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Assessing bio-economic impacts and climate adaptation potential in Flanders

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According to Global Circulation Model predictions, Belgium is situated on a wedge between a wetter and drier climatic regime. Observed changes show an increase of 1.3°C during the past decade, a higher frequency of warm summer days and a 6% increase in rainfall with a pronounced rise in winter precipitation of about 25% as compared to the normal (1961-1990). Since agriculture is particularly sensitive to climate variability and occupies more than 61% of the land surface in Flanders, the rural landscape will be confronted with profound changes. A combination of climate scenarios, production models and economic evaluation was used to assess climate impacts on agricultural goods & services, adaptation costs due to production losses and adaptation options.

Agro-ecosystems offer a wide range of productive, supporting, regulating and cultural services to society. Productive services relate to crop, animal and energy production, but will alter with climate change. Supporting services such as biodiversity, soil and water quality will be negatively affected by a higher climate variability, increasing erosion and sediment transport, enhancing the breakdown of soil organic matter, lowering soil quality and increasing runoff or leaching of agri-chemicals. The effect of a warmer climate on regulating services is an intensification of most nutrient cycles with increased emissions, which may be compensated for by carbon storage in faster and longer growing crops. The need for flooding areas may result in a net-reduction of the agricultural area. A higher probability of dry weather during summer time and a longer growing season may enlarge the attraction of recreating in rural areas. Knowledge on the interaction of agro-ecosystem services and climate change is required to formulate sustainable adaptation measures.

Heat stress and water shortages lead to reduced crop growth, whereas increased CO2-concentrations and a prolonged growing season have a positive effect on crop yields. The interaction between these effects depends on the crop type. The impact on crop production was simulated with a dynamic vegetation model for eight crops (winter wheat, potatoes, sugar beet, fodder maize, grass, grain maize, cauliflower spring, cauliflower autumn), three soil types (loamy sand, loam, clay) and four climatic data series (historic and three cc-scenarios). The three climate change scenarios were selected on the basis of multi-criteria analysis of the PRUDENCE RCM runs. In total 3480 year simulations were executed with a daily modelling step. Pronounced yield losses mainly due to water shortages and heat stress occur for all climate change scenario's, to a lesser extent in the case of winter and spring crops. Yield losses of up to 30% are simulated for sugar beet, whereas winter wheat losses are only 6 % on loamy sand. High critical temperatures lead to heat stress, decreased fodder uptake, outbreaks of diseases and ultimately to animal production losses. Changes in animal production were calculated with a threshold model, whereby a daily maximum temperature of 30°C was taken as the production limit. Calculated animal production losses are up to 9 % for sheep, 8 % for cattle, 6 % for pigs and 3% for poultry. An economic prognosis of the technical productivity, the price effect, the required agricultural area and number of animals was used to estimate the potential productivity for 16 agricultural activities. The impact of climate change was included through aggregating the modelled production losses for Flanders and assuming the agricultural area, the number of animals and the prices constant to the economic prognosis. The total financial impacts are 0.1 % or 6.6 million euro for the first scenario, 1.5% or 71 million euro for the second scenario and 4.1% or 201 million euro for the third scenario. The results represent the acceptable cost of adaptation measures to maintain current efficiencies and production levels.

Three gradations of adaptation were defined as different adoption rates. In total 22 adaptation measures were identified. Measures for crop production include cultivation techniques, prevention of pests and diseases, and sustainable use of genetic resources. Measures for animal production relate to stables, feed composition, selection of breeds and prevention of diseases. Measures for agro-ecosystem services other than production concern the sustainable use of natural resources and the quality of the environment and overall community support. The extent of adaptation depends on the farm's economic buoyancy, its vulnerability and the severity of climate variability. Climate change issues therefore have to be integrated in agricultural policy by means of instruments that allow for refined insurance against natural hazards, sustainable management of natural resources, sustaining agro-ecosystem services, supporting sustainable measures and combating vulnerability through adapting infrastructure. This requires sufficient technical and institutional capacity to develop timely information systems.