



SUPPLY OF WATER FOR IRRIGATION OF FARMLANDS IN THE NEW ORGANIZATIONAL AND LEGAL CONDITIONS

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Abstract

Types of water abstraction sources for irrigation, examples of water supply and water storage in the farmlands as well as advantages and disadvantages of the suggested solutions were analyzed in the article. In addition, the organizational and legal requirements relating to the groundwater and surface water intakes were discussed. From the point of view of the interests of the farmer it is necessary to know the changes that occurred in the fees and administrative responsibilities related to agricultural water intake, introduced by the new Water Law Act since 1 January 2018. The differences between legislation in force and repealed associated with both agricultural water management and environmental protection were demonstrated in the paper.

Key words: irrigation, water intake, Water Law, charges for water services

INTRODUCTION

Atmospheric precipitation is the basic source of water necessary for the growth of crops. However, the increased frequency of atmospheric and soil droughts observed in recent years and the deterioration of climatic water balances have shown that the natural water resources are insufficient to meet the needs of plants (Łabędzki 2009, Biniak-Pieróg 2014). This requires then actions aimed at supporting the supply of water for crops in a controlled way by employing an

artificial irrigation system. According to numerous studies on agricultural and horticultural plants, irrigation ensures the correct rhythm of plant growth and development and intensifies physiological processes. As a result, it contributes to the improvement of the quantity and quality of the crop (Żarski *et al.* 2013). In Poland, irrigation of plants has an interventional character and is limited to supplementing periodic shortages of rainfall in relation to the water requirements of crops (Łabędzki 2009, Rzekanowski 2009). In the face of increasing climate changes and growing requirements of recipients of products offered by farmers, irrigation of crops seems to be the future solution. The evidence of this is the CSO data (Statistical Yearbook of Voivodships 2017), which shows that the area of irrigated agricultural land in Poland, although much smaller compared to other countries with warmer climate, has been growing in the last five years. The economic and financial effectiveness of the enterprise is the underpinning for the decision on the selection of the irrigation system and carrying out the irrigation of individual plants (Lipiński 2015, 2016, Kledzik 2015). Technical and legal conditions that are an inherent element of economic analysis are no less important and should be considered by the investor at the initial stage of decision making. The adoption of new regulations on water management resulted from the necessity to introduce the EU regulations (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000, the so-called Water Framework Directive – WFD) into the Polish legal order, establishing a framework for Community action in the field of water policy. Amendments to the Water Law result from the need to implement the EU regulations, according to which users are obliged to pay fees for water used for business purposes.

The purpose of the article was to present examples of solutions for supplying water to arable fields and to demonstrate the possibilities and limitations in the use of water from various types of boreholes. In addition, the aim of the analyses undertaken was to present the reader with current organizational and legal requirements related to the water intake from surface and underground boreholes, and to demonstrate differences between legislation in force and repealed related to water management and environmental protection.

WATER SUPPLY VARIANTS FOR IRRIGATION OF FARMLANDS

Irrigation of farmlands can be done using gravity or pressure. Gravitational irrigation is utilized to a limited extent, mainly on grassland, because its functioning depends on the terrain's shape and location. However, pressure irrigation is widely exploited. Pressure irrigation systems can be divided into sprinkling irrigation and micro-irrigation. Each irrigation system consists of three basic elements, which include a water intake with a pumping station, lines in the form of pressure pipelines supplying water to the irrigated field and sprinkler or drip

irrigation devices. Depending on the method of installation and operation, sprinklers can be divided into permanent, semi-permanent, portable and mobile ones.

Water intake seems to be the most expensive element of the whole system as well as the most important, and at the same time the most difficult problem to be solved. Lakes and natural and artificial water reservoirs as well as flowing channels and streams seem to be the best sources of water for irrigation. If a farmer has the option of collecting water from a river or other large water reservoir, the limit specifying the amount of water taken in (in m³/h), stated in the water permit, is an key issue.

