OptFor-EU

Smart decisions for sustainable forest management

Innovativeness of
Essential Forest Mitigation Indicators

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OptFor-EU Task 1.2 –
Develop a set of novel Essential Forest Mitigation Indicators (EFMIs) with open access code

- **March 2023-December 2024**
- **Literature review and desk work to collate a pool of potential indicators (130) with input from consortium**
- **Investigation on data sources**
- **Internal indicator survey**
- **External indicator survey**
- **Fact sheets for 21 Indicators**

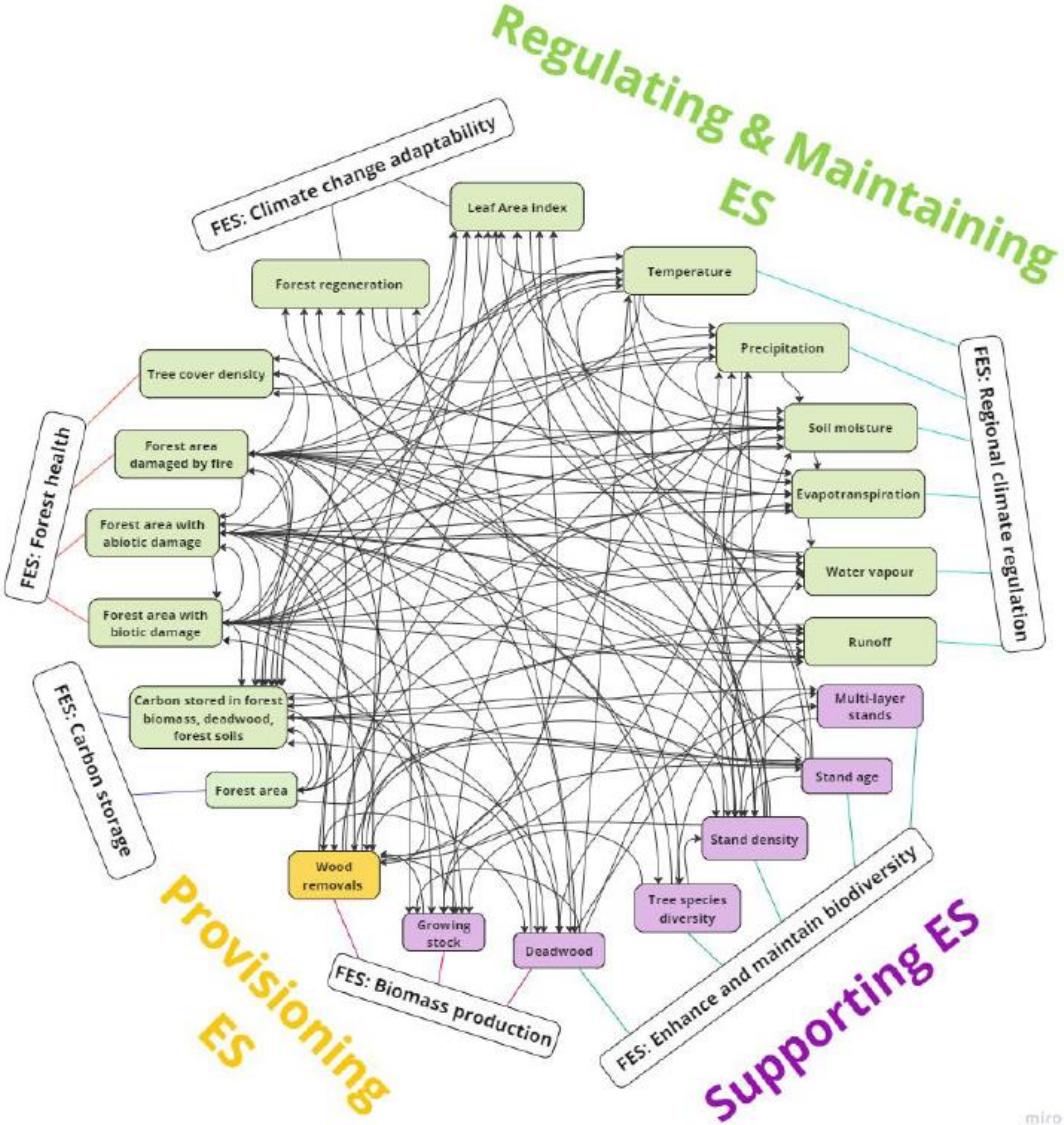
Innovativeness of the EFMI set

- ❑ Novelty in concept and design
- ❑ Participatory and bottom-up development process
- ❑ Integration into a decision support system (DSS)
- ❑ Alignment with policy and frameworks
- ❑ Comprehensive scope and scalability
- ❑ Empowering evidence-based decision-making
- ❑ Innovative impact on forest management practices

21 Indicators related to

6 Forest Ecosystem Services (FES) and to

3 Ecosystem Services (ES)



Data open accessible

- In OptFor EU database
- Via International Data Provider
- Open source code for RS data published on *Zenodo* available at https://doi.org/10.5281/zenodo.14789833

Indicator presentation in Factsheets

ESSENTIAL FOREST MITIGATION INDICATORS (EFMIs)

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Carbon stored in forests

Indicator full text: 4 Carbon stored in forest biomass and in soils

Sub-indicators:

4.1 Carbon stored in living biomass

4.2 Carbon stored in deadwood

4.3 Carbon stored in forest soils

Measurement units:

- Tons C/ha for living biomass and deadwood
- Tons C/m^2 for forest soils

