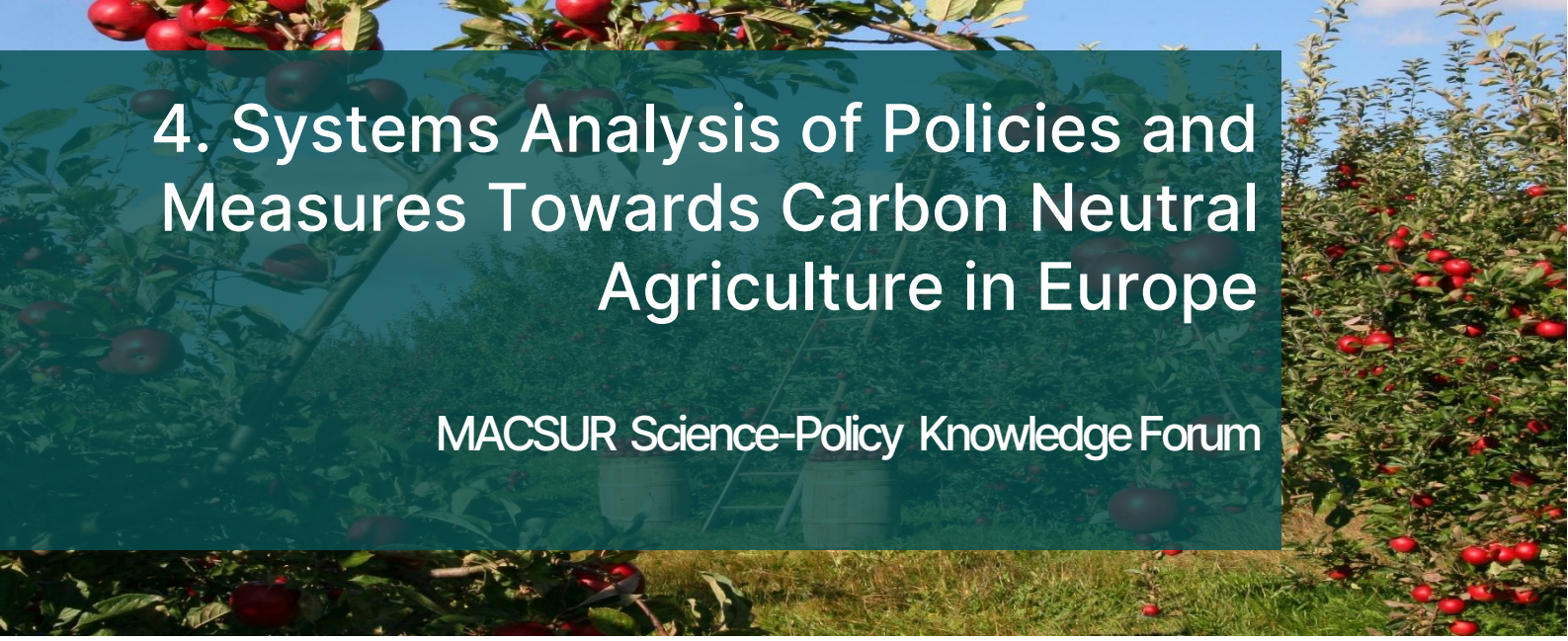

4. Systems Analysis of Policies and Measures Towards Carbon Neutral Agriculture in Europe

MACSUR Science-Policy Knowledge Forum

This policy brief provides a systems analysis of climate measures in agriculture for nine selected MACSUR partner countries showing that more system-level actions are needed if the EU is to achieve its goal of climate neutrality by 2050.

Key Messages

- Most of the planned mitigation policies and measures target efficiency gains through technology and advanced agriculture practices at the field/livestock management level. They are expected to lead to emission reductions of only 5% by 2040 compared to 2019.
- Reaching the target of reducing agricultural emissions by 55% below 1990 levels by 2030 requires a transformation beyond the level of individual technologies.
- Mitigation measures have to be extended to target the agri-food system like dietary changes and food waste reduction.
- Country and regional-specific emission drivers and pressures should be included in designing future policies.

Carbon Neutral Agriculture Targets in Europe

The Paris Agreement and the recent Farm to Fork strategies under the European Green Deal drive momentum to achieve carbon neutrality in all sectors including agriculture. An emission reduction target of at least 55% below 1990 levels by 2030 is set by the Fit for 55 package. Each country proposes different sets of policies and measures (PaMs) to decarbonise the agriculture sector. The emission reduction from agriculture is designed within the Effort sharing legislation (Effort Sharing decision-ESD & the Effort sharing regulation-ESR). The countries have not specified the agriculture sector emission reduction targets so far. However, the efforts to decarbonise agriculture are reflected in the PaMs.

In MACSUR partner countries, new PaMs are introduced, and existing measures are revised, for example, under the new Common Agricultural Policy reforms. The PAMs target major sources of agricultural emissions: enteric fermentation, agriculture soils, and manure management. This policy brief compares the PaMs currently implemented and planned in the selected MACSUR partner countries (Austria, Denmark, France, Germany, Hungary, Ireland, Italy, The Netherlands, and Norway) to evaluate mitigation efforts towards carbon-neutral agriculture.

