Rough estimate of the climate change mitigation potential of the CAP Strategic Plans (EU-18) over the 2023-2027 period

Summary report for 19 CAP Strategic Plans

November 2024

This document represents a preliminary version of the Rough Estimate of the Climate Change Mitigation Potential of the CAP Strategic Plans over the 2023-2027 Period. It is intended to provide an accessible summary of the analysed EU-18 findings to diverse stakeholders. Please note, however, that this document may still contain some inaccuracies or omissions as the final proofreading will be applied to the version encompassing the full scope of the EU-27. According to the current planning, this final version will be published in the EU CAP Network publications database in Quarter 1, 2025, and will serve as the official reference text.

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Highlights

This study examines the Common Agricultural Policy Strategic Plans (CSP) adopted under the Common Agricultural Policy (CAP) 2023-2027 programming period, and it analyses their potential contribution to reducing greenhouse gas (GHG) emissions, enhancing carbon removals and conserving existing carbon stocks. It establishes for the first time the link between CSP planned instruments and their mitigation potential at EU level, representing a starting point for the development of a further refined methodology using Member State data, and for the improvement in their GHG emissions and removals inventories. The study does not account for the contribution of other policies and measures implemented in Member States beyond the CSPs in terms of their mitigation or protection potential.

Context and methodology

- According to data reported by Member States of the European Union (EU) under the EU Governance Regulation (EU) 2018/1999[1], in 2022, the agricultural sector is estimated to have emitted 366 million tonnes of carbon dioxide equivalent (CO_2e), accounting for 11% of the estimated EU's total GHG emissions, with two thirds emitted by the livestock sector (enteric fermentation and manure management) (European Environment Agency, 2024). Land Use, Land Use Change and Forestry (LULUCF) sector activities are estimated to have removed 236 million tonnes net of CO_2e from the atmosphere in 2022, equal to 7% of the EU's annual estimated GHG emissions; however, LULUCF categories cropland and grassland are estimated to have emitted 41 million tonnes of GHG, accounting for 1.2% of EU's annual estimated GHG emissions.
- To enhance the contribution of the EU farming sector to the EU climate objectives, multiple CSP instruments were designed to increase carbon sinks and to reduce emission sources. In addition, in the CSPs, 32% of the total CAP funding is aimed to be devoted to delivering benefits for the climate, water, soil, air, biodiversity and animal welfare, and to encourage practices beyond the mandatory conditionality.
- The methodology applied in this study is based on programming data extracted from the CSPs as approved by the European Commission in December 2022,

[1] 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 (Text with EEA relevance.), OJ L 328, p. 1–77, ELI: http://data.europa.eu/eli/reg/2018/1999/oj.

on rough estimates of expected implementation levels, and on average emission and removal coefficients of farming practices mainly derived from meta-reviews of scientific papers.

- The study establishes the link between CSP instruments and their mitigation potential in 18 Member States (EU-18). This represents a starting point for deriving the mitigation potential of planned actions. Further refinements in methodology, such as the use of local coefficients and data on the actual uptake of the interventions, will improve the accuracy of the estimates. Furthermore, the estimated potential effect encompasses all the areas where farming practices supported through various types of intervention are planned. This includes areas where these practices would be adopted even without financial support or were already supported under the previous CAP programming period.

- At this stage, the results provide a preliminary indication of the CSPs' overall potential contribution and should be interpreted with caution. Conservative choices were made during the estimation process. This includes accounting for the risk of double counting in cases of possible overlap between farming practices as well as setting the coefficient value of farming practices or the estimated potential uptake area to zero when data available are insufficient.
- Potential effects of the CSP instruments on GHG emissions and removals are differentiated from those on carbon protection, and results for both categories are kept separate.

The analysis indicates a potential positive contribution of the 19 CSPs (which correspond to 18 Member States) to GHG emission reduction and enhanced removal of 31 million tonnes of CO_2e per year.

- This positive contribution is clearly potential and comes at this stage with a range of uncertainties due to the numerous assumptions made. In particular, the extent to which this yearly positive contribution can be cumulated until 2027 strongly depends on the additionality of actual yearly uptake of practices by farmers.
- In terms of practices, crop rotation or diversification, expansion of cover crops, and conversion to organic farming contribute 78% of the estimated mitigation potential.

- In terms of instruments, Eco-schemes account for 38% of the estimated mitigation potential, ENVCLIM interventions 30%, and Good Agricultural and Environmental Conditions (GAEC) compliance 27% (notably GAEC 6 – Soil Cover and GAEC 7 – Crop Rotation on arable land). The Coupled Income

Support (CIS) and INVEST interventions are expected to contribute to the mitigation potential only in a few CSPs.

- Results are aggregated according to the United Nations Framework Convention on Climate Change (UNFCCC) Common Reporting Format (CRF) categories developed for the inventories of GHG emissions and removals.
    - The analysis shows that 64% of the estimated mitigation potential is associated with CRF category 4.B – Cropland, which corresponds to storage of carbon in cropland soils. This estimated potential accounts for 5% of the total emissions reported for 2021 under the agricultural and LULUCF sectors.
    - The second-largest estimated potential effect is a reduction of non-CO_2 emissions from agricultural soils and wetlands (CRF categories 3.D - Agricultural Soils and 4.D – Wetlands) accounting for 30% and 5% respectively.
    - The estimated potential mitigation contribution of CSPs associated with the CRF categories 3.A - Enteric Fermentation and 3.B - Manure Management is expected to be low. This is particularly notable given that emissions from livestock represent a significant share of non-CO_2 emissions of the agricultural sector, accounting for 66% of emissions reported for 2022 in CRF sector 3 – Agriculture[2]. However, this study is not assessing other policies and measures programmed by Member States to reduce emissions from livestock.

The 19 CSPs could potentially contribute to the climate targets set in the Effort Sharing Regulation (ESR) (EU) 2018/842[3] and LULUCF Regulation (EU) 2018/841[4].

- Although the ESR does not entail targets for the agricultural sector, in certain countries agricultural mitigation is crucial for meeting the 2030 target. At the

[2] European Environment Agency data available on: https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-from-agriculture
[3] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013 (Text with EEA relevance), OJ L 156, p. 26–42,
ELI: http://data.europa.eu/eli/reg/2018/842/oj.
[4] 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 (Text with EEA relevance), OJ L 156, p. 1–25,
ELI: http://data.europa.eu/eli/reg/2018/841/oj.

19 CSPs level, the estimated potential to mitigate non-CO_2 emissions (9 million tonnes of CO_2e per year) represents 2.6% of 2021 reported emissions from agriculture (CRF sector 3 - Agriculture) in the 18 Member States covered. This also accounts for 43% of the difference between 2021 estimated emissions levels and the figure associated with agriculture for 2030 as modelled in the impact assessments of the Fit for 55 package and the 2040 climate target for these 18 Member States[5].

- For the LULUCF sector, the LULUCF Regulation (EU) 2018/841 sets an EU-wide net removal target of 310 million tonnes of CO_2e by 2030, which is distributed among Member States. To achieve this target, an increase in carbon sink capacity by 42 million tonnes CO_2e is required. The analysis suggests that the CSPs could contribute to enhancing carbon sequestration by approximately 22 million tonnes of CO_2e per year. This represents **8% of the LULUCF 2030 target and 56% of the required increase in sink capacity by 2030 for the EU-18**.

- The potential effects of the CSPs are estimated on a yearly basis. This entails that the CSPs potential contribution to emissions reduction and increased removals objectives could be delivered every year from 2023 to 2027, making the contribution quite significant. However, whether this potential will fully realise and the magnitude of the contribution to the 2030 LULUCF and ESR targets, will depend on the final uptake of the measures by farmers, whether supported practices will have additional effects every year and whether the practices were already financed under the previous CAP programming period, which is not possible to assess at this stage. Actions outside CSPs will also help reaching the 2030 LULUCF and ESR targets.

In addition to contributing to enhanced carbon removal and GHG emissions mitigation, the 19 CSPs could potentially contribute to the protection of existing carbon sinks, with an estimated potential of 29 million tonnes of CO_2e per year.

- The CSPs' GAECs and interventions also seek to protect the carbon stored in soil (grassland, peatlands, arable land) and woody features (forests,

[5] European Commission, *Commission Staff Working Document – Impact assessment report - Part 3 Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Securing our future - Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society*, 2024, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024SC0063.

hedgerows) by maintaining these areas and encouraging sustainable management**.**

- Support to the maintenance of organic farming accounts for more than half (54%) of the estimated potential, followed by forestry maintenance or management (22%) and grassland protection (18%).

- Maintenance of organic farming is supported through ENVCLIM and Eco-scheme interventions, whereas the INVEST interventions contribute to support sustainable forest management in certain Member States.

- In the case of GAECs, due to the difficulty to quantify their contribution against a baseline, such as for GAEC 1 – Maintenance of permanent grassland, an obligation in place for many years, and the lack of information on the areas potentially concerned for GAEC 2 - Protection of wetlands and peatlands, the applied conservative approach shows a small net additional potential contribution (these measures are mostly to maintain carbon in soils).

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List of acronyms

CAP	Common Agricultural Policy
CIS	Coupled Income Support
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CRF	Common Reporting Format
CSP	CAP Strategic Plan
DG AGRI	Directorate-General for Agriculture and Rural Development
EEA	European Environment Agency
EU	European Union
EU-18	18 Member States covered
ESR	Effort Sharing Regulation (EU) 2018/842
GAEC	Good Agricultural and Environmental Conditions
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
LULUCF	Land Use, Land-Use Change, and Forestry
N_2O	Nitrous oxide
SOC	Soil organic carbon
UAA	Utilised agricultural area
UNFCCC	United Nations Framework Convention on Climate Change

Units of measurements

ha	hectare
kg	kilogram
MW	megawatt
t	tonne
yr	year

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Questions and suggestions regarding the content of the publication can be addressed to the European Evaluation Helpdesk for the CAP at evaluation@eucapnetwork.eu

1 Introduction

According to data reported by Member States of the European Union (EU) under the EU Governance Regulation (EU) 2018/1999[6], in 2022 the agricultural sector is estimated to have emitted 366 million tonnes of carbon dioxide equivalent (CO_2e), accounting for 11% of the estimated EU's total greenhouse gas (GHG) emissions including international transport. Methane (CH_4) emissions from enteric fermentation and nitrous oxide (N_2O) emissions from soils are estimated to be responsible for 49% and 30% of total agricultural GHG emissions, respectively. Non-CO_2 emissions from manure management is the third largest source, accounting for an estimated 17% of total agricultural GHG emissions. The remaining sources are estimated to make relatively small contributions, accounting for less than 5% of agricultural estimated GHG emissions in total[7].

The Land Use, Land-Use Change, and Forestry (LULUCF) sector primarily involves activities that sequester and protect carbon in land and biomass (i.e. carbon sink), such as forestry (afforestation and reforestation). In 2022, the LULUCF sector is estimated to have removed 236 million tonnes of CO_2e, mainly through removals in forestry. However, the LULUCF sectors croplands, grasslands and wetlands are estimated to be net emitters (by nearly 70 million tonnes CO_2e yearly).

The Common Agricultural Policy (CAP) 2023-2027 is a key tool in reaching the European Green Deal goals[8]. In particular, integrating the specific objective 'to contribute to climate change mitigation and adaptation, including by reducing GHG emissions and enhancing carbon sequestration, as well as to promote sustainable energy'[9]. In addition, in the CAP Strategic Plans (hereinafter CSPs), 32% of the total CAP funding is aimed to be devoted to delivering benefits for the climate, water, soil,

[6] See note 1.
[7] European Environment Agency, 'EEA greenhouse gases – data viewer', consulted in May 2024, https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer. Emission reported in 2024; animal sector emissions are emissions reported under IPCC sectors 3.A – enteric fermentation and 3.B – manure management.
[8] European Commission, Directorate-General for Agriculture and Rural Development, *Report from the commission to the European Parliament and the Council – Summary of CAP Strategic Plans for 2023-2-27: joint effort and collective ambition,* Publications office of the European Union, 2023, https://op.europa.eu/en/publication-detail/-/publication/a0b0a342-89e9-11ee-99ba-01aa75ed71a1/language-en.
[9] See Article 6(d) of the CAP Strategic Plans 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) 1305/2013 and (EU) 1307/2013, OJ L 435, pp. 1–186, ELI: http://data.europa.eu/eli/reg/2021/2115/oj.

air, biodiversity and animal welfare, and to encourage practices beyond the mandatory conditionality.

This underscores the necessity of improving methodologies for evaluating the contribution of the CSPs on climate change mitigation.

The current estimation of GHG emissions from the agricultural sector in the EU GHG inventories carried out within the framework of the United Nations Framework Convention on Climate Change (UNFCCC) is mostly based on Tier 1 and Tier 2 methodologies. A recent preliminary analysis carried out by DG AGRI mapping the methods used to report agricultural emissions to the UNFCCC[10] points out the need for higher tier reporting and more disaggregated activity data to reflect the potential mitigation effect of measures in the CSPs. In addition, the Annual European Union greenhouse gas inventory 1990–2021 and inventory report 2023[11] points to uncertainties in the estimation of GHG emissions at EU level. Tables 1.16, 5.59 and 6.32 of the European Environment Agency (EEA) publication[12] provide information on the EU uncertainty estimates (level uncertainty and trend uncertainty). The tables indicate significant level of uncertainty particularly for N_2O emissions and CO_2 in cropland, which also evidences the need for improvement.

In this context, this study is a contribution to the methodologies to further analyse and better quantify the potential contribution of certain farming practices to climate change mitigation.

[10] European Commission, Working paper 'Agriculture in the EU GHG Inventory, moving to a higher tier reporting', 11 March 2024.
[11] European Environment Agency, *Annual European Union greenhouse gas inventory 1990–2021 and inventory report 2023 – Submission to the UNFCCC Secretariat*, 2023, https://www.eea.europa.eu/ds_resolveuid/a9f7f010d2d348488e4345e7fdb3709e.
[12] Table 5.59 indicates level on uncertainties of the different GHG from the different sources as declared by Member States. For example:_N_2O in manure management: 68.4% uncertainty,_N_2O in agricultural soils: 75.7%,_CH_4 enteric fermentation: 11.9%, Average EU: 24.7%. While for LULUCF, Table 6.32 indicates level of uncertainties: CO_2 – cropland: 188.4% uncertainty, CO_2 - grassland: 110.0%, CO_2 - forest land: 20.3%, Average EU: 39.9%.

Box 1 – EU climate change mitigation objectives

EU Climate Law (EU) 2021/1119[13]

The European Climate Law sets out the EU's commitment to shift into a climate-neutral economy by 2050, with an intermediate target to reduce GHG emissions by at least 55% by 2030 compared to 1990 levels.

Effort Sharing Regulation (EU) 2018/842 (ESR)[14]

Agriculture GHG emissions, except those from land use, are covered by the ESR, which mandates an overall GHG reduction target of 40% compared to 2005 levels by 2030. The target is distributed among Member States. Although there is no specific target solely for agriculture within the ESR, some Member States[15] have independently set national targets for reducing agricultural emissions.

LULUCF Regulation (EU) 2018/841[16]

The LULUCF regulation aims to achieve a net greenhouse gas removal target of 310 million tonnes of CO_2e by 2030. To fill in the gap of 42 million tonnes of CO_2e to reach this target, the regulation sets national contributions for 2030.

Methane Pledge[17]

The EU is one of the initiators of the Global Methane Pledge, launched in 2021 ahead of COP26. The pledge aims to reduce global methane emissions by 30% by 2030 compared to 2020 levels. Reducing methane from the livestock sector is considered as key to achieve this goal.

[13] 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, 9.7.2021, p. 1–17, ELI: http://data.europa.eu/eli/reg/2021/1119/oj

[14] See note 4.

[15] Belgium, Denmark, France, Germany, Ireland, Lithuania, Malta, the Netherlands, Portugal, Slovenia – see note in section 5.1.1 for details.

[16] See note 3.

[17] Climate Analytics and New Climate Institute, '*Climate Action tracker',* Climate Action Tracker website, 2024, https://climateactiontracker.org/countries/eu/policies-action/

2 Objectives and method

The aim of this study is **to provide a rough estimate of the climate change mitigation potential of the CSPs over the 2023-2027 CAP programming period,** based on the programming information included therein and GHG emission reduction and enhanced carbon sequestration potential of the farming practices they support.

The study focuses on estimating the potential contribution of the CSPs on reducing CH_4 and N_2O emissions, as well as on increasing and safeguarding carbon stocks in soil and biomass.

To carry out this study, the European Evaluation Helpdesk for the CAP (hereinafter the Evaluation Helpdesk) developed a methodology that has been applied to 18 Member States (EU-18), corresponding to 19 CSPs[18]. The results are aggregated to provide an estimation at EU-18 level. **These 19 CSPs collectively cover a substantial portion of EU agricultural areas, accounting for approximately 92% of the European utilised agricultural area (UAA) (Eurostat, 2020[19]) and encompassing around 95% of the estimated EU GHG emissions from agriculture** for 2021 as reported to the EEA.

This report provides an estimation of the potential for climate change mitigation and carbon stock protection expected from the 19 CSPs in contributing to the EU's climate change objectives.

The calculations are primarily based on three key sources:

1. The information extracted from the **CSPs as approved by the European Commission in December 2022.** These documents serve as the primary source of programming information and estimation of the areas concerned.

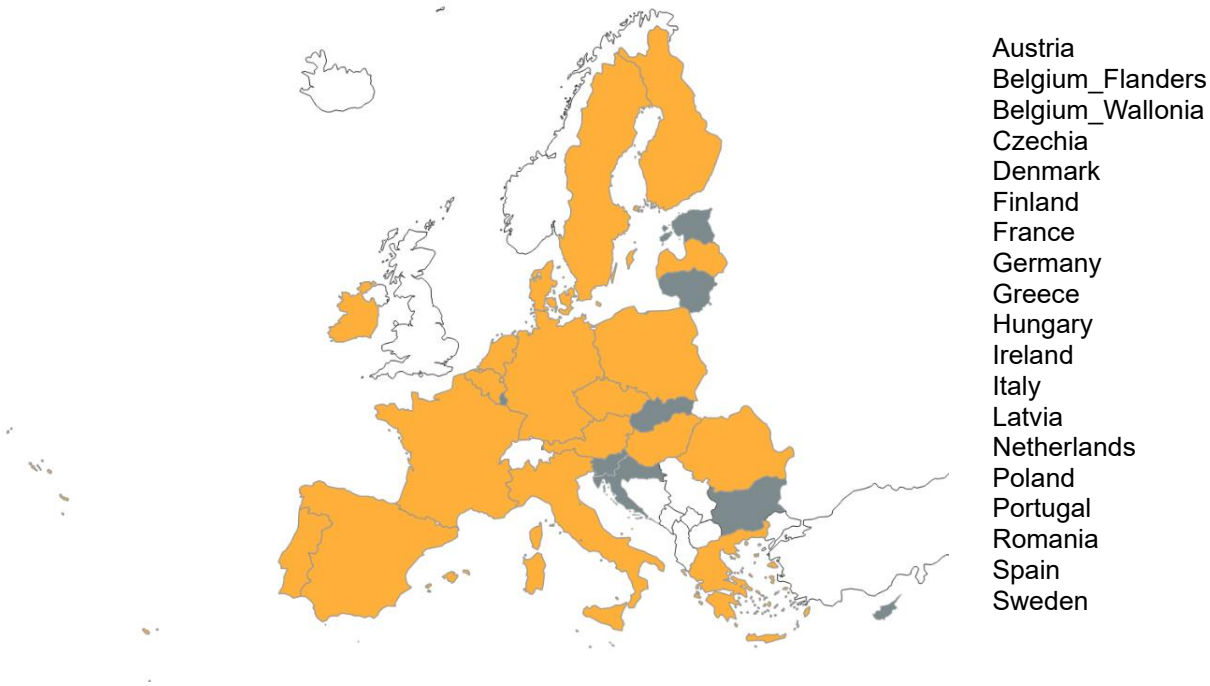
2. The result of the study 'Mapping and analysis of CAP Strategic Plans – Assessment of joint efforts for 2023-2027'[20], in which the Evaluation Helpdesk and the Joint Research Centre (JRC) linked (hereinafter 'labelled') requirements of the Good Agricultural and Environmental Conditions (GAECs) and CAP

[18] There are two CSPs for Belgium, one for Flanders and one for Wallonia.
[19] Eurostat EF_LUS_MAIN__custom_6398292 – data 2020.
[20] European Commission, Directorate-General for Agriculture and Rural Development, Chartier, O., Krüger, T., Folkeson Lillo, C. et al., *Mapping and analysis of CAP Strategic Plans – Assessment of joint efforts for 2023-2027*, Chartier, O.(editor), Folkeson Lillo, C.(editor), Publications Office of the European Union, 2023, https://data.europa.eu/doi/10.2762/71556

interventions at unit amount level with farming practices, using the classification scheme developed by the JRC[21].

