GLOBAL WARMING IN THE INDIAN CONTEXT
An Introductory Overview

This booklet is based on conversations with many people from different states, chats with fellow-activists, public meetings and talks, activist reports, state action plans, India’s INDC and other government publications, IPCC reports, published books and scientific papers. I have avoided giving references so it does not become too academic.

It is mainly aimed at college students in towns and cities, other young people and activists.

- Nagraj Adve

What they told us in Gujarat
A few years ago, a group of us went to parts of Gujarat to find out how climate change was affecting small farmers there. In villages in eastern Gujarat, they told us that the winter maize crop had been getting hit. Because winters have been getting warmer, the dew (ős) 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. Maize is a very important source of nutrition for poor households in these and nearby regions. In other villages in north Gujarat, we were told of other effects: that nowadays, it is not raining when it should, or it rains when it should not, that lots of rain happens in little time, people are facing new illnesses and cattle are falling sick more often, pest attacks have gone up, etc.

The people’s response there to all this was interesting. When we asked them why they thought these changes were happening, they would say, “Prakruti ki baat hai (it has to do with Nature).” It is striking that they did not consider it even imaginable that human beings had the power to alter Nature on this scale.

We do. Whenever we burn coal and oil – the 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 smelled. Unlike oxygen, carbon dioxide has the capacity to absorb and trap some of the Sun’s radiation that is coming back off the Earth’s surface. There are other gases that do this, such as methane (from burning 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. For that reason, and for simplicity, we will largely focus on carbon dioxide in this booklet.

The Earth’s razai is making us warmer
Carbon dioxide though is not the villain; in fact, it is essential to life on Earth. Without carbon dioxide, the Earth would have been over thirty degrees Celsius colder, and not been habitable, certainly not for humans. It is the presence of carbon dioxide naturally in the atmosphere that maintained temperatures which helped the growth of agriculture and the spread of human civilizations.

But now we are adding to the amount of carbon dioxide that is naturally present in the atmosphere. We dig carbon out from under the Earth, and burn it to run factories, drive cars, generate electricity, fly planes, make cement, transport goods, fight wars. Some of it essential activity, some socially wasteful, and some completely unnecessary, even damaging. In such activity,
the world sent up 34 billion tonnes (1 tonne = 1,000 kgs) of carbon dioxide from burning fossil fuels and two billion from cement production in 2013, the latest year for which worldwide data is available. Another four billion tonnes’ carbon dioxide got added by our cutting forests; when wood burns or rots, it emits CO2. The contribution of the other greenhouse gases is calculated as an equivalent of CO2 in their capacity to cause warming. So, methane’s share is nine billion tonnes of CO2-equivalent, and nitrous-oxide and other gases, four billion tonnes. To repeat this simply, CO2’s share from burning fossil fuels is 34 billion tonnes, from all activity is 40 billion tonnes, and other gases are equal to another 13 billion tonnes, for a single year’s (2013) total of 53 billion tonnes of CO2-equivalent.

Over time, a little over a quarter of the carbon dioxide gets absorbed by the oceans, making their waters more acidic. About the same amount gets taken up by trees, soil and grass, etc on land. The rest – little under half – remains in the atmosphere. Roughly every eight billion tonnes of carbon dioxide in the atmosphere equals one part per million (ppm). In 2015, CO2 levels in the atmosphere crossed 400 ppm for the year not just for the first time in human history, but for the first time in the last four million years. It used to be 280 ppm around the start of the Industrial Revolution.

Carbon dioxide spreads all over the Earth’s atmosphere in about a year. Up there, 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, CO2, methane and nitrous oxide trap some of the Sun’s invisible heat radiation coming up off the Earth, hence causing global warming. Adding fifty billion tonnes of carbon dioxide and other gases to the atmosphere each year is like adding another layer to the blankets that we have covered ourselves with. A thicker blanket traps more heat.

Over ninety per cent of the excess heat so trapped by greenhouse gases goes into the oceans, because water has a high heat absorption capacity. Making oceans warmer is disrupting the hydrological/rainfall cycle, makes cyclones more intense, and causes sea level rise. What’s left melts the glaciers and ice, warms the soils, etc.

Global warming is measured by taking the average over time of the air temperature just above the surface of the Earth all over the globe. How much warmer have we become? Between 1961 and 1990, India used to be 24.87 degrees celsius, on average. That’s an average of all seasons during those years, mind you, and includes both the cold heights of Ladakh and warm South India. By the first decade of this century, 2001-2010, the average had risen to 25.51 deg C. Importantly, though temperatures expectedly went up and down between years, not a single year was cooler than the 1961-1990 average. The coldest year was 0.4 degrees C warmer than that average, and the warmest year was 0.93 degrees warmer.

What about the world as a whole? They compare that with what it used to be in the mid-18th century, at the start of the Industrial Revolution. The world has become one degree Celsius warmer since then. The Earth’s average used to be little over 13.5 degrees C then, it is 14.5 degrees C now. Some regions and ecosystems, such as the Arctic, North Africa, southern Europe and the Himalayas are warming a lot more than this average.