Agriculture-related Policies and Measures

Greenhouse gas emissions (GHGs) from agriculture must be reduced to meet carbon neutrality targets required by the Green Deal and national laws. However, the mitigation measures currently implemented or planned in the MACSUR partner countries are not sufficient to meet those targets. Agricultural emission trends show an overall decrease of 21% in Europe between 1990 and 2019. However, the emission reduction slowed down after 2005. Emission projections are 1.5% reductions with currently implemented and 5% with planned mitigation measures by 2040 compared to 2019 levels (German et al. 2021).

- The highest number of PaMs was reported from France (58), followed by Denmark (32), Netherlands (18), Austria (14), Ireland (12), Hungary (11), Germany (10) and Italy (6). The number of measures also links with the potential mitigation of GHGs from agriculture.
- Most popular measures were the reduction in the amount of nitrogen fertiliser (13), anaerobic digestion from manure (12), the conservation or restoration of wetland/peatland/organic soils (11) and improved farm efficiency (10).

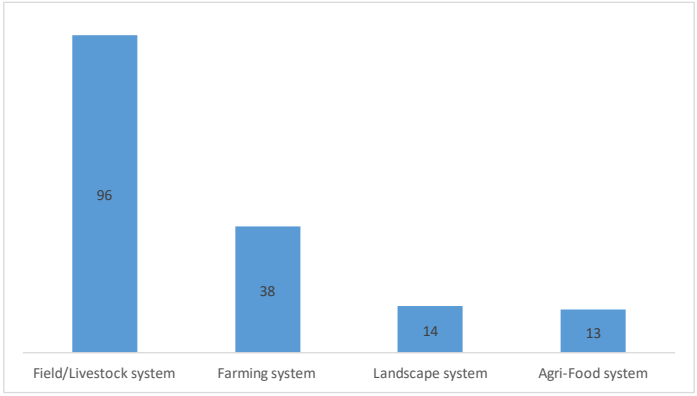

Figure 1: System level of mitigation measures (existing and planned) in MACSUR Partner countries reported in 2020

Table 1: Systems-level targeted by agriculture-related policies and measures

System Level Category of PaM	Austria	Denmark	France	Germany	Hungary	Ireland	Italy	Netherlands	Total
Field/Livestock system	11	17	35	5	8	8	3	9	96
Farming system	3	6	17	3	3	3	1	2	38
Landscape system	0	9	0	1	0	1	1	2	14
Agri-Food system	0	0	6	1	0	0	1	5	13
Total	14	32	58	10	11	12	6	18	161

The countries' differences can be seen in the number of measures and their implementation status (refer to table 1). The dominant measures in Denmark, France, Germany and Ireland are crops and soil N_2O mitigation measures, while in Hungary the focus is on carbon storage/sequestration measures, in Italy on improved manure management, in the Netherlands on energy measures and in Austria both livestock production, efficiency and diets and improved manure management measures dominate.

To better understand the PaMs, the systems level target of measure is adopted (Gliessmann 2016; Geels 2005): Field/livestock level, Farming system, Landscape system, and Agri-Food System. Farm-level mitigation measures refer to the single agricultural practice farmers use on their fields or with their livestock (Figure 1). Farming system mitigation measures induce changes in the management and thinking of the whole farm instead of changing single practices. Landscape mitigation measures refer to a change in land use, the spatial arrangement of land uses, or landscape water management. Lastly, agri-food system measures address the broader value chain and include more of the processing industry and consumers.

Mitigation Potential of PaMs

This analysis reveals that most mitigation measures are field or livestock measures and address the lowest system level. **To reach large-scale transformations towards carbon-neutral agriculture, mitigation measures have to be extended to target higher system levels up to the agri-food system. Here, important mitigation examples include dietary changes and food waste reduction.** Measures at the field/livestock level can be implemented directly by farmers without the involvement of many other stakeholders in the agri-food system, thus without broadly transforming the farming system (Gliessmann 2016; Geels 2005). While it is useful to focus mitigation efforts on those "low-hanging fruits" for quick improvements, those are not sufficient to meet the emission reduction targets (EEA 2021). Therefore, policymakers must refine agricultural mitigation measures (ibid.).

The analysis further indicates the opportunities to reduce the GHGs in the agriculture sector. By directing mitigation measures at the broader farming system, the landscape and the whole agri-food system, their emission reduction potential can be leveraged. In doing so, the thematic focus has to be adapted to country-level specific emission drivers and context circumstances of the agricultural sector.

Further Reading

- EEA (2021): Trends and projections in Europe 2021, EEA Report No 13/2021. Available online at: https://www.eea.europa.eu/themes/climate/eu-greenhouse-gas-inventory
- Geels, F.W. (2005): Technological Transitions and System Innovations: A Co-evolutionary and Socio-Technical Analysis; Edward Elgar Publishing: Cheltenham
- German, R., Raoult, J., Schmid, C., Mandl., N., Peglidou, P. (2021): Agricultural climate mitigation policies and measures. Good practice, challenges, and future perspectives.
- Gliessman, S. (2016): Transforming food systems with agroecology. Agroecol. Sustain. Food Syst. 2016, 40, 187–189 https://doi.org/10.1080/21683565.2015.1130765

The MACSUR SciPol knowledge forum is a pilot exercise initiated by the Joint Programming Initiative for Agriculture, Food Security and Climate Change (FACCE-JPI) to bring science and policy actors together for the strategic design of climate change adaptation and mitigation solutions in the agri-food sector in Europe. This policy brief contributes to this mission by providing evidence-based information to policy for achieving carbon neutrality by 2050, adapting to climate change and understanding synergies and trade-offs in achieving these targets.

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