NPTEL ONLINE CERTIFICATION COURSE

ECOLOGY AND ENVIRONMENT

Chasing Sustainability – The Challenge – Part 1

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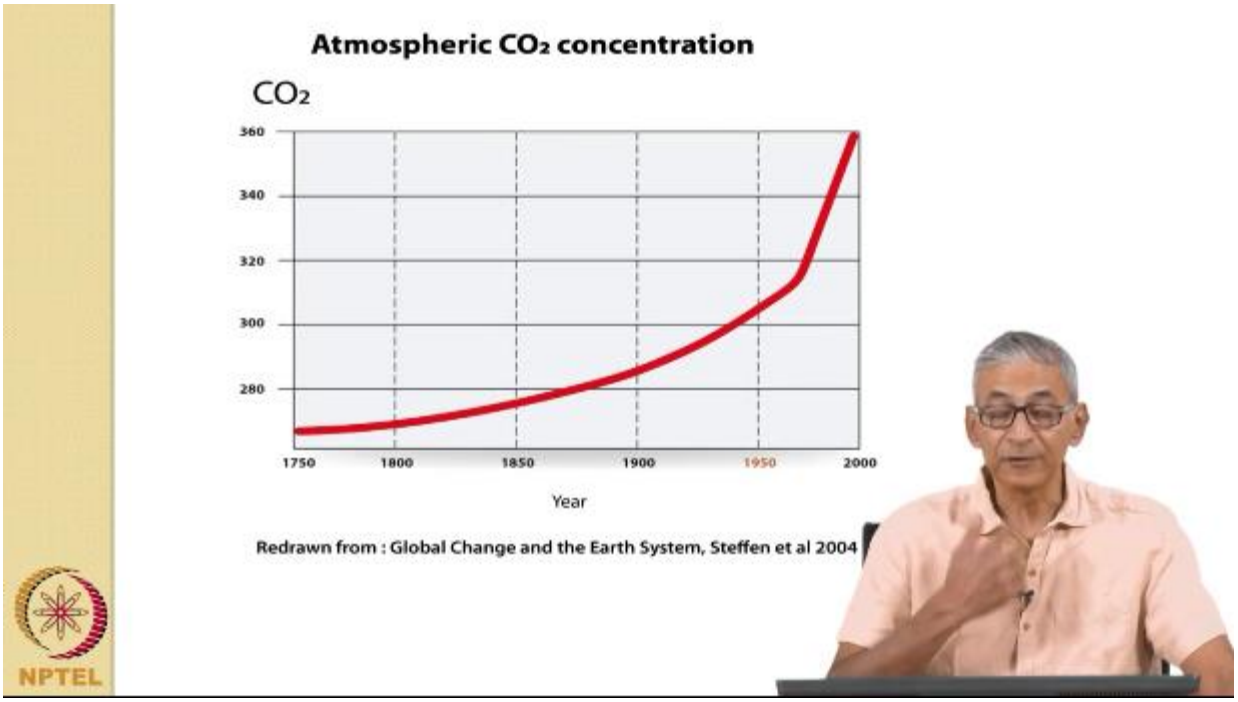
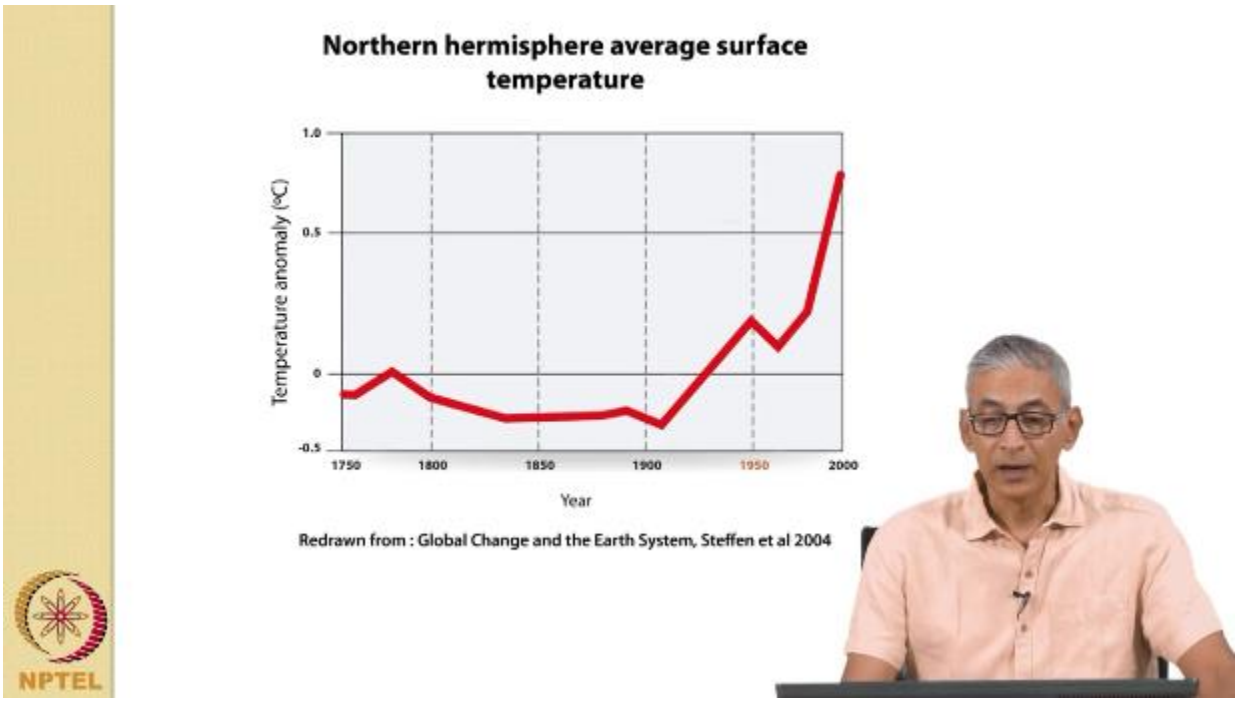
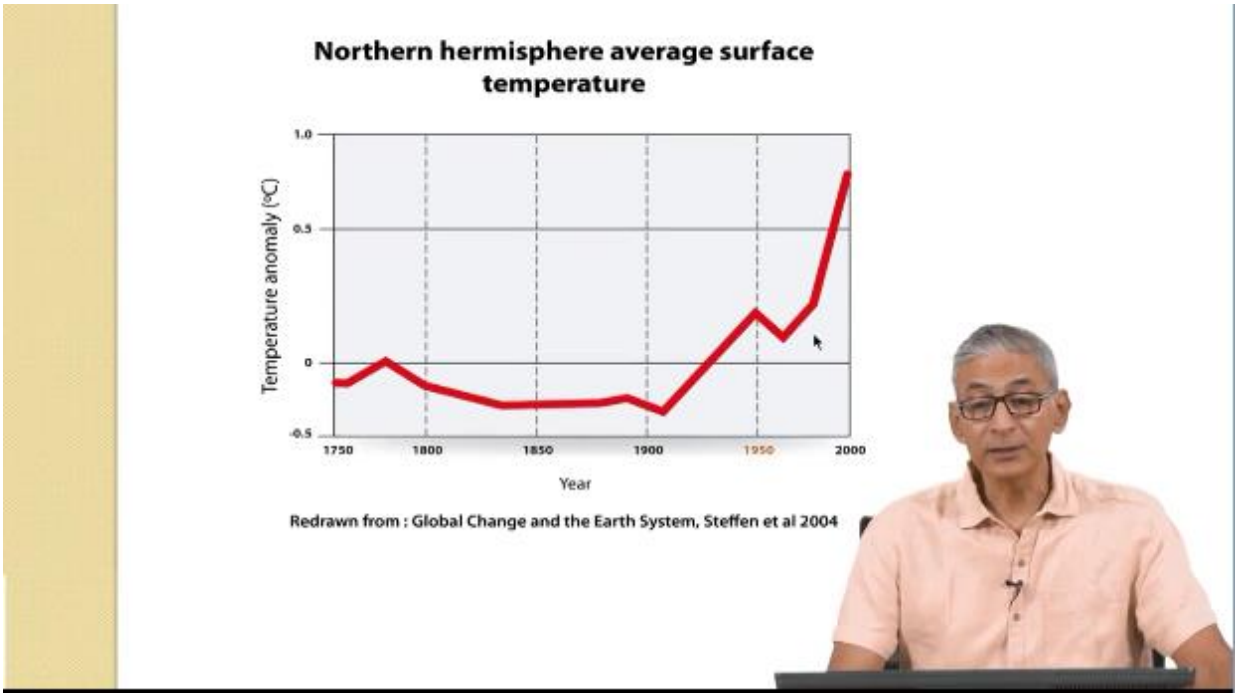
In this lecture we are going to look at sustainability and chasing sustainability, meaning how do we actually achieve sustainability given the various challenges in terms of the indicators.



