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The topic of presentation is

- Keynote presentation 1: Forests in carbon-neutral/ net-zero commitments: challenges and opportunities in EU
- Keynote presentation 2: Six principles for successful FLR: ITTO Guidelines for FLR in the Tropics





■ Dr. Ma Hwan-Ok

Project Manager
Forest Management Division
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■ Ms. Sonam Peldon

Principal Forestry Officer
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Senior Assistant Secretary
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AFoCO-ITTO Forest Landscape
Restoration Capacity Building
Workshop in the Asia-Pacific
Region



Forests and climate change: Forests as element in a carbon neutral commitment

- (i) Some general observations
- (ii) The role of forests in climate change
- (iii) Forests in a “carbon net-zero commitment”
- (iv) Example: EU Green Deal and forests



Virtual, 30 August 2021
Jürgen Blaser – Bern University of Applied Sciences

Global Forest Area: about 4'000 million ha (FAO 2020)



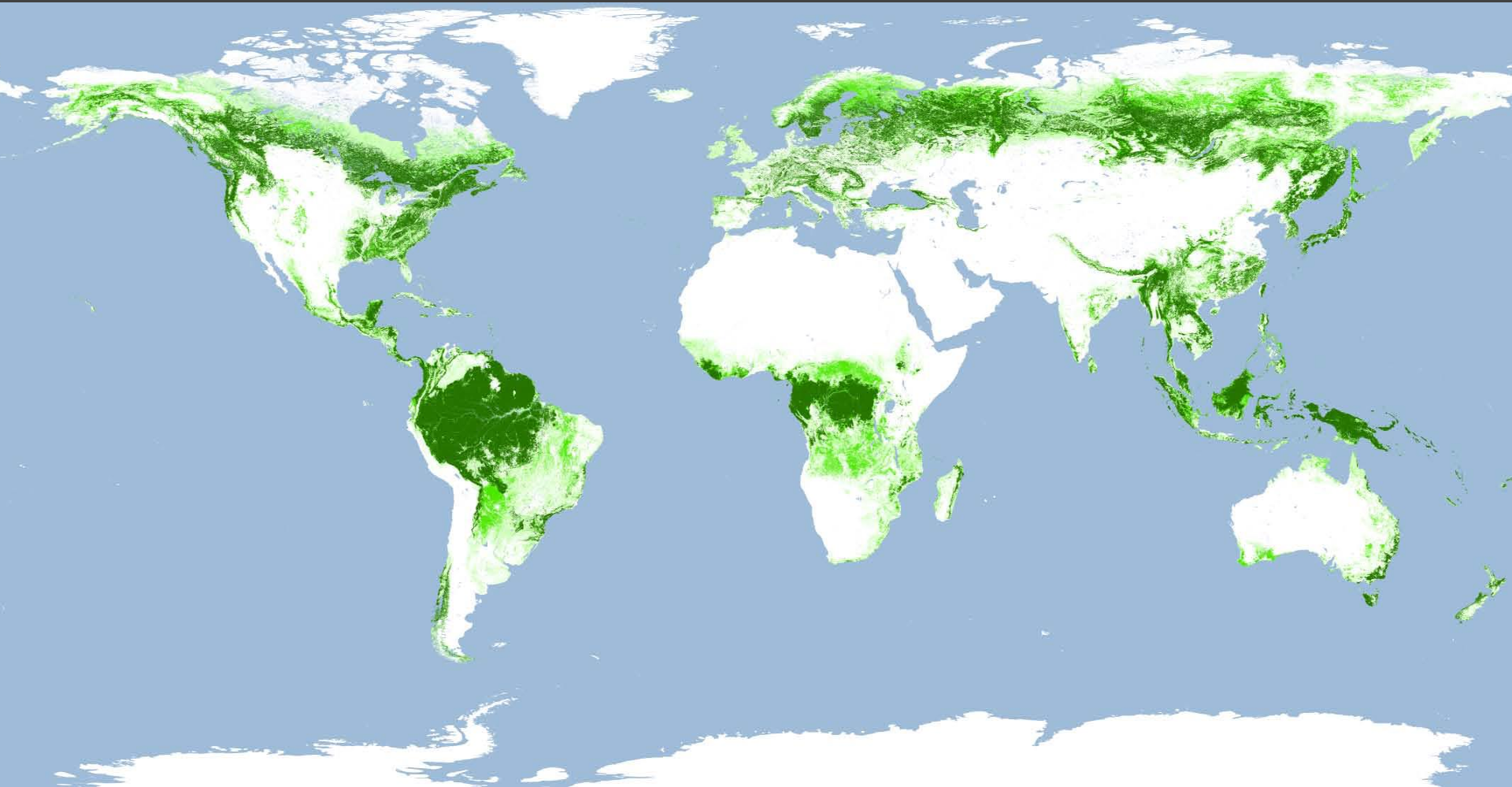
47% (1,900 Mill. Ha) temperate and boreal

One-Third of the world's land area is forest
(93% natural and semi-natural forest, 7% planted forest)



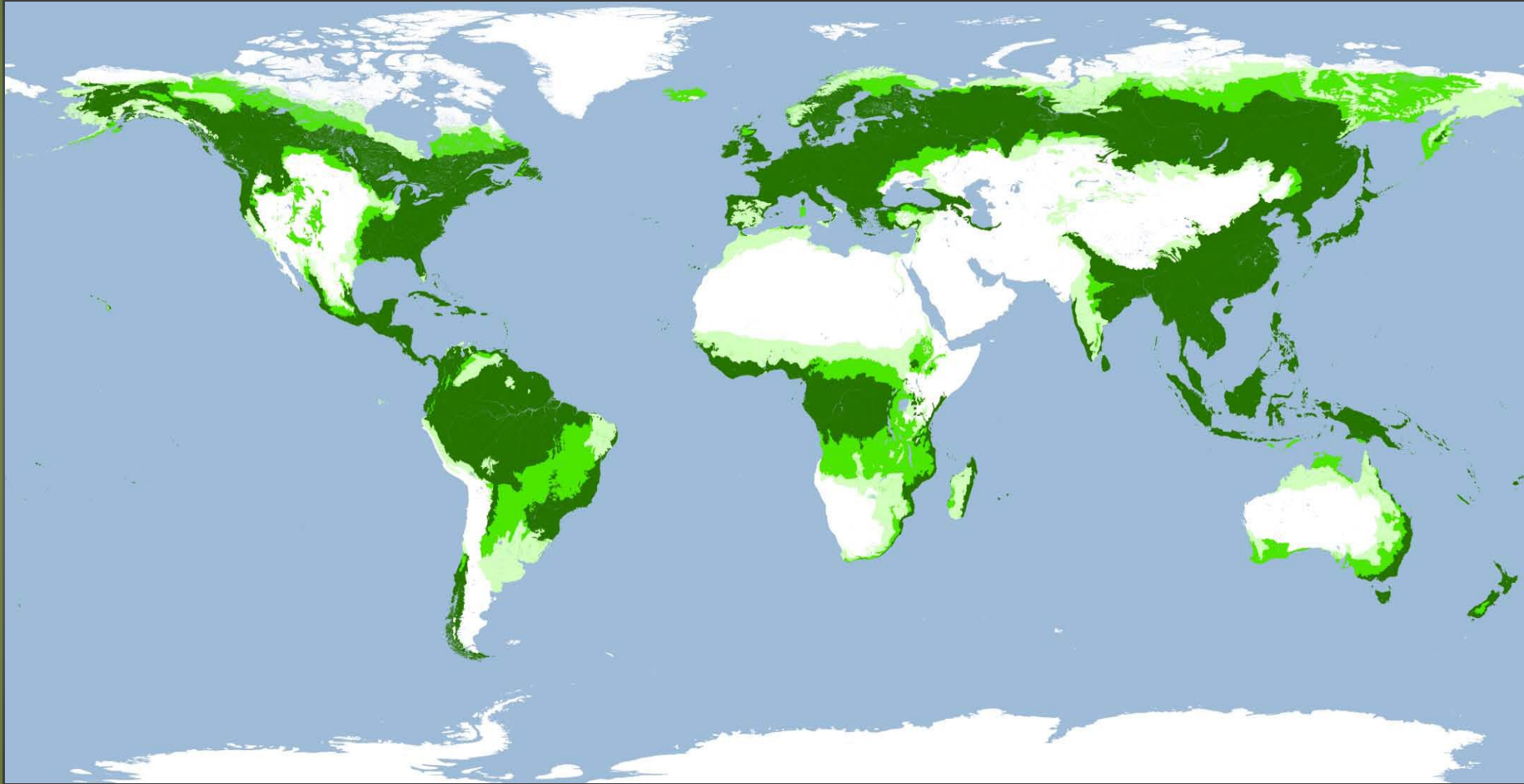
53% (2,100 Mill. Ha) tropical and subtropical

