# 1. Agriculture and climate change

Agriculture is essential for humankind – it provides the food we eat, serves as the livelihood of millions of people worldwide, and manages a large share of the landscape. In doing so, however, greenhouse gases (GHG) are released, making agriculture also a source of emissions which contribute to climate change[1]. Since agriculture depends on natural resources and the climate to provide a suitable environment for crops to grow, climate change threatens to cause major disruptions for agriculture in the future[2]. Adaptation or building resilience in agriculture must therefore be prioritised alongside efforts to reduce emissions from the sector and maintain food production[3]. Balancing these competing interests presents a significant policy challenge.

## 1.1 Greenhouse gas emissions from agriculture

Various types of GHGs are released during agricultural production. Of the six official GHGs that are accounted for under the international climate change treaty, the United Nations Framework Convention on Climate Change (UNFCCC), only methane ($CH_4$) and nitrous oxide ($N_2O$) are accounted for as agriculture emissions[4] [5]. These gases are emitted during activities such as livestock production (which releases a large amount of CH4 from manure storage) and spreading of manure or chemical fertilisers on fields to nourish the crops (which releases $N_2O$ emissions)[6].

Additionally, emissions from managing agricultural soils, land use change, and forestry activities are accounted for separately under the Land use, land use change and forestry (LULUCF) sector of the UNFCCC. Agriculture is a source of carbon dioxide ($CO_2$), $N_2O$, and $CH_4$ emissions, resulting from management activities, such as the ploughing of soil (which alters the carbon stored there and releases $CO_2$) and draining of wetlands to use for agriculture (which releases large amounts of $CO_2$ since the organic soils rapidly decompose with lower water tables)[6]. Forestry also results in emissions when wood products are harvested (resulting in $CO_2$ releases)[7].

Agriculture and forestry are unique sectors, however, because they act not only as sources of emissions but also as sinks, with the ability to remove atmospheric carbon by soaking it up and storing it above or below ground in the plants and soil[8]. This natural process allows these land-based sectors to mitigate global emissions to a certain extent, though processes such as deforestation of tropical rainforests and large-scale grassland conversion reduce their potential. Figure 1 below demonstrates the various ways in which agriculture and forestry act as sources and sinks for GHGs.

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**Agriculture and forestry act as a GHG source and sink**

Plants remove atmospheric carbon and store it above and below ground, while agricultural practices and deforestation contribute to varying levels of GHG emissions.

Figure 1:The main greenhouse gas emission sources, removals and processes in managed ecosystems.

Source: Intergovernmental Panel on Climate Change (IPCC), (2006). “IPCC Guidelines for National Greenhouse Gas Inventories", prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). (IGES: Japan, 2006), 16.

Agriculture accounts for approximately 10% of the EU’s total GHG emissions[9]. In comparison to other sectors, transportation comprises nearly 20% and electricity and heat generation in the EU accounts for over 25% of the total GHG emissions. However, agriculture also contains "hidden emissions" that are attributed to other sectors, e.g., $CO_2$ emissions from fossil fuel and electricity used for machinery, drying crops, and the manufacture of fertilisers / pesticides are accounted for by the energy sector[10].

In addition, the type of emissions from agriculture and the number of actors / scope of activities make it a challenging sector for emissions reductions. Methane and nitrous oxide emissions are particularly potent GHGs – $CH_4$ has 20 times more heat-trapping potential than $CO_2$ and $N_2O$ has 300 times more[11]. The activities which create these emissions are also spread throughout the EU-28 and done by different actors of varying sizes. Thus, unlike a power plant which can install a piece of equipment to help reduce emissions by a certain amount, each farm grows different things and the same change in management style may not cause the same emissions reduction when applied in different locations by different individuals.

### 1.2 Agriculture also needs to adapt to climate change

Agriculture is a nature-based, climate-dependent sector which will experience multiple impacts from climate change. Some of the key anticipated impacts of climate change for agriculture will include decreased annual rainfall, increased frequency of droughts and flooding, and increased risk of pests and diseases [12] [13]. Thus, it is important that agriculture builds the capacity to adapt to climate change in order to reduce negative impacts.

