Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

EU 2007 DE

Time to Adapt – Climate Change and the European Water Dimension
Discussion Paper: Agriculture

Introduction

For agriculture, an economic sector which is highly dependent on weather conditions and vulnerable to climate change impacts, there will be a particular need to develop and implement adaptation. This discussion paper addresses the water-related impacts of climate change on agricultural farming systems, and outlines options for adaptation in the context of the European Common Agricultural Policy (CAP).

Climate-driven changes in water resources and impacts on agriculture

Agriculture is one of Europe's largest land users and as such highly dependent on environmental conditions. Inter-annual climate variability is one of the main sources for uncertainty in crop yields.

Water shortages, which are amongst the main problems expected in a changing climate, would have a significant impact on the agricultural sector. In central Europe, the projected shifts in precipitation patterns would reduce water availability during the vegetation period in summer and possibly increase the demand for irrigation water. Rising temperatures and evaporation rates would aggravate the situation in southern Europe further, where the dependency on water for irrigation is considerably higher. The consequences for farmers could be critical, starting with higher costs for irrigation, and potentially leading to production losses or the complete loss of land due to desertification. In Spain, one fifth of the land is currently at risk of turning into deserts, as for instance in the Guadalquivir river basin, where years of over-abstraction to irrigate rice fields and olive groves have led to serious water deficits. In coastal areas, the water shortage and land-loss problem would be exacerbated by sea-level rise and subsequent salinisation processes, whilst recurring flood events could render agricultural land-use in flood-prone areas uneconomical.

Higher precipitation, on the other hand, is initially perceived as a lesser problem or even an advantage. Combined with an increase in temperature, it will prolong vegetation periods in the northern latitudes of Europe, increase crop yields, allow the cultivation of new crop species or make new land available for farming. However, higher temperatures and humidity might also lead to production losses due to a rise in certain plant diseases (e.g. fungi) or the introduction of new pest species. Overall, the largest risk associated with higher precipitation will probably lie in the anticipated increase in the frequency and intensity of extreme weather events. Subsequent flooding or the occurrence of hailstorms could seriously impact crop yields.

On the other hand, agriculture itself contributes to climate change, although on a smaller scale than other sectors. In the EU-25, agriculture accounts for around 10% of total greenhouse gas emissions,[1] being a source of mainly methane and nitrous oxide. Also, while being highly dependent on water resources and sensitive to changes, the agricultural sector also exerts significant pressures on water resources, being one of the largest users of water (Herbke et al., 2006).

Sector overview

In the EU-25, 162 million hectares are under agricultural use, which amounts to roughly half the Union's land. Farming has contributed over the centuries to shape the EU's landscapes, plays a key role for the health of economies in

[1] EU press release STAT/05/113, September 9, 2005.

rural areas, and continues to be a determinant of the quality of the countryside and the environment, although it has become less important for the national economies over the last few centuries. The contribution of the agricultural sector to the GDP of EU-25 was around 1,6% in 2004.

Food production is still the major concern of agriculture, but the role of farmers today increasingly includes other activities such as countryside management, nature conservation, and tourism. The production of biomass for energy production is also becoming increasingly important, as climate change and rising oil prices are stimulating interest in renewable energy sources. There are concerns that the expansion of biomass production may lead to a further intensification of European agriculture and put additional pressures on water resources (EEA 2005a).

The main driving force for the use of water in agriculture is irrigation. The total area equipped for irrigation (*total irrigable area*) in the EU-12 increased from 12.3 million hectares to 13.8 million hectares between 1990 and 2000 (increase of 12 %). In 2000, the total irrigable area amounted to 11.7% of the total utilised agricultural area (UAA). The demand for irrigation water differs strongly between regions, with the regions with the highest use of water for agricultural being located in southern Europe (EEA 2005b).