3. **Mitigation coefficients** per farming practice, which are crucial for estimating the potential contribution of each intervention. These coefficients are derived from various sources, primarily the iMAP project[22] (Integrated Modelling platform for Agro-economic and resource Policy analysis), supplemented with additional data where necessary (see Box 2).

Figure 1 – 19 CSPs included in the study



[21] Angileri, V., Guerrero, I. and Weiss, F., *A classification scheme based on farming practices*, Publications Office of the European Union, Luxembourg, 2024, doi:10.2760/33560, JRC133862.

[22] Guerrero, I., Bielza Diaz-Caneja, M., Angileri, V., Assouline, M., Bosco, S., Catarino, R., Chen, M., Koeble, R., Lindner, S., Makowski, D., Montero Castaño, A., Perez-Soba Aguilar, M., Schievano, A., Tamburini, G., Terres, J. and Rega, C., *Quantifying the Impact of Farming Practices on Environment and Climate*, Publications Office of the European Union, Luxembourg, 2024, doi:10.2760/20814, https://publications.jrc.ec.europa.eu/repository/handle/JRC137826 & Schievano, A., Perez-Soba Aguilar, M., Bosco, S., Montero Castaño, A., Catarino, R., Chen, M., Tamburini, G., Landoni, B., Mantegazza, O., Guerrero, I., Bielza Diaz-Caneja, M., Assouline, M., Koeble, R., Dentener, F., Van Der Velde, M., Rega, C., Furlan, A., Paracchini, M.L., Weiss, F., Angileri, V., Terres, J. and Makowski, D., '*iMAP Farming Practices dataset – An evidence library of the effects of Farming Practices on the environment and the climate*', European Commission, Joint Research Centre (JRC) [Dataset] (created 8 November 2023, last updated on 25 June 2024). doi: 10.2905/4e3c371a-be72-4ea0-aa0b-45f8cdda2064.

The study covers both mandatory requirements of the **GAECs** (Article 13 of CAP Strategic Plans Regulation (EU) 2021/2115[23]) and several **types of interventions** (voluntary commitments):

- **Schemes aimed at promoting climate, environmental, and animal welfare objectives** (hereinafter referred to as Eco-schemes), covered under Article 31 of CAP Strategic Plans Regulation (EU) 2021/2115.
- **Coupled Income Support (CIS) targeting protein crops,** including legumes and mixtures thereof, with legumes being predominant in the mixture, as specified in Article 33(c) of CAP Strategic Plans Regulation (EU) 2021/2115.
- **Environmental, Climate-related, and Other Management Commitments,** (hereinafter referred to as ENVCLIM), detailed in Article 70 of CAP Strategic Plans Regulation (EU) 2021/2115.
- **Investments** (hereinafter referred to as INVEST), delineated in Article 73 of CAP Strategic Plans Regulation (EU) 2021/2115.
- **Sectoral interventions specifically targeting the Fruit and Vegetable sector,** covered under Articles 42 to 68 of CAP Strategic Plans Regulation (EU) 2021/2115. Sectoral interventions are investigated only in selected CSPs.

The methodology employed is based on a series of assumptions and simplifications necessary at various stages of the analysis. It is crucial to consider these assumptions when interpreting the final estimates. A comprehensive outline of the general approach and underlying assumptions is provided in a separate document: the General Methodology deliverable. **The methodology is based on the following key steps:**

1. at CSP level, identification of the CAP interventions and GAECs that have the potential to positively contribute to GHG emission reduction and enhance carbon removal, or to protect existing carbon sinks,
2. labelling each CAP intervention and GAEC with farming practices, using the farming practices classification scheme developed by the JRC[24] (see Box 2),

[23] CAP Strategic Plans 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) 1305/2013 and (EU) 1307/2013, OJ L 435, pp. 1–186, ELI: http://data.europa.eu/eli/reg/2021/2115/oj.
[24] See note 21.

3. estimation of the area (in terms of hectares[25]) covered by a farming practice,
4. assignment of mitigation or protection coefficients to the farming practices (see Box 2),
5. estimation of the mitigation or protection potential of each CAP intervention and GAEC at CSP level, by multiplying the estimated area (or other unit of measurement) of each farming practice by its coefficient value, before aggregating them at the intervention/GAEC and then CSP level,
6. aggregation of estimates from the 19 CSPs.

Box 2 – Farming practices classification scheme and coefficient values

Farming practices classification scheme[26]

To enable the assessment of similar interventions across different Member States and different CAP areas, the JRC drew up a classification scheme of farming practices. The classification scheme is built so that the classes reflect the different levels of detail with which requirements are described in the interventions of the CSPs. Therefore, the classification scheme is divided into tiers, where the farming practices are described with more detail from Tier 1 to Tiers 2 and 3. To guide the user through the classification, these farming practices are aggregated into sections. In total there are 18 sections, 45 Tier 1 classes, 164 Tier 2 classes and 157 Tier 3 classes. This classification scheme is utilised to provide the rough estimates.

Mitigation versus protection

For this study, the distinction between two groups of farming practices is particularly important:

- Mitigation: practices actively contributing to reducing GHG emissions and/or enhancing carbon removal from the atmosphere.
- Protection of carbon sinks: practices safeguarding existing carbon sinks and preserving carbon stocks in soil or biomass.

[25] Other units of measurement can also be used, such as livestock units or megawatts.
[26] See note 21.

Assigning coefficient values to farming practices

Farming practices are assigned coefficient values representing their estimated contribution in terms of reducing GHG emissions, enhancing carbon removal, or protecting carbon stocks in soil or biomass, expressed in kilograms of CO_2e per unit (hectares or other unit of measurement) per year.

Original coefficients are extracted from the JRC work for the iMAP project[27] and from Ricardo estimates[28].

These coefficients are predominantly drawn up at the European or global level. Fine-tuning at national levels (or even lower levels) would greatly improve the accuracy of the estimates. Also, the effects captured in the coefficient values pertain to the farm level, and do not include indirect land-use change effects. Finally, there is also no consideration for combined contribution of different practices on the same area.

The study has some gaps as for few farming practices no data are available to determine a coefficient. They are listed in Annex 2 – Farming practices without data. However, the overall coverage in terms of coefficient is considered as adequate, because the main practices with a potential to reduce GHG emission and/or enhance carbon removal are associated with a coefficient value.

The list of farming practices used for the estimates, their coefficient values and categories is available in Annex 1 – Farming practices emissions and removal coefficients. Other specificities on the coefficients are reported in the General Methodology deliverable.

These estimates are based on the interventions and GAECs planned in the CSPs as approved by the European Commission in December 2022, in the absence of information on actual uptake. The areas estimated per farming practices are derived from the planned outputs, result indicators, and other data included in the CSPs on expected uptake of interventions by farmers.

[27] See note 22.

[28] Ricardo estimates of mitigation potential of farming practices, developed in European Commission: Directorate-General for Agriculture and Rural Development, Pražan, J., Nanni, S., Redman, M., Vedrenne, M. et al., *Evaluation study of the impact of the CAP on climate change and greenhouse gas emissions – Final report*, Publications Office, 2019, https://data.europa.eu/doi/10.2762/54044 and revised in European Commission: Directorate-General for Climate Action, Wiltshire, J., Keesje, A. and Gill, D., *Guidance to Member States in improving the contribution of land-use, forestry and agriculture to enhance climate, energy and environment ambition*, Publications Office of the European Union, 2023, https://data.europa.eu/doi/10.2834/19417.

Calculating an order of magnitude for the positive contribution of CSPs

The calculation provides an order of magnitude for the potential contribution of the CAP instruments listed above. It does not strictly compare the effect expected from the CSPs to a reference scenario (for instance, previous CAP or hypothetical scenario without CAP). Moreover, the GAECs and CAP interventions are treated differently.

For CAP interventions, **the estimated potential contribution encompasses all the areas where supported farming practices are expected to be implemented through the different types of intervention covered**. The areas on which the given practices would apply, even without the CAP support, or that were already supported in the previous CAP, are included in the calculation. Therefore, the final estimate represents the potential contribution of all the areas expected to receive CSP support compared to a hypothetical situation where 'standard' farming practices would be implemented instead. With this approach, the estimated potential contribution of the interventions is the maximum potential the CSP could reach, without considering farming practices already implemented in the previous period or without any CAP support.

For GAECs, a different approach is adopted compared to the one used for the CAP interventions. **The study aims to estimate only the potential contribution of the additional areas where farming practices will be implemented to comply with the standards in the new programming period, compared to the previous programming period.** With this approach, the potential contribution estimated for GAECs might result underrated.

Yearly potential, hypothetically delivered each year of the programming period

The potential contribution of the CSPs is estimated on a yearly basis (total planned output indicated in the CSPs for the 2023-2027 programming period are divided by 5, to calculate annual averages).

This entails that the CSPs potential contribution to emission reduction and removal objectives could be delivered every year from 2023 to 2027, making the estimated potential contribution quite significant. However, whether this potential will fully realise and the magnitude of the contribution, will depend on the final uptake of the measures by farmers, whether supported practices will have additional effects each year and whether these practices were already financed under the previous CAP, which is not possible to assess at this stage.

It is crucial to acknowledge **the tentative nature of these estimates, as they rely on programming data, rough estimates of expected implementation levels, and average emission and removal coefficients of farming practices.** Consequently, results should be interpreted with caution and only as an indicative order of magnitude.

Further improvement in the approach and data would bring more accurate results, particularly with coefficient values more specific to national or local conditions and better estimations of the areas per farming practices (using data on the actual uptake of the various interventions).

The next chapters present the estimated results separated between GHG emissions and removals (Chapter 3) and protection of carbon sinks (Chapter 4). Chapter 5 considers the CSPs' potential contribution to climate change mitigation estimated within the context of the EU climate policy framework.

3 Estimated mitigation potential

3.1 Estimates at the level of 19 CAP Strategic Plans

This Chapter focuses on the total effects estimated at the level of the 19 CSPs. Results are detailed per farming practice (as per the JRC classification scheme), per GAEC and type of interventions, and according to the UNFCCC Common Reporting Format (CRF) categories[29].

In Chapter 3.2, the estimations are presented per CSP.

3.1.1 Mitigation potential per farming practice

The analysis of the 19 CSPs indicates an estimated potential positive contribution to GHG emission reduction and enhanced removal of 31.2 million tonnes of CO_2e annually across the 18 Member States. Over the five-year implementation period, this amounts to a cumulative total of 156 million tonnes of CO_2e.

This positive contribution is clearly potential and comes at this stage with a range of uncertainties due to the numerous assumptions made. In particular, the extent to which the yearly positive contribution can be cumulated until 2027 strongly depends on the additionality of actual yearly uptake of practices by farmers. Figure 2 presents the breakdown of the GHG emission reduction and enhanced removal potential per category of farming practice[30]. Conversion to organic farming (O – Organic farming), the implementation of rotation or diversification of crops (R – Crop rotation and diversification), and the expansion of cover crops (S – Soil management) as required through GAECs or supported by the voluntary schemes account for over three quarters (i.e. 78%) of the estimated mitigation potential.

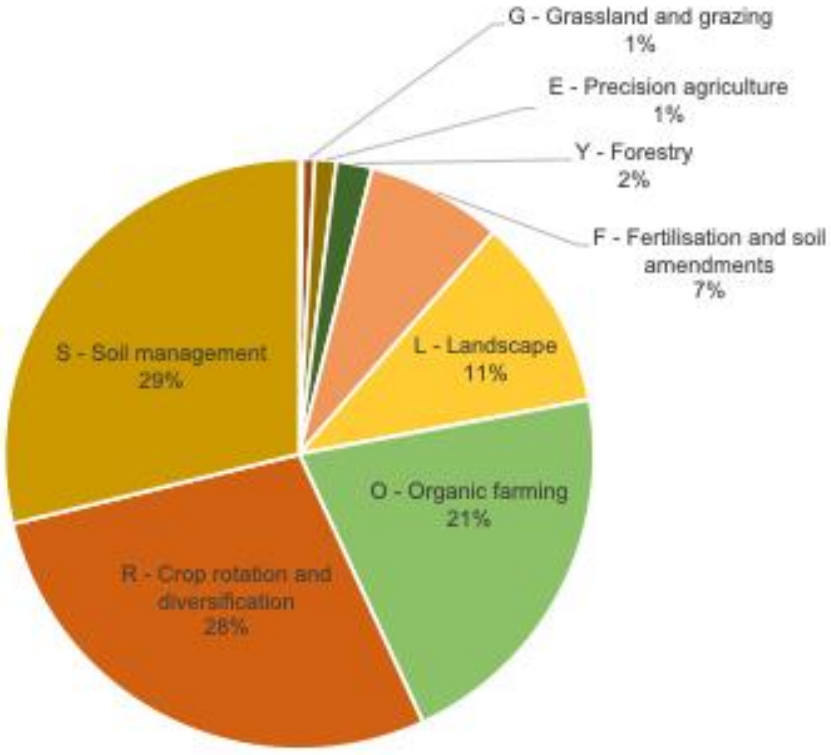
[29] National inventory report and CRF under the UNFCCC and the Kyoto Protocol; see the '*National Inventory Submissions 2023,* United Nations Climate Change website, 2024, https://unfccc.int/ghg-inventories-annex-i-parties/2023.
[30] Tier 1 of the JRC classification scheme; see note Box 2.

Figure 2 - Distribution of the total estimated mitigation potential, aggregated by categories of farming practices (according to the JRC farming practices classification scheme) (%)

Aggregation is done by summing the estimated mitigation potential per category of farming practice for each CSP. The estimated mitigation potential per farming practice is calculated as the sum of the areas (or heads) covered by each practice multiplied by the mitigation coefficient associated with the practice.

Categories M - Manure management, A – Animals and B - Bioeconomy, energy efficiency and production do not appear on the graph because they each contribute to less than 0.5% of the total.

Example on how to read the graph: 28% of the total mitigation and enhanced removal estimated (31.2 million tonnes) is due to the implementation, in the 19 CSPs, of farming practices linked to the category R -Crop rotation and diversification.



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

Figure 3 - Estimated mitigation potential per farming practice, all types of interventions and requirements (GAECs) included, in the 19 CSPs - million tonnes of CO_2e/year

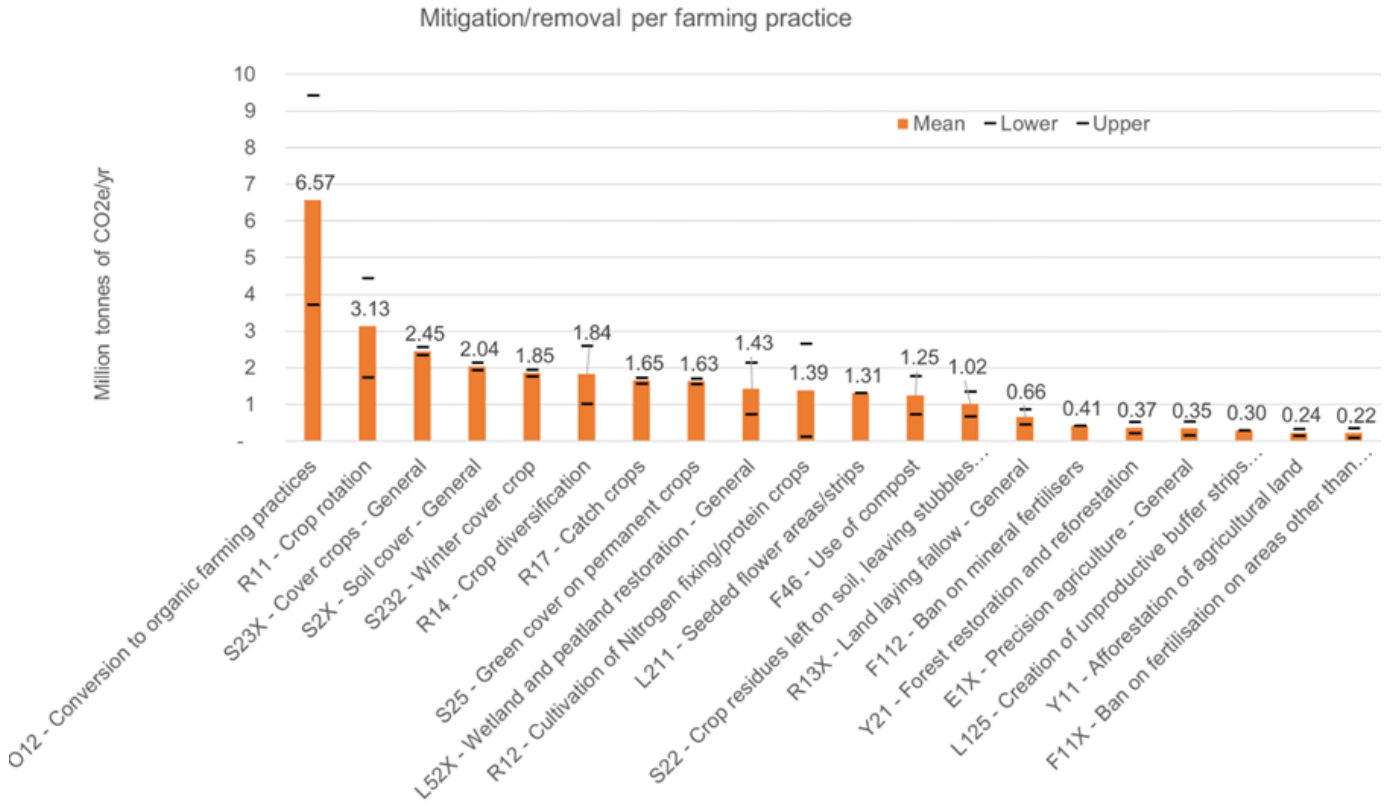
The 20 farming practices listed in this figure are estimated to contribute to 96% of the total estimated mitigation potential (i.e. 31.2 million tonnes of CO_2e annually).

