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The Role of Benchmarking for Improving the Water Use Efficiency in Irrigated Areas

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Benchmarking is defined as "a systematic process for securing continual improvement through comparison with relevant and achievable internal or external norms and standards" [1]. Contrarily to the urban water supply, the application of benchmarking techniques to improve irrigation district performance is a relatively recent phenomenon. The main objective of this technique is to enhance the performance of a given irrigation district by comparing its current performance with that of other districts.

Related to this, it is possible to determine which practices lead to better performance in a district and subsequently adapt these practices to irrigation districts that perform less efficiently. Similarly, irrigation districts that perform more poorly will be able to determine which aspects are in need of improvement and take the necessary steps to achieve better performance.

Performance indicators are the main tool in a benchmarking process. A performance indicator is a ratio that relates variables (i.e. irrigated area, volume of irrigation water applied or productivity) in such a way that a large amount of information can be reduced to a single number. By comparing performance indicators it is possible to determine when an irrigation district is more or less efficient than another and take the necessary measures to correct any existing deficiencies.

Although a great number of researchers have developed and applied sets of performance indicators to measure the efficiency and sustainability of irrigation systems [2-6] there are few examples in the literature of improving efficiency by comparing several irrigation districts by means of performance indicators. Nevertheless, performance indicators are becoming an increasingly important tool in irrigation district management. This is the case, for example, of Australia where performance indicators have been applied to irrigation water management since 1996 [5] and several regions of Spain, e.g. Andalucia and Castilla La Mancha, where benchmarking techniques have been successfully applied in districts with different water sources, irrigation systems, etc [7,8].

The benchmarking initial research focused on evaluating the irrigation water use. Thus, in these studies, the evaluations were done for water but not other resources that play an important role in modern irrigated agriculture such as energy. However, mainly after the modernization plans where traditional open channels systems were replaced by pressurized networks, other recent research has highlighted the necessity of improving the use of both resources (water and energy) together, focusing on the analysis of alternatives for reducing energy consumption and energy costs [9]. For example, the Spanish Institute for Diversification and Energy Savings (IDAE) has recommended the implementation of periodic energy audits, based on performance indicators, in pressurized irrigation networks to improve their efficiency and reduce total energy consumption [10-12] developed a methodology based on performance indicators for the evaluation of water and energy use in irrigation districts. This methodology was applied in ten irrigation districts and the results showed that there are strong interactions between water use and energy demand. Thus, in irrigation districts with higher energy requirements, farmers usually trend to apply deficit irrigation.

In most previous research these indicators have been applied to comparative analyses of different irrigation districts within a single year. But these indicators have rarely been applied to analyze the impacts of scheme modernization. However there are a few examples in the literature about their use after modernization of the irrigation infrastructures. Mateos et al. [13] studied the impact of rehabilitation measures on irrigation districts in Mauritania. In this case, modernization consisted of improvements in the open channel network, without replacing the existing infrastructure with a new pressurized system Lecina et al. [14] used performance indicators to evaluate hypothetical modernization scenarios in the Riegos del Alto Aragón project in northeast Spain. Recently, Rodríguez et al. [15] used performance indicators to evaluate the impacts of modernization in Bembezar MD irrigation district in Southern Spain. The results showed a reduction of approximately 40% in water diverted for irrigation due to the migration to more efficient conveyance and application systems. However, from a farmer perspective, it has not provided a clear benefit, as incomes have not increased significantly because water costs are now much higher (mainly due to the increased energy costs).

In modern irrigated agriculture, the efficient use of the resources is more important every day, since it contributes to the environmental sustainability of the agricultural production and to the farmer's profits. Benchmarking and performance indicators are essential tools to achieve this goal. Thus, they have proven to be very useful for detecting inefficiencies in irrigation districts and also to evaluate the impacts of investments in modernization plans.

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