

Lidia KŁOS

AGRICULTURAL PRODUCERS' KNOWLEDGE OF RATIONAL WATER MANAGEMENT – CASE STAGE (POLAND, EU)

Lidia Kłos (ORCID: 0000-0001-7573-2626) – *University of Szczecin*

Correspondence address:

Niemierzyńska Street 28A/16, 71-436 Szczecin, Poland

e-mail: Lidia.Klos@usz.edu.pl

ABSTRACT: Water is considered the most critical resource for agricultural development worldwide. The increasing extreme weather phenomena require rational management of water resources in agriculture, which is the most vulnerable to the effects of climate change. The article is an attempt to take on the subject of agricultural producers' awareness of selected aspects of rational water management in agricultural production. For this purpose, a pilot survey was used and carried out in selected poviats (counties) in the zachodniopomorskie (West Pomerian) Voivodeship, implemented as part of the "Support for the Creation of Local Water Partnerships" project (Support for the creation of LPW, SIR, 2020).

KEYWORDS: water management, agricultural production, rational use of water

*„ only then is the water respected, when there is no water in the well”
(Polish proverb)*

Introduction

The recent years have particularly shown that climate change has become a reality. According to the report of the International Climate Panel (IPCC), currently up to 3.6 billion people worldwide feel the effects of climate change (IPCC Working Group I Report, 2021). Heat waves, combined with droughts, water shortages and floods are particularly troublesome and dangerous for Europe (Feyen et al., 2020, pp. 20-23, 50-53).

July 2022 turned out to be the sixth hottest month in Europe with a heat-wave setting local and national records in both Western and Northern Europe (Climate Bulletins).

Agriculture, which directly depends on the quantity and quality of water resources, is particularly sensitive to the negative consequences of climate change. It is the agricultural sector that is the largest consumer of water, which currently accounts for 70% of global consumption, including about 25% for irrigation of crops (Un World Water Development Report, 2022) As a result of changes in the distribution and intensity of rainfall and an increase in air temperature, agricultural sector is already struggling with an increasingly frequent shortage or excess of water, which causes significant losses in agricultural production.

Climate change is projected to reduce crop productivity in parts of southern Europe. While the northern regions may experience longer growing seasons and more suitable cropping conditions in the future, the number of extreme events negatively affecting agriculture in Europe is projected to increase significantly (EEA Report, 2019, pp. 12-19, 25-35).

In the geographical region in which Poland is located, we can also expect an increase in the frequency and worsening of extreme weather phenomena, in the form of increasingly severe and longer periods of drought, or sudden torrential rainfall resulting in local flooding and floods (Climate change trends, <http://klimada.mos.gov.pl,Komunikat01/2020>). In Polish weather conditions, in order to mitigate the described phenomena, it is necessary to: increase the natural retention capacity of the catchment area, limit the rapid runoff of rainfall and meltwater through drainage networks and introduce precise irrigation systems (Karaczun, 2020, pp. 10-12; Karaczun et al., 2020, pp. 75-94). This means that the challenges faced by Polish agriculture require the involvement of not only the government and local administration responsible for creating organizational and legal frameworks for the rational management of water resources, but – above all – the participation of farmers (Kolasińska & Wawer, 2020, pp. 74-86, 188-190) Their decisions and

applied agricultural practices, after all, directly affect the quantity and quality of water in agriculture (EAA, 2021; Wawer, 2020, pp. 38-45). Therefore, knowledge and awareness in the area of rational management of water resources is so important in counteracting the negative effects of climate change and its impact on agricultural production. An important role in the educational area of agricultural environment is played by Agricultural Advisory Centers (AAC), which provide broadly understood consultancy in the field of agriculture, sustainable development of rural areas and improvement of professional qualifications of farmers. The tasks include organizing training and implementing knowledge exchange programs aimed at educating farmers in the use of more efficient water management practices in agricultural production (Kolasińska & Wawer, 2020, pp. 16, 55, 147-158, 179). These centers have recently expanded their information campaign with an educational and training offer in the field of melioration and retention of water resources and irrigation.

The aim of the article is to show the state of knowledge of agricultural producers in the area of rational water management in agriculture. It is a case study involving farmers in the selected poviats of the Zachodniopomorskie Voivodeship (Poland, EU), which is characterized by a certain specificity, due to its large-area and intensive nature of agricultural production.

To achieve the objective, preliminary pilot studies were use carried out among agricultural producers concerning their knowledge of irrigation, water retention and melioration treatments in agriculture, as well as knowledge of the competencies of individual institutions and bodies operating in the area of rational water management.

In order to answer these questions, the following research tools were used: analysis of existing data (reports, domestic and foreign statistical studies, source documents and legal acts), literature review and a quantitative research method – a survey.

Water resources in agriculture

Water is one of the most important elements of the natural and anthropogenic environment; necessary for life and development (Water resources in the world). In recent years, a rapid decline in water resources has been noticeable due to increasingly frequent droughts and intense weather phenomena that affect the limited and vulnerable nature of this resource. Therefore, water is one of those goods the improper use of which may limit the socio-economic development or, at best, the production efficiency of almost all branches: industry, agriculture, transport and services (Kłos, 2013b, pp. 263-274; Kaca et al., 2011, pp. 14-21).

