31 May – 5 June 2026
Bol, Brač Island, Croatia

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Safety for future generations

2026

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ORIGINAL SCIENTIFIC PAPER

Estimating the climate change mitigation potential of CAP interventions in Slovenia

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Summary
Agriculture is both a source of greenhouse gas emissions and a sector with mitigation potential. The aim of this paper is to assess the potential contribution of interventions under the Slovenian CAP Strategic Plan 2023-2027 to climate change mitigation in agriculture using a qualitative expert assessment. The highest ratings were assigned to interventions linked to Specific Objective 4, especially agri-environment-climate measures and payments for areas facing natural or other specific constraints. Several biodiversity-related, land-management and investment interventions were also assessed as relevant. The results show that mitigation potential is distributed across several groups of interventions.

Keywords: climate change, mitigation, CAP Strategic Plan, expert assessment, Slovenia

Introduction

Agriculture has a dual role in climate change, as it is both an important source of greenhouse gas (GHG) emissions and a sector with considerable mitigation potential. It can contribute to climate change mitigation through measures such as improved nutrient management, livestock feeding, manure treatment, reduced energy use, and increased carbon sequestration in soils and biomass (Smith, 2011).

Within the European Union, the Common Agricultural Policy (CAP) is one of the main policy frameworks shaping agricultural practices and, indirectly, the environmental and climate performance of the sector (Pe'er et al., 2020). In the 2023-2027 programming period, CAP Strategic Plans provide Member States with greater flexibility in designing interventions, which makes country specific assessments of their likely environmental effects particularly relevant. However, the mitigation potential of individual CAP interventions is not always straightforward to evaluate, since it depends not only on their formal objectives, but also on the mechanisms through which they influence production practices, input use, livestock management, land use, and investment decisions (Santeramo et al., 2020).

As a result, evidence on their expected mitigation relevance at the level of individual interventions remains limited, particularly in the context of national CAP Strategic Plans. In Slovenia, this issue is especially relevant in relation to the amended CAP Strategic Plan 2023-2027 (Ministry of Agriculture, Forestry and Food, 2026).

This paper therefore aims to assess the potential contribution of interventions under the Slovenian CAP Strategic Plan 2023-2027 to climate change mitigation, focusing on their expected effects on methane and nitrous oxide emissions, carbon sequestration, energy use, and renewable energy production. Because no systematic methodological approach has yet been established in Slovenia for the ex ante evaluation of the climate mitigation potential of CAP interventions and related environmental parameters, an expert workshop was conducted to provide a transparent and comparable assessment of these interventions.

Material and Methods

In May 2025, an expert workshop was conducted to systematically assess the potential contribution of individual interventions and operations under the Slovenian CAP Strategic Plan 20232027 to climate change mitigation and their effects on selected climate-related parameters. Expert-based qualitative evaluation has also been applied in previous climate-related agricultural assessments (Travnikar et al., 2025).The workshop brought together 11 experts in agriculture and forestry, from the Agricultural Institute of Slovenia and the Slovenian Forestry Institute, who evaluated the expected effects of individual interventions on methane, nitrous oxide and ammonia emissions, nitrogen and phosphorus balances, energy use, renewable energy production, and nitrate pollution of water.

For the analysis, a matrix was prepared containing all interventions and sub-interventions under the Slovenian CAP Strategic Plan 2023-2027, their specific objectives, and the selected assessment parameters. In total, the expert assessment covered 112 interventions and operations, grouped into four thematic areas: competitiveness and resilience of the agricultural sector; environmental and climate protection; rural development, food quality and health; and knowledge transfer, innovation and digitalisation.

Interventions were identified using the official codes of the CAP Strategic Plan (e.g. INP for income support interventions and IRP for investment-related interventions). The classification into thematic groups followed the structure of the CAP Strategic Plan and was retained as defined in the original policy framework.

The qualitative rating scale was defined for this assessment to ensure a consistent evaluation of expected effects. The potential effectiveness of each intervention was assessed using the following scale: strong negative effect (---), medium negative effect (--), weak negative effect (-), no contribution (0), weak positive effect (+), medium positive effect (++), strong positive effect (+++), and not relevant (NR). The assessment refers to the substantive or technical potential of individual interventions to influence the selected parameters and does not consider the expected scale or actual extent of implementation. Consequently, an intervention may be assessed as having high mitigation potential even if its uptake in practice is limited.

Results and Discussion

The highest ratings were assigned to interventions linked to Specific Objective 4, which addresses climate change mitigation and adaptation and sustainable energy. In particular, agri-environment-climate-measures (AECM) and payments for areas facing natural or other specific constraints (ANC) stood out, as they were evaluated as having the strongest potential to reduce methane, nitrous oxide and ammonia emissions.

