Land Use and Land Use Change and Forestry

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Dear Friends,

We shall deal with reversing the GHG emissions from Land Use and Land Use Change in this month.

This is a very important but complex topic and is commonly abbreviated as LULUCF meaning Land Use and Land Use Change and Forestry. This forms one of the nine planetary boundaries. The Inter-governmental Panel on Climate Change (IPCC) has published a special report in January 2020 on the subject, and my blog is based primarily on this report [1]. I shall try to pick up only a small part of this comprehensive report for understanding the role of land in climate change.

Here is an introductory paragraph from the report, to give you a flavour of the complex inter-relations present:

> 'This report addresses greenhouse gas (GHG) fluxes in land-based ecosystems, land use and sustainable land management in relation to climate change adaptation and mitigation, desertification, land degradation and food security.'

We can break this up as under:

- It talks of the GHG fluxes, which implies that human use of land results in both emission and absorption of GHGs.
- It is a part of our ecosystem in which multiple players interact.
- The way we manage land impacts climate change.
- Appropriate land management can help us to adapt to climate change and contribute towards reducing the impacts of climate change.
- A wide-ranging subjects like food security, soil erosion, aerosol loading, and desertification are linked with our use of land.

We would deal with the important ones below:

We depend on land for our food, freshwater, energy, biodiversity and a host of ecological services. In prehistoric times, humans lived with all other living beings on land shared by all. Our need for land increased, as we learned agriculture, and we started to clear forests. However, our ability to clear forests was limited. Mankind learned to harness energy and use

it. This enabled us to clear the forests much faster than before. Simultaneously, our needs for land have steadily grown, and currently, we use 70% of all global ice-free land surface. However, as we have seen before, we are reaching the limits, and the adverse impacts are slowly manifesting in terms of reduced ecological services. According to one estimate, every year, we derive as much ecological services from land as the total annual GDP of all nations on Earth. You can well imagine how important it is to preserve the land-based ecosystems.

Since 1961 (for which data is available), both population and per capita consumption of 'food, feed, fibre, timber and energy' have gone up leading to greater use of land and fresh water on scales never seen before. As a result, net GHG emissions have increased, and loss of forests, savannahs, grasslands and wetlands have led to biodiversity loss.Due to overeating, 2 billion population are obese, although 821 million people are still undernourished.We are degrading roughly 25% of the ice-free land area.

Agriculture, Forestry and Other Land Use (AFOLU) is another common acronym you would find, because together they accounted for 23% of all GHG emissions by we humans during 2007 – 2016.

The condition of land affects the average surface temperature, as we all know that cities are usually warmer than the countryside, and even in hot summer, we feel a cool ambience under a tree. Scientists have tried to measure these effects and have found that if we change the land conditions, it affects 'the intensity, frequency and duration of extreme events' in a region. Extreme events include floods, draught, hurricanes, tsunami, earthquakes, forest fires and epidemics / pandemics.

As our consumption grows, we clear more forests to meet the increased demands, and impact the livelihoods of indigenous people who have lived for generations in the forests sustainably. We fill up wetlands for our needs. What happens to the other forms of life that these forests or wetland are home for? The effect is the same as razing to ground an urban slum area to build skyscrapers. Thus, by grabbing more and more land for our use, we impact both livelihoods and biodiversity. Climate change adds to these effects.

Scientists have attempted to study and quantify these effects, and found that the net effect depends on:

