Climate Action Network – Ecosystems

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Reforming carbon accounting to support nature-based solutions

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1. Overview

Our position is that current carbon accounting as used for LULUCF is not fit-for-purpose for assessing climate mitigation activities and prioritising nature-based solutions.

1. Understanding carbon dynamics in the global carbon cycle
2. Limitations with current carbon accounting for LULUCF that leads to perverse outcomes
3. Reforming carbon accounting using an international standard information system – the System of Environmental Economic Accounting – Ecosystem Accounts
4. Show an example of a carbon stock account used to assess mitigation benefits of forest management scenarios
5. Discuss applications of carbon accounts for mitigation policies and prioritising nature-based solutions

2. Global Carbon Cycle

Information needed to manage the interactions between human activities, impacts on the carbon cycle, and consequences for the atmosphere is based on an understanding of components of the global carbon cycle.

These components have different characteristics and cycle at different rates. This diagram shows natural and human-induced flows between reservoirs and differentiation between short and long time scales. Losses and gains in carbon stock are shown for each reservoir.

Geocarbon – carbon stocks in fossil fuels, as well as sedimentary rocks particularly limestone in the lithosphere, that operate on a very slow cycle of accumulation and turnover under natural environmental conditions, but very rapid loss under human disturbance.

Biocarbon – organic carbon stocks in the land and surface ocean that are transferred via gaseous exchange with the atmosphere and via hydrological fluxes into rivers and the ocean at short to medium time scales, depending on the characteristics of the ecosystems.

3. Current carbon accounts are not fit-for-purpose to assess mitigation actions

Current carbon accounting that is used under LULUCF is not fit-for-purpose to assess mitigation actions. Three main limitations and examples:
1. Reporting net emissions
natural forest growth in the entire forest estate is used to numerically “offset” the emissions from the area logged each year.

2. All carbon stocks are considered “fungible”
carbon stocks contained in reservoirs of different longevities and stabilities, and hence risks of loss, are considered equivalent and transferable.

3. Forest reference level

This baseline is set using existing harvesting levels, so that these emissions are not revealed in the accounts.

These limitations have led to perverse outcomes:

- Conversion of carbon-dense forests and peatlands into fast-growing plantations.
- Harvesting and regrowing forests to maintain young fast-growing trees, but foregoing the carbon stock gain from allowing forests to attain their carbon carrying capacity.
- Harvesting forests for wood products and bioenergy does substitute for fossil fuel use but the depletion of ecosystem carbon stocks creates a carbon debt for many decades to centuries.
- Carbon stocks in long-lived stable primary forests are not the same as carbon in short-rotation plantations or wood products.

5. Limitation 1: reporting net emissions

6. Limitation 2: carbon stocks are not fungible

Reservoirs vary in their condition or quality that determines the stability, longevity and resilience of the carbon stocks.

These reservoirs represent types of ecosystems and their condition, which influences the risk of loss of the carbon stock.

Natural ecosystems, semi-natural ecosystems and plantations all contain carbon stocks in their trees and soil, but the risk of loss of this carbon varies depending on the condition of the ecosystem.

7. Limitation 3: setting baselines

The baseline for assessing emissions reduction for LULUCF is the Forest Reference Level (FRL) derived from combining the following estimates:

1. Average net emissions under business-as-usual or an historic period (2000 – 2009)
2. Includes age-related forest dynamics
3. Natural disturbance provision that subtracts average emissions from natural disturbances.

This gives the projected level of net emissions for 2021 – 25
In setting the forest reference level in NDCs there is little consistency in the methods used between countries.

In reporting annual net emissions:
Carbon loss from forest harvesting is only counted if > FRL (that is, as Debits)

In assessing mitigation benefits:
Carbon loss due to harvesting ≤ FRL is not counted as an emission (that is, as Credits)

8. Reforming carbon accounting

The system of carbon accounting employed is critical because if the accounting rules do not fully reflect the mitigation outcomes, then a gap opens up between policy goals and actual mitigation achieved. The ways in which the characteristics of ecosystems are defined, measured and reported have major implications for how ecosystems are perceived, valued and managed. A more holistic and comprehensive approach to carbon accounting is needed if the potential of NbS is to be realised and the most effective options prioritised.

I have contributed to the revision of the System of Environmental Economic Accounting Ecosystem Accounts, an international process led by the UN and recently adopted as a statistical standard by the UN Statistical Commission. These ecosystem accounts are compiled using spatially explicit data and information about the functions of ecosystem assets and the ecosystem services they provide.

Key elements of the carbon accounting system include:

1. Accounts for stocks and flows
2. All land and associated ecosystems are included and spatially referenced
3. All stocks are disaggregated into categories of carbon reservoirs, e.g. biocarbon and geocarbon
4. Classification of the quality/condition of reservoirs in terms of stability, longevity and resilience of their carbon stocks
5. All carbon pools within ecosystems are included, e.g. above- and below-ground biomass, dead biomass and soil carbon
6. Reporting of gross flows, i.e. gains (additions) and losses (reductions) of carbon stocks
7. Ecosystem carbon stocks are assessed against a reference level that represents ecosystem integrity
8. Physical measures of carbon stocks and flows within ecosystem assets are linked to the economic system through land use and ownership, valuation of ecosystem services, and sectors that benefit.

