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Winter flooding as a promising technique for improving the sustainability of Italian rice agro-ecosystems

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Rice agro-ecosystems face several environmental problems, such as low water and nitrogen use efficiency, reduced soil fertility, GHGs emissions. The RISTEC project (EU-RDP 2017) is focused on winter flooding of rice fields in northern Italy, a practice still scarcely adopted in this country and recently supported by EU-RDP. Winter flooding is known to foster the creation of habitats for foraging winter birds and to favour straw degradation. However, its effects on nutrient cycles, GHGs emissions, soil water balance, groundwater recharge and hydrological properties of soils are still poorly understood, hence needing further investigation.
This project represents a first attempt to conduct a multidisciplinary study on winter flooding in the main Italian rice basin, located across Lombardy and Piedmont regions. Activities started in October 2017 and will continue until the end of the 2019 cropping season in three pilot study areas. The first pilot area consists of six 20*90 m2 plots, with three out of six flooded during winter. Traditional flooding is applied during summertime. Effects of winter flooding are evaluated based on production, nutrient cycles, GHGs emissions, hydrological balance and groundwater recharge. Since the last two aspects are more easily quantifiable in large areas, the second and third pilot areas have an extension of 35 and 85 ha, respectively. In the two areas, the effects of this practice on hydrological balance, groundwater recharge and soil hydraulic properties are being quantified through both field and laboratory measures and hydrological models.
Results presented refer to the first year (October 2017 - September 2018). Winter flooding showed to have a positive impact on straw degradation and nitrogen immobilization, although the amount of available N was not different from traditionally managed plots. This led to no significant differences in yield. However, winter flooding showed a higher plant vigour at panicle differentiation stage. Methane emissions were absent during winter flooding and the following fallow period and reduced during the following cropping season. Lastly, about 97% of water applied through winter flooding reached groundwater. During winter flooding the groundwater table reached the same level than during the cropping season, when irrigation is applied over larger areas. However, when winter flooding stops the groundwater depletion rate seems to be faster (about one month for water table to return to pre-winter flooding conditions) compared to the depletion rate following the summer flooding (about two months). This is mainly due to the fact that winter flooded areas are surrounded by dry land, while a large surface upstream of the study sites is submerged in summertime. Consequently, to maintain a high water table at the beginning of summer, which would allow to reduce water losses due to percolation (thus increasing the irrigation efficiency of rice agro-ecosystems), winter flooding should be ended not long before the summer flooding, and should be adopted over large areas. Results produced during the first year indicate this technique to be promising under different aspects. The progression of the research during the second year is expected to provide further elements to complete the evaluation.