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Rural Science-Society-Policy  
Interfaces

## MAP Position Paper

# CLIMATE CHANGE AND ENVIRONMENTAL SUSTAINABILITY



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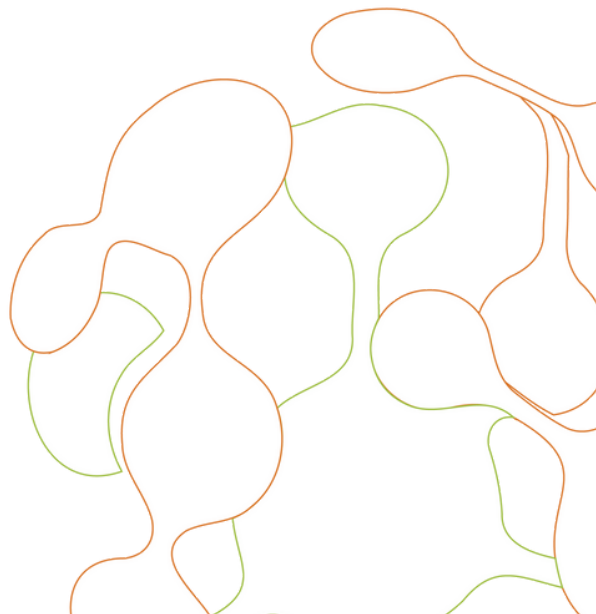
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## Topic and headline messages

The topic addressed by the Emilia-Romagna Multi-Actor Platform (MAP) in Italy concerned local scale interventions (both mitigation and adaptation) that could enable the transition to carbon neutrality. According to the MAP, transition means a gradual and constant process of reconversion of production activities that should be balanced with the economic and social dimension of the region. In this process, the territorial approach, encouraging the creation of partnerships, should be the basis of each action to achieve carbon neutrality. Promising themes in this process of transition are result-based approaches, carbon markets and environmental certification. This last subject was stressed by the MAP given the growing demand from business to showcase the outputs of sustainability strategies to consumers (e.g. in terms of reduced emissions and/or enhanced biodiversity). For all the themes discussed, the need for making progress in research was highlighted to enhance the effectiveness of the strategies to achieve carbon neutrality targets. In this regard, the link between policy and research should be strengthened and the next RDP could provide an example of evidence-based policy.

## Problem being addressed and key questions

Interventions to support mitigation and adaptation are part of a portfolio of strategies to address climate change. Therefore, they are key for achieving the EU's 2050 climate neutrality target. [IPCC](#) defines mitigation as "A human intervention to reduce emissions or enhance the sinks of greenhouse gases" including carbon dioxide removal options. Adaptation covers both human and natural systems and means the process of adapting to the actual or projected climate, and its effects, in order to moderate harm or exploit beneficial opportunities.

The Emilia-Romagna MAP held two meetings to discuss which mitigation and adaptation strategies in the regional context can contribute to the achievement of the European climate neutrality target by 2050. In doing so, both mitigation and adaptation strategies were discussed with a focus on the agri-food value chain. The discussion revolved around the following questions:

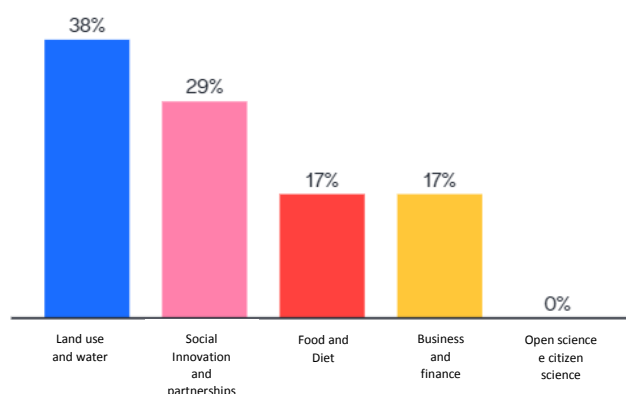
1. What **transitions** are required to achieve climate neutrality in the context of the MAP?
2. How can **policy interventions** enable or facilitate these transitions, considering the solutions needed at local and national levels, and the related implications for the wider policy framework (EU and global)?
3. What are the **research needs and gaps**?

