THEMATIC CENTRE • Forestry and Agriculture

Pilot Study 2

OrientGate

Adaptation measures in Romanian agriculture

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Under the OrientGate project's Thematic Centre on Forestry and Agriculture, two pilot studies were carried out: Pilot Study 1 focused on climate change adaptation in the forests of the Austrian Alps; Pilot Study 2 investigated agricultural adaptation in Romania.

Working together

Pilot Study 2 focused on the city of Caracal in Olt County, southern Romania; and the centrally located Covasna County. Work was carried out by the National Meteorological Administration and the Environmental Protection Agency of Covasna.

Municipalities provided technical support to develop a drought risk management tool and adaptation measures. Local farmers also contributed by testing techniques and implementing results. The Agricultural Research Development Station of Caracal will use the findings to develop its own research into varieties and hybrids with high adaptability to local climate and soil conditions. Thematic seminars and scientific meetings brought together OrientGate partners and local, regional and national authorities in the agriculture, water, environment, emergency response, education and public administration sectors; urban planners; academics; and civil society representatives.

Establishing goals

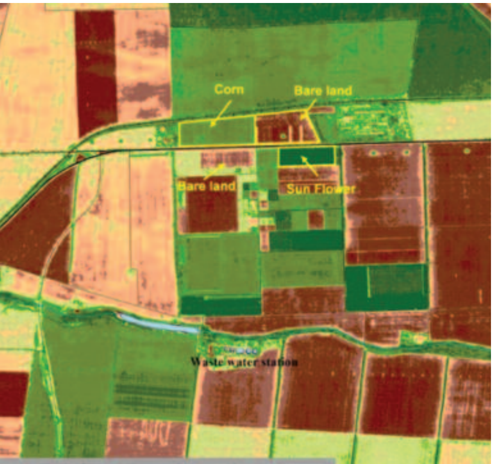
The aim was to identify adaptation measures via collaboration between researchers and farmers. Winter wheat and maize were selected, and Crop Environment Resource Synthesis (CERES) models were used along with climatic predictions obtained by the EU ENSEMBLES project and the CMIP5 experiments carried out by the World Climate Research Programme. The Decision Support System for Agrotechnology Transfer (DSSAT) model was applied in order to evaluate the potential impact of weather patterns on crop productivity. Technological sequences were analysed by simulations of crop management practices: changes in sowing date, altered genetic coefficients for genotype selection, and crop irrigation needs during the vegetation season.

Managing results

Data on soil moisture, water demand, rainfall and air temperature were recorded on regional geographic information system (GIS) maps. Land cover/land use categories were identified via the unsupervised classification of images from the Pleiades satellite on May 10, July 3 and August 26, 2013, and a map showing land cover/land use classes (water, winter crops, summer crops, pasture, barren soil, urban) was obtained. A set of indicators (1961–2010) was used for risk assessment: standardised precipitation index, three months; soil moisture reserve; heat stress aridity index; total precipitation on wet days; and consecutive dry days. Satellite-derived indices such as the normalised difference vegetation index; the normalised difference drought index; and the normalised difference water index were applied.

Analysing the findings

In Caracal, mean annual air temperature rose by 0.5°C in the 1981–2010 period, and in Covasna by 0.4°C compared to the reference period (1961–1990). There was a decreasing trend in annual precipitation in Caracal (526.1 mm compared to 565.9 mm) and a slight increase in



Covasna (513.1 mm compared to 500.8 mm). Climate projections suggest an increase in mean annual air temperature by around 1.8°C in Caracal and 1.5°C in Covasna. Projections also indicate a 0.7 percent decrease in annual rainfall in Caracal and a 6.1 percent increase in Covasna. In summer, monthly rainfall will decrease compared to the present. Projections suggest that the vegetation period for winter wheat may be 9 to 13 days shorter, and for maize crops 15 to 18 days, in the 2021–2050 period due to higher air temperatures. Maize yields may thus be 10.8 to 14.4 percent lower due to higher in-soil water deficits mainly during the grain fill period (July to August) at both sites. Water is used more efficiently by winter wheat with a later sowing date (October 20 and November 1 in Caracal; September 10 and October 5 in Covasna) compared with the end of September and beginning of October. In maize, water is used more efficiently by crops with an earlier sowing date (April 1 and 11 in Caracal; and March 20 and April 1 in Covasna) compared with April 20 or 10. Under future climate conditions, the most suitable winter wheat varieties will have high or moderate vernalisation and moderate photo-period requirements.

