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Nitrogen oversight could lead to revision of emissions from land use change

A new global-scale modelling study that takes into account nitrogen – a key nutrient for plants – estimates that carbon emissions from human activities on land were 40 per cent higher in the 1990s than was estimated in studies at the time, which did not account for limited nitrogen availability for plant growth.

Credit: John Coppi/scienceimage

Researchers from the University of Illinois at Urbana-Champaign, USA, and the University of Bristol Cabot Institute, UK, **published their findings** in the journal *Global Change Biology*. The findings will be a part of the Intergovernmental Panel on Climate Change's upcoming Fifth Assessment Report.

Study leader, Atul Jain, a professor of atmospheric sciences at the University of Illinois, said one nutrient can make a 'huge impact' on the carbon cycle and net emissions of the greenhouse gas carbon dioxide.

'We know that climate is changing, but the question is how much? To understand that, we have to understand interactive feedback processes – the interactions of climate with the land, but also interactions between nutrients within the land,' he said.

The carbon cycle is a balance of carbon emissions into the atmosphere and absorption by oceans and terrestrial ecosystems. Carbon is absorbed by plants during photosynthesis and by the oceans through sea-air gas exchange.

On the other side of the cycle, carbon is released by burning fossil fuels and by changes in land use – deforestation to expand croplands, for example. While fossil fuel emissions are well-known, there are **large uncertainties** in estimated emissions from land use change.

Prof. Jain said that when humans disturb the land, the carbon stored in the plants and the soil goes back into the atmosphere. But when plants regrow, they absorb carbon through photosynthesis. Absorption or release of carbon can be enhanced or dampened depending on environmental conditions, such as climate and nutrient availability.

Nitrogen is an essential mineral nutrient for plants. In non-tropical regions especially, plant regrowth – and therefore carbon assimilation by plants – is limited by nitrogen availability.

According to Prasanth Meiyappan, a co-author of the study, most models that have been used to estimate global land use change emissions to date do not have the capability to model nitrogen limitation on plant regrowth following land use change. Such models overestimate regrowth and underestimate net emissions from the harvest-regrowth cycle in temperate forest plantations.

Prof. Jain's team, in collaboration with Joanna House, from the University of Bristol, concluded that by not accounting for nitrogen as a limiting nutrient for plant growth, other models might have underestimated the 1990s carbon emissions from land use change by 70 per cent in non-tropical regions and by 40 per cent globally.

This has significant implications for international policy, according to the paper’s authors. If emissions from land-use change are higher than we thought, or the land sink (regrowth) is more limited, then future emissions cuts would have to be deeper to meet the same mitigation targets.

Prof. Jain commented that, while soil has great potential to sequester carbon, ‘the question is, how much that's being released is being sequestered in the soil? We have to understand how human behaviour is changing our environment and interacting with our ecosystems.’

Credit: University of Illinois at Urbana-Champaign

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