The Discussion Paper "Climate change and environmental sustainability" (Miller et al., 2021) provided the knowledge basis to support the discussion within the MAP. The paper offers a wide overview of topics related to climate change; for this reason, the first meeting of the Emilia-Romagna MAP was to understand which of the topics<sup>1</sup> developed in the Discussion Paper were perceived as priorities in the regional context.

A short survey led to the identification of the topics "Land use and water" and "Social innovation and partnerships" as priorities (Figure 1). In addition to these topics, the MAP also discussed other issues, such as the role of innovation and, more generally, the Common Agricultural Policy (CAP) reform and the next Rural Development Programme (RDP).

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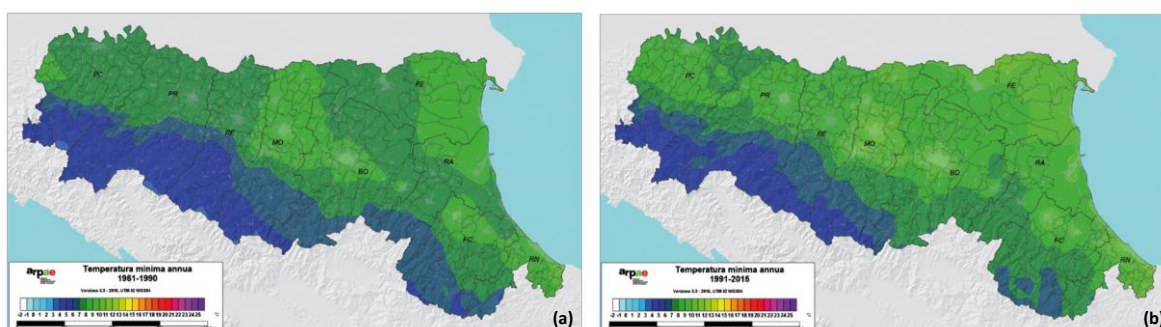
<sup>1</sup> The topics are: Land use and water, Social innovation and partnerships, Food and diet, Business and finance, Open science and citizen science.



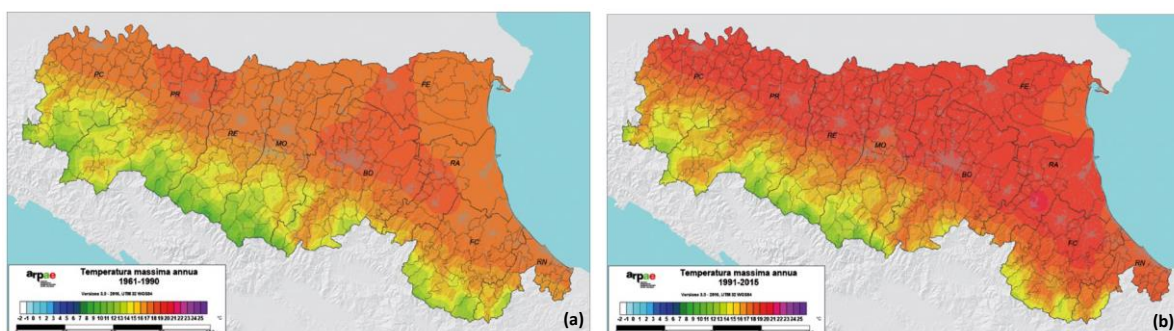
**Figure 1.** Results of the survey conducted during the first meeting of the Emilia-Romagna MAP: priority issues

## 1. Key scientific evidence

"The climate of Emilia-Romagna is changing, and we can expect further changes in the near future". This is the conclusion of the Atlante climatico dell'Emilia-Romagna 1961-2015 (Arpae Emilia-Romagna, 2017), documenting the changes in the period 1991-2015 compared to the 30-year period 1961-1990. The Atlas reports that average regional temperatures increased by 1.1°C (+1.4°C for maximum, +0.8°C for minimum temperatures) while the decrease in annual precipitation was moderate, on annual average (-2%), but with significant seasonal variations (drier summers and wetter autumns).



