

Investigating the reporting requirements for the indicators soil organic carbon and deadwood across multiple policies

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Contents

Abstract	2
Acknowledgements	3
Authors	3
Executive summary	4
1 Introduction	7
2 Reporting requirements on SOC and deadwood	9
2.1 Land Use, Land Use Change and Forestry Regulation	9
2.2 Nature Restoration Regulation	13
2.3 Soil Monitoring Law	16
2.4 New environmental economic accounts modules	19
2.5 The Common Agricultural Policy	22
2.6 Carbon Removals and Carbon Farming Regulation	25
2.7 Climate Adaptation Strategy	27
2.8 European Climate Law	27
3 Linkages, synergies and differences in the reporting requirements of deadwood and SOC indicators across the included policies	29
3.1 Linkages between monitoring and reporting across policies	29
3.2 Synergies and differences in reporting across policies	32
4 Implications of Member States' chosen methodologies for greenhouse gas inventories in relation to SOC and deadwood indicators	38
5 Conclusions	40
References	43
List of abbreviations and definitions	45
List of figures	46
List of tables	47
Annexes	48
Annex 1: Brief description of the tiered methodology of the IPCC 2006 guidelines	48
Annex 2: Classification criteria for organic soils	48
Annex 3: How MS must determine their sampling points for the Soil Monitoring Law	48

Abstract

Policies on climate, nature, agriculture and soils that support the EU Biodiversity Strategy for 2030 (BDS) have indicators (used for the monitoring of their implementation) in common – such as soil organic carbon (SOC) and deadwood indicators. The EU Biodiversity Platform Sub-Group on Monitoring & Assessment (EUBP MA) proposed that a task for 2024, assigned to the European Commission's Knowledge Centre for Biodiversity (KCBD), would be the “harmonisation of monitoring methods across policy areas” related to the implementation of the BDS. As a starting point on this task, **this report presents a semantic interoperability study focused on the linkages, synergies, and differences in reporting requirements on SOC and deadwood indicators across eight different policies relating to climate, nature, agriculture and soil.**

We identified explicit cross-policy linkages written in the policy documentation in addition to some synergies, and also identified differences in the reporting requirements of these indicators across policies. These differences are related to indicator scope and definition, to the level of detail given for indicator definitions and methodologies, or to the resolution of land use categories, meaning that an indicator measured for one policy may not fit for purpose to be used in another policy having a different purpose. On the other hand, the synergies include the measurement of the same indicator for overlapping land categories across multiple policies, and references to the same well-established methodologies. This reflects the overall coherence of EU policies on the area of natural resources. By consulting greenhouse gas inventory reports, we additionally identified instances whereby current methodological choices by certain Member States may not be compatible with the requirements of some of the investigated incoming policies (i.e. policy proposals).

The cross-policy linkages that we identified highlight the importance of achieving scientific and technical consistency in the monitoring methodologies used across policies, but also highlight the potential for improving synergy in monitoring and reporting across policies. The differences in reporting requirements for SOC and deadwood indicators and the potential lack of alignment on methodologies identified in this report could provide a starting point for cross-sectoral technical guidance documents or discussions with experts groups aiming to achieve greater harmonisation, simplification and cost-effectiveness of monitoring methods across these policies, particularly in view of the new and revised legislative proposals.

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Executive summary

The objective of this study is to identify possible ways to support the effort of simplification and reduction of the reporting burden based on the analysis of the linkages, synergies, and differences in reporting requirements on soil organic carbon (SOC) and deadwood indicators across multiple policies relating to climate, nature, agriculture and soil. This is achieved through the analysis of legal texts, guidance and implementation documentation. We examined the type of policy indicators, their definitions, the methodologies to calculate them (including land categories and units), and the timeframes and frequency for reporting those indicators. All in all, we analysed 6 policy indicators related to the content of SOC and 6 indicators related to deadwood and litter content, all of them closely interlinked (see **Section 3.2**).

Policy context

The EU Biodiversity Strategy for 2030 (BDS) is supported by policies on climate, nature and natural resources. These policies have indicators (used for the monitoring of their implementation) in common – such as SOC and deadwood indicators. Concerning these common, cross-policy indicators, it is important for there to be technical and scientific consistency across policies to aid in the ease, quality, and consistency of reporting of these indicators by Member States (MS), which in turn facilitates the monitoring of the implementation of these policies that are integral to achieving the BDS targets.

The EU Biodiversity Platform Sub-Group on Monitoring & Assessment (EUBP MA), who provides support to the implementation and monitoring of the BDS, proposed that an area of work for the EUBP MA, assigned to the EC's Knowledge Centre for Biodiversity (KCBD), for 2024 was to be the **“harmonisation of monitoring methods across policy areas”** related to the implementation of the BDS, “to facilitate technical and scientific consistency” across policy areas. SOC and deadwood indicators were given as example indicators for this task.

Eight policies relating to climate, nature, agriculture and soil were investigated in this study:

- The Land Use, Land Use Change and Forestry Regulation (LULUCF)
- The Regulation on nature restoration (NRR)
- The Directive on Soil Monitoring and Resilience (also referred to as Soil Monitoring Law, SML)
- The Regulation to amend the European environmental economic accounts Regulation
- The Common Agricultural Policy
- The Regulation establishing a Union certification framework for carbon removals (Carbon Removals and Carbon Farming Regulation)
- The EU Strategy on adaptation to climate change
- The Regulation establishing the framework for achieving climate neutrality

Main findings

We identified explicit cross-policy linkages written in the policy documentation relating to SOC and deadwood indicators. For example, certain policies explicitly state how they should aid in the implementation of another policy (for example, the Carbon Removals and Carbon Farming Regulation, by promoting carbon farming, contributes to the achievement of targets in the LULUCF Regulation and NRR). Other examples are how the value of certain indicators in one policy must be

evaluated against the targets of another policy (for example, land take indicators of the Soil Monitoring Law against targets in the LULUCF Regulation), or how several policies refer to the LULUCF Regulation for the specific indicators that are used in the monitoring of their implementation.

The most prominent communalities that we found in the reporting requirements for SOC and deadwood indicators across these investigated policies were that certain specific variations of the SOC and deadwood indicators need to be reported for the same land categories across different policies. For example, the volume of standing and lying deadwood must be reported for forest ecosystems in the NRR and re-used in the Environmental Economic Accounts Regulation.

In terms of differences in the reporting requirements for SOC and deadwood indicators, we found instances of, for the same land category, different policies requiring reporting of a different scope of an indicator. For example, for forested land, the reporting of carbon stock in deadwood *and* litter in the LULUCF Regulation but only in litter for the NRR. We also found instances of different policies requiring a different definition (and sometimes different unit) of indicator. For example, the Environmental Economic Accounts Regulation specifies carbon stock in *topsoil*, whereas the NRR and LULUCF Regulation do not specify topsoil – although clarification is needed on whether these are in fact the same definition of the indicator. We also found examples of where an indicator measured for one policy may not fit for purpose to be used in another policy having a different purpose, due to differences in the level of detail given for indicator definitions and methodologies, or in the resolution of the land categories. Furthermore, we highlighted some uncertainties in certain policies, when there is not sufficient level of detail provided with regards to the definition of the indicator or the methods to be used. For example, the definition of ‘topsoil’ is absent from the Environmental Economic Accounts Regulation, despite its weight, while it is provided in other policy frameworks (see later discussion). This, however, is also an opportunity to better align concepts and approaches across policy areas.

In consulting the 2021, 2022 and 2023 greenhouse gas inventory reports to the UNFCCC from the Commission and from Austria, this elucidated some of the current methodological choices of MS in calculating *carbon stock* of soil and deadwood. Through this, we identified some instances where current methodological choices by certain MS may not be compatible with the requirements of some of the investigated new or incoming policies.

Key conclusions

There is an **overall coherence** in the existing and proposed regulations evidenced by the cross linkages, especially to the LULUCF Regulation and the IPCC 2006 guidelines, and by relationship between the SOC and deadwood indicators, which could be derived from one another if the selected monitoring methodologies were compatible. Other explicit **cross-policy linkages** written in the policy documentation include cases where policy measures of one regulation contribute to achieve the objectives of another one; cases where certain indicators in one policy must be evaluated against the targets of another policy; and cases where definitions and methods refer back to a previous monitoring requirement.

However, these cross-policy linkages also highlight the **potential for there to be an even greater amount of synergy** between the reporting of SOC and deadwood (and potentially also other) indicators in accordance with these policies, if a greater degree of cross-policy *technical and scientific consistency* could be achieved in the future. The most evident differences and outstanding uncertainties are due to technical details related to the definition and scope of the indicators required across different policies, and to the level of detail provided for the monitoring methodologies *versus* the methodological choices open to MS.

Slightly different or unspecific reporting requirements across policies could generate an arduous work for measuring and reporting the investigated indicators. But this report shows that there are large **opportunities to facilitate the streamlining and interoperability** of data collection and calculation of indicators across policies. In the cases where we have aligned methodologies at EU level, we could work on possible ways of increasing the coherence across policies while reducing reporting burden by further aligning the definitions of an indicator that can answer more than one policy. When possible, this could be facilitated by Earth Observation data or any other EU-wide sustainable source of data. Clearly, further elaborations could be necessary to meet the original criteria of the indicator in each policy.

The differences in reporting requirements for SOC and deadwood indicators identified in this report, in addition to the uncertainties in their definitions, could provide a starting point for devising plans that aims to achieve greater harmonisation of monitoring methods across these policies. Such future work could involve, as suggested in the EUBP MA work plan for 2024, setting up “*ad hoc* technical groups with the objective to work on a detailed technical overview of specific methods used, or in clarifying reporting requirements or methodologies within policies”, based on the specific purpose of each policy and on what is already available and could be reused as indicator.

Where methodological details chosen by MS to measure different indicators (in particular in the greenhouse gas inventory submissions to the UNFCCC) may lead to difficulties in reporting against the policies covered in this report, it could create extra burden if a change of methodologies is needed in order for them to be compatible with what is required from incoming policies. We identified just a few examples of potential lack of alignment on methodologies, but a more systematic analysis of national reports under the assessed policies could elucidate many more examples.

1 Introduction

The EU Biodiversity Strategy for 2030 (BDS) is a ‘comprehensive, ambitious and long-term plan to protect nature and reverse the degradation of ecosystems’. The BDS is supported by policies on nature, climate and the sustainable use of natural resources. To ensure policy coherence and efficiency, the same or similar indicators are often present in more than policy – for example, SOC indicators are, among many other things, relevant to carbon sequestration, ecosystem functioning, agriculture, and soil health, and thus are often used in monitoring the implementation of policies that relate to these topics. Concerning these common, cross-policy indicators, it is important to ensure the technical and scientific consistency across policies to aid in the ease, quality, and consistency of reporting of these indicators by Member States (herein referred to as MS), which in turn facilitates the monitoring of the implementation of these policies that are integral to achieving the BDS targets.

The EU Biodiversity Platform Sub-Group on Monitoring & Assessment (EUBP MA) provides advice to the Commission and MS on knowledge-related topics, and supports the coordination between the Commission and the various other stakeholders for implementing and monitoring the BDS. Following on from discussions during the fourth EUBP MA meeting and subsequent additional inputs from members, one of the areas of work for 2024 for the EUBP MA was decided to be the **“harmonisation of monitoring methods across policy areas”** related to the implementation of the BDS¹. Specifically, the description of this task identified a **“need for developing crosswalks across policy areas to facilitate technical and scientific consistency.”** Indicators on deadwood and SOC, used in monitoring climate, nature, agriculture and soil policy implementation were given as specific example indicators for this task and were therefore the chosen indicators for the focus of this work. SOC and deadwood indicators are an appropriate choice for this task given their relevance and inclusion in several different policies relating to the BDS. The Land Use, Land Use Change and Forestry (LULUCF) Regulation was given as an example policy for this task. This task was initially assigned to the EC’s Knowledge Centre for Biodiversity (KCB²).

Deadwood is often defined as all non-living woody biomass in forest ecosystems that is not contained in the litter, whether standing, lying on the ground, or belowground. SOC is the carbon component of soil organic matter, which originates from root exudates, as well as the decomposition of organic matter from plants, animals and microbial organisms. Deadwood therefore serves as one precursor to SOC in the carbon cycle, while also providing habitat for specific taxa, and therefore is an important indicator for forest inventories and biodiversity monitoring. SOC provides a quantifiable measure of stored carbon. The integration of monitoring and reporting of SOC and deadwood is relevant to EU environmental policy because they are both integral components for monitoring relating to the BDS.

As a first step in this task, a scoping investigation is needed, to uncover the linkages, synergies, and differences in reporting requirements for SOC and deadwood indicators across different policies relating to climate, nature, agriculture and soil that have relevance to the BDS. Such a scoping investigation will then allow effective designation of resources to further work on this task, for example through, as suggested in the EUBP MA work plan for 2024, setting up “*ad hoc* technical

¹ See task A.3 in the EUBP-MA work plan: <https://circabc.europa.eu/ui/group/03c84fa2-7896-4cb9-b743-11646b4daf0e/library/0b58b805-8e69-460b-85d7-d131ab68f407/details>

² https://knowledge4policy.ec.europa.eu/biodiversity_en

groups with the objective to work on a detailed technical overview of specific methods used, or in clarifying reporting requirements or methodologies within policies”, or further investigations comparing the actual data reported under multiple regulations.