Aggregation is done by summing the estimated mitigation potential per farming practice for each CSP. The estimated mitigation potential per farming practice is the sum of the areas (or heads) covered by each practice multiplied by the mitigation coefficient mean value.

The markers in black (Lower/Upper) represent the upper and lower bounds indicating the 95% confidence interval of the mitigation coefficient per practice (the bigger the interval, the less accurate is the coefficient value of the farming practice concerned). When markers overlap, it means that the confidence interval is not available.

Annex 1 – *Farming practices emissions and removal coefficients* details the emission and removal coefficients of the farming practices mentioned in Figure 3.

Example on how to read the graph: 'Conversion to organic farming practices' (O12) is estimated to potentially avoid GHG emissions and increase carbon sequestration by an average of 6.57 million tonnes of CO_2e annually, compared to the emissions and removals expected if the areas had remained cultivated using conventional practices.



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

20 farming practices contribute the most to the estimated mitigation potential.

Figure 3 provides a detailed view of the 20 farming practices contributing the most to this estimated mitigation potential (out of 47 practices identified in the 19 CSPs that were associated with a coefficient value, i.e. that are estimated to contribute to effect of the CSPs).

At farming practice level, O12 – Conversion to organic farming stands out as the primary contributor, accounting for 21% of the total estimated mitigation potential (6.6 million tonnes out of 31.2 million tonnes).

The group of practices related to soil management is expected to make significant contribution to the total estimated, cumulating 29% of the total estimated mitigation potential (9.0 million tonnes out of 31.2 million tonnes). These include practices such as:

- S23X - Cover crops – General (8%; 2.5 million tonnes out of 31.2 million tonnes)
- S2X - Soil cover – General (7%; 2.0 million tonnes out of 31.2 million tonnes)
- S232 - Winter cover crop (6%; 1.9 million tonnes out of 31.2 million tonnes)
- S22 - Crop residues left on soil, leaving stubbles on the field (3%; 1.0 million tonnes out of 31.2 million tonnes)
- S25 - Green cover on permanent crops (5%; 1.6 million tonnes out of 31.2 million tonnes).

Following closely, are practices related to crop rotation and diversification, contributing 28% of the estimated potential effect (8.8 million tonnes out of 31.2 million tonnes). This group includes:

- R11 - Crop rotation (10%; 3.1 million tonnes out of 31.2 million tonnes)
- R14 – Crop diversification (6%; 1.9 million tonnes out of 31.2 million tonnes)
- R17 - Catch crops (5%; 1.6 million tonnes out of 31.2 million tonnes)
- R12 - Cultivation of Nitrogen fixing/protein crops (4%; 1.4 million tonnes out of 31.2 million tonnes)
- R13X - Land laying fallow – General (2%; 0.7 million tonnes out of 31.2 million tonnes).

The group of practices related to the protection of landscape features contribute 11% to the total estimated potential effect (3.3 million tonnes out of 31.2 million tonnes). This includes practices such as:

- L52X - Wetland and peatland restoration – General (5%; 1.4 million tonnes out of 31.2 million tonnes)
- L211 - Seeded flower areas/strips (4%; 1.3 million tonnes out of 31.2 million tonnes)
- L125 - Creation of unproductive buffer strips along water courses (1%; 0.3 million tonnes out of 31.2 million tonnes).

Fertilisation-related practices contribute 8% to the total estimated potential effect (2.3 million tonnes out of 31.2 million tonnes), including:

- F46 - Use of compost (4%; 1.3 million tonnes out of 31.2 million tonnes)
- F112 - Ban on mineral fertilisers (1%; 0.4 million tonnes out of 31.2 million tonnes)
- F11X - Ban on fertilisation on areas other than along water courses – General (1%; 0.2 million tonnes out of 31.2 million tonnes).

The other practices among the 20 that contribute the most to the estimated mitigation potential are:

- Y21 - Forest restoration and reforestation (1%; 0.4 million tonnes out of 31.2 million tonnes) and Y11 - Afforestation of agricultural land (1%; 0.2 million tonnes out of 31.2 million tonnes)
- E1X - Precision agriculture – General (1%; 0.4 million tonnes out of 31.2 million tonnes).

No mitigation potential is estimated for the animal-related practices

The potential positive effect of practices in the sections A - Animals and M - Manure management is estimated to be negligible. This is due to a small number of farming practices associated with a coefficient value, and to a limited number of CSP interventions focusing on these farming practices.

- Out of 41 animal-related practices in the JRC classification scheme (Sector A – Animals in the classification), only two have a proven mitigation potential (A21 - Animal trait selection for GHG emission and A23 - Animal trait selection for longer lifespan; see Annex 1 – Farming practices emissions and

removal coefficients). For eight of them, the data are not sufficient to determine their mitigation potential (see Annex 2 – Farming practices without data).

- A21 - Animal trait selection for GHG emission is only labelled in Ireland with an estimated potential contribution of 11 505 tonnes of CO_2e per year (reduction of non-CO_2 emissions). A23 - Animal trait selection for longer lifespan is not identified in any of the 19 CSPs.

- Section M - Manure Management includes four practices with a mitigation potential effect (i.e. M114 - Manure acidification during storage, M122 - Composting with forced aeration, M12X - Composting – General and M141 - Solid-liquid separation). However, these practices are labelled only in the CSPs of Austria, Belgium-Flanders and Latvia with an estimated potential contribution of only 5 906 tonnes of CO_2e per year.

- Additionally, some manure-related practices are classified under the section F – Fertilisation and Soil Amendments

Box 3 – Confidence in the coverage of farming practice classification and coefficient values

It is important to acknowledge some methodological limitations to assess the estimated results in this study.

1. Most farming practice coefficients are provided with a mean value, with lower and upper bounds, indicating the 95% confidence interval of the given coefficient. These intervals are indicated by black markers in the figures, providing an indication of the accuracy of the estimated contribution linked to the coefficient associated with the farming practice. It is important to note that these intervals do not account for other sources of uncertainty in the estimated results, particularly the areas estimated to be covered by the practice. This interval can be significant for farming practices such as O12 – conversion to organic farming practices, R11 – Crop rotation, and R14 – Crop diversification, according to the literature consulted in the iMAP project[31]. This affects the precision of the estimated results.

2. As mentioned previously, the effects captured in the coefficients do not include indirect land-use change effects. These effects can be significant in certain cases, particularly the coefficient value for the conversion to organic farming practices

[31] It is even higher for the coefficient values of R12 - Cultivation of Nitrogen fixing/protein crops, L211 - Seeded flower areas/strips and F112 - Ban on mineral fertilisers. See detail in the General Methodology deliverable.

(O12 – conversion to organic farming practices) could be lower if these effects were considered.

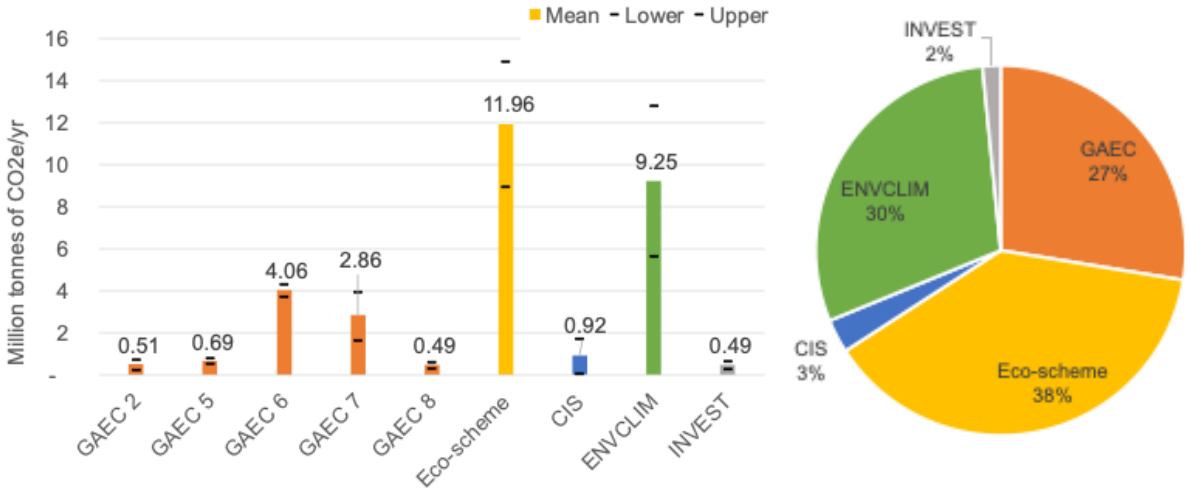
3. Finally, the adopted approach is conservative. As mentioned in Box 2, the study includes farming practices that are expected to have a mitigation or protection potential, but for which no data are available to determine a coefficient, so no mitigation contribution have been considered for those practices. See Annex 2 – Farming practices without data

3.1.2 Estimated mitigation potential per GAEC and type of intervention

Figure 4 reports the distribution of the GHG mitigation and enhanced carbon removal estimated potential per GAEC and type of intervention.

Figure 4 - Estimated mitigation potential per GAEC and type of intervention (million tonnes of CO_2e/yr and %)

Examples on how to read the graph: (graph on the left) Eco-schemes estimated potential contribution at the level of the 19 CSP amounts to 11.96 million tonnes CO_2e of avoided emissions and/or enhanced sequestration compared to the emission/removal level that would occur should all the areas concerned be cultivated with 'standard' farming practices. (graph on the right) 38% of the total estimated GHG emissions mitigation and enhanced removal potential is associated with the implementation, in the 19 CSPs, of the Eco-scheme type of intervention.



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

It is important to consider the difference in approach between interventions and GAECs when reading these results. As explained in Section 2.1.1 of this report, for CAP interventions, the estimated potential contribution encompasses all the areas where farming supported practices are expected to be implemented through the different types of intervention, whereas, for GAECs, the study aims to estimate only the potential

contribution of the additional areas where farming practices will be implemented to comply with the standards in the new programming period, compared to the previous programming period. With this approach, the potential contribution estimated for GAECs might result underrated.

Eco-scheme is the type of intervention that is expected to contribute the most: 38% of the total estimated mitigation potential.

There is a great diversity of Eco-schemes across the 19 CSP, but 75% of the estimated mitigation potential is associated with the following farming practices: R14 - Crop diversification (14%), S2X - Soil cover – General (13%), S232 - Winter cover crop (11%), O12 - Conversion to organic farming practices (9%), S25 - Green cover on permanent crops (9%), L211 - Seeded flower areas/strips (8%), F46 - Use of compost (8%) and R17 - Catch crops (8%).

More details on the distribution of the estimated potential contribution of the Eco-scheme type of intervention per farming practice and per CSP is available in Annex 3 - Estimated mitigation/removal potential contribution of Eco-schemes and ENVCLIM, per CSP and farming practice.

The ENVCLIM type of intervention arises as the second most important contributor, with 30% of the total estimated mitigation potential.

Under this type of intervention, O12 - Conversion to organic farming practices is estimated to be, by far, the main contributing farming practice, accounting for 60% of the estimated potential effect, followed by L52X – Wetland and peatland restoration – General (10%), F112 - Ban on mineral fertilisers (4%) and L211 - Seeded flower areas/strips (4%).

More details on the distribution of the estimated potential contribution of ENVCLIM per farming practice and per CSP is available in Annex 3 - Estimated mitigation/removal potential contribution of Eco-schemes and ENVCLIM, per CSP and farming practice.

Compliance with GAECs has an estimated potential contribution that varies depending on the GAEC.

Compliance to GAECs contributes 27% to the total estimated mitigation potential (see Figure 4).

GAEC 6 – Soil cover and GAEC 7 - Crop rotation on arable land are expected to potentially contribute 13% (4.1 million tonnes out of 31.2 million tonnes) and 9% respectively (2.9 million tonnes out of 31.2 million tonnes).

The other GAECs are expected to contribute less (around 2% each out of the 31.2 million tonnes of CO_2e).

- The estimation of the potential contribution of GAEC 2 - Protection of wetlands and peatlands is challenging due to the lack of information in the CSPs on the areas potentially concerned, and due to the limited number of CSPs including specific requirements in 2023. Its contribution, therefore, is clearly underestimated in this study. See Box 4 for further information.

- GAEC 5 – Tillage management is estimated to have a very small mitigation potential contribution at the 19 CSP level. The farming practices associated with this GAEC are exclusively identified in the CSPs of Belgium-Flanders, Belgium-Wallonia, Czechia, Hungary, Ireland, and Sweden. However, the estimated mitigation contribution appears significant in Czechia and Hungary.

- The potential mitigation contribution estimated for GAEC 8 - Non-productive areas and features is also low at the 19 CSP level. The potential contribution of this GAEC is only linked to the farming practice R13X - Land laying fallow (see the General Methodology deliverable for further detail). It is important to note that part of the potential effect of the GAEC is also reported under the protection of carbon sinks (in Chapter 4). See Box 5 for further information.

- GAEC 1 – Maintenance of permanent grassland does not appear in the results for mitigation. Due to its nature, there is no estimated potential for reduction of GHG emissions or enhanced removals of carbon associated with the protection of existing grasslands. The potential contribution of this GAEC is accounted under protection of carbon sinks (in Chapter 4).

Box 4 – Focus on peatlands and wetlands restoration and maintenance

Restoring peatlands, i.e. rewetting drained peatlands is very effective in terms of carbon sequestration increase compared to drained organic soils. The additional sequestration capacity of a functioning peat forming soil compared to drained peatland, is estimated above 2 tonnes of CO_2e per hectare per year (farming practices L522 - Peatland restoration and L52X - Wetlands and peatland restoration - General). The second most effective practice as regards organic soils, according to the data available for the study, is to maintain them in wet conditions or implement paludiculture. This is protecting existing carbon sinks (farming practices L512 - Peatland maintenance and conservation and L51X - Wetlands and peatland maintenance and conservation – General).

GAEC 2 - **Protection of wetlands and peatlands**

GAEC 2 aims to protect wetlands and peatlands. The standards set in the CSP provide for different types of options, which are associated with both mitigation and protection of carbon sinks. Yet the estimation of the potential contribution of GAEC 2 is challenging and the estimated results presented in this report are overall underrated.

- Potential contribution of GAEC 2 could only be estimated for Latvia and Sweden, as their CSPs provide precise information on the requirements, and data to estimate the areas potentially covered are available[32].
- Mitigation potential is anticipated for several other CSPs (Austria, Belgium-Flanders, Belgium-Wallonia, Finland, Italy, Portugal, and Romania), but data gaps hinder an accurate estimation.
- In particular, the potential effect of the ban on peat extraction is not estimated here. Peat extraction can be quite significant in northern countries. The CRF data for Finland 2021 emissions reported in 2023 indicate that the emissions from peat extraction are estimated to represent, in 2021, 1.8 million tonnes of CO_2e[33]. Cutting all or even part of these emissions would make a very significant difference in the estimations for Finland and even at the level of the 19 CSPs. This is not done due to lack of information on the extent to which the implementation of GAEC 2 could reduce the 1.8 million tonnes mentioned. The other CSPs providing restrictions on peat extraction are those of Austria, Belgium-Flanders, Spain, Portugal and Romania, but the estimated potential effect in these countries is expected to be much less significant.
- No expected potential effect is estimated for Denmark, Germany or Greece due to CSP standards that do not include practices with a potential mitigation effect.
- No conclusion could be drawn for Czechia, France, Hungary, Ireland and the Netherlands.

Voluntary schemes

The screening of the CSPs also led to identify a series of ENVCLIM interventions supporting peatland restoration in Germany, Hungary, Ireland, Latvia, the Netherlands, Finland, Italy and Poland, as well as INVEST interventions in Finland and Belgium-Wallonia.

Effects could be estimated for part of these interventions in Germany, Hungary, Ireland, Latvia and the Netherlands. In the other cases, the lack of data to estimate the area potentially covered or the lack of coefficient values hinders the estimation.

Other types of interventions, namely CIS and INVEST, have a marginal expected potential contribution.

It should be noted that INVEST interventions, particularly non-productive investments, may work in synergy with ENVCLIM interventions. Thus, part of the potential mitigation linked to ENVCLIM interventions may rely on associated INVEST interventions.

[32] Relevant UNFCCC CRF data for 2021 emissions reported in 2023 is available (Cat. 4.II.B. Cropland-Drained organic soil and 4.II.C. Grassland-Drained organic soil)
[33] United Nations climate change, Finland National Inventory Submissions 2023 – 2021, Table 4.D 1.1. Peat extraction remaining peat extraction

Additionally, the estimation of INVEST potential contribution is challenging and possibly underestimated in this study.

Also, the estimated potential contribution of CIS for protein crops, although not significant at the level of the 19 CSP, appears to be significant at national level in Italy and France.

Box 5 – Implication of changes in the CSP regulation on the estimated potential effects

In May 2024, Regulation (EU) 2024/1468[34] amended the CAP Strategic Plan Regulation (EU) 2021/2115[35], leading to significant changes to the standards for GAEC 7 – Crop rotation and GAEC 8 - Non-productive areas and features. The regulatory changes removed stipulations on non-productive areas from the GAEC 8 standard[36] and included the possibility to fulfil GAEC 7 through crop diversification instead of crop rotation.

Within the scope of this study, the potential contribution of GAEC 8 was assessed according to the standards delineated in the CSP adopted in December 2022. The findings indicate that across the 19 CSPs analysed, the implementation of GAEC 8 could potentially contribute to the mitigation of GHG emissions by approximately half a million tonne of CO_2e annually (ranging from 0.33 to 0.64 million tonnes), representing 2% of the total estimated mitigation potential at the level of the 19 CSP. This estimated potential effect is due to the anticipated potential increase in areas with land lying fallow.

Additionally, GAEC 8 is expected to potentially contribute to the protection of existing carbon sinks, predominantly stored in hedgerows and trees, by an estimated 0.89 million tonnes of CO_2e annually. This aspect is not directly affected by the regulatory amendments as GAEC 8 still requires maintenance of existing features.

For GAEC 7, within the scope of the study, the coefficient value of the farming practice associated with crop diversification (farming practice R14 - Crop diversification) is approximated by the value of the coefficient for crop rotation (farming practice R11 - Crop rotation). Therefore, the change in standards is not expected to affect the estimated potential effect of GAEC 7, provided no other modifications are included in the CSP.

[34] Regulation (EU) 2024/1468 of the European Parliament and of the Council of 14 May 2024 amending Regulations (EU) 2021/2115 and (EU) 2021/2116 as regards good agricultural and environmental condition standards, schemes for climate, environment and animal welfare, amendment of the CAP Strategic Plans, review of the CAP Strategic Plans and exemptions from controls and penalties, OJ L, 2024/1468, ELI: http://data.europa.eu/eli/reg/2024/1468/oj

[35] See note 23.