**Figure 2.** Annual average values of **minimum temperatures** (a) in Emilia-Romagna in the 30-year reference period 1961-1990 and (b) in the recent period 1991-2015. Source: Atlante climatico dell'Emilia-Romagna 1961-2015



**Figure 3.** Annual mean values of **maximum temperatures** (a) in Emilia-Romagna in the 30-year reference period 1961-1990 and (b) in the recent period 1991-2015. Source: Atlante climatico dell'Emilia-Romagna 1961-2015

Still with reference to the Emilia-Romagna region, temperatures higher than average were also recorded in 2020, which was the fifth hottest year after 2014, 2015, 2018 and 2019 (ARPAE, 2020). In addition, 2020 was mainly a dry year, even during the autumn, which contributed to closing the year with a negative hydroclimatic balance.

Climate variability, together with the direct effects of the increase in CO<sub>2</sub> concentration (generally positive effects), may cause significant consequences on agro-ecosystems, such as: a decrease in production of the main agricultural crops, a shift in cultivation areas towards the north, the need to introduce varieties and species more tolerant of water and heat stress, increases in the frequency of extreme weather events (heat waves, heavy rainfall, drought periods), changes in the spread of plant diseases and pests, and a shortage of water resources.

Referring to water, as highlighted by the Report SNPA (2021), changes in climate conditions are increasing the risk of drought in agriculture in Emilia-Romagna because of its direct impacts on evapotranspiration. Measurements of transpiration deficits<sup>2</sup> conducted on some of the main crops produced in the region (alfalfa, maize, grapevine) and for typical soil conditions have shown that in the last 60 years the risk of drought in agriculture is increasing for all the considered crops, with the higher deficit increases recorded for maize (Report SNPA, 2021).

In addition, the forage systems of Emilia-Romagna are likely to be subject to profound changes in the coming years due to a significant reduction of the agricultural area dedicated to maize production ([Assosementi, 2017](#)) and the threat to forage systems based on species of the *Lolium* genus (Becker et al., 2020), which are not very resilient to water stress.

## 1.1. Good practices and initiatives

The Emilia-Romagna region is one of the partners of the Horizon 2020 project [CONSOLE](#) that deals with promoting the delivery of Agri-Environmental Climate Public Goods (AECPGs) by agriculture and forestry in Europe through the development of improving contractual solutions. CONSOLE focuses on four typologies of contract solutions: (i) Result-based/result-oriented contracts (RB/RO), specifying an environmental/climate result as reference parameter, (ii) Collective implementation/cooperation contracts, implementing a formalised cooperation among farmers/actors in view of delivering AECPGs, (iii) Value chain-based contracts, connecting the delivery of AECPGs with the production of private goods, and (iv) Land tenure-based contracts including environmental clauses (Eichhorn et al., 2020).

Some of the case studies conducted in Italy are located in Emilia-Romagna. The CONSOLE project reports on three successful examples of contracts implemented in the region: incentives for the construction of small-medium [collective reservoirs](#) for irrigation in the province of Ravenna, "[Carta del Mulino](#)" – [Barilla](#) that proposes a new type of contract for wheat production to enhance biodiversity protection, and [Rewilding of detention basin in Massa Lombarda](#) (province of Ravenna) managed by the Consorzio di Bonifica della Romagna Occidentale. The success in the first two examples is evidenced by the high adhesion rate by farmers to these types of measures, which provide benefits both in terms of the delivery of AECPGs and in terms of opportunities for farmers for income stabilisation. In the rewilding of the detention basin, the role of the Consorzio determined the success of the measure as it enabled the purchase of private land for public purposes to ensure a lasting supply of public goods. The project also reports a case of failure related to a measure of RDP incentivising local collaboration between public and private actors for [interventions to protect biodiversity in Natura 2000 sites](#). The low uptake of the measure by farmers seems to be due to the high complexity of regulation, which made the realisation of the project extremely difficult.