Panta Rhei – Extent of forests today

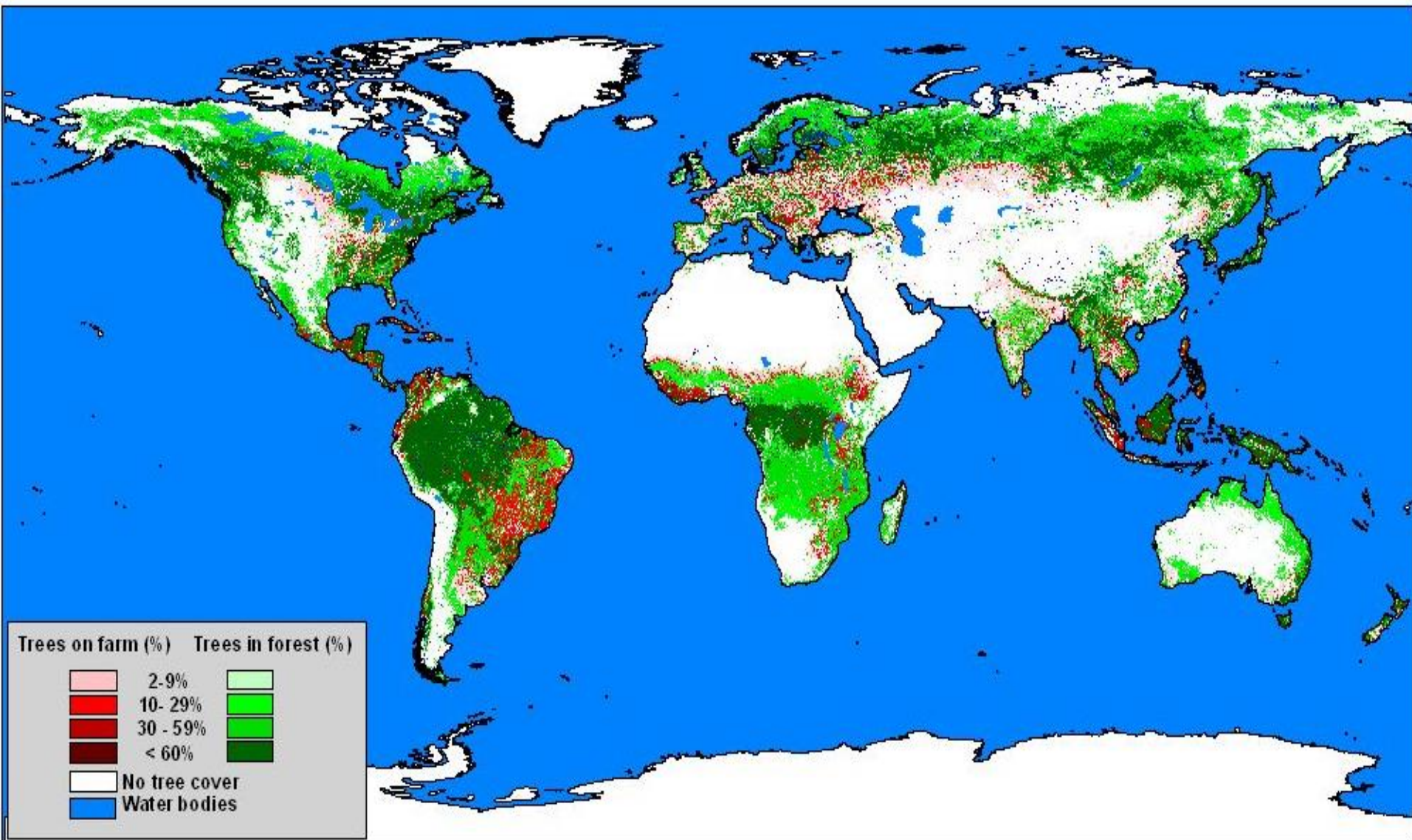


Map: FAO 2015

Panta Rhei – where forests could grow



Panta Rhei - the integrated NRM view....



Forests and global climate: more than carbon

Biophysical climate forcing :

- ⇒ Reflection of solar irradiation (albedo)
 - Snow: 40 – 90%
 - Broadleaf forests: 15 – 25%
 - Conifer forests: 5 – 15%
- ⇒ Radiation of sensible and latent heat (evapotranspiration)
- ⇒ Aerosols / VOCs / Clouds
- **Climate regulation:**
 - ⇒ Warming effects of forests in boreal zones and mountain areas in winter
 - ⇒ Cooling effects of forests, particularly in the tropics

Biochemical climate forcing

- ⇒ **C-storage in biomass and soils and the change of C-stocks due to absorption (sinks) and emission (sources) of CO₂**



→ Can forests still perform these functions today/in the near future? Given the human influence? Speed of change?



Volatile Organic Compounds

The central role of forests in climate change



Forests are vulnerable

Impacts on ecosystems, people and the wood chain



Forests emit GHG

Second most important source of GHG Emissions,
Totalling to about 10% of the World's GHG emissions



Forests (trees) can:

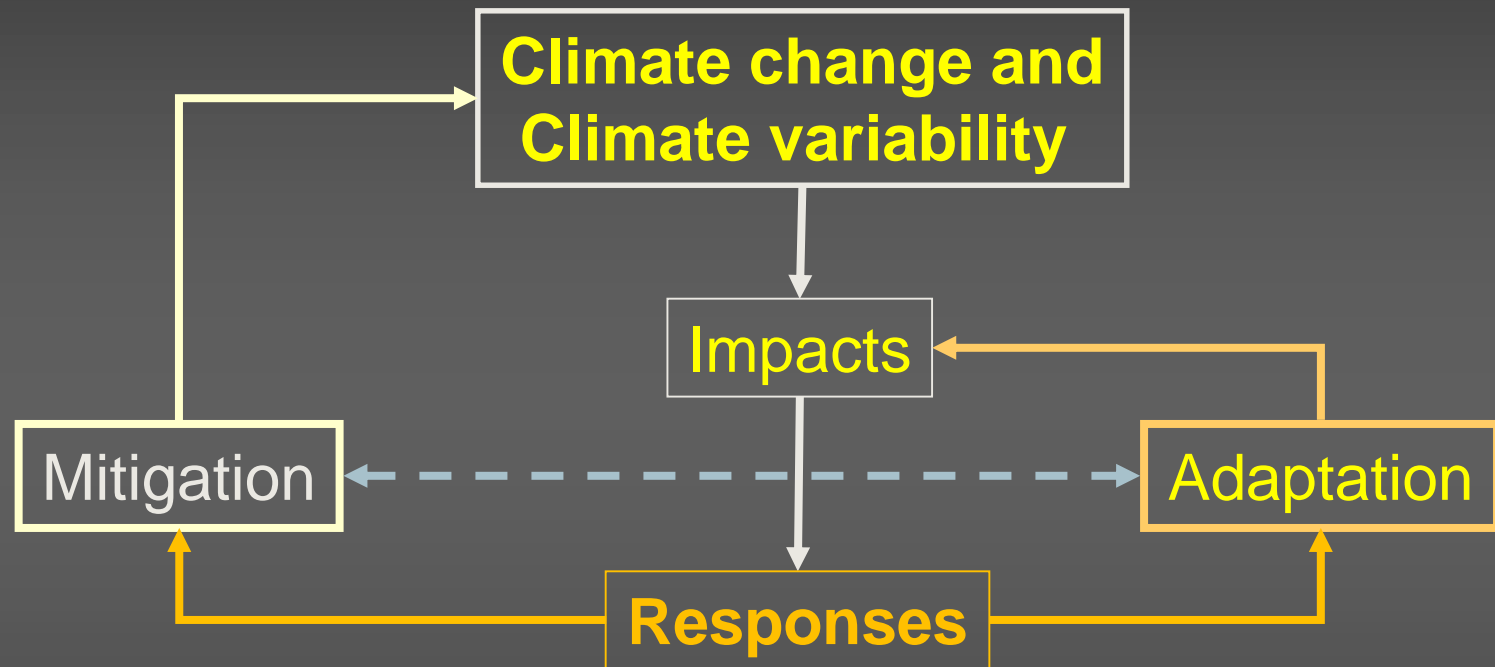
- increase resilience of people and ecosystems (= adaptation),
 - fix and store carbon (= mitigation) = REDD+.