As such, this report presents a scoping investigation on the communalities and differences in reporting requirements on SOC and deadwood indicators across the following policies:

- The Land Use, Land Use Change and Forestry Regulation, herein referred to as the ‘LULUCF Regulation’
- The Regulation on nature restoration, herein referred to as the ‘Nature Restoration Regulation’ (NRR)
- The Directive on Soil Monitoring and Resilience, herein referred to as the ‘Soil Monitoring Law’
- The Regulation to amend the European environmental economic accounts Regulation, herein referred to as the ‘new environmental economic accounts modules’
- The Common Agricultural Policy (CAP)
- The Regulation establishing a Union certification framework for carbon removals, Carbon Removals and Carbon Farming Regulation, herein also referred to as the ‘Carbon Removal Certification’
- The EU Strategy on adaptation to climate change, herein referred to as the ‘Climate Adaptation Strategy’
- The Regulation establishing the framework for achieving climate neutrality, herein referred to as the ‘European Climate Law’

This report first provides information on the reporting requirements on SOC and deadwood for each of the eight policies, giving information on additional, explicit cross-policy references from within the policy documentation, and including also some open questions from this investigation. This report then examines and illustrates the linkages, synergies and differences in the reporting requirements of deadwood and SOC indicators across these eight policies. After that, we provide some examples of potential implications of MS’ chosen methodological details for adherence to reporting requirements on SOC and deadwood indicators. Finally, we conclude with a summary of the main findings and recommendations for future analyses.

2 Reporting requirements on SOC and deadwood

By consulting the legal texts, guidance and implementation documentation of each of the eight aforementioned policies, information was extracted on:

- The SOC and deadwood indicators mentioned, their definitions, and the land categories in which to report each of these indicators.
- The methodology to be used for calculating these indicators and the units in which to report them.
- The timeframes and frequency of reporting for these indicators.

Five of the policies investigated generate new data *reported by the MS themselves*, while the other four policies refer to data generated by other policies or data not reported by the MS themselves. In this section, the policies for which new data is generated for reporting by MS or other new data sources have their information displayed in tables, whereas those that instead refer only to data being generated in from other policies are discussed without the use of tables.

PART 1: Regulations that generate new data reported by the Member States

2.1 Land Use, Land Use Change and Forestry Regulation

The LULUCF Regulation (EU) 2018/841³ sets out the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework. The Regulation was amended most recently by Regulation (EU) 2023/839⁴ regarding the scope, simplifying the reporting and compliance rules, and setting out the targets of the MS for 2030 and the overall Union target of net greenhouse gas removals in the LULUCF sector to 310 million tonnes of CO₂ equivalent in 2030 (corresponding to an increase of 42 MtCO₂eq in net removals compared to the average levels in 2016–2018).

2.1.1 Indicators, definitions and land categories

The LULUCF Regulation requires reporting on the change in carbon stock (i.e. emissions and removals) of five carbon pools related to the indicators deadwood and SOC: organic soils, mineral soils, deadwood, litter, and soil organic matter. Specific combinations of these carbon pools are required to be reported on for specific land categories. The LULUCF Regulation itself does not give any definitions of these carbon pools. Instead, article 2 of Regulation 2023/839 states that

³ Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU. OJ L 156 19.6.2018, p. 1, <http://data.europa.eu/eli/reg/2018/841/2023-05-11>

⁴ Regulation (EU) 2023/839 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/841 as regards the scope, simplifying the reporting and compliance rules, and setting out the targets of the Member States for 2030, and Regulation (EU) 2018/1999 as regards improvement in monitoring, reporting, tracking of progress and review. OJ L 107, 21.4.2023, p. 1–28, <http://data.europa.eu/eli/reg/2023/839/oj>

greenhouse gases should be reported pursuant to Article 26(4) of Regulation (EU) 2018/1999⁵. This article requires national inventories and a Union greenhouse gas inventory to be submitted to the UNFCCC Secretariat. Annex V part 3 of Regulation 2018/1999 details the methodologies for monitoring and reporting in the LULUCF sector, stating that the 2006 IPCC guidelines for national GHG inventories (IPCC 2006) should be used. Definitions of carbon pools are given in table 1.1 of Volume 4 Chapter 1 of the IPCC 2006 guidelines. Table 1a summarises the definitions (taken from the IPCC 2006 guidelines) and land categories for reporting the indicators in each of these five pools according to the amendment in Regulation 2023/839.

Table 1a. SOC and deadwood indicators, their definitions, and the land categories that they must be reported for, for the LULUCF Regulation.

INDICATOR	INDICATOR DEFINITION (definitions of the carbon pools from IPCC 2006)	LAND CATEGORIES
(Change in carbon stock in the carbon pool) organic soils ⁽¹⁾	IPCC 2006 does not give a definition of this specific indicator. The information given is 'C stocks in organic soils can be estimated in a Tier 3 method that can be selected by the MS (see Annex 1 of this report for a brief description of the tiered methodology in the IPCC 2006 guidelines). Definition of organic soils for classification purposes is provided'. Organic soils are identified on the basis of FAO 2006 (see Annex 2 of this report for details).	All of the land categories stated in Article 2 of LULUCF Regulation 2023/839: Afforested land Deforested land Managed cropland Managed grassland Managed forest land Managed wetland ⁽³⁾
(Change in carbon stock in the carbon pool) mineral soils ⁽¹⁾	IPCC 2006 does not provide a definition of this specific indicator; a definition is given only for 'soil organic matter': - Organic carbon in mineral soils to a specified depth chosen by the country. - Live and dead fine roots and dead organic matter (DOM) within the soil, that are less than the minimum diameter limit (suggested 2 mm) for roots and DOM, are included with soil organic matter where they cannot be distinguished from it empirically. - The default for soil depth is 30 cm but guidance on calculating country-specific depths is given. Mineral soils are defined as all soils that do not meet the criteria (Annex 2) for classification as organic soils.	All of the land use categories stated in Article 2 of LULUCF Regulation 2023/839 (as listed above)
(Change in carbon stock in the carbon pool) deadwood ⁽²⁾	Includes all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Deadwood includes wood lying on the surface, dead roots, and stumps, larger than or equal to 10 cm in diameter (or the diameter specified by the country).	Afforested Land and Managed Forest Land only

⁵ Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council. OJ L 328, 21.12.2018, p. 1-77. <http://data.europa.eu/eli/reg/2018/1999/oj>

(Change in carbon stock in the carbon pool) litter ⁽²⁾	Includes all non-living biomass with a size greater than the limit for soil organic matter (suggested 2 mm) and less than the minimum diameter chosen for deadwood (e.g. 10 cm), lying dead, in various states of decomposition above or within the mineral or organic soil. This includes the litter layer as usually defined in soil typologies. Live fine roots above the mineral or organic soil (of less than the minimum diameter limit chosen for below-ground biomass) are included in litter where they cannot be distinguished from it empirically	Afforested Land and Managed Forest Land only
(Change in carbon stock in the carbon pool) dead organic matter ⁽²⁾	Deadwood and litter	Deforested Land, Managed Cropland, Managed Grassland and Managed Wetland only ⁽³⁾

(1) Before the regulation was updated, this was just 'soil organic carbon'

(2) Before the regulation was updated, this was just 'deadwood' and 'litter' in all land use categories

(3) Only where a MS has notified the Commission that they will include the land category 'managed wetland' in their greenhouse gas inventory

Source: Own elaboration

2.1.2 Units and methodologies

The LULUCF Regulation states that the greenhouse gases should be reported pursuant to Article 26(4) of Regulation (EU) 2018/1999. This Regulation gives the information on compiling the greenhouse gas inventories for monitoring and reporting in the LULUCF sector (Annex V part 3), which consists of the following:

- Geographically explicit land-use conversion data in accordance with the 2006 IPCC Guidelines for national GHG inventories.
- Tier 1 methodology in accordance with the 2006 IPCC guidelines for national GHG inventories.
- At least tier 2 methodology in accordance with the 2006 IPCC guidelines for national GHG inventories for emissions and removals for a carbon pool that accounts for at least 25-30 % of emissions or removals in a source or sink category which is prioritised within a MS's national inventory system. This category will have been prioritised by a MS's national inventory system because its estimate has a significant influence on a country's total inventory of GHGs in terms of the absolute level of emissions and removals, the trend in emissions and removals, or the uncertainty in emissions and removals in the land-use categories.
- MS are encouraged to apply Tier 3 methodology, in accordance with the 2006 IPCC guidelines for national GHG inventories.

The 2006 IPCC guidelines for national GHG inventories relevant to LULUCF is Volume 4: Agriculture, Forestry and Other Land Use. The relevant information from these IPCC guidelines on the units and methodologies for MS reporting for the LULUCF Regulation on the indicators relating to SOC and deadwood is shown in Table 1b. It must be noted that LULUCF needs regular validation of the emission factors which requires field sampling.

Table 2b. The units and methodologies for the SOC and deadwood indicators of the LULUCF Regulation.

INDICATOR	UNITS TO BE REPORTED IN	METHODOLOGY
All indicators relating to SOC and deadwood. I.e. change in organic carbon stock in: - deadwood - litter - dead organic matter - organic soils - mineral soils	tonnes C	2006 IPCC guidance. Three tiers of methodology guidance given (see Annex 1 for a brief description of the tiered methodology in the IPCC 2006 guidelines). Tier 1 methodology is acceptable for source/sink category that is not a key category. At least Tier 2 methodology required for key source/sink categories

Source: Own elaboration

2.1.3 Timeframes and frequency of reporting

The reporting obligations of the updated LULUCF Regulation include emissions and removals of the greenhouse gases listed in Section A of Annex I to this Regulation, reported pursuant to the requirements of Article 26(3) and 26(4) of Regulation (EU) 2018/1999. The LULUCF Regulation itself specifies that in 2027 and 2032, MS must submit to the Commission a compliance report, based on annual datasets, containing the balance of total emissions and total removals for the relevant period on each of the land accounting categories specified. The details on timeframes and frequency of this reporting is given in **Table 1c** and displayed in **Figure 3** (alongside the information from the other Regulations for which new data is reported by MS themselves).

Table 1c. The timeframes and frequencies of reporting for the SOC and deadwood indicators of the LULUCF Regulation.

INDICATOR	TIMEFRAMES AND FREQUENCY OF REPORTING
All indicators relating to SOC and deadwood (i.e. carbon stock in: deadwood litter dead organic matter organic soils mineral soils)	2021: 31st July 2021: <i>approximated</i> GHG inventories for the previous year reported by MS to the Commission. Annual reporting thereafter (always for the previous year). 2023: - By 15th March: GHG inventory data reported by MS to the Commission for the year X-2 (e.g. for the year 2021 submitted in 2023). Annual reporting thereafter. - By 15th April: GHG inventory data reported by MS to the UNFCCC Secretariat for the year X-2 (e.g. for the year 2021 submitted in 2023). Annual reporting thereafter. 2027: - By 15th January, MS submit to the Commission their <i>preliminary</i> GHG inventory data for their LULUCF compliance report (see main text for details) for the period from 2021-2025. - By 15th March, MS submit to the Commission their GHG inventory data comprising their LULUCF compliance report (see main text for details) for the period from 2021-2025. 2032: - By 15th January, MS submit to the Commission their <i>preliminary</i> GHG inventory data for their LULUCF compliance report (see main text for details) for the period from 2026-2030.

INDICATOR	TIMEFRAMES AND FREQUENCY OF REPORTING
	By 15th March, MS submit to the Commission the GHG inventory data comprising their LULUCF compliance report (see main text for details) for the period from 2026-2030.

Source: Own elaboration

2.2 Nature Restoration Regulation

The Commission presented a proposal for a Nature Restoration Regulation (NRR) on 22nd June 2022, as one of the flagship initiatives from the BDS. BDS called for an ambitious EU nature restoration plan based on ‘a proposal for legally binding EU nature restoration targets to restore degraded ecosystems, in particular those with the most potential to capture and store carbon, and to prevent and reduce the impact of natural disasters’. The proposal was iteratively negotiated and amended by the Commission, the Parliament and the Council, until its adoption on 17th June 2024.

The Regulation on nature restoration⁶ combines an overarching restoration objective for the long-term recovery of nature in the EU’s land and sea areas with binding restoration targets for specific habitats and species. Restoration measures should cover at least 20% of the EU’s land and sea areas by 2030, and ultimately all ecosystems in need of restoration by 2050. MS are expected to submit their National Restoration Plans by mid-2026, showing how they will deliver on the targets.

2.2.1 Indicators, definitions and land categories

The NRR requires reporting on various indicators relating to SOC and deadwood for ‘*agricultural ecosystems*’ and ‘*forest ecosystems*’. For the indicators for agricultural ecosystems, MS must put in place measures which aim to achieve an increasing trend in at least two out of three indicators (of which the SOC indicator detailed in **table 2a** is one). For the indicators for forest ecosystems, MS must put in place measures which aim to achieve an increasing trend in at least six out of seven indicators of which the SOC and deadwood indicators detailed in **table 2a** represent three such indicators. The definitions and scope of these indicators are slightly different, depending on whether they are being reported for agricultural or forest ecosystems. This information (from Annex IV for agricultural ecosystems, and from Annex VI for forest ecosystems) is detailed in **Table 2a**.