Adaptation options

In order to avoid or reduce negative impacts of climate-driven changes in water resources on farming systems and to exploit potential positive effects, a range of technological and management options are available. Most adaptation will be performed at farm level, but also the sectoral and regional level will play a role. Farmers carry out adaptive changes to weather conditions (as short term forecasts) continuously. By contrast, adaptation to climate change has to take place on a more permanent, large-scale and structured basis.

Adaptive efforts may for instance include the following measures (Bindi and Howden, 2004; Olesen and Bindi, 2004):

- **Improving irrigation efficiency:** Land management techniques (e.g. conservation tillage) or irrigation management (e.g. adjusting timing and volumes of water application to plant needs) may be used to improve the efficiency of water use in agriculture. A considerable potential for water savings exists here. More effective rainwater harvesting could also help.
- **Crop substitution** to reduce dependence on irrigation or to increase water availability. Some crops use less water or are more resistant to heat so they cope better with dry conditions than others. In addition, the choice of crops may contribute to adaptation in terms of "**evapotranspiration management**", in particular in rain-fed agriculture. In many regions, a large proportion of the water that falls as precipitation is evaporated and transpired again by the vegetation. Through the appropriate choice of crop types, evapotranspiration on agricultural lands may be reduced, which could lead to increased runoff and a generally enhanced availability of water for other plants or purposes.
- **Changes in farming systems** to make them more resilient to changes and to a higher variability in climatic conditions. Mixed farms, for instance, are likely to be less sensitive to changes than specialised arable and livestock farms, since their income relies on a larger range of products. Diversification of production may thus be a way for farmers to increase their management flexibility and adaptive capacity. Also, organic farming approaches may enhance the capacity of agricultural soils to perform under changing and more adverse climatic conditions.
- **Changes in land use and landscape management** may help conserve water, for instance replacing arable land by grassland. To reduce sensitivity of farming systems to flood damage, a change of land use in flood risk areas might be necessary. For instance, crop farming in flood risk areas may be replaced by extensive grassland management.
- **Crop breeding** and development of more resistant varieties. Seed breeding should be aimed at developing crops that are more resistant to water stress.
- Changing or improving **harvest insurance mechanisms** to protect farmers from the economic impacts of flood or drought damage.
- Furthermore, agriculture may benefit from **adaptation measures** (e.g. flood

protection, water supply) taken in the water management sector.[2]

A need for further **research** exists both with respect to the integrated impacts of CO_2 increase and climate change on farming systems, and with respect to adaptation strategies that can improve sustainability and resilience of farming systems under more variable climatic conditions. Issues for research include spatial resolution in vulnerability mapping, technological and management-based adaptation measures, and the breeding of more drought- or heat-resistant crops. A key political issue to be discussed in this context is the role of genetic modification and biotechnology for seed breeding. There are strong concerns among the European public about the risks of genetic engineering, which should be taken into account. Furthermore, little is known yet about the feedback effects from adaptation measures in agriculture on the biosphere-atmosphere system and on regional climate.

Appropriate **communication strategies** are also necessary to ensure that farmers and farm advisory services are sufficiently informed about impacts and adaptation strategies to take the necessary actions.

Adaptation under the current EU policy framework

Policy-making at regional, national and EU level may play a key role in facilitating adaptation. The adaptation dimension in particular needs to be considered in the European Common Agricultural Policy (CAP) in order to set appropriate incentives and support adaptive measures.

The Common Agricultural Policy

Among the main drivers behind agricultural production patterns in the EU is the CAP. Its primary objectives are to increase agricultural productivity, to ensure a fair standard of living for the agricultural community and to stabilise markets. Recent reforms have increasingly incorporated environmental concerns.

Financial support is provided to farmers based on two 'pillars'[3] which influence farmers' production decisions.