The project [LIFE Forage4Climate](#) focused on assessing different mitigation actions implemented in dairy farms with different characteristics both in terms of climatic area and forage system. The project ended in 2020; following, we report some of the main results based on the [Layman's report](#). In Forage4Climate, the farm system was studied as a whole, looking at both the greenhouse gas emissions related to milk production and the carbon sequestration and storage capacity resulting from the implementation of several mitigation actions. One of the case studies concerned the Po plain where 20 farms producing cow's milk, distributed over six forage systems, were evaluated. Two mitigation actions were assessed, both *ex-ante* and *ex-post*: increasing the area (UAA) under legume crops, and precision feed (i.e. increased production efficiency as result of improved animal diets). Figure 4 shows that both mitigation actions produced positive effects in terms of reducing the carbon footprint of milk production.

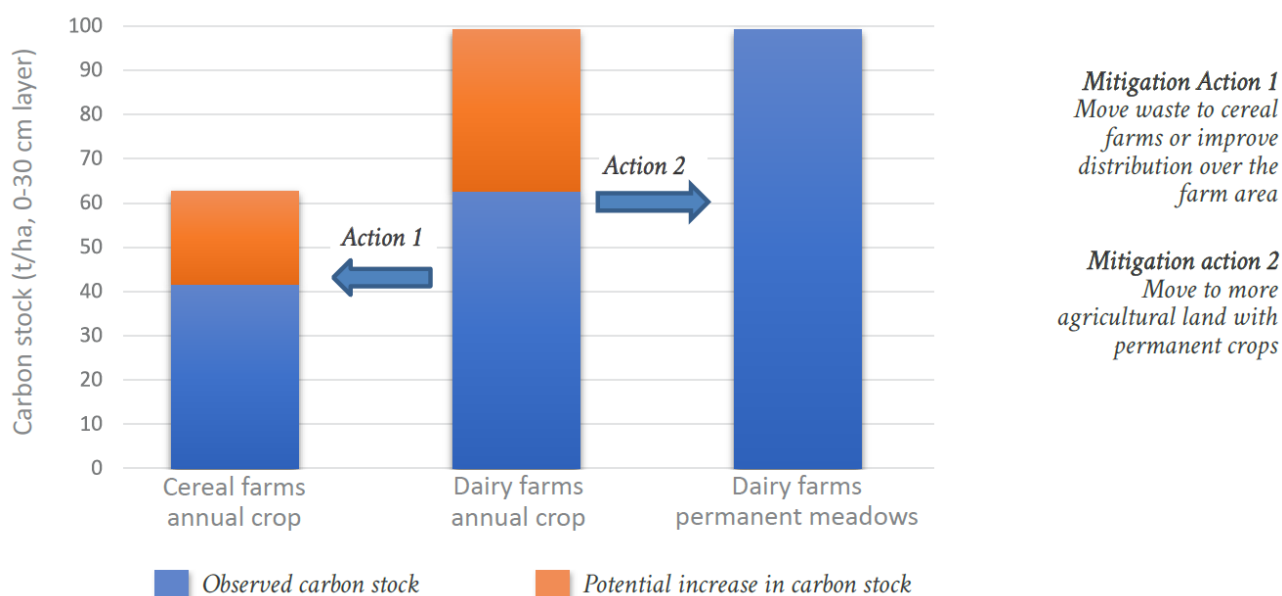
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<sup>2</sup> The indicator "transpiration deficit" expresses the maximum annual value of the cumulative transpiration deficit (over 30 and 90 days) and indicates the difference between maximum transpiration and actual transpiration, calculated using the Criteria water balance model (SNPA Report, 2021).



