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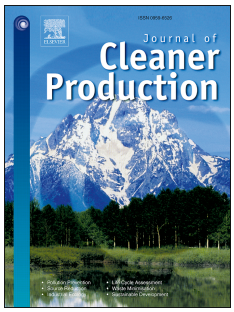

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ASSESSING SUSTAINABILITY OF AGRICULTURE THROUGH WATER FOOTPRINT ANALYSIS AND IN-STREAM MONITORING ACTIVITIES

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Abstract

Agriculture is one of the main causes of water consumption and degradation. Assessing its sustainability is important to determining how the current use of water resources can affect their availability in the future and to safeguard their quantity and quality. In this context, this research was designed to develop a simple approach for the evaluation of agricultural sustainability, based on coupling the assessment of the total water footprint (WF) of catchment-scale crops and in-stream monitoring activities. The study focussed on a Mediterranean agricultural watershed (Celone, southeast Italy). Results for the study period (July 2010–June 2011) show the total WF to be 79.9 Mm^3 y^{-1}, subdivided into 30.3% green water, 0.5% blue water and 69.2% grey water, thus highlighting the importance of grey water in agricultural water use. The grey WF estimates are highly sensitive both to leaching and runoff fractions and applied water standards, and they are affected by large uncertainty. Tomato is the crop having the highest total crop water use (CWU), which is equal to 2521 mm (286 mm green CWU, 412 mm blue CWU, 1823 mm grey CWU). Legumes relied only on green water (217 mm green CWU). The sustainability assessment of present water consumption, subdivided into the three WF components, indicates sustainable use of green water, fluctuating sustainability of blue water resources, depending on the season and the environmental flow requirement, and unsustainable grey water production and water pollution level for the Celone River. The methodology employed in this paper could be useful in watershed planning and management, helping farmers and decision-makers choose suitable crops for locally sustainable water use.

Keywords: water footprint, grey water, nitrogen pollution, nitrogen export coefficients, soil-water balance, Mediterranean Basin

1 Introduction

Water is a core component of human well-being and is essential for a thriving economy and healthy ecosystem (Vigerstol and Aukema, 2011). Increasing human population and anthropogenic activities (Lamastra et al., 2014), unsustainable development and economic growth (Vitousek et al., 1997a), put pressure on water quality and availability.

Agriculture is one of the main causes of water consumption and degradation because it requires large volumes of water for irrigation (Willaarts et al., 2012) and pesticides (Rulli and D'Odorico, 2013) and fertilisers (Ventura et al., 2008). The use of fertilisers exceeding plant demand has dramatically increased the amount of nutrients, such as nitrogen compounds, entering the terrestrial biosphere (Bennett et al., 2001). The total nitrogen (TN) surplus accumulates in soils