Marta GUTH • Anna MATUSZCZAK • Agnieszka POCZTA-WAJDA •
Agnieszka SAPA • Katarzyna SMĘDZIK-AMBROŻY

WHAT DRIVES EUROPEAN FARMERS' ATTITUDE TOWARDS WATER MANAGEMENT – A SYSTEMATIC LITERATURE APPROACH

Marta **Guth** (ORCID: 0000-0001-9332-1193) – *Poznan University of Economics and Business*
Anna **Matuszczak** (ORCID: 0000-0002-5045-5447) – *Poznan University of Economics and Business*
Agnieszka **Poczta-Wajda** (ORCID: 0000-0001-5618-1590) – *Poznan University of Economics and Business*
Agnieszka **Sapa** (ORCID: 0000-0003-2963-1175) – *Poznan University of Economics and Business*
Katarzyna **Smędzik-Ambroży** (ORCID: 0000-0001-5228-2263) – *Poznan University of Economics and Business*

Correspondence address:
Niepodległości Avenue 10, 61-875 Poznan, Poland
e-mail: marta.guth@ue.poznan.pl

ABSTRACT: Considering challenges related to climate change, projected population growth, and increasing food demand, the long-term use of water in agriculture is becoming a pressing concern. Therefore, effective water resource management by farmers is crucial and warrants extensive scientific investigation. Consequently, the primary objective of this article was to identify pertinent studies addressing farmers' approaches, attitudes, and actions concerning water management and the adoption of water innovations. The review was conducted using the PRISMA method, serving as the foundation for subsequent quantitative and qualitative analyses. The findings suggest that water management in agriculture is gaining significance due to increasing exposure to the risk of limited water availability and compellement to adapt to changing climate conditions. Previous research has predominantly focused on selected southern regions of Europe. Farmers' attitudes toward water management are primarily influenced by socio-economic and institutional factors. Education emerged as a crucial determinant in encouraging farmers to use water conservation practices.

KEYWORDS: water resource management, water innovations, farmers' approach, PRISMA, climate change, drought, limited water availability, water conservation practices

Introduction

Agriculture stands as the largest global consumer of water, accounting for an average of 70 per cent of total freshwater withdrawals and is a primary contributor to water pollution through the discharge of nutrients, pesticides, and various contaminants (FAO, 2017). The disruption of hydrological patterns, a consequence of climate change and the escalating demands of agricultural production, intensifies the significance and complexity of water management issues in agriculture (Rosegrant et al., 2009; Pereira, 2017). This trend is notably observable in Europe (EEA, 2018; Gruère et al., 2020). Farmers emerge as pivotal influencers in addressing the challenge of restricted water access (United Nations, 2024). Consequently, a crucial inquiry arises: What is the level of awareness among farmers regarding this issue, and what measures are they talking to enhance water efficiency and adapt to evolving climatic conditions?

Our objective is to assess European farmers' knowledge of water management challenges in agriculture and their efforts to adapt to climate change within the context of water resources. We aim to explore the drivers motivating their actions. In essence, our focus is on examining the water conservation predicament in European agriculture at the farmers' level, encompassing their awareness and activities related to water utilisation in the agricultural production process. Consequently, the primary research goal of this paper is to identify the determinants influencing European farmers' attitudes and behaviours in the realm of water conservation practices.

To fulfil these objectives, we conducted a systematic review of articles available in the Scopus database. The papers were categorised, and their content was scrutinised to address five key research questions:

1. What methods and datasets are employed in the articles?
2. What are the techniques applied in water conservation management?
3. What are the political and institutional determinants of water management?
4. What are farmers' attitudes towards water management and its determinants?
5. What is the farmers' perception of climate change?

The subsequent section of this paper outlines the methodology employed for the systematic review. Following that, the paper presents bibliometric and content analyses. The concluding section offers insights and discussions.

Research methods

Study design and sampling procedure

The review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for literature research, as extended by Hutton et al. (2016) and Page et al. (2021). The PRISMA method follows a checklist of guidelines for systematic reviews, encompassing three essential steps: (1) identification, (2) selection, and (3) inclusion. PRISMA has become widely adopted to enhance the clarity, transparency, and comprehensiveness of reporting in systematic reviews (Li et al., 2020).

The research was conducted in October 2023. During the identification step, we utilised the Scopus search engine, recognised as one of the most comprehensive, reliable, and pertinent sources of information. To ensure relevance, our search procedure for identifying articles adhered to the following inclusion criteria: (i) articles focusing on behaviours, attitudes, and actions, (ii) within the realm of water management, (iii) specific to Europe, and (iv) pertaining to agricultural producers. Consequently, the following search criteria were implemented: (i) restricting the search to titles, abstracts, and keywords; (ii) incorporating key search terms related to behaviours and attitudes, including relevant theories; (iii) including key search terms related to water management; (iv) limiting the search to European countries; (v) narrowing the search to farm/farmers or agricultural producers; (vi) specifying the subject area to economics, econometrics and finance; social sciences; business, management, and accounting; agricultural and biological sciences; (vii) setting the language limitation to English. Ultimately, our data collection involved employing the following search phrase: TITLE-ABS-KEY ((behavio* OR attitude OR action* OR TPB OR adoption OR "expected utility theory"

OR "theory of reasoned action" OR "theory of planned zechi*" OR "value-belief norm") AND ("water management" OR "water innovations" OR "water conservation" OR "water saving") AND (eu OR europe OR "european union" OR spain OR poland OR germany OR italy OR greece OR france OR malta OR cyprus OR uk OR "United Kingdom" OR portugal OR bulgaria OR sweden OR finland OR austria OR romania OR hungary OR iceland OR denmark OR luxembourg OR montenegro OR estonia OR slovenia OR slovakia OR latvia OR kosovo OR "north macedonia" OR lithuania OR albania OR "Bosna and Hercegovina" OR moldova OR croatia OR ireland OR norway OR switzerland OR serbia OR belarus OR romania OR ukraine OR netherlands OR belgium OR czechia OR "Czech republic") AND (farm* OR producer*)) AND (LIMIT-TO (SUBJAREA,"ECON") OR LIMIT-TO (SUBJAREA,"SOCI") OR LIMIT-TO (SUBJAREA,"BUSI") OR LIMIT-TO (SUBJAREA,"AGRI")) AND (LIMIT-TO (LANGUAGE,"English")).

Exclusion criteria

The exclusion criteria employed during the screening process enabled us to consider only studies specifically addressing the behaviour of individual farmers or groups of farmers. We did not include studies conducted on a sectoral level. Additionally, we excluded papers that did not rely on primary data or were literature reviews. Other exclusion criteria were applied to limit the focus to papers analysing European farmers or cases where European farmers constituted at least a part of the research.