Table 2a. SOC and deadwood indicators, their definitions, and the land categories that they must be reported for, for the NRR.

INDICATOR	INDICATOR DEFINITION	LAND CATEGORIES
Stock of organic carbon in cropland mineral soils	The stock of organic carbon in cropland mineral soils at a depth of 0 to 30 cm.	Agricultural ecosystems

⁶ Regulation (EU) 2024/1991 of the European Parliament and of the Council of 24 June 2024 on nature restoration and amending Regulation (EU) 2022/869. OJ L 2024/1991. <https://eur-lex.europa.eu/eli/reg/2024/1991/oj>

Stock of organic carbon	The stock of organic carbon in the litter and in the mineral soil at a depth of 0 to 30 cm in forest ecosystems	Forest ecosystems
Standing deadwood	The amount of non-living standing woody biomass in forest and other wooded land.	Forest ecosystems
Lying deadwood	The amount of non-living woody biomass lying on the ground in forest and other wooded land.	Forest ecosystems

Source: Own elaboration

2.2.1.1 Uncertainties

- In the NRR, when referring to reporting the volume of deadwood, it would be beneficial to seek clarification on the meaning and scope of ‘taking into account the methodology as set out in Annex V of Regulation 2018/1999 in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories’ and ‘monitored in a manner consistent with the monitoring required under Regulations (EU) 2018/841’. Both for the deadwood and SOC indicators, the IPCC 2006 methods and Regulation 2018/841 (LULUCF) refer to changes in carbon stock, rather than volume (for deadwood) or stock in absolute values (for SOC) as in NRR. However, deadwood indicators for the NRR will be provided by the national forest inventories.
- Linked to the uncertainty in the bullet point above, it is not clear whether or not this clause means that MS have to use the IPCC 2006 land use categories (aggregated up into the NRR ‘agricultural ecosystems’ and ‘forest ecosystems’). Land use categories in IPCC 2006 guidelines come with specific emissions factors and other parameters and thus it may be deemed that this clause requires the same land categories to be used in order to monitor indicators in a manner consistent with IPCC 2006 guidelines. For example, in the IPCC 2006 guidelines, when a land use category changes to a different type (e.g. a forest converted to cropland), the MS must put this land into a conversion category (i.e. ‘forest converted to cropland’) rather than the remaining category it was originally in (i.e. ‘forest remaining forest’). They then must use the emissions factors associated with this conversion category. Only after 20 years of this land being the ‘new’ land type (cropland in this case) can the land be changed back to a remaining category (i.e. in this case cropland remaining cropland), and then the emissions factors for this remaining category can be used. DG Environment and the JRC are carrying out ongoing work preparing guidelines material to MS which could include clarification on this.

2.2.2 Units and methodologies

The NRR gives information on the methodology to be used to calculate the indicators related to SOC and deadwood in Annexes IV and VI. This information is detailed in **Table 2b**. Different indicators that have the same methodology are presented in the same row, separated the word ‘AND’.

Table 2b. The units and methodologies for the SOC and deadwood indicators of the NRR.

INDICATOR	UNITS TO BE REPORTED IN	METHODOLOGY
Stock of organic carbon in cropland mineral soils	tonnes organic carbon/ha	2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Stock of or-ganic carbon (in litter and mineral soil of forest eco-systems)		Land use types to be determined using: Land Use and Coverage Area frame Survey (LUCAS) Soil (Jones <i>et al.</i> , 2021).
Lying deadwood AND Standing deadwood	m ³ /ha	FOREST EUROPE (2020) and the description of national forest inventories in Tomppo <i>et al.</i> , (2010), <i>taking into account the methodology as set out in Annex V of Regulation 2018/1999 in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.</i>

Source: Own elaboration

2.2.3 Timeframes and frequency of reporting

The NRR specifies the timeframes and frequency of monitoring, measurement of trends and reporting. The various indicators shall be monitored in line with Article 20 and their trend shall be measured according with Article 11 (Restoration of Agricultural Ecosystems) and Article 12 (Restoration of forest ecosystems). Finally, Article 21(2) indicates the way of reporting. The information about measurement and reporting is detailed in **Table 2c** and displayed in **Figure 3** (alongside the information from the other Regulations for which new data is reported by MS themselves). MS must submit their overall National Restoration Plans by mid-2026.

Table 2c. The timeframes and frequencies of reporting for the SOC and deadwood indicators of the NRR. Different indicators that have the same timeframes and frequency of reporting are presented in the same row, separated the word ‘AND’.

INDICATOR	TIMEFRAMES AND FREQUENCY OF REPORTING
Stock of organic carbon in cropland mineral soils AND Stock of organic carbon (in litter and mineral soil of forest ecosystems) AND Standing deadwood AND Lying deadwood	The trend of the indicators at national level should be <i>measured</i> ‘in the period from 18 August 2024 until 31 December 2030, and every six years thereafter’. MS shall <i>report</i> electronically those data and information to the Commission by 30 June 2031 (for the period up to 2030) and at least every six years thereafter.

Source: Own elaboration

2.2.4 Additional, explicit cross-policy references within the NRR policy document

2.2.4.1 NRR - LULUCF

Article 17(6) of the NRR states that, “Member States shall ensure that the indicators for agricultural ecosystems referred to in Article 11(2), point (b), and the indicators for forest ecosystems referred to in Article 12(3), points (a), (b) and (e), of this Regulation, are monitored in a manner consistent with the monitoring required under Regulations (EU) 2018/841 [the LULUCF Regulation] and (EU) 2018/1999 [the regulation that states how the indicators in the LULUCF (and in other Regulations) should be reported]”. This article emanates some of the uncertainties presented above.

2.3 Soil Monitoring Law

On 5th July 2023, the Commission proposed a Soil Monitoring Law to protect and restore soils and ensure that they are used sustainably. It is a key deliverable of the EU soil strategy for 2030 and, ultimately, of the BDS. The Soil Monitoring Law provides a legal framework to achieve healthy soils by 2050 by putting a monitoring framework in place, by requiring MS to support farmers and soil managers to improve soil health and resilience, and by requesting that MS identify potentially contaminated sites and address the unacceptable risks to human and environmental health in these sites. The Law entered in to force on 16 December 2025⁷. However, the analysis of this report was based on the Commission proposal.

The loss of soil organic carbon is one of the soil degradation aspects that this law will address (cfr. Annex I of the proposal).

⁷ <https://eur-lex.europa.eu/eli/dir/2025/2360/oj>

2.3.1 Indicators, definitions and land categories

The Soil Monitoring Law does not mention deadwood. SOC concentration is listed as an indicator in this Directive (one of the ‘soil descriptors’ listed in Annex I). For the criteria for healthy condition of organic soils, the proposal makes cross-reference to the restoration targets of the NRR. For mineral soils, an additional indicator, the SOC/clay ratio should be above 1/13, with the possibility for MS to correct for specific pedo-climatic conditions. MS must also set an operational trigger value (OTV), below which MS should set in motion support to achieve soil health and soil resilience. The Soil Monitoring Law also refer to *carbon stocks* (as is specified for the LULUCF Regulation and the NRR) above a “minimum value” by soil texture where non-binding sustainable target values (STV) and OTVs are established by MS. An optional soil descriptor is SOC concentrations, which can be used to calculate stocks. This is detailed in **Table 3a**.

Carbon concentration is actually a necessary parameter for estimating soil carbon stocks:

Carbon stock (tonnes) = Carbon concentration (g kg⁻¹) x Bulk Density (tonnes m⁻³) x Volume of soil (m³)

Table 3a. SOC indicators, their definitions, and the land categories that must be reported for the Soil Monitoring Law proposal.

INDICATOR	INDICATOR DEFINITION	LAND CATEGORIES
Soil organic carbon <i>concentration</i>	Concentration of organic carbon in soil up to a depth of 30cm	The Soil Monitoring Law covers all soils in the EU. MS must establish soil districts and units throughout their territory and monitor soil health, soil sealing and soil removal in each soil district.

Source: Own elaboration

In principle, when establishing their soil units, MS should aim for homogeneity of the following:

- soil type as defined in the map of Soil Regions of the EU and Adjacent Countries (i.e. World Reference Base for Soil Resources 1996);
- land cover as referred to in LULUCF Regulation.

MS may also take into account additional spatial data to establish their soil units, such as climate or environmental zones.

2.3.2 Units and methodologies

The Soil Monitoring Law specifies the unit of the indicator in part A and B of Annex I, and the methodology for the measurement of the SOC indicator in Part B of Annex II. The information is detailed in **Table 3b**.

Table 3b. The units and methodologies for the SOC indicators of the Soil Monitoring Law proposal.

INDICATOR	UNITS TO BE REPORTED IN	METHODOLOGY
Soil organic carbon <i>concentration</i>	g per kg	MS must take soil samples at specific sampling points (see Annex 3 of this report for how MS must determine their sampling points) and collect, process and analyse the data to determine the value of soil organic carbon concentration.

		Methodology for calculating soil organic carbon concentration: ISO 10694 and ISO 10693 (see Reference list).
SOC stocks	tC ha ⁻¹	Methodology as set out in Annex V to Regulation (EU) 2018/1999 in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Forest floor	Not defined	Forest floor shall be subdivided into litter and organic layers shall be sampled separately and their thickness and weight recorded.

Source: Own elaboration

2.3.3 Timeframes and frequency of reporting

Article 8 of the Soil Monitoring Law proposal specifies the timeframe and frequency to perform the soil measurements and soil health assessments and, thus, to monitor the SOC indicator. Information is detailed in **Table 3c** and displayed in **Figure 3** (alongside the information from the other Regulations). One year after performing the soil measurements, MS are expected to assess the soil health (comparing values of soil descriptors to criteria for healthy soils) (Article 10), and 6 months later, MS shall electronically report the data and results of the soil health monitoring and assessment (which includes the SOC indicator), and the trend analysis of the soil health descriptors (of which the SOC indicator is one) to the Commission and the EEA (Article 19). The frequency of this exercise is a six-year cycle. Following entry into force in 2025, the indicator on SOC concentration will be measured for the first time by 2030, assessed by 2031, and reported digitally (together with the soil health assessment) 6 months later, and for all new cycles, every 6 years thereafter.

Table 3c. The timeframes and frequencies of reporting for the SOC indicators of the Soil Monitoring Law proposal.

INDICATOR	TIMEFRAMES AND FREQUENCY OF REPORTING
Soil organic carbon concentration	Carrying out soil measurements: the cycle for the collection of soil data shall, to the extent that those data are available, start on 16 December 2024, and new measurements performed at least every 6 years (Article 9). Carrying out soil health assessments (i.e. comparing SOC concentration values to criteria of healthy soils): 6 years after entry into force of the Directive, and at least every 6 years (Article 10). Electronic reporting of information on the SOC indicator (data and results of monitoring and assessment of soil health (and trend in soil health with regard to SOC) to the Commission and to the European Environment Agency (EEA): 6 years and 6 months after entry into force of the Directive, and every 6 years thereafter.

Source: Own elaboration

2.3.4 Additional, explicit cross-policy references within the Soil Monitoring Law policy document

2.3.4.1 Soil Monitoring Law - LULUCF

The Soil Monitoring Law states that, "Member States shall analyse the values of soil sealing and soil removal indicators listed in part D of Annex I and assess their impact on the loss of ecosystem services and on the objectives and targets established under Regulation (EU) 2018/841 [LULUCF]."

When defining the un/sustainable soil management practices and measures, MS should take into account and identify synergies with the targets set out under the LULUCF Regulation (listed in Annex IV). The LULUCF Regulation moreover requires that MS set up systems to monitor soil carbon stocks, with the expectation of enhanced implementation of nature-based climate mitigation in soils. Thus, LULUCF and the Soil Monitoring Law are mutually reinforcing.

2.3.4.2 Soil Monitoring Law – Carbon Removal Certification

The Soil Monitoring Law states that, "...creating soil units... and generating the related data and knowledge will facilitate implementation of the carbon removal certification". Regenerating soil to good health is instrumental in increasing its capacity to absorb and store carbon and to generate carbon removal credits.

2.3.4.3 Soil Monitoring Law – NRR

For the criteria for healthy condition of organic soils, the Soil Monitoring Law proposal makes cross-reference to the restoration targets of the NRR for consistency reasons and to avoid duplication. MS should take into account and identify synergies with the nature restoration plans (listed in Annex IV). The monitoring and assessment data, should also inform the development of the national restoration plans. For example, MS can use the information collected for the Soil Monitoring Law to report under the NRR about SOC aspects on croplands and forest land.

2.4 New environmental economic accounts modules

The original European environmental economic accounts Regulation⁸ establishes an information framework to easily compare environmental economic accounts across EU countries, through understandable and accessible environment-related data. The ultimate goal is to capture the sustainability aspects of our economy in a way that national accounts, which underpin GDP, take account of environmental aspects in production, consumption, investment or financing.