Various opportunities exist for mitigation and adaptation in agriculture. Many agricultural practices which are beneficial for mitigation also have positive contributions for water, soil and biodiversity protection, as well as for adaptation. There are various synergies which exist between adaptation and mitigation activities in agriculture. For example, including grasses in crop rotations decreases emissions while providing year-round cover of the ground, thus reducing soil erosion and increasing the retention of water in the soils[14]. Many actions exist that can reduce the impact the sector on climate change while maintaining productivity levels to meet food demand.

Since there is great diversity in natural conditions and farming systems, the choice of the most appropriate practices will vary according to context and depend on specific agronomic, environmental and climatic conditions. Management options can be divided into several key categories: grassland management, cropland management, land use change, livestock management, efficient energy use, and efficient water use. In general, the most relevant measures include improved manure management, increased efficiency of nitrogen inputs, and improved soil management, including the protection of soils rich with organic matter.

## 2. Policies relating to agriculture

The Common Agricultural Policy (CAP) provides the framework legislation for EU agriculture. Pillar 1 of CAP provides direct payments to farmers that are not linked towhat farmers produce, as well as greening measures (crop diversification, permanent grassland protection and ecological focus areas). Farmers must meet minimum cross-compliance requirements in order to receive direct payments, including statutory management requirements according to various EU regulations and good agricultural and environmental conditions (GAECs). Pillar 2 of CAP provides voluntary incentives through Rural Development Programmes. These programmes can fund a lot of practical actions to mitigate emissions and adapt to the changing climate: sustainable soil management, organic agriculture, cover cropping, minimum or no tillage, retaining crop residues, integrating legumes into crop rotations, restoring wetlands, etc[14]. These agricultural practices may result in lower greenhouse gas emissions and/or provide for more resilience against climate change impacts, e.g., increased infiltration and water retention through cover cropping for better flood management.

The Nitrates Directive (91/676/EEC) aims to reduce surplus nitrate levels in water bodies throughout the EU by limiting nitrogen fertiliser application on farms and requiring certain management practices. Fewer nitrogen losses in the form of nitrous oxide emissions (a highly potent greenhouse gas) reduce the climate impact of agriculture. Additionally, the Water Framework Directive (2000/60/EC) also requires measures to reduce water pollution from agriculture through river basin management plans, resulting in management practices which may lower the impact of agriculture on climate change. Wetland restoration, for example, results in

large reductions of greenhouse gas emissions and benefits water quality and biodiversity. The Soil Thematic Strategy (COM (2006) 231) also promotes soil protection, including agricultural management practices that reduce soil pressure and maintain or improve soil quality, through identification of risk areas for key soil threats and development of programmes with measures to address such threats. The programmes can build on the measures already incorporated under the previously described policies, as well as "flood risk management plans, national forest programmes and sustainable forestry practices and forest fire prevention measures"15.

## 2.1 Links to other policy areas

Agriculture is a sector with far-reaching impacts and influences in terms of food security, trade, natural resources, chemicals, waste, transport, and environment. Products may be exported from or imported into the EU at varying rates as influenced by international trade policy or agreements between the EU and other countries or regional trading blocs. For instance, the Economic Partnership Agreements entered into with African, Caribbean and Pacific (ACP) banana suppliers allow for duty and quota free access to the EU market16. Long supply chains and the emissions which are embedded in them may impact climate change. The Renewable Energy Directive (2009/28/EC) also mandates an increase of renewable energy use in the transport sector, thereby incentivising the production of biofuel crops in an effort to reduce fossil fuel use and emissions. However, biofuels are controversial due to the energy and water needed to not only grow the crop but also process it, which may not result in large overall emission reductions and potentially impact food stocks, thereby also possibly causing an increase in food imports. Chemical fertiliser manufacture for use in agricultural production also causes emissions and results in a certain amount of waste, which must be disposed of according to the Waste Framework Directive.

Sources


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