Agriculture is especially exposed to those deficits, potentially bringing a serious challenge to ensuring food security, due to a rapid growth in the world's population (World population., ONZ, 2022). In the early 2000s, 40% of the world's food came from 18% of the cultivated land that had been irrigated. The global irrigated area has increased more than sixfold over the last century, from about 40 million hectares in 1900 to over 260 million hectares (Chartzoulakis & Bertraki, 2015, pp. 88-98; FAO, AQUASTAT Database). Water abstraction for irrigation is a major driver of groundwater depletion worldwide, further exacerbating the water supply situation. The United States, China, Iran and Pakistan are responsible for 67% of the world's groundwater consumption. It is estimated that the increase in groundwater extraction by 2050 will amount to 1,100 km³ per year, i.e. 39% (Boretti & Rosa, 2019, pp. 1-15). The intensification of the use of groundwater for irrigation can lead to overall water depletion at the water catchment level (Wada et al., 2016, pp. 175-222).

Due to the fact that the current efficiency of irrigation was very low, with only 55% of the water being used for crops, measures were taken to minimize water losses from storage and retention systems and to find economical crops with minimal water consumption and the use of application methods in irrigation systems (the so-called: precise – drip irrigation) (Beluhova-Uzunowa et al., 2019, pp. 142-155; Berbel et al., 2018, pp. 423-429).

Moreover, water retention capacity of the agricultural landscape can be improved by maintaining drainage systems, establishing a variable water flow regime, restoring and reconstructing morphological structures in rivers, adopting ad hoc crop rotations and utilizing other agricultural practices (crop systems, soil cover management) or creating flood protection reservoirs (Climate-ADAPT, 2019). Therefore, for environmental reasons, agrotechnical and planning measures are gaining importance (Mrozik & Przybyła, 2013, pp. 1767-1773).

Studies conducted in various countries such as: India, Israel, Spain and the United States have shown that drip irrigation reduces water consumption by 30-70% and increases yields by 20 to 90% (Postel et al., 2001, pp. 3-13). The combination of water savings and higher yields currently makes it the leading technology in addressing the global challenge of increasing crop production in the face of severe water shortages. This method is the only viable way to optimize agricultural production and encourage water conservation in order to improve the efficiency and durability of irrigation systems. For this purpose, knowledge of the water requirements of crops, water requirements and soil & water characteristics that determine the timing of irrigation is essential. In most cases, the farmer's skills determine the effectiveness of irrigation planning (Wawer et al., 2016, pp. 290-296; Savari et al., 2021).

The problem of optimizing water management also applies to European agriculture, which – due to its geographic and climatic conditions – is particularly exposed to water deficits. According to the European Environment Agency (EEA), droughts and water scarcity are no longer rare and extreme phenomena and affect about 20% of the territory of Europe and 30% of Europeans every year (EEA Report, 2021). That is the reason why, in the past, a combination of rain and irrigation farming was used. Consequently, agriculture in Europe is responsible for about 40% of the total water consumption, in some regions reaching even 80% (Agenda 2030). In southern Europe in particular, the demand for irrigation is projected to increase in the coming years, while water availability is expected to decline in part due to climate change.

Greece, Italy, Portugal, Cyprus, Spain and the south of France are the most exposed to the risk of climate change and the need to irrigate crops. In these areas, almost 80% of water used in agriculture is currently used for irrigation purposes (EEA Report, 2021).

Thanks to the introduction of new water-saving practices and strategies, irrigation does not have to be as water-intensive. The benefits of water efficiency can now be seen all over Europe, both through efficient water transport systems (the amount of water abstracted actually delivered to the field) and through efficient water distribution in the field (the ratio of the water actually used by the crops to the total amount of water with which the crop were provided). A good example is France and Greece, where the introduction of an improved transport network and efficient water distribution has led to an increase in water efficiency of 95% compared to previously used irrigation methods (Rouillard, 2020, pp. 461-479).

Another solution for the rational management of water resources is the use of treated wastewater for agricultural purposes. For example, in Cyprus, the targets for the use of recycled water set for 2014 correspond to about 28% of the water demand reported by the agricultural sector in 2010. In Gran Canaria, treated wastewater accounts for about 20% of the water used in all sectors; such water is used, for example, to irrigate tomato plantations (Gelati et al., 2020, pp. 227-253).

Significant water savings of more than 40% of the volume of abstracted water can be achieved by improving irrigation infrastructure and technologies, such as: improving the efficiency of the provision and application of irrigation systems, changing agricultural practices, planting drought-resistant crops, and reusing treated water (EEA Report, 2020, pp. 18-24).

Poland is also one of the countries with very severely limited resources (Thier, 2020, pp. 9-16; Eurostat, 2021). According to the Togetair¹ Climate

¹ Polish Multimedia Climate Report - TOGETAIR.

Report, there is 1.5 thousand m³ of water per one Pole per year, which is three times less than for a statistical European (Statistics Poland, 2021). Almost 20% of Poland has precipitation lower than 500 mm, which ranks these areas among the driest in Europe (Mrozik, 2012, pp. 75-79).

