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Impact on Environment and Society

Agriculture

The Impact of Climate Change on Crop Production in Austria

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The COIN project evaluates economic impacts of climate change on Austrian agriculture.

Main findings

- Under a moderate climate change scenario and moderate socio-economic developments, Austrian agriculture may experience an increase in average crop yields by the middle of the 21st century. Thus, the sector's annual value added would increase by approximately € 120 million (mn) (€ 110 mn) for the periods of 2016–2045 and 2036–2065, respectively. These results do not consider global effects of climate change (e.g., food shortage).
- Model results show that the western regions of Austria with high precipitation sums could especially benefit from the assumed developments, while the dry regions in the east would profit only little or not at all. In particular, grassland in western Austria would contribute to the productivity increase.
- However, costs which may arise from losing ecosystem services essential to agriculture, such as pollination or natural pest control, counteract higher crop yields. These costs are estimated at up to € 100 mn per year.
- Moreover, dry periods increase crop yield risks to agriculture. Drought scenarios for Austria and the 2010 to 2040 period show that particularly Lower Austria, Vienna, and Burgenland may face crop yield losses and high inter-annual crop yield variability under rain-fed conditions. On Austrian average, these scenarios project decreasing crop yields of up to 7 % when irrigation systems are not considered.

Hardly any sector is more dependent on climatic conditions than agriculture. Merely small changes in temperature and precipitation may have a noticeable impact on the level and inter-annual variability of crop yields as well as on the agricultural income. Data provided by Statistics Austria show, for instance, that the high temperatures and low precipitation sums during the growing season in 2003 caused high crop yield losses compared to the long-term average (1990–2012). Throughout the EU, the damage amounted to approx. € 13 billion (Tubiello et al. 2007). Conversely, crop yield increases were observed in the year 2008 (+13 % for both, winter wheat and soybean) due to an approx. 1.5 °C higher average annual temperature and an advantageous precipitation situation during the growing period.

Project info box

The interdisciplinary COIN (Cost of Inaction – Assessing Costs of Climate Change for Austria) project evaluates economic impacts of climate change in Austria. For this purpose, a scenario-based analysis of and across twelve key sectors is conducted, which assesses the possible impact of climatic change in combination with socioeconomic developments. The main scenario assumes a temperature rise within the two degrees Celsius margin for the period up to 2050. This assumption presupposes stronger climate policies than the ones currently in place. The analyses presented here only show that part of all potential impacts which has already been quantified and takes into consideration individual adjustments made.

What has been analysed?

The COIN project has analysed different impact chains relevant to the agricultural sector to assess potential climate change impacts on average crop yields. On the one hand, the study has investigated the impacts of rising average annual temperatures and a correlating extended growing season; on the other hand, it has analysed the effects of changes in precipitation sums and distribution on agricultural productivity. The latter impact chain also includes the analysis of how changing aridity and drought levels affect selected crop yields. For this purpose, drought scenarios for Austria were modelled. Their probability of occurrence remains thus far unknown.

Among other things, the calculations do not take into account technological progress, potential increases in extreme weather events (e.g., hail storms), changing environmental conditions (e.g., changes in disease and pest pressure), alterations in crop yield quality, or the effects that global climate change may have on world market prices and on global food availability with possible repercussions in Austria. It is expected that climate change will cause agricultural net yields to decrease significantly on a global level by the middle of this century (IPCC, 2014).

What impacts are to be expected?

The study shows that under moderate climate change[1] and moderate socio-economic developments[2] agricultural production value would, on average, be higher by approx. € 190 mn (€ 180 mn) per year in the periods 2016–2045 (2036–2065) period. The annual production costs would increase by approx. € 80 mn (€ 70 mn) (for the periods 2016–2045 [2036–2065]), on average. This leads to a higher value added of approx. € 120 mn (€ 110 mn) p.a. resulting from the aforementioned climate change-related impact chains. However, when modelling periods of extreme drought with a not yet defined probability of occurrence, the results for the period 2010–2040 show crop yield decreases between 2 % and 7 % on Austrian average, depending on the drought scenario.