Given our emphasis on understanding farmers' behaviour and attitudes toward water management and innovation, additional exclusion criteria were implemented to filter out articles that explored innovations in farming generally, where water was not the primary area of interest. The detailed exclusion criteria are outlined in Figure 1.

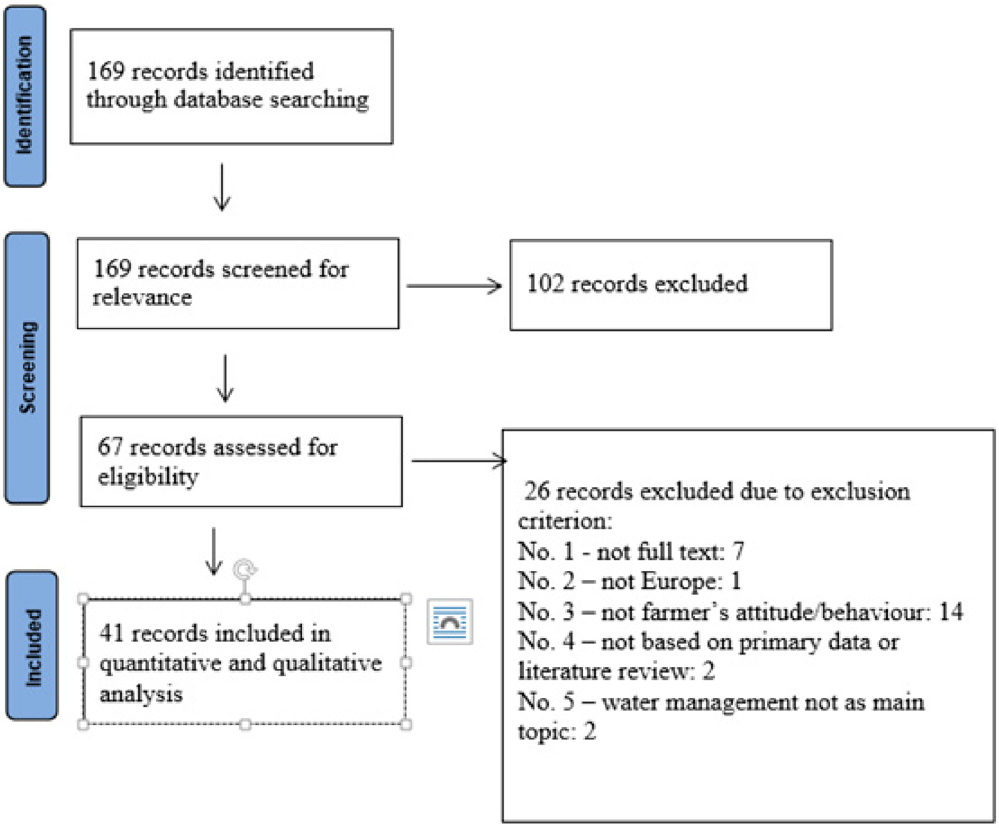

Figure 1. PRISMA flow diagram modified to authors' research

Source: authors' work based on PRISMA (2020).

Data collection process

After the initial search, we identified 169 documents. During the abstract screening phase, 102 records were excluded due to a lack of relevance. The primary reasons for exclusion were: i) papers not related to Europe and ii) instances where keywords related to water management and farmers' attitudes only appeared in titles or abstracts as a background to other issues, with the content not specifically dedicated to water management matters. Subsequently, the remaining 67 papers underwent a thorough assessment for eligibility. In 7 cases, full-text access to the article was unavailable, and in 19 cases, the abstracts did not accurately represent the content of the papers, leading to their exclusion based on our criteria. Overall, 26 papers were excluded in the process of full-text screening. Consequently, we arrived at a sample of 41 publications, forming the basis for further quantitative and qualitative analyses. A visual representation of the literature selection process is presented in Figure 1.

Content Analysis

Bibliometric statistics

The analysis of results commences with an examination of the temporal and spatial scope of the research, as outlined in Table 1. Several noteworthy trends emerge from this analysis. Firstly, a majority of studies were conducted in Spain (36%). This prevalence can be attributed to the severity of water-related issues in the country, where over 80 percent of fresh water is utilised by agriculture. Spain holds the status of being the orchard of Europe and is the leading producer of fruits and vegetables. Similar challenges are evident in the southern regions of Italy (16%) and France (14%), where the impacts of climate warming, including 40-plus degree heat waves, are being experienced. In contrast, northern regions face extreme weather events, such as torrential downpours. Secondly, the issue prominently affects small southern islands, where there is a natural shortage of fresh water, exemplified by places like Crete and Malta. Thirdly, the problem of water in agriculture is acknowledged in some other developed countries as part of a broader discourse on the sustainable use of natural resources.

Table 1. Spatial, time and journal scope of reviewed papers

Spatial scope of articles by country		Time scope of articles		Journal scope of articles	
Country	%	Year	No. of articles	Journal name	No. of articles
Spain	36	1998	1	Agricultural Water Management	6
Italy	16	2002	1	Water	5
France	14	2005	3	Agricultural Systems	3
UK	9	2007	1	International Journal of Agricultural Sustainability	2
Crete	5	2008	3	Irrigation and Drainage	2
Sweden	5	2011	3	Journal of Environmental Planning and Management	2
Malta	3	2013	1	Land Use Policy	2
Macedonia	2	2014	1	Water Alternatives	2

DOI: 10.34659/eis.2024.89.2.738

Spatial scope of articles by country		Time scope of articles		Journal scope of articles	
Country	%	Year	No. of articles	Journal name	No. of articles
Germany	2	2015	4	Agricultural Economics, Environmental Science and Policy, European Review of Agricultural Economics, Experimental Agriculture, International Journal of Green Economics, International Journal of Sustainable, Agricultural Management and Informatics, Journal of Agricultural Science, Outlook on Agriculture, Sociologia Ruralis, Sustainability, Technological Forecasting and Social Change, World Development, Ecohydrology and Hydrobiology	1
Croatia	2	2016	2		
Greece	2	2017	4		
Finland	2	2018	3		
Poland	2	2019	1		
		2020	4		
		2021	4		
		2022	1		
		2023	4		

The journal scope of articles indicates that the highest number of papers came from Agricultural Water Management (6) and Water (5). Three were published in Agricultural Systems, and two in the following journals: International Journal of Agricultural Sustainability, Irrigation and Drainage, Journal of Environmental Planning and Management, Land Use Policy, and Water Alternatives. A table summarising content analysis has been included in the Appendix.