On 11th July 2022, the Commission tabled a proposal⁹ to amend the original Environmental economic accounts Regulation. The final regulation, (EU) 2024/3024, was subsequently published in the Official Journal on 6 December 2024, following agreement by the Parliament and Council¹⁰. This amendment introduces three new accounts' modules:

- A module for forest accounts
- *A module for ecosystem accounts*
- A module for environmental subsidies and similar transfers accounts

⁸ Regulation (EU) No 691/2011 of the European Parliament and of the Council of 6 July 2011 on European environmental economic accounts. OJ L 192, p. 1-16. <http://data.europa.eu/eli/reg/2011/691/oj>

⁹ Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) No 691/2011 as regards introducing new environmental economic accounts modules. COM/2022/329 final. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022PC0329&qid=1728731093385>.

¹⁰ Regulation (EU) 2024/3024 of the European Parliament and of the Council of 27 November 2024 amending Regulation (EU) No 691/2011 as regards introducing new environmental economic account modules. OJ L, 2024/3024. <http://data.europa.eu/eli/reg/2024/3024/oj>

2.4.1 Indicators, definitions and land categories

Ecosystem accounts should present data on the extent and condition of ecosystem assets and the services they provide to society and the economy. The new module on ecosystem accounts includes a SOC and a deadwood indicator, as characteristics of ecosystem condition, for which there is obligatory reporting. The information is detailed in **Table 4a**.

Table 4a. SOC and deadwood indicators, their definitions, and the land categories that they must be reported for, for the new environmental economic accounts modules.

INDICATOR	INDICATOR DEFINITION	LAND CATEGORIES
Soil organic carbon stock in topsoil	No definition given in the Regulation	Cropland and grassland (reported separately)
Deadwood	No definition given in the Regulation	Forest and woodland (as a single land category)

Source: Own elaboration

2.4.1.1 Uncertainties

- In the amendment to the European Environmental Economic Accounts Regulation, which added the indicator ‘soil organic carbon stock in topsoil’, it seems that neither the definition of ‘topsoil’ nor the methodology for calculating topsoil carbon stock are specified yet.
- In the amendment to the European Environmental Economic Accounts Regulation, which added the indicator ‘deadwood’, it seems that neither the definition of ‘deadwood’ nor the methodology for calculating its volume are specified yet.
- The wording of the SOC indicator (to be reported in cropland and grassland) implies that this is not referring to carbon stock change as in the LULUCF Regulation, but rather absolute carbon stock (which in any case is the basis for calculating the stock change). The wording is as follows: “soil organic carbon stock in topsoil shall be reported in tonne/ha, as a national average for the reporting period”. However, since the methodology for calculating this SOC indicator are not given in the recent amendment to the Environmental Economic Accounts Regulation, it is not completely clear whether this is the case.
- It would be beneficial to seek clarification on whether the ‘forest and woodland’ in the Environmental Economic Accounts Regulation differ (in definition, scope, etc.) from ‘forest ecosystems’ in NRR or ‘afforested Land’ and ‘managed Forest Land’ in the LULUCF Regulation.
- It would be beneficial to seek clarification on whether the ‘cropland’ and ‘grassland’ land categories in the Environmental Economic Accounts Regulation differ (in definition, scope, etc.) from ‘managed cropland’ and ‘managed grassland’ in the LULUCF Regulation, and how these overlap with the ‘agricultural ecosystems’ of the NRR.

2.4.2 Units and methodologies

The new modules for European environmental economic accounts specifies the units for reporting of these indicators relating to SOC and deadwood (section 3 of Annex IX), but does not specify the methodology to be used (**Table 4b**).

Table 4b. The units and methodologies for the SOC and deadwood indicators of the new environmental economic accounts modules.

INDICATOR	UNITS TO BE REPORTED IN	METHODOLOGY
Soil organic carbon stock in topsoil	tonnes/ha	Not specified in the Regulation
Deadwood	m ³ /ha	Not specified in the Regulation

Source: Own elaboration

2.4.3 Timeframes and frequency of reporting

In section 4 of Annex IX, this document sets out the timeframes and frequency of the indicators relating to SOC and deadwood (**Table 4c** and displayed in **Figure 3** alongside the information from the other Regulations for which new data is reported by MS themselves).

Table 4c. The timeframes and frequencies of reporting for the SOC and deadwood indicators of the new environmental economic accounts modules. Different indicators that have the same timeframes and frequency of reporting are presented in the same row, separated the word 'AND'.

INDICATOR	TIMEFRAMES AND FREQUENCY OF REPORTING
Soil organic carbon stock in topsoil AND Deadwood	Within 24 months of the end of 2024 and every 3 years: data on the SOC and deadwood indicators, as a national average for the reporting year. This seems only possible using the LULUCF approach or modelling. For the first data submission, the data is reported for 2024 (the 'reference year'). For subsequent submissions, data must be provided for the reference year, and for the year 3 years before the reference year. MS may (optionally) provide data for the years preceding 2024 if they have this data. MS must resubmit data from 2024 onwards whenever the data are revised.

Source: Own elaboration

PART 2: Regulations that do not require new data reported by Member States

2.5 The Common Agricultural Policy

The reformed CAP¹¹, applied in full since January 2023, aims to ensure a sustainable future for European farmers, provide more targeted support to smaller farms, and allow greater flexibility for EU countries to adapt measures to local conditions. While each country is free to choose the specific interventions it considers most effective to meet its specific objectives, a clear strategic planning (CAP Strategic Plans) and a common set of result and impact indicators agreed at EU level are established.

In particular, Regulation (EU) 2021/2115¹² sets the rules of such Strategic Plans. The Plans are designed to make a significant contribution to the ambitions of the European Green Deal, and Biodiversity Strategy. Regulation (EU) 2021/2115 gives information in Annex I about impact, result, output and context indicators pursuant to Article 7 (which discusses the indicators used to evaluate achievement of the objectives of the CAP). Some of these objectives relate to climate, sustainable use of natural resources and protection of biodiversity. The indicators are part of the new CAP performance, monitoring and evaluation framework.

2.5.1 Indicators, definitions and land categories

An indicator on SOC is explicitly mentioned in the CAP impact indicator I.11: Soil organic carbon in agricultural land. This is actually equivalent to the CAP context indicator C.41 “Soil organic matter in arable land”. Deadwood is not mentioned in the CAP monitoring framework. The information is detailed in **Table 5a**.

Table 5a. The SOC indicator, its definition, and the land categories that it must be reported for, for the CAP. Deadwood is not mentioned in the CAP monitoring framework.

INDICATOR	INDICATOR DEFINITION	LAND CATEGORIES
Soil organic carbon in agricultural land	The indicator estimates the total organic carbon content in agricultural land (just in topsoil). The indicator is expressed with 3 sub-indicators of which all three are to be used: 1. Estimate of the total organic carbon content in soils on agricultural land of EU MS (with a breakdown by arable land, grassland and permanent crops) 2. The mean organic carbon content in agricultural land 3. Estimate of SOC changes over time	Agricultural land, in some cases breakdown by arable land, grassland and permanent crops

Source: Own elaboration

¹¹ https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en#cap2023-27

¹² Regulation (EU) 2021/2115 of the European Parliament and of the Council of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under the common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulations (EU) No 1305/2013 and (EU) No 1307/2013, OJ L 435, <http://data.europa.eu/eli/reg/2021/2115/oj>

2.5.2 Units and methodologies

In the case of this SOC indicator, MS do not need to report anything themselves. Instead, the data is collected by LUCAS and the JRC's EU Soil Observatory. The units and methodologies for the CAP I.11 (or C.41) indicator are given in indicator fiches (European Commission, 2024), and the relevant information is detailed in **Table 5b**.

Table 5b. The units and methodologies for the SOC indicator of the CAP. Deadwood is not mentioned in the CAP monitoring framework.

INDICATOR	UNITS TO BE REPORTED IN	METHODOLOGY
Soil organic carbon in agricultural land: 1) Estimate of the total organic carbon content in soils on agricultural land of EU MS 2) The mean organic carbon content in agricultural land 3) Estimate of SOC changes over time	1) megatonnes (Mt) of C 2) g of C / kg 3) %	The methodology is based on the integration of ground data, from the LUCAS soil survey (Jones <i>et al.</i> , 2021), with an advanced modelling framework coupling process-based and machine learning models. The model will also include scenarios on actual implementation of practices which are relevant for SOC accumulation. The data sources are: - High resolution map (100 m) of SOC stock in agricultural soils (JRC) - Stock estimates through time in LUCAS points by a biogeochemical modelling approach - 2018 LUCAS dataset (2022 data in preparation), available in the EU Soil Observatory (JRC)

Source: Own elaboration

LUCAS data of 2022 are being processed. In this new version, topsoil will change from 0-20 cm to 0-30 cm, aligning to the Soil Monitoring Directive, NRR and default LULUCF depth. Also, forest soils will include carbon litter.

2.5.3 Timeframes and frequency of reporting

There is no national reporting by MS required for data on this I.11 (or C.41) CAP indicator on SOC (Table 5c). This is because the data collection for the SOC indicator does not come from MS themselves, and because the annual performance reporting on the implementation of the CAP Strategic Plan to be prepared by MS do not include impact indicators. Article 141 of Regulation (EU) 2021/2115 states that 'Member States shall provide the Commission with the available information necessary to enable it to perform the monitoring and evaluation of the CAP', but this does not include any data provision by MS themselves on this SOC indicator because the data comes from external sources. However, MS can voluntary report on their SOC if they want.

Table 5c. The timeframes and frequencies of reporting for the SOC indicator of the CAP. Deadwood is not mentioned in the CAP monitoring framework.

INDICATOR	TIMEFRAMES AND FREQUENCY OF REPORTING
Soil organic carbon in agricultural land	No <i>national</i> reporting by MS required for data on this indicator, only on a voluntary basis. In principle, there should be at least one value at the beginning of the programming period ('Context', close to 2023) and one value at the end ('Impact', close to 2028).

Source: Own elaboration

2.5.1 Additional, explicit cross-policy references within the CAP policy documents

2.5.1.1 CAP – LULUCF

The CAP impact indicator I.11 on SOC in agricultural land does not refer to the LULUCF Regulation.

However, the CAP impact indicator I.10, 'GHG emissions from agriculture' refers to the LULUCF Regulation. This indicator is composed of seven specific indicators presenting anthropogenic emissions from agriculture and land use, of which specific indicator 3 and 4 refer to LULUCF.

Specific indicator 3 is 'GHG emissions and removals from LULUCF'. The definition of this is: 'Aggregated annual emissions and removals of carbon dioxide (CO₂), and emissions of methane (CH₄) and nitrous oxide (N₂O) from cropland and grassland, reported by Member States under the IPCC Land Use, Land Use Change and Forestry (LULUCF) sector (cropland and grassland from sector 4 (LULUCF)) in the national GHG inventories to the UNFCCC... These emissions and removals are covered by the LULUCF Regulation (Regulation 2018/841), and reporting on these emissions and removals is mandatory under the Governance Regulation (Regulation 2018/1999). The LULUCF categories that are relevant to this indicator are those related to cropland and grassland management, as defined in the Implementing Act accompanying the Governance Regulation.'

Specific indicator 4 is defined as 'GHG emissions from agriculture including cropland and grassland: Sum of GHG emissions from agriculture and GHG emissions and removals from LULUCF for cropland and grassland'.

Regarding these two specific indicators, CAP then gives information about the data source: 'The indicator is based on the annual national inventory submissions to the EU and subsequently the UNFCCC through the Monitoring Mechanism Regulation (Regulation 2018/1999). This reporting framework moreover describes requirements for monitoring and reporting under the Effort Sharing Regulation and LULUCF Regulation, e.g., geospatial data sources for meeting IPCC approach 3 for LULUCF, such as services from the Copernicus programme, IACS/LPIS, LUCAS and others compliant with the INSPIRE directive. The inventory is compiled by each Member State, and then collated and quality-assured by the European EEA and the European Topic Centre for Air Pollution and Climate Change Mitigation.'

Additionally, the references/location of the data for these specific indicators is detailed:

- Annual EU GHG inventory, (year X-2), sector 4 (note that year X-2 refers to the fact that MS annual GHG inventory submissions to the UNFCCC are for two years prior – e.g. the report for 2021 is submitted in 2023).

- CO₂, CH₄ and N₂O emissions from cropland and grassland are reported annually in CRF Tables—EEA, which includes standard reporting table for sector 4 (LULUCF), set out through Arts 26 and 37 of 2018/1999.
- The reporting also has to take into account the MS compliance report as specified in the Article 14 of the LULUCF Regulation. Article 14 of LULUCF: 'By 15 March 2027 for the period from 2021 to 2025, and by 15 March 2032 for the period from 2026 to 2030, Member States shall submit to the Commission a[n annual] compliance report' specifying how they are complying with the objectives of the LULUCF Regulation (including SOC and deadwood indicators).

Therefore, the data from the MS reporting in compliance with the LULUCF Regulation (which takes its reporting details from Regulation 2018/1999) is utilised for this CAP I.10 indicator (and thus the IPCC 2006 methodologies for LULUCF reporting apply for this I.10 indicator). This means that **deadwood indicators are indirectly relevant to the CAP** because the reporting by MS of change in carbon stock in the carbon pool 'dead organic matter' (defined as deadwood + litter) in the LULUCF Regulation for cropland and grassland is used for the I.10 CAP indicator. However, the 'deadwood' carbon pool (and the 'litter' carbon pool) in the LULUCF Regulation is only required to be reported on for forested land, and therefore may not apply to this I.10 CAP indicator.