Rationale: Carbon accumulates in forest ecosystems through absorption of atmospheric CO_2 and its assimilation into biomass. Although the main goal of the Kyoto Protocol is to secure agreement on reducing emissions of greenhouse gases at source, it also recognises that carbon sequestration in forest ecosystems contributes to a reduction in the concentration of greenhouse gases in the atmosphere. Carbon is retained for long periods in forest biomass and soils. Soil organic carbon is important for several soil functions and related processes.

Common International Classification of Ecosystem Services (CICES):

The indicator carbon stored in forest biomass and in soils can be assigned under '**Regulating and Maintaining** Ecosystem Services' and linked to 'carbon storage' under Forest Ecosystem Services because the indicator directly quantifies the forest's ability to store carbon, a critical regulating service that mitigates climate change.

Reference to indicators in international indicator sets:

- Forest Europe 1.4
- Sub-indicator of SDG 15.2.1 (biomass stock)
- Global Core Set of forest-related indicators 8 (biomass stock)
- EU Nature Restoration Law
- Essential Climate Variable

Explanation of decarbonisation benefit or loss:

Increasing carbon storage in deadwood, whether standing or lying, is an important factor for climate change mitigation. In the early decomposition stages, deadwood serves as a carbon sink. Retention of deadwood during forest management operations thus contributes to climate change mitigation (Błońska et al., 2017 [18]). Increasing carbon stocks in forest living biomass, both above- and below-ground, through sustainable forest management practices, contribute to climate change mitigation (Eggers et al., 2008[19]). Soil carbon levels are impacted by reforestation and afforestation activities and by different exploitation techniques. In continuous-cover forests soil carbon levels are rather "static". Increasing carbon stocks in forest soils through sustainable forest management practices and soil-friendly logging contribute to climate change mitigation (Mayer et al., 2020[20]).

