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Preliminary Assessment of Nature-Based Solutions Performance for Improving Irrigation Water Management Using the SWAT Model

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Nature-based solutions (NBS) offer innovative and sustainable approaches to address irrigation water management challenges, since they can contribute significantly to enhancing water retention, reducing soil erosion, and optimizing water use efficiency. Within this framework, the Soil & Water Assessment Tool (SWAT) model was applied in the Pinios Hydrologic Observatory (PHO) in central Greece to quantify the impact of two NBSs on irrigation water use: a) effective soil water management through irrigation scheduling and b) increased soil water holding capacity through mulching and mowing. Encompassing an area of approximately 55 km^2, PHO comprises forested and agricultural lands, predominantly cultivated with apples, followed by cherries and other orchards.

The SWAT model was applied in the PHO watershed for the period 2018-2022 and calibrated against soil water content with daily observed data obtained from soil moisture sensors installed both in forested and agricultural areas. A hybrid land use map, compiled by combining CORINE land cover and field-scale crop distribution, was utilized and the watershed was subdivided into 15 sub-watersheds and 696 Hydrologic Response Units (HRUs). Monitoring of actual irrigation water consumption in 10 orchards revealed an average of 670 mm per cultivation period. Simulation of irrigation scheduling using the SWAT model indicated a potential reduction of more than 20% in irrigation water consumption in the apple orchards.

Continuous cultivation for several decades, irrational irrigation and the excessive use of herbicides practiced in PHO affect soil health, potentially leading to soil organic content (SOC) depletion, microbial activity disruption, and overall soil fertility compromise. Augmenting SOC enhances soil water holding capacity, fostering improved moisture retention and resilience against drought conditions. Analysis of over 500 soil samples collected from orchards implementing mulching/mowing practices compared to those predominantly using herbicides revealed an average SOC 1.2% higher for soil depths of 0-10 cm and 0.6% higher for depths of 10-30 cm. This increase in SOC is estimated to potentially raise soil available water content by 2%, contributing to 3% more irrigation water savings when coupled with effective soil water management through irrigation scheduling. While this water-saving potential may not be high, it can contribute significantly to mitigating water scarcity during drought periods, whilst should SOC increase is achieved by mulching/mowing and no use of herbicides, soil erosion is prevented, soil aeriation is

improved, natural pollinator population is increased and agrochemicals' runoff potential is reduced.

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