Table 1. Statutory regulations applicable to the constructions of groundwater boreholes

Act	Type of legal regulations
The Water Law Act of 20 July 2017	It regulates water management, water use and water resources management.
The Construction Law Act of 7 July 1994	It specifies technical aspects and minimum distance standards for wells. Construction Law does not regulate the construction of „water equipment for groundwater abstraction” at all, hence the frequent difficulties in interpreting the provisions of this issue. The construction of the intake for normal use of water (of the depth up to 30 m and the intake of up to 5m ³ per day) can be done on the basis of an application without a building permit. <i>The Supreme Administrative Court in the sentence of 10 April 2014 (ref. no. II OSK 2713/12) stated that the phrase „groundwater intake enclosure”, being part the provision of Art. 29 para. 2 (10), refers to the enclosure both in the aboveground part of the drilled well and in its underground part. Application for the construction of the well is therefore tantamount to the application of the enclosure of the aboveground part and the construction of its underground part.</i>
The Geological and Mining Law of 9 June 2011	It defines the rules and conditions for taking up, executing and terminating activities in the scope of performing geological works related to excavation and boreholes of depth up to 30 m in order to build groundwater boreholes for the purposes of groundwater intake in a quantity not exceeding 5m ³ per day.

In areas where there are no conditions for surface water intake, the possibility of groundwater intake should be examined. The undertaking of groundwater intake consists in making a hydrogeological hole for a well. The costs of such intakes vary greatly depending on the depth of the deposit and the aquifer yield. In such a case, it is vital to determine the well capacity (in dm³/min or m³/h) and the depth at which the pump should be positioned. It is also necessary to assess the possibility of supplying eclectic power, so as to ensure the pump’s operation and thus ensure adequate efficiency. The quality of water in physical (temperature, suspensions), chemical (pH, compounds including iron and manganese) and sanitary terms is also important.

Construction of wells that contain groundwater is subject to the provisions of the Construction Law, Water Law and Geological and Mining Law. The formalities related to the construction of deep wells are ambiguous, and each of the three legal acts regulates other issues regarding groundwater boreholes (Table 1 and 2).

Table 2. Documents and permits applicable to the construction of groundwater boreholes

	Construction of water devices for groundwater abstraction		
	for the purposes of ordinary use of water:		for the specific use of water, including:
Type of document, permits	from boreholes of the depth up to 30m with the average annual amount not exceeding 5m ³ per day	from boreholes of the depth over 30m with the average annual amount not exceeding 5m ³ per day	– irrigation of land or crops with the average annual amount of water exceeding 5m ³ per day – use of water for business purposes
Water-legal service	Not required	Required	Required
Hydrogeological documentation	Not required	Required	Required
Geological works design	No approval required	Development of a plan and <i>its approval by the governor of the province/president</i> required	The geological work project/well drilling project <i>is approved by the voivode</i>
Water permit	Neither the permit nor water law application required.	Water permit required: Aquatic legal survey and hydrogeological documentation should be enclosed to the application for the permit. It is necessary to use measuring devices for water abstraction. <i>Authority issuing the permit: The State Water Farm of Polish Waters</i>	
Building permit	No building permit required <i>Starost Office</i> needs to be notified of building a well.	A building permit based on a construction project required. Therefore, all works related to drilling (a borehole) of a deep well can be launched on the basis of the final building permit. <i>Authority issuing the permit: Starost Office.</i>	

When considering the suitability of the source of water intake for irrigation, it should be assessed whether it will ensure a sufficient unit supply of water to the pump set and thus enable its continuity during the supply of water for cultivation. For surface water boreholes with relatively large water resources,

sprinklers are most often utilized, whereas if the water source is very small, it is possible to use micro irrigation, of which micro-sprinklers and sprinkling ducts are most beneficial. They require smaller unit inflows than sprinklers due to the application of smaller, but more frequently administered sprinkling units. The advantages and disadvantages of using surface and underground boreholes are presented in Table 3.