One crucial point here: all the warming does not happen as soon as carbon dioxide is sent into the atmosphere. There is a gap of many years between heat going into the oceans and the full surface warming it causes. Hence, some of the heat from the billions of tonnes of CO2 we have emitted over the last few decades are yet to be felt. This unavoidable, further warming will be at least another 0.6 degrees Celsius, likely higher, over and above the current 1 degree rise.

Newspapers often tend to use the terms ‘global warming’ and ‘climate change’ as if they mean the same thing. Global warming is what we have discussed above. Climate change is a change
in weather patterns, rainfall, storms, etc, over time. It is the most important consequence of global warming but not the only one. Global warming also causes, for example, sea ice to melt in the Arctic. It causes the ocean waters to get warmer. It causes soils to get drier. Some of these would in turn contribute to climate change but they are not the same as climate change.

Who is responsible for global warming?
There are different ways of approaching this question.

One way would be to examine different kinds of economic activity. World over, in 2010, emissions totalled about 50 billion tonnes of CO2 and other gases. Of this, industry and manufacturing was responsible for 32 per cent; agriculture and deforestation 24 per cent, homes and buildings 19 per cent, transport 14 per cent, and other energy 11 per cent (data from the Intergovernmental Panel on Climate Change (IPCC)). This includes the heat and electricity used in these sectors. Though transportation may seem low, it’s one of the fastest growing sectors.

Another way of looking at emissions is: which areas is it coming from? Only 30 per cent comes from rural areas. As much as 70 per cent comes from urban areas. Urban areas tend to have a lot of wasteful consumption by the better-off, air-conditioning, malls. Over 35 per cent of electric- used in Mumbai is consumed running air conditioners (ACs), personal and commercial. Cities also have a lot of structures, which though used by most people, take a lot of resources and energy to build, such as bridges, Metros, flyovers, etc.

A third way – a very common approach – is to see which nation is responsible for how much carbon dioxide emissions. China, at about ten billion tonnes out of the total of 34 billion tonnes of CO2 in 2013, has been jumping like a kangaroo past the United States (5.3 billion tonnes). India at 2 billion tonnes is a distant third, followed by Russia (1.8 billion tonnes), and Japan (1.4 billion). Include methane and other gases, and India’s total jumps to nearly 3 billion tonnes of CO2-equivalent. But the US’ and Europe’s emissions are a lot higher than China’s if one considers their current per capita average, emissions for each person. It’s even higher if one were to consider their historical emissions, what each country has emitted since the start of the Industrial Revolution.

Each of these approaches has its merits, and 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 global warming are forces driving the modern economy, primarily the relentless quest for profits and growth. Also crucial are the growing differences in incomes, consumption and wealth, in India and worldwide.

The roots of the problem
Some people say that the global warming problem began thousands of years ago. As the human race spread across the world, human beings cut forests to clear land for settlements, agriculture, and firewood. A dead tree releases carbon dioxide. Then, rice farming in China and India over hundreds of years used standing water and flooding from rivers, which emits methane. So they are not totally off the mark. Yet, the development of industrial capitalism powered by fossil fuels around the late-18th century marks a radical shift for what we are discussing.

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

Two, profits – and 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 making them work faster. Companies also profit from exploiting Nature, by gaining control over the commons resources of ordinary people such as forests, coastlines, and rivers. It is not a coincidence that China became the biggest emitter of carbon dioxide in recent years. So much manufacturing had moved to China, which has lots of coal and cheap labour. It came at a huge ecological cost, for Chinese people and the world. But then corporations pursue profit at any cost, the people and environment be damned.

Some of the surplus they extract is reinvested in the company to expand the business. This accumulation does not depend upon the whims of an individual manager; it is a compulsion for all. Companies that do not do this would over time stagnate and close down, or be swallowed by others. And because it is a compulsion, they can’t stop trying to reinvest and expand. Accumulation and growth are part of the DNA of capitalism.

As a consequence, the world economy, which grew at barely 0.1 per cent 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 per cent a year between 1700 and 2012, and in the last sixty years at over 3.5 per cent a year. In 1820, global output was 694 billion dollars, in 1917, it was 2.7 trillion (a thousand billion) dollars; by 1973 this had grown to 16 trillion dollars, by 2003, 41 trillion. Currently, the world’s annual GDP is about 70 trillion dollars. It keeps ballooning, and at a higher rate. Keeping in step, half of all carbon dioxide emissions since the mid-18th century have occurred over just the last thirty years.

World economic growth is currently about 3 per cent per year, and is expected to continue at that annual rate until 2050. 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, i.e. at half the rate of GDP growth. That may now improve slightly as coal consumption slows down in China. Still, a three per cent annual rate of GDP growth would mean a rise in emissions of 1-1.5 per cent on average.

To underline an important point being made: accumulation and profit constitute the inherent dynamic of the world capitalist economy, and hence lie at the roots of global warming. Those who see and discuss the issue only in nation-state terms or in other frameworks miss this underlying logic. Most meetings I attend are silent about it. You can’t hope to solve a problem if one has not defined the problem correctly in the first place.

