



## Estimating the economic impacts of drought on agriculture through models and surveys in the Po river basin (Northern Italy)

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Drought economic impacts, even if non-structural, are a significant threat for those sectors highly dependent on water resources. Agricultural production is highly sensitive to extreme weather events such as droughts and heatwaves. Climate change is expected to exacerbate the frequency and the severity of droughts, as stated by the Intergovernmental Panel on Climate Change (IPCC), which raises concerns about food security for the next decades.

The Food and Agriculture Organization (FAO) estimated that between 2005 and 2015, 83% of all drought-related losses were absorbed by agriculture. The huge monetary losses are mainly due to crop yield reduction because of high temperatures and reduced precipitation, which are linked to additional expenses for field irrigation.

This study aims at estimating the economic impacts of drought on the agricultural sector. The investigation has been carried out for a specific case study area within the Po river basin (Northern Italy). The Po valley is the largest agricultural area in Italy and accounts for 35% of Italian agricultural production. It has experienced multiple droughts over the past 20 years, with the long and severe drought from 2003 to 2008 that caused relevant impacts to the agricultural sector. The total economic impact of the 2005-2007 drought was estimated to be around 1.850M€. Climate change projections over the Italian peninsula from the PRUDENCE regional experiments showed that the frequency and the severity of droughts in Northern Italy will increase in the next century due to a decrease in precipitation during critical crop growing seasons (spring and summer).

The proposed methodology consists of two steps. At first, farmers have been subjected to surveys for assessing the monetary losses they experienced during past drought events and the cost associated with the mitigation strategies implemented to reduce the economic impacts of the extreme event, with special attention to irrigation practices.

Secondly, the crop growing season and yields have been estimated using the Agricultural Production Systems sIMulator (APSIM), calibrated with local yields retrieved from the Italian National Institute for Statistics (ISTAT) over the period from 2006 to 2020. Weather parameters for simulations in APSIM were derived from remote-sensing images. The comparison between the average growing season and the ones with low yields allows the identification of the crop growing stages that experienced stress. Among the identified stresses, the ones related to water shortages

are considered. The economic costs associated with agricultural practices are computed to obtain an estimation of farmers' expenses. Besides, farmers' income is computed based on crop prices and simulated yield. The reduced income obtained by farmers during the previously identified water-related stresses represents their loss due to drought.

Results reveal that the use of the developed methodology to identify drought stress in combination with the information coming from surveys helps in quickly assessing the economic impacts of past and present droughts in the Po river basin and represents a useful tool to evaluate which cultivations and which areas suffered the highest economic impacts of droughts.