[36] It is suggested in Regulation (EU) 2024/1468 that Member States provide instead support by the means of Eco-schemes covering practices for the maintenance of non-productive areas, such as land lying fallow, and for the establishment of new landscape features, on arable land.

3.1.3 Estimated mitigation potential aggregated according to UNFCCC CRF sectors

As a part to the UNFCCC, the EU reports annually on GHG emissions and removals within the area covered by its Member States. To put CSPs estimated potential contribution into context with regard to current emissions and removals estimated in the 18 Member States, the estimates are aggregated per CRF categories employed by EU Member States under the EU Governance Regulation (EU) 2018/1999[37], to report to the UNFCCC.

For that, each farming practice is linked to one (or several) CRF category(ies). Although the correspondence is not always straightforward because the methodology employed to estimate the mitigation potential effect of the CSP deviates from the IPCC inventory methodologies, this step makes it possible to contextualise the estimated potential contribution of the CSPs. The correspondence between farming practices classification and CRF categories is provided in Annex 1 – Farming practices emissions and removal coefficients. The emission and removal data reported for 2021 in the 2023 submission serve as the basis for comparison with rough estimates calculated in this report.

Figure 5 compares the distribution per CRF categories of the estimated potential contribution of the CSPs (graph on the left) to the distribution of the emission values estimated in the GHG inventory submission to UNFCCC of 2023 (graph on the right).

- Figure 5 illustrates that the CRF categories 3.A – Enteric Fermentation and 3.B - Manure Management contribute to nearly 50% of the emissions reported at national level (graph on the right), while the potential contribution of CSPs to reduce emissions from these categories is estimated to be negligible (17 thousand tonnes of CO_2e annually). This limited potential is due to two primary reasons: a lack of available data to establish coefficient values for several farming practices related to these categories and the fact that, out of the 19 CSPs, very few interventions specifically target these types of practices.

- Conversely, the storage of carbon in cropland soils plays a significant role in the CSPs estimated potential contribution. Almost two thirds (64%) of the estimated annual mitigation potential are associated with the CRF category 4.B – Cropland, which accounts for 5% of the UNFCCC emissions estimated in 2021.

[37] See note 1.

Figure 5 - Comparison of the distribution per CRF category (excluding category 4.A – Forestry) of the CSPs estimated mitigation potential contribution (left) and the national emissions reported to the UNFCCC (right)

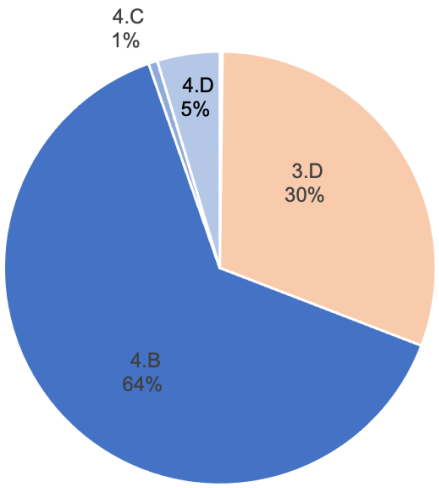
Emission from the energy consumption in the agriculture fisheries and forestry sector (CRF category 1.A.4.C) are also considered here as they are directly related to the agricultural activity (although they also include fisheries and forestry).

The CRF category 4.A – Forestry is excluded from these graphs because this category represents a net sink and cannot be included in the pie chart.

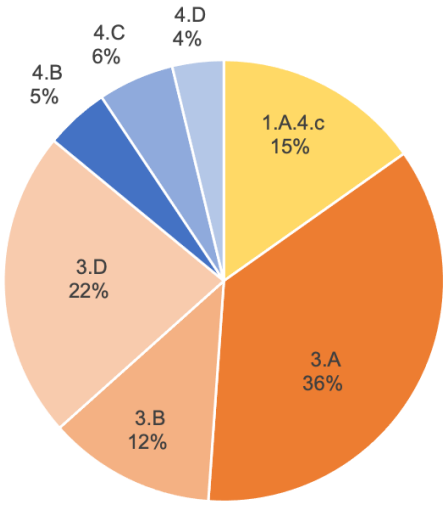
The totals presented above the pie charts only include the categories reported in the pie charts.

Examples on how to read the graph: (graph on the right) Emissions reported under CRF category 3.A – Enteric fermentation account for 36% of the total estimated emissions reported in the 2021, including energy, excluding forestry. (graph on the left) The estimated mitigation potential of the CSPs, associated with CRF category 4.B – Cropland accounts for 64% of the total estimated potential effects of the CSPs; including energy, excluding forestry.

Estimated annual mitigation potential: 31 182 thousand tonnes CO_2e



2021 UNFCCC National emissions: 495 236 thousand tonnes CO_2e



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo, EAA

Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo, EAA

Figure 6 provide more detailed information on the estimated cumulative mitigation potential of the 19 CSP per CRF categories, compared to the 2021 emissions and removal values reported in the GHG inventory submission to UNFCCC of 2023.

Table 1 - Estimated potential mitigation, per CRF categories (thousand tonnes of CO_2e/year and for 5 years) and GHG emissions and carbon removal reported for 2021 (GHG inventory submission to UNFCCC of 2023) of the 19 CSPs

Category 1.A.4.c covers emissions from energy consumption in Agriculture/Forestry/Fishing. Emissions from energy consumption are only available in aggregate for energy consumption in agriculture, forestry and fisheries. Category 3 refers to GHG emissions from agricultural activities. Category 4 pertains to changes in carbon stocks, including emissions and removals, from LULUCF.

The second column displays the estimated annual mitigation potential (data consolidated from this study) aggregated per CRF category, while the last column presents the values cumulated over a five-year period. In these two columns, the estimated mitigation potential indicated with positive values in all categories represent a mitigating effect (enhanced carbon storage or decrease in GHG emissions).

The fourth column indicates the combined 2021 UNFCCC National values[38] from the 18 Member States included in the study, per CRF category. In this column, positive values represent net emissions, while negative value indicate a net removal effect.

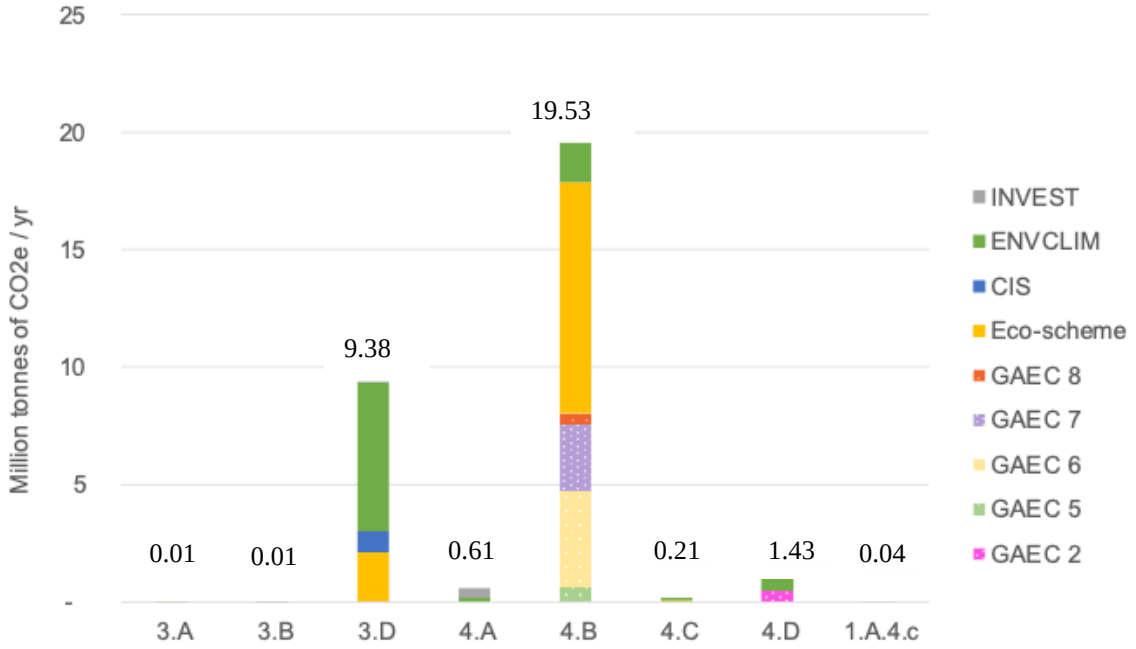
The fifth column illustrates the share of the estimated mitigation potential over the 2021 UNFCCC national values.

	Estimated annual mitigation potential (kt CO_2e/yr)	Main effect	2021 UNFCCC National values (kt CO_2e/yr)	Share (estimate/ annual emissions)	Cumulated 5-year estimated potential (kt CO_2e)
1.A.4.c - Agriculture/Forestry/Fishing	43	Renewable energy	75 435	0%	217
3.A - Enteric Fermentation	12	Reduction of non-CO_2 emissions	177 763	0%	58
3.B - Manure Management	6		60 824	0%	30
3.D - Agricultural Soils	9 381		111 613	8%	46 905
Total CAP related (CRF 3.A + 3.B + 3.D)	9 398		350 201	3%	46 992
Total non-ETS agricultural emissions (CRF 3)	9 398		364 730	3%	46 992
4.A - Forest Land	611	Increase in carbon sinks	- 251 789	0.2%	3 056
4.B - Cropland	19 534		23 227	84%	97 671
4.C - Grassland	206		27 672	1%	1 030
4.D - Wetlands	1 432	Increase in carbon sinks / reduction in emissions from drained peatlands	18 701	8%	7 162
Total CAP related (CRF 4.A + 4.B + 4.C + 4.D)	21 784		- 182 188	12%	108 919
Total LULUCF (CRF 4)	**21 784**		**- 200 226**	**11%**	108 919
Total estimated	**31 226**		**239 938**	**13%**	**156 128**
Total estimated without Energy	**31 182**		**164 504**	**19%**	**155 911**

Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo, EAA

Figure 6 - Estimated mitigation potential, per CRF category, type of intervention and GAEC (million tonnes of CO_2e/yr)

Example on how to read the graph: Mainly three types of intervention contribute to the estimated mitigation potential associated with the CRF category 3.D – Agricultural Soils (9.38 million tonnes in total). In this CRF category, the ENVCLIM type of intervention is responsible for approximately 6 million tonnes of CO_2e, while the Eco-scheme for just over 2 million tonnes.



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

The main estimated mitigation potential is expected in CRF categories 4.B – Cropland and 3.D – Agricultural soils

The main estimated mitigation potential contribution from the CSPs (62% of 31.2 million tonnes total estimated potential) regards the enhanced carbon storage in soils on cropland (specifically, CRF category 4.B – Cropland), resulting in a potential yearly contribution of 19.5 million tonnes of CO_2e. As shown in Table 1 above, this represents 84% of the GHG emissions reported under this category for 2021 (19.5 million tonnes out of 23.2 million tonnes), and 11% of the total of sector 4, including forestry sink capacity (19.5 million tonnes out of 200 million tonnes).

[38] See note 29.

This outcome is due mainly to the Eco-scheme interventions and compliance with GAEC 6 – Minimum soil cover and GAEC 7 – Crop rotation in arable land. It is associated with practices:

- S23X - Cover crops – General, S2X - Soil cover - General and S232 - Winter cover crop, S22 - Crop residues left on soil, leaving stubbles on the field, S25 - Green cover on permanent crops
- R11 - Crop rotation, R14 - Crop diversification, R17 - Catch crops
- L211 - Seeded flower areas/strips
- F46 - Use of compost.

The other noticeable estimated mitigation potential is the decrease in non-CO_2 emissions from agricultural soils (category 3.D – Agricultural soils) by an estimated yearly potential of 9.4 million tonnes of CO_2e, accounting for 30% of the total estimated potential effect (9.4 million out of 31.2 million tonnes). As shown in Table 1 above, the 9.4 million tonnes represent 8% of the emissions reported under this category for 2021 (9.4 million tonnes out of 111.6 million tonnes), and constitute 3% of the emissions levels from the whole agricultural sector – sector 3 (9.4 million tonnes out of 364 million tonnes).

These outcomes are due primarily to the ENVCLIM interventions and, to a lesser extent, to the Eco-scheme and CIS interventions. The support for conversion to organic farming (associated with farming practice O12 - Conversion to organic farming) is by far the main contributor to the potential effect in category 3.D – Agricultural soils, followed by practice R12 - Cultivation of Nitrogen fixing/protein crops.

Limited potential effects are expected in the other categories.

The estimations show some mitigation potential in CRF category 4.D - Wetlands, i.e. enhanced carbon storage in restored peatland. The estimated potential effect represents nearly 5% of the total estimated (1.4 million tonnes out of 31.2 million tonnes), and 8% of the emissions reported in this category for 2021 (1.4 million tonnes out of 18.7 million tonnes).

These outcomes are due primarily to the ENVCLIM interventions in Italy and Germany (54% of the estimated potential effect). As already mentioned, the estimation of GAEC 2 is particularly challenging and the contribution to this category is only due to two CSPs providing enough information to perform the estimations, i.e. Latvia and Sweden. The potential contribution of the GAEC 2 standards to CRF 4 is certainly significantly higher (see Box 4).

The estimations show no or non-significant mitigation potential in CRF categories 3.A – Enteric Fermentation, 3.B – Manure Management, 4.A – Forest Land, 4.C – Grassland and 1.A.4.c - Agriculture.

For **category 3.A - Enteric fermentation**, only very few farming practices are expected to have a potential positive contribution to mitigate methane emissions (see Annex 1 – Farming practices emissions and removal coefficients), and these are planned only through ENVCLIM interventions in Ireland. Similarly, very few farming practices target manure management (which would contribute to mitigate methane emissions from CRF **category 3.B - Manure management**) with significant mitigation potential (M12X - Composting – General and M141 - Solid-liquid separation). Only four interventions include these practices, and it regards three CSPs (in Austria, Belgium-Flanders and Latvia).

As for the forest category, **CRF category 4.A - Forest**, only afforestation interventions can potentially enhance carbon removal. Hence only two farming practices are associated with this CRF category: Y11 - Afforestation of agricultural land and Y21 - Forest restoration and reforestation[39]. The mitigation potential is estimated in eight CSPs, through the ENVCLIM and INVEST interventions.

In the case of grasslands, the estimated potential effect on carbon removals (**CRF category 4.C – Grassland**) exclusively refers to the conversion of arable land to grassland (farming practice G27 - Conversion of arable land to grassland, as per the JRC classification scheme). The conversion of arable land to grassland was identified in four CSPs (Italy, Germany, Czechia and Belgium-Flanders) only, almost exclusively in ENVCLIM interventions.

Finally, **CRF category 1.A.4.c - Energy - Agriculture/Forestry/Fishing** indicates the potential contribution of investment in renewable energy supported through INVEST interventions identified considering result indicator R.15 'Renewable energy from agriculture, forestry and from other renewable sources'. Although 18 of the 19 CSPs included in the study provide support to renewable energy, the estimated mitigation potential is marginal compared to the national emissions reported in category 1.A.4.c[40] and compared to the overall estimated mitigation potential contribution of the 19 CSPs.

[39] Forest restoration and management are expected to protect existing carbon storage capacity; therefore, their effect is accounted under 'Protection of sinks'.
[40] 'Emissions from energy consumption in agricultural production' is only available in aggregate form for energy consumption in agriculture, forestry and fisheries.

3.2 Comparative analysis of the 19 CSPs studied

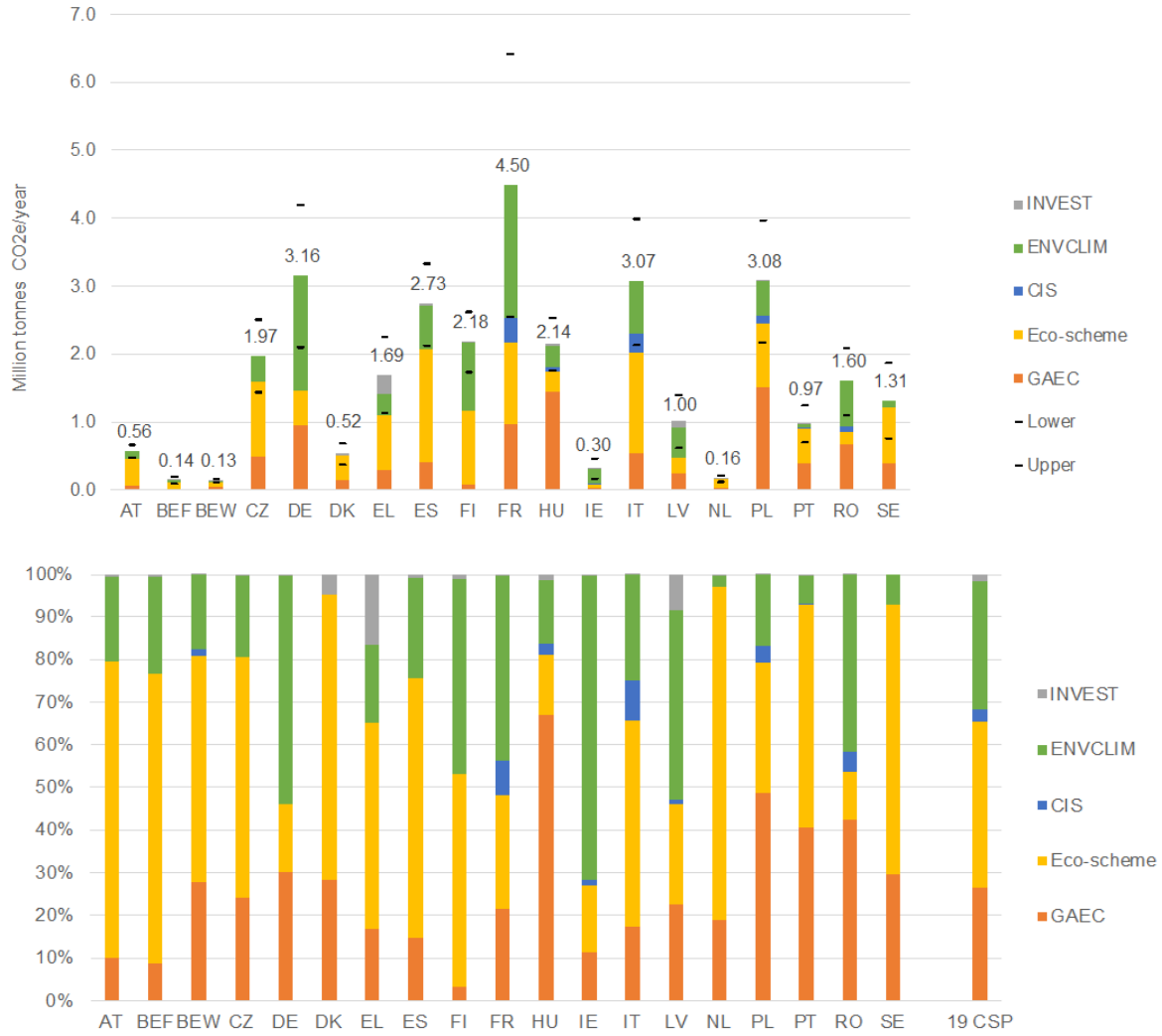
This section analyses the potential contribution of the 19 CSPs to the overall mitigation estimated potential of 31 million tonnes of CO_2e per year.