Overall, no intervention was assessed as having a strong negative effect on climate mitigation. However, a weak negative effect (-) was identified for some biodiversity-related interventions and for Organic Farming, mainly because these measures may increase methane emissions through changes in feed composition or adapted feeding practices in livestock production. At the same time, they were assessed positively for nitrous oxide emissions and soil carbon stocks, suggesting that their overall environmental effect cannot be judged by a single parameter. Coupled income support for livestock production was also associated with a potential increase in methane emissions. Similarly, some crop-management measures, such as successive crops and intercrops or greening of arable land over winter, may increase energy use and, indirectly, carbon dioxide emissions.

By contrast, almost no interventions were assessed as increasing nitrous oxide emissions. Payments for natural or other constraints which were evaluated as having a weak negative effect from a climate mitigation perspective. Without this support, part of the land could be abandoned, likely reducing methane and nitrous oxide emissions, lowering agricultural energy use, and increasing above-ground carbon stocks through natural vegetation regrowth. However,

this finding should be interpreted with caution, given the intervention's positive effects on landscape maintenance, biodiversity and the socio-economic conditions of rural and remote areas, which is consistent with broader discussions on CAP trade-offs and multifunctionality (Pe'er et al., 2020; Cuadros-Casanova et al., 2023).

Table 1. Interventions of the Slovenian CAP Strategic Plan 2023–2027 with strong (+++) and moderate (++) positive effects on selected climate mitigation dimensions

Methane (CH_4)	
+++	++
Renewable energy investments (**IRP36)**; Additives to reduce ammonia and GHG emissions (**INP08.04)**; Targeted feeding of cattle (**PS.1);** Targeted feeding of sheep and goats **(PS.3)**; Livestock welfare adaptation investment (**IRP29)**	Animal welfare **(IRP28)**
Nitrous oxide (N_2O)	
+++	**++**
Additives to reduce ammonia and GHG emissions **(INP08.04)**; Targeted feeding in fattening pigs **(PS.2)**; Integrated production systems (crop, vegetable, hop, fruit/olive and grape production) (**NV.3** – **NV.7)**; Precision Fertilization and Spraying **(NV.11)**; Grassland and habitat conservation measures (**BK.2** – **BK.6**, **BK.14, BK.15)**	Basic income support for sustainability (**INP01)**; Complementary redistributive income support for sustainability (**INP02)**; Investments in productivity, technological development and digitalisation of agricultural holdings (**IRP02)**; Investment in competitiveness and market orientation of organic farms **(IRP04)**; Coupled income support for protein crops (**INP07)**; Investments in efficient use of nitrogen fertilisers (**IRP17);** Organic farming (**IRP19)**; Fertilisation with low-emission organic fertilisers (**INP08.03)**; Successive crops and intercrops **(INP08.05)**; Greening of arable land over winter (**INP08.06)**; Targeted feeding of cattle (**PS.1)**; Targeted feeding of sheep and goats (**PS.3)**; Water resources **(NV.1)**; Special grassland habitats **(BK.1)**; Livestock welfare adaptation investment **(IRP29)**
Carbon sink	
+++	**++**
Investments in forest rehabilitation and restoration following natural disasters and adverse climatic events **(IRP15)**; Successive crops and intercrops (**INP08.05)**; Greening of arable land over winter (**INP08.06)**; Conservation tillage (**INP08.07**); Water resources **(NV.1)**; Maintenance of Crop Rotation **(NV.2)**; Conservation of wetlands and peatlands **(BK.5)**	Investments in primary wood processing and digitalisation **(IRP08)**; Investments in the establishment and development of forest tree nurseries **(IRP09)**; Integrated production systems (crops, vegetables and hops) (**NV.3** – **NV.5)**; Precision Fertilization and Spraying (**NV.11);** Grassland, habitat and landscape conservation measures **(BK.1** – **BK.4**, **BK.7**, **BK.10, BK.14)**
Energy consumption	
+++	**++**
Investments in productivity, technological development and digitalisation of agricultural holdings (**IRP02)**; Collective investment in market preparation and resilient food value chains **(IRP03)**; Investments in competitiveness and market orientation of organic farms (**IRP04)**; Agro-melioration and land consolidation **(IRP05)**; Agro-melioration and land consolidation **(IRP35)**	Investments in the improvement of forest infrastructure **(IRP06)**; Investments in the purchase of new machinery and equipment for work in the forest (**IRP07)**; Investments in primary wood processing and digitalisation **(IRP08)**; Construction of multi-user irrigation systems **(IRP13)**; Investments in renewable energy sources **(IRP36)**; Conservation tillage **(INP08.07)**
Renewable energy sources	
+++	**++**
Investments in productivity gains and digitalisation of agricultural holdings **(IRP02)**; Investments in competitiveness and market orientation of organic farms **(IRP04)**; Investments in processing and marketing of agricultural products (**IRP35)**; Investments in renewable energy sources (**IRP36)**; Intervention Support for non-agricultural activities, bio-economy and conservation of heritage **(IRP25)**	Investments in the purchase of new machinery and equipment for work in the forest **(IRP07)**; Investments in primary wood processing and digitalisation (**IRP08)**; Investment in adaptation to climate change in permanent crops (**IRP16)**; Investments in the adaptation of agricultural holdings to the implementation of above-standard livestock welfare requirements **(IRP29)**

Source: Authors' own elaboration based on expert assessment; Note: For ease of presentation, the official names of interventions have been shortened in the table.