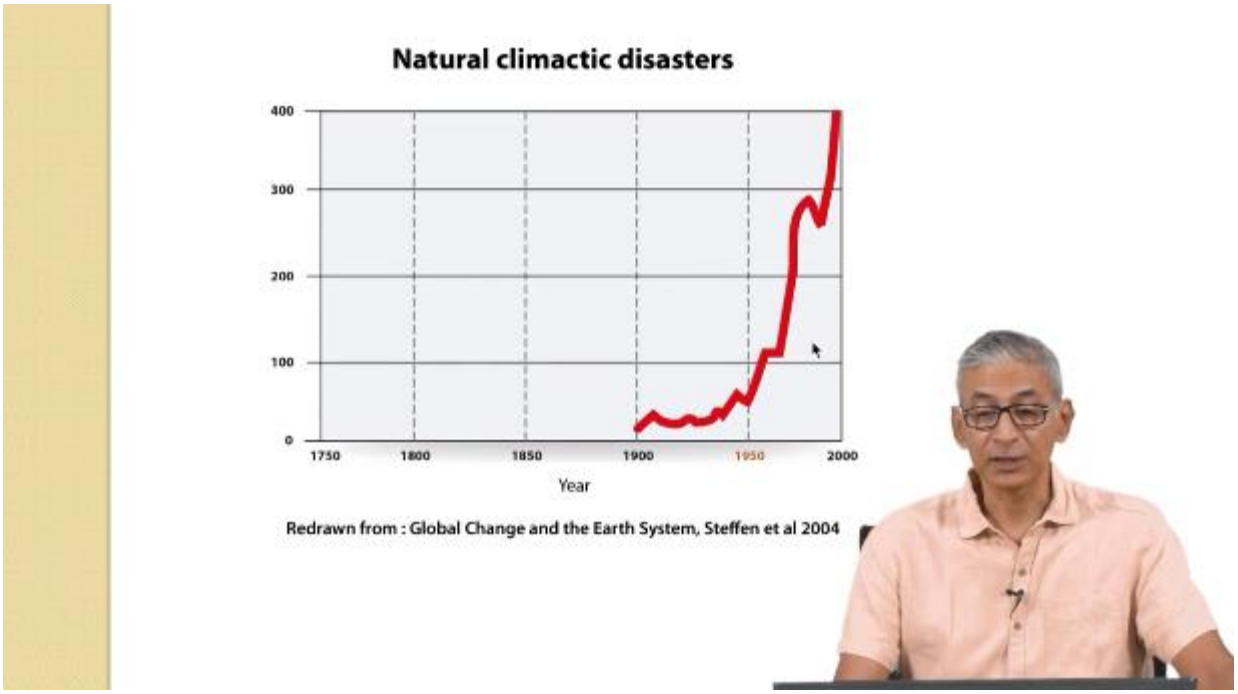
So, first of all, we know that atmospheric carbon dioxide concentrations have been going up, this is actually a graph from a few years ago. But by 2000 you can already see that upward trend, the accelerating upward trend in carbon-dioxide concentrations, average surface temperatures have also been increasing quite rapidly in the last few decades.



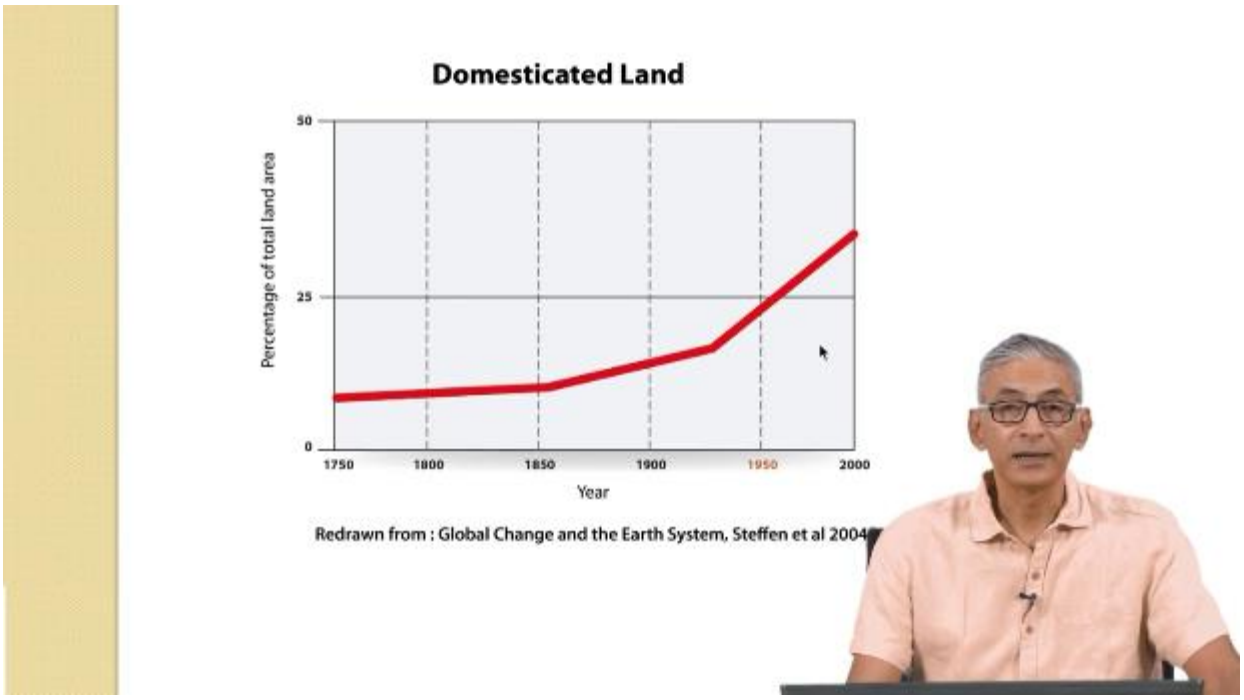
And of course, if you start looking at natural catastrophes worldwide between 1980 and 2011 again, you see a growing trend, and you will notice that much of this has to do with weather and climate-related events worldwide.



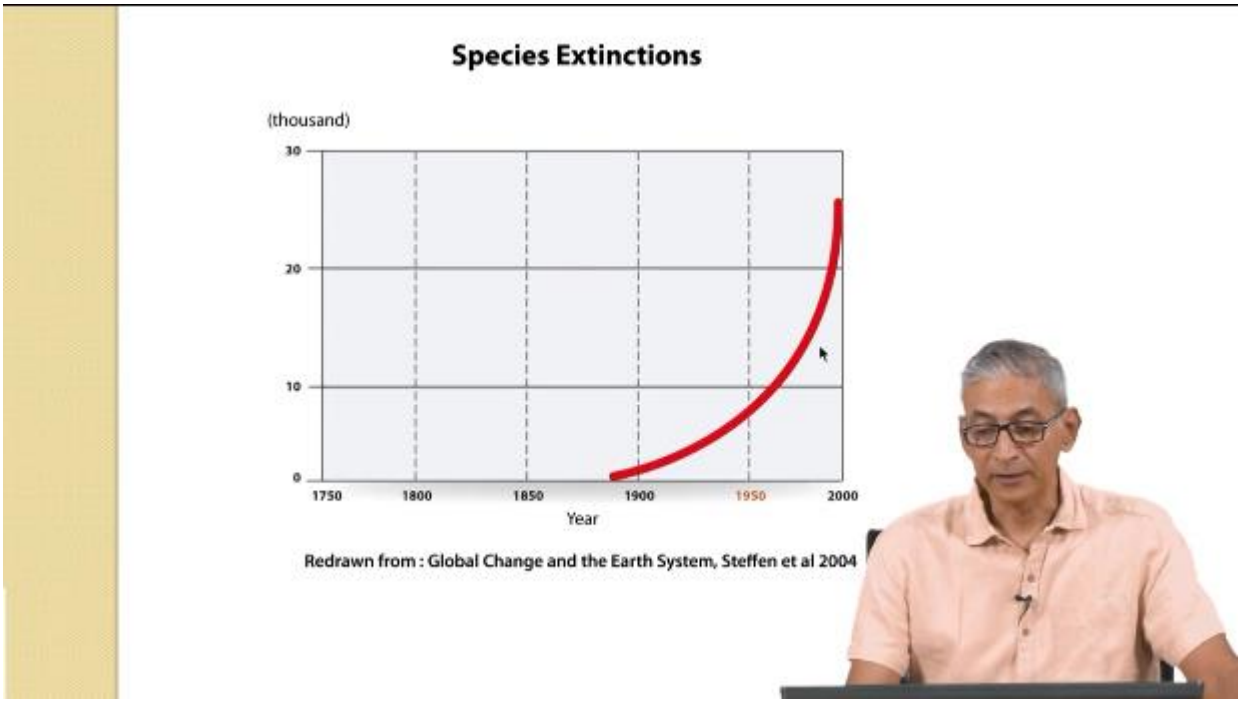
The Northern hemispheres average surface temperature has gone up; this is also known as the temperature anomaly.