**Figure 4.** Results of mitigation actions in the two reference periods. Source: [Layman's report](#)

With regard to carbon (C) sequestration within the farms, the project analysed some good practices such as optimising the use of livestock manure and the presence of multiannual crops. For all forage systems identified by Forage4Climate, the content of organic C stored (stock) in the first 30 cm of soil was good. In more detail, all the dairy-related forage systems of the Po plain have medium-high C stocks, and in particular those related to Parmigiano Reggiano with large areas of permanent meadows and multiannual forage crops. The report emphasises that the results of good practices are only appreciable in the medium-long term; however, the practices “Move waste to cereal farms or improve distribution over the farm area” and “Move to more agricultural land with permanent crops” have already shown good results for different types of farms (Figure 5).



**Figure 5.** Examples of good practices for increasing carbon stock. Source: [Layman's report](#)

## 2. Summary of position of the Emilia-Romagna Multi-Actor Platform

The inputs collected during the two MAP meetings were reorganised in terms of opportunities, challenges and obstacles, main research gaps, and recommendations. As already mentioned, MAP expressed a particular interest in the topics of land use and water and social innovation and partnerships, which are described in the following sub-sections.

### 2.1. Opportunities

#### 2.1.1. Land use and water

As noted, soil and water management are strongly interrelated, although the former has a predominant function in terms of mitigation compared to water management. Regarding mitigation, the opportunities discussed concerned actions that can increase the sequestration and storage of C in soils. In this respect, the issue of **markets for carbon credits** was addressed. In perspective, for example, the great heterogeneity of rural areas of the Emilia-Romagna could favour the development of compensation mechanisms between productive districts that emit CO<sub>2</sub> and areas of the territory that can accumulate it (e.g. through pilot projects of agroforestry management, forest management, pasture management).

Linked to the topic of carbon sequestration and storage is the issue of **environmental certification**. There is, indeed, a growing demand from companies to show consumers how they contribute to the emission reduction targets. According to the MAP, this topic represents an opportunity of paramount importance also in the view of the introduction of the mandatory environmental labelling. Taking advantage of the growing demand for 'carbon neutral' certifications, however, is not enough. The marketing objectives of companies should be complemented by interventions and technical elements (in the certifications) that can actually help to achieve reductions' targets.

This issue also concerns water management, as it will be increasingly important **to reduce the incidence of energy consumption** at the various stages of the water cycle (capture, transport, distribution). Assessment tools, such as Life Cycle Assessment, and certification schemes, such as the Environmental Product Declaration (EPD), can help to measure and demonstrate the reduction of water emissions and consumption.

Furthermore, the topic of **Result-based and Result-oriented approaches** has been given great prominence in the MAP discussion because they are seen as opportunities for both the agricultural and livestock sectors to improve environmental sustainability. This theme requires the definition and testing of new incentive mechanisms to support the provision and maintenance of environmental goods and services over time.

#### 2.1.2. Social innovation and partnerships

The focus of the discussion was more on the importance of building partnerships and network on the territory rather than on social innovation. All the opportunities described so far, in fact, require a **territorial approach** that puts the agri-food industry into a broader network of relations. This is the basis for building resilient systems and becomes particularly relevant for the tracking and certification of value chains.

### 1.1. Challenges and Obstacles

The issue of environmental certification poses at least two major challenges to agri-food sector, research and policy. The first issue concerns **how to measure and qualify the impacts** (or impacts' reduction) and provide this information to consumers. Secondly, certifying the sustainability of productions implies **collection, management and transmission of a large amount of data**. The first challenge requires innovation in measurement methods and, for instance, the measurement of carbon stock in soils still requires much research and experimentation (see next paragraph). The second issue requires an improvement in the data management structure that makes data as



uniform as possible throughout the supply chain, so that each segment can collect and transmit them in a way that are usable in the markets.

The issue of measurement is also relevant to Result-based approaches where results (in terms of the delivery of AECPGs) are the reference parameter for payments. This aspect is complex as it requires the **identification of a few indicators for the monitoring of AECPGs**, which are recognisable to all the involved actors and in particular to farmers.