- **Market and income support (Pillar 1)** covers direct payments to farmers and market-related measures under the common market organisations (CMO), such as intervention schemes (buying of products into public storage), surplus disposal schemes, and export subsidies.
- **Rural development policy (Pillar 2)**, among other objectives, aims to encourage environmental services and the sustainable use of resources in rural areas, providing assistance to difficult farming areas and promoting food quality, higher standards and animal welfare. These objectives are reflected in the new Rural Development Regulation for the period 2007-2013 (RDR[4]) and its related funding mechanism. It is built along four axes including several rural development measures that can be used to improve the environment (see Dworak et al., 2005). Member States (and regions) select measures from the catalogue provided by the RDR for their national (regional) rural development strategies and programmes, in order to target them specifically to their needs.

Adaptation under the Common Agricultural Policy

Current European policy on climate change takes account of the role of agriculture for mitigation (European Commission 2000), but also recognises that the agricultural sector will have to adapt to climate change impacts in order to secure food production and the functioning of rural areas (ECCP 2006). Despite the lack of explicit references to adaptation in the current framework of the CAP, adaptation concerns might be integrated into the CAP and supported through the existing instruments.

Market and income support

Since the establishment of the CAP, changes in land management practices and agricultural production patterns were significantly influenced by product-related (coupled) payments that farmers received. As a consequence, production decisions not always considered environmental conditions. The 2003 CAP reform introduced the "de-coupled" single farm payment, and market-based

[2] See also discussion papers on water resources management and water supply and sanitation.

[3] See http://europa.eu.int/comm/agriculture/.

[4] Council Regulation (EC) No 1698/2005 of September 20, 2005, on support for rural development by the European Agricultural Fund for Rural Development (EAFRD).

incentives became more relevant. Income support is still provided to the agricultural community, but its influence on production decisions is reduced. The de-coupling of support encourages farmers to respond to market signals generated by consumer demand rather than by production-related policy incentives.

However, under the 2003 CAP reform not all payments were de-coupled, and several water-intensive products still receive specific area payments (for example rice). During a transitional period lasting until 2007 at the latest, Member States and regions have options for partial de-coupling in different sectors (cereals, livestock). During this period, incentives for farmers to grow water-intensive crops in dry areas continue to exist.

Rural development policy

The new Rural Development Regulation also provides opportunities to strengthen the contribution of the CAP in combating climate change and supporting adaptation. Climate change mitigation and adaptation are acknowledged as Community priorities in the Community strategic guidelines for rural development (RD[5]), and Member States (and regions) are encouraged to incorporate appropriate actions in their RD programmes to address these priorities. Axis 2 (improving the environment and countryside) of the new regulation could play a crucial role in meeting this objective. In addition, a wide range of measures available under all four axes can make a contribution to the adaptation of agriculture to **long-term effects** resulting from climate change. These measures include:

- investment support for new equipment needed for adaptation (e.g. Art 26 RDR modernisation of agricultural holdings),
- support for the development of new products, processes and technologies in the agricultural, food and forestry sector (Art 29 RDR),
- training and information measures (e.g. Art 22 RDR and Art 58 RDR).

In addition, the new RDR provides an opportunity to set up measures that aim to restore agricultural production damaged by **natural disasters** (for example, extreme events such as flooding) and introducing appropriate prevention actions (Art 20 (b) (Vi) RDR). In a 2005 communication (European Commission, 2005a), the Commission explores possibilities to introduce **new risk and crisis management measures** into the menu of rural development policy. It suggests instruments such as financial contributions to premiums paid by farmers for insurance against natural disaster, support for mutual funds in the agricultural sector, and a generalised approach to respond to income crises. Increasing frequencies of extreme events due to climate change and the associated risks for farmers might be an additional argument to further pursue such approaches.

Currently, Member States are in the process of selecting measures and drafting their national RD programmes. It will depend on the priorities set by the Member States whether the measures provided by the new RDR will be used to encourage the adaptation process. If, for the moment, adaptation measures are not featured, Member States have the opportunity to rearrange their RD strategies towards an adaptation strategy in the future; however, as experiences from previous programmes have shown, changes on a broader scale cannot be expected (European Commission, 2004).