2.6 Carbon Removals and Carbon Farming Regulation

The EU Carbon Removals and Carbon Farming (CRCF)¹³ set out a voluntary EU-wide framework to certify carbon removals generated in Europe. It sets out criteria to define high-quality carbon removals and the process to monitor, report and verify the authenticity of these removals. The Carbon Removal and Carbon Farming (CRCF) Regulation (EU 2024/3012) entered into force on December 26, 2024. It aims to boost sustainable carbon farming (soil, forests), permanent carbon removals (geological storage), and carbon storage in products.

2.6.1 Indicators, definitions and land categories

Unlike the LULUCF Regulation and the NRR, the reporting of the indicators specified in the CRCF is not an obligation of the MS themselves, but is instead something to be carried out by operators of the carbon removal scheme – for example a farmer or a forest holder. The Regulation outlines the rules for determining whether a carbon removal is eligible for certification under this Regulation. Such carbon removals include those into the biogenic carbon pool, which is defined as, 'above-ground biomass, below-ground biomass, litter, deadwood and soil organic carbon as set out in points (a) to (e) of Part B of Annex I to Regulation 2018/841 [the LULUCF Regulation]'. I.e. the definitions of the indicators relating to SOC and deadwood are taken directly from the information given in the LULUCF Regulation. The Regulation does not specify the land categories for reporting of these indicators, which may mean that the guidance given in the LULUCF Regulation about the specific definition and scope of indicators within the different land categories is to be followed.

¹³ Regulation (EU) 2024/3012 of the European Parliament and of the Council of 27 November 2024 establishing a Union certification framework for permanent carbon removals, carbon farming and carbon storage in products

2.6.2 Units and methodologies

To support the quantification of temporary carbon removals and soil emission reductions generated by a carbon farming activity, the operator or group of operators shall, where feasible, gather data on carbon removals and greenhouse gas emissions based on the use of tier 3 methodologies in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and the refinements to these 2006 IPCC Guidelines, and in a manner compatible with national greenhouse gas inventories under Regulation (EU) 2018/841 and Part 3 of Annex V to Regulation (EU) 2018/1999.

Therefore, the units for the indicators to be reported in are tonnes CO₂eq (the same as for the indicators in the LULUCF Regulation), although the detailed methodology will be detailed in the Delegated Act (currently under open consultation).

2.6.3 Timeframes and frequency of reporting

As stated above, the reporting of the carbon credits (as certified units) specified in the Carbon Removals and Carbon Farming Regulation should be carried out by operators of the carbon removal scheme – for example a farmer or a forest holder. Carbon removal claims will be, ‘regularly monitored, reported and independently verified by certification bodies’.

2.6.4 Additional, explicit cross-policy references within the Carbon Removals and Carbon Farming Regulation policy document

2.6.4.1 Carbon Removal Certification – LULUCF

The Carbon Removals and Carbon Farming Regulation states that, “Under the proposal for amending the Regulation on Land Use, Land Use Change, and Forestry (LULUCF), the European Commission proposed, for the first time, a separate land-based net removals target of -310 million tonnes of CO₂ equivalents by 2030. This (i.e. the Carbon Removals and Carbon Farming Regulation) enables MS to channel more effective and result-based support toward *carbon farming activities* that can contribute to the achievement of this target.”

It is also stated in the Carbon Removal Certification that, “...the importance of enabling a business model that rewards land managers for *carbon sequestration in full respect of ecological principles* (i.e. ‘*carbon farming*’), and of creating an EU internal market for capture, use, storage and transport of CO₂ through innovative technologies. Goal for 2028: carbon farming approaches should contribute to reaching the LULUCF target of -310 Mt CO₂ eq net removals; and industrial technologies should remove annually at least 5 Mt CO₂ eq by 2030.”

2.6.4.2 Carbon Removal Certification – Nature Restoration Regulation

The Carbon Removals and Carbon Farming Regulation states that, “The proposed certification framework for carbon removals will contribute to achieve the restoration targets and fulfil the obligations set out in the NRR. For instance, carbon farming activities that enhance carbon storage can contribute to meeting the obligation to ensure an increasing trend at national level of the stock of organic carbon in forest ecosystems and in cropland mineral soils in agricultural ecosystems... The NRR and the CRCF will therefore reinforce each other, contributing to both climate and biodiversity policies.”

2.7 Climate Adaptation Strategy

This Strategy¹⁴ was adopted by the Commission on 24th February 2021 as part of the European Green Deal action plan. The Strategy aims to make adaptation to climate change smarter, swifter and more systematic, and to step up international action on adaptation to climate change. These objectives are underpinned by 14 actions and the steps to be taken to deliver them.

SOC and deadwood are not explicitly mentioned in this strategy. However, these indicators are relevant to objective number 3: making climate adaptation more systematic. In this systematic approach objective (which is detailed in section 7-11 of the strategy documentation), it states that there are three cross cutting priorities, of which one is nature-based solutions for adaptation. This strategy states that, 'through *carbon farming*, the Commission will promote a new business model for *land-based carbon removals*, including financial incentives to rollout *nature-based solutions*'. This strategy also states that, 'the Commission will propose nature-based solutions for carbon removals including accounting and certification in upcoming carbon farming initiatives'. The 'certification' referred to here is the Carbon Removal Certification. The 'accounting' is likely the greenhouse gas inventory accounting rules and methods specified in other Regulations. The Climate Adaptation Strategy does not explicitly mention itself any indicators, definitions, methods, units or timeframes.

2.8 European Climate Law

This Regulation¹⁵ writes into law one of the main goals established by the European Green Deal, setting out the EU's greenhouse gas emission reduction target of at least 55% in 2030 and a binding objective of climate neutrality in the Union by 2050.

2.8.1 Indicators, definitions and land categories

Indicators on SOC and deadwood are not explicitly mentioned by name in this Regulation. However, via referring to other Regulations, SOC and deadwood indicators are included in the list of indicators for which progress towards the targets stated in this European Climate Law is assessed. Article 6 of the European Climate Law states that "the Commission shall assess, together with the assessment provided for under Article 29(5) of Regulation (EU) 2018/1999 [on the Governance of the Energy Union and Climate Action]: (a) the collective progress made by all Member States towards the achievement of the climate-neutrality objective set out in Article 2(1) of this Regulation". Article 29(5) of Regulation 2018/1999 refer to the Commission assessing whether, according to the greenhouse gas inventory information provided pursuant to the Regulation (2018/1999), the Union and its MS have made sufficient progress towards meeting the 'obligations set out in Article 4 of Regulation 2018/841 [the LULUCF Regulation]'. Regulation 2018/1999 requires MS's reporting on 'their anthropogenic GHG emissions by sources and removals of CO₂ by sinks resulting from LULUCF

¹⁴ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Forging a climate-resilient Europe – the new EU Strategy on Adaptation to Climate Change. COM/2021/82 final. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2021:82:FIN>

¹⁵ Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'). OJ L 243, p. 1-17. <http://data.europa.eu/eli/reg/2021/1119/oj>

[Annex V part 1 (c)]'. Therefore, *the same SOC and deadwood indicators that are specified in the LULUCF Regulation are those that will be assessed for compliance with the European Climate Law*, and so the definitions and land categories of the SOC and deadwood indicators are those in **Table 1a**.

2.8.2 Units and methodologies

The units and methodologies are those specified in Regulation 2018/1999 (Annex V part 3) (which are also those that are referred to in the LULUCF Regulation), and are therefore those specified in the 2006 IPCC guidance, detailed in **Table 1b**.

2.8.3 Timeframes and frequency of reporting

There are no additional reporting timeframes and frequency explicitly stated for MS in the European Climate Law documentation, meaning that for MS, the same timeframes and frequency of reporting referred to in the updated LULUCF Regulation and in Regulation 2018/1999 apply – which are detailed in **Table 1c**.

The European Climate Law Regulation has additional requirements for the Commission: 'by 30 September 2023, and every five years thereafter, the Commission shall assess, together with the assessment provided for under Article 29(5) of Regulation (EU) 2018/1999, the collective progress of MS towards the climate targets and the progress towards climate adaptation outlined in this Regulation'.

Article 29(5) of Regulation 2018/1999 (which is referred to in the European Climate Law– see section 2.5.1) also specifies timeframes and frequency of reporting, stating that, 'the Commission shall assess whether the Union and its MS have made significant progress towards meeting the obligations set out in the LULUCF Regulation, by 31 October 2021 and every year thereafter.'

3 Linkages, synergies and differences in the reporting requirements of deadwood and SOC indicators across the included policies

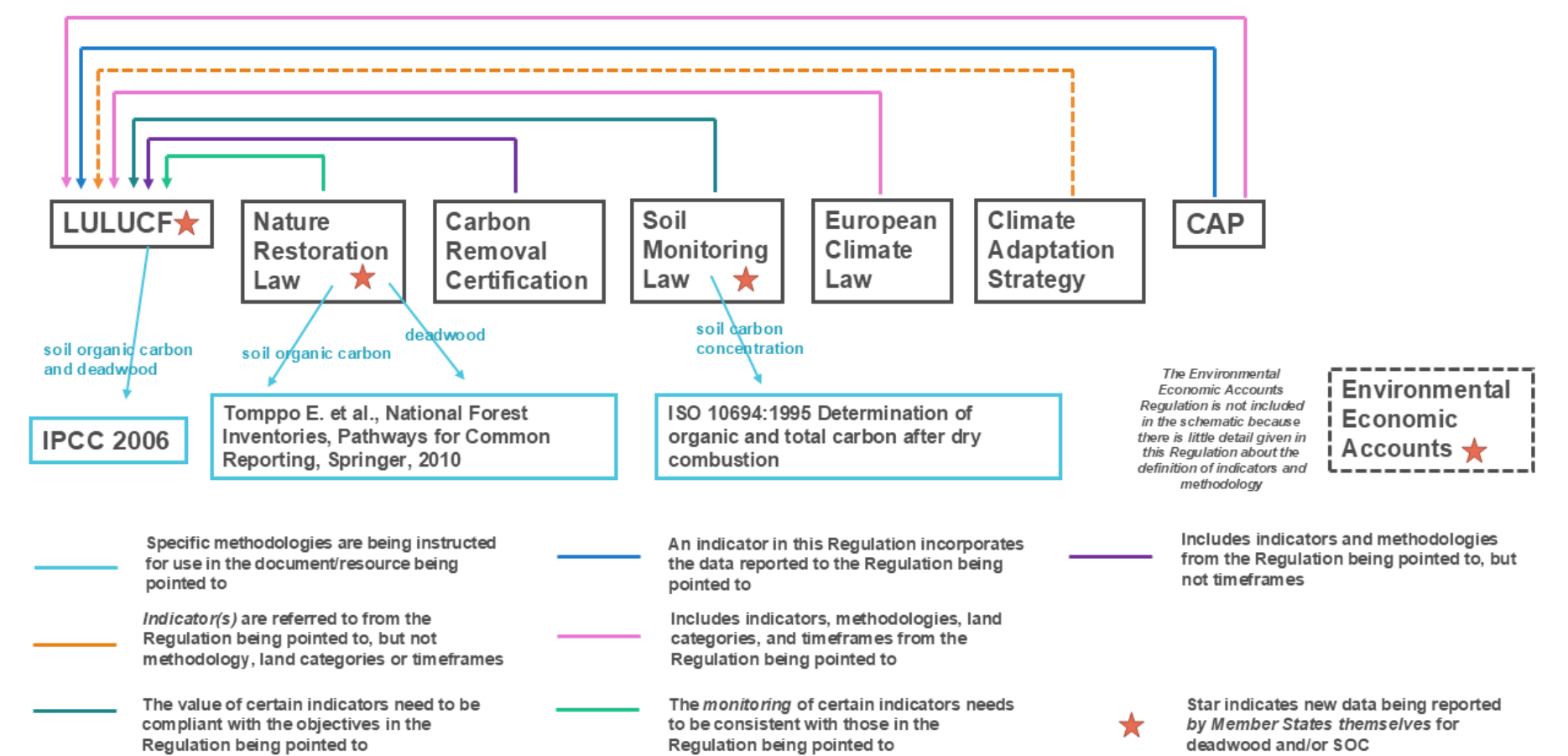
3.1 Linkages between monitoring and reporting across policies

The information extracted about the linkages in monitoring and reporting between different Regulations/frameworks in this report is summarised in **Figure 1**. The main conclusions that can be inferred from this schematic are:

- Each of the policies are linked to at least one of the other policies, but each in a unique way; the way in which the policies are linked is represented by the different colours of lines connecting the policies in **Figure 1**.
- Regarding SOC and deadwood indicators, all of the Regulations covered in this report (apart from the new modules of the Environmental Economic Accounts Regulation which give little detail about the definition of indicators and methodology to be used for their calculation) refer to details in the LULUCF Regulation in some way; the way in which each Regulation refers to LULUCF is detailed by the colour of the lines in **Figure 1**. The policy links include:
 - References to the same indicator(s), methodologies, land categories and/or timeframes of LULUCF
 - Consistency with the objectives and/or the monitoring of LULUCF.
 - Re-use of LULUCF data
 - Expected interoperability of new data with existing databases
- The four included policies that do not generate new data reported by the MS themselves on SOC and deadwood indicators (the Carbon Removals and Carbon Farming Regulation, the European Climate Law, the Climate Adaptation Strategy and the CAP) refer to LULUCF, but to different extents:
 - Three of these policies (Carbon Removal Certification, European Climate Law, and the CAP) refer to the LULUCF Regulation for indicator definitions and for methodologies. The remaining policy (the Climate Adaptation Strategy) potentially refer(s) to LULUCF for indicator definitions, but this is not explicitly clear.
 - Only the European Climate Law and the CAP refer undoubtedly to the land categories and to the timeframes of reporting of the LULUCF Regulation
- The remaining policies in this figure that do generate new data reported by MS themselves on SOC and deadwood indicators (the NRR, the Soil Monitoring Law, excluding the new Environmental Economic Accounts modules because of lack of information given) all link to LULUCF, but again to different extents:
 - The NRR requires that the monitoring of the SOC and deadwood indicators are *monitored in a manner consistent with* the SOC and deadwood indicators in the LULUCF Regulation, which in the end can come from the Soil Monitoring Law and the LUCAS programme.

