Atti del XXV Convegno Nazionale di Agrometeorologia

L'Agrometeorologia per la gestione delle risorse e delle limitazioni ambientali in agricoltura

MATERA, 14 -16 Giugno 2023

A cura di Francesca Ventura, Gabriele Cola, Francesca Di Cesare

Dipartimento di Scienze e Tecnologie Agro-Alimentari

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SESSIONE 1 - La gestione degli stress abiotici

POSTERS

SESSIONE 2 - Gli strumenti agrometeorologici al servizio delle politiche di sviluppo agricolo

POSTERS

SESSIONE 3 - Previsione e gestione delle avversità in agricoltura

LA PERCEZIONE DEGLI AGRICOLTORI COME STRUMENTO UTILE PER MIGLIORARE IL SERVIZIO DI CONSULENZA IRRIGUA

FARMERS' PERCEPTIONS AS AN USEFUL TOOL TO IMPROVE IRRIGATION ADVISORY SERVICE

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Abstract

Agricultural water scarcity, which is subject to the impacts of rainfall changes is affecting many regions of the world and it is leading to water competition between various users and uses. To deal with these issues, research concerning the application of Decision support systems (DSS) in agriculture has rapidly increased. In the current strategic agriculture framework, the new Common Agricultural Policy (CAP 2023- 2027) encourages farmers to use DSS. In this context, Irrigation Advisory Services (IAS) can play a key role in supporting users to adopt new techniques for a more efficient water use and increased production. In order for DSS and IAS to be able to approach the territory through efficient solutions in sustainable irrigation management, it is necessary to undertake a detailed study on the preferences expressed by final users through MCDA (Multi-Criteria Decision Analysis) in particular Analytical Hierarchy Process (AHP). In this research the judgments of stakeholders have been collected, analysed, and compared to enable advanced management strategies in the IAS, to address heterogeneous decision-making processes in the complex context of irrigation strategies. Improving access to information, ensuring data coherence and communication of data detected by climate variability are some of the issues investigated through this work.

Parole chiave

Servizio consulenza irrigua, Analytic Hierarchy Process (AHP), processo decisionale in agricoltura; gestione delle risorse idriche

Keywords

Irrigation advisory service; Analytic Hierarchy Process (AHP); agricultural decision making; water management.

Introduction

Since its inception in 1962, the Common Agricultural Policy (CAP) has evolved over the years to respond to the needs of European citizens and to adapt to changing environmental and economic conditions (Cabello Villarejo and Madrid Lopez, 2014). In particular, the 2014-2020 CAP reform provided more targeted support to agricultural practices significantly important for both climate and environment (Special report on the common agricultural policy and climate, 2021). Several changes were carried out with a focus on climate action and with the aim of fostering 'CAP greening' (Ciaian *et al*., 2018). These environmental priorities are updated and supported until today in the CAP 2023-27 framework. Currently, the interest in promoting a form of agriculture capable of adapting to climate change has carried the management of water resources is one of the keys points in the reforms of the CAP. As a matter of fact - *Foster sustainable development and efficient management of natural resources such as water, soil and air* and *Fostering knowledge, innovation and digitalisation in agriculture* - has been designated to be two of the ten new legislation objectives, which entered into force on 1st January 2023, in the new CAP 2023-2027. In order to improve water use, EU countries are called to invest and encourage, research and innovation in the sector by the implementation of "smart irrigation" technologies. An efficiency use of water for irrigation is a priority driven by the evidence that many areas in the Mediterranean region suffer a structural water scarcity (Noto *et al.*, 2023) imposed by the periodic droughts and by the expansion of water demands from agriculture and other sectors of society. With the advance of climate change, higher temperatures and changing precipitation patterns, the demand for water by the agricultural sector has increased. It has started to affect, not only areas where irrigation has always been an essential element of agricultural production (southern Europe) but also areas traditionally considered not irrigated such as some areas of central and northern Europe (Zajac *et al.*, 2022).