Methodologies and data sets used in articles

Among all the articles, those conducting interviews with farmers predominate. These surveys explore farmers' attitudes toward water management practices, factors influencing the adoption of practices reducing water use, perceptions of climate change, and the role of support policies as stimulants for farmers' water management (e.g., Nguyen et al., 2016; Ulén & Kalisky, 2005; Whaley & Weatherhead, 2015; Aznar-Sánchez et al., 2017; Altobelli et al., 2019; Vollaro et al., 2015; Binet & Richefort, 2011). A limited number of articles focus on the impact of farmers' behaviour, particularly within family farms, on the efficiency of water use in agricultural production (e.g., Piedra-Muñoz et al., 2018) or the influence of new irrigation technology on the economic and technical outcomes in agricultural production (e.g., Vrachioli et al., 2021).

Researchers primarily employ face-to-face interviews with farmers (e.g., Tójar-Hurtado et al., 2017; Barnes et al., 2011; Graveline et al., 2021; García-Vila et al., 2008; Ducros et al., 2002; Pino et al., 2017; D'Agostino et al., 2020). To identify key determinants influencing water management practices, researchers also use interview methods involving relevant stakeholders. Poblador et al. (2021) contrast farmers' opinions on water management with those of technicians, researchers, and lawyers. In the research by López-Felices et al. (2023a), the presidents of the three most important irrigation communities in the Almeria region and three farmers with extensive experience in intensive agriculture were interviewed. Subsequently, a focus group with eight farmers from the study area was formed.

Gorton et al. (2009), Giannoccaro et al. (2013), and Ortega-Reig et al. (2017) conducted research among the managers of water use associations to identify farmers' attitudes toward the water market. In the research by Olsson et al. (2011), a methodology for involving local stakeholders in water management using a catchment model as a platform for dialogue was developed and tested in the Kaggebo Bay drainage area in the southeast of Sweden. The process involved farmers, rural households not connected to municipal wastewater treatment facilities, local and regional authorities, and different water and agricultural experts.

Analysis of the structure and dynamics, coupled with the descriptive method (content analysis of interviews), is the most commonly used approach to analyse interview results. Other methods for analysing results of interviews with farmers and experts to identify attitudes toward water management practices in agriculture are rarely employed. However, López-Felices et al. (2023b) applied a cluster analysis of four groups of farmers to indicate water practices in agriculture. On the other hand, Pronti et al. (2023) used a microeconomic panel regression to estimate farmers' decisions to adopt sustainable irrigation technologies. Earlier, Varela-Ortega et al. (1998) built a dynamic mathematical programming model that simulates farmers' behaviour and their response to different water pricing scenarios. An advanced mathematical model (Heckman Selection Model, censored least absolute deviations (CLAD) model) was used by Gorton et al. (2009). Maton et al. (2005), using multivariate analysis, linear regression, and regression trees, created typologies of three agricultural subsystems and irrigation strategies and highlighted the links between them.

The second group includes articles using data to determine the impact of economic and institutional factors, such as licenses, fees, production efficiency, and agricultural advisory institutions (Grammatikopoulou et al., 2016; Leathes et al., 2008; Chabé-Ferret et al., 2019), and prices of fresh and recycled water (Menegaki et al., 2007), on farmers' water intake. In the research by Grammatikopoulou et al. (2016), findings derived from probit models indicated that, for active farmers, financial variables were the key determinants. Leathes et al. (2008) used the case study method of WAGs (Water Abstractors Groups from the UK) and GIS spatial analysis modelling using datasets related to irrigation abstraction and water resource availability.

Techniques of water conservation management

Considering the methods employed for water conservation management in agriculture, the analysed papers can be categorised into two main groups. The first group focuses on "water-saving practices" or "irrigation," while the second group delves into specific methods of water conservation.

In the first group of articles, investigations into the adoption of water-saving measures or irrigation strategies were conducted for farmers in Italy (Pino et al., 2017; Pronti et al., 2023), Spain (Cuesta et al., 2005; García-Vila et al., 2008), France (Maton et al., 2005; Graveline & Grémont, 2021), and Poland (Michalak, 2020). Special certifications promising efficient water resource use were explored as a technique supporting water conservation (Altobelli et al., 2019; Piedra-Muñoz et al., 2018), along with the Agri-Environmental Program in Finland (Grammatikopoulou et al., 2016), innovative arrangements in groundwater governance in Spain (Delgado-Serrano & Borrego-Marin, 2020), and irrigation smart meters encouraging water conservation management among French farmers (Chabe-Ferret et al., 2019).

The second group of articles can be further subdivided into those dedicated to (a) irrigation techniques (the method of water provision), (b) methods of collecting water for irrigation, and (c) studies on instruments for improving water quality. Within the papers focused on irrigation techniques (a), an examination of the drip irrigation method (as an alternative to surface irrigation) can be found (Ortega-Reig et al., 2017; Tarjuelo et al., 2015). The diffusion and adaptation of more effective techniques minimising evapotranspiration were assessed, including a sprinkler irrigation system (Binet & Richefort, 2011) or a sprinkler overhead irrigation system (Vrachioli et al., 2021). Seawater desalination for gathering non-conventional water resources (b) for agriculture was considered, helping address water resource shortages in some Mediterranean countries (Ricart et al., 2020; Aznar-Sánchez et al., 2017). Regarding specific water conservation techniques, the reclaimed wastewater reuse in agriculture was surveyed—a "win-win" solution and an alternative water resource to mitigate water scarcity problems (Menegaki et al., 2007). Another practice facilitating irrigation water management is the use of ponds (López-Felices et al., 2023a). Several reviewed works are devoted to methods employed by farmers to improve water quality (c), including the riparian buffer zone (Ducros & Watson, 2002) and Nitrate Vulnerable Zones (Barnes et al., 2011).

Political and institutional determinants of water management

An essential aspect is the modelling of water management policies and instruments. The challenges posed by water scarcity necessitate significant changes in the criteria and objectives of water policies, particularly focusing on enhancing the efficiency of current water use in the agricultural sector. An example of an instrument to incentivise water conservation is the introduction of water fees or differentiated water prices. However, there is a potential risk that this may adversely affect agricultural income, leading to a partial loss of revenue, especially in southern European countries like Spain, Italy, and Greece, where a substantial amount of water is used for agricultural production.

DOI: 10.34659/eis.2024.89.2.738

This outcome is highly dependent on regional, structural, and institutional conditions (Varela-Ortega et al., 1998). Another proposed tool for optimising water management in agriculture is the implementation of water permits. Farmers also suggest instruments they could employ to contribute to better water management. Although variations exist based on the nationality of respondents (producers from Italy, Croatia, and Greece), the most preferred option is certificates confirming effective water resource utilisation for agricultural production. These certificates could provide a competitive advantage in the market, with certified products being more appealing to consumers (Altobelli et al., 2019).