Mitigation and adaptation options in the forest sector need to be fully understood and used in an integrated way in the context of promoting sustainable development

(ii)

Forests and climate change strategies



... maintaining and increasing ecosystem C pools and C sequestration – reducing emissions from biosphere

... maintaining and increasing ecosystem resilience – reducing vulnerability

Forests in Climate Change:

Forests can increase resilience, fix and maintain carbon

- ➔ If the average CO₂ concentration in the atmosphere continues to increase to 500 ppm or higher, forests will become highly vulnerable (year 1900: 295 ppm; year 1995: 360 ppm; August 2021: 415 ppm)
- ➔ High risk that GHG sinks become sources of GHG emissions (which has been already reported for the southern Amazon in 2021, see Art. In Nature)
 - Forests are a mitigation option now and over the next 50-80 years (?), thus, maybe only a transitional measure towards a low carbon economy
 - Need to increase resilience of forest trees and ecosystems at the same time as using forests as a mitigation option.
- ➔ Presently, the potential of forests as a mitigation option is considerable
- ➔ But also the particular risks: including the many governance issues prevailing in forestry, such as unplanned deforestation, continuous degradation, lack of social inclusion (rights, tenure, access, land use planning, benefit sharing, insufficient law enforcement...)

The role of SFM in climate change: Adaptation

Maintaining and increasing ecosystem resilience – reducing vulnerability

⇒ Forest ecosystems are affected by climate variability/change:

What are the direct and indirect impacts

- forest-dependent people?
- on the forestry production chain?
- at the landscape level?

⇒ How can forests and trees contribute to reduce vulnerability (of social systems and ecosystems)?

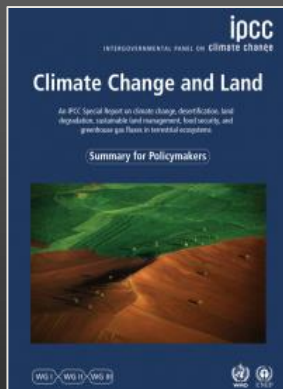
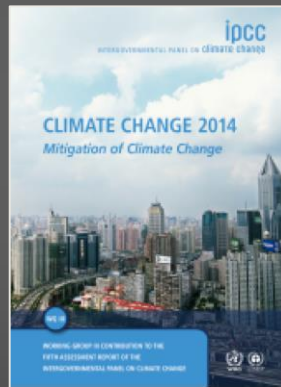
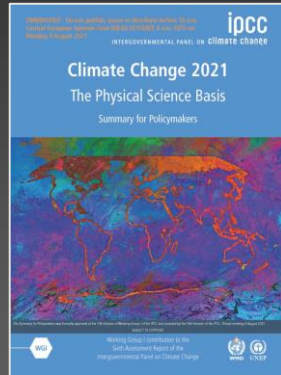


→ **A forest management/FLR agenda that includes a CC adaptation analysis and measures can increase the value of forests**

“Avoid the unmanageable and manage the unavoidable..” (Sigma Xi)

(ii)

IPCC 5th and 6th assessment reports



- Deforestation is the cause of 1/3 of anthropogenic CO₂ emissions since 1750. Today, about 10% of CO₂ emissions come from land-use change, mainly tropical deforestation.
- Emissions from land-use change are compensated by growth of established forests, mainly in the temperate and boreal regions. The world's forest are a net sink of carbon, re-absorbing about 1/3 of anthropogenic CO₂ emissions.
- Forests are vulnerable to projected climate change. Cases of increased tree mortality due to droughts have been observed on all continents. 70% of tree species are operating close to their limits of waterstress tolerance.
- Late successional trees belong to the species with longest generation time and slowest distribution velocity. Genetic adaptation and migration might not keep track with even moderate scenarios of climate change.

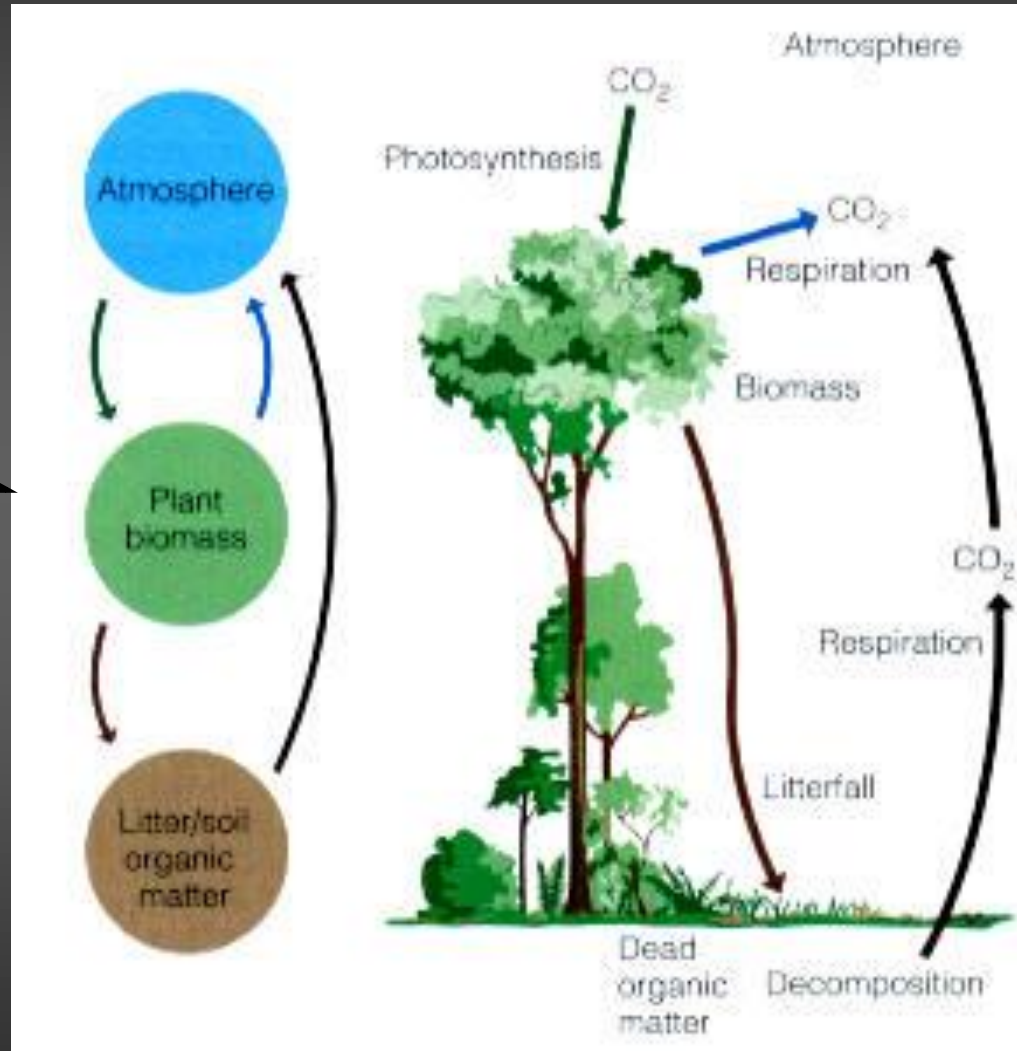
Mitigation: Carbon cycle and forest

Source



Emissions:

- Deforestation
- Degradation
- Devegetation



Sink



Sequestration

- Biomass (AGB + BGB)
- Litter
- Dead wood
- Soil

(ii)

SFM/FLR:

Proactively increase CO₂ storage in forests

Reduce
sources



Increase
sinks

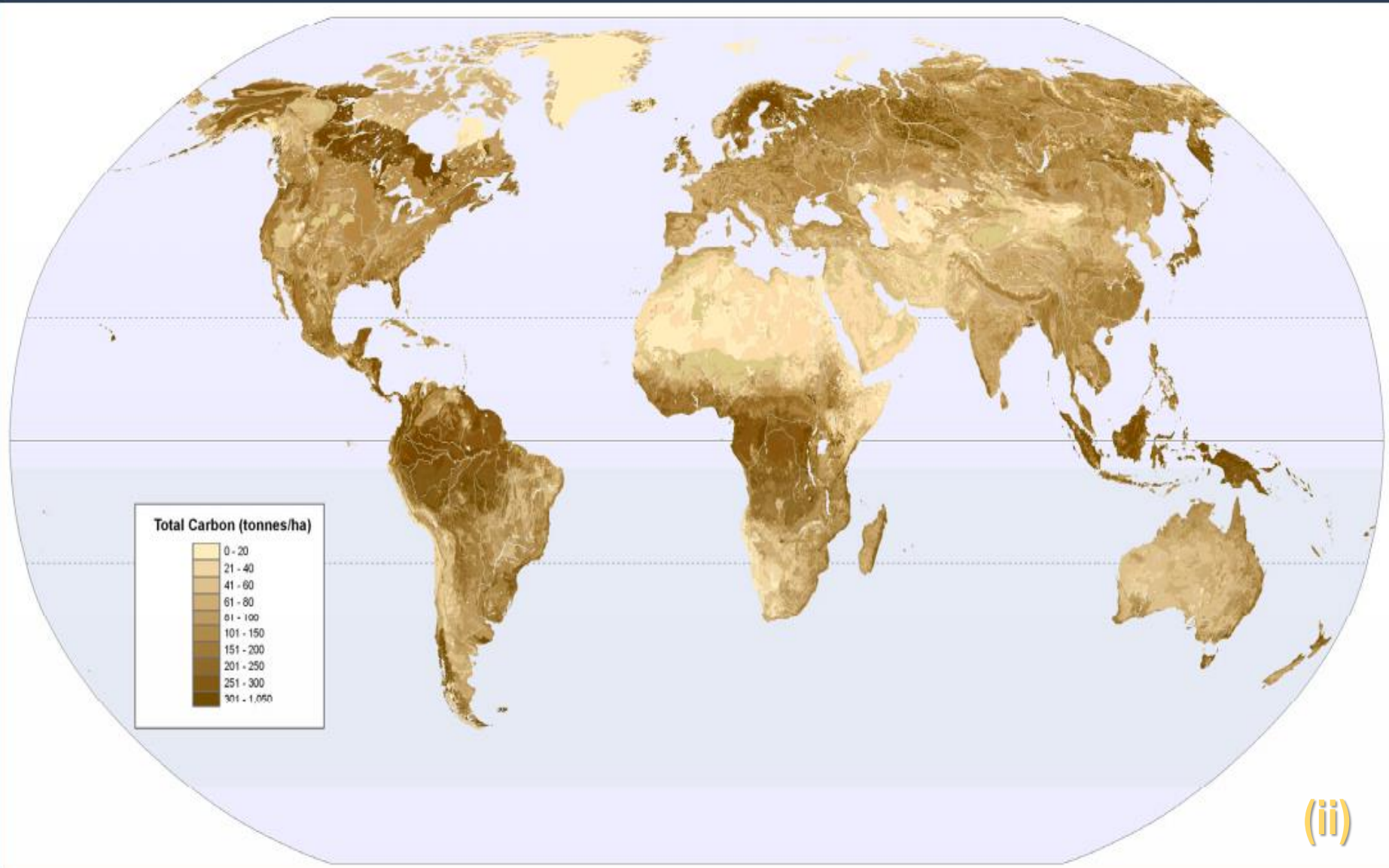


- ▶ Reducing deforestation
- ▶ Sustained yield mgmt/
“Avoid degradation”
- ▶ Keep carbon storage
intact (“adaptation”)

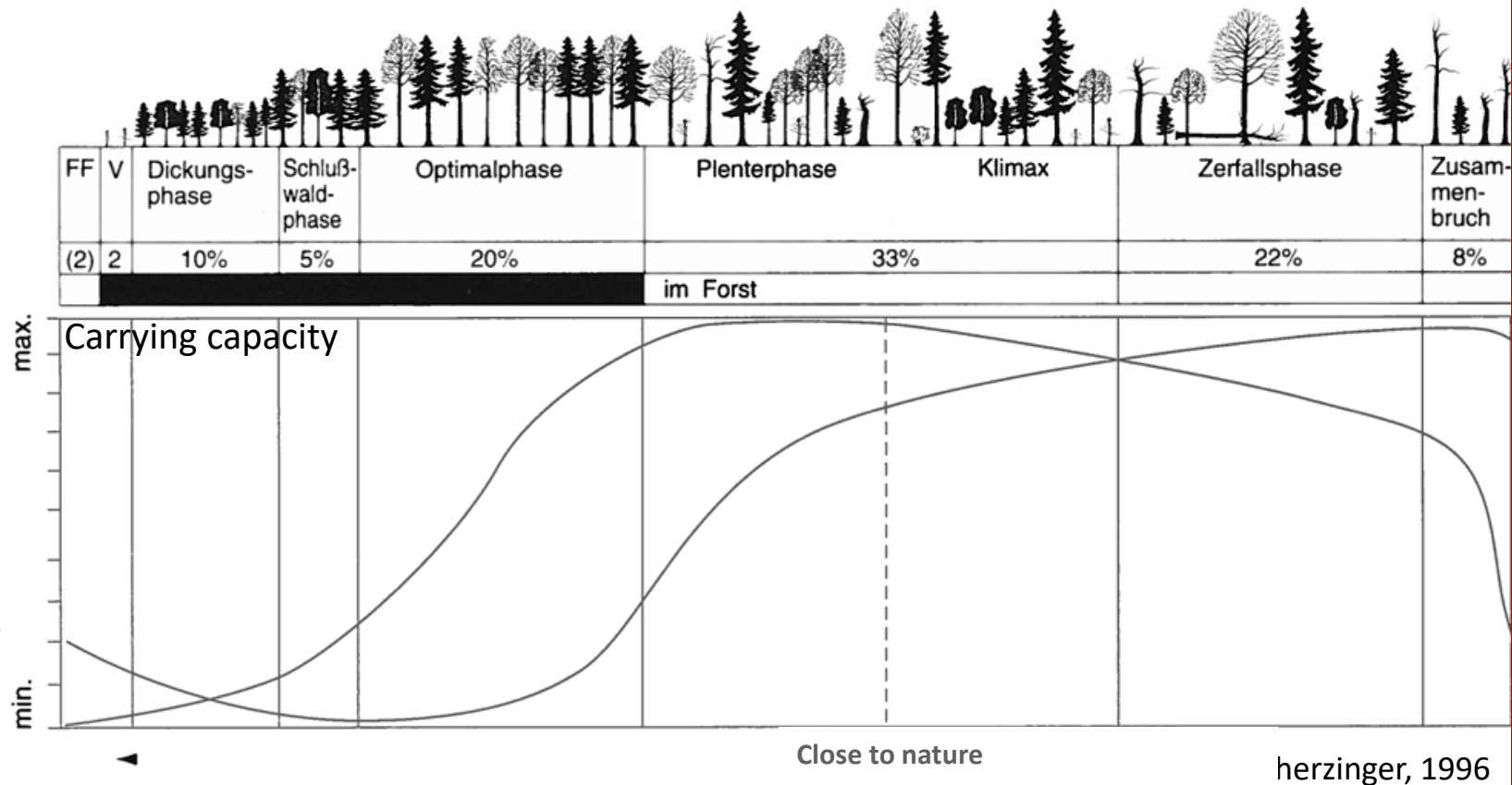
- ▶ Managed forests,
enrichment
- ▶ Afforestation/Reforestation,
FLR
- ▶ Increase biomass growth

Where is the World's Forest Carbon (WRI 2011)

Updated global map of terrestrial carbon stocks



But: Forests cannot grow into the sky...