Considering these issues, to protect water resources and their integrity for future use, attention could be focused to the so-called Advisory Irrigation Services (IASs), able to bring innovation of irrigation technology and to raise water-use efficiency. The IASs refer to the measures and support services provided to the irrigation sector with the aim of improving its performance. Some keys IAS' activities are irrigation scheduling and distribution network and on-farm irrigation systems. Water management decisions are based not only on technical issues, but also on an economic and socio-political (Altobelli *et al.*, 2021) context, which changes according to geographical areas. Techniques and management tools that allow the application of water in a uniform manner and in pre-determined quantities to meet in part or totally the crop needs have been developed. The current low level of irrigation performance is therefore a paradoxical situation. Despite its advantages, irrigation technology either has not been adopted by farmers or, in the case where the hardware has been introduced, its adoption has not met the expectations (FAO, 2002). Investigation about the priorities of final users becomes very important when considering the large gap (Smith *et al.*, 2002) between the innovations achieved in the irrigation sector and the limited adoption of these technologies by farmers. This work provides an integrated approach to the decision-making process necessary to deliver efficient IAS; presents an application of a multiple-criteria decision analysis - the Analytic Hierarchy Process (AHP) - which involves the conversion of a linguistic judgement of farmers and carry out a ranking of weights of criteria by case study, through ranking groups and associated properties between farmers' profile. Furthermore, the present study tackles a decision-making process, aimed to improve the use of IAS, evaluating the preferences expressed by stakeholder.

Materials and Methods

As shown in Figure 1, the current research is organized as a four-phases methodology. Questionnaires were addressed to a total of 120 farmers (users of IAS), distributed among the study areas as follows: Campania (IT): 40; Limburg (NL): 7; Kujawsko-pomorskie (PL): 53, and Andalusia (ES): 20. The questionnaire was structured in four sections. In the present work, only the first two sections will be analyzed. The first section was focused on general information: main activity, gender, age, educational level, farm's location, farm surface, farm management, cultivated crop, main irrigation systems, sales channels etc.. The section 2 is named "Improving water use efficiency and the use of Advisory Services" and it collects the data used for the AHP application. In this section, farmers, evaluated the preference among a set of criteria (Table 1).

We asked farmers to make a comparison and express their own preference, among the C1 to C5 criteria using the Saaty's scale 1 – 9. In particular, the questions are formulated as: "According to you, is it more important C1 than C2, and by how much?" The pairwise comparison at the core of the AHP methodology is easily identifiable within the structure of the questions, as it will be discussed below.

The results of questionnaires dispensed to the users of IAS were analyzed and then the given priorities were evaluated by the AHP to determine the weights of the five assessment criteria and finally to select the one with highest value. The AHP was developed by Thomas L. Saaty in the 1970s (Saaty, 2008; Saaty and Vargas, 2012), who, by clarifying the relation between thinking and decision making, conceived the model.