It's noteworthy that the Common Agricultural Policy (CAP) utilises water metering as a tool for efficient water management. A study by Chabé-Ferret et al. (2019) underscores the potential of nudges as an agricultural policy tool. Nudges can complement other policy instruments, such as water pricing (incentive pricing, peak pricing, time-of-use pricing, etc.), water fees, and environmental taxes.

Another intriguing phenomenon is the growing demand and competition for water, leading to the development of farmers' institutional capacity to defend themselves. Some farmers are integrating and forming water-collector groups to collectively manage scarce resources like water (Leathes et al., 2008). Pino et al. (2017) research confirms favourable attitudes towards water-saving measures, with environmental associations and public bodies positively influencing farmers' intentions to adopt such measures. Farmers' innovativeness and water footprints also significantly impact their adoption intentions. Notably, environmental associations and public bodies are identified as the organisations most likely to positively influence farmers' decisions related to water resources.

In a study by Menegaki et al. (2007), the introduction of water management innovations, such as recycled water use in agriculture, requires public acceptance supported by education and information from authorities until the public is convinced of the safety of these new practices. Other literature (D'Agostino et al., 2020) indicates the need for defining socially and environmentally acceptable policies to address complex water challenges in the agricultural sector. Proposed solutions include developing support for farmer training, knowledge translation, raising public awareness of the importance and value of water for high-value crop production, and fostering multi-sectoral cooperation for shared investment opportunities in water infrastructure.

Effective communication among various stakeholders, including local authorities, politicians, householders, and farmers, is crucial. Social values are identified as a factor defining environmental goals in water management (Ulén & Kalisky, 2005). Pino et al. (2017) stress that communication policies supporting the adoption of water-saving measures should emphasise benefits in terms of increased productivity, making farmers aware that water conservation does not compromise crop quality. Organisations dealing with farmer communication can play a role in stimulating innovation in water management through workshops, meetings, and targeted training programs or projects involving innovation creators on farms.

However, support from government institutions for effective water resource management by farms varies across countries. Farmers' responses to challenges arising from climate change also differ. For instance, in Poland, institutional support is either nonexistent or negligible. Polish farmers are attempting to independently address the consequences of climate change on water management. However, these individual, ad hoc actions may reduce the economic efficiency of production and have negative impacts on ecosystems, hydrology, and other economic entities whose activities depend on water resource quality, aspects of which they might not be fully aware (Michalak, 2020).

Farmers' attitudes towards water management and it's determinants

Understanding the factors influencing farmers' behaviour towards water management is crucial because they ultimately decide whether to adopt it (López-Felices et al., 2023a). Numerous studies in existing literature have analysed the socio-economic factors affecting the implementation of water management systems, such as rainwater harvesting systems (RWH) (López-Felices et al., 2023b). Among the factors considered, the authors mention age, level of experience, educational level, family size, income, group affiliation, availability of income from other activities, contact with extension groups, participation in government projects, access to credit, or the availability of advice. Findings from probit models conducted by Grammatikopoulou et al. (2016) indicated that, for active farmers, financial variables were the key determinants. For passive owners, the adoption of water management systems was also explained by attitudes.

DOI: 10.34659/eis.2024.89.2.738

Farmers who had water management systems (RWH) valued the following reasons in the decision to install them: increased water availability, higher quality water, crop diversification, preventing damage to the holding or other elements, cost savings, environmental benefits, affordable installation cost, and compliance with regulations. Farmers without water management systems provided reasons for not being interested in installation: space limitations, holding characteristics, installation cost, water availability, regulations, avoiding problems, and rainfall variability. López-Felices et al. (2023b) confirmed that farmers with RWH systems who have experience in agricultural irrigation value its advantages more than the limitations for implementation. Similar results have been obtained for other types of water or irrigation technologies, such as desalinated water for irrigation in Spain (Aznar-Sánchez et al., 2017).

Nguyen et al. (2016) emphasised that water consumption and management behaviours are complex, dynamic, and systemic, often rooted in habits and socio-political backgrounds, making them challenging to change. Culture can influence farmers' behaviour toward developing sustainable water management practices (Tójar-Hurtado et al., 2017). Large water consumers are less inclined to participate in water-saving programs. Piedra-Muñoz et al. (2018), based on a hierarchical regression model, demonstrated that family farms strive to be more efficient in their water use when they are destined for inheritance, when there are younger decision-makers with better education, and when women are involved. Pronti et al. (2023) have shown a significant correlation between understanding and sustainable behaviours in agriculture, indicating that environmental education can foster sustainable behaviour, leading to substantial water savings. The positive relationship between education and the adoption of water management systems has been the subject of several studies in the existing literature (Cuesta et al., 2005; Delgado-Serrano & Borrego-Marin, 2020; Pino et al., 2017).

Farmers' perception of climate changes

Farmers' perceptions of climate change play a crucial role in shaping actual water management practices, as demonstrated by Pronti et al. (2023). However, disparities exist between farmers' perceptions and scientific evidence. Nguyen et al. (2016) indicated that Mediterranean region farmers while acknowledging climate change, believe it has led to increased temperatures and precipitation. Consequently, they perceive sufficient irrigation water availability despite scientific forecasts predicting heightened pressure on water resources in the future. This asymmetry poses challenges, potentially leading to inadequate preparedness for climate change-related threats.

Graveline and Grémont (2021) observed a similar pattern among wine producers in south eastern France. Farmers practising irrigation were less likely to acknowledge past climate changes confirmed by meteorological data, resulting in smaller planned adaptations to water management compared to rainwater-dependent farmers. Moreover, a study among UK commercial fruit and vegetable growers (Sutcliffe et al., 2023) highlighted polarisation between agricultural and environmental stakeholders. Farmers believed climate change was inevitable, irrespective of their chosen water management model, underscoring the need to consider farmers' beliefs in irrigation management policies.

Egerer et al. (2021) revealed farmers' insufficient awareness of climate change in north eastern Lower Saxony. Limited knowledge and societal perception hindered their understanding of climate change consequences and adaptation strategies. The authors emphasised the need for changing farmers' social awareness, noting that individual actions maximising yields through irrigation might conflict with the common good. Thus, addressing farmers' beliefs is vital for effective and sustainable adaptation strategies in irrigation management policies.

Discussion and conclusions

Water is a critical and irreplaceable factor in agricultural production. While issues related to limited water resources have traditionally been prevalent in southern European countries, they are now emerging in other parts of Europe. Our research aims to analyse the extent to which European farmers' approaches, attitudes, and actions towards water management and the implementation of water innovations are explored in the context of climate change and anticipated water scarcity problems across European countries. Responsible water management in agriculture involves complex activities at individual, collective, and public levels, and our analysis focuses specifically on farmers.