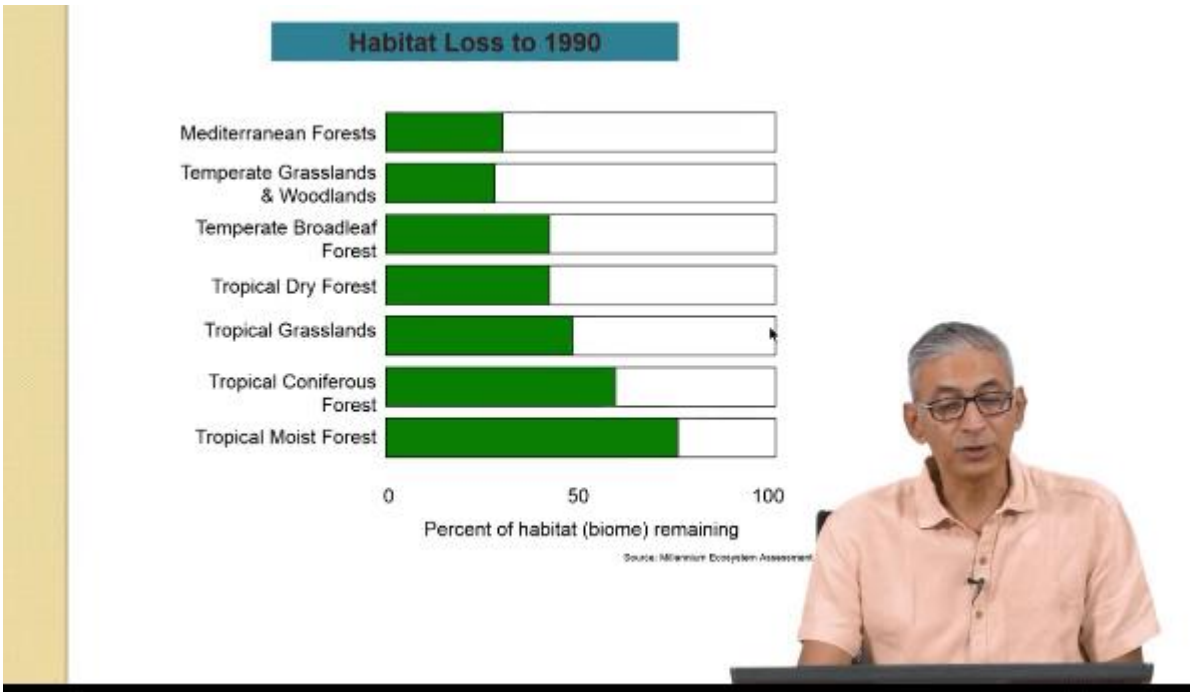


Natural climatic disasters are on the rise; this is again something that we have not seen in the first half of the 20th century to the same extent as what was observed in the second half of the 20th century,

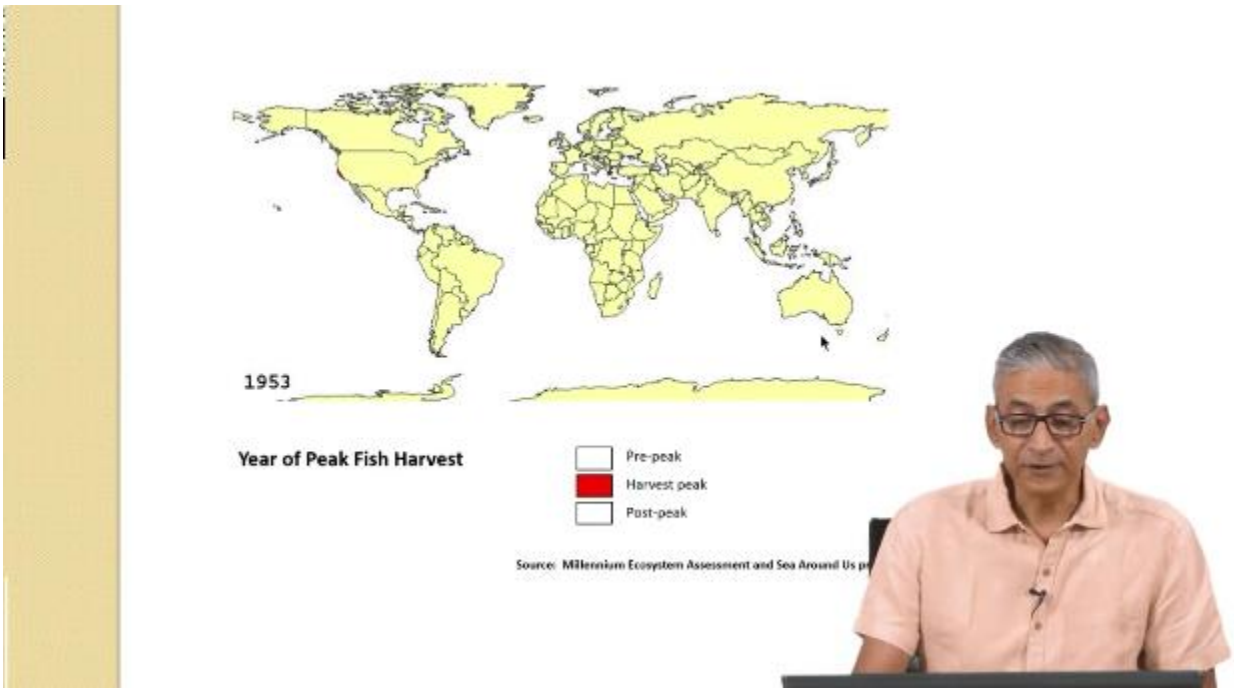


Domesticated land, the way in which land has been converted from forestry largely to urban land or agriculture, that too has been on the rise, and of course the effect of this is also being seen particularly in the second half of the 20th century, huge number of species have gone extinct, and that number is also increasing quite rapidly.