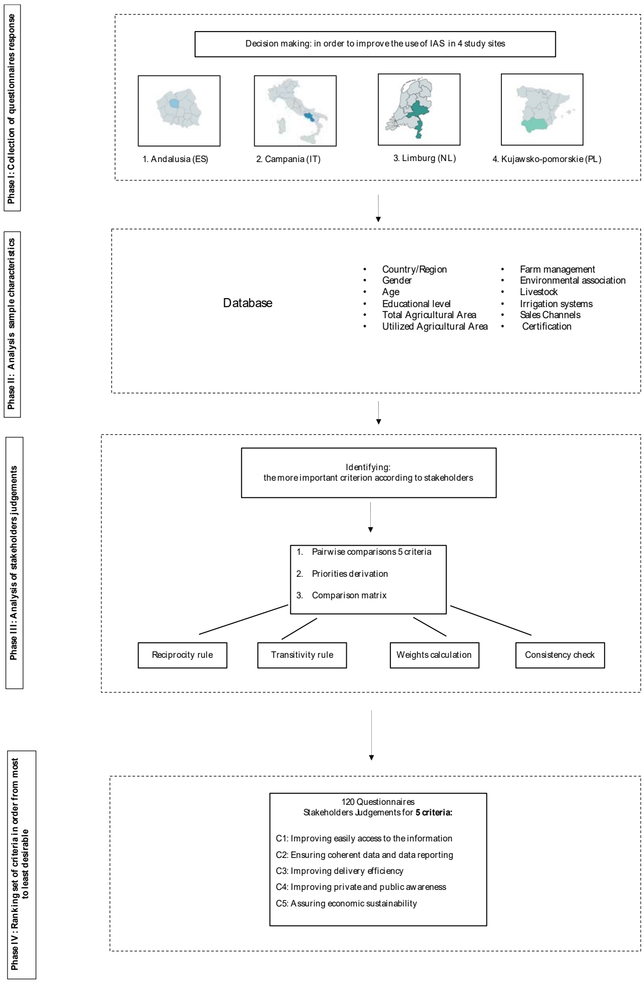


Fig. 1- Research methodology.
Fig. 2- Metodologia della ricerca

In the following stage, we proceeded with the aggregation of individual priorities in each study area and in each interest group, by relating the preferences expressed by stakeholders and thoroughly analyzing the key information provided by interviews, up to the construction of a database.

Subsequently, a mathematical aggregation of the weights of each criterion was done using the geometric mean method. Finally, the weights are grouped according to the decision makers profiles.

Tab. 1 - Description of AHP criteria.
Tab. 1- Descrizione dei criteri AHP

Type of criteria	Description
C1. Improving easily access to the information	Refers to the ease of access to information for farmers, either through electronic information (sms, email, etc.), more traditional communication systems, technical operators and journals, newspapers etc.
C2. Ensuring coherent data and data reporting.	Refers to the ability to implement an IAS based on high quality data providing valuable technical information to farmers.
C3. Improving delivery efficiency	Refers to ability to ensure prompt and constant delivery of information to farmers.
C4. Improving private and public awareness	Refers to improving public awareness and preparedness by informing the public about the risks and consequences in cases of excessive use of water for irrigation related to environmental and economic phenomena (e.g., water scarcity, conflict for use of water with others economic sectors).
C5. Assuring economic sustainability	Refers of cost of IAS that should be economically justified (i.e., economically affordable).

Results

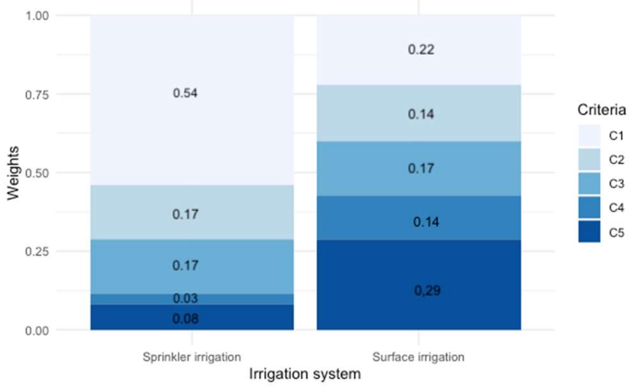
As shown in Table 2 , first results of the study demonstrated that the decision criterion with higher weight and therefore more important is the criterion C5- Assuring economic sustainability, which refers of cost of IASs that should be economically justified. (i.e. economically affordable).

Tab. 2- Overall results of the four study areas
Tab. 2- Risultati complessivi delle quattro aree di studio

	Criteria	Weights of criteria	Final ranking
Valuate possible allocation of Adoption Options to IAS	C1: Improving easily access to the information	0,207	3
	C2: Ensuring coherent data and data reporting	0,218	2
	C3: Improving delivery efficiency	0,196	4
	C4: Improving private and public awareness	0,148	5
	C5: Assuring economic sustainability	0,231	1

Hereafter the most relevant results of stakeholders' preferences are provided for some of the pilot areas.

Italy: The results show that C5- Assuring economic sustainability "improving private and public awareness" and "assuring economic sustainability" are the most preferred options.