**Household consumption and class**

How many gadgets does one use regularly at home? How many bulbs, fans; does the house have a water heater, a toaster, a fridge, an AC? Do we cycle, take a bus or drive a car? Our carbon emissions depend on all of these things. When going out of town, do we catch a bus, train, or fly? Say, if you took a train from Warangal to Delhi – 1,545 kms – your share of emissions would be roughly 35 kgs of carbon dioxide. In a plane, each passenger would emit over 200 kgs.

All of this obviously depends on one’s income and consumption. The huge differences of incomes and wealth in India have deepened over the last twenty-five years, aided by government
policies. There’s been an explosion in the number of the very rich while at the same time, wages for factory workers after taking inflation into account (what’s called real wages) was five per cent lower in 2014 than they were in 1996. This deepening inequality is reflected in energy access and use. Even as India’s electricity generation capacity has trebled over the past decade, to 2,34,000 MW, over 300 million people, including about 25 million in urban areas, don’t have access to any electricity in their homes even now, and another 300 million get it for a scant few hours daily.

A colleague conducted workshops in colleges in Delhi on measuring how much carbon dioxide a household emits. With his help in working through the numbers, we found that most of Delhi’s middle class emits 4-5 tonnes of CO2 per person a year; the rich households in India emit much higher, European levels. Whereas factory workers or security guards who earn Rs 6,000-7,000 a month, domestic workers who earn less than that, agricultural workers who earn even less, how much carbon dioxide can they possibly emit?

Inequalities in emissions from current consumption and incomes are deepened by inequalities in emissions embodied in the products and property one owns. To take just two examples: in a car – which less than ten per cent of Delhi’s population owns – 3,500 kilos of carbon dioxide are embodied just in making the aluminium that goes into making a car, because the process of refining bauxite and then alumina 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 carbon source. And it’s 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”. Some of them, three. While the urban poor are being thrown out of the bastis they live in.

A nation-state framework of viewing global warming chooses to ignore these huge internal differences of income and wealth. For instance, the Indian government says ‘India’s per capita emissions are low’. It is hiding behind the poor. A Planning Commission report a few years ago revealed that more than 800 million Indians consume less than Rs 20 a day. 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, because that is the only way there will be the ecological space for the poor to improve their lives. How we ensure that and yet generate decent work and employment for the millions of young people seeking jobs each year is one key question.

**IMPACTS OF GLOBAL WARMING**

Before we consider impacts in India and elsewhere, a few things are useful to keep in mind:
- Impacts began to be felt in different parts of the world about forty years ago, from the mid-1970s.
- Unlike most other forms of pollution, the source of carbon dioxide and where its effects are felt can be very far apart. Carbon dioxide generated in the United States affects the Maldives.
- A significant portion of CO2 remains in the atmosphere for thousands of years. Also, climate change continues for a thousand years even after emissions stop. Hence, climate change is here to stay. It is the new ‘normal’.
- Impacts will worsen. Some of it is unavoidable. **Our urgent intervention is needed to make sure they do not get much worse, and that the situation does not get out of our control.**
Major Impacts of Global Warming in India

Climate change adds on to all the other issues facing small and marginal farmers, the urban poor and other communities in India – higher costs of seeds, fertilizers and other inputs; falling groundwater levels; small agriculture becoming less viable; landlessness among dalit communities; takeover of commons resources by industry and real estate companies, land alienation among adivasis, land not being in the women’s name, rising prices, etc. Climate change impacts are both affected by and worsen the many inequalities in Indian society. For millions of small and marginal farmers – who are 87 per cent of the agricultural holdings in this country – for agricultural workers, poor women and other social groups, climate change will be the last straw that broke their backs. It is one of the worst violations of justice that those least responsible for global warming bear its burdens the most.

1. Irregular rains and hailstones: The most common impact across India has been to rainfall patterns. Farmers say they first noticed changes in rainfall 15-20 years ago, but that it has intensified over the last 5-6 years.

Nowadays it rains when it should not and does not rain when it should. The southwest monsoon has begun to come early in some places and drags on late in others. Farmers sow crops expecting rains that don’t arrive or come late. Or there is intense rain at the time of harvesting and threshing, which damages the standing crops and fodder. Hailstones are also falling more frequently, in bigger chunks than they used to, sometimes in areas where it has not hailed before. Millions of farmers were affected by such unseasonal rains and hail in successive spring seasons of 2013, 2014 and 2015. In 2015, it devastated crops over 18 million hectares across 15 states, a huge 30 per cent of all rabi acreage, causing losses worth Rs 20,000 crores. It triggered a spate of farmers’ suicides.

There’s a worrying relentlessness with which agriculture is being hit. Every season in the past 3-4 years has been affected: kharif, rabi, kharif, rabi. [These are the two main Indian cropping seasons: kharif is from June to October, during the south-west monsoon, rabi is from October to March (winter).] If it is drought in one season, it is hail 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 only 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. But 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. More intense rains in little time: Earlier it used to rain not evenly but reasonably predictably over a monsoon season. Farmers used to be familiar with its unevenness and have local names for varied rains in the season, across different cultures. Nowadays, in most places, it does not rain for many days and then a lot of rain falls in a few hours or couple of days. This has been linked to warmer sea surface temperatures. It also happens because warmer air has the capacity to hold more moisture, which it lets go in a more intense burst. Intense bursts of rain tend to damage the standing crop, affect the planting of crops, and damage topsoil. It causes flooding, and adversely affects people’s access to water.

