful, energy choices

Nuclear power has obvious dangers. Coal is the dirtiest fuel and kills millions of people each year worldwide. There is widespread opposition to large dams in many regions. So, we are *against* a lot; what are we *for*?

We need a **faster transition to cleaner energy sources** (Figure 9). Some unions and other collectives in India—and elsewhere—have begun to engage with the question of a transition away from fossil fuels and what that might imply for workers. Solar power, whose unit price is dropping, and wind power, which is expanding, are the most promising. Solar power has the potential to be used in cooking, heating water, and other basic uses. For electricity, it is ideal as a decentralized application (rooftop photovoltaic). All towns in India should also rapidly expand the share of wind and solar in their electricity use, while seeking to control their carbon emissions. Expanding renewables, reducing the dirtiest coal, and increasing public transport also helps deal with air pollution, which has become such a huge issue in India.



Fig. 9: We need a faster transition away from fossil fuels

Source: Sunstar Solar Energy, Tirunelveli

A faster transition won't happen without pressurizing governments to move away from subsidising and promoting coal and other fossil fuels, and strongly support solar and wind. The German example is instructive: over the last decade, solar power capacity expanded there from a few hundred to over 30,000 megawatts. This was helped by favourable policy, but that was enacted because there was a huge environmental Green movement of workers, students, and other ordinary citizens who demanded a halt to nuclear power and greater support for renewables. Half of Germany's new renewable energy has been organized by citizen groups, farmers, and newly-formed energy cooperatives.

Even renewables have social costs. Most large solar parks take up a lot of agricultural land. The only way we can have a socially less harmful energy transition is by also restricting energy demands to **first meeting people's basic needs**. We need to have a steep carbon tax. Earlier this year, two economists proposed a progressive carbon tax for India, the revenues from which would be distributed to the poor through universal

access to energy and public transport. Ensure the reduction of wasteful use of resources by the well-off. Otherwise we end up recklessly trying to grab all kinds of energy from everywhere, which is harmful to other people and species.

3. A people's perspective

To understand and strengthen a **people's perspective on climate change**, one needs to chat with people, both in urban and rural areas, about how they view climate change. How it is affecting their lives. What impacts do they face, what they are doing (or not able to do) about it. Creating greater awareness about the climate crisis is also useful.

Local farmers and other communities are trying to adapt in different ways: changing their cropping mix, the timing of their crop cycle, reverting to traditional seeds, adopting the system of rice intensification (SRI), digging small ponds, improve soil health, revive older water bodies, etc. To know what responses work is particularly important since adaptation that has been successful in one place can be replicated elsewhere in similar conditions.

This work of developing a people's perspective on climate change can be done particularly by groups of students, young people, farmers' collectives, and other organizations. Climate impacts on urban dwellers include flooding, water shortages, heat stress, adverse health impacts, and higher food prices. Viewing the issue through the lens of multiple inequalities helps us see through unsatisfactory frameworks that are constantly thrown at us. A gendered perspective on climate change is particularly important, for which students can get in touch with collectives that organize or work with women. All of this takes the issue away from abstract science, to where it should be located: in people's lives and livelihoods.

4. In colleges

In case you don't already have a student group or union in your college, form one. It could be an environmental group, Nature group, or a student collective. Begin by talking to friends and anyone else interested, call for a first meeting to discuss the idea, set up a WhatsApp group if enough students have a smartphone, put up posters about it in college. Perhaps you could start off by having a discussion or film screenings. Supportive teachers can help. A Teachers Against Climate Crisis group was formed in September 2019, probably the first of its kind in India, and organizes public talks and other activity. Every town should have one, to deepen engagement among teachers, and through them, students. There's also a rainbow coalition, SAPACC, which has an active youth group engaged with many aspects of the environment and climate change.

Spreading awareness about the climate crisis, and what one can do about it, via social media is timely. Nowadays many students and youth use WhatsApp, Facebook, Twitter, and Instagram, on which messages, photos, and short videos can be widely forwarded.

Small but specific actions are also a good way to get going. For instance, college students could measure the space available on the roofs of their college buildings, and calculate how many solar panels can be installed there. Then approach the relevant department office or the appropriate company for installing solar panels. The same goes for having water harvesting facilities in college. You would need to pressurize the college administration and perhaps the local government authorities to implement these measures. Students could also engage with some of the issues discussed above. Push for better and safer bus and other public transport for students to your college or university. For all of this, students getting together collectively is essential. After your group gets going, contact friends in other colleges and help start the process there. Once a group forms, sustaining it becomes important. The crux is for students to engage beyond their college, with development and inequality in their city and beyond.

