



Photo : Simon Koopmann

Sectoral Climate Change Impacts and Adaptation Responses:

Agriculture

Agricultural practices, products and productivity are closely linked with and dependent on climatic conditions. The sector contributes to climate change through the release of greenhouse gases, but it can also have a significant positive effect, e.g. by offsetting some greenhouse gas emissions through enhancing carbon storage in soil. The sector will also inevitably be affected by the projected climate change impacts and thus it needs to adapt to these impacts, e.g. through technical, management or infrastructural measures. Both mitigation and adaptation are needed for ensuring the future sustainability and competitiveness of agriculture in Europe.

This factsheet presents an overview of the main climate change impacts and adaptation options available to policy-makers and practitioners in the agriculture sector.

Climate change impacts on agriculture

Rising CO₂ concentration levels, higher temperatures, changes in precipitation patterns, and an increase in the frequency of extreme weather events will have an effect on the future of the agricultural sector. There is a large variation in projected impacts in each EU region and these effects can be positive in some regions and for some time, but are largely negative in most regions of Europe. Some of the main risks and impacts for the agriculture sector resulting from these climatic changes are:

- Variations in crop productivity, and yields, depending on species and water availability;
- Increased risk of floods;
- Increased risk of drought and water scarcity;
- Increased areas needing supplementary irrigation;

- Deterioration of water quality;
- Deterioration of soil quality and desertification;
- Sea level rise intrusion in coastal agricultural areas;
- Increased risk of agricultural pests, weeds, parasites and diseases that can impact crops and livestock production;
- Deterioration of livestock conditions such as increased risk of heat waves and reduced or lower quality pasture, forage and feed supplies.

Figure 1 highlights observed and projected climate change impacts on agriculture in Europe by biogeographical region.



Figure 1: Observed and projected climate change impacts on agriculture in the different regions of Europe (Source: EEA 2016)

Adaptation responses and options for the agriculture sector

Adaptation measures in the agriculture sector can be technical, managerial or infrastructural in nature, as shown in the scheme below. The different measures can be adopted at farm level and can be supported by wider measures and sector-wide cooperation, resulting in, for example, research on new crop varieties, provision of advice and information, and policy changes.

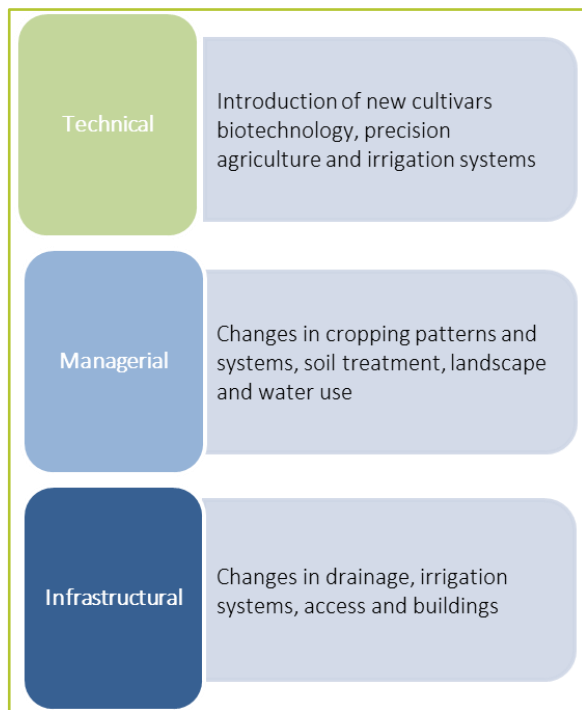


Figure 2: Typology and examples of adaptation measures

The following practices in the agriculture sector have shown to not only benefit climate adaptation, but to also contribute to mitigation objectives and ecosystem services:

- **Increasing soil organic matter and soil quality:** This can improve water retention in dry periods and reduce waterlogging in wet periods, while at the same time increasing soil biodiversity and carbon sequestration.
- **Adapting cropping systems:** Low tillage methods, crop rotation, catch crops, natural features such as hedgerows, and buffer strips can improve resilience to weather events, while at the same time providing other important ecosystem services.

- **Agroforestry, forest protection belts and sylvopasture systems:** Combining perennial trees with crops and/or livestock offers a variety of environmental and climate benefits such as reduction of soil erosion, minimisation of flood damages, improved water storage, reduction of damages from high temperatures and additional sources of feed for the livestock.
- **Improving farm water management, harvesting and storage:** This can provide multiple benefits in relation to extreme dry and wet periods for both crop and livestock production.
- **Providing information, knowledge exchange and funding:** Funding mechanisms, such as the rural development programmes, can support farm advisory services and research efforts in order to facilitate the implementation of adaptation measures.

The table below lists examples of adaptation measures available to respond to expected climate change impacts on agriculture. In addition, a range of **supporting adaptation measures** can encourage or aid practitioners in their adaptation actions:

- **Investment in research** to better distinguish between the impacts of uncontrollable natural processes and those derived from anthropogenic activities, with the aim of reducing uncertainties related to current monitoring and accounting rules for land-use, land-use change, and forestry activities.
- **Provision of advice and vocational training** to improve the adaptive capacity of farmers.
- **Incentives and reward mechanisms** to compensate farmers for their adaptation efforts in the face of climate change uncertainties.
- **Strong focus on ecosystem-based adaptation** addressing the crucial links between climate change, biodiversity, ecosystem services and sustainable resource management.