Table 3. The advantages and disadvantages of the use of groundwater and surface water for irrigation

Advantages	Disadvantages
Groundwater	
1. In the absence of access to surface water, this is the only source of water virtually always available.	1. Limited availability of disposable resources.
2. Rather constant quality and quantity of water during the hydrological year.	2. Cold water sprinkling – exposure of plants to thermal shock
3. Water quality better than for surface water.	3. In boreholes, operating periodically, only 4-5 months in a year, the well filters are quickly overgrown, which shortens their operating lifetime.
4. Low threat to water quality.	4. Dissolved iron, calcium and manganese compounds, usually found in large quantities in groundwater, may precipitate in wires or emitters when in contact with air
	5. The operation of the well will require power supply.
Surface water	
1. Possibility of collecting large amounts of water using fairly simple technical solutions.	1. Variable amount of water during the hydrological year.
2. Lower costs of water intake and construction of a possible borehole.	2. High variability of such qualitative features as temperature, turbidity, suspension as well as large quantitative variations.
3. Sprinkling with (warmer) standing water.	3. Potential or real threat to water quality higher than in the case of groundwater.
4. Lack of iron and manganese compounds causing precipitation of suspensions in wires or emitters.	4. Reservoirs of stagnant water might be overgrown.

In the absence of sources of water for irrigation in the form of natural or artificial watercourses in the vicinity of farmlands, it is possible to assess the possi-

bility of storing surface water in retention reservoirs, as long as terrain conditions permit. For this purpose, natural depressions, adequately deepened and sealed, where surface water from melting snow and heavy summer precipitation gathers, are employed. The amount of water stored in such reservoirs should correspond to the demand for water throughout the entire irrigation period (Praca zbiorowa Dyrekcji Generalnej Lasów Państwowych [Collective work of the General Directorate of State Forests] 2002). The reservoirs can be of different construction: concrete, earth sealed with foil, clay, geomembranes, such as: HDPE foil, bituminous linings or rubber membranes. If artificial sealing of reservoirs is needed in case of plastic soils suitable for chemical stabilization, the reservoirs can be sealed using polymers added to the topsoil and mechanically cured. Another, more expensive constructional solution of the reservoir may be its construction made of acid-resistant sheet. Water is usually supplied to the reservoirs from surface or underground boreholes. The sets of devices used here are the same as in the case of direct water intake for the irrigation omitting the reservoir. This is done by constructing a pumping station or employing a pump set consisting of pumps and control cabinets. Pump aggregates or motor pumps powered by a car engine are used for water supply, for example, from a river or from drainage ditches, to an open reservoir. The advantage of such a solution is sprinkling with heated and oxygenated water from the reservoir, while higher costs and the need to use a separate pump set for the sprinkler system are the downside. Sample variants of water supply to farmlands are presented in Figure 1.

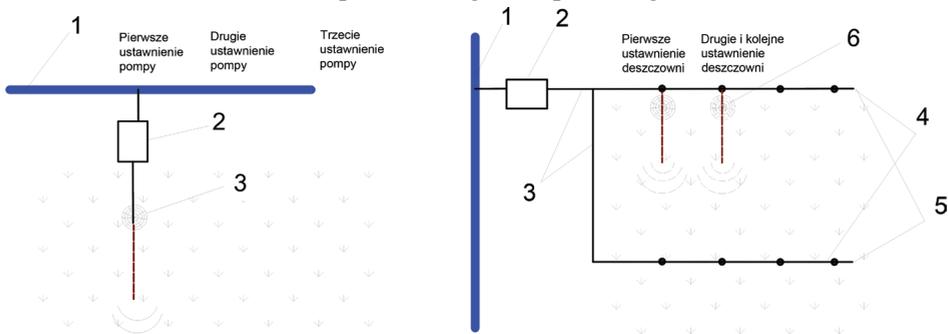
The first setting of a pump

The second setting of a pump

The third setting of a pump

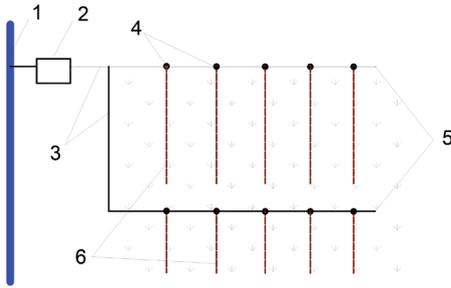
The first setting of a sprinkling machine