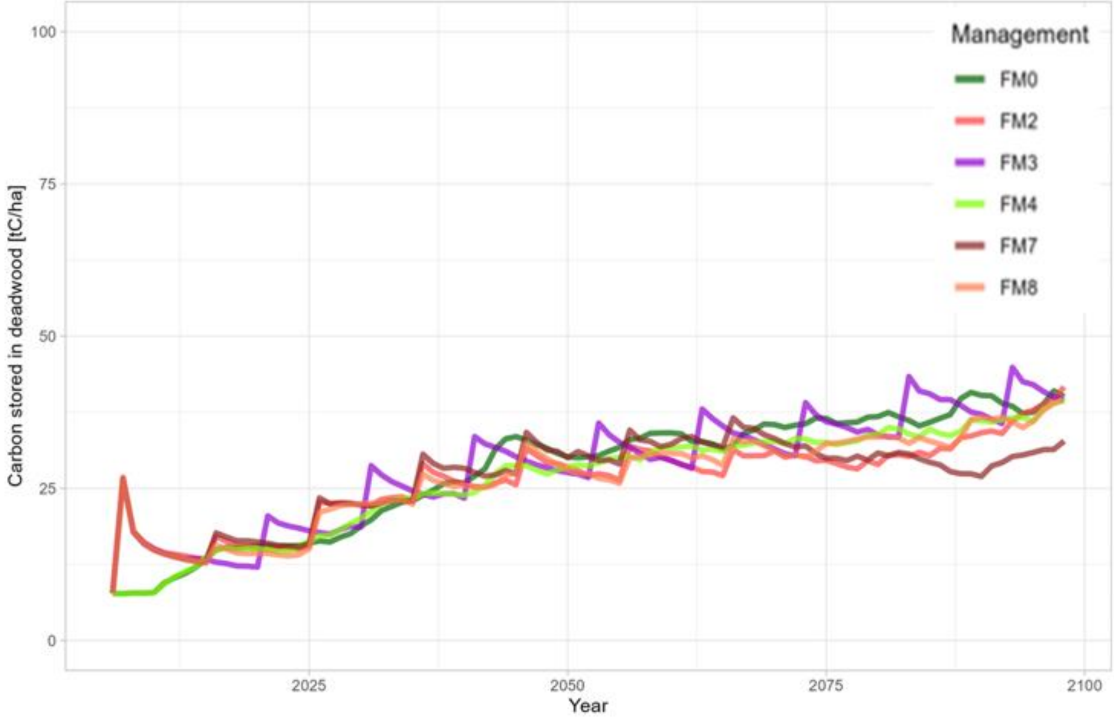

Figure 7. Simulation for carbon stored in deadwood (tons/ha) in beech forests (EFT6) in the CSA Romania from 2006-2100 for 6 different forest management options. Source: PICUS model.

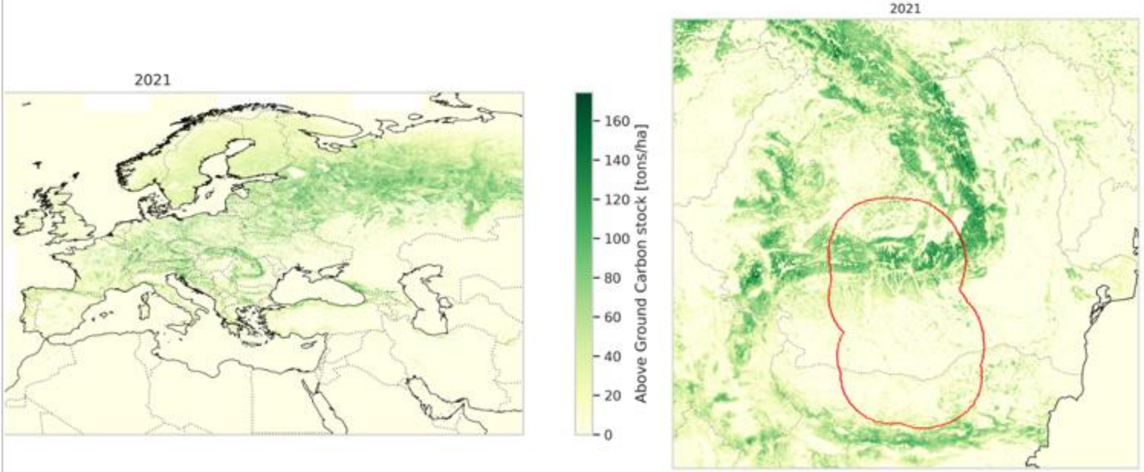

Figure 8. Above-ground carbon stock in forest (tons/ha). Data calculated from ESA-CCI biomass map v5 for 2021, resampled to 1km spatial resolution. Left: EURO-CORDEX region. Right: Zoom into the CSA Romania region (red polygon).

Indicator presentation in Factsheets cont.