5. People's struggles and climate change

All over India, struggles have intensified against displacement and for local community control over common resources like forests, agricultural land, wetlands, rivers, and the sea. These are being waged against mining projects, coal power plants, aluminium projects, nuclear plants, against land being taken for 18 vast industrial belts, such as the Delhi–Mumbai Industrial Corridor, and most recently, against the Mumbai–Ahmedabad bullet train.

Local residents who resist have been agitated by the loss of livelihoods, control over resources and agricultural lands, and sometimes by health concerns. Their immediate motive may not be climate change, but connects with it in different ways. These include struggles about energy choices: resistance to coal mining and coal power plants have exploded in a number of places such as Mahan, Chandrapur, and Sompeta, where huge ultra-mega power projects are being built or planned. In Kakrapalli, in Andhra Pradesh, people opposed the setting up of a 2,640 MW thermal power plant in the middle of diverse wetlands in the face of brutal police violence (Figure 10). Other struggles have been waged in Kudankulam (nuclear), Jaitapur (nuclear), the Narmada Valley (large hydro), and Polavaram (hydro). There are movements against dams in the Himalayan states, from Himachal Pradesh in the northwest to Arunachal Pradesh in the Northeast.

Their struggles address climate change directly and indirectly. Such as preventing wasteful carbon dioxide emissions that would occur from daft projects such as the bullet train between Mumbai and Ahmedabad, which would benefit only a small elite, to say nothing of the companies building it. By preserving wetlands—such as in Kakrapalli—or forests, as in Niyamgiri, these people's struggles not just preserve important local ecologies, but also help combat global warming by retaining carbon sinks. At the heart of these struggles are questions of justice and what an appropriate development trajectory might be, questions at the heart of

global warming. Any understanding of 'climate justice' needs to internalize the idea that such struggles need to be respected, not repressed.



Fig. 10: People resisting a huge coal power plant in Kakrapalli, AP

Over the years, students and other youth have related to these in many ways: joined these movements directly; some have joined progressive organizations or parties; others formed support organizations for specific struggles, yet others have visited those places and published reports or campaigned in different ways.

A brief mention of **campaigns outside India**, to give a sense of the global nature of both the problem and the response: struggles to resist the extraction and burning of fossil fuels, particularly coal and oil, have intensified worldwide over the past three years. These include vibrant resistance to the Rampal coal power plant on the edge of the Bangaldeshi Sunderbans, the Keystone and Dakota Access pipelines in North America,

and Adani's Carmichael coal mine in Australia. Protests are being carried out in many countries simultaneously at sites where coal is being mined and oil extracted, or in front of offices of their financial backers, in a Break Free from Fossil Fuel campaign. Google it, or check out the website of 350.org.

Over the last few years, youth have led campaigns to pressurize institutions to withdraw their investments from fossil fuels. Over a thousand entities—including pension funds, government organizations, universities and colleges, and wealthy foundations—with assets totalling trillions of dollars have committed to withdraw their money from fossil fuels investment worldwide. The list has over thirty educational institutions thus far, including the London School of Economics, SOAS, and Oxford University.



Fig. 11: Students and youth protest against the climate crisis in Berlin
Source: Fridays for Future

The issue of, and movement against global warming has received fresh impetus over the last two years. In the UK, tens of thousands of people have repeatedly come out on the streets in a mass civil disobedience campaign organized under the banner Extinction Rebellion (XR). Among XR's key demands are that the UK's government should 'Tell the Truth', declare a climate and ecological emergency, and communicate its urgency; act now to halt the country's biodiversity loss and reduce greenhouse gas emissions to 'net zero' by 2025; and create and be led by a citizens' assembly on climate and ecological justice.

Also remarkable are the protests of school students. It began when a young girl called Greta Thunberg sat outside the Swedish parliament for three weeks in August 2018, to protest the lack of action around the climate crisis. Catalysed by her sit-in, students and other young people have been striking from school in innumerable towns worldwide since. In September 2019, more than 5 million students and others took part in protests around the world organized by Fridays for Future (Figure 11). Why study for a future, they ask, which may not be there?

The appeal of XR and Greta Thunberg, and the use of WhatsApp, Twitter, and other social media have enabled this movement to spread surprisingly rapidly in India. Protests elsewhere have catalysed the formation of Extinction Rebellion and FFF groups in many towns in India. XR in India staged climate protests in Delhi, Bhopal, Bangalore, Mumbai, Gurgaon, and many other cities through 2019. In 2020, the protests moved largely online.

This has spread awareness and — to a lesser degree — understanding of the climate crisis among thousands of young people in India. Which is extremely welcome. A caveat though: these movements need to recognise that Twitter and other social media, used in particular by socially privileged students, do not threaten elite dominance. To deepen climate justice, we need greater engagement with the many forms of structural inequality in India and to build alliances with the varied social movements that challenge them.