9. Carbon account

An example of an asset account table shows:

1. Opening and closing stocks of carbon in the row headings
2. Gross additions and reductions in stocks
3. Differentiation of reservoirs based on ecosystem types and their condition as the column headings, related to storage of carbon and its risk of loss:
   In decreasing order of condition or increasing risk with natural ecosystems, semi-natural ecosystems, plantations, agriculture.

10. Reference levels should include the carbon carrying capacity

From a carbon and climate change perspective, it is the carbon carrying capacity that is the appropriate metric to define the reference level in ecosystem accounting. The current carbon stock can be used as a baseline to determine change from current activities.

This figure shows the distribution of carbon stock densities across the landscape. The curves show the proportion of the area occupied by each value of biomass carbon stock in tC per ha. Each distribution encompasses a range in biomass due to forest age and environmental conditions influencing productivity.

The Carbon Retention Potential represents the gain in carbon stock when secondary forests are managed for regeneration and restoration to allow continued growth and increasing age classes to eventually reach the carbon carrying capacity. This represents the opportunity cost of not allowing forests to continue growing and accumulating carbon. This process is seen in the images below of a mosaic of different forest ages that are continuing to grow.

11. Ecosystem integrity: the basis for environmental assessment

Ecosystem integrity is the conceptual basis for defining carbon carrying capacity and underpins the assessment of ecosystem condition in the ecosystem accounts.

Ecosystem integrity is defined as the system's capacity to maintain composition, structure and function over time using processes and elements characteristic for its ecoregion and within a natural range of variability. The system has the capacity for self-organization, regeneration and adaptation by maintaining a diversity of organisms and their interrelationships to allow evolutionary processes for the ecosystem to persist over time at the landscape level. Ecosystem integrity encompasses the continuity and full character of a complex system.

12. Example of carbon accounts to assess forest management scenarios

Accounts for carbon stocks and flows were developed from site and spatial data for a wet, temperate forest in south-east Australia and this allowed assessments of forest management scenarios in terms of their mitigation benefits.

The data show the decrease in carbon stocks in the biosphere (vegetation, soil and wood products) and increase in the atmosphere due to conversion of primary forest to secondary forest to plantation.

It is the final carbon stock in the atmosphere that is critical in determining the impact on the climate. Carbon stocks in ecosystems are counted as the long-term average stock at a landscape scale. This is the key metric by which to assess the exchange between the biosphere and atmosphere. Using data only for the annual rates of flow is not adequate to assess the mitigation outcome.

13. **Assessing mitigation benefit depends on the accounting rules**

Results from the carbon account demonstrate how the accounting rules, in terms of areas, stocks and flows, can influence interpretation of mitigation benefits.

Three areas of forest are shown in these figures:

A. Entire estate of secondary forest managed for commodity production that includes all areas that have been logged and regrown and areas available for logging.
B. Subset of this area of forest that has been logged during the accounting period and is regrowing.
C. A separate area of primary forest that is managed for conservation.

Annual growth rate (blue dotted line) is often used as the metric for carbon sequestration. This rate is highest in young regrowing forests (B). However, it is the carbon storage in the forest ecosystem that is the relevant metric for assessing mitigation benefit. This is shown as the net stock change (solid green line) and is highest in primary forest (C), intermediate in the entire estate of managed secondary forest (A) and negative for much of the time in the area of logged forest (B).

14. Application of carbon accounts in LULUCF for policy

The SEEA-Ecosystem Accounting system for carbon accounting enables management activities designated as NbS to be evaluated in terms of the response of the carbon cycle through the biosphere and atmosphere, and this is linked to human activities, their economic impacts, and the sectors of society that benefit.

The key points are to:

1. Separate biocarbon and geocarbon:

Different accounts, reporting and targets are needed for different components of the carbon cycle because they have different characteristics in terms of the quality of their reservoirs.

2. No offsetting between targets for different components:
Emissions from fossil fuel combustion should not be offset with removals by tree planting.

3. Ecosystem condition integrates biodiversity and carbon:
Biodiversity loss impacts stability of carbon stocks
And as a positive feedback, climate change impacts biodiversity

4. Selection criteria for prioritizing NbS:
Criteria based on classifications of ecosystem type and condition within the carbon account and understanding of carbon cycle processes.

5. Reformed carbon accounting provides an improved information base for NDCs
Making actions and targets transparent.
The target is to increase the cumulative long-term carbon storage in the biosphere.

6. Creates greater certainty for investment:
Carbon stocks are identified, geolocated and have an associated level of risk.

15. Prioritising nature-based solutions

Comprehensive carbon accounting based on the SEEA Ecosystem Accounting system enables the effectiveness of NbS activities for climate change mitigation and biodiversity conservation to be evaluated and then prioritised.

Priority 1. Protect:
Avoid carbon stock loss from long-lived, stable reservoirs in fossil fuels and stable ecosystems, such as primary forests.

Priority 2. Restore:
Increase carbon stocks through restoration and recovery of secondary forests.

Priority 3. Manage:
Manage carbon dynamics at time scales relevant for climate mitigation, i.e. to 2030 and 2050.
A carbon debt is created for decades to centuries by using wood to substitute for other products or energy.

References

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