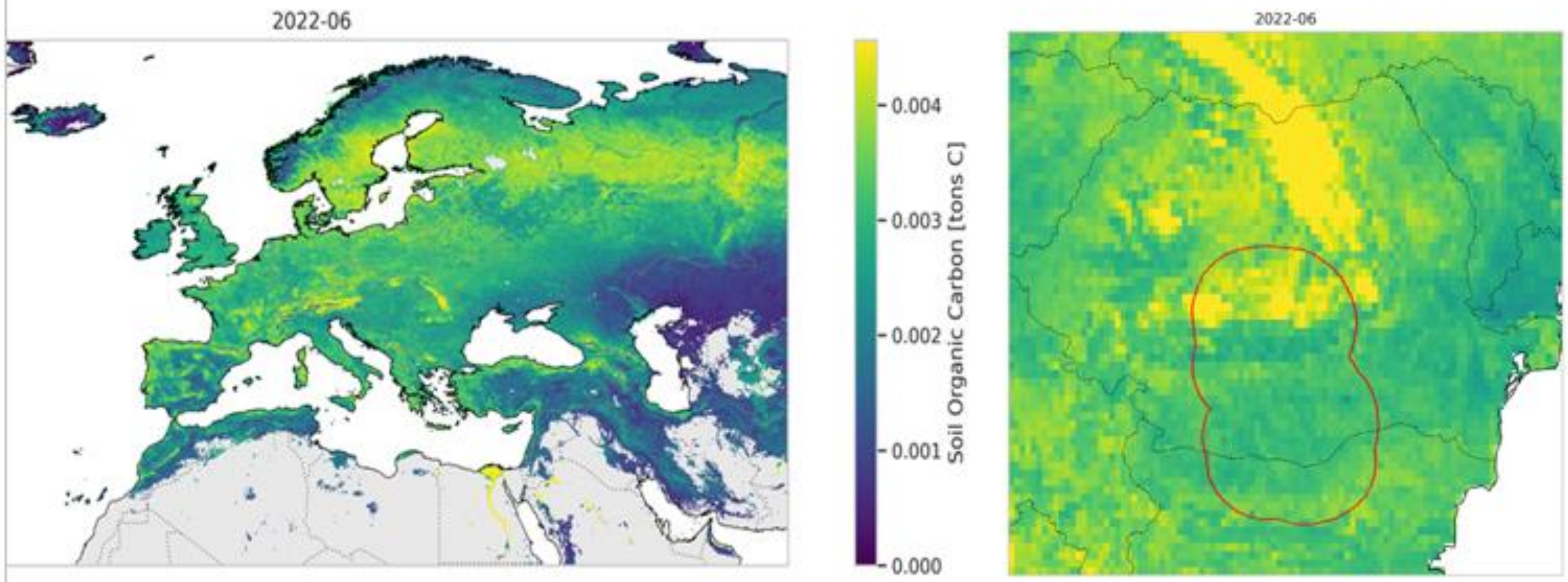

Figure 9. Soil organic carbon (tons C). Data from SMAP L4 Global Daily 9 km EASE-Grid Carbon Net Ecosystem Exchange, v7, June 2022, at a 9km spatial resolution, averaged from daily to monthly temporal resolution. Left: Subset to EURO-CORDEX region. Right: zoomed into CSA Romania region (red polygon).

Direction of indicator value for a positive effect on carbon mitigation: Increase ▲

Model output data for CSA level from:	National up to pan-European data from IDP:	Pan-European-wide EO data:
• PICUS (C in biomass, and in soil) (Link DSS) • 3D-CMCC-FEM (C in biomass and in soil) (Link DSS) • JULES output (C in biomass for point runs in CSAs) (Link DSS)	• FRA database • Forest Europe database • ICP Forest soil survey	• SMAP L4 Soil organic carbon (gC m-2 day-1), 2015-2024, re-gridded to 10 km monthly resolution • Sentinel-1/ASAR/ALOS ESA-CCI living Biomass, 100 m resolution, annual data, 2010, 2015-2021, re-gridded to 1 km resolution and multiplied by 0,5 to obtain carbon stock of living biomass[21] • Data code accessible via Zenodo

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