- The Soil Monitoring Law requires that the values of the 'soil removal and soil sealing indicators' are compliant with the objectives of the LULUCF Regulation (the objectives on net carbon removals in the EU).

Figure 1. Summary of the linkages in monitoring and reporting between different policies in this report. The meaning of the coloured lines is explained in the figure. Stars indicate new data being reported by the MS themselves for SOC and deadwood indicators. The black rectangles represent the policies, and the blue rectangles represent the documents referred to for methodologies. The new Environmental Economic Accounts modules are not included because there is little detail given about the definition of indicators and methodology to be used for their calculation. The dotted orange line indicates uncertainty: SOC and deadwood are not explicitly mentioned in the Climate Adaptation Strategy but they are relevant to objective 3 of this strategy (see Section 2.7).



Source: Own elaboration

3.2 Synergies and differences in reporting across policies

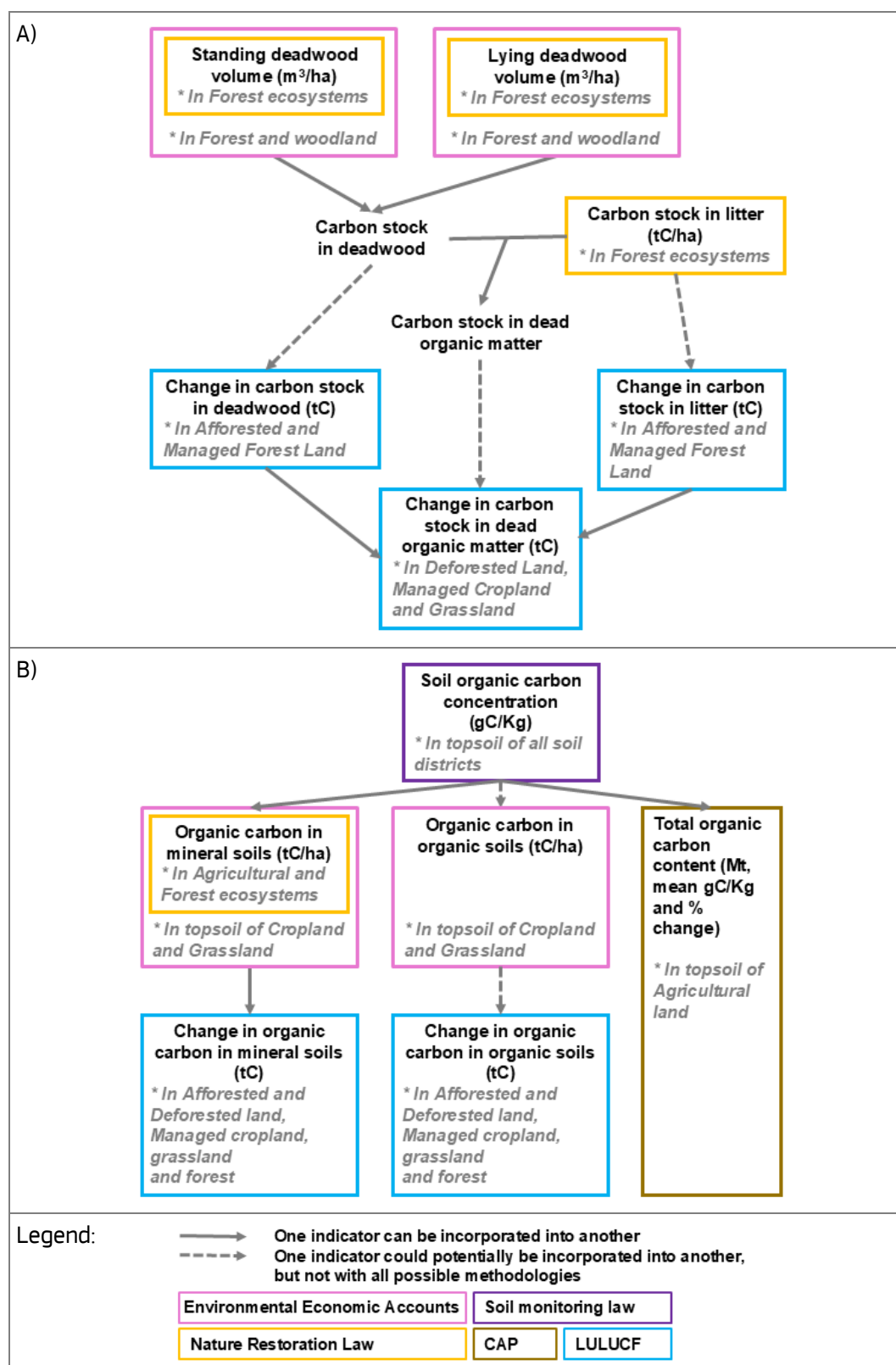
There are both synergies and differences in the reporting of SOC and deadwood indicators across the different policies. **Figure 2** summarises the synergies and differences in the *definitions* and *land use categories* to be reported in, for the SOC and deadwood indicators across the Regulations covered in this report (plus the CAP) that generate new data reported by the MS themselves. The key synergies and differences will now be discussed, structured by specific indicator definition. Additionally, we specifically discuss the re-use of data from existing reporting.

3.2.1 Carbon stock in litter

Figure 2 shows that the indicator absolute carbon stock in litter is only required to be reported for the NRR, while LULUCF requires change in carbon stock in litter. Carbon stock in litter is being measured with the new LUCAS 2022 data and in the SML.

When calculating GHG stock changes in accordance with the IPCC 2006 guidance, there are two types of methods: The 'Stock-Change Method', in which carbon stock values must be known at two points in time to calculate the change, and the 'Gain-Loss Method', which instead uses emission factors per unit hectare, and thus does not require knowledge of absolute carbon stocks. Still, it must be noted that LULUCF needs regular validation of the emission factors which requires field sampling. In LULUCF reporting, the data tables that must be submitted to the UNFCCC and to the Commission only ask for information on stock changes rather than absolute stock values, and hence MS may not always have data on absolute stock values if they use the 'Gain-Loss Method'. In LULUCF reporting, the methodology most commonly used by MS for calculating stock change of mineral soils is the Stock-Change Method, and therefore MS are likely to know the absolute values of carbon stocks in these pools in addition to the final stock change value they must report for LULUCF, meaning that it is indeed the absolute carbon stock value asked for in NRR. However, in LULUCF reporting, the methodology most commonly used by MS for calculating stock change of organic soils is the Gain-Loss method. Therefore, MS may not have already calculated absolute carbon stock values and this could be an additional measurement that MS need to carry out for NRR. Still, the new LUCAS data of 2022 is expected to provide this information.

Figure 2. Summary of the indicators and land categories to be reported in across the policies covered in this report: A) deadwood indicators; B) SOC indicators. Each individual indicator relating to deadwood (A) or SOC (B) has a distinct definition. The colour boxes indicate requirements under the different policies, as explained in the legend. The arrows denote possible links between the indicators



Source: Own elaboration

3.2.2 Change in carbon stock in deadwood, litter and dead organic matter

The LULUCF Regulation requires reporting of change in carbon stock in litter and deadwood (as separate categories) for forested land categories, and reporting of change in carbon stock of dead organic matter (deadwood + litter as one combined category) for non-forest land. As explained in section 2.2.1, LULUCF monitoring may have synergies with the NRR indicator, because if MS use the Stock-Change method for calculating change in carbon stock in litter, then they need to know the absolute carbon stock in litter at time point A and B to calculate the change. However, the deadwood indicators for the NRR are expected to be provided by the national forest inventories.

It is not yet determined the extent to which the land categories in the NRR and LULUCF Regulations overlap, and therefore it is not yet determined how the 'forest ecosystems' for reporting of the carbon stock in litter indicator of the NRR overlaps with the 'afforested land' and 'managed forest land' land use categories for reporting of the stock change in deadwood litter and dead organic matter in the LULUCF Regulation. This is because there are differences in the resolution of the land categories between NRR and LULUCF/IPCC 2006: The categories in NRR are very broad e.g. 'agricultural ecosystems', whereas in the LULUCF Regulation and in the 2006 IPCC methods, the categories go down to a much higher resolution (e.g. 'cropland remaining cropland' which is included in the LULUCF 'managed cropland' category). The IPCC 2006 land categories are land use categories, which are just one type of several ways of categorising land – another example is administrative land categories. This difference in resolution of land categories could potentially lead to differences between MS in the way that high-resolution IPCC land categories are aggregated into the higher-level NRR land categories. On the contrary, the level of granularity (spatial resolution) required for reporting units seems much higher in the NRR than in the LULUCF Regulation.

It is not yet decided whether or not the requirement of NRR indicators to be “monitored in a manner consistent with the monitoring required under Regulations (EU) 2018/841 [the LULUCF Regulation] and (EU) 2018/1999 [the regulation that states how the indicators in the LULUCF (and in other Regulations) should be reported]”, means that MS have to use the IPCC 2006 land use categories (aggregated up into the NRR 'agricultural ecosystems' and 'forest ecosystems'). The Commission is preparing guidelines material to MS.

3.2.3 Soil organic carbon concentration

The Soil Monitoring Law is the only policy out of the eight investigated that requires reporting of SOC *concentration*. This requirement of reporting SOC concentration has major synergies with other policies because SOC concentration is a mandatory parameter for calculating carbon *stock* in soil and, thus, SOC concentration will already be calculated by MS when addressing the reporting requirements of LULUCF, NRR and CAP. Even if MS do not use the IPCC Stock-Change method for calculating change in carbon stock in soil for LULUCF and use the alternative Gain-Loss method (employing emissions factors per unit area instead of the calculation of absolute carbon stock), IPCC proposes regular field monitoring to validate and adjust emission factors (especially for higher tier methodologies), and soil carbon concentration must be one such field measurement. Therefore, there is synergy in the calculation and monitoring of indicators soil organic carbon concentration, absolute stock and change in stock.

3.2.4 Stock of organic carbon in mineral soils (absolute and change)

The NRR and SML requires that the absolute stock of organic carbon in mineral soils is reported for both agricultural ecosystems and forest ecosystems.

For agricultural ecosystems in the NRR, this is specifically for cropland mineral soils (i.e. does not include soils in pasture or other agricultural land). As explained in section 2.2.1 and 3.2.2, there are synergies between the required reporting for LULUCF and for the NRR, especially if MS use the Stock-Change method for calculating change in carbon stock and, hence, they should have in place a process for calculating absolute stock values. Regarding the time interval of reporting, it should be taken into account that to observe significant changes in SOC one may need around one decade, given the relatively slow rate of accumulation and measurement error.

The new ecosystem accounting module for the Environmental Economic Accounts Regulation requires reporting of carbon stock in topsoil in the land categories cropland and grassland (as separate land categories), but does not specify whether this is for mineral soils, organic soils or both. The ecosystem accounting module does not make it explicitly clear whether the indicator is absolute carbon stock or change in carbon stock, and therefore the extent of the synergy with the reporting of carbon stock change in mineral soils for the LULUCF Regulation is uncertain. However, the wording of the indicator implies that the SOC indicator is an absolute value rather than a change in carbon stock: the exact wording of the indicator is “soil organic carbon stock in topsoil... reported in tonne/ha, as a national average for the reporting period”. If this is the case, then the same principle applies as discussed for the NRR applies, in that there is potential synergy if the Stock-Change method is used by MS for calculating change in carbon stock in soils.

In the NRR, the definition given for the maximum depth of soil at which to measure soil organic carbon stock is 30cm, whereas in the LULUCF Regulation, a depth is not stated in the Regulation itself but in the 2006 IPCC guidelines it is stated that “[there is] the possibility of estimating C storage to a greater depth in the soil [than] 30 cm... it is good practice to derive reference C stocks to a greater depth if there is sufficient data, and if it is clear that land-use change and management have a significant impact over the proposed depth increment.” (This is for MS using tier 2 or 3 methodology for this indicator). Thus, when MS measure their carbon stock in mineral soil below a depth of 30cm or shallower than 30 cm, they must take note of the 30cm demand to be compatible with the requirements of the NRR for this indicator. The last LUCAS soil monitoring and the SML adopted the 30 cm topsoil delimitation. The new ecosystem accounting module for the Environmental Economic Accounts Regulation does not give a definition of topsoil, and so it is unclear how this relates to the 30cm depth specified in the NRR, and the default 30cm depth with possibility of extension in the LULUCF Regulation. The definition adopted by MS of topsoil may be 30cm in which case this reporting would be overlapping, but a 30cm definition of topsoil may not be adopted. For example, in their 2023 greenhouse gas inventory reports to the UNFCCC, Bulgaria and Croatia defined topsoil as 0-40cm depth instead of 0-30cm; additionally, the MS differed in their definitions of which soil layers were included in the measurement of soil organic carbon – some including only topsoil and some multiple layers (EEA 2023 Table 6.11).