Moreover, Poland's surface water resources are highly variable in time and space, which intensifies periodic water excesses or deficits in rivers (Prandecki et al., 2018, pp. 78-98; Walczykiewicz, 2020, pp. 4-10). An additional problem is also posed by the rapid disappearance of surface waters and fluctuations in the amount of water available during the year; this phenomenon being the result of the changing amount and nature of rainfall (Projekt KLIMADA, 2020). Meanwhile, agricultural production in Poland is based mainly on rainwater, which additionally worsens the situation, because Poland experiences low rainfall due to being located in a transitional climate zone, where continental and oceanic influences collide. The average annual rainfall in Poland is 619 mm, which means that 196 km³ of water i.e. 70% is lost due to evaporation while 62 km³ runs off into rivers (Institute of Meteorology and Water Management, 2020; Mrozik, 2012, pp. 75-79). All these conditions make the periodical scarcity of water resources particularly burdensome for agricultural production in the times of its greatest demand by crops (Furdyna, 2020, pp. 62-67).

In Poland, about 60% (and including forest crops – 90%) of the country's area is related to the demand for agricultural production and uses more than 40% of the total annual precipitation and about 70% of the volume of generally available water in the catchment area to produce food (Statistics Poland, 2021). For this reason, water management in the catchment area is of key importance for its long-term preservation and its use in a satisfactory amount (Kaca, 2015, pp. 23-30).

In order to improve water balance in Poland, more water should be kept where it falls, slowing down the process of its evaporation from the soil by storing it in retention reservoirs and by reusing drainage waters (Szymczak, 2014, pp. 53-85). Unfortunately, currently the total amount of water stored in the existing storage reservoirs in Poland is slightly more than 6.5% of the average annual river runoff volume over many years. On the other hand, the geographical conditions of Poland allow for the retention of as much as 15% of the annual river runoff. This means that the water retention program to regulate the flow of water, initiated as early as 1995, is still insufficient, does not provide full protection against floods and droughts, and does not guarantee adequate water supply. For proper water management, this indicator should be at the level of at least 20% (Opania & Gama Marques, 2021, pp. 2-10; Raport, Stop suszy! 2020, pp. 1-40). This is a huge challenge for water management in rural areas.

Meanwhile, in the climatic conditions forecast for the coming decades – just to maintain the current agricultural production – Polish farmers will be forced to increase the area of irrigated crops (Institute of Meteorology and Water Management, 2020). It should be assumed that, in the perspective of several decades, the use of irrigation will be an indispensable element of agricultural crops in a large part of the country. For this to be possible without disturbing the country's strategic water resources, it is necessary to increase the efficiency of water use by implementing, among others, precise irrigation of plants. Detailed rules for drawing water for irrigation are regulated by the Water Law Act (Journal of Laws of 2017, item 1566). The aim should be to significantly increase the irrigated area with only a slight increase in water consumption. For this purpose, in many parts of the country, the main source of water for agriculture should be surface waters collected in retention reservoirs.

Challenges faced by water management in Poland in the face of climate change

Rational water management is a process of obtaining, collecting, using and protecting water, removing its excess and limiting the related risks, as well as mitigating water shortages and their elimination (Kłos, 2013a, pp. 198-200). It is particularly visible in rural areas, where water management is subordinated to: the challenges faced by the agro-food sector, health safety of people living in the countryside, animal welfare, production of healthy food, preservation of landscape and environmental values (Mosiej et al., 2011, pp. 25-36; Kaca et al., 2011, pp. 16-18). Due to the growing problems caused by climate change, poor water management and insufficient retention, the following aspects of water management come to the forefront in rural areas:

- development of new methods for the optimization of hydrological balance of soils in the soil-water-plant system, including water melioration through increasing soil retention and using precise irrigation,
- development of new methods for monitoring, rating and forecasting of water availability for agriculture at the farm, commune and water catchment level,
- adoption of water management as one of the leading elements of spatial planning in a rural commune,
- adaptation of agricultural practices to the changing availability of water resources,
- increase of water retention in the agricultural landscape and diversifying water sources for farms,

- prevention of the deterioration of soil quality resulting from water deficits, especially preventing the mineralization of soil humus,
- stimulation of the economic and environmental effects of implementing good water management practices on farms through subsidies and consultancy, as well as educational and training programs (Treder et al., 2021, p. 8).

These challenges require careful planning pertaining to the use of water resources in the region in accordance with the principles of rationality in access to water and with simultaneous implementation of agricultural, social and environmental goals. Achieving these goals involves adapting agricultural production which can lead to land consolidation aiming to improve water retention and flood protection. Such activities are undertaken, among others, in Poland and the Netherlands (Stańczuk-Gałwiazek et al., 2018, pp. 498-511).

Therefore, water management in rural areas requires a wide range of activities, ranging from planning and organizational activities, through design and investment, to operational, modernization and educational activities (Mioduszewski et al., 2011, pp. 179-202).

In the decision-making process, it is worth taking into account all the ecosystem services provided by individual treatments that increase the drainage capacity of the water catchment (Mrozik & Idczak, 2017, pp. 37-48).

For this purpose, it is necessary to develop methods of rational water management in agriculture (Wawer & Kozyra, 2021). To implement these measures, it is imperative that all water managers and water users collaborate and work together to manage water in rural areas.

Around the world, partnerships are used to solve complex problems related to rational water management. An example of participatory management of water resources in agriculture is Egypt, where numerous associations have been established involving all water users, including farmers, in the area of irrigation at the water catchment level. The result is an increase in agricultural production, savings and an increase in the productivity of water resources (El-Hafez & Negm, 2018, pp. 605-622).