Though it is not possible to ascribe single rainfall events to climate change, however intense – after all, climate change is a process over time, not an event – the huge disaster in Uttarakhand of June 2013 was likely the worst climate change disaster people here have faced. A very wide region
was hit by intense rains, and that too for three days. The National Disaster Management Authority said 11,000 people may have died. 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 at this, the height of the tourist season. The worst loss of life was in Kedarnath, Rambara, and below. The extreme rain burst the wall (moraine) of a mountain lake (Chorabari Taal) just above Kedarnath. The surging waters rushed downhill destroying that town, everything and everybody was either swept away or submerged in mud and rocks.

Hundreds of villages were devastated in Uttarkashi, Rudraprayag, Chamoli and Pithoragarh districts, and beyond. In village after village in different river valleys, homes were swept away, 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 [= hundreds of thousands] of locals and migrant workers depend for jobs and earnings – was hit. Children were not being able to go to school. Women in particular are badly hit as they nurture households, cook food, get fodder.

As usually happens, the devastation in Uttarakhand was made worse by chaotic ‘development’: blasting of hills for run-of-the-river hydro projects, dumping of the rubble, unsafe widening of roads, shoddy constructions for tourists near rivers, etc. The alarming thing is that large hydropower and this kind of unregulated ‘development’ is being promoted across the Indian Himalayas, from Himachal Pradesh to Arunachal Pradesh in the east.

3. Droughts in many places: Some parts of Bundelkhand in central India (straddling Uttar Pradesh and Madhya Pradesh) have been experiencing droughts for most of the last fifteen years. Global warming causes intensified droughts in interior regions, and dries up soils even more in places that are already dry. When a team of us visited Bundelkhand a few years ago, we saw a complete collapse of agriculture. Large lakes had dried up for the first time, lakhs of agricultural workers, small farmers, 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 that visited Bundelkhand in 2015 found the same grim conditions prevailing.

Droughts are now happening in regions of India that rarely or never had droughts before – parts of the Northeast, parts of Jharkhand since 2000, Kerala recently. It is also happening more frequently that droughts happen in one place and floods happen close by. India is suffering one of its worst droughts in recent decades as I write this; up to 400 million people across thirteen states are affected.

Women face the brunt of this. In Bundelkhand, 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 poor women do all kinds of work inside and outside the house – procuring water, as marginal farmers, getting fodder and wood, as agricultural workers – they are the largest social group to be hit by climate change in India.

4. In the Himalayas/ Garhwal hills/ Himachal region: The Himalayas have warmed by 1.5 degrees Celsius on average, which is more than twice India’s rise in temperature. The rise is even more in winters; warmer, shorter winters are being felt all over India but in particular at higher altitudes. Warming is causing a change in snowfall patterns in Kashmir and Ladakh, and reduced snow at mid-to high-altitudes. Instead of snowing, precipitation is happening as rain. Or it snows at the wrong time in the season. Small glaciers are disappearing and large glaciers melting from above and below.
All this gravely impacts people’s access to water for drinking and for irrigation. There’s a drying of streams on which locals are dependent and an increase in forest fires and pests in some hill regions.

Other species are affected too. Oak trees, apple trees, vegetables, reptiles, butterflies, birds and other fauna are all 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 species are already at mountain tops; how far can they climb as it gets warmer?

5. Impacts on Health: Many factors affect health; to isolate climate change is neither easy nor necessary. There’s been reduced nutrition for the poor due to less food as a consequence of climate change. This adversely impacts health over time. Climate change has contributed to – among other factors – higher food prices in recent years. The reduced food intake has resulted in increased rate of death and serious illness among the poor in parts of central India in the last one year. It is also hitting the urban poor in Delhi and other places.

Mosquitoes and diseases like malaria, dengue and chikungunya have spread wider as winters get milder in the plains, or mountain places get less chilly; viruses and bacteria generally flourish in less cold weather. There has also been an increase in the number, area and duration of heat waves in parts of India. This causes acute heat stress, chronic kidney disease and deaths, particularly of the poor and aged, the homeless, and those who work outdoors for long hours. For instance there’s been an increase in the number of deaths due to sunstroke in Orissa in recent years. One of the most alarming impacts in future will be large areas across India, indeed across South Asia, becoming inhabitable. So hot and humid combined, they will go beyond our bodies’ capacity to lose heat.

6. Coastal Areas: Sea level rise due to warmer oceans has been experienced by coastal peoples for thirty years in the Sunderbans, in Gujarat, and elsewhere in India. For them it has meant a slow erosion of their lands, villages, homes, and salination of wells and fields. Tens of thousands of people have been forced to migrate elsewhere in a search for livelihood.