Table 1 summarises interventions assessed as having a potential strong or moderate positive effect. The examination did not consider the extent of implementation of individual interventions. Knowledge-transfer and innovation-related interventions (IRP31, IRP32 and IRP38) were consistently assessed as having moderate positive effects across all assessed

dimensions. Their contribution is primarily indirect, through support for the uptake of mitigation practices, innovation and advisory capacity.

Methane (CH_4). Interventions evaluated as having potential strong and medium positive effect on methane reduction are associated primarily with measures targeting methane emissions from the digestive tract of livestock. In particular, this includes financial incentives for the use of feed additives that reduce methane formation in enteric fermentation, as well as interventions that contribute to methane mitigation through improved feed quality for ruminants and targeted feeding of cattle and small ruminants, taking into account, among other factors, the results of chemical feed analyses. Furthermore, highly rated interventions also comprise measures aimed at reducing methane emissions from livestock manure storage, either through the introduction of pasture-based animal husbandry or through methane capture by biogas plants.

Nitrous oxide (N_2O). The reduction of nitrous oxide emissions is associated primarily with interventions that improve the efficiency of nitrogen fertiliser use and thereby reduce the need for mineral nitrogen fertilisers. Most notably, this applies to interventions requiring increased greening of arable land and different forms of precision fertilisation. Among the most effective are interventions that prohibit or strongly restrict the use of nitrogen fertilisers, such as Organic Farming and most operations aimed at preserving biodiversity. Moreover, strong positive effects were also identified for incentives supporting the use of urease, nitrification and denitrification inhibitors, as well as for investment interventions contributing to improved nitrogen use in agriculture. Basic Income Support for Sustainability and Complementary Redistributive Income Support for Sustainability were likewise assessed as relevant for nitrous oxide mitigation. On the one hand, these interventions require compliance with the Prescribed Behaviour Requirements; on the other hand, income support reduces the dependence of agricultural holdings on market revenues, which are generally associated with the intensification of agricultural production and processing.

Carbon sink. Interventions assessed as having a strong positive effect (+++) on the carbon sink are implemented mainly within the framework of AECM and ANC payments, and interventions in the field of Environmental and Climate Protection. Particularly important in this respect are investments in the rehabilitation and restoration of forests following natural disasters and adverse climatic events, incentives for conservation tillage, and payments for the conservation of wetlands and bogs. Furthermore, interventions requiring increased greening of arable land, together with measures aimed at preserving grassland habitats, hedgerows and high-density meadow orchards, contribute to increasing organic carbon inputs to the soil and above-ground biomass. In the forestry sector, moreover, alongside investments in forest rehabilitation and restoration, interventions supporting the development of forest arboriculture were also assessed as relevant.

Energy consumption. The analysis showed that interventions including technological development, digitalization and efficient use of natural resources, as well as other investments contributing to the optimization of energy consumption in agriculture, contribute mainly to the reduction of energy consumption.

Renewable energy sources. As expected, the intervention Investments in Renewable Energy Sources was assessed as having a strong positive effect on the production of renewable energy sources (RES), thereby directly contributing to increased use of renewable energy and reduced dependence on fossil fuels. In addition, interventions promoting technological development and digitalisation, including investments in renewable energy production such as micro-biogas plants, were also assessed as having a strong positive effect.

Conclusion

The expert-based assessment showed that the climate change mitigation potential of the Slovenian CAP Strategic Plan 2023-2027 is distributed across several groups of interventions rather than concentrated in a single policy instrument. The highest ratings were assigned primarily to interventions linked to Specific Objective 4, especially AECM and ANC payments, which target key mitigation-related parameters, including methane, nitrous oxide and ammonia emissions.

Several biodiversity-related, land management and investment interventions were likewise assessed as relevant, although in some cases their effects involved important trade-offs between climate mitigation and other environmental or socio-economic objectives. In addition, knowledge-transfer and innovation-related interventions were identified as relevant supporting measures through their contribution to advisory capacity, innovation uptake and the wider adoption of mitigation practices.

The present assessment reflects the substantive or technical potential of interventions and does not account for their actual uptake or implementation intensity. Future research should therefore complement this qualitative assessment with information on the financial allocation, expenditure and implementation of individual interventions. Linking estimated mitigation potential with financial support and actual uptake would provide a more realistic basis for assessing the overall contribution of the Slovenian CAP Strategic Plan 2023-2027 to climate change mitigation in agriculture. This also highlights the need for a more systematic and continuous approach to the assessment of CAP interventions, in order to support more consistent monitoring, evaluation and future design of mitigation oriented measures.

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