DOI: 10.34659/eis.2024.89.2.738

The EU water policy serves as one of the cornerstones of environmental protection. These regulations protect water resources, both fresh and saltwater ecosystems, and ensure our drinking and bathing water are clean. In the context of the European Green Deal, the Water Framework Directive provides the main framework and the objectives for water policy in Europe. The Water Framework Directive (WFD) is the primary legislation. It is supported by two so-called daughter directives on the quality and quantity of groundwater and on the quality of surface water. In 2010, EU Member States released 160 river basin management plans. In 2012, the European Commission published A Blueprint to Safeguard Europe's Water Resources (European Commission, 2012). It focuses on policy actions that will improve how current water legislation is applied in practice and on integrating water policy objectives with other policies. The Blueprint builds on water policies relating to water resource efficiency and sustainable water management in the same timeframe as the EU's 2020 Strategy up to 2050. In December 2019, a Fitness Check concluded that the water legislation is broadly fit for purpose, with room for improvement related to investments, implementation, integrating water into other policies, chemical pollution, administrative simplification and digitalisation. The key findings show that the directives have led to a higher level of protection for water bodies and flood risk management than could have been expected without them. The objectives of the directives are as relevant now as they were at the time of the adoption, if not more. They contribute to achieving a range of sustainable development goals. In October 2022, the Commission adopted a proposal to revise the lists of pollutants in surface water and groundwater. In addition to the WFD and the Blueprint, there are four water directives to ensure the good status of Europe's waters: the Urban Waste Water Directive (Directive, 1991a), the Bathing Water Directive (Directive, 2006), the Nitrates Directive (Directive, 1991b) and the Drinking Water Directive (Directive, 1998). In addition, the Floods Directive (Directive, 2007), which encourages the development of flood risk management plans, also significantly supports the objectives of the WFD. Taken together, it can be concluded that the EU has a solid legal basis for long-term integrated water management, including frameworks for the application of water pricing (e.g. tariffs) and non-pricing measures (e.g. water-saving devices, education and awareness campaigns) for more efficient water use. However, without the willingness of key water users to implement water management systems, the law itself may not be effective. It is, therefore, crucial to recognise farmers' attitudes towards water management.

Our findings indicate that the literature on water-related issues is concentrated mainly in geographic areas where limited access to water is already established. European areas facing water scarcity challenges are well-represented, but there is a scarcity of papers considering farmers and agriculture in regions where water access issues are escalating. Therefore, our survey aims to fill this research gap by evaluating the awareness and attitude of farmers in Europe more broadly, shedding light on their preparedness for new government solutions or grassroots initiatives.

The analysed papers present results from primary surveys among farmers, typically with relatively small and region-specific samples. Despite this limitation, some common conclusions emerge, offering valuable recommendations for further analysis and water policy design. Socio-economic and institutional factors significantly influence farmers' decisions regarding water conservation management, with financial incentives being key for actively engaged farmers. Water management experience and education also play pivotal roles, with experienced farmers being more inclined to adopt water-saving practices.

Concerning financial water incentives, a variety of solutions exist to encourage water conservation or facilitate water management. Designing effective water policies requires cohesion among different interest groups and acceptance among stakeholders, including farmers, food consumers, environmentalists, and local and central governance. Implementing incentives successfully also requires robust communication policies that blend technological and environmental knowledge with productivity benefits over the long term.

Water management experience highlights the benefits of water conservation practices for actively engaged farmers compared to their passive counterparts. Involving experienced farmers in designing water strategies, especially at the local level, is justified, as their knowledge and experiences can positively influence other farmers to adopt water-saving activities through imitation effects. This bottom-up approach holds significant promise for responsible water management in agriculture.

Education is a crucial factor in changing farmers' behaviour and steering them towards water-saving practices. The threefold nature of education involves comprehensive knowledge of ecological

DOI: 10.34659/eis.2024.89.2.738

education, understanding the relationship between water conservation practices and agricultural productivity, and accommodating hydrological regional differences. This holistic approach becomes especially vital in the face of emerging progressive solutions and increased knowledge availability.

The contribution of the authors

Conceptualization, M.G., A.M., A.P.-W., A.S. and K.S.-A.; literature review, M.G., A.M., A.P.-W., A.S. and K.S.-A.; methodology, A.P.-W.; formal analysis, M.G., A.M., A.P.-W., A.S. and K.S.-A.; writing, M.G., A.M., A.P.-W., A.S. and K.S.-A.; conclusions and discussion, A.S.

The authors have read and agreed to the published version of the manuscript.

References

Alcon, F., Navarro, N., de-Miguel, M. D., & Balbo, A. L. (2019). Drip irrigation technology: Analysis of adoption and diffusion processes. In A. Sarkar, S. Sensarma & G. van Loon (Eds.), *Sustainable Solutions for Food Security: Combating Climate Change by Adaptation* (pp. 269-285). Cham: Springer. http://dx.doi.org/10.1007/978-3-319-77878-5_14

Altobelli, F., Monteleone, A., Cimino, O., Dalla Marta, A., Orlandini, S., Trestini, S., Toulios, L., Nejedlik, P., Vucetic, V., Cicia, G., Panico, T., Cavallo, C., D'Urso, G., Del Giudice, T., & Giampietri, E. (2019). Farmers' willingness to pay for an environmental certification scheme: promising evidence for water saving. Outlook on Agriculture, 48(2), 136-142. https://doi.org/10.1177/0030727019841059

Aznar-Sánchez, J. A., Belmonte-Ureña, L. J., & Valera, D. L. (2017). Perceptions and acceptance of desalinated seawater for irrigation: A case study in the Níjar district (Southeast Spain). Water, 9(6), 408. https://doi.org/10.3390/w9060408

Barnes, A. P., Willock, J., Toma, L., & Hall, C. (2011). Utilising a farmer typology to understand farmer behaviour towards water quality management: Nitrate Vulnerable Zones in Scotland. Journal of Environmental Planning and Management, 54(4), 477-494. https://doi.org/10.1080/09640568.2010.515880

Binet, M.-E., & Richefort, L. (2011). Diffusion of irrigation technologies: The role of mimicking behaviour and public incentives. Applied Economics Letters, 18(1), 43-48. https://doi.org/10.1080/13504850903425025

Chabé-Ferret, S., Le Coent, P., Reynaud, A., Subervie, J., & Lepercq, D. (2019). Can we nudge farmers into saving water? Evidence from a randomised experiment. European Review of Agricultural Economics, 46(3), 393-416. https://hal.science/hal-02380993/document

Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment, Pub. L. No. 31991L0271, 135 OJ L (1991a). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31991L0271

Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources, Pub. L. No. 31991L0676, 375 OJ L (1991b). https://eur-lex.europa.eu/eli/dir/1991/676/oj

Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption, Pub. L. No. 31998L0083, 330 OJ L (1998). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31998L0083

Cuesta, T. S., Cancela, J. J., Dafonte, J., Valcárcel, M., & Neira, X. X. (2005). Social aspects influencing water management in the Lemos Valley Irrigation District, Spain. Irrigation and Drainage, 54(2), 125-133. https://doi.org/10.1002/ird.162

D'Agostino, D., Borg, M., Hallett, S. H., Sakrabani, R. S., Thompson, A., Papadimitriou, L., & Knox, J. W. (2020). Multi-stakeholder analysis to improve agricultural water management policy and practice in Malta. Agricultural Water Management, 229, 105920. https://doi.org/10.1016/j.agwat.2019.105920

Delgado-Serrano, M. M., & Borrego-Marin, M. M. (2020). Drivers of innovation in groundwater governance. The links between the social and the ecological systems. Land Use Policy, 91, 104368. https://doi.org/10.1016/j.landusepol.2019.104368

Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC, Pub. L. No. 32006L0007, 64 OJ L (2006). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32006L0007

Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks, Pub. L. No. 32007L0060, 288 OJ L (2007). https://eur-lex.europa.eu/eli/dir/2007/60/oj

Ducros, C., & Watson, N. M. (2002). Integrated land and water management in the United Kingdom: narrowing the implementation gap. Journal of Environmental Planning and Management, 45(3), 403-423. https://doi.org/10.1080/09640560220133423

EEA. (2018). *EEA Signals 2018 Water is life.* https://www.eea.europa.eu/publications/eea-signals-2018-water-is-life

Egerer, S., Valencia Cotera, R., Celliers, L., & Máñez Costa, M. (2021). A Leverage Points Analysis of a Qualitative System Dynamics Model for Climate Change Adaptation in Agriculture. Agricultural Systems, 189, 103052. https://doi.org/10.1016/j.agsy.2021.103052

European Commission. (2012). *A Blueprint to Safeguard Europe's Water Resources.* https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0673:FIN:EN:PDF

FAO. (2017). *Water for Sustainable Food and Agriculture – A Report Produced for the G20 Presidency of Germany.* https://www.developmentaid.org/api/frontend/cms/file/2023/02/i7959e.pdf

García-Vila, M., Lorite, I. J., Soriano, M. A., & Fereres, E. (2008). Management trends and responses to water scarcity in an irrigation scheme of Southern Spain. Agricultural Water Management, 95(4), 458-468. https://doi.org/10.1016/j.agwat.2007.11.009

Giannoccaro, G., Pedraza, V., & Berbel, J. (2013). Analysis of stakeholders' attitudes towards water markets in Southern Spain. Water, 5(4), 1517-1532. https://doi.org/10.3390/w5041517

Gorton, M., Sauer, J., Peshevski, M., Bosev, D., Shekerinov, D., & Quarrie, S. (2009). Water communities in the Republic of Macedonia: An empirical analysis of membership satisfaction and payment behavior. World Development, 37(12), 1951-1963. http://dx.doi.org/10.1016/j.worlddev.2009.04.003

Grammatikopoulou, I., Pouta, E., & Myyrä, S. (2016). Exploring the determinants for adopting water conservation measures. What is the tendency of landowners when the resource is already at risk? Journal of Environmental Planning and Management, 59(6), 993-1014. http://dx.doi.org/10.1080/09640568.2015.1050551

Graveline, N., & Grémont, M. (2021). The role of perceptions, goals and characteristics of wine growers on irrigation adoption in the context of climate change. Agricultural Water Management, 250(1), 106837. http://dx.doi.org/10.1016/j.agwat.2021.106837

Gruère, G., Shigemitsu, M., & Crawford, S. (2020). *Agriculture and water policy changes: Stocktaking and alignment with OECD and G20 recommendations.* https://www.oecd.org/en/publications/2020/07/agriculture-and-water-policy-changes_a652bb10.html

Hutton, B., Catala-Lopez, F., & Moher, D. (2016). The PRISMA statement extension for systematic reviews incorporating network meta-analysis: PRISMA-NMA. Medicina Clínica, 147(6), 262-266. https://doi.org/10.1016/j.medcle.2016.10.003

Leathes, W., Knox, J. W., Kay, M. G., Trawick, P., & Rodriguez-Diaz, J. A. (2008). Developing UK farmers' institutional capacity to defend their water rights and effectively manage limited water resources. Irrigation and Drainage, 57(3), 322-331. http://dx.doi.org/10.1002/ird.436

Li, T., Hua, F., Dan, Sh., Zhong, Y., Levey, C., & Song, Y. (2020). Reporting quality of systematic review abstracts in operative dentistry: An assessment using the PRISMA for abstracts guidelines. Journal of Dentistry, 102, 103471. https://doi.org/10.1016/j.jdent.2020.103471

López-Felices, B., Aznar-Sánchez, J. A., Velasco-Muñoz, J. F., & Mesa-Vázquez, E. (2023a). Examining the perceptions and behaviours of farmers regarding the installation of covers over irrigation ponds: Evidence from South-east Spain. Agricultural Water Management, 275, 107999. https://doi.org/10.1016/j.agwat.2022.107999

López-Felices, B., Aznar-Sánchez, J. A., Velasco-Muñoz, J. F., & Mesa-Vázquez, E. (2023b). Farmers' profiles and attitudes towards the implementation of rainwater harvesting systems in intensive agriculture. International Journal of Agricultural Sustainability, 21(1), 2189402. https://doi.org/10.1080/14735903.2023.2189402

Maton, L., Leenhardt, D., Goulard, M., & Bergez, J. E. (2005). Assessing the irrigation strategies over a wide geographical area from structural data about farming systems. Agricultural Systems, 86(3), 293-311. http://dx.doi.org/10.1016/j.agsy.2004.09.010

Menegaki, A. N., Hanley, N., & Tsagarakis, K. P. (2007). The social acceptability and valuation of recycled water in Crete: A study of consumers' and farmers' attitudes. Ecological Economics, 62(1), 7-18. https://doi.org/10.1016/j.ecolecon.2007.01.008

Michalak, D. (2020). Adapting to climate change and effective water management in Polish agriculture – At the level of government institutions and farms. Ecohydrology & Hydrobiology, 20(1), 134-141. https://doi.org/10.1016/j.ecohyd.2019.12.004

Naulleau, A., Gary, C., Prévot, L., Vinatier, F., & Hossard, L. (2022). How can winegrowers adapt to climate change? A participatory modeling approach in southern France. Agricultural Systems, 203, 103514. https://doi.org/10.1016/j.agsy.2022.103514

