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Bridging the knowledge gap: study measures economic water scarcity for agriculture

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As the global population increases, the benefits of increased agricultural production are distributed unequally, partly due to inequality in access to water resources. However, even in some countries where hydrological resources are abundant, water is not always readily available for agriculture, due to economic, institutional or infrastructural reasons. A study explores economic water scarcity in agriculture by repurposing an indicator from the United Nations' Sustainable Development Goals and observing the relation between economic water scarcity, agricultural productivity and water use efficiency at a global scale.

A key factor influencing land productivity, agricultural performance and, consequently, food security is the abundance and the accessibility of water. However, mapping the abundance — or lack — of water in a region is complex; many countries have a high level of water availability according to hydrological indicators, but still face severe difficulties in the use of water resources for human activities, for reasons ranging from lack of infrastructure to institutional inefficiencies. This concept is defined as 'economic water scarcity' (EWS)[1].

Quantifying the impacts of EWS on agriculture requires data-driven studies, but research suffers from a knowledge gap around EWS measurability. There are efforts to fill this gap under EU policies on sustainable water management, and as part of the United Nations' Sustainable Development Goals — specifically Goal 6 (Ensure availability and sustainable management of water and sanitation for all), indicator 6.5.1, which describes integrated water resource management (IRWM). This indicator combines information on the legislative, managerial and financial environment for water management; on agreements about the management of transboundary watersheds and rivers; and on stakeholder participation processes. It quantifies the level of water management at the national level.

This study widens the scope of this indicator and uses it to quantify potential EWS, something that had not previously been attempted. The researchers aimed to contribute to research on

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water availability and water footprint, while also widening the focus from the physical and hydrological aspects of water scarcity to include the economic perspective.

The researchers explore the extent to which the IWRM provides information that overlaps with popular indicators on a country's wealth and climatic conditions, and conclude that the IWRM brings new insights with respect to the other indicators considered — such as the gross domestic product per capita, the human development index (in which people and their capabilities are the ultimate criteria for assessing the development of a country, beside economic growth alone), and the Falkenmark Indicator on water stress (which links total freshwater resources with a country's population). The researchers find that socioeconomic development is not always associated with sophisticated water management. From a policy perspective, high investment in water management seems to be driven by necessity only in countries facing very severe water scarcity. Overall, a high level of water management is neither necessarily linked to a country's economic power, nor to its low physical water availability.

The study subsequently explores whether the IWRM indicator is useful for describing the typical effects of EWS in agriculture: low yield or excessive use of water (due to inefficient infrastructure and management). The results show a statistically significant positive association between IWRM level and crop yield, and consequently a significant negative association between IWRM level and crop water footprint[2]. Despite strong climatic and economic differences, this link holds across countries, with high IWRM levels associated with yield increases of up to 13% and unit water-footprint decreases of up to 20%. The researchers conclude that the IWRM indicator could be a good quantitative measure of EWS in agriculture.

From their results, the researchers infer that good water management, as detectable through the IWRM indicator, improves land productivity and water-saving behaviour, in turn mitigating EWS. They suggest that their study demonstrates how the IWRM indicator can be used as a proxy to measure EWS in agriculture while considering the economic aspects of water stress and scarcity, to bridge the EWS measurability gap and inform effective policy for food security and development.

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1. Economic water scarcity (EWS) is defined in this study as "*a situation in which technical and institutional capacities or financial resources are insufficient to supply adequate water quantities for human use*".

2. For crops, the unit water footprint (uWF) is the ratio between the water consumed by the crop during the growing season and lost through evapotranspiration (in mm), and the crop yield (in tons per hectare). It is an inverse measure of efficiency: the lower the value, the more efficient the use of water resources in crop production. Water can originate from rainfall (green water) or irrigation, surface or groundwater (blue water). This study considers the sum of both.