Fig, 3- Weights of criteria grouped according to irrigation systems in Limburg (NL). C1-Easily improve access to information C2-Ensuring coherent data and data reporting, C3-Improve delivery efficiency, C4-Improve public and private awareness, C5-Ensuring economic sustainability.
Fig, 2- Pesi dei criteri raggruppati in base ai sistemi di irrigazione in Limburg (NL). C1-Migliorare facilmente l'accesso alle informazioni C2-Garantire dati coerenti e reporting dei dati, C3-Migliorare l'efficienza della consegna, C4-Migliorare la consapevolezza pubblica e privata, C5-Garantire la sostenibilità economica

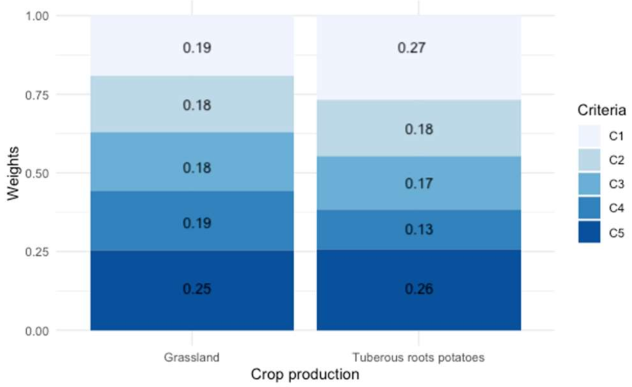


Fig.3- Main farm activity: aggregation weights of criteria in The Netherlands. C1-Easily improve access to information C2-Ensure coherent data and data reporting, C3-Improve delivery efficiency, C4-Improve public and private awareness, C5-Ensure economic sustainability.
Fig.3- Attività principale dell'azienda agricola: pesi di aggregazione dei criteri nei Paesi Bassi. C1-Migliorare facilmente l'accesso alle informazioni C2-Garantire dati coerenti e reporting dei dati, C3-Migliorare l'efficienza della consegna, C4-Migliorare la consapevolezza pubblica e privata, C5-Garantire la sostenibilità economica

The Netherlands: the preference of farmers adopting Surface irrigation is C5- Assuring economic sustainability.

Poland: results show that stakeholders prefer Improving delivery efficiency (C3), that refers to the ability to ensure prompt and constant delivery of information to farmers.

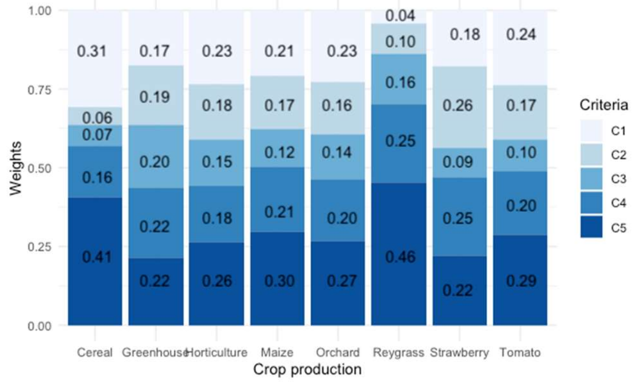


Fig. 4- Weights of criteria grouped according to the dominant farm activity in Campania (IT). C1-Easily improve access to information C2-Ensuring coherent data and data reporting, C3-Improve delivery efficiency, C4-Improve public and private awareness, C5-Ensuring economic sustainability.

Fig. 4- Pesi dei criteri raggruppati secondo l'attività agricola dominante in Campania (IT). C1-Migliorare facilmente l'accesso alle informazioni C2-Garantire dati coerenti e reporting dei dati, C3-Migliorare l'efficienza della consegna, C4-Migliorare la consapevolezza pubblica e privata, C5-Garantire la sostenibilità economica

Discussion and Conclusion

The implementation and management of an efficient irrigation system have to take in consideration the influence of many factors such as crop density, growing conditions, water quality or topography. Additionally, it is important to consider whether judgments are representative of farmers or decision makers experience (Srdjevic and Obradovic, 1997; Srdjevic, 2005). For this reason, part of the present study has been focused on the investigation of some crucial aspects concerning farmers' work: the irrigation systems adopted, the main farm activity, and to aggregate the relative weights according to the characteristics of stakeholders involved in the four agricultural sites. These results can be used as data/information exploitable in establishing common professional, social and political environment where research experts could make decisions to improve irrigation management by using advanced scientifically sound techniques.

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