6. Challenging capitalism

By targeting fossil fuel corporations, the climate justice movement has put a face to the enemy. But the crux, and the difficulty, lies in challenging capital's logic itself, which is one of maximizing profit and endless accumulation for more profit. That accumulation is brutal—in its history of colonialism, violent cornering of resources, profiting from Nature, resource wars, overexploitation of workers, sexual assault on women, the murder of key organizers, false cases on activists, repressive laws. Working against global warming means challenging the system, in whatever work we do. The problem is that whereas political alternatives to capitalism exist, the difficulty lies in evolving *economic alternatives on the scale necessary*.

Global warming and other ecological crises have lent renewed urgency to a number of questions that some had already been asking for years: do we really need high economic growth? The media and politicians are obsessed with growth. But where does this growth come from? Does it result in quality work, large-scale employment, and a living wage? The distress migration by millions following the COVID lockdown in India clearly shows it has not. Who does 'development' actually benefit? High economic growth has mostly resulted in contractual, insecure, stressful, and poorly paid jobs in the last twenty years in India. Rather than blindly accept 'growth' as a mantra, I would argue for a more equitable development trajectory that prioritizes basic goods and services that most people need to improve the quality of their daily lives. As people's lives improve, they will consume a bit more, and low but more sustainable growth will happen automatically.

Ecological concerns have to be a part of our politics or worldview. Much criticism has rightly been levelled against 20th century Left practice in varied countries—its lack of democracy; industrial-technological primacy, and the ecological damage that ensued. In this, they mirrored capitalist relations with Nature. Progressive politics cannot henceforth remain blind to these issues.

Ecological concerns, or local peoples' collective relationship with what Nature provides, have been integral to a number of movements in recent times—Niyamgiri, Gandhamardhan, Jaitapur—both in India and elsewhere. Global warming makes that an issue for us all. Whichever of these elements of Nature we may relate to—the seas, rivers, forests, the hills, birds, cows, fish, other species large and small—they are all being affected. This urges us to think more deeply about our relationship with the natural world, and renders greater urgency in tackling global warming.

Equity is at the core of ways forward. In the context of global warming, there are at least four aspects to equity:

One, equity between people, which is linked to our development trajectory, and would include making small agriculture viable, land distribution, female control over land, and expanding workers' rights.

Two, improving the capacity of people to cope with the impacts of climate change. Coping is not merely reacting after the event, but also preparing for and cushioning impacts, reducing risk before an adverse climate impact hits.

Three, equity between generations. Future generations also have a right to common resources, to forests, to groundwater, to minerals, to rivers, to marine resources, etc, as much as we do. What kind of world will we bequeath to them, young people protesting around the world are asking. But how far ahead are we willing to think? What does 'sustainable development' mean in an economy that is constantly growing? How can we live sustainably for the future if we so deeply valorise growth and consumption?

Four, equity between species. We need to discard an anthropocentric worldview that focuses on human beings, and conflicts between humans alone. Other species have as much a right to the commons, to energy, to rivers, to the forests, as we do. Human beings are only one among 1.7 million known species on this planet. Ecosystems are intertwined, life is a web, and we need to preserve that web and its interconnections better.

Finally, global warming is urging, but also enabling us to think about a number of issues in an interconnected manner—energy, water, consumption, transport, urbanization, agriculture, what we would like our town to be like. The picture may seem bleak, and, without doubt, we need to think and act with urgency. But history teaches us that **positive social change happens when people come and work together, and therein lies hope for the future.**



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Author bio

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Note

To discuss or respond to anything contained in this text, or if you have any queries about global warming, feel free to email me at nagraj.adve@gmail.com, or call at 9910476553. Likewise, if you are a teacher and wish to engage with the teachers' group. Or if you wish to get in touch with SAPACC's youth group.

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Language versions available

- An earlier **English** version of this text was published by Ecogise Hyderabad in August 2019.
- This document has been translated into **Gujarati** in September 2020, and is available on the Paryavaran Mitra website, <https://paryavaranmitra.org.in/wp-content/uploads/2020/09/Global-Warming-booklet-Gujarati-by-Nagraj-Adve.pdf>
- A **Telugu** version, published by Human Rights Forum (HRF), Andhra/Telangana, will be available soon.
- It has been translated into **Hindi** and published by Khedut Majdoor Chetana Sangath (Madhya Pradesh) in 2016.
- It was translated into **Kannada** in 2014.
- It was translated into **Tamil** in 2017 and published by Vidiyal Publishers, Coimbatore. For Tamil copies, call 0422-2576772, 09443468758, or email vidiyal@vidiyalpathippagam.org.
I can email a soft copy of the English, Hindi, Gujarati, Tamil, or Kannada versions to anyone interested.

Ongoing translations and updates:

Translations into **Oriya** and **Bengali**, and **updates** of Hindi and Kannada are ongoing, and will be made available as soon as possible.

Delhi, 3 October 2020