Tens of millions of people practice agriculture, fishing and other livelihoods in fertile, biodiverse stretches along India’s coasts. As it is, numerous ports, ultra mega power coal plants and other projects on the coast are eroding coastlines, displacing people and damaging agriculture, water bodies and local ecosystems. And now climate change is adding to it. Fisherman in Karnataka tell us that their going out to sea has become more uncertain because there is no clear pattern any more of rainfall and storms. Sea surface 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.

Rising sea surface temperatures is causing storm surges and greater intensity of storms along the Eastern Coast. It is quite likely that this contributed to the intensity of Cyclone Phailin that hit Orissa and Andhra in late 2013. The salt water that comes in with storms, and that which seeps into the groundwater harms coastal agriculture and drinking water sources.

7. Impacts in urban areas: People living in towns are being impacted by increased heat stress in a warming world, or by rising food prices when climate change impacts agriculture. Most of all, by floods or droughts. The huge drought in parts of Maharashtra in 2016 has meant that people of Latur town are being supplied water by train. Innumerable other small towns in Marathwada are panting for water. At the other end of the hydrological cycle, towns have been deluged by extreme
rainfall events – Chennai most recently in December 2015 – 340 mm fell on a single day, – Srinagar in September 2014, and of course Mumbai in June 2005. In every case, the brunt is faced more by the urban poor in jhuggi bastis [shanty settlements made ad-hoc from e.g. bricks and corrugated iron] with less firm housing structures in low-lying areas, wage workers who lose their daily wages, and poor women. An in every case, the climate impacts were worsened by chaotic ‘development’ fuelled by the drive for profit – run-of-the-river projects in Uttarakhand, the builder lobby in Mumbai, and buildings shrinking the wetlands in Chennai. “Who is this ‘development’ benefiting?” is a reasonable question to ask.

It is not easy to do justice in a booklet to the complex ways in which climate change is impacting us. For instance, how are adivasis [indigenous peoples, making up about 9% of the Indian population, many of whom live by agriculture or as migrant labourers] and others dependent on forests getting affected, as the species composition of trees and vegetation changes due to global warming, medicinal plants on which they depend die out, or as species climb higher up mountain slopes?

We need to realize that the climate impacts mentioned are going to intensify and will happen simultaneously. Sea level rise in one place, drought in another, flooding close by, hailstones, intense rains … It will hit food security, access to water, livelihoods, lands, health, etc of the poor everywhere.

Impacts elsewhere in the world

- **Sea levels** are rising by an average of 3.2 mm a year over the last twenty years
- **Droughts** in parts of Africa since the mid-1970s
- Rise in ‘extreme events’: floods in Pakistan and the heat wave in Russia in 2010; the drought in Texas, USA in 2011; heat waves in Argentina in 2013; fires in California, the drought that affected parts of Jordan, Lebanon, Israel and Palestine, and the blizzard that killed 43 people including 21 trekkers in Nepal, all in 2014
  - In September 2012, **Arctic sea ice** melted to its lowest area and mass ever
  - **Oceans** have warmed to a depth of 2,000 metres, and even lower
  - 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
  - **Food production** is beginning to get hit in some of the poorest countries and also in China

Impacts on Other 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 in Gujarat. In the Bay of Bengal, earlier only up to Andhra, they are now found in Orissa’s waters. A similar shift of location northwards is happening with river fish in the Ganga.
- Migration of species to higher altitudes in North Indian mountains, such as oak and apple trees, animal species, vegetables.
- Greater spread of pests and growth of weeds in some forest areas.
- Early or erratic flowering of many plants and trees, such as of mango in Orissa and Karnataka, rhododendrons across the Himalayas, saffron in Kashmir
- change in the timing of spawning of certain fish due to higher sea surface temperature
- Slow death on a large scale of cows and other livestock in times of drought

**Worldwide**, a survey of over 800 published papers covering hundreds of species showed:
- Species are moving northward, or away from the Equator, towards the poles, to look for the right 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
- Birds are laying their first eggs earlier
- Disruption in timing between lifecycles of predators and prey, and of insect pollinators with flowering plants
- A high percentage of all known species – scientists now believe up to 40-70% – could become extinct because of heatwaves, 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 is warming but it is not significant; that yes, it is warming but humans are not responsible; that yes it is warming, but has happened before, so what’s the big deal?

Official data given above shows how much warmer India has become since the base years of 1961-1990. Let alone the data, one only needs to open one’s eyes to responses in Nature to warming that are happening all over India or indeed in any country – the early flowering of trees, melting of glaciers, early spring, warmer winters, submergence of small islands, Arctic ice melting, etc.

To say it has happened before naturally is true but what matters is the speed at which current changes are happening. 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 have been questioning the basic science because Earth surface warming slowed down for some years after 1998. This happened because most of the heat being trapped was going into the deeper oceans below three hundred metres. This lull in rising surface temperatures may have ended, with 2014 and 2015 successively breaking records as the hottest years ever, since instruments began recording temperatures in 1880. So far, 2016 is confirming the warming trend with each month breaking the highest ever temperature recorded by a huge margin. If we send more carbon dioxide and other greenhouse gases into the atmosphere each, they will trap more heat energy. This basic physics of global warming has been well established for well over a hundred years.