It is important to note that the total share of CAP funding spent on the rural development pillar is still small compared to the budget available under pillar one.

Interaction with other policy areas

Other EU policy areas related to agriculture, such as energy and environmental policy, or national or regional spatial policies, may influence the adaptive capacity of the agricultural sector. There is a need to discuss potential conflicts of interests between different policy objectives, and to identify policies that may exacerbate problems caused by climate change or counteract adaptation efforts.

For instance, the EU has the objective, as part of its energy policy, to promote the use of biomass in order to double the share of renewable energy in total EU energy consumption. The Community Biomass Action Plan (European Commission, 2005b) aims to increase total biomass production from 56 Mtoe[6] in 2001 to 74 Mtoe by 2010. Given that some of the crops used for the production of biofuels, such as maize, may require large amounts of water, fertiliser and pesticides, this

[5] Council Decision of 20 February 2006 on Community strategic guidelines for rural development (programming period 2007 to 2013) (2006/144/EC), published in OJ L 55 of 25.2.2006.

[6] Megatonnes of oil equivalent.

development may further exacerbate pressures on water resources (e.g. increase of abstraction for irrigation and risk of groundwater pollution) by agriculture, which may raise concerns with respect to the resilience of agricultural systems to the expected changes in climate. However, it has to be taken into account that the relative environmental impacts of biofuel crops production will depend to a large extent on the farmland areas used, the crops cultivated and the farming practices, and the wide range of climatic, physical, and economic conditions across the EU, which makes the overall assessment difficult.

Adaptation measures in water and flood management may also impact on the agricultural sector. Further, adaptation measures in the water supply and sanitation sector might require a prioritisation of water uses (see discussion paper on water supply and sanitation) resulting in lower preferences for agriculture.

Conclusions and key issues

The impacts of climate change on the agricultural sector will vary across Europe, and the adaptation efforts required will be different. The challenges will be most pronounced for farmers in southern and parts of central Europe. Here, the projected reductions in water availability will seriously impact on crop yields. Reducing the dependence of farming systems on irrigation water will thus be a key issue for effective adaptation strategies. By contrast, regions at higher latitudes might also benefit from rising temperatures.

The 2003 CAP reform facilitates adaptation efforts. The new support scheme introduced de-coupled payments, which gives flexibility to farmers to adapt their production decisions to economic and agronomic criteria, and reduces their incentives to further intensification, such as growing water-intensive crops under water-scarce conditions. However, further de-coupling may be desirable.

Under the second pillar on rural development, several measures exist to support the adaptation process. However, it should be recognised that adaptation to climate change is not the primary goal of EU rural development policy, and that different objectives may compete. The use of the measures for adaptation is strongly dependent on the priority that adaptation is given within a Member State. The adaptive capacity of European agriculture is likely to benefit from a strengthening of the second pillar.

There is no doubt that the adaptation measures in agriculture will strongly interact with measures in other sectors. **Synergies** with other policy areas, such as the Water Framework Directive, the future Soil Framework Directive, and the Flood Risk Management Directive should be promoted.

Key questions

1. **Impacts and vulnerability**: Which climate change-driven changes in water resources will pose the greatest challenges to agriculture? Which benefits can be expected? Which regions will be most affected?
2. **Adaptation options**: What options for adaptation are available, and which of them should be implemented in a long term perspective ?
3. **Policy action**: What could be gained from co-ordinating and implementing adaptation at EU level? Which modifications of the Common Agricultural Policy are needed to better support adaptation processes? What can be done to ensure that different (agriculture-related) policies are consistent, more co-ordinated and compatible with adaptation to climate-driven changes in water resources?
4. **Integrated approach**: What role should the agricultural sector play in an integrated adaptation effort at river basin level? What are suitable approaches to mitigate conflicts between agriculture and other water users when water becomes scarce?
5. **Research needs**: Which knowledge gaps need to be addressed with regard to impacts, vulnerability and adaptation options?

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