Nguyen, T. P. L., Mula, L., Cortignani, R., Seddaiu, G., Dono, G., Virdis, S. G. P., Pasqui, M., & Roggero, P. P. (2016). Perceptions of Present and Future Climate Change Impacts on Water Availability for Agricultural Systems in the Western Mediterranean Region. Water, 8(11), 523. https://doi.org/10.3390/w8110523

Olsson, A. J., Jonsson, A. C., Andersson, L., & Arheimer, B. (2011). A model-supported participatory process for nutrient management: a socio-legal analysis of a bottom-up implementation of the EU Water Framework Directive. International Journal of Agricultural Sustainability, 9(2), 379-390. https://doi.org/10.1080/14735903.2011.582361

Ortega-Reig, M., Sanchis-Ibor, C., Palau-Salvador, G., García-Mollá, M., & Avellá-Reus, L. (2017). Institutional and management implications of drip irrigation introduction in collective irrigation systems in Spain. Agricultural Water Management, 187, 164-172. https://doi.org/10.1016/j.agwat.2017.03.009

Page, M., McKenzie, J., Bossuyt, P., Boutron, I., Hoffmann, T., Mulrow, C., Shamseer, L., Tetzalaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Wilson-Mayo, E., McDonald, S., McGuinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., Weich, V. A., Whiting, P., & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ, 372, n71. https://doi.org/10.1136/bmj.n71

Pereira, L. S. (2017). Water, agriculture and food: challenges and issues. Water Resources Management, 31(10), 2985-2999. https://doi.org/10.1007/s11269-017-1664-z

Piedra-Muñoz, L., Vega-Lopez, L. L., Galdeano-Gomez, E., & Zepeda-Zepeda, J. A. (2018). Drivers for efficient water use in Agriculture: An empirical analysis of family farms in Almería, Spain. Experimental Agriculture, 54(1), 31-44. https://mpra.ub.uni-muenchen.de/119885/

Pino, G., Toma, P., Rizzo, C., Miglietta, P. P., Peluso, A. M., & Guido, G. (2017). Determinants of farmers' intention to adopt water saving measures: Evidence from Italy. Sustainability, 9(1), 77. https://doi.org/10.3390/su9010077

Poblador, N., SanchisIbor, C., & Kuper, M. (2021). The landing of parachuted technology: Appropriation of centralised drip irrigation systems by irrigation communities in the region of Valencia (Spain). Water Alternatives, 14(1), 228-247. https://www.water-alternatives.org/index.php/alldoc/articles/vol14/v14issue1/611-a14-1-6/file

PRISMA. (2020). *PRISMA Flow Diagram.* https://www.prisma-statement.org/prisma-2020-flow-diagram

Pronti, A., Auci, S., & Mazzanti, M. (2023). Adopting sustainable irrigation technologies in Italy: a study on the determinants of inter-and intra-farm diffusion. Economics of Innovation and New Technology, 33(2), 299-322. https://doi.org/10.1080/10438599.2023.2183854

Ricart, S., Villar-Navascués, R., Gil-Guirado, S., Rico-Amorós, A. M., & Arahuetes, A. (2020). How to close the gap of desalinated seawater for agricultural irrigation? Confronting attitudes between managers and farmers in Alicante and Murcia (Spain). Water, 12(4), 1132. https://doi.org/10.3390/w12041132

Rosegrant, M. W., Ringler, C., & Zhu, T. (2009). Water for agriculture: maintaining food security under growing scarcity. Annual Review of Environment and Resources, 34, 205-222. https://doi.org/10.1146/annurev.environ.030308.090351

Sutcliffe, C., Knox, J., & Hess, T. (2023). 'I think this is where this lovely word "sustainability" comes in': Fruit and vegetable growers' narratives concerning the regulation of environmental water use for food production. Sociologia Ruralis, 63(3), 493-513. https://doi.org/10.1111/soru.12437

Tarjuelo, J. M., Rodriguez-Diaz, J. A., Abadía, R., Camacho, E., Rocamora, C., & Moreno, M. A. (2015). Efficient water and energy use in irrigation modernization: Lessons from Spanish case studies. Agricultural Water Management, 162, 67-77. https://doi.org/10.1016/j.agwat.2015.08.009

Tójar-Hurtado, J. C., Mena-Rodríguez, E., & Fernández-Jiménez, M. Á. (2017). Spanish agriculture and water: Educational implications of water culture and consumption from the farmers' perspective. Water, 9(12), 964. https://doi.org/10.3390/w9120964

Ulén, B. M., & Kalisky, T. (2005). Water erosion and phosphorus problems in an agricultural catchment – need for natural research for implementation of the EU Water Framework Directive. Environmental Science & Policy, 8(5), 477-484. http://dx.doi.org/10.1016/j.envsci.2005.06.005

United Nations. (2024). *The United Nations World Water Development Report 2024: Water for Prosperity and Peace.* https://unesdoc.unesco.org/ark:/48223/pf0000388948

Varela-Ortega, C., Sumpsi, J. M., Garrido, A., Blanco, M., & Iglesias, E. (1998). Water pricing policies, public decision making and farmers' response: implications for water policy. Agricultural economics, 19(1-2), 193-202. https://doi.org/10.1111/j.1574-0862.1998.tb00526.x

Vollaro, M., Zavalloni, M., Raggi, M., & Viaggi, D. (2015). Adapting to climate change: The social perception of voluntary water transfers in the Italian context. International Journal of Sustainable Agricultural Management and Informatics, 1(1), 26-48. http://dx.doi.org/10.1504/IJSAMI.2015.069044

Vrachioli, M., Stefanou, S. E., & Tzouvelekas, V. (2021). Impact evaluation of alternative irrigation technology in Crete: Correcting for selectivity bias. Environmental and Resource Economics, 79, 551-574. https://doi.org/10.1007/s10640-021-00572-y

Whaley, L., & Weatherhead, E. K. (2015). Competition, conflict, and compromise: Three discourses used by irrigators in England and their implications for the comanagement of water resources. Water Alternatives, 8(1), 800-819. https://www.water-alternatives.org/index.php/alldoc/articles/vol8/v8issue1/266-a8-1-10/file