As in section 2.2.3, due to the fact that it is not yet determined how the land categories of the NRR must overlap with those of the LULUCF Regulation, it is unclear how the ‘agricultural ecosystems’ land category of the NRR overlaps with the land use categories ‘managed cropland’ and ‘managed grassland’ of the LULUCF Regulation, and thus the extent to which there is synergy in reporting of the indicators on [change in] stock of organic carbon in mineral soils in the NRR and LULUCF Regulation across the same land parcels.

3.2.5 Change in carbon stock in organic soils

The only Regulation that requires reporting of carbon stock [change] in organic soils is the LULUCF Regulation, for all land categories. The renewed Environmental Economic Accounts Regulation may

require reporting of organic carbon in topsoil of organic soils, but it is not clear whether this refers to mineral soil, organic soil or both. The fact is that organic soils already have high carbon concentrations/stocks and changes are extremely slow. Consequently, recent regulations (like NRR and the Soil Monitoring Law) put the emphasis, not on their organic carbon, but on the need to restore them.

Unlike for calculating change in carbon stock in mineral soils and litter/deadwood/dead organic matter, MS rarely use the Stock-Change method for calculating change in carbon stock in organic soils – instead they usually use the Gain-Loss method. Therefore, MS will not necessarily already be in the practice of calculating values for carbon stock in organic soils for their LULUCF reporting. Hence if the renewed Environmental Economic Accounts Regulation does require reporting of absolute carbon stock in organic topsoil then this could represent an additional monitoring task for MS. As detailed in 2.2.3, soil organic carbon concentration (which is an indicator of the Soil Monitoring Law) may be used to calculate carbon stock changes with the Gain-Loss method, hence there may synergy with this Soil Monitoring Law indicator.

3.2.6 Total organic carbon content

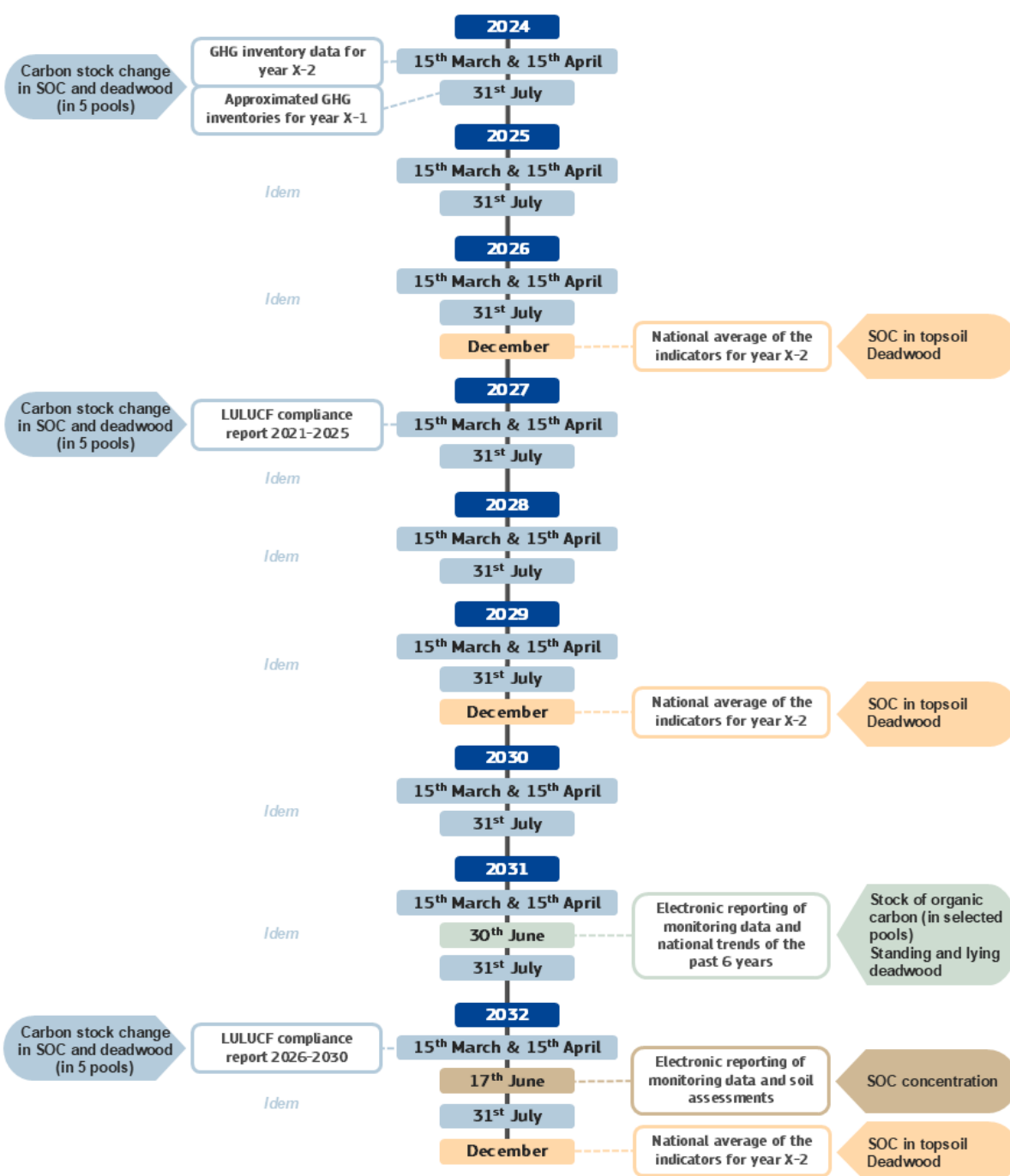
The CAP, for its indicator I.11, requires reporting of total organic carbon content in units of mass (rather than units of mass per unit area as for the carbon stock indicators). This CAP indicator incorporates data collected through work by the LUCAS surveys and JRC and, therefore, does not use the IPCC 2006 methodology. Again, this indicator is derived from the soil organic carbon concentration required by the Soil Monitoring Law.

3.2.7 Re-using existing reporting

Figure 2 shows how the data collected and reported under the policies that require updated information to MS feed to one another, i.e. how some parameters and indicators can be derived from each other, at least when they are monitored in the same land type. In all cases, the use of remote sensing is accelerating the technical capabilities and should be further exploited to reduce reporting burden. Still, both for deadwood and for soil characteristics, well-designed field sampling remains indispensable for an accurate quantification of the carbon stocks and their change over time. A remarkable example of coordinated field and remote data collection is the LUCAS programme that can lighten MS reporting obligations while ensuring harmonised approaches across the EU.

Further re-use of reported information is expected for the policies that do not require new data from MS. There is synergy between the reporting of changes in carbon stocks for the LULUCF Regulation and the data requirements for the European Climate Law and the CAP indicator I.10: these two Regulations utilise the data reporting on greenhouse gas inventories in the LULUCF sector to the UNFCCC (which is the same data that is reported in accordance with the LULUCF Regulation). The Carbon Removal Certification refers to the LULUCF Regulation for specification of the indicators that land managers must report in order to have their carbon removal schemes certified, and thus it could be possible that some of the data reporting from the MS greenhouse gas inventories could be utilised for this purpose. None of those policies (will) require a high level of spatial resolution in their reporting.

Figure 3. Timeline of the investigated policies that involve new data reporting from MS themselves (LULUCF with its annual reporting illustrated on the left hand side and the rest on the right).



Key:

LULUCF, Environmental Economic Accounts, Soil Monitoring Law, NRL

Source: Own elaboration

4 Implications of Member States' chosen methodologies for greenhouse gas inventories in relation to SOC and deadwood indicators

As a supplement to the information gathered from the policy documents themselves, the EU greenhouse gas inventory submission to the UNFCCC Secretariat was consulted to identify the methods that MS are currently using in their measurement of *change in carbon stock* of soil and deadwood. EU MS (as Parties to the UNFCCC) have been reporting greenhouse gas inventories to the UNFCCC for decades. While the exact required scope of these reports has changed over time, consulting the *recent* greenhouse gas inventory submissions informs us of the methodologies currently in use by the MS. The purpose of investigating the currently used methodologies by MS was to screen for any examples of instances where chosen methodological details of certain MS may lead to difficulties for their reporting against the policies covered in this report. The main focus of this analysis was the NRR. This could provide a starting point for future work of the EUBP MA in working to achieve scientific and technical consistency across policies. Further and deeper analyses of this kind, comparing the actual monitored and reported information by MS against the policy requirements, are needed to provide technical guidance on the consistency and alignment of reporting requirements.

The annual EU greenhouse gas inventory reports for 2021, 2022 and 2023 (EEA 2021, 2022 and 2023) were consulted. Additionally, for examples of more detailed information on methodology used by MS, the annual *national* greenhouse gas inventory reports for 2021, 2022 and 2023 from Austria (Umweltbundesamt 2021, 2022 and 2023) were consulted (Austria was chosen simply as the first MS in the alphabetically ordered list).

Some examples of where methodological details chosen by MS may not be fully aligned with the reporting requirements of other policies are as follows:

- The methodology that certain MS currently use for greenhouse gas inventory reporting (i.e. their interpretation of the IPCC 2006 guidance) may be incompatible with incoming laws. For example, in Austria's National Inventory Report in 2023 (and also in previous years 2022 and 2021), they state that, "the estimates on C-stock changes in deadwood include only standing deadwood, because any falling dead tree (part) is accounted for as a C flux to litter/soil in the modelling of the litter/soil C stock changes". The NRR requires reporting of standing and lying deadwood volume, and states that the methodology needs to take into account the 2006 IPCC methods. However, if a MS's interpretation of the IPCC 2006 guidance is for lying deadwood carbon stock to be incorporated into the litter/soil carbon stock, then this may not be compatible with the NRR requirement to be 'monitored in a manner consistent with' those in LULUCF. The same applies for reporting volume of standing and lying deadwood separately as stand-alone categories, e.g. not reporting litter (for agricultural ecosystems), or reporting litter carbon stock as a separate entity from lying deadwood volume (for forest ecosystems).
- Since MS use different methodologies, they therefore may have different levels of aggregation/disaggregation of indicators available. The EU greenhouse gas inventory report 2021, 2022 and 2023 states that, "*depending on the availability of datasets in individual countries, carbon stock changes in dead organic matter are often disaggregated between deadwood (DW) and litter (LT) or some countries include their estimates within soil organic carbon pool (e.g. Finland).*". The NRR requires reporting of stock of organic carbon in mineral soils but not dead organic matter, and so if a country's methodology does not disaggregate carbon in soil with carbon in dead organic matter, then this would not be compatible with reporting for the NRR.

- Table 6.22 of the EU greenhouse gas inventory report submission to the UNFCCC in April 2023 (EEA 2023) gives the definition of lands included in the category ‘grasslands’ – i.e. the definition of this category that MS use for creating the greenhouse gas inventories for reporting in line with the LULUCF Regulation. This table shows that all MS include both non-agricultural and agricultural (e.g. pasture, hay meadow) grassland types in the category of ‘grasslands’. While the NRR requires reporting of SOC indicators in ‘agricultural ecosystems’, the LULUCF Regulation and the Environmental Economic Accounts Regulation on the other hand require reporting of SOC indicators in cropland and grassland as separate land categories (‘cropland’ and ‘grassland’ for Environmental Economic Accounts; ‘managed cropland’ and ‘managed grassland’ for LULUCF). The LULUCF category ‘managed grassland’ includes ‘grassland remaining grassland’ and so any land included in ‘grassland’ by MS in their UNFCCC greenhouse gas inventory report would be included in the ‘managed grassland’ category for LULUCF reporting. Therefore, it seems that ‘grassland’ land category of LULUCF reporting would not be able to be used in its entirety for the NRR reporting in the ‘agricultural ecosystems’ category, since unmanaged grasslands are not agricultural, and since many types of unmanaged or non-agricultural grassland are specified in Annex I and included within the scope of ‘terrestrial ecosystems’ (Article 4) rather than ‘agricultural ecosystems’. Hence, it is likely that MS would need to divide up the ‘grassland’ category (and its associated measurements/calculations) that they have been using for years of reporting to the UNFCCC into those that are agricultural and those that are not, for reporting for the NRR.

5 Conclusions

The **aim of this study** was to carry out a scoping investigation into the communalities and differences in reporting requirements of SOC and deadwood indicators across eight different EU policies relating to climate, nature, agriculture and soil. SOC and deadwood monitoring is essential to track resilience under the implementation of these policies. The goal was to identify possible ways to support the Commission's effort of simplification and reduction of the reporting burden, in particular fostering interoperability and re-use of terminology, methodologies and data. This work contributes to task A.3 of the EUBP MA: 'harmonisation of monitoring methods across policy areas' relating to the BDS.