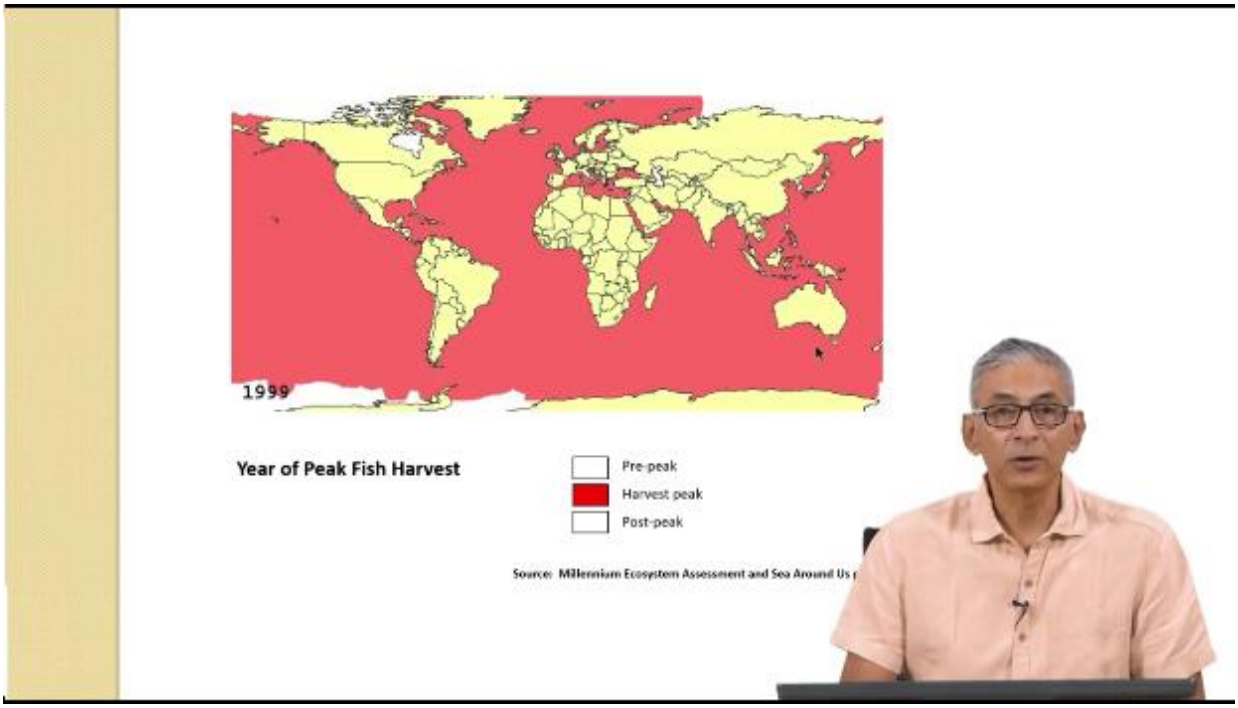


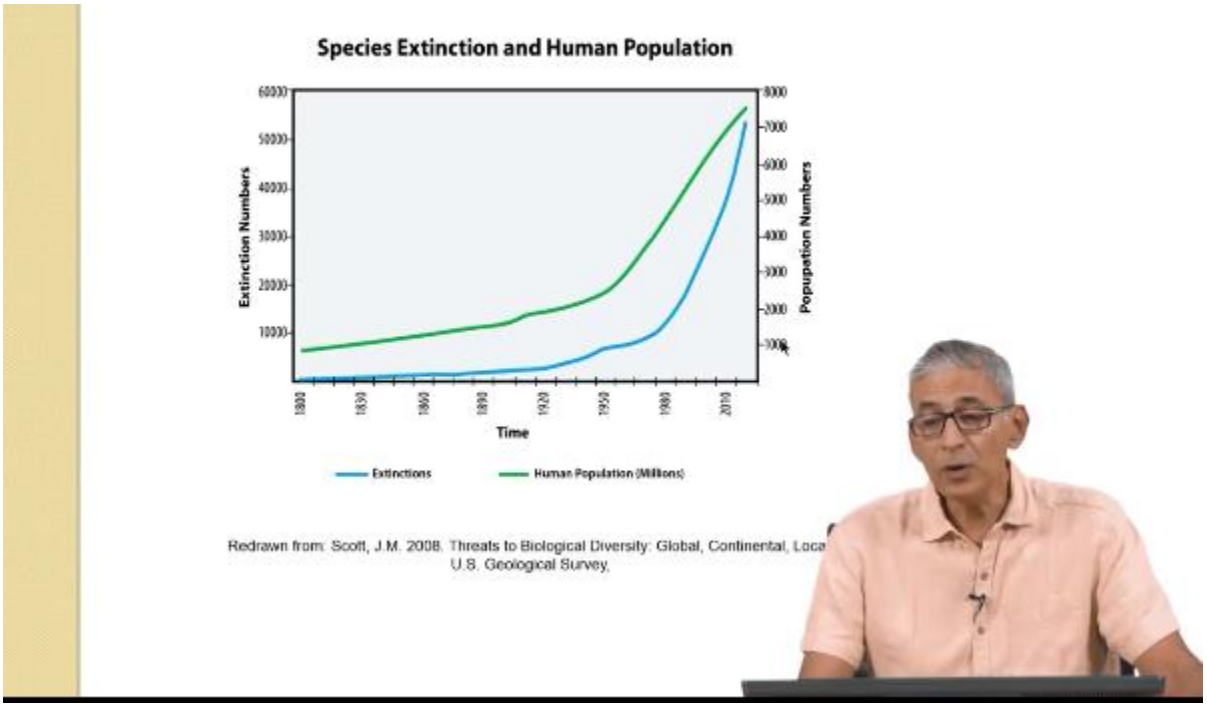


This actually shows you what has happened to habitat loss across different biomes, so certainly the Mediterranean forest and temperate grasslands until 1990 have experienced the greatest loss, but you also see that in most other biomes including tropical dry forest and moist forest.

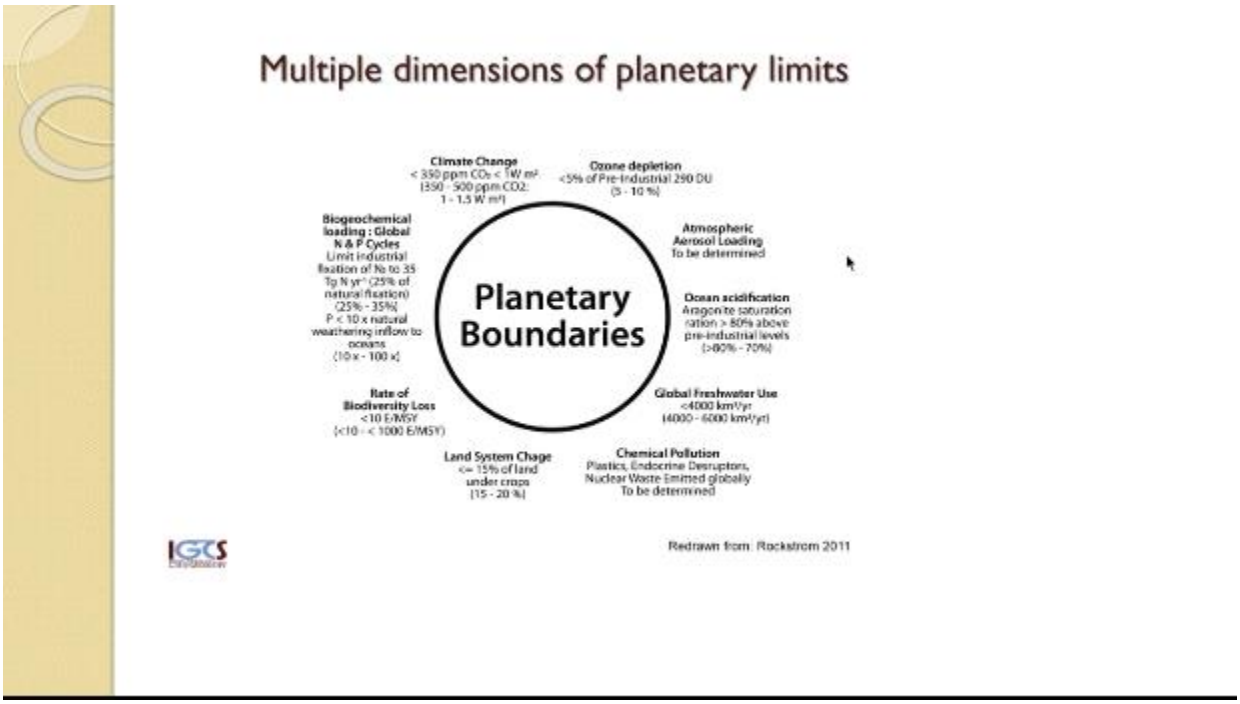


Fish, the world fisheries have been seeing an alarming increase in the over-harvesting, these images show you what has happened, you know, when peak harvest took place and in all these different fisheries and as you can tell by the end of the 20th century, almost the entire oceans and seas have been over-harvested for fish.



