Bioeconomy 2.0

Forest-based bioeconomy and climate change mitigation

The 2015 Paris Agreement aims to ensure that the global average temperature increase remains below 2˚C above pre-industrial levels and pursues further efforts to limit the temperature increase to 1.5°C. Achieving these goals requires major societal and economic reforms to significantly reduce anthropogenic greenhouse gas (GHG) emissions and increase carbon sinks. Forests and forestry play an essential role, as they provide natural carbon sinks and their products can substitute for emissions-intensive materials, thereby reducing emissions.

A new study from the European Forest Institute provides an overview of the role of the forest-based sector in carbon management, from carbon sequestration to carbon storage in forests and wood products, to material substitution for emissions-intensive materials. Quantifying how these forest roles interact is not simple, and there is relatively limited understanding of the issue, especially in the public debate. The study presents an overview of:

- the *carbon dynamics in managed forests where harvest takes place*, as well as considering other climate impacts, such as the connection between harvesting and adaptation to climate change, and the effect of harvesting on biodiversity
- the *climate contribution of harvested wood products*, including carbon storage and their role in substitution of non-renewable and GHG-intensive materials, for example in sectors like construction and energy
- how *forests and the forest-based sector can contribute to climate change mitigation through Climate-Smart Forestry* that holistically considers climate change mitigation and adaptation, as well as biodiversity and ecosystem service provisioning.

Conclusions

Consideration of all climate-forcing agents (biochemical and biophysical) related to forest use is necessary to define credible policy and management strategies for mitigating climate change. In addition to carbon sequestration and storage, forests provide a wide range of benefits to society, and the maintenance and improvement of these functions is a fundamental part of sustainable forest management.

The carbon balance of forest landscapes is affected by many factors, including changes in the intensity of biomass harvest. Increased harvesting intensity of forests generally reduces the amount of carbon stored in forest biomass. A decrease in forest carbon caused by additional harvest may lead to an increase in atmospheric carbon concentrations – depending on the counterfactual development of forests if harvest would not have occurred, as well as on storage and substitution effects through the use of wood products.

Short-lived wood products and uses which provide a minor substitution benefit (e.g., energy) generally provide small or no benefit to climate change mitigation. However, long-lived wood products provide carbon storage opportunities by stockpiling previously fixed carbon from the atmosphere for decades to centuries. Furthermore, using wood-based

products to substitute high-emission intensity alternatives could yield significant climate benefits; however, technological change could reduce the emission intensity of competing products, which would reduce the substitution factors. Comprehensive analyses which consider all aspects of forest use should be used to weigh the trade-offs between different strategies and aim to reduce the amount of fossil fuel that is extracted.

As well as carbon sequestration and storage, forests are of key importance to biodiversity and provide a wide range of benefits to society, and the maintenance and improvement of these functions is a fundamental part of sustainable forest management. Climate-Smart Forestry is an integral approach to sustainable forest management that combines climate change mitigation with the need to adapt to the impacts of climate change. It offers a holistic approach, reconciling and aligning mitigation, adaptation needs as well as maintaining or enhancing biodiversity and ecosystem services to guarantee resilient forests and a positive contribution by forests and the forest-based sector towards GHG emission mitigation today and in the future.

Key messages

The contributions of forestry and the forest sector to mitigating climate change could be optimized by:

- *Taking a holistic approach that considers carbon storage in forest biomass, soil and wood products, substitution effects, as well as potential leakage effects.* Sustainable, climate-smart forest management must ensure the current and future supply of raw materials, protect and improve biodiversity, and preserve soil and water quality, for a balanced contribution to all ecological, economic and social functions.

- *Strengthening forest carbon sequestration in managed forests by stimulating forest productivity* (e.g., tree species and provenance selection, thinning and harvest regimes) *and by strengthening the resilience of forests to climate change* (e.g., by increasing species diversity). This should be achieved by sustainable forest management practices that are locally relevant and which consider future climate conditions.

- *Analyzing forest harvesting and carbon storage in conjunction with the other functions that forests fulfill.* Reducing wood harvest increases carbon storage in forest ecosystems in the short term, and may bring benefits to biodiversity, soil and water quality. However, it may compromise economic benefits from forests, and the increase of carbon storage is valid until the carbon sink saturates in the forest. In addition, forest management should also consider that natural disturbances such as storms, wildfires and pests are expected to increase under climate change conditions, having immediate economic impact regarding wood applications, and eventually leading to carbon release to the atmosphere.

- *Following the principles of cascade use for the sustainable use of wood for materials and products.* In this approach wood is used, reused and recycled, thereby extending the material's lifetime within the system. In addition, wood should be used for products that store carbon for as long as possible, and for products that provide large substitution benefits by avoiding emissions.

- *Forest-based bioenergy has a role in the transition of the energy sector towards emissions-free energy production.* When using woody biomass for energy purposes, preference should be given to post-consumer wood and forest residues that are not suitable for the production of other materials and which do not lead to additional harvest.

Blasius Schmid, Fredric Mosley, Mariana Hassegawa, Pekka Leskinen and Pieter Johannes Verkerk. 2021. Forest-based bioeconomy and climate change mitigation. European Forest Institute.

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