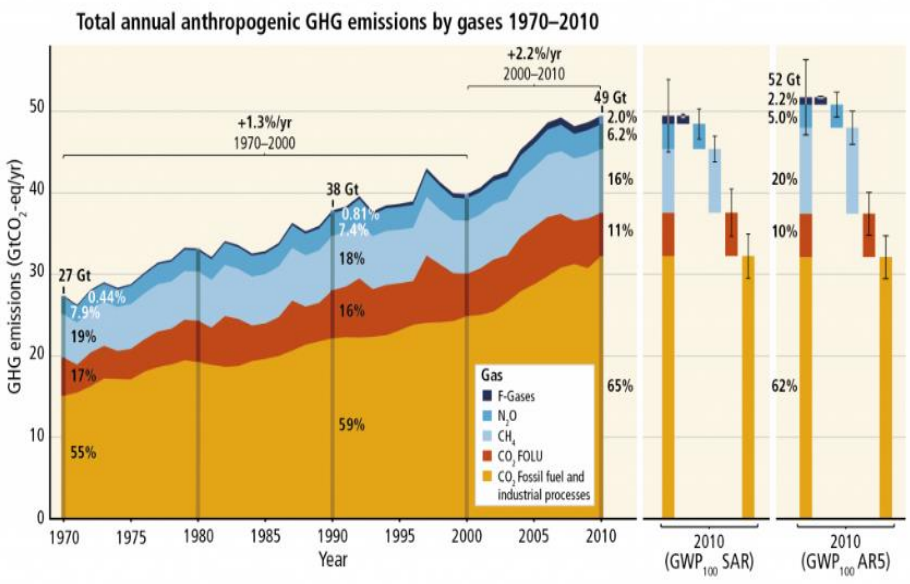
1. The degree of warming, and
2. Our consumption pattern and the associated production patterns (SDG 12).

Some of the visible impacts are water scarcity in dry regions (Chennai for example), degradation of land and regional food shortages.

So far, we have seen that human uses of land in the past have led to net GHG emissions and global warming. But we have an opportunity to reverse this trend, as land can also act as a carbon sink. We shall now see how this may be possible.

Agriculture, animal husbandry and agroforestry have an estimated potential to provide carbon sinks between 2.3 to 9.6 $GtCO_2$ equivalent per year by 2050. Changes in food habits can yield 0.7 to 8 $GtCO_2$ equivalent per year by 2050. One $GtCO_2$ represents 1 billion ton of CO_2. In order to get an idea of the relative magnitude of these amounts, here is a comparison [6]. According to this blog, we are emitting approximately 50 $GtCO_2$ per year as of 2020 and the carbon sinks from Agriculture, Forestry and Other Land Use (AFOLU) has the potential of reducing about 6 $GtCO_2$ and changes in food habits – about 4.3 $GtCO_2$, totalling about 10 $GtCO_2$ per year, i.e. almost 20% of total emissions. Please note that I have used the average of the range of the values provided by IPCC.

Land based solutions to address climate change have multiple associated benefits like improving food security and preventing desertification and land degradation. Their potential varies according to the adaptive capabilities of the communities and regional characteristics; and there are some barriers as well.



Some solutions like better management of cropland, grazing lands and forests and increasing soil organic carbon content do not require additional land. Others like better food productivity, more vegetarian food habit and reduction in food waste can free land for reforestation. These solutions may be applied from small to large scales – the individual farm to the entire region.

Some solutions like preserving and restoring forests, coastal lands and peatland; measures to conserve biodiversity, manage fires, soil management, using local seeds, manage / share disaster risks etc. can also help reduce poverty, eliminate hunger, provide clean water and sanitation, protect livelihoods and remove GHGs.

However, some options require more land and may have adverse side effects, if applied on a large scale. If done on a smaller scale and integrated with proper land management, this can offer many benefits with limited side effects.

It has been found that stopping desertification is a better option compared to restoration of degraded land, as it improves soil fertility, leading to higher agricultural output, food security and higher carbon sequestration in soils and biomass.

Scientists have developed several models to predict the expected outcomes of following different approaches known as 'pathways'. All these pathways require some form of land-based responses including 'reforestation, afforestation, reduced deforestation, and bio-energy'.

In conclusion, we must remember:

> 'Only when the carbon is removed from atmosphere and is put into long term storage like geological formations, the deep ocean, minerals, biochar, trees and soils and long-lived products like cement, can we call it as Carbon Removal. Only this helps in reducing atmospheric CO_2.'

Solutions that burns the carbon captured from the atmosphere simply returns the carbon to the atmosphere and cannot be considered as 'sinks'. Please follow the following links for further reading.

Kindly send your feedback to s_banerji@amrita.edu

1. https://www.ipcc.ch/srccl/chapter/summary-for-policymakers/
2. https://unfccc.int/topics/land-use/the-big-picture/introduction-to-land-use
3. https://unfccc.int/topics/land-use/workstreams/land-use--land-use-change-and-forestry-lulucf/reporting-of-the-lulucf-sector-by-parties-included-in-annex-i-to-the-convention
4. IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry
5. https://ourworldindata.org/emissions-by-sector
6. https://www.nature.com/articles/s43016-021-00358-x