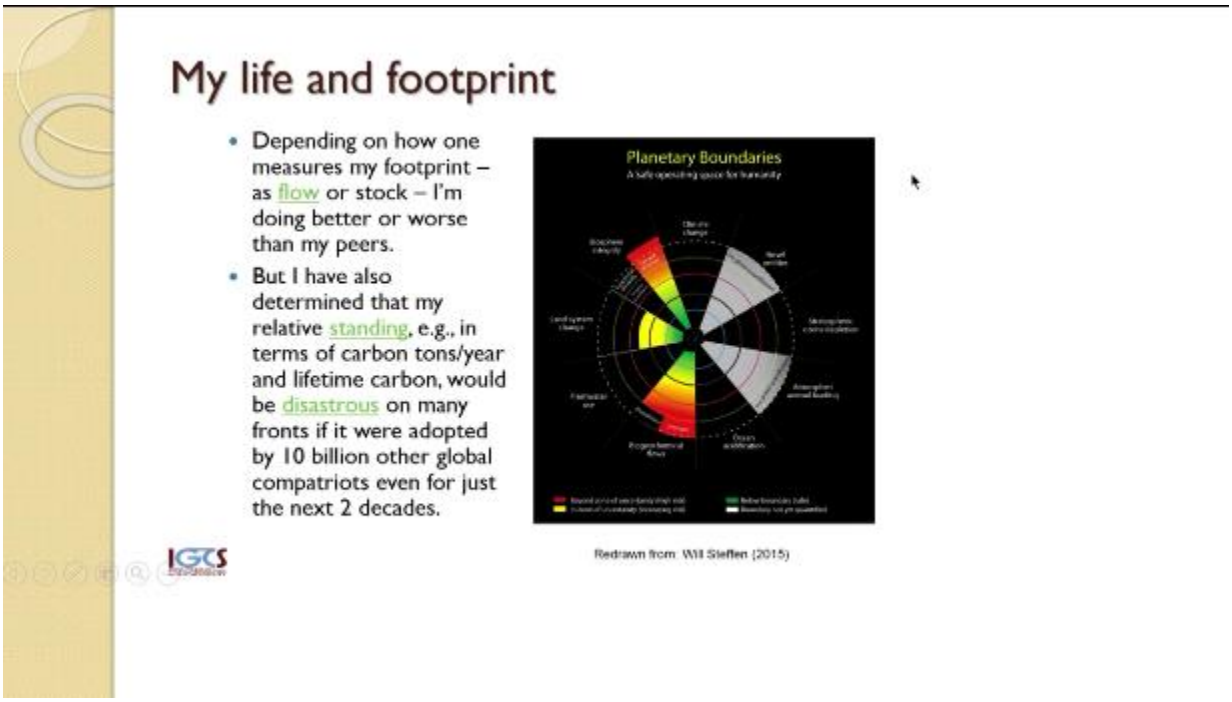


Now, of course, human population has also been on the rise in all these, during all these events in this period, but if you look at the blue line which has to do with extinctions, that pace is actually exceeding, the pace of human population growth.

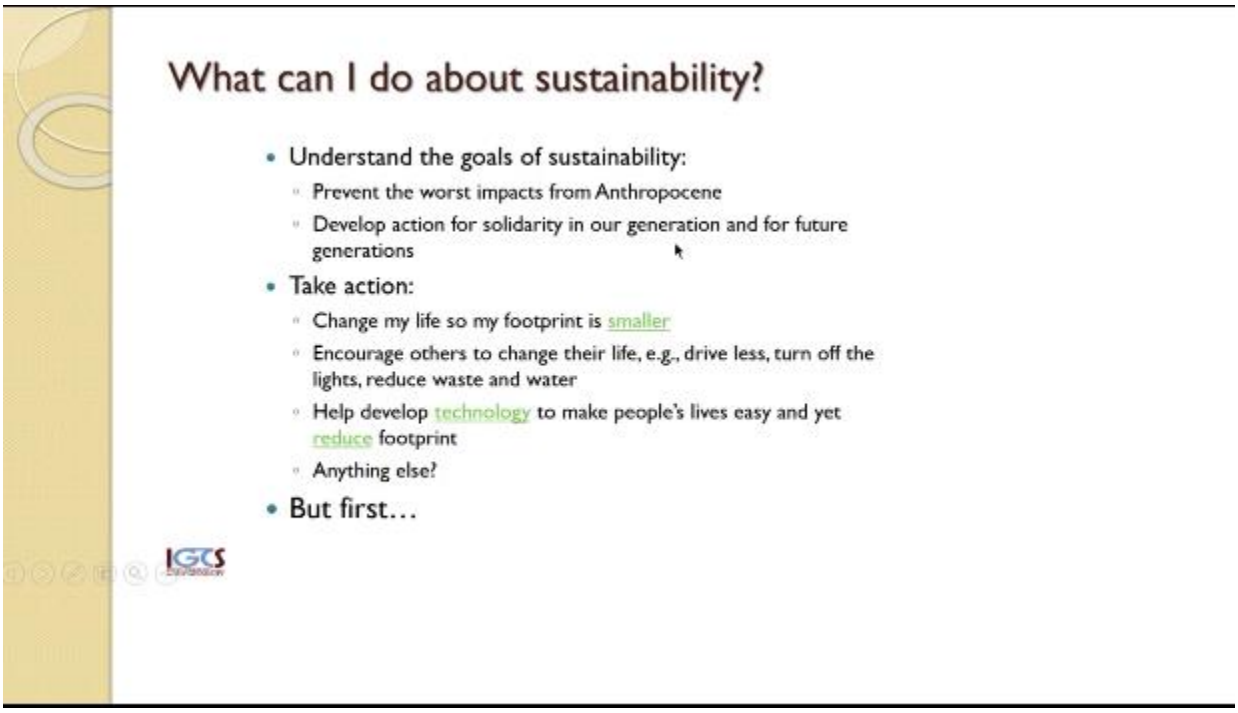


And the way to think about that has been to focus on what is being known as planetary boundaries, and this is this is a new framework, relatively new framework to think about sustainability. And Johan Rockström and several of his colleagues have put together about 11 planetary boundaries, and limits to planetary expansion and climate change as you can tell is one of them. We need to be within 350 parts per million of average atmospheric concentrations of carbon dioxide and carbon dioxide equivalent greenhouse gases, in order to reach a safe limit for climate change and we have already exceeded that figure as of last year way above over 400 parts per million of CO_2.

Ozone depletion, another serious challenge, ozone in the upper atmosphere, depletion of ozone causes all sorts of challenges to the earth's climate, but also to human health. And then a whole series of other limits around biogeochemical loading especially the nitrogen and phosphorous cycles, the rate of biodiversity loss, land use change, chemical pollution, global freshwater use, ocean acidification, and atmospheric aerosols. So, these Rockström and his colleagues have identified as planetary boundaries or planetary limits, if we exceed those limits, then the chances of achieving any kind of sustainability is really minimized.

