Hydrological drought index insurance in irrigated agriculture in a highly regulated system: an economic instrument for risk mitigation for the Jucar River Basin

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Water scarcity is increasingly recurring in irrigated agriculture in Mediterranean climate regions, and it is, therefore, necessary to establish alternatives to enable irrigators to deal with such problems, in a planned manner and in accordance with the technical and economic implications. Although insurance schemes for droughts has long been standardized for rainfed crops, their application to irrigated crops is still under discussion. This study presents a new index-based drought insurance scheme, totally aligned with the river basin drought management procedures.

When considering a highly regulated water system, where natural water availability is altered by the operation of water infrastructure, traditional drought indicators (e.g., SPI, SPEI, SRI) lose significance, and ad-hoc index formulations tailored to the basin characteristics are required to reflect both regulation effects and natural fluctuations in the basin. Spain provides a paradigmatic example of a practical and systematic policy for the identification and mitigation of operational droughts: the river basin authorities are bound by law to design basin-specific state indexes. The state indexes are monthly monitored and used to trigger water demand and supply measures when entering a drought period, according to the specifications of the drought management plan. The study was carried out in an irrigation district (90% citrus fruits) in the Jucar river basin in Spain, a highly regulated water system.

Three insurance scheme options were evaluated: 1, a variable premium and/or variable franchise based on the forecast of water availability for the insured irrigation campaign, 2, a multi-annual insurance contract, and 3, an advance contract with a constant premium. In each of them, the values of the fair risk premiums, the maximum compensation, and the deductible franchise were established for different state indexes based on different combinations of system state variables (such as reservoir storages and inflows) and precipitation. The design of the insurances was done under the preexisting drought system operating rules to reduce the issue of the moral hazard, which is one of the main problems for this kind of insurance index. The selection of the insurance scheme is based on the gross margin of citrus crops with and without insurance contracts, including the value of additional premium loads, in addition to a basis risk analysis.

To evaluate the performance of the insurance, synthetic hydrological time series were generated

using an ARMA model and implemented in the basin-wide water resource simulation management developed in DSS Shell AQUATOOL. The premium-claim ratio was used to assess the performance of the insurance company, finding stable values that can generate a balance of the long-term insurance scheme.