3.2.1 CSP estimated mitigation potential, per GAEC and type of intervention

Figure 7 presents the breakdown of the estimated mitigation potential per CSP and per type of intervention or GAEC. As mentioned in Chapter 2, it is important to consider the difference in approach between interventions and GAECs.

Figure 7 – CSP estimated mitigation potential per GAEC and type of intervention

Example on how to read the graph: In Austria (AT), it is estimated that 0.56 million tonnes of CO_2e per year of GHG emissions can potentially be avoided and/or removed from the atmosphere (upper graph). Approximately 70% of the potential estimated is due to the Eco-scheme type of intervention, around 20% to ENVCLIM, about 10% to GAECs and less than 1% to INVEST (lower graph).



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

The estimated mitigation potential of the 19 CSPs ranges from 0.13 million tonnes to 4.5 million tonnes of CO_2e. Notably, four CSPs – those of France, Germany, Italy and Poland, with a combined estimated potential of 13.8 million tonnes – account for 44% of the total estimated mitigation potential (representing 45% of the EU-27 UAA[41]).

The relative estimated mitigation contribution of the different types of intervention to the national estimated mitigation potential varies significantly from one CSP to another.

Overall, the contribution of the GAECs to the total mitigation potential ranges from 3% to 67% among the CSPs.

GAECs show a relatively higher estimated mitigation potential in Hungary and Poland compared to the 19 CSPs average. The factors contributing to the relatively higher GAEC contribution in Hungary and Poland are:

- high values for GAEC 6 - Minimum soil cover
- high values for GAEC 5 – Tillage management, in Hungary

Box 6 – Specific observations on GAECs in Hungary and Poland

GAEC 6 in Hungary and Poland

The calculation method is based on the difference between CSP soil cover targets and a baseline which is the 2016 Eurostat soil cover data for the country. In these two Member States, the targets are ambitious compared to the baseline conditions. The significant difference indicates that large areas should see new soil covers installed. These areas are associated with farming practices such as S25 - Green cover on permanent crops, S22 - Crop residues left on soil, leaving stubbles on the field and S23X - Cover crops – General.

GAEC 5 in Hungary

In addition, in Hungary, GAEC 5 is estimated to have a significant potential effect as well. Hungary is one of the few Member States where GAEC 5 shows a significant potential, alongside Czechia.

On the other hand, GAECs are estimated to have a relatively low potential contribution in Finland, Austria, Belgium-Flanders, Ireland and the Netherlands, compared to the average.

[41] See note 19.

Box 7 – Specific observations on GAECs in Austria, Belgium-Flanders, Finland, Ireland and the Netherlands

These CSPs show low values in GAEC 6 - Minimum Soil Cover and GAEC 7 - Crop Rotation. In addition, no other GAEC is estimated to have a potential significant contribution for these CSPs, thereby contributing to the relatively low overall estimated mitigation potential from GAECs.

GAEC 6 - Minimum Soil Cover

To estimate the potential contribution of GAEC 6, a comparison was made between the target set in the requirements and a baseline which is the 2016 Eurostat soil cover data for the country. The CSPs of Austria (only for arable land), Belgium-Flanders, Finland and the Netherlands set targets lower than their bare soil ratios. In these cases, it is considered that the GAEC does not have a constraining potential and will not result in an increase in the area covered. Therefore, for these CSPs, no mitigation potential is estimated for the GAEC.

For Ireland, the estimate for GAEC 6 is low due to the limited areas of bare soil.

GAEC 7 - Crop Rotation

For GAEC 7, the approach considers the proportion of annual rotation required at farm level. For Austria, Belgium-Flanders, Finland and the Netherlands, the requirement is low, at around two third of the farm total area. Combined with exemptions that can amount to half the arable land area, and/or with the limited UAA in the country, this may explain the low contributions estimated for these CSPs.

GAEC 2 - Protection of wetlands and peatlands

As mentioned already, the estimation of the potential effects of GAEC 2 is challenging and certainly underrated. This is particularly the case for Finland, whose CSP provides for a ban on peat extraction, the potential effect of which is not included in the calculation. See Box 4

The contribution of different types of intervention to the total estimated mitigation potential varies significantly across CSPs.

The contribution of the Eco-scheme intervention to the total estimated mitigation potential varies between 11% and 78%, while the contribution of the ENVCLIM intervention ranges from 0% to 72%.

In the Netherlands, Austria, Belgium-Flanders and Denmark, the Eco-Schemes account for a relatively higher share to the estimated potential, compared to the 19 CSPs average. Whereas in Ireland and Germany, ENVCLIM interventions account for a relatively higher share.

Box 8 - Specific observations on the contribution of Eco-Scheme and ENVCLIM interventions in selected CSPs

Below is discussed the relatively high share of Eco-scheme and ENVCLIM types of intervention in the estimated mitigation potential of selected CSPs

Eco-scheme > ENVCLIM
Belgium-Flanders: • In the estimation, the Eco-Scheme outweighs the ENVCLIM interventions because of the potential contribution of two farming practices with high coefficient values: F46 - Use of compost and F112 - Ban on mineral fertilisers. These two farming practices account for 44% of the estimated mitigation potential of the Eco-scheme of the Belgium-Flanders CSP. **Netherlands:** • The Eco-scheme primarily targets farming practices with mitigation effect such as S2X - Soil cover, L111 - Creation of new hedges/wooded strips, R17 - Catch crops or R12 - Cultivation of Nitrogen fixing/protein crops. • On the contrary, 50% of the area planned to be covered by ENVCLIM are linked to farming practices that are not expected to contribute directly to climate change mitigation (G12, G221, G2X, L15X, L45, S13 and P22)[42]. **Austria:** • The Eco-scheme is expected to contribute significantly to increasing the areas with catch crops (R17), thereby contributing 31% of the estimated mitigation potential of the CSP. • In contrast, the ENVCLIM interventions focus on the protection of sinks (O11 - Maintenance of organic farming practices) and have a lower expected mitigation potential. **Denmark:** • Eco-scheme type of intervention is relatively higher than the ENVCLIM type because no mitigation potential could be estimated for the ENVCLIM type of intervention. The ENVCLIM intervention is associated with the farming practice Y22 - Sustainable Forest management, that contributes to the protection of sinks (and not to mitigation) and with the farming practice L5X - Management of wetland/peatland, that has a high mitigation potential, but for which data to estimate the areas concerned are not sufficient.
ENVCLIM > Eco-scheme
Ireland: • In the ENVCLIM intervention, the organic farming scheme support to conversion (farming practice O12) contributes 57% of the estimated mitigation potential of the CSP. • On the other hand, the estimated mitigation potential of the Eco-scheme is low because the intervention is associated with farming practices that do not have coefficient values, due to lack of data or absence of proven positive effect (G131, G132, F214, F121, F33)[43].

[42] G12 - None or restricted grazing, G1X - Grazing management, G21 - Mowing obligations, G221 - Mowing restriction on timing, G2X - Grassland management, L15X - Ditches, P22 - Limitation in quantity of plant protection products, S13 - Restriction on tillage

[43] G131- Minimum stocking density, G132- Maximum stocking density (extensive grasslands), F214 - Solid manure incorporation (within 24h), F121 - Max mineral fertiliser input, F33 - Amendment with Lime.

Germany:

- The ENVCLIM support to the conversion to organic farming (farming practice O12) is expected to be very large and it is estimated to contribute to half of the CSP estimated mitigation potential.
- On the other hand, the Eco-scheme (extensification of permanent grassland) does not contribute to the mitigation estimated potential, despite the area covered (nearly 10 million hectares in total over the period 2023-2027), because the three farming practices supported have no coefficient value[44].

Contribution of CIS for protein crops and INVEST interventions is relevant only in few CSPs.

The estimated mitigation potential of CIS interventions is relevant only in Italy, France, Romania and Poland, where CIS interventions for protein crops are included. In these Member States, the planned outputs for these interventions are significant compared to the other CSPs.

As for INVEST, this type of intervention is contributing to the estimated mitigation potential mainly in Greece and Latvia.

Box 9 – Specific observations on the contribution of INVEST in Greece and Latvia

In Greece and Latvia, section Y – Forestry is responsible for the relatively high estimations.

In **Greece** the farming practices Y21 - Forest restoration and reforestation and Y11 - Afforestation of agricultural land account for 17% of the total estimated mitigation potential (0.3 million tonnes out of 1.7 million tonnes). In **Latvia**, the farming practice Y21 - Forest restoration and reforestation represents 11% of the total estimated mitigation potential of the CSP (0.11 million tonnes out of 1.0 million tonnes).

The estimation of INVEST interventions' mitigation potential is particularly challenging and requires specific assumptions, as this type of intervention is usually paid per operations. The approach to estimate a potential contribution primarily relies on result indicators (R.15, R.16, R.17, R.27 and R.30)[45]. However, relevant data are not always provided in the CSPs, making it impossible to estimate the INVEST potential contribution. For instance, in Germany, the potential contribution of non-productive

[44] The intervention is associated with 3 farming practices for which no coefficient value is available: G11 - Minimum grazing period, G131 - Minimum stocking density and G132 - Maximum stocking density (extensive grasslands).

[45] R.15 - Renewable energy from agriculture, forestry and from other renewable sources; R.16 - Investments related to climate; R.17 - Afforested land; R.27 - Environmental or climate-related performance through investment in rural areas; and R.30 - Supporting sustainable forest management

investments in the forestry sector (intervention EL-0407) cannot be estimated due to insufficient information in the CSP regarding the areas expected to be covered.

Additionally, there is a risk of double counting in cases where INVEST interventions are complementary to ENVCLIM or Eco-scheme interventions. For example, potential contributions of INVEST support for productive investments on farms related to organic farming, such as in the intervention 3.23 in the CSP of Belgium-Flanders, are not estimated in order to avoid any double counting with the potential contribution estimated for direct support for conversion to or maintenance of organic farming.

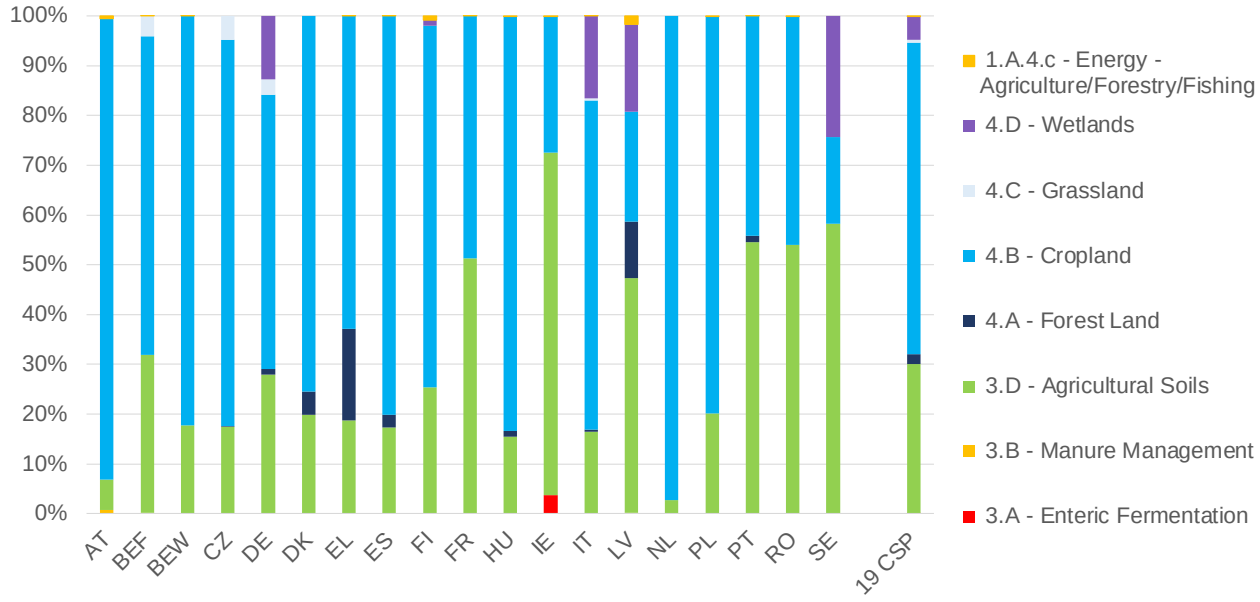
3.2.2 Estimated mitigation potential per CRF category

In Figure 8, the estimated potential contribution per CRF category shows significant variation across the 19 CSPs in the study.

At the EU-18 level, almost two thirds (64%) of the estimated annual mitigation potential are associated with the CRF category 4.B – Cropland, while 30% are associated with the category 3.D – Agricultural soils (see Figure 5).

Figure 8 - Estimated mitigation potential per CSP and CRF category

Example on how to read the graph: In Austria (AT), it is estimated that more than 90% of the mitigation potential is linked to enhancing carbon sequestration in cropland areas (CRF category 4.B – Cropland), and around 6% is linked to reducing non-CO_2 emissions from agricultural soils (CRF category 3.D – Agricultural Soils).



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

In Figure 8, some outstanding elements appear when comparing the various CSP with the 19 CSPs estimated average:

Six CSPs are estimated to have a relatively lower mitigation potential linked with CRF category 4.B – Cropland.

For Sweden, Latvia, Ireland, Romania, Portugal and France, the estimated mitigation potentials associated with CRF category 4.B - Cropland range from 17 to 49% of the total estimated at CSP level. In these CSPs, the estimated mitigation potential is mainly due to a large contribution from organic farming practices (O12), E1X - Precision agriculture and R12 - Cultivation of Nitrogen fixing/protein crops.

Two CSPs are estimated to have a relatively lower mitigation potential linked with CRF category 3.D – Agricultural Soils.

Austria and the Netherlands have only few interventions linked with farming practices contributing to reduce non-CO_2 emissions from agricultural soils (CRF category 3.D - Agricultural soils) and, therefore, their estimated potential contribution is limited. In Austria, ENVCLIM interventions contribute relatively more to this category, while in the Netherlands, Eco-scheme, ENVCLIM and INVEST interventions are relatively more important.

Only four CSP are estimated to have a relatively higher mitigation potential linked with CRF category 4.D - Wetlands.

Sweden, Italy, Latvia and Germany are the only CSPs which include farming practices related to category 4.D – Wetlands (linked with GAEC 2 for Latvia and Sweden, and with ENVCLIM interventions for Italy and Germany). It is important to note, as already mentioned in Box 4, that the estimated potential contributions of GAEC 2 on the restoration of wetlands and peatlands presented in this report are overall underrated.

Other remarks

In Belgium-Flanders, Czechia, Germany and Ireland the protection of grasslands (CRF 4.C - Grassland), holds particular importance thanks to the expected implementation of farming practice G27 - Conversion of arable land to grassland.

In Greece, Latvia and, to a lesser extent, Spain and Germany, interventions targeting the increase of agroforestry or sustainable forest management (CRF category 4.A – Forest Land) have a relatively higher contribution to the mitigation potential than in the other CSPs.

Ireland stands out as the only CSP for which a mitigation potential linked to subcategory 3.A – Enteric fermentation is estimated. As mentioned above, this is because the Irish CSP is the only one including an intervention promoting animal selection.

4 Estimated protection of carbon sink potential

The protection of carbon sinks describes the estimated potential contribution expected from the CSP interventions and the application of GAECs towards the protection of carbon stored in the soils (grasslands, peatlands, lands under organic farming) or in woody features (forests, hedgerows), by maintaining these areas and encouraging their sustainable management.

The coefficient values associated with the farming practices favourable to the carbon protection, as per the JRC classification scheme, account for the difference in carbon sequestration compared to the maintenance of existing practice. The coefficient can be null when maintaining a practice does not deliver an additional effect and it is in any case lower than the corresponding farming practice that is newly implemented (for instance the coefficient value of G26 – Conservation/maintenance of grassland is lower than the one of G27 – Conversion of arable land to grassland). See the Annex 1 – Farming practices emissions and removal coefficients for the practices with a coefficient value associated with protection.

The estimated carbon sink protection potential is linked to a smaller number of farming practices compared to farming practice linked to emission reduction and removals. The dedicated chapter presents the results of the protection of carbon sinks of the 19 CSPs assessed more concisely than the chapter analysing the estimated mitigation potential but following the same logic.

4.1 Protection of carbon sink at the level of the 19 CSPs

The analysis of the 19 CSPs indicates a potential positive contribution to the protection of existing carbon sinks of 29 million tonnes of CO_2e yearly across the 18 Member States.

Ten farming practices are estimated to contribute to protect carbon stored in soil or in biomass**.**

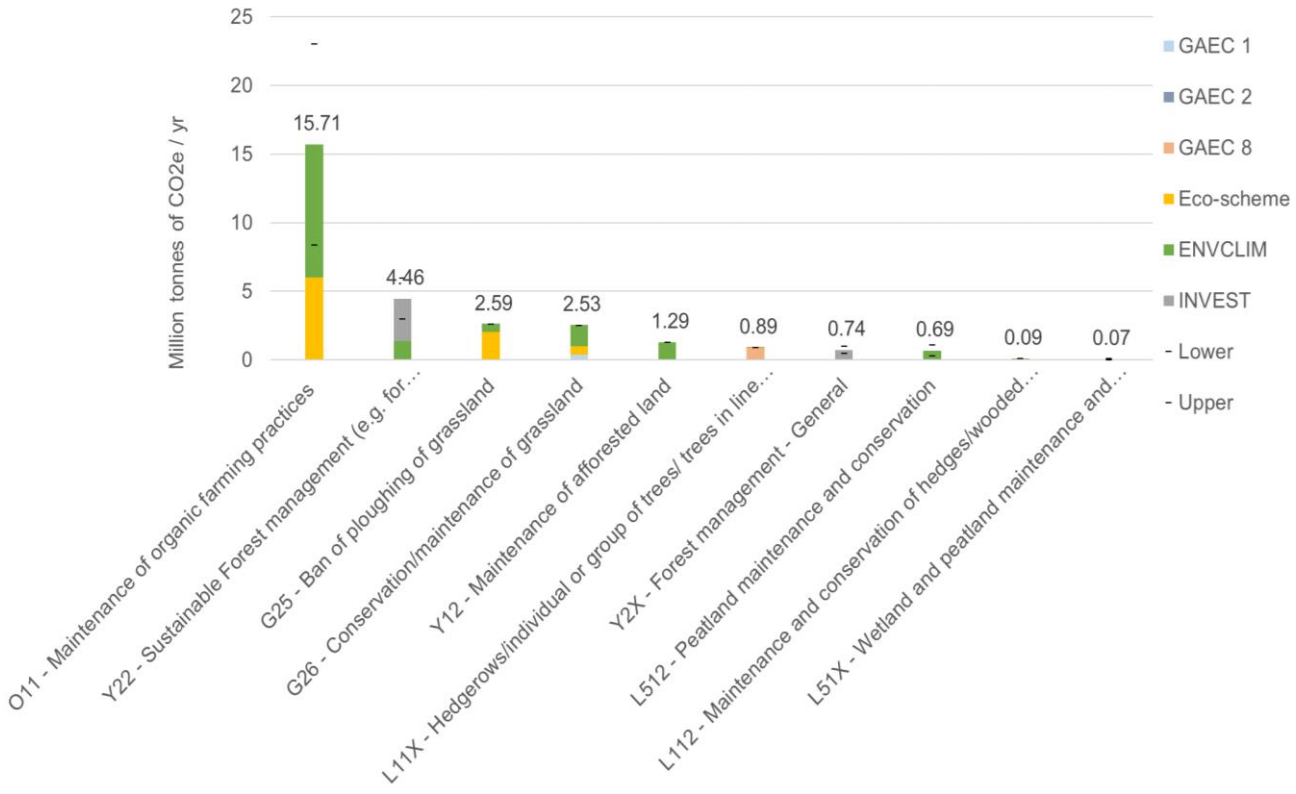
Figure 9 - Estimated carbon sinks protection potential (million tonnes of CO_2e/year) - all types of interventions and requirements (GAECs) included, in the 19 CSPs

The graph presents the exhaustive list of farming practices estimated to have a potential effect on the protection of carbon sinks (10 farming practices).