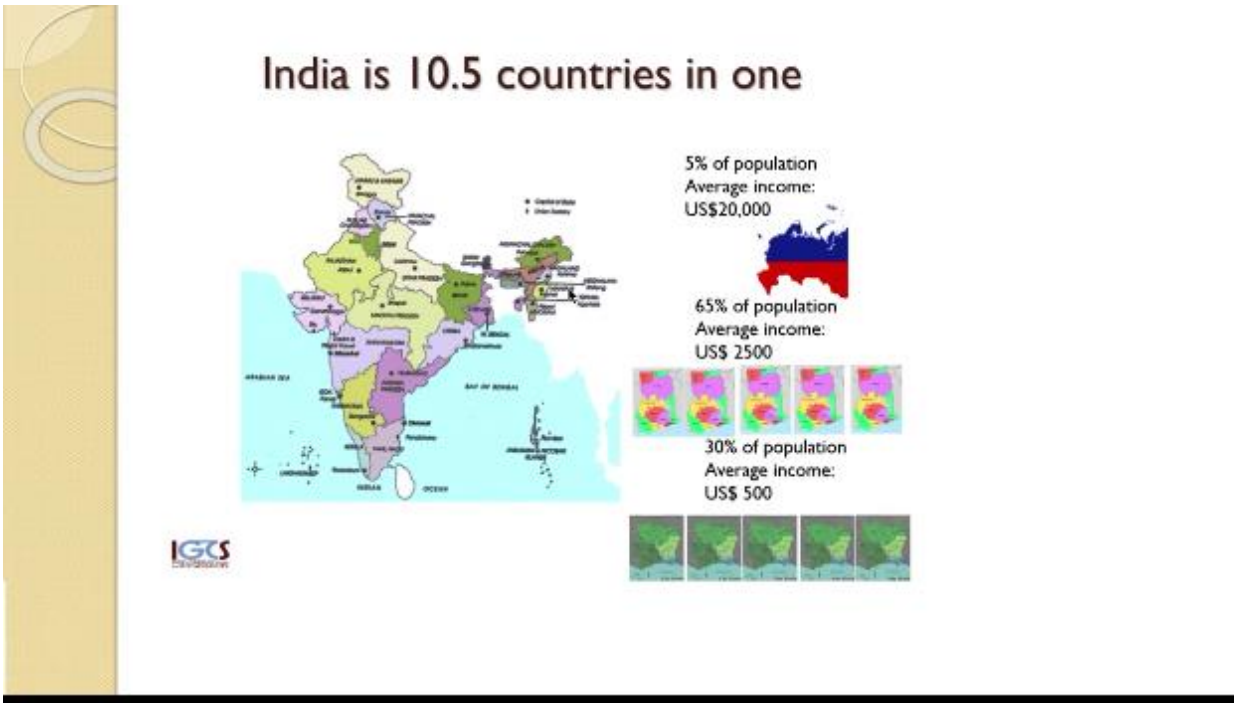


This is another image showing these planetary boundaries again, it is sort of trying to identify the safe operating space for humanity. But one of the things to bear in mind is that this is related to human footprints, and so every individual needs to look at his or her own contribution to these planetary limits. Of course, on an individual basis, the amount of CO_2, one expands or the amount, the consumption of resources that leads to some of these chemical, biogeochemical limits, for instance, may vary, one needs to know how one is doing, am I doing better or worse than my peers, and also in terms of what is my relative standing and in terms of say for instance carbon tons per year, and the lifetime carbon, and what would happen if everybody in the world plan it with 10 billion humans by this, say the 2050's, what would happen if everybody adopted my footprint ? And so clearly we will be exceeding all of these planetary boundaries if that were the case. It turns out of course that the use of resources around the world is not uniform, there is some people and some living in certain countries who might be consuming a lot more and therefore expending a lot more emissions than others, and so this kind of analysis helps to determine where one is standing in relation to others in the planet.



So, if you were to ask the question what can you do about sustainability? The first thing is to try and understand what are the goals of sustainability, and the first is to try and avoid the worst possible impacts from what is known as the Anthropocene, Anthropocene, of course, is the name given to the new geological age we have entered in the 20th century and the 21st century. This is basically an age where human beings have had enough of an impact on the earth's systems to actually cause a permanent change in its flows, in the climate systems and various other features of the bio-geo hub, so Anthropocene is a dangerous age, but there might still be a possibility of achieving sustainability in the Anthropocene.

And certainly, we need to think about working together with other members of our generation and work in the service of future generations. So one issue of course that we need to pay attention to is how do we change our life, so that of collective footprints and individual footprints are smaller? How do we encourage others to change their life? And this might require both technological change but also certainly lifestyle change, for instance, driving less using vehicles less often, turning of the lights when they are not needed, reducing waste and water use etcetera. And is indeed to the extent possible to use technologies that might make people's life easier but also reduce their footprints.



So, one thing to bear in mind is since this lecture is taking place in India, we need to sort of try and focus a little bit on what are the conditions within India that actually contributes to emissions and also contribute to addressing or sort of exacerbating the limits on our planetary systems.

It turns out that we are rather unequal country, this is not a new issue for India, but things have been getting worse of late, at least in the last, between the 1991 and 2011 census we have seen vast changes in inequality. So, if you try and divide the country into different fractions of, different income fractions, it turns out that about 5% of the population constituting roughly half the population of Russia has a same average income as Russia, about 65% of the population has an average income of about US $2500 per year and that, and this is in purchasing parity terms, and this is same as 5 Ghanaian populations and the same average income as Ghana, and the poorest 30% of India have an average income that is about the same as the average income of Côte d'Ivoire or Ivory Coast, and that amounts to about 5 such populations of Cote D'ivoire. So one way of thinking about India is that we are then, and a half countries and that actually gives us something to ponder on as to you know, who is being affected when certain policies are being come to contemplated for instance, but also how, or relative footprints across the population may vary wide quite widely.

MDG Progress in India

http://www.financialexpress.com/article/economy/keeping-the-mdg-targets/59801/ Accessed 13 Sep 2015

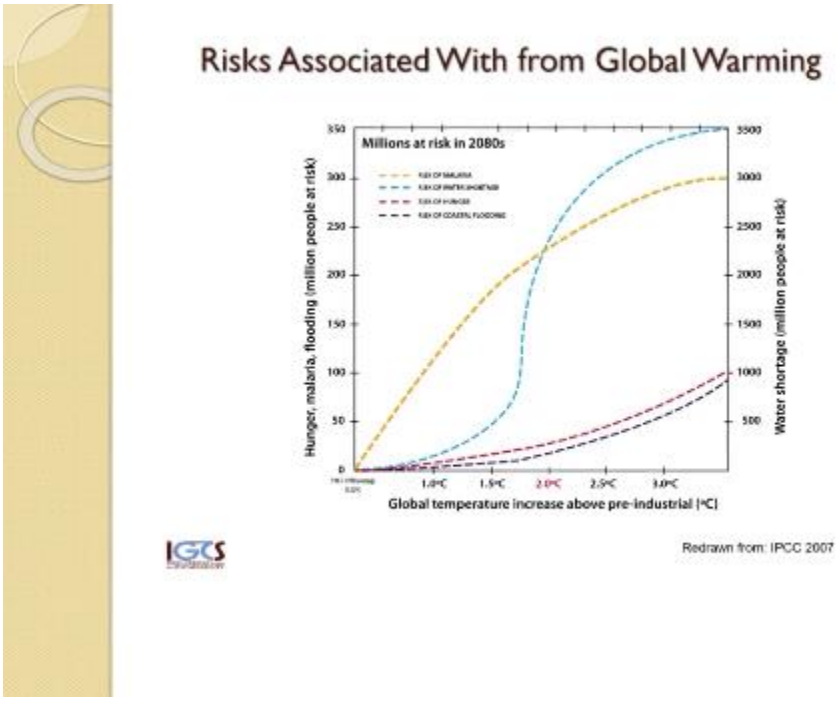
Now, the millennium development goals and the sustainable development goals are approaches using multilateral help but also a lot of innovation within the country to try and reduce the challenges of poverty, and India has been doing reasonably well on many of these fronts, but you know and some others, there is a lot more progress to be made, and clearly also there is a great deal of diversity within the country in terms of you know, which states are doing better, and which states are doing worse.

What can I do about sustainability (contd.)?

- Understanding sustainability
  - Lots of people don't have lights, don't use much water and have no proper way to dispose of waste
  - Many of them have extremely precarious forms of livelihood, including relying on the waste of Russians and many Ghanaians
  - These people have to improve their lifestyle, not curtail it.

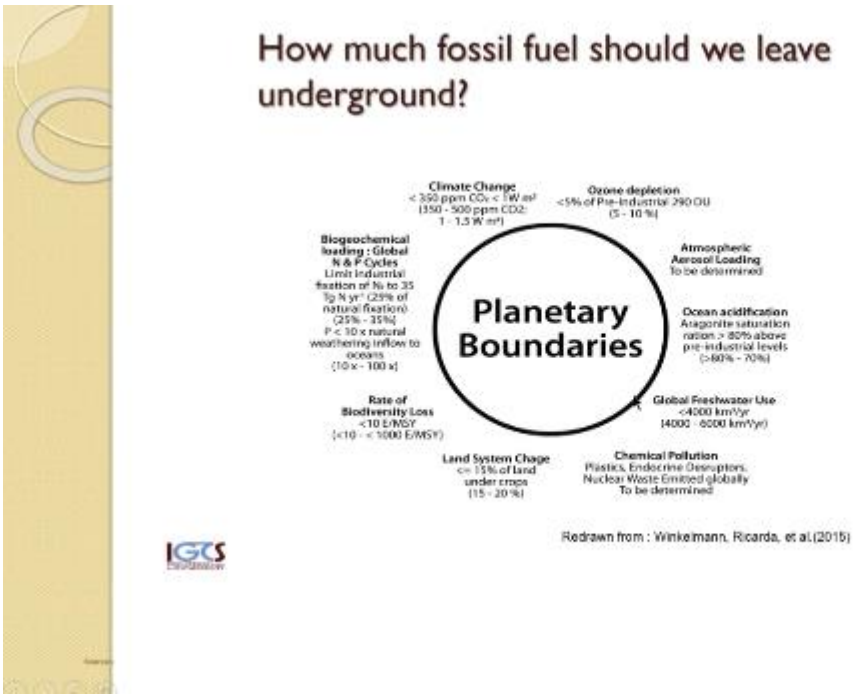
Coming back to this question of what, any individual can do about sustainability, the first issue, of course, is understanding what we mean by sustainable development or sustainability, and also paying attention to the fact that access to services and especially in the context of extreme poverty having access to some other services needed for a decent life is one of the most important things that we should think about. So, clearly some people will have to start increasing their footprint, and many others will have to reduce their footprint even in a country like India, which is considered an emerging economy and or a developing country that is sort of trying to come out of poverty.