This approach sees decision-making as a dialogue and negotiations with stakeholders from the central government and local government sectors, organizations operating in the field of rational water management, and rural residents themselves (Margerum & Robinson, 2015, pp. 53-58). Collaborative Partnerships have been established for a range of water issues, operating at different levels in many parts of the world: South America, Australia and Europe. In the field of drought prevention, Poland is a member of the Global Water Partnership for Central and Eastern Europe (Bokal et al., 2014, pp. 37-46, more at: Country Water Partnership; Global Water Partnership).

This requires a number of activities and knowledge in the field of water management in agriculture, both on the part of institutions interested in the subject of water management, agricultural producers, as well as inhabitants of rural areas.

In the process of adapting Polish agriculture towards rational water management, it is extremely important to have reliable information on: the condition of water resources, forecasts of their dynamics in the current season, estimating the rate of their renewal in the current climatic conditions and consumption (Michalak, 2020, pp. 134-141). Good practices include, on the one hand, optimizing the use of water and, on the other hand, its accumulation in periods of excess, so that water stocks can be used during shortages (Kolasińska & Wawer, 2020, pp. 51-74).

Therefore, the Ministry of Agriculture and Rural Development (MARD) in cooperation with the Agricultural Advisory Centers (AAC) and representatives of local government have developed an outline of rational water management for agriculture at the municipal level, consisting of 7 pillars:

- development of a study of the commune's water resources as part of the procedure for creating and updating local spatial development plans (LSDP),
- creation of Local Water Partnerships (LWP) associating water management institutions – the Polish Water Management Authority (PWMA) and its local units, as well as units responsible for government and local administration, water companies and water users,
- reform of water companies and taxation for the maintenance of drainage networks in rural areas,
- creation of irrigation communities to manage their assigned surface water and groundwater,
- optimization of water usage in irrigation based on reliable climatic, soil or plant criteria,
- increase of the retention of water reservoirs and soil water capacity through appropriate agro-technical measures: crop rotation, organic fertilization, slowing down surface runoff to waters, collecting rainwater, reuse of greywater (gray water <https://www.eea.europa.eu/pl/articles/woda-na-potrzeby-rolnictwa>; Kolasińska & Wawer, 2020, pp. 54-55),
- education of farmers, advisers, local government administration in the field of water management and water-saving management in agriculture (Trader et al., 2021, pp. 7-8).

The implementation of the above-mentioned pillars of rational water management in rural areas requires an efficiently functioning organizational and legal framework, in particular:

- the inclusion of water management in the spatial planning of the commune,

- full identification of water resources in the commune: surface and underground waters, creation of local hydrogeological models describing the boundary states of groundwater levels for resource renewal programs that enable the estimation of safe levels of annual water retainage and consumption,
- renewal and modernization of water drainage systems and the launch of small and large retention programs that increase the supply of surface water in rural areas (Trader et al., pp. 9-10).

All this will be possible through the active involvement of all users in the process of rational water management, especially at the commune and poviat level. To this end, the Ministry of Agriculture and Rural Development (MARD) initiated the creation of local communities operating to ensure access to information and transfer of knowledge in the field of rational water management in the region. The initiative to create water partnerships was taken by Voivodeship Agricultural Advisory Centers, under which Local Coordinators for LWP were appointed.

Local Water Partnership (LWP) – goals and tasks

Local Water Partnership (LWP as Local Water Partnerships) is a voluntary, informal association of people / entities interested in or involved in water management in a given area. The legal form of LWP functioning is optional and depends on the needs, for example it can be a form of a Letter of Intent.

The main purpose of LWP is to improve water management in the poviat (county). It is assumed that LPW will be a cooperation platform in the field of water management in rural areas. An efficiently functioning LWP can identify problems that may serve as the basis for the introduction of new solutions, in particular in the field of the operation of water companies or the maintenance of water drainage facilities (Support for the creation of LWP, 2020, <https://sir.cdr.gov.pl/2020/06/22/support>).

The scope of LWP operation in the short-term period includes:

- facilitating the implementation of support for water investments financed under the Rural Development Program (RDP, transition period) and the National Reconstruction Plan (NRP),
- exchange of information on the principles of investment implementation with regard to the necessary documentation,
- in the scope of NRP, assistance in identifying investments that meet environmental criteria in accordance with the guidelines of the European Commission on the application of the principle of „do not do serious damage” (Journal of Laws UE.C.2021.58.1).

LWP's long-term activities include:

- activating and strengthening cooperation between all entities,
- diagnosis of the situation in the field of water resources management,
- development of joint solutions (co-decision) to improve the broadly understood water management,
- expressing opinions and developing investment plans (indicating priorities),
- conducting educational campaigns to increase the awareness of farmers and all rural residents on the issues of economical and rational water management (Kamiński et al., 2021, pp. 6-8).

The Local Poviats (county) Water Partnerships (LPWP) created in 2020 are to work towards overcoming institutional barriers and creating efficient communication between various stakeholders for the efficient resolution of water scarcity, water excess and quality problems. The coming years will show whether the undertaken initiative will improve water management in the area of communes and poviats (counties).