Aggregation is done by summing the estimated potential per farming practice in each CSP. The protection potential per farming practice is the sum of the areas covered by each practice multiplied by the coefficient mean value.

The markers in black (Lower/Upper) represent the upper and lower bounds of the 95% confidence interval of the coefficient per practice (the bigger the interval, the less accurate is the coefficient value of the farming practice concerned). When markers overlap, it means that the confidence interval is not available.

Example on how to read the graph: By maintaining organic farming practices (O11), the CSPs contribute to protect the carbon stock already stored. The overall quantification of the potential contribution is estimated at 15.7 million tonnes of CO_2e yearly, i.e. the annual additional removal capacity of organic farming compared to conventional practices, multiplied by the areas benefiting from support to organic maintenance.



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

One single farming practice, i.e. O11 - Maintenance of organic farming practices, significantly contributes to the estimated protection potential, accounting for 54% of the total estimated protection potential. Across the 19 CSPs, this farming practice is usually supported via Eco-scheme and/or ENVCLIM types of interventions.

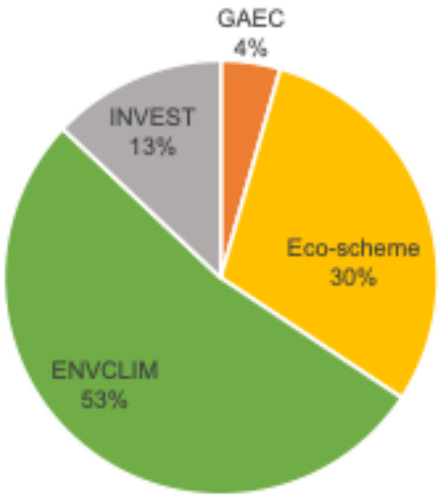
The group of farming practices related to forestry, Y22 - Sustainable Forest management (e.g. for biodiversity, carbon sequestration, fire, genetic resources clearance), Y12 - Maintenance of afforested land and Y2X - Forest management – General, accounts for 22% of the estimated protection potential altogether.

Protection of grasslands (practices G25 - Ban on ploughing of grassland and G26 - Conservation/maintenance of grassland) comes third, contributing to 18% of the total estimated protection potential.

Finally, some limited contributions are estimated to be due to the maintenance or protection of hedgerows, trees, and peatlands.

Figure 10 - Estimated protection potential per type of intervention and GAEC (%)

Example on how to read the graph: across the 19 CSPs, 53% of the estimated carbon sink protection potential is linked with the implementation of ENVCLIM interventions.



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

Looking at the results per type of intervention and GAEC, the following can be noted:

- **ENVCLIM** stands out as the main type of intervention contributing to the estimated protection potential. The maintenance of **organic farming** is mostly supported through this type of intervention (accounting for 63% of the ENVCLIM protection potential). The farming practices G26 – Conservation/maintenance of grassland and Y22 – Sustainable forest management, each represent about 10% of the ENVCLIM protection potential estimated.

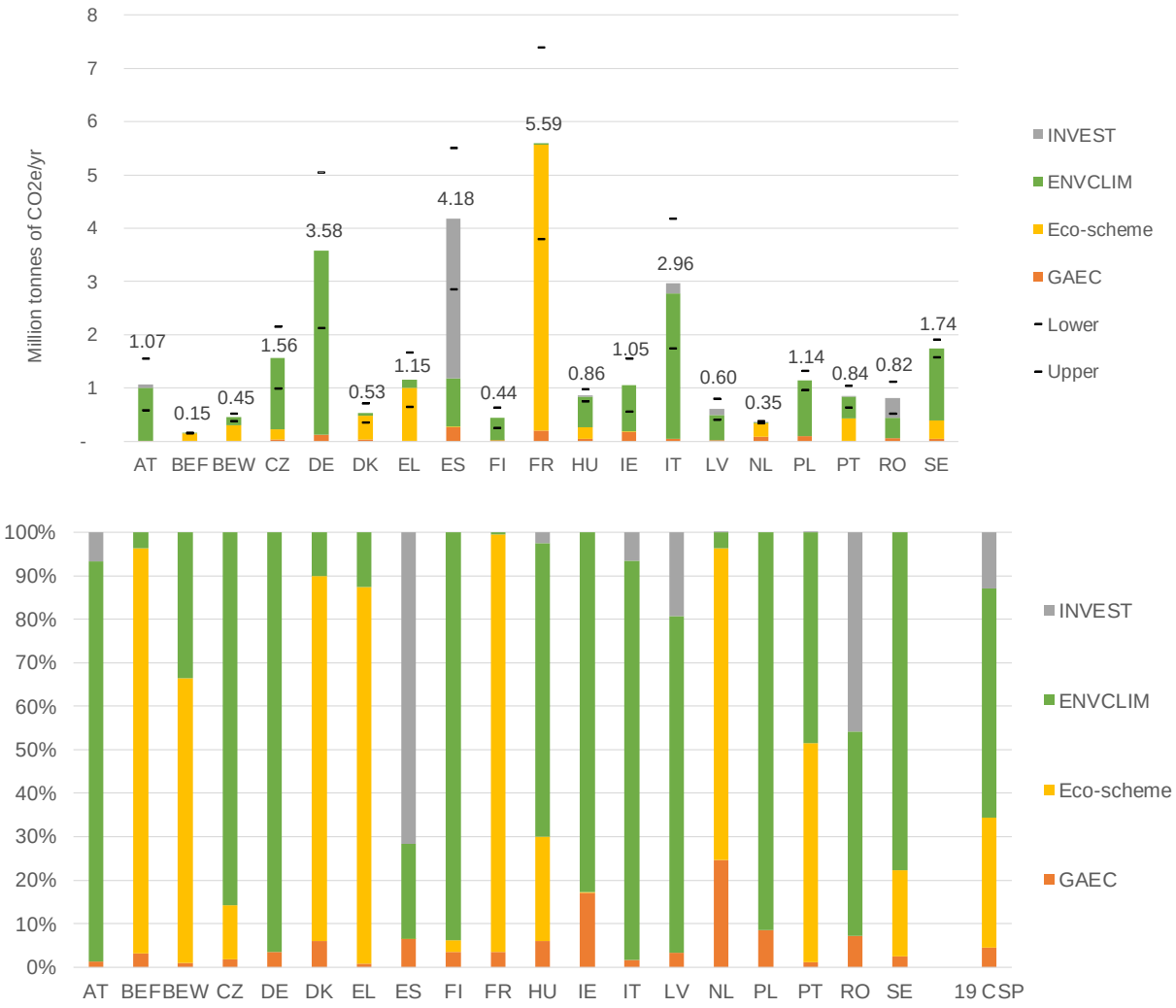
- **Eco-schemes** also have estimated significant protection potential. Also in this case, this is mostly because they support the **maintenance of organic farming practices** (69% of the estimated protection potential of Eco-schemes), but also significantly through the farming practice G25 - ban on ploughing grassland (23% of the estimated protection potential of Eco-schemes).
- The estimated protection potential of **INVEST** interventions is instead almost exclusively linked to support to **sustainable forest management**.
- Due to the difficulty to quantify GAECs' contribution against a baseline, the applied approach for GAECs shows an estimated small net additional contribution (these measures are mostly to maintain carbon in soils).
    - The expected potential contribution **of GAEC 1 - Maintenance of permanent grassland** estimated in the study is limited to the grassland areas that will not be converted into cropland to comply with the standards. The estimated contribution of this GAEC to carbon is also limited since this obligation is in place for many years.
    - **GAEC 2 - protection of wetlands and peatlands** includes, in certain CSPs, restrictions on land-use change, which should contribute to the protection of carbon sink. However, in the assessed CSPs data are missing to precisely estimate the areas protected. It should be noted that, based on the coefficients available for the farming practices related to peatland conservation, the contribution of GAEC 2 on the protection of carbon sinks could be potentially more significant providing that the data to estimate the area covered are available.
    - **GAEC 8 - non-productive areas and features** is expected to contribute to the protection of carbon stored in biomass and soil by preserving the existing hedgerows. Nevertheless, the conservative approach applied to this GAEC delivers limited results.

4.2 Comparative analysis of the 19 CSPs studied

In this section, the contribution of the 19 CSPs to the overall carbon sink protection potential is assessed.

Figure 11 - Estimated carbon protection potential per CSP, all types of interventions and GAECs included, in mass units and relative values

Examples on how to read the graph: (upper graph) In Austria (AT), the estimated carbon sink protection potential is estimated in approximately 1.1 million tonnes of CO_2e per year. (lower graph) Approximately 90% of the estimated protection potential is due to ENVCLIM interventions, around 5% to INVEST and about 1% to GAECs.



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

France has the CSP with the highest estimated protection potential (almost 20% of the total protection potential across EU-18). The protection potential effect of the French CSP is due almost exclusively to the Eco-scheme intervention which promotes both the maintenance of organic farming (72% of the estimated protection potential) and the maintenance of grassland (28% of the estimated protection potential).

By contrast, **in most CSPs showing a relatively higher level of estimated protection potential, the relative contribution of ENVCLIM interventions is higher** (Germany, Italy, Sweden, Czechia). In Italy, for instance, the estimated protection potential is due mainly to the payments to maintain organic farming (accounting for 88% of the estimated protection potential under the Italian ENVCLIM intervention). In Germany, it is also due to the maintenance of organic farming (77% of the estimated protection potential under the German ENVCLIM intervention) and to sustainable forest management (21% of the estimated protection potential under the German ENVCLIM intervention).

Another outstanding feature is the contribution of INVEST interventions to the estimated protection potential for the Spanish and Romanian CSPs. In these two countries, INVEST interventions target substantial areas for sustainable forest management, explaining the high protection potential estimated. INVEST interventions are estimated to contribute to a limited extent to the protection of carbon sinks in four other Member States (Austria, Hungary, Italy, and Latvia).

Finally, the estimated contribution of GAECs to protection potential varies from one CSP to the other. This variation is mainly linked to the estimations for GAEC1 – Maintenance of permanent grasslands, as it is estimated that this GAEC does not have a potential effect on the trends in permanent grassland areas except in Spain, Ireland and the Netherlands.

Figure 12 - Estimated carbon sink protection potential per CSP and per farming practice

The 10 farming practices estimated to have a potential contribution on the protection of carbon sinks are grouped under four types of practices (called 'sections' in the JRC classification scheme – which correspond to the first letter of the code):

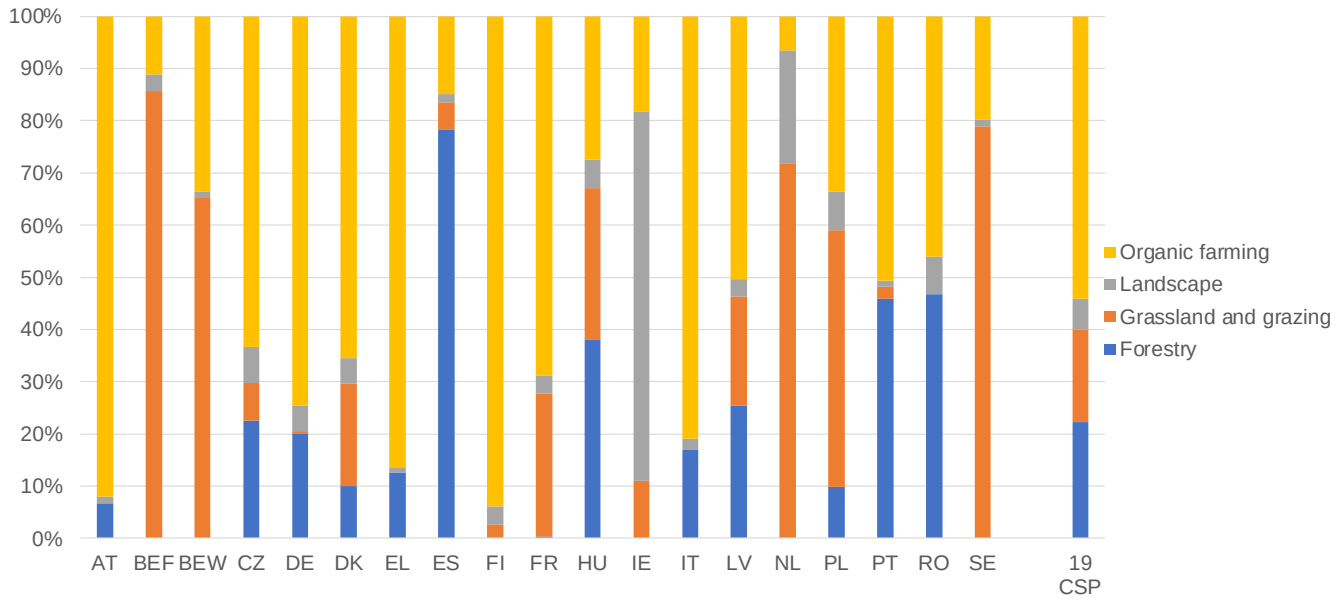
Organic farming:
- O11 - Maintenance of organic farming practices

Landscape:
- L112 - Maintenance and conservation of hedges/wooded strips
- L11X - Hedgerows/individual or group of trees/ trees in line - General
- L512 - Peatland maintenance and conservation
- L51X - Wetland and peatland maintenance and conservation - General

Grassland and grazing:
- G25 - Ban on ploughing of grassland
- G26 - Conservation/maintenance of grassland

Forestry
- Y12 - Maintenance of afforested land
- Y22 - Sustainable Forest management (e.g. for biodiversity, carbon sequestration, fire, genetic resources, clearance)
- Y2X - Forest management - General

Example on how to read the graph: In Austria (AT), it is estimated that approximately 90% of the protection potential is due to maintenance of organic farming, around 5% to forestry-related farming practices and the remainder to landscape-related practices. No estimated protection potential is due to grassland and grazing farming practices.



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

Figure 12 shows that **the maintenance of organic farming often represents the main source of estimated protection potential**. This farming practices is either supported by Eco-scheme or ENVCLIM interventions.

As previously outlined, interventions linked to forest management can also play a significant role in safeguarding carbon sinks, notably in Spain and Romania, as well as in Portugal and Hungary, where ENVCLIM interventions support the maintenance of afforested land.

The preservation of carbon sinks through grassland maintenance varies widely across CSPs. In Sweden and Poland, ENVCLIM interventions are estimated to contribute significantly to the protection of grassland. On the other hand, in Belgium-Wallonia, Belgium-Flanders and the Netherlands, grasslands conservation is primarily achieved through Eco-schemes, which are estimated to cover extensive areas. In all these CSPs, grassland protection is expected to constitute a significant share of the CSP estimated protection potential.

Finally, in Ireland most of the CSP estimated protection potential is linked to an ENVCLIM intervention aiming at protecting peatlands.

5 Towards meeting the climate targets

Overall emissions of agriculture and LULUCF

According to data reported by EU Member States under the EU Governance Regulation (EU) 2018/1999[46], the agricultural sector is estimated to have emitted 366 million tonnes of CO_2e in 2022, accounting for 11% of the estimated EU's total GHG emissions. Two thirds of the emissions originate from the livestock sector (enteric fermentation and manure management)[47]. LULUCF sector activities are estimated to have removed 236 million tonnes of CO_2e from the atmosphere, equal to 7% of the EU's annual estimated GHG emissions. Within the LULUCF sector, emissions from cropland and grassland were estimated at 41 million tonnes of CO_2e, while removals thanks to forests were estimated at 292 million tonnes.

Estimated CSP potential contribution

Analysis of the 19 CSPs indicates a potential positive contribution to GHG emission reduction and enhanced removal across the 18 Member States covered of 31 million tonnes of CO_2e annually (see section 3.1.1). This represents 8% of the EU's total GHG emissions from agriculture estimated in 2022.

This positive contribution is clearly potential and comes at this stage with a range of uncertainties due to the numerous assumptions made, as explained in Chapter 2. Results are to be considered with caution and only as an indicative order of magnitude.

The 31 million tonnes of estimated yearly potential contribution break down mainly into (see Table 1):

- 9 million tonnes of GHG emission reduction under CRF category 3.D – Agricultural soils,
- 20 million tonnes of removals under CRF category 4.B – Cropland, and
- 2 million tonnes under the other CRF 4 categories.

EU's climate neutrality objectives

This final chapter puts the CSPs estimated potential contribution into context with the European Union's climate neutrality objectives within the agriculture and LULUCF sectors. The goal is to assess how far it is possible define whether the 19 CSPs

[46] See note 1.
[47] See note 2.

assessed support emission-reduction actions and removals that are consistent with the targets set at EU level.

The analysis focuses on two key regulations which are integral components of the EU's climate framework and impact assessments:

- **The Effort Sharing Regulation (EU) 2018/842[48],** covering non-CO_2 emissions from agriculture (methane and nitrous oxide)
- **The LULUCF Regulation (EU) 2018/841[49],** mainly addressing CO_2 emissions and carbon removals from Land Use, Land-Use Change and Forestry
- The impact assessments of the Fit for 55 package and the 2040 climate target[50], where modelled values for 2030 concerning emissions and removals are included. They include emission levels for different scenarios for several sectors, including agriculture, consistent with the modelled targets in 2030.

5.1 Non-CO_2 emissions from agriculture and the ESR

5.1.1 ESR targets

The ESR, which encompasses the agriculture sector, excluding land use, mandates an overall GHG reduction target of - 40% by 2030, distributed among Member States. There are no specific EU or national targets set for agricultural emissions in the regulation. The national targets refer to all ESR sectors, where the relative importance of agriculture varies among Member States.

Each Member State can decide on the emission reductions to be achieved in its own agricultural sector following cost efficiency principle. Recent reviews of national agricultural policies related to climate change indicate that in a majority of EU Member States (19 out of 27), no sectoral target for agricultural emissions was set (Van Hoof 2023)[51].

[48] See note 3.
[49] See note 4.
[50] See note 5 (Table 3 p. 8 'Excludes fossil fuel combustion in the sector, but includes "category 3" CO_2 emissions, assumed constant at 10 Mt CO_2').
[51] Van Hoof, S., Climate Change Mitigation in Agriculture: Barriers to the Adoption of Carbon Farming Policies in the EU. *Sustainability* 2023, *15*, 10452. https://doi.org/10.3390/su151310452

The few national targets[52] are not considered here due to the diversity in the format of the targets, which hinders comparability.