Speaking in general, **complexity of regulation** is one of the main obstacles for farmers to adhere to agri-environmental measures. This was the case for some measures of the last RDP, such as measures to safeguard biodiversity through cooperative mechanisms in Natura 2000 sites (M16.05), and measures concerning the management and maintenance of ecological connections and natural spaces in Natura 2000 sites (M10.1.09). The regulatory complexity of these measures, eligibility criteria based on the definition of biodiversity targets, and the constraints these measures place on primary production, are likely to be the main causes for the low uptake by farmers. Another limitation is **policy uncertainty** that discourages farmers from participating in measures that take a long time to implement (e.g. afforestation) because the rules might change from one programming period to another.

Another obstacle, although not directly linked to the issue of climate change, concerns the **contraction of agricultural activity** experienced in recent decades in Italy, which has penalised small farms in particular. Less diversity of farms contributed to a greater homogenisation of the rural landscape to the detriment of biodiversity protection.

Moreover, the increasing interest, especially of the younger generation, towards rurality and agriculture might represent a good opportunity for repopulation of these areas, but it clashes with a land market where **prices represent a barrier to access for newcomers**. The CAP itself has contributed to this situation through, for instance, hectare-based payments that have led to an increase in land values. These distortions need to be discussed and addressed, otherwise they risk undermining the incentive mechanism itself.

Finally, the issue of possible **trade-offs** between adaptation and mitigation measures was mentioned. One example is the guidelines for combating the spread of thermophilic pests that affect maize production. The guidelines suggest the removal of crop residues through deep tillage, although this is in contrast with the objective of increasing soil organic matter. It is therefore important to recognise these risks in order not to undermine the effects of these interventions.

## 1.2. Key research gaps

Result-based approaches and the creation of carbon markets are topics on which there are still many knowledge gaps; hence, research and innovation are key to understanding and enhancing the effectiveness of these strategies. Furthermore, on the topic of **C storage in soils**, some scientific gaps need to be filled through field measurements and long-term monitoring. As one MAP's member noticed, although organic agriculture is assumed to have a good C storage capacity, this assumption is based on very simplistic models and few long-term field measurements. Therefore, action is needed in this subject in terms of modelling, measurement and monitoring.

In addition, it is important to promote research that helps **to measure the economic value of environmental actions**, for example, in terms of production of primary goods or trade effects. Demonstrating the economic value and the income opportunities of climate and environmental measures would be a strong incentive for farmers to adopt such measures. Similarly, there should be a clearer understanding of the optimal level (i.e. individual farm or collective/chain level) at which different measures based on Result-based approaches are more effective.



### 1.3. Recommendations from the Emilia-Romagna MAP

This phase is called 'transition towards climate neutrality' because it implies a **gradual and constant process of reconversion of production activities** that must be balanced with the economic and social dimension of the Emilia-Romagna region.

The Emilia-Romagna MAP has discussed some key elements of this process of transition:

- Firstly, there is the need to **improve the ability to measure and qualify the impacts of the agri-food value chain**. There is a growing demand from business to showcase the outputs of the implemented sustainability strategies to consumers (e.g. in terms of reduced emissions and/or enhanced biodiversity). This implies more research and innovation both for what concerns measurement and monitoring tools, and regarding data management. For the latter, digitisation and a common data management structure along all the value chain are important to make data available and usable for the market.
- **Thinking in terms of a territorial approach**, encouraging the creation of networks, and enhancing the diversity of the regional agro-forestry heritage.
- **Applied research plays a key role in this process**. It is necessary to invest resources in experiments, pilot projects, and field observation to improve the understanding of which actions enable the achievement of greater environmental protection while enhancing the socio-economic reality of the territory. Approaches such as Result-based payments, carbon credits and environmental certification represent good opportunities to improve the sustainability of production and to encourage the creation of new partnerships in the region. However, it is necessary to demonstrate that these approaches and instruments are also able to provide income opportunities for farmers. Research, therefore, can do much to **highlight the possible connections between environmental protection and economic sustainability**.
- **Reducing the complexity and improve the clarity of the regulation** will be even more important if Result-based approaches are adopted in the next RDP. The monitoring of these measures, indeed, should be based on a few indicators, selected on the basis of the real characteristics of the contexts in which they are applied, and easy to understand for the actors involved. The next RDP could facilitate the identification of these indicators through the financing of local pilot projects that envisage the use of new contract solutions.

