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Off-season irrigation as a climate adaptation strategy for future groundwater management in Northern Italy

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Across 2021 and 2023, Northern Italy suffered a harsh meteorological drought due to severely under the norm precipitation. This strongly affected the pre-alpine lake levels as well as rivers discharge and soil moisture. Groundwater was also impacted, resulting in decreased water table levels. These factors led to harsh consequences on agriculture, that in Lombardy region largely relies on flooding and surface irrigation methods using Ticino and Adda rivers water coming from lakes.

To address the challenges posed by this last drought event and to be prepared to possible future dry scenarios, we propose and show the first results of our research around the possibility to harness the capillary irrigation network as an infrastructure for a diffused managed aquifer recharge (MAR). The main idea is to infiltrate water into aquifers in periods of surface water exceedance (historically autumn/winter in this region) using the irrigation network by keeping water in the channels or providing it as irrigation. The increased underground water storage would lead to groundwater levels increase. Relying on the slow groundwater velocity (ca. 350 m/year), water would remain stored in the subsoil just below the irrigated areas, bringing two main advantages during the following spring and summer seasons. First, the possibility to harness groundwater as an additional reservoir from which to extract water for agricultural or urban purposes if surface and meteorological water is insufficient. Second, a sustained flow rate at lowland springs that are scattered around the Po plain, whose water is reused for irrigation downstream and represent biodiversity hotspots. The adaptation measure feasibility will be assessed through field tests by providing water in channels and on fields and through agricultural and groundwater integrated models able to consider climate change scenarios.

During the 2023/24 winter season, a first field test was carried out distributing water in the irrigation network and over some fields selected through the cooperation of farmers. Helped by a regional scale numerical model we tested the potentiality of such practice both at basin and at local scale, by simulating the additional winter recharge. The model simulations clearly show the adaptation measure potentiality both at local and at regional scale. Furthermore, monitored wells around the pilot are showing signs of the expected short-term effects of the measure, but a longer time series is needed to assess its actual impacts. Here some model simulation outcomes are shown together with the first results of the field activities, which are the first steps for planning the

main experimental activity planned for the next winter season.

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