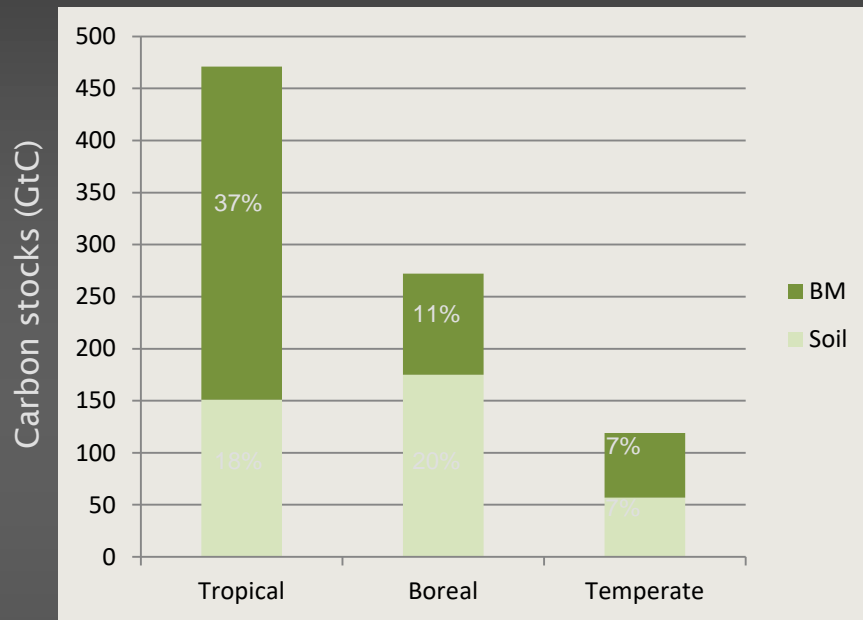
Typical carrying capacity:
(based on Liu et al., 2012)

- ▶ Boreal forests: 65 tC/ha
- ▶ Temperate forests: 136 tC/ha (~= 500m³/ha)
- ▶ Tropical forests: 186 tC/ha

(ii)

C Stocks (storage) in World's Forests

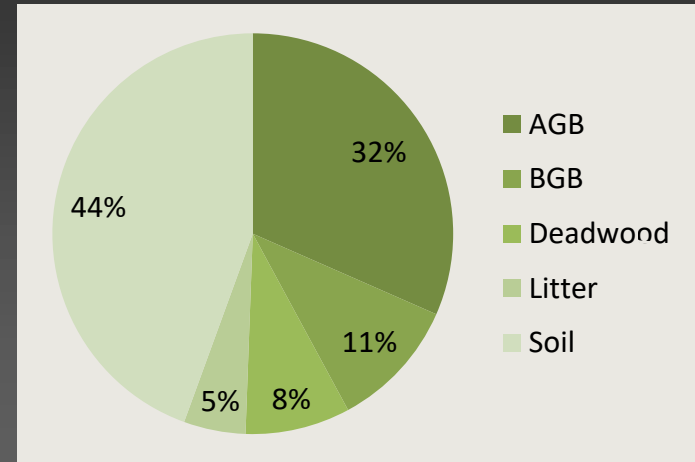
The current C stock in the world's forests is estimated to be 861 (+/- 66) GtC



The overall carbon density in tropical and boreal forests is comparable (about 240 tC/ha), whereas the density in temperate forests is ~60% of the other two biomes (155 tC/ha).

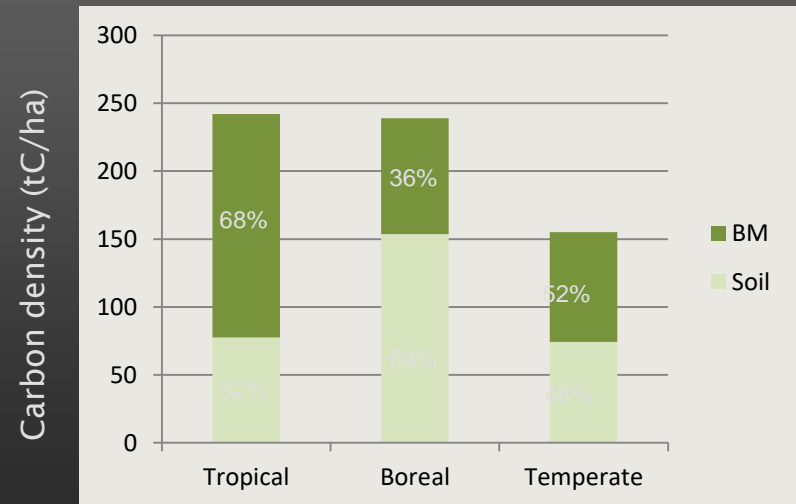
(compiled from Pan et al. 2011)

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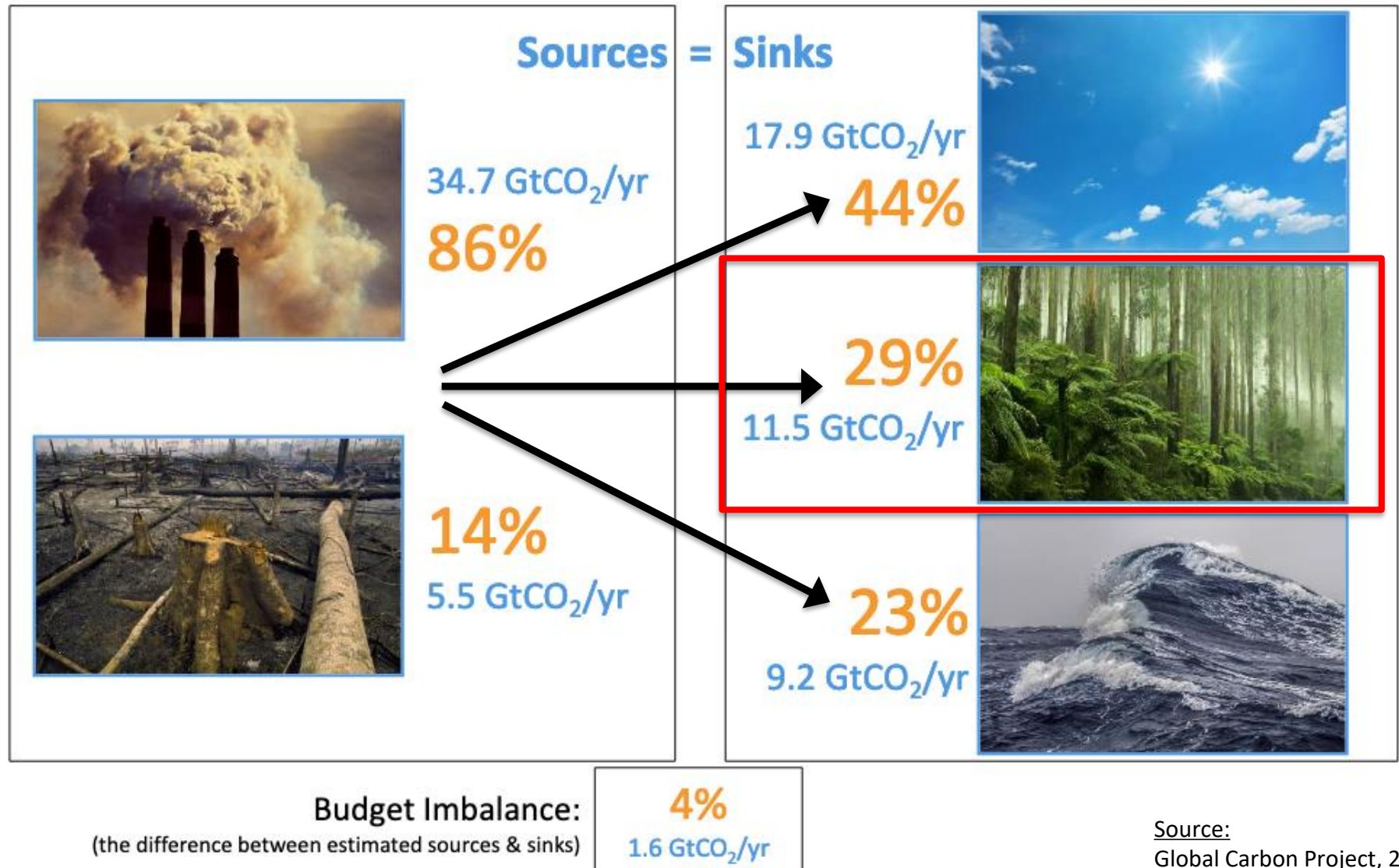
Biomass (BM)