5.1.2 Potential contribution estimated at EU level

The estimated potential contribution of the 19 CSPs assessed to the mitigation of non-CO_2 emissions from agriculture is **9 million tonnes per year, which represents 2.6% of overall reported emissions in the EU-18 for 2021. This also represents 43% of the difference between 2021 estimated emissions levels and the figure associated with agriculture for 2030** as modelled in the impact assessments of the Fit for 55 package and the 2040 climate target (Table 2) for these 18 Member States.

Table 2 - Comparison of the estimated potential contribution of the CSPs with the ESR target

Estimated mitigation effect (EU-18) A[53]	2021 national inventory – CRF 3 (EU-18) B[54]	2040 impact assessment 2030 value for agricultural GHGs (EU-18) C[55]	'Effort required' D=C-B	Share of the estimated potential over 2021 inventory A/B	Share of the estimated potential over the effort expected A/D
9 $MtCO_2e$	365 $MtCO_2e$	343 $MtCO_2e$	22 $MtCO_2e$	2.6%	43%

Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo, EEA, impact assessment report

Table 3 shows that the ratio of the CSPs estimated potential contribution over the UNFCCC 2021 estimated emissions. Ratios range from 0% in the Netherlands to 21% in Latvia.

[52] OECD. *Agricultural Policy Monitoring and Evaluation 2022: Reforming Agricultural Policies for Climate Change Mitigation;* OECD Publishing: Paris, France, 2022. https://doi.org/10.1787/22217371

Denmark	55% to 65% CO_2e reduction in GHG emissions from agriculture and forestry by 2030 compared to 1990 levels	2021
France	72 Mt CO_2e carbon budget for agriculture and forestry (excl. LULUCF) in 2029-2033	2020
Germany	56 Mt CO_2e permissible annual emission budget for agriculture in 2030	2019
Ireland	25% emission reduction for agriculture by 2030 (17.25 Mt CO_2e), compared to 2018 levels (23 Mt CO_2e)	2022
Lithuania	11% GHG emission reduction in 2030 compared to 2005	2021
Malta	50% reduction of nitrogen in manure	2009
Netherlands	3.5 Mt GHG emission reduction in agriculture and land use sectors by 2030	2019
Portugal	11% reduction of CO_2e emissions for Agriculture (CRF 3 and 1A4c) by 2030 compared to the 2005 reference values	2019
Slovenia	22% emission reduction by 2050 in agriculture, compared to 2005	2021
Belgium	25% reduction in agriculture GHG emissions by 2030 compared to 2005	2021

Revised and additional commitments may have been made.

[53] Own calculation.

[54] EEA 2023 – CRF 3.

[55] See note 50, page 44.

Table 3 - Estimated mitigation potential of agricultural non-CO_2 emissions (CRF categories 3.A - Enteric Fermentation, 3.B - Manure Management, 3.D - Agricultural Soils and 1.A.4.c - Energy - Agriculture/ Forestry/Fishing) as a share of 2021 estimated emissions, at national level

	Estimated potential emission reduction (tCO2e / yr)						UNFCCC 2021 emissions**		Ratio estimated effect / UNFCCC 2021 emissions	
	3.A - Enteric Fermentation	3.B - Manure Management	3.D - Agricultural Soils	1.A.4.c - Energy - Agriculture/ Forestry/Fishing	CRF 3 and 1.A.4.c	CRF 3 only	CRF 3 and CRF 1.A.4.c	CRF 3 only	CRF 3 and 1.A.4.c	CRF 3 only
AT	0	4 141	34 398	2 724	41 264	38 540	8 188 164	7 221 163	0.5%	0.5%
BE*	0	193	67 702	51	67 946	67 895	12 271 854	9 414 187	0.6%	0.7%
CZ	0	0	342 832	0	342 832	342 832	9 072 219	7 844 543	3.8%	4.4%
DE	0	0	882 547	0	882 547	882 547	62 666 352	56 332 889	1.4%	1.6%
DK	0	0	104 223	0	104 223	104 223	13 470 194	12 074 393	0.8%	0.9%
EL	0	0	316 314	136	316 451	316 314	8 655 767	8 045 988	3.7%	3.9%
ES	0	0	472 023	339	472 362	472 023	46 788 935	34 369 391	1.0%	1.4%
FI	0	0	552 803	17 135	569 938	552 803	7 708 802	6 303 107	7.4%	8.8%
FR	0	0	2 308 644	49	2 308 693	2 308 644	77 625 698	66 213 863	3.0%	3.5%
HU	0	0	331 745	1 990	333 735	331 745	8 773 451	7 201 976	3.8%	4.6%
IE	11 505	0	209 471	386	221 362	220 976	23 626 149	22 953 527	0.9%	1.0%
IT	0	0	504 109	780	504 889	504 109	40 494 283	32 717 215	1.2%	1.5%
LV	0	1 572	474 313	16 535	492 420	475 885	2 775 790	2 252 956	17.7%	21.1%
NL	0	0	4 420	0	4 420	4 420	28 590 084	17 974 705	0.0%	0.0%
PL	0	0	618 658	1 646	620 304	618 658	45 471 596	34 035 260	1.4%	1.8%
PT	0	0	530 883	333	531 217	530 883	8 620 971	7 258 181	6.2%	7.3%
RO	0	0	861 433	1 349	862 782	861 433	20 873 229	19 169 304	4.1%	4.5%
SE	0	0	764 456	0	764 456	764 456	14 491 132	13 347 189	5.3%	5.7%
19 CSP	**11 505**	**5 906**	**9 380 976**	**43 454**	**9 441 840**	**9 398 386**	**440 164 670**	**364 729 838**	**2.1%**	**2.6%**

* No individual data for Belgium-Flanders and Belgium-Wallonia are available in the UNFCCC reporting.
** Reported in 2023 (EEA)
Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo, EEA (2023)

5.1.3 Putting Member States ambitions into context

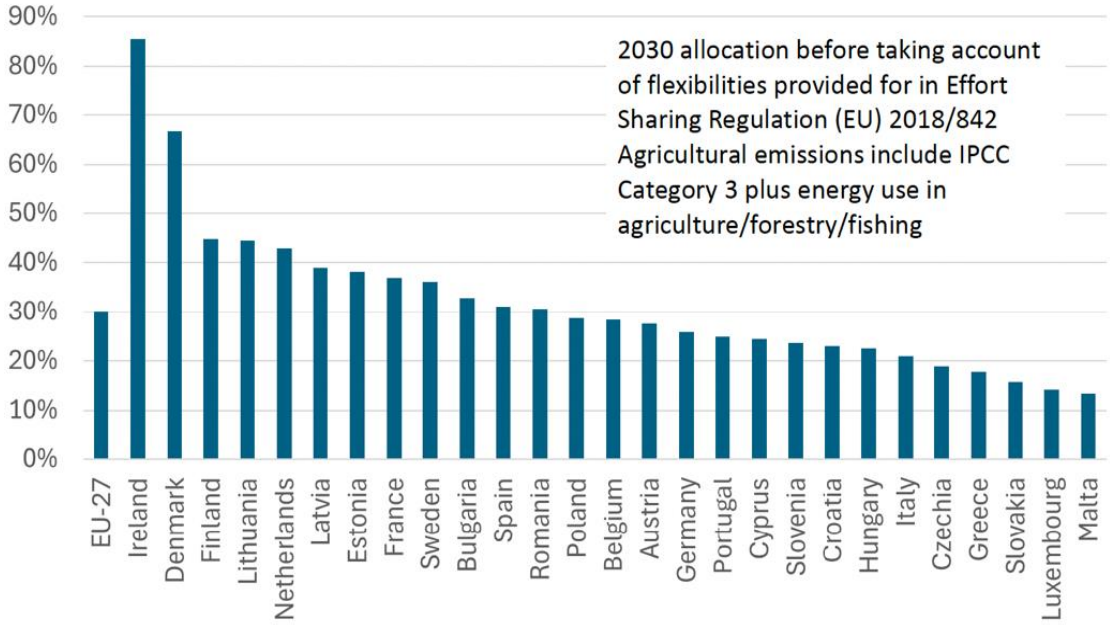
While there are no specific targets for agricultural emissions, it is possible to have an indication on the extent to which the assessed mitigation potential of the 19 CSPs is aligned with the level of the agricultural emissions within national total emissions and the ESR targets. This assessment compares the potential contribution estimated in the study with the 2021 agricultural emissions as a share of the 2030 ESR annual emissions allocation[56].

Figure 13 illustrates the comparison of 2021 agricultural emissions with the total (all ESR sector) emissions that Member States are allowed to emit under the ESR in 2030[57]. The percentage for each Member State indicates the share of agricultural emissions in relation to the 2030 ESR emissions limit. For example, the EU-27 value indicates that emissions from the agricultural sector in 2021 represent 30% of the limit expected for all ESR emissions in 2030. This ratio varies significantly across EU Member States, ranging from approximately 85% (in Ireland) to 15% (in Malta).

Member States with a relatively small proportion of agricultural emissions over the total ESR emissions have more flexibility, compared to those Member States with relatively higher ratio, to intervene to tackle agricultural emissions if they can meet their ESR targets through reductions in other ESR sectors. Conversely, in the latter reducing emissions from agriculture becomes central to achieving the ESR target.

[56] Alan Matthews keynote speech at the DG AGRI GREXE meeting on 11 March 2024.
[57] Not taking into account the flexibility mechanisms in Article 5 (Flexibilities by means of borrowing, banking and transfer) and Article 6 (Flexibility for certain Member States following reduction of EU ETS allowances) of the Effort Sharing Regulation (EU) 2018/842.

Figure 13 - 2021 agricultural emissions as a share of 2030 ESR annual allocation



Source: EEA, GHG data viewer and European Commission Implementing Regulation (EU) 2023/2019.

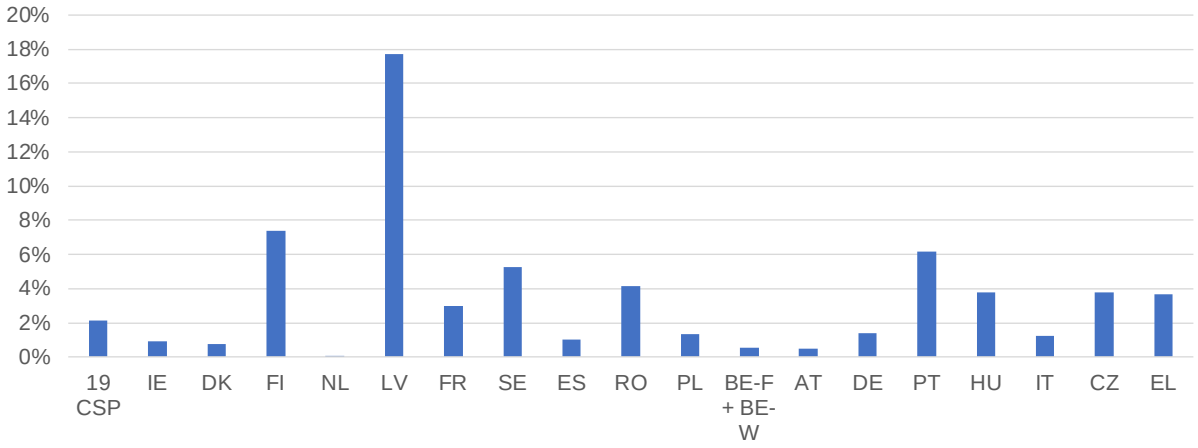
Figure 14 presents **the estimated potential reduction contribution of the CSPs as a percentage of 2021 GHG emissions from agriculture.**

It can be noted that for Ireland, Denmark and the Netherlands, where the current agricultural emissions represent a relatively high share of 2030 ESR target, the current study estimates a relatively low potential for their CSPs to reduce emissions from the agricultural sector compared to the current levels. By contrast, for Member States such as Portugal, Hungary, Czechia and Greece, the current agricultural emissions represent a relatively low share of the 2030 ESR target, and the current study estimates show a relatively high potential for their CSPs to reduce emissions from the agricultural sector compared to the current levels.

It must be recalled that this study is assessing only the role of the CSP. Several MS set in place also other policies and measures to address emissions in agriculture.

Figure 14 - Estimated mitigation potential (in CRF categories 3 and 1.A.4.c) as a share of 2021 estimated emissions for the national GHG inventory

Member States order follows the one in Figure 13 to facilitate the comparison.
Data for Belgium-Flanders and Belgium-Wallonia are aggregated to align to the data reported to the UNFCCC.
Example on how to read the graph: Overall, the estimated yearly mitigation potential in CRF categories 3 and 1.A.4.c of the 19 CSPs assessed accounts for about 2% of the 2021 emissions estimated for the national GHG inventory.



Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo, EEA

5.2 LULUCF Regulation (EU) 2018/841 and removal values

Since 2023, the LULUCF Regulation (EU) 2018/841[58] sets an EU-wide net removal target of 310 million tonnes of CO_2e by 2030, with specific targets assigned to each Member State[59]. Based on the sector's average sink between 2016 and 2018, in order to achieve the EU target, an increase in carbon sink capacity of 42 million tonnes CO_2e is required.

Focusing on the farming practices contributing to increase CO_2 removals within the LULUCF scope, the analysis suggests that the CSPs could contribute to enhancing carbon sequestration by approximately 22 million tonnes of CO_2e on average every year (Table 1 – CRF 4).

Achieving the LULUCF target involves reducing net emissions of CO_2 from agricultural area and other land uses and/or increasing carbon removals. The approach applied in the current study provides an estimation of the potential contribution of CSP interventions and GAECs towards this target.

[58] See note 4.
[59] Annex II of LULUCF Regulation (EU) 2018/841.

As reported in Table 4, **the 19 CSPs assessed are estimated to potentially contribute to:**

- **8% of the LULUCF 2030 target**[60], and
- **56% of the required increase in sink capacity to achieve the LULUCF 2030 target**[61]**.**

As illustrated in the last column of Table 4 below, the estimated contributions vary significantly among Member States. For instance, in Ireland and Sweden, this study estimates that the yearly potential contribution from their CSP is relatively low (below 20% of the relative target 2030, i.e. the required increase), while it is significantly higher in Hungary, Czechia, Greece, Denmark, Italy and Latvia. Notably, in Hungary and Czechia, this study estimates that the potential contribution from their CSPs could even exceed the required increase.

[60] The accumulated target for the 18 MS covered by the study is -280 million tonnes CO2e, as per annex II. of LULUCF Regulation (EU) 2018/841. 21million/280million = 7.5%.
[61] The accumulated increase in sink capacity required for the 18 CSPs covered by the study is -39 million tonnes CO_2e, as per annex II. of LULUCF Regulation (EU) 2018/841.
21million/39 million = 7.5%.

Table 4 - Estimated potential contribution to enhanced sequestration compared to the national targets for net removals set in the LULUCF regulation (EU) 2018/841

The second column reports the estimated potential contribution (all types of intervention and GAECs are included) of farming practices that contribute to enhancing annual stock change emissions and removals from LULUCF (i.e. CRF 4 category) supported by the CSPs.

The third column shows the national target values for 2030 (end-point 2030) as set in Annex II of LULUCF Regulation (EU) 2018/841 (column D). The fourth column presents the ratio between the CSPs estimated potential contributions and these 2030 target values.

The fifth column shows the relative 2030 target, referenced to the average sink of the sector in 2016-2018, as set in Annex II of LULUCF Regulation (EU) 2018/841 (column C). The last column shows the ratio between the estimated potential contribution and these related 2030 targets.

Example on how to read the table: In Spain (ES), the CSP estimated potential contribution on the CRF 4 category represents 5% of the net emissions targeted in 2030 (end-point) for the country in the LULUCF sector, and 43% of the relative target 2030 (gap) required to reach this target.

Member states	Estimated contribution on CRF cat. 4 (kt CO_2e)	LULUCF reg. end-point 2030: GHG net removals in 2030 (kt CO_2e)	% of the estimated contribution over the 2030 end-point	LULUCF reg. relative target 2030: gap to 2030 level (kt of CO_2e)	% of the estimated contribution over 2030 relative target
AT	524	- 5 650	9%	- 879	60%
BE-F + BE-W*	203	- 1 352	15%	- 320	63%
CZ	1 625	- 1 228	132%	- 827	197%
DE	2 275	- 30 840	7%	- 3 751	61%
DK	421	5 338	8%	- 441	95%
EL	1 376	- 4 373	31%	- 1 154	119%
ES	2 262	- 43 635	5%	- 5 309	43%
FI	1 608	- 17 754	9%	- 2 889	56%
FR	2 188	- 34 046	6%	- 6 693	33%
HU	1 808	- 5 724	32%	- 934	194%
IE	83	3 728	2%	- 626	13%
IT	2 562	- 35 758	7%	- 3 158	81%
LV	512	- 644	80%	- 639	80%
NL	154	4 523	3%	- 435	35%
PL	2 461	- 38 098	6%	- 3 278	75%
PT	443	- 1 358	33%	-968	46%
RO	732	- 25 665	3%	- 2 380	31%
SE	547	- 47 321	1%	- 3 955	14%
19 CSP	**21 784**	**- 279 857**	**8%**	**- 38 636**	**56%**

*The LULUCF Regulation (EU) 2018/41 report data at Member State level. Therefore, estimates for Belgium - Flanders and Belgium – Wallonia are aggregated.

Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo, LULUCF regulation (EU) 2018/841

6 Recommendations for improvements

The estimation process delivers rough estimates with levels of uncertainty contingent on the information available in the CSPs, the applied mitigation coefficients, and the assumptions made to estimate the area on which the farming practice is applied.

Several improvements can be suggested at different levels to enhance the accuracy of the results. These recommendations are detailed in the General methodology deliverable and will be included as well to the future EU-27 summary report.

Annex 1 – Farming practices emissions and removal coefficients

Table 5 below presents an overview of the coefficient values associated with each farming practice as per the JRC classification scheme.

These GHG emissions mitigation and carbon removal coefficients are primarily sourced from JRC work in the iMAP project[62] and from Ricardo in an evaluation study of the impact of the CAP on climate change and GHG emissions[63], supplemented with additional data from national inventory submissions, specifically the common reporting format tables. Full details of the selection of these coefficients are included in the General Methodology deliverable.

The table below reports only the farming practices for which a coefficient value exists, i.e. for which a significant effect is documented in the sources mentioned.

'Coefficient value – range of the mean value' indicates the mean value(s) of the coefficient. As explained in the General Methodology deliverable, these coefficients primarily refer to *grand means* calculated from a large number of individual studies, usually from many different countries. In some cases, more specific values are also available for specific countries. The original value can thus be replaced by country-specific coefficients, (e.g. if the modifier is a typical SOC stock value for a country) or if it can be modified e.g. for converting from one unit to another (e.g. emissions of N_2O to emissions expressed as CO_2e). For certain coefficients, the indication 'From-to' provides the highest and lowest coefficient mean values, depending on the Member State. When there is one value in the table, the mitigation potential is identical for all the Member States.

Section '**SOC and type of gas (example for Ireland)**' breaks down the mean value in the different types of gas and SOC that constitute it.

