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Wappfruit, a project for the optimization of the irrigation in agriculture: final results

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The Wappfruit project objective is to optimize the irrigation techniques for water and energy saving in fruit orchards in the Piemonte Region, Northwest Italy. The stakeholders of the project are Politecnico and the University of Torino, Piemonte Region, Agrion Foundation for Research in Agriculture, Astel S.r.l. (for the industrialisation of the experimental hardware developed by Politecnico di Torino), and three farms ("La Marchisa" and "Lorenzo Sacchetto" – apple orchards and "Paolo Vassallo" – actinidia orchard). In each farm, two areas were identified, an "experimental area" where the new set-up was tested and a control area where the farmers continued the irrigation as usual.

In the year 2023, the Wappfruit project has shown the potentiality of a smart irrigation solution composed of two kinds of IoT (Internet of Things) nodes employing LoRa technology and governed by a 24/7 server script, written in Python, that acquires soil matric potential and decides the opening and closure of the irrigation pumps in real-time. The soil matric potential thresholds, identified in 2022 and early 2023, (-60 kPa and -25 kPa at 20 cm of depth for the activation of the irrigation, respectively in the apple and Actinidia orchards; -50 kPa at 40 and 20 cm of depth and -18 kPa at 20 cm of depth, for the deactivation of the irrigation, again respectively for apple and Actinidia orchards) were verified again after a campaign in which soil parameters (saturated soil water content, infiltration velocity at saturation) were measured. These values were used for new model simulations that included irrigation. The thresholds for the apple orchards were confirmed, whereas new thresholds were identified for the Actinidia: -12 kPa (activation) and -5 kPa (deactivation). Results highlight that these thresholds can activate and deactivate the irrigation appropriately. The 2022 simulations show a matric potential in agreement with the measures collected (R between 0.51 and 0.88). Moreover, the 2023 simulations with modelled irrigation show a good agreement with the measures in the experimental area. Both the simulations and the real optimized irrigation generally show lower values if compared with the irrigation of the farmers (range: 13 – 217.5 mm/ha), with an exception in one apple orchard, where the model suggests more irrigation than expected, likely because of an overestimation of the water infiltration velocity. The hardware/software design and implementation have shown that low-cost low-power

electronic devices and artificial intelligence can be reliable and very inexpensive for water and energy savings. The remote control of the system is another important achievement. Moreover, optimized irrigation does not affect the vegetation productivity and increases the fruit quality.