- 55% of forest C is stored in tropical forests, 32% in boreal, and 14% in temperate forests.
- The fraction of soil C is about 1/3 in tropical, 2/3 in boreal and 1/2 in temperate forests



Role of forest-based mitigation

(data of 2005-2014)



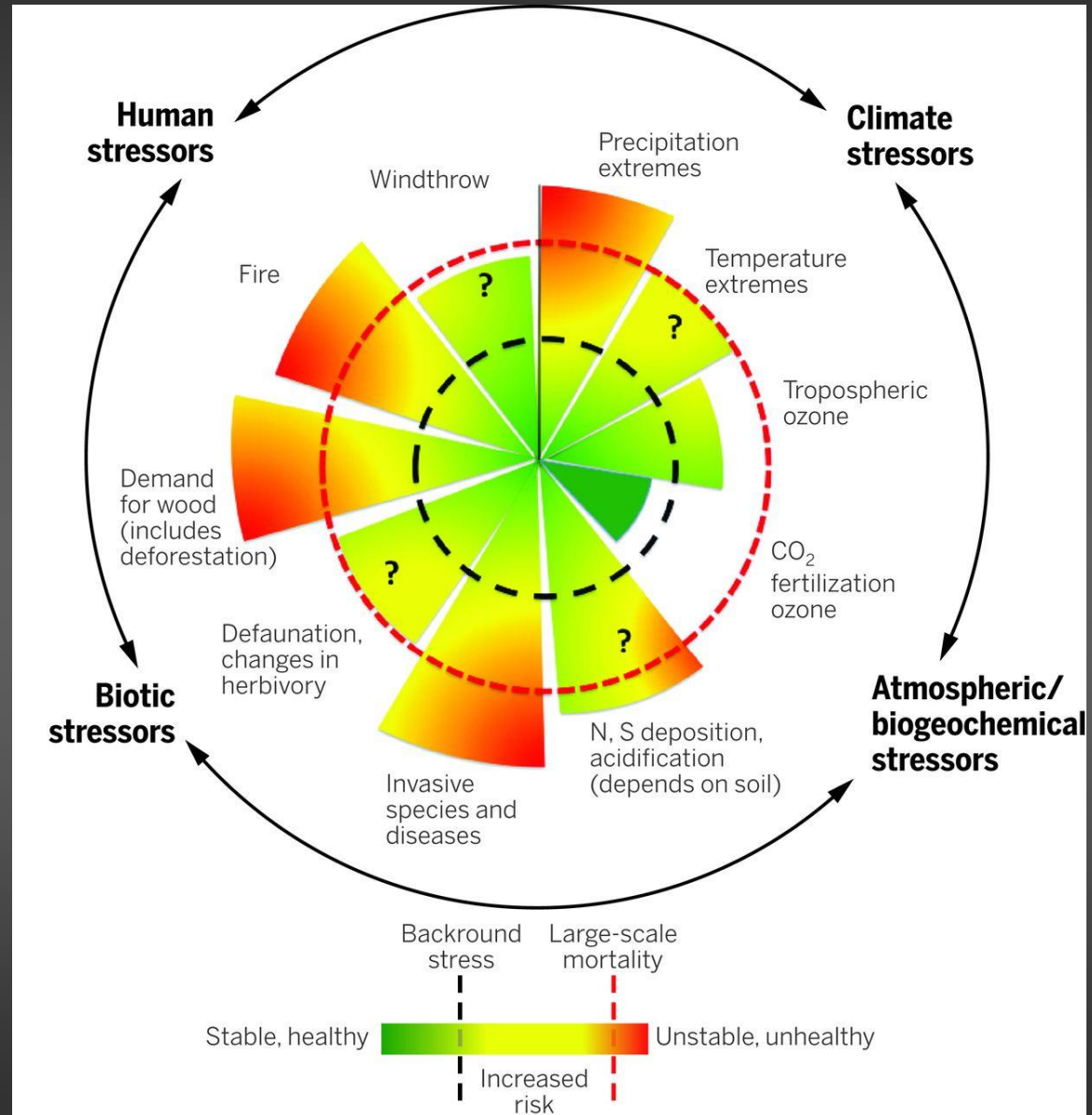
But: Major stresses and disturbances affecting forests

Up to 2050 and beyond:

Can forests play a positive role in a carbon neutral world?

Presentation based on
the methodology of
planetary boundaries

Trumbore et al 2015



Forests in a net zero CO₂ commitment?

Forests are both, sources and a sinks of CO₂. Currently, the sink effect dominates

- ⇒ Deforestation
- ⇒ Forest degradation
- ⇒ Droughts
- ⇒ Fire
- ⇒ Pests and Diseases
- ⇒ Windstorms

- ⇒ Forest extended growth in times of moderate climate change
 - Longer growing period (boreal, temperate)
 - CO₂ fertilization
 - Using less water for same productivity
 - Atmospheric nitrogen deposition
 - Effects of increasing forestation
- ⇒ **Now!! And in the future??)**

Estimated forest-based mitigation potential at global level:

- Reforestation/Afforestation/FLR **3.7 (0.5–10) GtCO₂e yr⁻¹**;
- SFM **1,8 (1– 2.1) GtCO₂e y⁻¹**.
- **Total about 5.5 GtCO₂e yr⁻¹**.

[AR6, 2021, unpublished]

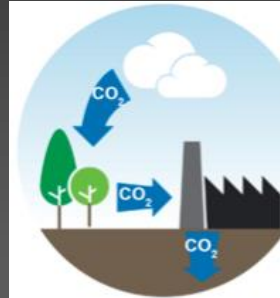
Negative Emissions Technologies (NET)

Carbon Dioxide Removal (CDR)



Afforestation and reforestation

Additional trees are planted, capturing CO_2 from the atmosphere as they grow. The CO_2 is then stored in living biomass.



Bioenergy with carbon capture and sequestration (BECCS)

Plants turn CO_2 into biomass, which is then combusted in power plants, a process that is ideally CO_2 neutral. If CCS is applied in addition, CO_2 is removed from the atmosphere.



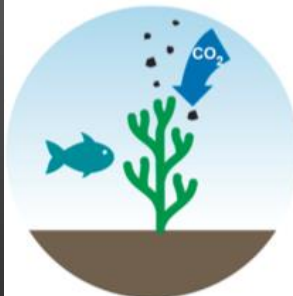
Biochar and soil carbon sequestration (SCS)

Biochar is created via the pyrolysis of biomass, making it resistant to decomposition; it is then added to soil to store the embedded CO_2 . SCS enhances soil carbon by increasing inputs or reducing losses.