'CRF Cat. or Protection' reports the category(ies) under which the effect of the farming practice is categorised if the estimated contribution concerns the mitigation potential. Otherwise, 'Protection' is reported if the estimated contribution concerns the carbon stock protection potential.

'Main effect' provides clarification on the type of effect.

'Source' reports the source of the coefficients (i.e. either JRC or Ricardo).

[62] See note 22.
[63] See note 28.

Table 5 - Detail on farming practices, range of mitigation potential value, type of gas, CRF category and mitigation/removal category

Practices	Coefficient value – range of mean value	Units	SOC and type of gas (example for Ireland)				CRF Cat or Protection	Main effect	Source
			N_2O	CH_4	SOC	CO_2			
A21 - Animal trait selection for GHG emission	-18	kg CO_2e/head/yr	-4	-13			3.A	Reduction of non-CO_2 emissions	Ricardo
A23 - Animal trait selection for longer lifespan	-378	kg CO_2e/head/yr	-94	-283			3.A	Reduction of non-CO_2 emissions	Ricardo
B21X - Biogas – General	-4 780 770	kg CO_2e/MW				-4 780 770	1.A.4.c	Energy	Other
B22 - Wind energy	-159 125	kg CO_2e/MW				-159 125	1.A.4.c	Energy	Other
B23 - Solar energy B24 - Other renewable energy production B2X - Renewable energy production – General	-75 774	kg CO_2e/MW				-75 774	1.A.4.c	Energy	Other
E11 - Variable rate application technologies E14 - Soil mapping E1X - Precision agriculture - General	-190	kg CO_2e/ha/yr	-171	-19			3.D	Reduction of non-CO_2 emissions	Ricardo
F112 - Ban on mineral fertiliser	from - 4 843 to -285	kg CO_2e/ha/yr	-4 843				3.D	Reduction of non-CO_2 emissions	n/a
F11X - Ban on fertilisation on areas other than along water courses - General F12X - Limitation on fertiliser quantity - General	-138	kg CO_2e/ha/yr	-138				3.D	Reduction of non-CO_2 emissions	Ricardo

Practices	Coefficient value – range of mean value	Units	SOC and type of gas (example for Ireland)				CRF Cat or Protection	Main effect	Source
			N_2O	CH_4	SOC	CO_2			
F1X - Limitations on the use of fertilisers - General									
F211 - Deep placement (mineral fertilisers) or deep injection	From -3 to -1	kg CO_2e/ha/yr		-2			3.D	Reduction of non-CO_2 emissions	JRC
F21X - Fertilisation practices with a focus on low ammonia emissions - General F2X - Fertilisation practices to reduce nutrient losses - General	-13	kg CO_2e/head/yr	-13				3.D	Reduction of non-CO_2 emissions	Ricardo
F311 - Application of raw biochar F31X - Amendment with Biochar - General	From -4 632 to -2 191	kg CO_2e/ha/yr	-1 470				3.D	Reduction of non-CO_2 emissions	JRC
		kg CO_2e/ha/yr			-2 916		4.B	Increase of sink / removal	JRC
F411 - Slow/controlled release fertilisers	From -2 397 to -115	kg CO_2e/ha/yr	-2 397				3.D	Reduction of non-CO_2 emissions	JRC
F44 - Use of green manure	From -2 771 to -978	kg CO_2e/ha/yr	-1 635				3.D	Reduction of non-CO_2 emissions	JRC
		kg CO_2e/ha/yr			-1 136		4.B	Increase of sink / removal	JRC
F46 - Use of compost	-4 840	kg CO_2e/ha/yr			-4 840		4.B	Increase of sink / removal	JRC
G25 - Ban on ploughing of grassland G26 - Conservation/maintenance of grassland	from -3 250 to -406	kg CO_2e/ha/yr			-2 012		Protection	Protection of sinks (in soil and biomass)	JRC

Practices	Coefficient value – range of mean value	Units	SOC and type of gas (example for Ireland)				CRF Cat or Protection	Main effect	Source
			N_2O	CH_4	SOC	CO_2			
G27 - Conversion of arable land to grassland	From – 4 631 to -578	kg CO_2e/ha/yr			- 2 867		4.B	Increase of sink / removal	JRC
L111 - Creation of new hedges/wooded strips	– 3 281	kg CO_2e/ha/yr			-3 281		4.B	Increase of sink / removal	JRC
L11X - Hedgerows/individual or group of trees/ trees in line - General	-3 281	kg CO_2e/ha/yr			-3 281		Protection	Protection of sinks (in soil and biomass)	JRC
L112 - Maintenance and conservation of hedges/wooded strips	-965	kg CO_2e/ha/yr			-965		Protection	Protection of sinks (in soil and biomass)	JRC
L121 - Creation of field margins L125 - Creation of unproductive buffer strips along water courses L211 - Seeded flower areas/strips	From -2 767 to – 1 286	kg CO_2e/ha/yr			- 1 839		4.B	Increase of sink / removal	JRC
L512 - Peatland maintenance and conservation L51X - Wetlands and peatland maintenance and conservation – General	- 6 417	kg CO2e/ha/yr			- 6 417		Protection	Protection of sinks (in soil and biomass)	Ricardo
L522 - Peatland restoration L52X - Wetlands and peatland restoration - General	-22 392	kg CO_2e/ha/yr	-209				3.D	Reduction of non-CO_2 emissions	Ricardo and JRC
		kg CO_2e/ha/yr			-22 183		4.D	Reduction of emissions from drained peatland	
L53 - Paludiculture	-6 417	kg CO_2e/ha/yr			-6 417		4.D	Reduction of emissions from drained peatland	Ricardo
L5X - Management of	-796	kg CO_2e/ha/yr			-796		4.D	Reduction of	Ricardo

Practices	Coefficient value – range of mean value	Units	SOC and type of gas (example for Ireland)				CRF Cat or Protection	Main effect	Source
			N_2O	CH_4	SOC	CO_2			
wetland/peatland - General								emissions from drained peatland	
M114 - Manure acidification during storage	From -281 to -79	kg CO_2e/ha/yr	-15	-165			3.B	Reduction of non-CO_2 emissions	JRC
M121 - Composting without forced aeration M122 - Composting with forced aeration M12X - Composting - General	From -83 to -35	kg CO_2e/ha/yr	-17	-35			3.B	Reduction of non-CO_2 emissions	JRC
M141 - Solid-liquid separation	From -63 to -12	kg CO_2e/ha/yr	0	-41			3.B	Reduction of non-CO_2 emissions	JRC
O11 - Maintenance of organic farming practices	-1650	kg CO_2e/ha/yr		-3	-1 650		Protection	Protection of sinks (in soil and biomass)	JRC
O12 - Conversion to organic farming practices O1X - Organic farming - General	-2 150	kg CO_2e/ha/yr	-497	-3	-1 650		3.D	Reduction of non-CO_2 emissions	JRC
R11 - Crop rotation R14 - Crop diversification R1X - Crop rotation or Crop diversification - General	From -506 to -235	kg CO_2e/ha/yr			-336		4.B	Increase of sink / removal	JRC
R12 - Cultivation of nitrogen-fixing/protein crops	-243	kg CO_2e/ha/yr	-243				3.D	Reduction of non-CO_2 emissions	Ricardo
R131 - Short-term fallow	-513	kg CO_2e/ha/yr			-513		4.B	Increase of sink / removal	JRC
R13X - Land laying fallow -	-990	kg CO_2e/ha/yr			-990		4.B	Increase of sink /	JRC

Practices	Coefficient value – range of mean value	Units	SOC and type of gas (example for Ireland)				CRF Cat or Protection	Main effect	Source
			N_2O	CH_4	SOC	CO_2			
General								removal	
R15 - Multicropping / mixed cropping / intercropping	From -1 366 to -889	kg CO_2e/ha/yr			-1 366		4.B	Increase of sink / removal	JRC
R17 - Catch crops S232 - Winter cover crop S23X - Cover crops - General S25 - Green cover on permanent crops S2X - Soil cover - General	-770	kg CO_2e/ha/yr			-770		4.B	Increase of sink / removal	JRC
S22 - Crop residues left on soil	-150	kg CO_2e/ha/yr			-150		4.B	Increase of sink / removal	Ricardo
Y11 - Afforestation of agricultural land Y21 - Forest restoration and reforestation	-14 832	kg CO_2e/ha/yr			-14 832		4.A	Increase of sink / removal	Ricardo
Y12 - Maintenance of afforested land	-8 763	kg CO_2e/ha/yr			-8 763		Protection	Protection of sinks (in soil and biomass)	Ricardo
Y22 - Sustainable Forest management (e.g. for biodiversity carbon sequestration fire genetic resources, clearance) Y2X - Forest management - General	- 12 600	kg CO_2e/ha/yr			-12 600		Protection	Protection of sinks (in soil and biomass)	Ricardo

Source: iMAP and Ricardo

Annex 2 – Farming practices without data

The farming practices reported in Table 6 are those from the JRC farming practices classification scheme for which no coefficient value is established in the study:

- 'No data' indicates that suitable data are not available for this study.
- 'Mitigation effect not known' means that currently there is not sufficient evidence in the meta-analyses examined by the JRC to conclude whether a positive effect can be expected. However, this does not exclude the possibility that a positive effect exists in practice.

The practices reported below are the ones that appear the most frequently in the CSPs according to the labelling of the CSPs interventions and GAECs[64]. Farming practices at Tier 1 level are not considered here, as they are too generic, while Tiers 2 and 3 are deemed more pertinent for describing CSPs specifications.

[64] Above 50 occurrences.

Table 6 - Selection of JRC farming practices with mitigation potential effects not known or missing data

Section	JRC farming practices (Tier 2 and Tier 3)		Occurrences in CAP EH labelling*
Animals	A14 - Feed additives	Mitigation effect expected– data available in iMAP for future refinements	65
	A15X - Optimised feeding plans - General	Mitigation effect not known	139
	A32 - Specific treatment plants	No data	114
	A51X - Outdoor access - General	No data	136
	A52 - Provision of enrichment materials	No data	79
	A53 - Improved litter and indoor flooring	No data	146
	A54 - Microclimate control	No data	100
	A57 - Monitoring and regular checking of the herd	Mitigation effect not known	111
Fertilisation and soil amendments	F124 - Max N input	No data	236
	F13 - Limitations on fertiliser timing	No data	53
Grassland and grazing	G11 - Minimum grazing period	No data	89
	G12 - None or restricted grazing (timing, animal species, etc.)	No data	192
	G131 - Minimum stocking density	No data	101
	G132 - Maximum stocking density (extensive grasslands)	No data	196
	G13X - Livestock density limitation - General	No data	56
	G16 - Rotational grazing	Mitigation effect expected– data available in iMAP for future refinements	50
	G21 - Mowing obligations	Mitigation effect not known	163
	G221 - Mowing restriction on timing	Mitigation effect not known	208
	G222 - Mowing restriction of number of cuts	Mitigation effect not known	52
	G223 - Other mowing restrictions	Mitigation effect not known	111

Section	JRC farming practices (Tier 2 and Tier 3)		Occurrences in CAP EH labelling*
	G22X - Mowing restrictions (timing, number of cuts, etc.) - General	Mitigation effect not known	88
	G23 - Idling of grassland	Mitigation effect not known	62
Landscape	L12X - Field margins, patches and unproductive buffer strips along water courses - General	No data [65]	89
	L3X - Agroforestry - General	No data	60
	L45 - HNV systems	Mitigation effect not known	207
Crop rotation and diversification	R192 - Use of certified seeds	No data	215
Soil management	S21X - Mulching - General	No data	54
	S31 - Restricted machinery usage	No data	65

*November 2023 version (28 CSP)
Source: Mapping and analysis of CAP Strategic Plans

[65] L12X encompasses 'maintenance' and 'new implementation' farming practices (L121 - Creation of field margins and L122 - Maintenance and conservation of field margins). For conservative estimates, the 'maintenance' coefficient is applied to L12X; in this case it is zero, due to lack of data for a better approximation.

Annex 3 - Estimated mitigation/removal potential contribution of Eco-schemes and ENVCLIM, per CSP and farming practice

Figure 15 - Estimated mitigation potential of the Eco-scheme type of intervention, per CSP and per farming practice (%)

	AT	BE-F	BE-W	CZ	DE	DK	EL	ES	FI	FR	HU	IE	IT	LV	NL	PL	PT	RO	SE	19 CSPs
R14 - Crop diversification			0.0%	0.1%	0.7%	0.5%				9.7%		0.1%		0.2%	0.0%	2.1%				13.5%
S2X - Soil cover - General			0.5%	0.5%		0.2%		11.4%							0.4%					13.0%
S232 - Winter cover crop							0.6%		8.9%		1.5%									11.0%
O12 - Conversion to organic farming practices						0.8%											4.3%		3.8%	8.8%
S25 - Green cover on permanent crops				0.3%			0.2%			0.0%	0.2%		8.1%							8.7%
L211 - Seeded flower areas/strips				1.6%	2.9%		0.6%						1.7%	0.4%		0.5%				7.8%
F46 - Use of compost		0.4%		1.7%			5.1%													7.2%
R17 - Catch crops	3.0%			0.3%		0.1%								0.3%	0.3%	2.0%			1.2%	7.1%
S22 - Crop residues left on soil, leaving stubble on the field				0.1%							0.3%		1.1%			3.3%		0.4%		5.2%
R12 - Cultivation of Nitrogen fixing/protein crops		0.0%	0.0%	0.3%	0.1%	0.0%	0.2%				0.6%		1.4%	0.0%	0.0%			1.1%		3.7%
E1X - Precision agriculture - General						0.0%	0.0%					0.3%		0.4%	0.0%				2.0%	2.8%
R11 - Crop rotation		0.1%						2.5%												2.6%
L125 - Creation of unproductive buffer strips along water courses		0.0%		1.6%		0.5%														2.2%
R13X - Land laying fallow - General				0.7%		0.3%		0.1%		0.0%										1.1%
F11X - Ban on fertilisation on areas other than along water courses - General				0.3%	0.5%	0.0%			0.1%											1.0%
F44 - Use of green manure				0.6%										0.2%						0.8%
S23X - Cover crops - General	0.3%													0.5%						0.8%
G27 - Conversion of arable land to grassland				0.7%																0.7%
L111 - Creation of new hedges/wooded strips										0.4%		0.0%			0.2%					0.6%
L121 - Creation of field margins		0.0%				0.4%	0.0%								0.1%					0.6%
R131 - Short-term fallow				0.4%																0.4%
F112 - Ban on mineral fertilisers		0.2%					0.0%													0.2%
F12X - Limitation on fertiliser quantity - General				0.1%																0.1%
R15 - Multicropping / mixed cropping / intercropping			0.1%									0.0%			0.0%					0.1%
E11 - Variable rate application technologies				0.1%																0.1%
F411 - Slow/controlled release fertilisers							0.1%													0.1%
Total	3.3%	0.8%	0.6%	9.3%	4.2%	2.9%	6.8%	13.9%	9.1%	10.1%	2.5%	0.4%	12.4%	2.0%	1.0%	7.9%	4.3%	1.5%	7.0%	100%

Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

Figure 16 - Estimated mitigation potential of the ENVCLIM type of intervention, per CSP and per farming practice (%)

	AT	BEF	BEW	CZ	DE	DK	EL	ES	FI	FR	HU	IE	IT	LV	NL	PL	PT	RO	SE	Total
O12 - Conversion to organic farming practices		0.2%	0.1%	1.5%	7.8%		3.0%	4.0%	5.8%	21.0%	1.9%	1.9%	0.1%	4.3%		4.7%	0.1%	3.4%		59.7%
L52X - Wetland and peatland restoration - General					4.2%								5.7%							9.9%
F112 - Ban on mineral fertilisers			0.1%		0.3%					0.0%	0.1%							3.7%		4.3%
L211 - Seeded flower areas/strips		0.0%		2.0%	1.1%						0.5%						0.4%			4.1%
R17 - Catch crops				0.0%	0.3%				2.2%							0.0%				2.6%
R14 - Crop diversification	0.8%				1.0%			0.3%	0.3%		0.1%									2.4%
F46 - Use of compost									2.2%	0.0%			0.1%							2.3%
R11 - Crop rotation					1.2%					0.0%			0.9%			0.0%				2.1%
F1X - Limitations on the use of fertilisers - General	0.3%			0.2%	0.2%			1.1%			0.0%		0.0%				0.1%			1.9%
G27 - Conversion of arable land to grassland		0.1%		0.1%	1.0%								0.1%							1.3%
F11X - Ban on fertilisation on areas other than along water courses - General		0.0%	0.0%	0.1%	0.2%		0.0%						0.0%	0.0%		0.1%			0.6%	1.1%
Y11 - Afforestation of agricultural land					0.4%		0.4%						0.2%				0.1%			1.0%
S25 - Green cover on permanent crops				0.0%					0.0%	0.1%			0.9%							1.0%
Y21 - Forest restoration and reforestation								0.5%						0.5%						1.0%
S23X - Cover crops - General					0.1%			0.7%		0.0%			0.1%							0.9%
L121 - Creation of field margins			0.0%		0.0%						0.5%	0.1%						0.1%		0.7%
F12X - Limitation on fertiliser quantity - General					0.0%										0.0%	0.6%				0.6%
L125 - Creation of unproductive buffer strips along water courses									0.0%					0.1%					0.3%	0.4%
F44 - Use of green manure				0.0%							0.3%		0.0%							0.4%
R13X - Land laying fallow - General					0.1%			0.2%												0.3%
L522 - Peatland restoration					0.0%				0.3%											0.3%
S22 - Crop residues left on soil, leaving stubble on the field					0.0%			0.1%			0.0%	0.1%			0.0%		0.0%			0.3%
R12 - Cultivation of Nitrogen fixing/protein crops	0.0%	0.1%			0.0%					0.0%	0.0%		0.0%				0.0%			0.2%
L111 - Creation of new hedges/wooded strips	0.0%				0.0%			0.0%				0.2%								0.2%
L53 - Paludiculture					0.2%															0.2%
S2X - Soil cover - General					0.0%					0.1%					0.0%	0.1%				0.2%
A21 - Animal trait selection for GHG emission												0.1%								0.1%
R15 - Multicropping / mixed cropping / intercropping		0.0%			0.1%					0.0%										0.1%
E11 - Variable rate application technologies													0.1%							0.1%
M141 - Solid-liquid separation	0.0%																			0.0%
M12X - Composting - General	0.0%													0.0%						0.0%
R131 - Short-term fallow										0.0%		0.0%								0.0%
F21X - Fertilisation practices with a focus on low ammonia emissions - General													0.0%							0.0%
E1X - Precision agriculture - General					0.0%															0.0%
R1X - Crop rotation or Crop diversification - General																	0.0%			0.0%
F2X - Fertilisation practices to reduce nutrient losses - General								0.0%												0.0%
Total	1.2%	0.3%	0.2%	4.1%	18.4%		3.4%	7.0%	10.8%	21.2%	3.5%	2.4%	8.2%	4.9%	0.0%	5.6%	0.7%	7.2%	1.0%	100%

Source: 19 CSPs, Mapping and analysis of CAP Strategic Plans, iMAP and Ricardo

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