Research methods

As part of the project called Support for the Creation of Local Water Partnerships (SiR, 2020), preliminary pilot surveys were carried out in eight randomly selected poviats (counties) of the West Pomeranian Voivodeship among agricultural producers. The following poviats were selected for the study: Białogardzki, Gryfiński, Koszaliński, Kołobrzesci, Myśliborski, Pyrzycki, Sławieński, Szczecinecki, to which 100 invitations (for each poviat) to participate in the survey were sent randomly. In total, a response was received from 277 agricultural producers who declared participation in the survey out of the total of 800 invitations sent. The largest number of agricultural producers reported in the Myśliborskie poviat, the fewest in the Gryfiński poviat.

The survey was conducted at the request of the West Pomeranian Agricultural Advisory Center in Barzkowice, which conducts training and consulting activities in the area of rational water management in agriculture and irrigation in the voivodeship. The questionnaire survey sheet contained 17 questions: four questions concerning the characteristics of the reported farm (i.e. farm size, structure of crops and breeding, agronomic category of soils), three questions were open-ended and concerned the identification of institutions providing support related to training and raising knowledge in the field of irrigation and drainage in agriculture. The remaining 10 questions were closed in the "Yes or No" answer. The study period was initially planned for 2019 but, due to the Covid 19 pandemic and restrictions on meetings and

direct contact with the beneficiaries, it was extended to 2020-2021. The study used a quantitative research method – a questionnaire, which was made available during the meetings with farmers.

Results of the research – Characteristics of the research area

Large-area farms dominate in the Zachodniopomorskie Voivodeship (West Pomeranian Voivodeship), where the average farm is 33 ha with the national average of 11 ha. (West Pomeranian Voivodeship in numbers, 2020).

In the survey, 80% of farms were in the range of 10-50 ha. Agricultural crops dominated in 90% of farms, and no animal breeding was carried out in over 67% of farms (Table 1).

Table 1. Characteristics of farms, size, structure of crops and type of farming in the surveyed poviats, 2019-2020

Characteristics of farms	Poviat, No of respondents	Size of agricultural farm in hectares (ha) in %					Type of crops in %				Type of animal breeding in %			
		<5	5-10	10-50	50-100	>100	Agricultural	Fruit plantation	Seed farms	Vegetable farms	Cattle	Pig farms	Poultry farms	None
Białogardzki, N=28	4	0	50	21	25	96	4	0	0	43	7	3	47	
Gryfiński, N=22	9	9	23	32	27	100	0	0	0	5	0	9	86	
Kołobrzeczki, N=49	10	20	40	20	10	96	0	2	2	25	10	0	65	
Koszaliński, N=33	21	24	40	3	12	100	0	0	0	17	0	9	74	
Mysłiborski, N=51	6	22	40	22	10	88	2	10	0	25	4	0	72	
Pyrzycki, N=17	0	0	47	12	41	71	6	23	0	12	1	0	82	
Sławieński, N=35	9	9	31	29	22	83	3	14	0	31	17	0	53	
Szczecinecki, N=42	16	5	55	14	10	86	2	12	0	28	5	5	62	

Source: author's work based on ODR surveys in Barzkowice (Poland).

The graphical image of the voivodeship with marked poviats participating in the study is presented on Figure 1.

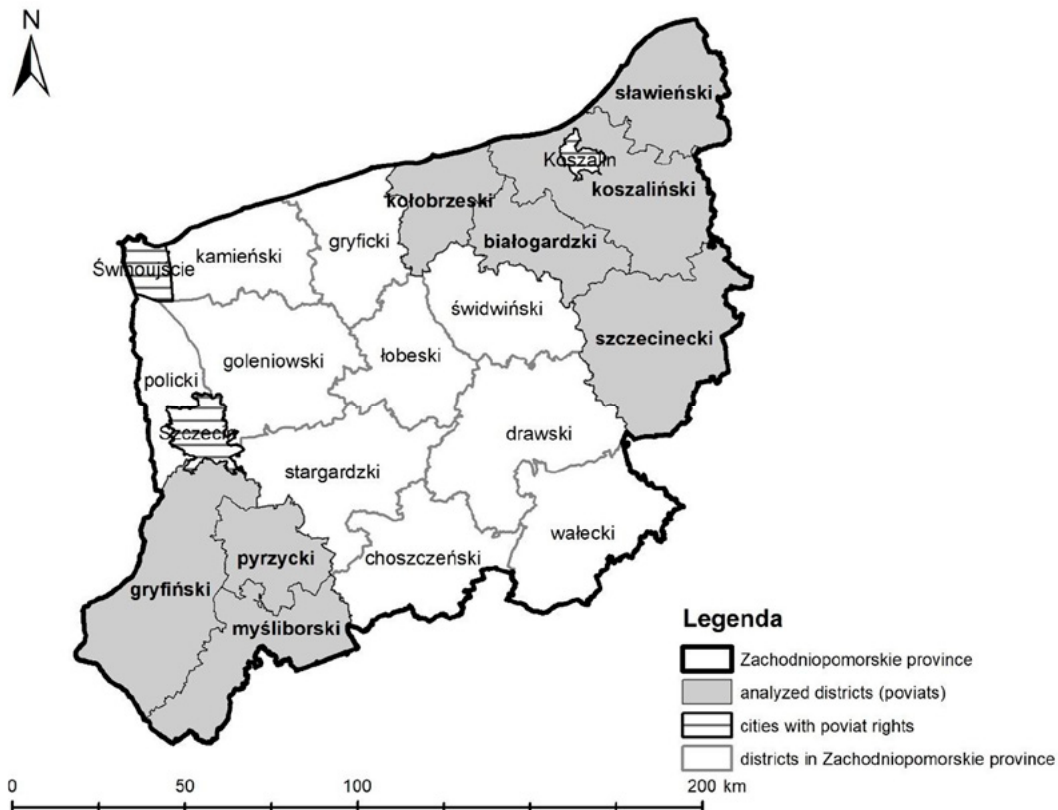


Figure 1. Poviats of the Zachodniopomorskie Voivodeship (Poland, EU)