So lots of people do not have lights, for instance, do not use much water and have no proper way of disposing a waste, there needs to be approaches, there need to be approaches to try and address their challenges. Many people have extremely precarious forms of livelihood and the persons I had identified as Russians, the top 5% they, in fact, generate much of the waste that people end up wasting their own livelihood activities on, and so there are lots of people you know one may say the Ghanaians and Côte d'Ivoire need to improve their lives, whereas the Russians need to reduce their footprint.

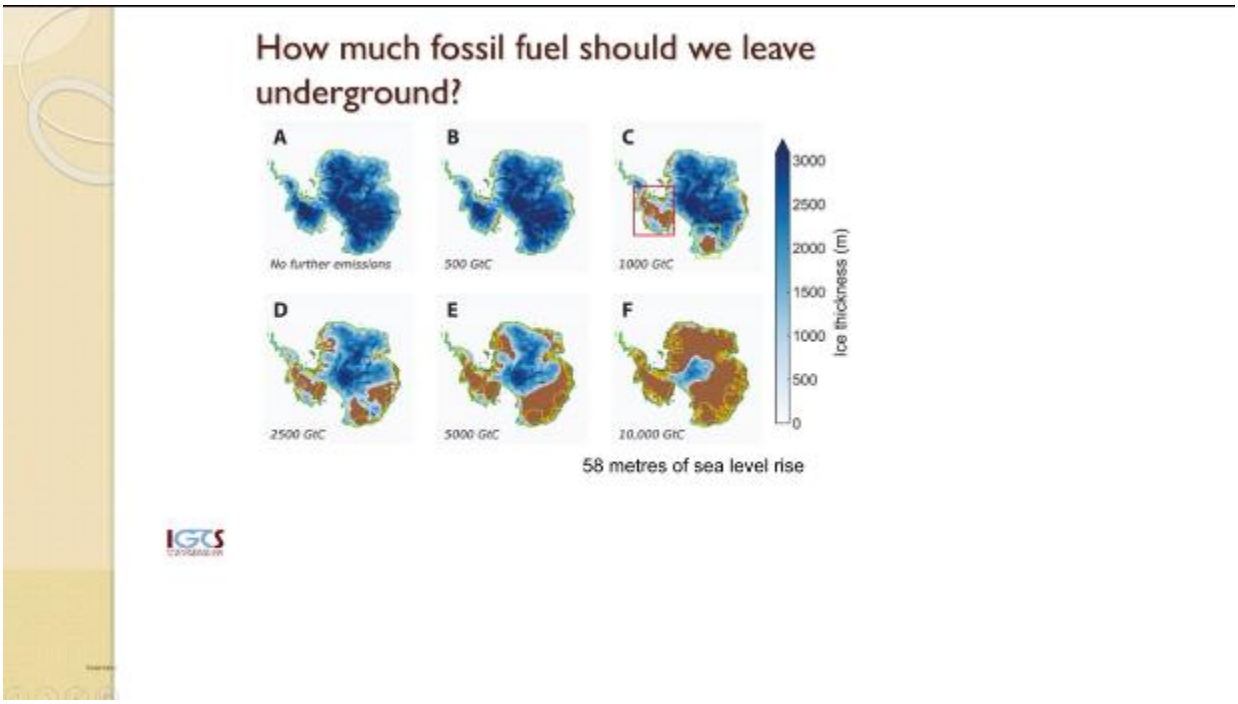


Now coming, focusing in on climate change and global warming, this constraint of global warming is one of the most urgent and serious challenges humanity has ever faced, and as another lecture in this series has described, climate change is a result of increasing concentrations of greenhouse gases, carbon dioxide being the most important of these, and the result of global warming is increase in average global temperatures. And there is plenty of evidence to show that increasing global average temperatures beyond 1.5 degrees Celsius above pre-industrial levels constitutes kind of a dangerous trend and especially if you were to cross 2 degrees warming, that is going to be quite significant. And in fact, recent work has suggested

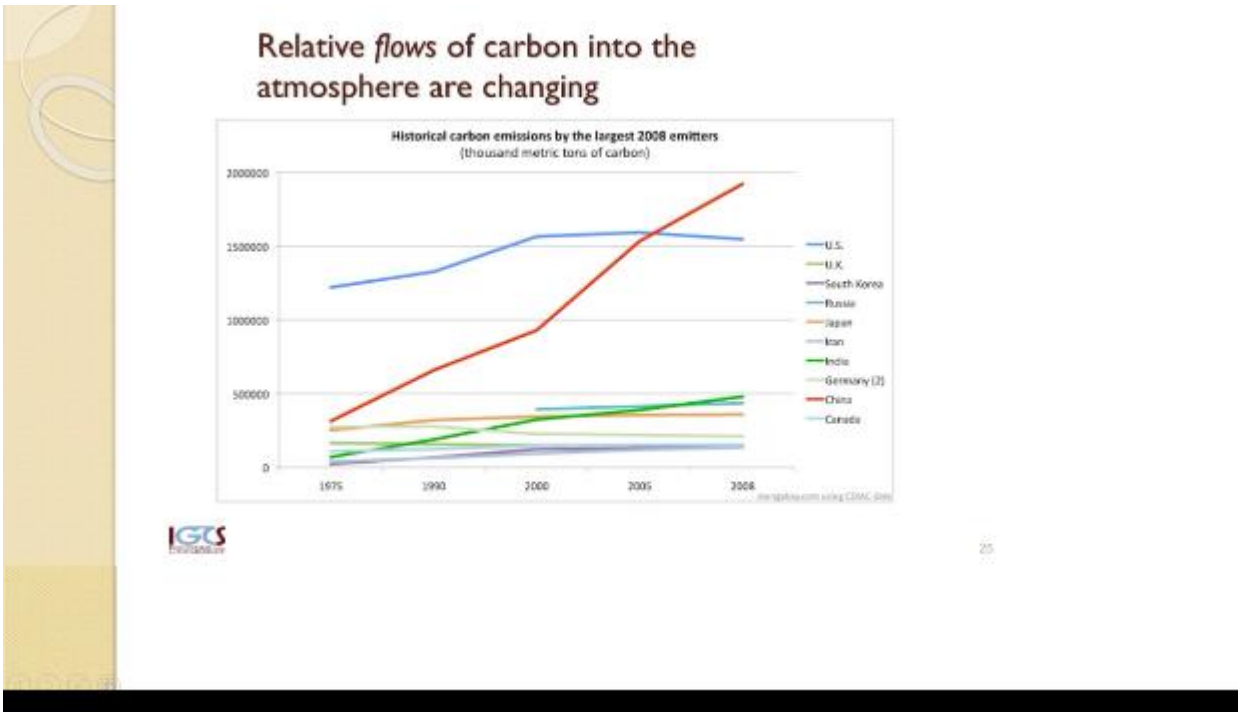
that this might lead to what is known as hot house earth or runaway global warming and so on, but even earlier research from IPCC this is a graph from the 2007 IPCC report. It shows that beyond 2 degrees of global warming you have millions, hundreds of millions of people facing dire risks especially risk of water shortage, risk of malaria, but also coastal flooding and rise in hunger. So, these are challenges which have been well known for quite some time, and the real concern is how do we deal with the problem of global warming.