There is an **overall coherence** in the existing and proposed regulations evidenced by two facts: (1) in general, the backbone of the information is related to the LULUCF Regulation and the IPCC 2006 guidelines, and (2) the sets of SOC and deadwood indicators can be derived among themselves (see **Figure 2**) and their variances are usually linked to the different policy targets they try to monitor. The most recently proposed or adopted policies (like NRR, the new modules for Environmental Economic Accounts, and the Soil Monitoring Law) try to bring to light and re-use some of the underlying information that supports the well-established LULUCF Regulation and the greenhouse gases inventories, although with different (spatial, temporal, conceptual and methodological) levels of detail. In particular, the Soil Monitoring Law seems more precise on specifying sampling designs and methodological standards, and fosters regular data sharing on top of reporting. Other policies limit reporting burden by collecting data or calculating indicators at EU level (e.g. I.11 of the CAP) or by listing relevant indicators from other Regulations (e.g. the European Climate Law), something that the BDS monitoring framework, based on the BDS dashboard¹⁶, also does.

We identified explicit **cross-policy linkages** written in the policy documentation relating to SOC and deadwood indicators. Examples of this include:

- how certain policies are designed to aid in the implementation of another (e.g. the data and knowledge generated by the Soil Monitoring Law will facilitate the implementation of the carbon removal certification; or the proposed certification framework for carbon removals will contribute to achieve the restoration targets),
- how the value of certain indicators in one policy must be evaluated against the targets of another policy (e.g. the soil removals or soil sealing indicators of the Soil Monitoring Law should be compliant with the LULUCF objectives on net carbon removals), or how several policies refer to the LULUCF Regulation for the specific indicators on SOC and deadwood. Actually, the cross-reference to the LULUCF definitions and monitoring methods is the most consistent link across all the analysed policies, probably due to the longer-term and frequent (annual) monitoring and reporting required under the LULUCF Regulation. However, these cross-policy linkages also highlight the potential for an even greater amount of synergy between the reporting of SOC and deadwood indicators in accordance with these policies, if a *greater degree of cross-policy technical and scientific consistency* could be achieved in the future (e.g. more specific and consistent definitions of the carbon pools, units and the land categories on which they are measured, instead of mere references to other policies).

¹⁶ <https://dopa.jrc.ec.europa.eu/kcbd/EUBDS2030-dashboard/?version=1>

The most prominent **communalities** that we found in the reporting requirements across the investigated policies were that certain specific variations of the SOC and deadwood indicators need to be reported for the same land categories across different policies (e.g. deadwood volume – sometimes disaggregated in sub-categories – should be reported for forests land under the LULUCF Regulation and the new modules of the Environmental Economic Accounts).

In terms of the **differences** we found in the reporting requirements, examples include:

- a different scope of the indicator is sometimes required for different policies (e.g. the depth of topsoil, normally assumed to be 30 cm, may differ between some national LULUCF methods, the Soil Monitoring Law and potentially the Environmental Economic Accounts),
- a different definition and thus sometimes different units of the indicator may be required across different policies (e.g. the concentration (in g/kg), stock (in t/ha), or change of stock (in t or Mt) of SOC are used in the Soil Monitoring Law, NRR and LULUCF, respectively, although these measurements and indicators can be derived from each other).
- an indicator measured for one policy may not fit for purpose to be used in another policy having a different purpose, due to variations in the level of detail given for indicator definitions and methodologies, or in the resolution of the land categories (e.g. it is unclear if the agricultural land of the NRR will correspond to the aggregation of the LULUCF system, and if these two may be consistent with the soil districts of the Soil Monitoring Law). An implication of these differences in reporting requirements across policies could be that measuring and reporting of these indicators is more arduous than is necessary for MS, and a potential solution could be to facilitate the streamlining and interoperability of data collection and calculation of indicators across policies. Furthermore, these differences may make it difficult for MS to fulfil some of the requirements specified in the aforementioned cross-policy linkages.

There remain some **uncertainties** from consulting the documentation of each of these policies. These can be a starting point for next steps of this investigation and for the work plan of EUBP MA. Some of these uncertainties are regarding:

- the definition of indicators (e.g. the amendment to the Environmental Economic Accounts Regulation does not give much detail on indicator definitions);
- the land categories for reporting (e.g. it is yet to be determined whether the NRR requires MS to use the IPCC 2006 land use categories for reporting of SOC and deadwood indicators, and therefore it is uncertain how the land categories for reporting for the LULUCF Regulation overlap with those for reporting for NRR, and also with those for reporting for the Environmental Economic Accounts Regulation);
- the methodologies (e.g. how far the requirement of NRR indicators to be “monitored in a manner consistent with” LULUCF indicators goes in terms of requiring NRR monitoring to employ IPCC 2006 guidelines methodologies).

The clarification of some of these uncertainties could alleviate some of the potential differences in the reporting of SOC and deadwood across policies that have been identified in this report.

We also identified examples of where **methodological details chosen by MS** (in particular in the greenhouse gas inventory submissions to the UNFCCC) may lead to difficulties in reporting against the policies covered in this report (e.g. if a MS has decided not to differentiate lying deadwood from litter/soil carbon, or not to differentiate organic carbon in mineral soil with carbon in dead organic matter, then these may not be compatible with the NRR requirements). Analysing in more detail the

actual monitored and reported information from MS under the current legislation, to understand the methods currently used by MS, could present an opportunity for working towards compatibility and re-use of the information required from policies relating to climate, nature, agriculture and soils or, alternatively, for providing guidance in how methodologies could be adapted to accommodate for new reporting requirements from the incoming and revised policies.

This investigation could be deepened by comparing the actual data/indicators and the corresponding methodologies of the EU datasets and national inventories generated by the reporting obligations mentioned in this report, in partnership with voluntary MS and with the Commission expert groups responsible for the implementation of those policies, although such a task could be time-consuming. Another approach would be to focus on well aligned methodologies at EU level and further work on aligning the definitions of an indicator that can answer more than one policy (when possible facilitated by Earth Observation data or any other EU-wide sustainable source of data). The EUBP MA work plan for 2024 suggests setting up “*ad hoc* technical groups with the objective to work on a detailed technical overview of specific methods used, or in clarifying reporting requirements or methodologies within policies”. This could eventually produce some scientific and technical guidance to improve the comparability, alignment and re-use of information, with the consequent alleviation of monitoring and reporting tasks, ensuring data are measured once but used many times. Access to comparable data is also a cornerstone for robust policy impact assessments and, as such, is being pursued by the existing and proposed legislation.

Another outstanding concept that is not yet sufficiently explained in the policy texts is that of **carbon farming**, although the details regarding are currently being addressed by a Delegated Act on Carbon Farming, which is currently under public consultation¹⁷. This is proposed as a key policy measure in the Carbon Removal Certification Regulation and the Climate Adaptation Strategy. The specific quantification of carbon removals generated by carbon farming, including in SOC and deadwood, should be methodologically compatible with LULUCF, adhere to ecological principles and contribute to NRR targets (e.g. in forest ecosystems and in cropland mineral soils in agricultural ecosystems). Technical guidance may be necessary to align the policy demands, especially for the businesses/operators targeted in the Carbon Removal Certification.

¹⁷ https://climate.ec.europa.eu/eu-action/carbon-removals-and-carbon-farming_en

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¹⁸ Previous information available at: https://agriculture.ec.europa.eu/cap-my-country/performance-agricultural-policy/cap-indicators/context-indicators_en and https://agridata.ec.europa.eu/extensions/DataPortal/cmef_indicators.html

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List of abbreviations and definitions

Abbreviations	
BDS	EU Biodiversity Strategy for 2030
CAP	Common Agricultural Policy
DOM	Dead organic matter
DG	Directorate-General
EEA	European Environment Agency
EU	European Union
EUBP MA	Sub-Group on Monitoring and Assessment to the EUBP
GDP	Gross Domestic Product
JRC	Joint Research Centre
KCBD	Knowledge Centre for Biodiversity
LUCAS	Land Use/Land Cover Area Frame Survey
LULUCF	Land Use, Land Use Change and Forestry
MS	EU Member States
NRR	Nature Restoration Regulation
SOC	Soil organic carbon
UNFCCC	United Nations Framework Convention on Climate Change

List of figures

Figure 1. Summary of the linkages in monitoring and reporting between different policies in this report.	31
Figure 2. Summary of the indicators and land categories to be reported in across the policies covered in this report: A) deadwood indicators; B) SOC indicators.....	33
Figure 3. Timeline of the investigated policies that involve new data reporting from MS themselves	37

List of tables

Table 1a. SOC and deadwood indicators, their definitions, and the land categories that they must be reported for, for the LULUCF Regulation	10
Table 1b. The units and methodologies for the SOC and deadwood indicators of the LULUCF Regulation	12
Table 1c. The timeframes and frequencies of reporting for the SOC and deadwood indicators of the LULUCF Regulation.....	12
Table 2a. SOC and deadwood indicators, their definitions, and the land categories that they must be reported for, for the NRR	13
Table 2b. The units and methodologies for the SOC and deadwood indicators of the NRR.....	15
Table 2c. The timeframes and frequencies of reporting for the SOC and deadwood indicators of the NRR.....	16
Table 3a. SOC indicators, their definitions, and the land categories that must be reported for the Soil Monitoring Law proposal.....	17
Table 3b. The units and methodologies for the SOC indicators of the Soil Monitoring Law proposal	17
Table 3c. The timeframes and frequencies of reporting for the SOC indicators of the Soil Monitoring Law proposal	18
Table 4a. SOC and deadwood indicators, their definitions, and the land categories that they must be reported for, for the new environmental economic accounts modules	20
Table 4b. The units and methodologies for the SOC and deadwood indicators of the new environmental economic accounts modules	21
Table 4c. The timeframes and frequencies of reporting for the SOC and deadwood indicators of the new environmental economic accounts modules	21
Table 5a. The SOC indicator, its definition, and the land categories that it must be reported for, for the CAP. Deadwood is not mentioned in the CAP monitoring framework.	22
Table 5b. The units and methodologies for the SOC indicator of the CAP. Deadwood is not mentioned in the CAP monitoring framework	23
Table 5c. The timeframes and frequencies of reporting for the SOC indicator of the CAP. Deadwood is not mentioned in the CAP monitoring framework.....	24

Annexes

Annex 1: Brief description of the tiered methodology of the IPCC 2006 guidelines

The IPCC 2006 guidelines present a three-tiered approach to the methods. In general, using methodology from higher tiers leads to more accurate GHG inventories with lower uncertainty; however, the higher tier methodologies are more complex thus requiring more resources. A combination of different tiers can be used for different carbon pools – i.e. one tier can be used to calculate one pool, and a different tier for a different pool.

Tier 1 methods are designed to be the simplest to use, and these IPCC 2006 guidelines provide equations and default parameter values. For the input activity data, for Tier 1 there are often globally available sources of activity data estimates that can be used.

Tier 2 can use the same methodological approach as Tier 1, but parameters values for equations are based on country- or region- specific data are used. For the input activity data, data with higher temporal and spatial resolution, and that is more disaggregated, is typically used.

Tier 3 employs higher order methods, such as models and inventory measurement systems tailored to address the national circumstances of the MS. For example, this may include consistent field sampling for high-resolution national data.

Annex 2: Classification criteria for organic soils

Organic soils are identified on the basis of criteria 1 and 2, or 1 and 3 (FAO 1998):

1. Thickness of organic horizon greater than or equal to 10 cm. A horizon of less than 20 cm must have 12 percent or more organic carbon when mixed to a depth of 20 cm.
2. Soils that are never saturated with water for more than a few days must contain more than 20 percent organic carbon by weight (i.e., about 35 percent organic matter).
3. Soils are subject to water saturation episodes and has either: a. At least 12 percent organic carbon by weight (i.e., about 20 percent organic matter) if the soil has no clay; or b. At least 18 percent organic carbon by weight (i.e., about 30 percent organic matter) if the soil has 60% or more clay; or c. An intermediate, proportional amount of organic carbon for intermediate amounts of clay.

Annex 3: How MS must determine their sampling points for the Soil Monitoring Law

Guidance on determining sampling points is outlined in part A of Annex II of the Soil Monitoring Law proposal. The soil sampling points are referred to as the sample survey.

“The sample survey shall be designed from a complete sample frame containing the best available information on the soil properties distribution, including but not limited to information resulting from previous national measurements and measurements under the LUCAS programme. The sampling scheme shall be a stratified random sampling optimized on the soil health descriptors. The size of the national sample shall meet the requirement of a maximum percent error (or Coefficient of Variation) of 5% for the estimation of the area having healthy soils.” (Quoted directly from part A Annex II Soil Monitoring Law proposal).

“The Commission shall, subject to agreement from Member States concerned, carry out regular soil measurements on soil samples taken in-situ... to support Member States’ monitoring of soil health” (Quoted from Article 6(4) of the Soil Monitoring Law proposal). “The Commission sample for the survey set under Art 6(4) may contribute to a maximum of 20 % of the size of national samples. The allocation and size of the sample shall be determined by applying the Bethel algorithm (Bethel, 1989) 6 accounting for the required maximum estimation error.” (Quoted directly from part A Annex II Soil Monitoring Law proposal).

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