Discussion of the obtained results and preliminary conclusions

The actual state of irrigation in the surveyed counties and losses in agricultural production due to water shortages as a result of drought periods are presented in Table 2.

In the surveyed poviats, crop losses caused by drought and water shortage exceeded 80% and, in some cases, even 100% of reported farms. Even more surprising is the small number of surveyed farmers irrigating their crops, in which the dominant form is rainwater and drip irrigation. As the main reasons for not using irrigation, the following were indicated: lack of funds for the implementation of comprehensive solutions regarding irrigation retention and ignorance of the regulations related to the possibility of developing irrigation.

Table 2. Selected answers of respondents in the poviats surveyed regarding irrigation

Poviats	What % of farmers irrigate crops	Crop losses due to water shortage [%]	Type of irrigation used [%]			Reason for non-hydration [%]				
Białogardzki	4	100	0	4	0	2	2	22	44	26
Gryfiński	4	100	0	4	0	2	2	22	44	26
Kołobrzeczki	6	85	3	3	0	3	23	24	27	23
Koszaliński	6	85	3	3	0	3	23	24	27	23
Mysłiborski	2	88	2	2	0	7	10	20	43	20
Pyrzycki	6	94	0	0	6	23	9	18	32	18
Stawieński	3	86	0	3	6	30	15	7	33	15
Szczecinecki	2	90	0	7	0	1	13	27	40	19

Legend: Type of irrigation used: 1 – drip, 2 – rain, 3 – percolating. The reasons for not using irrigation: 4 – lack of needs, 5 – lack of technical support, 6 – lack of water for irrigation, 7 – lack of funds, 8 – complicated regulations.

Source: author's work as in Table 1.

In terms of knowledge about support mechanisms in the area of water management, including irrigation, 18% of the total respondents confirmed the knowledge of the available activities, while 82% of the respondents had no knowledge on this subject of Figure 2.



Figure 2. Do you have knowledge about the mechanisms of supporting the development of irrigation in agriculture? (in %, n = 277)

Source: author's work based on questionnaire research.

The knowledge of the issues of irrigation support mechanisms in agriculture was significantly above the overall average in the following poviats: Szczecinecki and Pyrzycki (24% each), but the result was below the average in the Kołobrzeczki poviat, where only 10% of respondents confirmed their knowledge of such mechanisms. In the study, a total of 70% of respondents

did not have knowledge about the available training courses related to the possibility of developing irrigation or water retention in farms (Figure 3).



Figure 3. Do you have knowledge about trainings related to the possibility of irrigation or water retention development in farms (in %, n = 277)

Source: author's work based on questionnaire research.

Regarding the above-mentioned question, the concerning situation is in the Białogard powiat, where as many as 96% of the respondents are not aware of what kind of training is organized by the West Pomeranian Agricultural Advisory Center (WPAAC) in Barzkowice. On the other hand, the following poviats are much above the overall average for the above-mentioned question: i.e. the Szczecinecki and Koszaliński poviats, in which slightly less than half of the respondents had knowledge in this field (46%).



Figure 4. Have you participated in training related to the possibility of irrigation or retention development on farms?

Source: author's work based on questionnaire research.

This lack of knowledge of the available training on irrigation and water retention translates into actual participation in the above-mentioned training. When asked about participation in trainings related to the possibility of irrigation and water retention development, only 18% of respondents in total benefited from such trainings (Figure 4).

Similarly, the smallest number of people participated in trainings in the Białogardzki and Kołobrzeczki poviats (7% each). The highest rate of participation in trainings was recorded in the Szczecinecki and Pyrzycki poviats: 24% each.

Another question asked in the survey was related to access to information on support for the development of irrigation and water retention (Figure 5). Over 80% of respondents believe that access to this information is insufficient, with as many as 96% in the Białogardzki poviats.

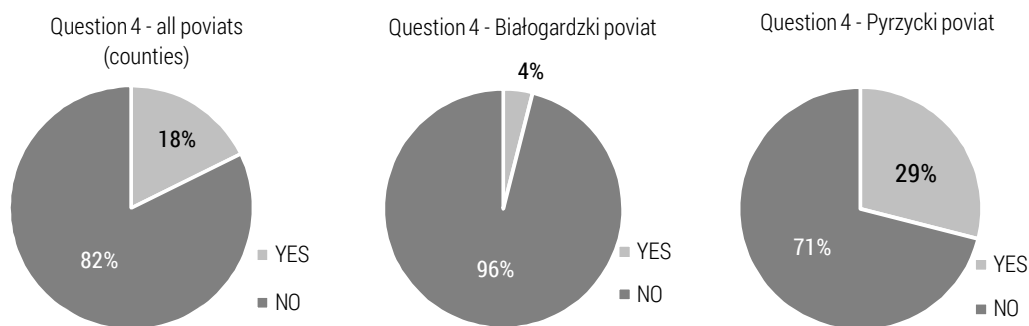


Figure 5. Do you think that access to information on the possibilities of supporting the development of irrigation and retention is sufficient? [in %]

Source: author's work based on questionnaire research.