**The urgency of global warming**
We need to act quickly so that impacts do not get much worse than they already are. As the Earth warms further, extreme events such as the floods in Uttarakhand and Chennai will occur more frequently. What was to happen once every fifty years could happen once every ten years, or even five. People will barely recover from one catastrophic event for another to hit them.
But the urgency also stems from something else. In some ecosystems, global warming can trigger feedbacks, ecosystem responses that in turn cause further warming. For instance, Arctic sea ice has melted to its smallest area ever. The Arctic has been called “the world’s airconditioner”; Arctic ice acts as a giant mirror, reflecting sunlight. Less ice means that more heat is getting absorbed by the Earth’s climate system. Second, in Arctic lands, beneath the frozen layer on top, are billions of tonnes of methane. Melting ice will release this methane, causing further warming. This feedback has already been happening for the last ten years. There are other known climate feedbacks already recorded: more water vapour (traps more heat), warmer soils (release carbon dioxide instead of absorbing it), etc. A current debate is whether the amount of carbon dioxide being absorbed each year by some oceans has stopped increasing. If so, more carbon dioxide will remain in the atmosphere, causing further warming. That would be catastrophic.

Some of these feedbacks have already gone out of hand. For instance, we will soon have Arctic summers without ice, it can’t be stopped. 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 seriously dangerous levels of warming. The urgency has never been greater.

What are the governments doing?

The Indian government: Given the urgency and complexity of these problems, not enough and not quickly enough. About cutting emissions – mitigation – the government’s latest position as stated in its Intended Nationally Determined Contribution (INDC) submitted to the United Nations in October 2015 is: India will “reduce the emissions intensity of its GDP by 33-35 per cent by 2030 from 2005 levels”. That is, not less in absolute numbers, but reduced carbon emissions per unit of GDP, i.e. less than what might have been. Is that an adequate response to an ecological crisis on a world scale, one which is already hitting India’s own people and other species so massively? Even with its reduced emissions intensity, India’s emissions will likely double to 5-6 billion tonnes of CO2-equivalent by 2030, a significant portion of what the Earth can safely absorb.

About helping people cope with climate impacts or preparing for them (adaptation), thousands of wells and ponds have been dug under the NREGA. Sadly, this scheme remains underfunded at this crucial time of nation-wide drought in 2016. Research into heat-coping hybrids and saline-resistant crops goes on in different agricultural research institutes, but it needs to reach small farmers quicker and wider. But agricultural extension services are being withdrawn as neoliberalism dictates that welfare and state support be squeezed. The government claims in the INDC document that 2.8 per cent of GDP has been allocated for adaptation; some of this is just a re-classification of existing government programmes as climate change adaptation. Economic and social equity is central for people to adapt and cope in a more resilient manner, but most government policies now and in the past few decades have been pushing society in the opposite direction.

The National Action Plan on Climate Change (NAPCC) has eight missions – solar, energy efficiency, water, agriculture, knowledge mission, etc. In many areas – water, agriculture, energy, etc – the government attempt has been to give greater scope for profit by private industry. The concerns of poor farmers have been largely sidestepped. State Action Plans have been drafted in 22 states, but with hardly any consultation with local people, unions or other organizations. (The Madhya Pradesh Climate Plan was one welcome exception.) The Uttarakhand disaster of 2013 shows how poorly prepared the central and state governments are, with rare exceptions, despite having a state action plan in place.
Among the welcome measures listed in India’s INDC is an expansion of rooftop photovoltaic connected to the electricity grid, and an expansion of mass transit public transport. Solar power capacity is slated to grow to 100 gigawatts (GW) by 2022. But unless it is on rooftops, even solar power can be problematic: roughly four acres of land are needed for generating every one MW of solar power. The INDC document mentions 25 solar parks, which will take over lots of agricultural land. This is one key problem with India’s INDC and energy policy in general: an indiscriminate grabbing of energy from all possible areas and forms: a massive expansion of nuclear power (which it shamelessly calls “environmentally benign”) to 63 gigawatts from 4 GW currently, large hydro to nearly 100 GW, and coal. This indiscriminate expansion is aimed at meeting the energy demands of the privileged in an increasingly unequal society.

In general, the economic policies of the last twenty-five years – cheap flights, easy finance for cars, malls in cities, easy access to ACs, fridges, TVs and other consumer durables, opening up mining and other sectors to foreign private capital, reduced taxes on the rich – cause and reflect the deepening inequalities of incomes and wealth. Successive governments continue to hide behind the poor by saying “India’s emissions are low”, while grabbing energy from everywhere, geared towards carbon emissions by the better-off, while causing displacement of the poor on a huge scale.

**Other governments:** For over twenty years, governments have been meeting annually at a Conference of the Parties (COP) to discuss emission cuts, adaptation measures, and financial help and technology transfers to developing countries to help them reduce emissions or adapt. The latest was the 21st COP, at Paris in December 2015.