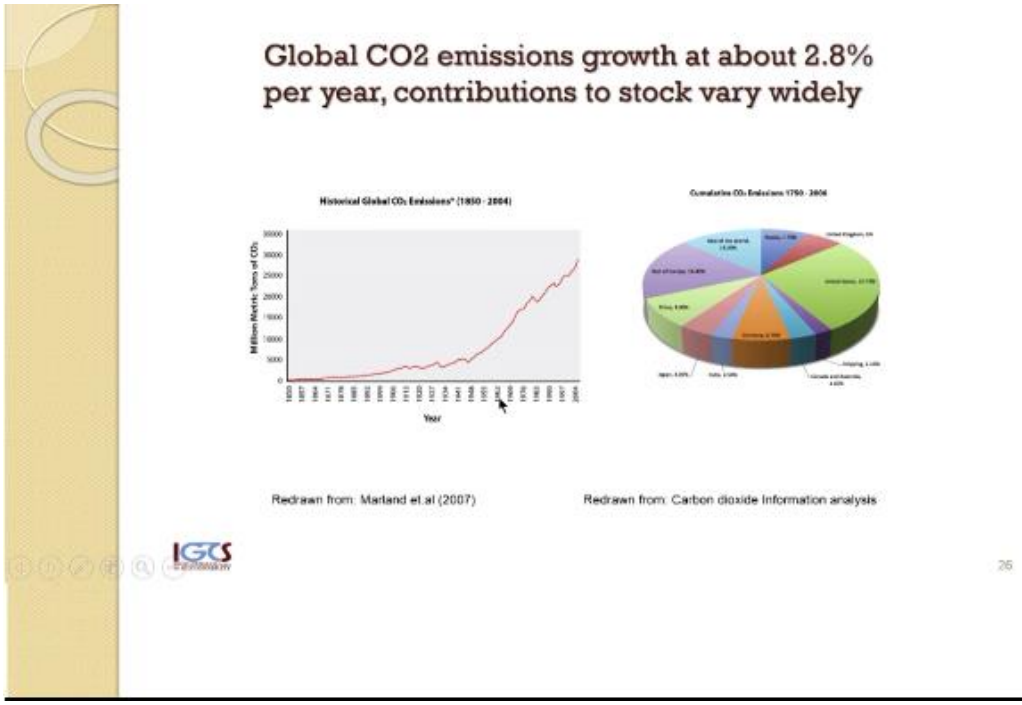
So, one question that has been posed is how much carbon, how much fossil fuel should we leave under the ground, and what we see in this image is the map of Antarctica which shows how the more carbon we leave underground, that is to say the less we mine from the rest of the earth, the more likely it is that Antarctica's enormous ice system is going to stay intact.



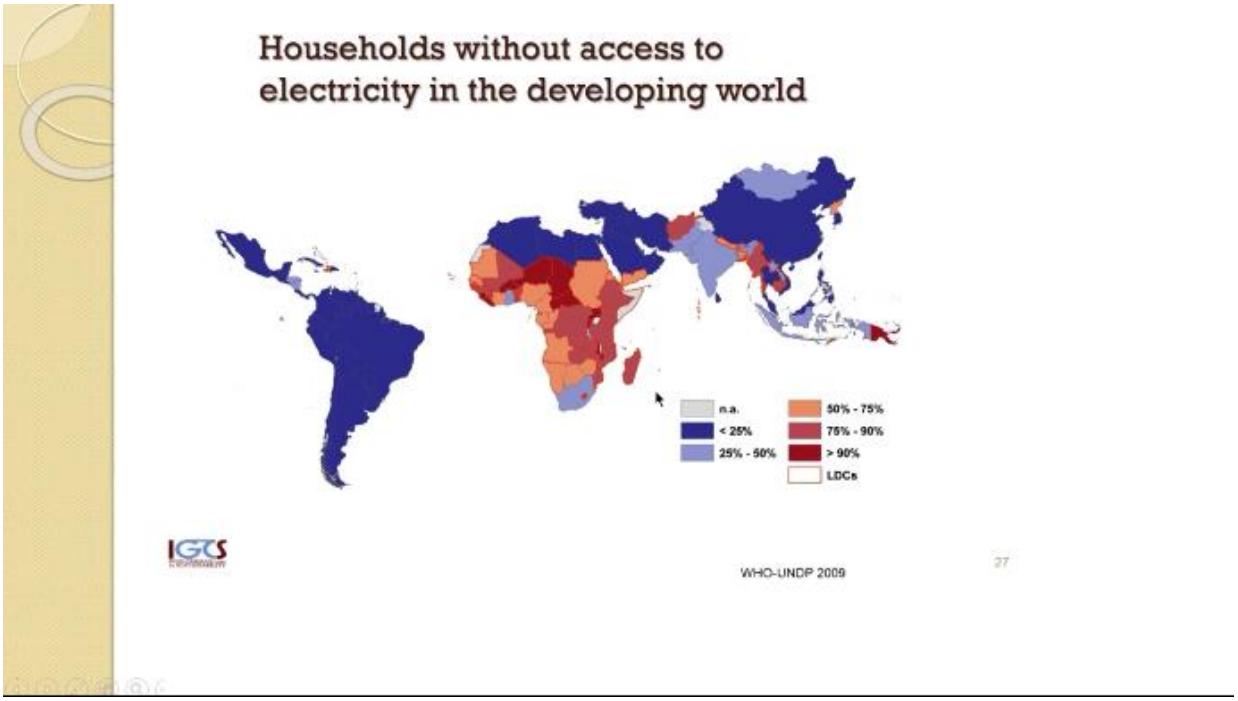
And so, this is a concern that has requires a lot more effort in terms of reducing greenhouse gas emissions, and it sorts of, it is a big graphic indication of how dire the challenge is.



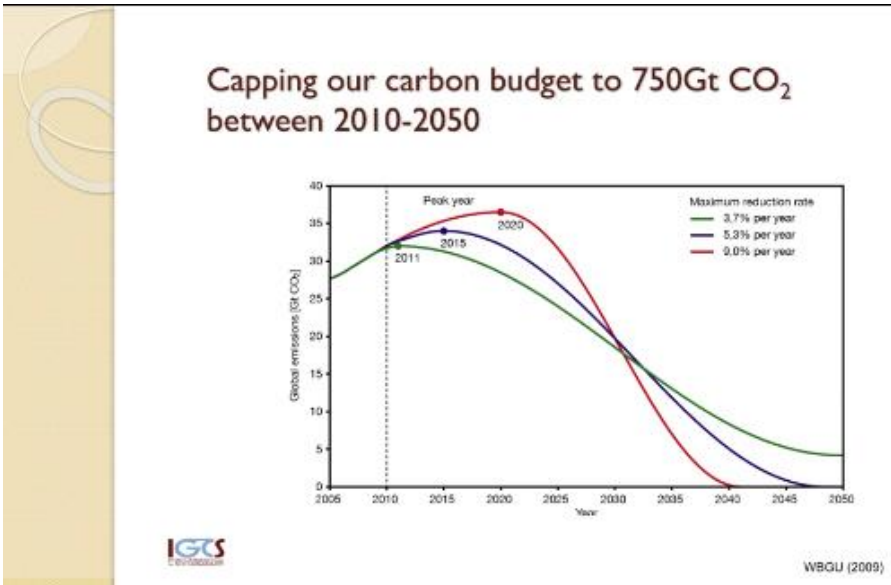
It also appears that relative flows of carbon dioxide into the atmosphere have been changing over time, and this certainly India, India is now the third largest emitter of greenhouse gases, we are a distinct third to China and the United States, but it turns out that if you look at historical emissions, globally historical emissions have been going up quite significantly.



Now, the shares of historical emissions, very quiet widely and about two thirds of the cumulative emissions in the atmosphere are result of emissions from the, what one might call the rich countries of the world, primarily the United States and Europe, North America and Europe and also Russia, and Japan and Australia, but that, of course, has been changing because as we saw in the last graph, India and China have been increasing their emissions well beyond historic limits.



Now, the challenge of developing countries increasing their greenhouse gases is also sort of matched by another challenge the developing countries face which has to do with lack of adequate access to modern energy services, particularly electricity. Now until recently the cheapest way to produce electricity was from coal which is a very greenhouse intensive, greenhouse gas intensive form of energy, a fuel, and now of course, renewables particularly solar photovoltaics have got in a lot cheaper and they pose a very interesting alternative to sort of dirty fuels, fuels that contain a lot of carbon dioxide. Nevertheless the fact that many countries in Sub Saharan Africa have very little access to electricity, poses a very significant challenge for those economies, for those planners because they have to find ways to provide access to clean electricity to hundreds of millions of households in a manner that does not actually significantly heighten the growth of carbon-dioxide or greenhouse gases.



Now, it turns out that we have a very serious constraint in terms of capping our carbon budget, we exceeding the total carbon in the atmosphere beyond an additional 750 billion tons of carbon dioxide will result in, will very likely result in global average temperature that exceeds 2 degrees. So, capping our carbon budget is a very serious and very difficult task, and doing that properly requires that we pay attention to number of technologies, new technologies for reducing carbon-dioxide emissions but also improving efficiency of the use of technologies, reducing the energy intensity, the carbon intensity of these technologies and perhaps also shifting lifestyles.

Thank you