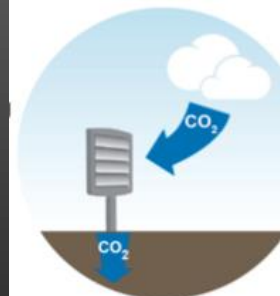
Enhanced weathering

Minerals that naturally absorb CO_2 are crushed and spread on fields or the ocean; this increases their surface area so that CO_2 is absorbed more rapidly.



Ocean fertilization

Iron or other nutrients are applied to the ocean, stimulating phytoplankton growth and increasing CO_2 absorption. When the plankton die, they sink to the deep ocean and permanently sequester carbon.



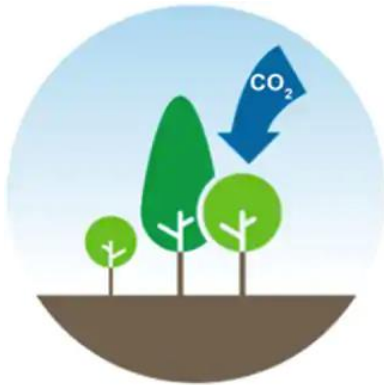
Direct air capture (DAC)

Chemicals are used to absorb CO_2 directly from the atmosphere, which is then stored in geological reservoirs.

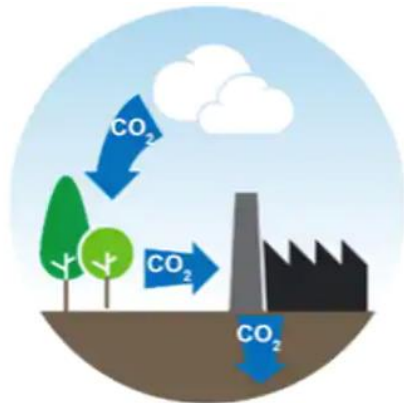
„Negative Emissions“ in IPCC Climate Scenarios

IPCC, 2019: carbon dioxide removal (CDR)

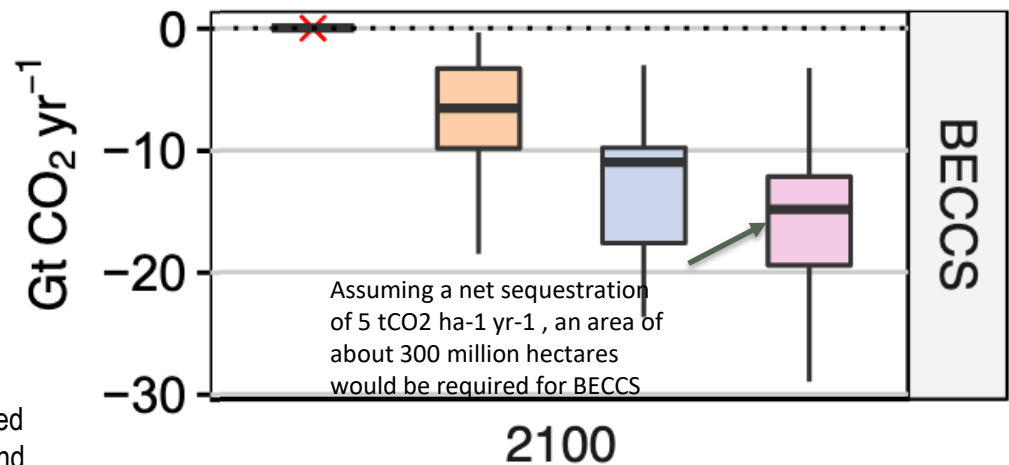
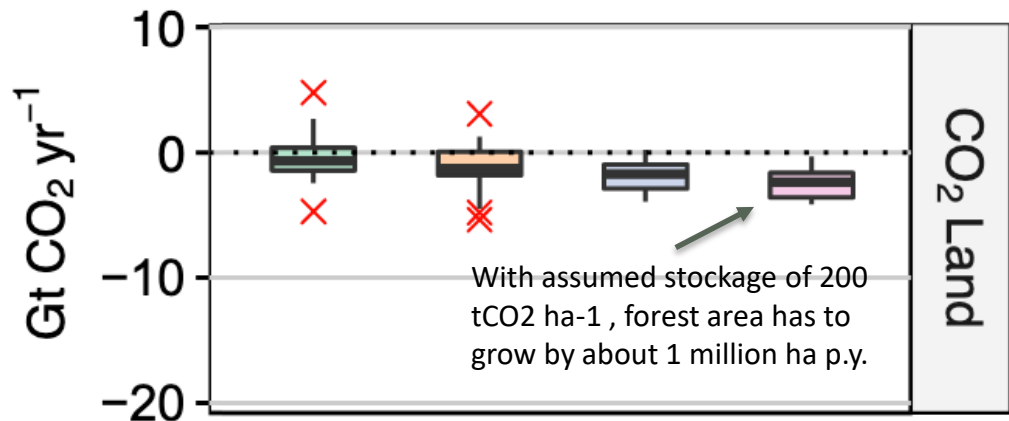
C-Storage
Forest



Bioenergy Carbon
Capture and Storage



Generate power, capture the CO₂ released during combustion for storage underground



Source: IPCC, 2019



Baseline



RCP4.5



RCP2.6



RCP1.9



What role of forests in the net-zero commitment?

A first conclusion

- ⇒ Combine mitigation and adaptation so that forests can play a role in a Carbon Neutral Economy
 - Reduce forest-based emissions (REDD)
 - Increase forest carbon sinks (REDD+) and A/R and FLR
 - Address vulnerabilities of ecosystems and social system
 - Increase forest ecosystem resilience (with the view of the long-term)
- ⇒ Next 50+ years or so: forests remain an important part of the solution: Carbon storage is key, but forest carbon cannot “grow into the sky”
- ⇒ To reach the 1.5°C goal there is a need to look beyond current boundaries → first and upmost: address fossil fuel emissions.
Explore the role of forest biomass in a package to come to negative emissions (→ Bioenergy, carbon capture and storage: BECCS)....but consider that the supply of the biofuels BECCS requires a lot of land and might jeopardize food production and biodiversity.

(iii)



Green deal: Making Europe the first climate neutral continent in the world

- ➡ Climate change and environmental degradation are an existential threat .To overcome these challenges, the European Green Deal will transform the EU into a modern, resource-efficient and competitive economy, ensuring:
 - no net emissions of greenhouse gases by 2050 (carbon neutral commitment)
 - economic growth decoupled from resource use
 - no person and no place left behind.
- ➡ One third of the 1.8 trillion € investments from the Next Generation EU Recovery Plan, and the EU's seven-year budget will finance the European Green Deal.
- ➡ Under the European Green Deal, the EU Biodiversity Strategy commits to plant at least 3 billion additional trees in the EU by 2030.

Transforming economies and societies

- ➔ Working with nature to protect our planet and health
- ➔ Restoring nature and enabling biodiversity to thrive again offers a quick and cheap solution to absorb and store carbon.
 - Restore Europe's forests, soils, wetlands and peatlands. This will increase absorption of CO₂ and will make our environment more resilient to climate change.
 - A circular and sustainable management of these resources will
 - improve our living conditions
 - maintain a healthy environment
 - create quality jobs
 - provide sustainable energy resources
- ➔ New targets to increase Europe's natural carbon sink **to 310 Mt** (old target 230 Mt)
- ➔ Bioenergy contributes to the phase-out of fossil fuels and the decarbonization of the EU economy. But it must be used sustainably. Strict new criteria to avoid deforestation and to protect areas of high-biodiversity value.