In 1997, at the Kyoto COP, most developed countries agreed to cut emissions by a small amount by 2012 over their 1990 levels. Countries had slightly different pledges; the overall average cut pledged was only 5.2 per cent over 1990-2012, less than what the science demanded. But since developing countries were not required to sign on (including China and India) and the US Congress did not ratify the Kyoto Protocol, the world’s three largest emitters were not covered by it. Not just were the target cuts so feeble, the Kyoto Protocol opened the way for corporations to profit from the atmosphere, via the Clean Development Mechanism (CDM) and the Reducing Emissions from Deforestation and Forest Degradation programme (REDD). They are now trying to expand this profit-making via REDD+, by putting a price on the ecological benefits that Nature bestows. It’s hardly surprising; capital will profit from anything. Like we discussed, it’s part of its DNA.

We are currently in the second phase of the commitment period, and in a limbo. The third phase starts after 2020. Towards that, each country was to submit its INDC before the Paris COP. Most have. China has pledged to cut its emissions intensity by 60-65 per cent by 2030. The United States pledged to reduce its emissions – absolute, not relative – by 26-28 per cent by 2025. This is a fragmented approach that disregards what the science is telling us.

The Paris Agreement of December 2015 talks of limiting warming to “well below 2 degrees C above pre-industrial levels, and pursing efforts to limit the temperature increase to 1.5 degrees C”. This may be a victory of sorts for all those who have for years pushed for thresholds below 2C. However, crucially, the present pledges of emission cuts by all countries, even if they are met, will lead to an average warming of 3 degrees Celsius, way above what is considered safe. It will be disastrous on a colossal scale; human civilization has no experience of these 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 recognized 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.

However, most governments represent 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 mass pressure from below, would be to put our faith in the wrong hands.

**What Should 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.

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. But the way forward is social, political change, combined with appropriate technologies, not technology in isolation.

What follows are some suggestions of ways forward. 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 young 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.

As for specific individual measures, try to identify your largest carbon-emitting activity and minimize it. This applies only to the well-off. For them it’s usually flying. If this applies to you, you could try to minimize flying to essential situations and emergencies. Besides, reduce your use of energy-guzzling gadgets like ACs; use buses and other public transport, buy local produce; cycle and walk as much as possible, etc. These individual lifestyle choices are linked to 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 connected to the electricity grid has just begun in Delhi. Growing vegetables in your verandah 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 restricted to the well-off. Incidentally, Cuban towns have done this for twenty-five years.

There is a view that since global warming is a huge and systemic problem, individual efforts are worthless. I do not agree. Individual efforts sustain our engagement. They help us dialogue – and sometimes argue – with friends and family about the issues that concern us. Also, it’s better if our lifestyle is consistent with our beliefs.

**Collective ways forward**

While relevant, 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 realize that something is wrong and needs to be changed or improved, and come together to do something about it.

1. 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 climate change is affecting their lives. What impacts do they face, what they think about it, what they are doing (or not doing) about it. Local farmers and other communities are trying to adapt in different ways: changing the cropping mix, the timing of the crop cycle, reverting to traditional seeds, digging small ponds, trying to revive older, traditional 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 can be done particularly by groups of students, young people, and by mass organizations. Climate impacts on the urban poor include flooding, water shortages, heat stress, and higher food prices due to climate change impacts on agriculture. Probing these helps us understand the issue from a class perspective, and helps us see through unsatisfactory frameworks that are constantly thrown at us. A gendered perspective on climate change is particularly important and has hardly been developed in India, 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.

2. In your college: In case you don’t already have a student group or union in your college, it helps to 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 screening. Sympathetic teachers can help.

   Small but specific actions are 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 MNRE website for installing solar panels. The same goes for having water harvesting facilities in college. You’d need to pressurize the college administration to implement these measures. For which, students getting together collectively is essential. Once your group gets going, contact friends in other colleges and help start the process there.

3. Work in your town: Any city in which we live and study have a number of issues that connect with global warming. In Delhi, for example, there was a campaign to expand rooftop solar power. Other organizations are demanding that public transport policy be extended beyond AAP’s odd-even plan. That more BRT bus corridors – which reserve one-third the road space for public buses and emergency vehicles – be built. They have also asked for a transport system that stops focusing on car users alone, and serves all, including cyclists, pedestrians and bus users. Many towns, even a state capital like Dehradun, do not have a public transport system to speak of, and run on ‘Vikrams’. Metros are expanding in some cities but priced high to deny access to working people, whereas access to metros should be made universal through cheap monthly passes like in Mumbai trains.

   Water is a key area in all towns in a climate-changed context. Work is possible at four levels. Pressurizing local authorities to create the infrastructure for rainwater harvesting along roads and public places, which helps falling groundwater levels. Two, reviving traditional or older water bodies
in your locality or town – bavadis/stepwells, ponds, lakes, older canals, streams. But first we need to know where they are; identifying such water bodies is something students can do along with interested teachers. Along with this, arguing for 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 told us how encroachments on wetlands, riverbeds and water bodies prove disastrous in the long run, and should be exposed and opposed in every town as India urbanizes.