In addition, climate change impacts on ecosystem services may have a strong impact on crop yields. The effects of higher temperatures on insects and their pollination and pest control services are known in qualitative terms. However, it is difficult to assess potential losses quantitatively. Both pollination and natural pest control are essential to the agricultural sector and can be estimated to amount to a total annual value of approx. € 500 mn in Austria. The disturbance of ecosystem services as a consequence of climate change may lead to a decrease in crop yields. A reduction of ecosystem services by up to 20 % by the middle of the 21st century (and thus a related loss of up to € 100 mn) is deemed probable.

Are there regional variations in Austria?

The COIN results show that climate change impacts on the Austrian agricultural sector may vary regionally. Increased crop yields will rather occur in the grassland-dominated western regions with high precipitation sums. In this region, the benefits of higher temperatures and higher atmospheric CO_2 concentrations prevail despite slightly decreasing precipitation sums in the climate change scenario. However, in the cropland dominated eastern parts of Austria, already existing water shortages may be exacerbated. If the climatic drought scenarios for the 2010–2040 period were to eventuate, the area prone to crop yield reductions of more than 30 % would expand to large parts of Lower Austria, Vienna, and Burgenland.

When interpreting these results, it has to be taken into account that model results may change under more or less moderate climate change scenarios. Likewise, alternative socio-economic developments (such as planting alternative cultivars or using alternative technologies, e.g., for irrigation purposes) would influence the sector's sensitivity to climate change. The present analyses do not consider the bandwidth of potential climatic and socio-economic scenarios and are hence to be understood as a first assessment. A comparison of several different studies will be necessary in order to obtain more robust findings. It should be noted that, on a global scale, climate change will have tremendous impacts on agriculture. Even within Europe individual regions may suffer economic losses despite growing crop yield potentials, e.g., if increasing crop yields in more competitive regions were to result in lower market prices.

What impacts on the Austrian national economy can be expected?

Taking into consideration the agricultural sector's interrelation with other sectors, the higher yields triggered by moderate climate change would increase the gross domestic product (GDP) by an annual average of approx. € 280 mn (€ 500 mn) in the 2016–2045 (2036–2065)[3] periods. It is important to note that this climate change-related contribution to the GDP (the gross value added) remains within the agricultural sector to only a relatively small extent. Other sectors, such as the food products, real estate, construction, and trade sectors would rather profit, since agricultural goods and food products would be cheaper with higher yields (relative to the baseline scenario), and thus more other goods and services can be consumed. The positive economic effects of higher yields may be reversed by droughts and by the loss of biodiversity.

References

Tubiello FN, Amthor JS, Boote KJ, et al. 2007. Crop response to elevated CO2 and world food supply: A comment on »Food for Thought...« by Long et al., Science 312: 1918–1921, 2006. European Journal of Agronomy 26: 215–223.

IPCC 2014. Fifth Assesment Report – Working Group II: Climate Change 2014. Impacts, Adaptation, and Vulnerability, Summary for Policy Makers.

Mitter H, Schönhart M, Meyer I, Mechtler K, Schmid E, Sinabell F, Bachner G, Bednar-Friedl B. 2015. Agriculture, Chapter 8 in: Steininger K, et al. (eds.), Economic Evaluation of Climate Change Impacts: Development of a Cross-Sectoral Framework and Results for Austria. Vienna, Springer.

Zulka KP, Götzl M. 2015. Ecosystem Services: Pest Control and Pollination, Chapter 10 in: Steininger KW, et al. (eds.), Economic Evaluation of Climate Change Impacts: Development of a Cross-Sectoral Framework and Results for Austria. Vienna, Springer.

1 When comparing the reference period (1981–2010) to the first (second) scenario period 2016–2045 (2036–2065), the moderate climate change scenario projects a mean temperature rise of 1.0 °C (2.0 °C) and changes in annual precipitation sums of +1.5 % (-2.3 %).

2 For the analysis we assumed socio-economic and land use scenarios. The socio-economic developments are based on the OECD-FAO Outlooks on Agriculture 2013–2022. The land use scenario is based on model results for 2020 and takes into account the latest reform of the Common Agricultural Policy.

3 The result is based on comparing the respective climate change scenarios to a baseline scenario (which interprets socio-economic developments at a medium sensitivity level of the agricultural sector, disregarding climate change).

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