New EU Forest Strategy for 2030

Forest strategy (europa.eu) July 2021

- ➔ Support the socio-economic functions of forests for thriving rural areas and boosting forest-based bio-economy within sustainability boundaries. It will also protect, restore and enlarge the EU's forests to combat climate change, reverse biodiversity loss and ensure resilient and multifunctional forest ecosystems by
 - promoting the sustainable forest bioeconomy for long-lived wood products
 - ensuring sustainable use of wood-based resources for bioenergy
 - promoting non-wood forest-based bioeconomy, including ecotourism
 - developing skills and empowering people for sustainable forest-based bioeconomy
 - protecting EU's last remaining primary and old-growth forests
 - ensuring forest restoration and reinforced SFM for climate adaptation and forest resilience
 - re- and afforestation of biodiverse forests, including by planting 3 billion additional trees by 2030
 - providing financial incentives for forest owners and managers for enhanced SFM

- ➔ The strategy also focuses on
 - strategic forest monitoring, reporting and data collection
 - developing a strong research and innovation agenda to improve our knowledge on forests
 - implementing an inclusive and coherent EU forest governance framework
 - stepping up implementation and enforcement of existing EU acquis

Why plant 3 billion additional trees? (600 million trees per year)

3 billion trees (europa.eu)
swd_3bn_trees.pdf (europa.eu)

“Forests are a key part of the solution to combat climate change and biodiversity loss. 3 billion additional trees across the EU by 2030 will increase the area of forest and tree coverage, increase the resilience of forests and their role in reversing biodiversity loss, mitigate and help adapt to climate change”

Planting the right mix of tree species not only in forests, but also in agroforestry, agricultural and urban areas. No trees should be planted in areas of high nature value

Tree planting is particularly beneficial in **cities**, while in rural areas it can work well with agroforestry, landscape features and increased carbon sequestration.

In order to count towards the pledge, tree-planting initiatives must:

- plant additional trees compared to a “business as usual” scenario
- benefit biodiversity and the climate
- exclude the planting of invasive alien species
- plant only native tree species unless it can be demonstrated that they are no longer adapted to projected climatic and pedo-hydrological conditions

Take away messages:

The role of forests in carbon neutral commitments

- ➡ From a global perspective, keeping existing forest areas intact and protected, and restoring/reforesting degraded landscapes is a priority → REDD+ and other means
- ➡ C-storage in forest is limited (and not permanent). Loss due to climate change and extreme events are increasingly to expect (from a sink → to a source of CO₂), in all biomes. Managing forest health thus is a priority
- ➡ Afforestation/Reforestation/FLR, Bioenergy and Carbon Capture and Storage (BECCS) are the dominant Carbon Dioxide Removal (CDR) methods available now and in the immediate future
- ➡ In those parts of the world where forests with high C storage are managed sustainability according to proven SFM standards, forest management assures highest level of climate protection. Wood used as a long-lasting material stores carbon beyond forests in the long-term and can be further developed.

Managing forests and restoring forest landscapes: Carefully and wisely use it as a carbon solution

OECD countries & other industrialized countries

1. **Phasing out fossil fuels**

- Sustainable, but intensive and efficient use of the renewable resource “wood”. Forests and forests goods (wood) will gain on importance and value.

2. **Maintaining the sink performance (forest health)**

- Ensure productivity. Adaptation to climate change and forest protection. Ensure equally the functionality of forest ecosystem services, incl. biodiversity

3. **Increase forest and tree areas in landscapes**

- Indirectly as this already happens in many countries. Not necessarily account for it as “reduction obligations”

Developing countries

1. **Reduce deforestation/ forest degradation, enhance carbon sinks, reforestation of degraded land**

- ▶ Mitigation + Adaptation as combined
- ▶ International compensation payments (e.g. REDD+ mechanism).

2. **SFM and adaptation to climate change**

- ▶ Sustainable use of the raw materials wood and NWFP without degrading forests. Value forests goods and services, incl. biodiversity (intern. compensation payments?)

3. **Efficient use of existing forests**

- ▶ Mainly driving away from traditional wood fuel to modern bioenergy.

What role of forests in carbon neutral commitment?

Look at the entire system

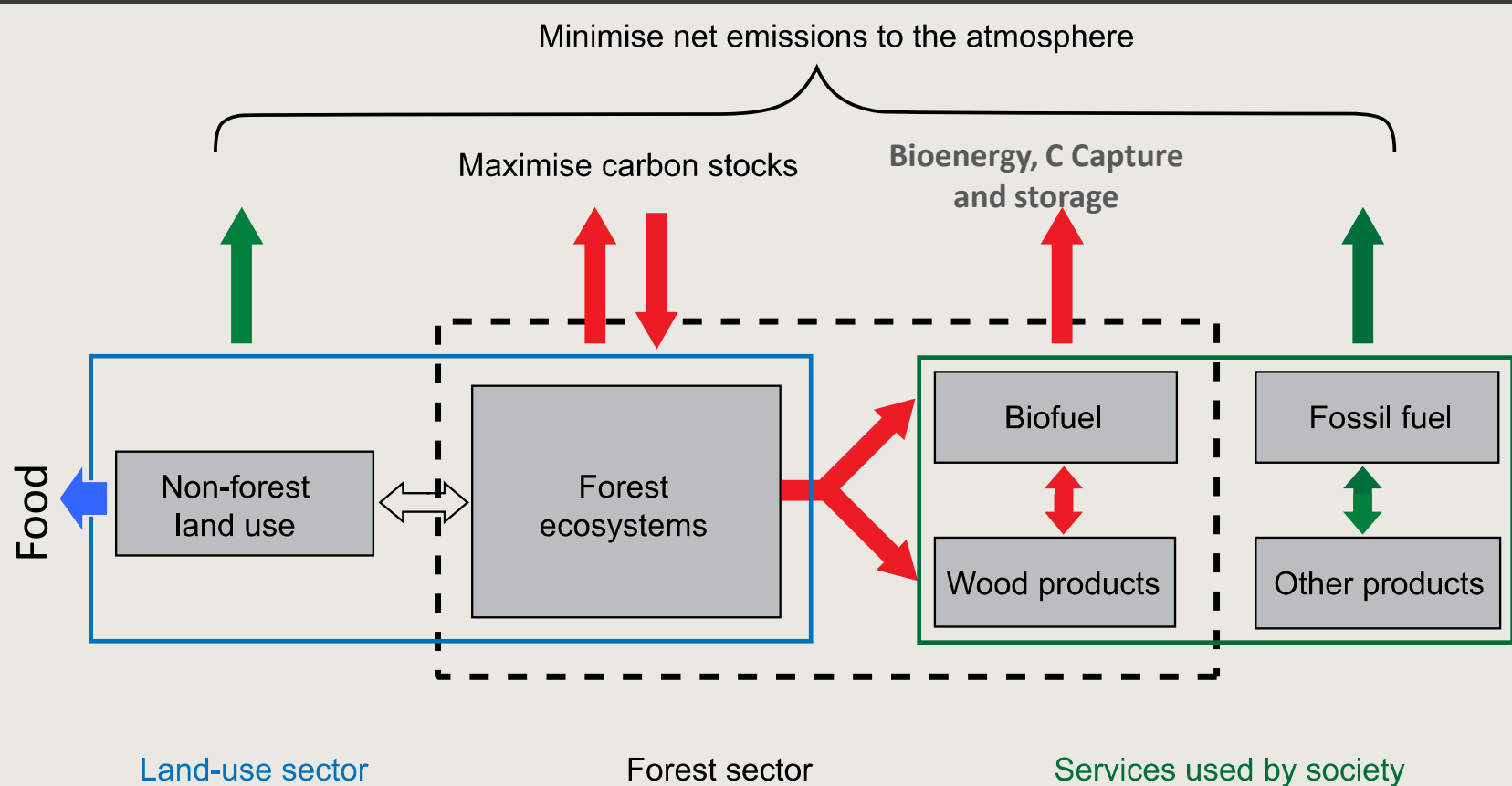


Figure 9.3: *Forest sector mitigation strategies need to be assessed with regard to their impacts on carbon storage in forest ecosystems on sustainable harvest rates and on net GHG emissions across all sectors.*

(IPCC AR4, 2007)