4. Demanding **renewable, less harmful, decentralized energy choices**: Nuclear power has obvious dangers (though being wrongly promoted by the Indian government and some individuals abroad as a solution to climate change). Coal is the dirtiest fuel and the source of life-threatening pollutants and toxins. There is widespread opposition to large dams in many regions. So we are **against** a lot; what are we **for**?

   We can’t stop using coal or other fossil fuels overnight. But we do need **a faster transition** to cleaner energy sources. Some unions and other collectives in India – and elsewhere – have begun to seriously engage with the question of a transition away from fossil fuels. Solar power and wind suggest themselves. 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). These are badly needed in urban areas, from where much of the carbon emissions come.

   But this won’t happen without pressurizing governments to move away from subsidizing and promoting coal and other fossil fuels, and strongly supporting solar and wind. The German example is instructive: over the last decade, solar power expanded there from a few hundred to over 30,000 megawatts. Helped by favourable policy, but that was enacted because there is 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. Large solar parks take up a lot of agricultural land. The only way we can transit from coal to socially less harmful renewable sources is by also restricting energy demands to first meeting basic needs. Ensure the reduction of wasteful use (which happens only by the well-off). Otherwise we end up recklessly trying to grab all kinds of energy from everywhere, which is what current policy seems to be, which is harmful to other people and species.

5. All over India, **struggles** have intensified against displacement and for local community control over commons resources like forests, land, rivers and the sea. These are being waged against mining projects, coal power plants, aluminium projects, nuclear plants, and most recently against land being taken away for 18 vast industrial belts, such as the Delhi-Mumbai Industrial Corridor.

   Local residents who resist have been angered by the loss of livelihoods, control over resources and agricultural lands, and sometimes by health concerns. Their immediate motives may not be climate change, but connect with it in different ways. These struggles are about energy choices: resistance to coal mining and coal power plants have exploded in a number of places such as Mahan, Chandrapur, Sompeta and Kakrapalli, where huge ultra mega power projects are being
built or planned. 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.

By preserving wetlands or forests – such as POSCO or in Niyamgiri – these people’s struggles not just preserve important ecologies, but also help 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 core of global warming.

Over the years, students and other youth have related 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: struggles to resist the extraction and burning of fossil fuels, particularly coal and oil, have intensified worldwide over the past couple of years. These include successful resistance to the Keystone pipeline in North America, and against coal plants in the UK. At the time of writing this, 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 couple of years, youth have led campaigns to pressurize institutions to withdraw their investments from fossil fuels. Over 500 entities – including pension funds, government organizations, universities and colleges, and wealthy foundations – with assets totalling 3,400,000,000,000 dollars have committed to withdraw their money from fossil fuels investment worldwide. The list has about thirty educational institutions thus far, including the London School of Economics, SOAS and Oxford University.

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 profit and relentless accumulation. That accumulation is brutal – in its history of colonialism, violent cornering of resources, resource wars, exploitation of workers, 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? Where does this growth come from? Does it result in quality work, large-scale employment and a living wage? Who does ‘development’ actually benefit? Growth under capitalism basically comes from making people work harder and faster and from exploiting Nature unsustainably. It has mostly resulted in contractual, insecure, stressful and poorly paid jobs in the last twenty years in India, and even the employment gains from it are currently shrinking. Rather than blindly accept ‘growth’ as a mantra, I would argue for a more equitable development trajectory that focuses on providing basic goods and services that most people need to improve the quality of their daily lives. As people’s lives improve, low but more sustainable growth will happen automatically.

Ecological concerns have to be a part of our politics. Much criticism has rightly been levelled against 20th century Left practice – its lack of democracy; the primacy it gave to technology; its industrial scale, and ecological destruction that ensued. In this, they mirrored capitalist relations with Nature. Progressive politics cannot henceforth remain blind to these issues.
7. **Equity** is at the core of ways forward in tackling global warming. In a global warming context, there are at least four aspects to equity, and possibly more:

a. Equity between people: This is linked to our development trajectory. A renewal of small agriculture, land distribution, and female control over that land is an important part of such equity. Greater equality among castes, communities, genders is essential in such a complex society as India’s. Prioritizing basic needs, getting the rich to consume less, demanding a cap on incomes and wealth, and changing collective societal priorities.

b. Furthering the capacity of people to cope with the impacts of climate change, linked to the above. Coping is not merely reaction after the event, it is also preparing for and cushioning impacts, improving lives and reducing risk before an adverse climate impact hits.

c. Equity between generations: How far ahead are we willing to think? Do we accept that we are not the only generation that has the right to consume? That future generations have a right to common resources as much as we do? That is part of what sustainable development means.

d. Equity between species: We need to move away from a worldview that focuses on human beings, and conflicts between humans alone. To internalise that other species have as much a right to the commons, to energy, to rivers, to the forests, as we do. That 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 better.

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**Note**: To discuss or respond to anything contained in this booklet, or if you have any queries about global warming, feel free to email me at nagraj.adve@gmail.com, or call at 09910476553.

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