DOI: 10.34659/eis.2024.89.2.738

Appendix

Table 1. Summary findings within selected content

Research scope	Sources	Key findings
Methodologies and data sets	a) Nguyen et al. (2016), Ulén and Kalisky (2005), Whaley and Weatherhead (2015), Aznar-Sánchez et al. (2017), Altobelli et al. (2019), Vollaro et al. (2015), Binet and Richefort (2011), b) Tójar-Hurtado et al. (2017), Barnes et al. (2011), Graveline and Grémont (2021), García-Vila et al. (2008), Ducros et al. (2002), Pino et al. (2017), D'Agostino et al. (2020), c) López-Felices et al. (2023b), d) Pronti et al. (2023), e) Gorton et al. (2009), Maton et al. (2005), f) Grammatikopoulou et al. (2016), g) Leathes et al. (2008).	**Frequently used methods and data set:** a) interviews with farmers – farmers' attitudes toward water management practices, factors influencing the adoption of practices reducing water use, perceptions of climate change, and the role of support policies as stimulants for farmers' water management, b) face-to-face interviews with farmers – identication key determinants influencing water management practices. **Rarely used methods and data set:** c) a cluster analysis of four groups of farmers – content analysis of interviews, d) a microeconomic panel regression to estimate farmers' decisions – estimation farmers' decisions to adopt sustainable irrigation technologies, e) an advanced mathematical model (Heckman Selection Model, censored least absolute deviations (CLAD) model) – typologies of three agricultural subsystems and irrigation strategies, f) probit models – determinants of economic and institutional factors on farmers' water intake, g) case study method – irrigation abstraction and water resource availability.
Techniques of water conservation management	**First group:** Pino et al. (2017), Pronti et al. (2023), Cuesta et al. (2005), García-Vila et al. (2008), Maton et al. (2005), Graveline and Grémont (2021), Michalak (2020), Altobelli et al. (2019), Piedra-Muñoz et al. (2018), Grammatikopoulou et al. (2016), Delgado-Serrano and Borrego-Marin (2020), Chabe-Ferret et al. (2019). **Second group:** a) Ortega-Reig et al. (2017), Tarjuelo et al. (2015), Binet and Richefort 2011, Vrachioli et al. (2021), b) Ricart et al. (2020), Aznar-Sánchez et al. (2017), Menegaki et al. (2007), López-Felices et al. (2023a), a) Ducros and Watson (2002), Barnes et al. (2011).	Water management techniques are presented into two overall ways. The first group refers to water saving measures in general or just irrigation, or the effective water management, or water saving adaptation measures, or efficient water use. In the second bunch of articles the particular water techniques are investigated within (a) special irrigation techniques (e.g. drip irrigation, overhead sprinkle system), (b) methods of collecting water for irrigation (e.g. bench terraces, ponds, covers over ponds), and (c) instruments for improving water quality (e.g. riparian buffer zones, nitrate vulnerable zones).

DOI: 10.34659/eis.2024.89.2.738

Research scope	Sources	Key findings
Political and institutional determinant of water management	Varela-Ortega et al. (1998), Altobelli et al. (2019), Chabé-Ferret et al. (2019),	A crucial aspect is the modelling of water management policies and instruments is enhancing the efficiency of current water use in the agricultural sector. In this context the benefits and costs of introduction of e.g. water fees, or differentiated water prices, or water permits, or certificates are analysed. This outcomes are highly dependent on regional, structural, and institutional conditions and the nationality of farmers.
	Leathes et al. (2008), Pino et al. (2017),	The competition for water stimulates the collective actions of farmers. They integrate and form water-collector groups to collectively manage water resources.
	Menegaki et al. (2007), D'Agostino et al. (2020), Ulén and Kalisky (2005), Pino et al. (2017).	The introduction of acceptable water policies and water management innovations needs public acceptance supported by set of education and information and communication activities.
Farmers attitudes towards water management and its determinants	Grammatikopoulou et al. (2016), López-Felices et al. (2023a), López-Felices et al. (2023b),	Passive and active approaches are identified among farmers behavior towards water management. Among determinants explained farmers attitude are: age, level of experience, educational level, family size, income, group affiliation, availability of income from other activities, contact with extension groups, participation in government projects, access to credit, or the availability of advice.
	López-Felices et al. (2023b), Aznar-Sánchez et al. (2017),	Farmers who have experience in agricultural irrigation, value its advantages more than the limitations for implementation.
	Nguyen et al. (2016), Tójar-Hurtado et al. (2017), Piedra-Muñoz et al. (2018), Pronti et al. (2023), Cuesta et al. (2005), Delgado-Serrano et al. (2020), Pino et al. (2017).	Water management behaviors are rooted in habits and socio-political backgrounds, making them challenging to change. Education has a special place among factors influencing farmers' attitude towards water-saving practices.
Farmers; perception of climate changes	Pronti et al. (2023), Nguyen et al. (2016), Graveline and Grémont (2021), Sutcliffe et al. (2023),	There are disparities between farmers' perceptions of climate change and scientific evidence that affect water management practices. Although farmers are aware of climate change and growing problems with limited water resources it doesn't reflect in adaptation strategies, they restricted.
	Egerer et al. (2021)	In other surveys, farmers' insufficient awareness of climate change and limited knowledge and societal perception hindered their understanding of climate change consequences and water-saving adaptation strategies.

DOI: 10.34659/eis.2024.89.2.738

Marta GUTH • Anna MATUSZCZAK • Agnieszka POCZTA-WAJDA • Agnieszka SAPA •
Katarzyna SMĘDZIK-AMBROŻY

CO WPŁYWA NA POSTAWĘ EUROPEJSKICH ROLNIKÓW WOBEC GOSPODARKI WODNEJ – SYSTEMATYCZNE PODEJŚCIE LITERATUROWE

STRESZCZENIE: Biorąc pod uwagę wyzwania związane ze zmianami klimatycznymi, prognozowanym wzrostem liczby ludności i rosnącym zapotrzebowaniem na żywność, długoterminowe wykorzystanie wody w rolnictwie staje się palącym problemem. Dlatego skuteczne zarządzanie zasobami wodnymi przez rolników ma kluczowe znaczenie i wymaga szeroko zakrojonych badań naukowych. W związku z tym głównym celem tego artykułu było zidentyfikowanie odpowiednich badań dotyczących podejść, postaw i działań rolników w zakresie gospodarki wodnej i przyjęcia innowacji wodnych. Przeglądu dokonano metodą PRISMA, która stała się podstawą do dalszych analiz ilościowych i jakościowych. Wyniki sugerują, że gospodarka wodna w rolnictwie zyskuje na znaczeniu ze względu na rosnące narażenie na ryzyko ograniczonej dostępności wody i konieczność dostosowania się do zmieniających się warunków klimatycznych. Poprzednie badania skupiały się głównie na wybranych południowych regionach Europy. Na podejście rolników do gospodarki wodnej wpływają przede wszystkim czynniki społeczno-ekonomiczne i instytucjonalne. Edukacja okazała się kluczowym czynnikiem zachęcającym rolników do stosowania praktyk oszczędzania wody.

SŁOWA KLUCZOWE: gospodarka wodna, innowacje wodne, podejście rolników, PRISMA, zmiana klimatu, susza, ograniczona dostępność wody, oszczędzanie wody

DOI: 10.34659/eis.2024.89.2.738