## Conclusions

This position paper represents the contribution of the Emilia-Romagna MAP to the debate on the types of transformational changes that are appropriate and feasible at local level to contribute to transition to climate neutrality by 2050. The MAP was invited to discuss three key questions concerning the type of transitions needed in the context of the MAP, the policy interventions that could facilitate these transitions, and the main research needs and gaps.

The MAP highlighted that transition means a gradual and constant process of reconversion of production activities that should be balanced with the economic and social dimension of the region. In this process, the territorial approach, encouraging the creation of partnerships, should be the basis of each action to achieve carbon neutrality. To this end, soil and water management are priority areas for mitigation. The discussion of the MAP stressed the importance of interventions that can enhance carbon sequestration and storage in soils; likewise, reducing emissions throughout the water cycle is pivotal. Carbon markets and environmental certifications are seen as good incentives for business to move towards carbon neutral strategies.

Besides mitigation, improving the delivery of AECPGs is crucial, and new contract solutions based on **Result-based and Result-oriented** approaches can play an important role in that.

All these issues, however, need progresses in research and innovation that means local pilot projects and field experiments. Policy should support this kind of research, whose results should feed back into policy. The next RDP could be a nice example of this virtuous cycle of evidence-based policy.

## Acknowledgements

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## References

ARPAE, 2020. Rapporto IdroMeteoClima Emilia-Romagna.

Arpae Emilia-Romagna, 2017. Atlante climatico dell'Emilia-Romagna 1961-2015.

Becker, T., Isselstein, J., Jürschik, R., Benke, M., Kayser, M., 2020. Performance of modern varieties of *Festuca arundinacea* and *Phleum pratense* as an alternative to *Lolium perenne* in intensively managed sown grasslands. *Agronomy* 10. <https://doi.org/10.3390/agronomy10040540>

Eichhorn, T., Targetti, S., Schaller, L., Kantelhardt, J., Viaggi, D., Amery, F., Andreoli, M., Bardaji, I., Bartollini, F., Berzina, I., Botarelli, L., Budniok, A., Byrne, N., Geronimo, G. De, Valença, A. De, Dupraz, P., Fyfe, D., Hamunen, K., Hänninen, H., Hennessy, T., Iglesias, A., Issanchou, A., Kurttila, M., Leeder, P., Leppänen, J., Majewski, E., Malak-rawlikowska, A., McCarthy, O., Nikolov, D., Olivieri, M., Pluimers, J., Raggi, M., Robles, F., Runge, T., Schulp, N., Schwarz, G., Tarvainen, O., Todorova, K., Tyllianakis, E., Jose, F., Velazquez, B., Viitala, E., Zavalloni, M., 2020. Report on WP2 lessons learned.

Miller, D., Nijnik, M., Irvine, K., Chartier, O., Martino, G., Bourneix, J., Schwarz, G., Verstand, D., 2021. Climate change and environmental sustainability. SHERPA Discussion Paper. <https://doi.org/10.5281/zenodo.4905655>

Report SNPA, 2021. Rapporto sugli indicatori di impatto dei cambiamenti climatici edizione 2021, *Angewandte Chemie International Edition*, 6(11), 951–952.

## Appendix

Table 1. Compilation of noteworthy projects

Name	Time of implementation	Contact & Internet address
<a href="https://console-project.eu/">CONSOLE</a>	2019-2022	<a href="https://console-project.eu/">https://console-project.eu/</a>
<a href="http://forage4climate.carpa.it/nqcontent.cfm?a_id=14261">LIFE Forage4Climate</a>	2016-2020	<a href="http://forage4climate.carpa.it/nqcontent.cfm?a_id=14261">http://forage4climate.carpa.it/nqcontent.cfm?a_id=14261</a>





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