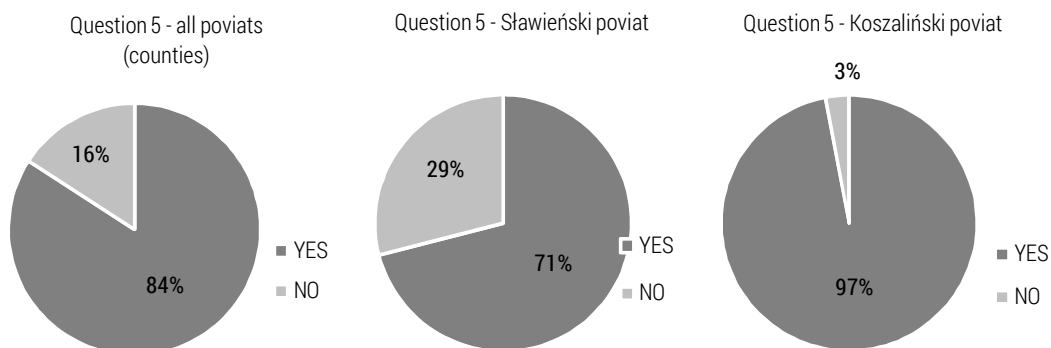


Figure 6. Do you think that training in this area is needed?

Source: author's work based on questionnaire research.

On the other hand, in the Pырzycki powiat, 29% of the surveyed agricultural producers considered that the access to information regarding this kind of support is sufficient.

Interesting answers were obtained in the question “Is training in this area needed”, as many as 84% of respondents in total indicated the legitimacy and need for such training (Figure 6).

It is worth noting that the highest percentage of indications as to the legitimacy and need for training in the field of irrigation in agriculture was obtained in the following powiats: Kołobrzeczki and Koszaliński, 97% and 96%, respectively, while the lowest number of indications was in Sławieński powiat – 71%.

An important element in rational water management in rural areas is the knowledge of the competences of individual bodies and institutions operating in this area.

For this purpose, a question was formulated regarding the knowledge of these competences among the survey respondents and the obtained results were as follows (Figure 7).



Figure 7. Are you aware of the competences of individual authorities (e.g. who should be asked for a water permit for the use of water?)

Source: author's work based on questionnaire research.

Only 32% of all respondents participating in the survey declared knowledge about the competences of individual bodies in the field of water management. In the Koszaliński powiat, only 16% of respondents had such knowledge. The highest indicator was recorded in the Szczecinecki powiat, where more than half (52%) of the respondents indicated knowledge of the competences of individual bodies and institutions in the field of rational water management.

The lowest level of knowledge about the applicable regulations concerning irrigation, development, maintenance of drainage and retention was recorded in the Białogardzki powiat (64%) (Figure 8).

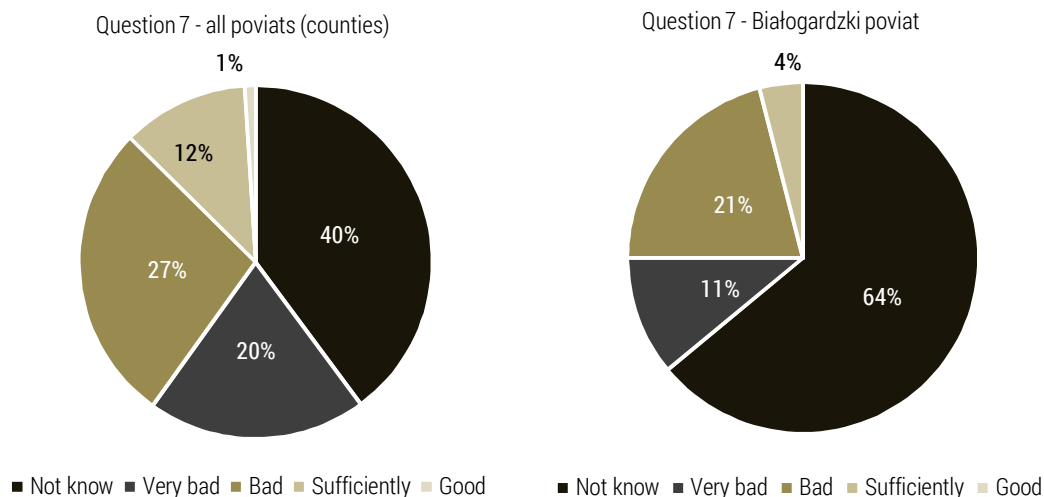


Figure 8. How do you rate the regulations on irrigation, development and maintenance of drainage and water retention?

Source: author’s work based on questionnaire research.

Then, the respondents were asked for their opinion on the newly established Local Water Partnerships (LWP) to coordinate and support activities in the field of rational water management in the powiat (Figure 9).