Table 1: Overview of adaptation measures available to respond to climate change impacts on agriculture

Variations in crop productivity, yields and quality
Changing crop sowing, tillage, fertilization and harvest schedules; introducing new cultivars; developing new crop varieties; devising infrastructural and/or socio-economic initiatives to maintain production and quality (e.g. initiatives for shared or collaborative water management).
Increased risk of floods
Improving soil structure, drainage and water retention and temporal storage by reservoirs like constructed wetlands; according to the soil slope providing 'breaks' such as hedges, agroforestry systems or forest protection belts; infrastructural adaptation including 'hard' defences and drainage systems.
Increased risk of drought and water scarcity
Changing land use and adapting soil management in drought-risk areas; investing in rain water harvesting equipment; depending on the soil type increasing the water-holding capacity of soils; improving irrigation system efficiency and practice (e.g. increasing the collection of rainwater over winter and/or summer depending on the precipitation patterns/projections or irrigation at night); contoured hedge planting; crop husbandry including intercropping; altering row and plant spacing; introducing and changing fallow and mulching practices to retain soil moisture and organic matter; introducing firebreaks with access to water for firefighting.
Deterioration of water and soil quality
Improving fertilizer efficiency and application methods; dissemination of best practices regarding the application of manures and fertilizers, the control of soil erosion and the increase of soil organic matter; using buffer strips (hedgerows, vegetative rows), agroforestry systems or forest protection belts beside water courses to reduce nutrient leaching.
Increased risk of agricultural pests, parasites weeds and diseases
Introducing resistant or less-susceptible varieties; using of thermostats and rapid cooling systems in greenhouses to reduce pest and disease infestation; vaccinating both domestic and wild livestock populations; increasing financial support to research institutes and extension services to increase capacity to identify potential risks and appropriate strategies to deal with them.
Deterioration of livestock conditions (reduced or lower quality feed supply)
Extending grazing season into autumn/early winter to compensate for reduced grazing opportunities in early spring/late summer; changing to forage which can grow during early spring/late autumn; increasing drought and heat resistant forage varieties; agroforestry and sylvopasture systems for additional feed supplies.
Deterioration of livestock conditions (increased risks of heat stress/ waves)
Exploring the genetic resources for more heat tolerant livestock breeds and adapting diet patterns of animals under heat stress conditions; introducing agroforestry and sylvopasture systems to benefit from natural shade and high temperature protection; Adapting animal housing infrastructure by e.g. introducing cooling systems.

The information in this factsheet is based on the following sources:

European Commission (2015) *EU agriculture and climate change – factsheet*, available at https://ec.europa.eu/agriculture/climate-change_en

European Commission (2013) SWD(2013) 139 final: *Principles and recommendations for integrating climate change adaptation considerations under the 2014-2020 rural development programmes*, Commission Staff Working Document, available at https://ec.europa.eu/clima/sites/clima/files/adaptation/what/docs/swd_2013_139_en.pdf

EEA (2016) *Climate change, impacts and vulnerability in Europe 2016, An indicator-based report*, available at <http://www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016>

Iglesias, A., Quiroga, S., Moneo, M, and L. Garrote (2012) *From climate change impacts to the development of adaptation strategies: Challenges for agriculture in Europe*, *Climate Change* 112(1), pp.143-168

Travers, A., Elrick, C., Kay, R. and O. Vestergaard (2012) *Ecosystem-based adaptation guidance: Moving from principles to practice*, Internal working document.

UNCTAD (2013) *Trade and environment review 2013: Wake up before it is too late – make agriculture truly sustainable now for food security in a changing climate*, available at http://unctad.org/en/PublicationsLibrary/ditcted2012d3_en.pdf

Useful sources for further information

- EU climate change policy - DG Climate Action: http://ec.europa.eu/clima/policies/adaptation/index_en.htm
- Data services – Copernicus Climate Change Services: <https://climate.copernicus.eu/>
- European Innovation Partnership (EIP) Agriculture: <https://ec.europa.eu/eip/agriculture/en>
- MOSES – an H2020 project testing the real scale application of an information platform devoted to facilitating planning of irrigation water resources: <http://www.moses-project.eu/>
- The FIGARO platform – an FP7 project aiming to increase water productivity in major water-demanding crops: <http://www.figaro-irrigation.net/about/overview/en/>
- Commission SWD SEC(2009)417, Adapting to climate change: the challenge for European agriculture and rural areas: <http://www.uni-mannheim.de/edz/pdf/sek/2009/sek-2009-0417-en.pdf>
- EU experience with agroforestry systems for livestock: <http://agforward.eu/index.php/en/home-redirect.html>

Box 1: Climate-ADAPT: The European Climate Adaptation Platform

Climate-ADAPT is the European Climate Adaptation Platform. It contains a vast database of sources and information about: climate change impacts, vulnerabilities and risks in different countries, regions and sectors; adaptation options, national strategies and case studies. It also allows users to share their own information and find useful links to other adaptation networks and databases. Climate-ADAPT has a dedicated Agriculture sector page which contains the most relevant information about climate change and adaptation in the sector, including relevant EU policies, research initiatives and funding.

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More information on Climate-ADAPT:

Website: <http://climate-adapt.eea.europa.eu/>

Newsletter: <http://climate-adapt.eea.europa.eu/newsletter>

Useful resources:

European Commission Climate Action website and social media:



ec.europa.eu/clima



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pinterest.com/EUClimateAction