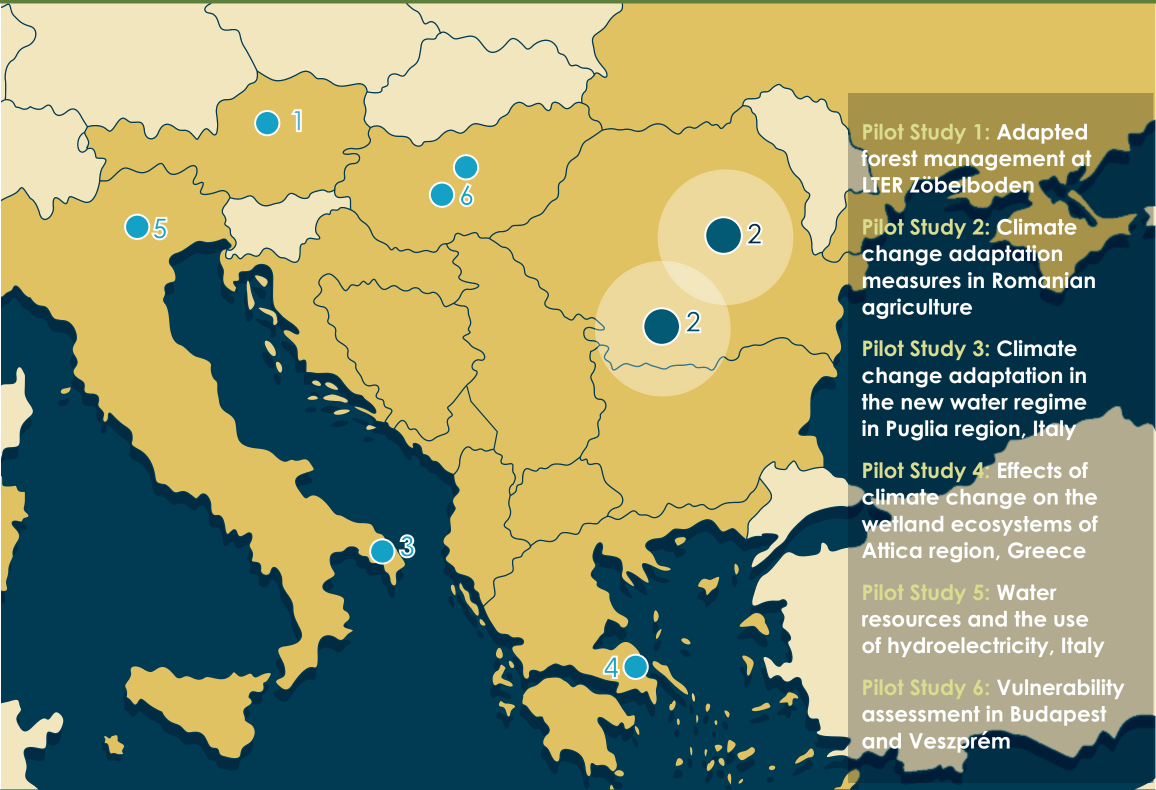
Ensuring stable production

In both areas winter wheat yields will slowly increase due to higher CO_2 concentrations in the air (affecting photosynthesis) and irrigation to counter the negative impact of shorter vegetation periods. Maize yields will decrease due to higher temperatures that shorten the vegetation season, along with water stress, mainly during grain formation and filling. Maize is thus more vulnerable to hot summers and droughts. Simulations suggest that climate change may have a big impact on crops, depending on interactions between local changes, the severity of the climate scenario, CO_2 concentrations and plant type. Field crop species should be selected for cultivation based on the correlation between the local environment and the degree of genotype resistance according to vegetation conditions (drought, excess humidity, high temperature, cold/frost periods, etc.).

Putting results into practice

The pilot study on agricultural crop production in Romania highlighted the following key points:

- Climate change will cause a significant shift in environmental conditions, and adaptation in the agricultural sector will be crucial.
- The frequency and severity of droughts are expected to increase.
- Yields of winter wheat are expected to increase and yields of maize to decrease mainly in the case of a scenario predicting hot summers and drought conditions.
- The agricultural sector will face more climate-related risks, and continuing research will be needed into adaptation options (such as the impacts of irrigation and the sustainability of yields in the context of various water-saving methods and irrigation technologies).
- The modelling of potential climate change impacts on farming systems, the identification of appropriate adaptation responses and the development of capacities for measure implementation are long-term goals.
- Numerical experiments must be carried out to determine optimal dates and amounts for crop irrigation under various climate scenarios, and calculations must be made taking into account biophysical analyses of final yields in association with economic models.
- Meteorological information must be better disseminated to farmers and awareness of water-saving techniques must be raised in order to prevent drought and water scarcity.



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