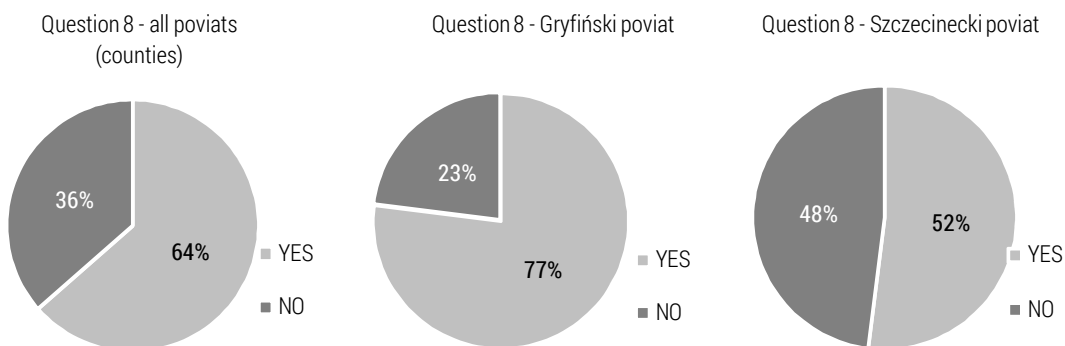


Figure 9. Do you think the Local Water Partnership initiative could have a positive effect?

Source: author’s work based on questionnaire research.

In total, 64% of the respondents expressed their positive opinion on the establishment of the LWP. The highest number was recorded in the Gryfiński powiat – 77%, while the lowest in the Szczecinecki powiat, where only 52% of the respondents positively assessed this initiative.

Despite the differences in the number of respondents reported in individual poviats of the West Pomeranian Voivodeship, the obtained results give the opportunity to formulate very preliminary conclusions related to the level of awareness of rational water management in agriculture among the participants of the survey and their interest in the available training offer.

Summary and conclusions

The escalating extreme weather events require a revision of the current approach to water management in agriculture; an industry most vulnerable to the effects of climate change and the related water shortages. In rural areas, this requires a holistic approach to rational water management, taking into account all the needs of residents with an emphasis on maintaining agricultural production, which is crucial for the country's food security. Rational water management means striving to meet the current needs related to the use of water resources in such a way as not to reduce the access of other users and, at the same time, to protect water and water-dependent ecosystems in order to maintain the sustainability of natural processes in the natural environment. Rational water management in rural areas includes not only the drainage of water from the fields, but also its retention, e.g. by building appropriate devices for irrigation or retention on farms. This requires the knowledge and commitment of agricultural producers in the use of economical water management practices in agricultural production. It is the farmers who, through the way of carrying out agro-technical operations on their crops, have an impact on the rational management of water resources and counteracting the effects of water deficit in agriculture and in rural areas.

The following conclusions can be drawn from the conducted pilot study:

1. In general, there is very little interest of agricultural producers in participating in surveys and meetings organized in poviats on rational water management in rural areas (277 people, i.e. less than 30%).
2. The vast majority (86%) of respondents participating in the study showed knowledge about the agronomic category and soil class on their own farm and the existence of areas that can be used for water retention in the farm area.
3. In terms of knowledge about support mechanisms for water matters – retention, drainage infrastructure or construction of irrigation systems, only 18% of farmers showed such knowledge.

4. 90% of the farmers participating in the survey believe that trainings on water management in agriculture and the application of good agricultural practices conducted by the Agricultural Advisory Center in order to increase and restore small retention are very necessary.
5. Over 70% of the respondents did not participate in training on water management in agriculture, pointing to insufficient publicity and poor access to information on this kind of training. At the same time, they postulated to introduce – apart from traditional lectures and thematic meetings – an online form, e.g. in the form of webinars.
6. Nearly 2/3 of the respondents do not know the competences of individual institutions dealing with water management, and the regulations on irrigation, development and retention maintenance are either completely unknown or incomprehensible to them – participants in the meetings indicated that the reception of complicated and constantly changing regulations posed a significant challenge.
7. The initiative to establish a Local Water Partnership was assessed very positively by the farmers. They hope it could create a communication platform for efficient problem solving in the field of water management in poviats.

In the poviats surveyed, there is a need to implement comprehensive irrigation solutions, mainly through financial support for the purchase of water retention devices for irrigation purposes and training in the applicable administrative procedures and the possibility of obtaining target funds.

This study attempts to look at only selected aspects of rational water management in agriculture related to the agricultural production retention and irrigation system, the main contractors of which are farmers. Unfortunately, the obtained conclusions from the conducted pilot study give a not-very-optimistic picture of the awareness and involvement of farmers in selected poviats of the West Pomeranian Voivodeship. However, there is no doubt that, without their active participation, activities in the area of rational water resources management in rural areas will not be possible to implement.

The issues raised regarding retention and introduction of irrigation systems constitute an important aspect of rational management of water resources in agriculture and counteracting the effects of water deficit in rural areas. However, to complete the presented issue, further research will be continued on the functioning of the established Local Water Partnerships, which will be presented in subsequent studies.

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Wytyczne techniczne dotyczące stosowania zasady „nie czyń poważnych szkód” na podstawie rozporządzenia ustanawiającego instrument na rzecz odbudowy i zwiększenia odporności (DZ.U.U.E.C. 2021.58.1). (in Polish).