The second and subsequent setting of a sprinkling machine

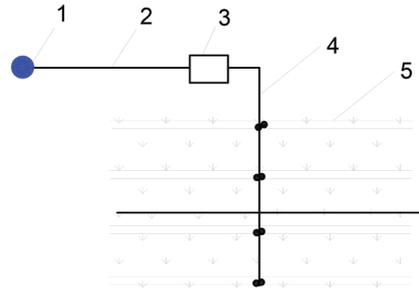


1 – water intake, 2 – motor water pipe, 3 – reel sprinkler

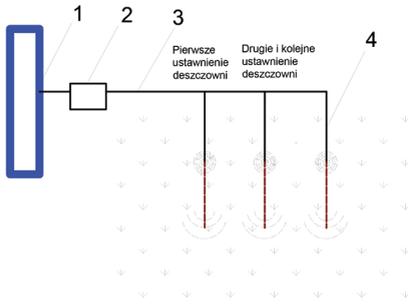
1 – water intake, 2 – motor water pipe, optionally permanent pumping station, 3 –water supply pipelines permanently installed under the surface, 4 – hydrants, 5 –dewatering of pipelines possible for the winter period, 6 – sprinklers



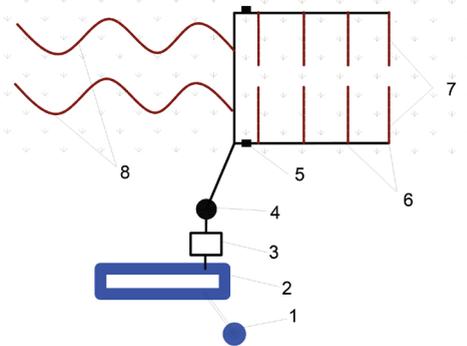
1 – water intake, 2 – pump-room, 3 –water supply pipelines permanently installed under the surface, 4 – hydrants, 5 – dewatering of pipelines possible for the winter period, 6 –irrigation ducts with sprinklers



1 – water intake, 2 – suction pipeline, 3 – motor water pipe, 4 – portable water supply pipeline, 5 – profiled recesses of the area distributing water



1 – reservoir, 2 – motor water pipe, 3 –portable pipeline supplying water to the sprinkling machine, 4 – sprinkling machine



1 – water intake, 2 – reservoir, 3 – pump set, optionally permanent pumping station, 4 – filters and optionally water conditioners, 5 –valve controlling water distribution, 6 – water supply pipelines permanently installed under the surface, 7 – irrigation ducts with sprinklers, 8 – drip irrigation pipes

Figure 1. Examples of water supply solutions for farmlands
(source: author's own elaboration)

FORMAL AND LEGAL CONDITIONS FOR WATER MANAGEMENT

Regardless of the design of the irrigation system, in order to be able to exploit it, its future owner must abide by the provisions of the law in force. The Water Framework Directive is the reference point for all water management activities. The objectives set out in the directive resulted in the necessity

to adapt the tasks of hydrogeology, water management and their protection to new requirements.

As of 1 January 2018, the new Water Law Act (the Act of 20 July 2017. Water Law, Journal of Laws 2017, Item 1566), hereinafter referred to as nPW, is in force. In nPW, irrigation of land or crops with water in excess of 5m³ per day on annual average and use of waters for business purposes is included in the specific use of waters beyond the general use of water and the normal use of water. The new regulations are to fully implement the EU WFD, including Article 9, which mentions the so-called reimbursement of water services fees. Water services include, *inter alia*, groundwater or surface water abstraction (Article 35 (3) of the nPW), for which fees are charged. The Act regulates the maximum rates of fees for water abstraction for agricultural purposes. The fee for water services for water abstraction consists of a fixed fee and a variable fee (Article 270, point 1); however, in the case of water abstraction for agricultural purposes for irrigation of land and cultivation, a fixed fee is not borne (Article 270, point 2). The amount of the fee for water services depends on the amount of water abstracted and the intended use of water, its average low flow from multi-year period (multi-year period includes at least 20 hydrological years) and available groundwater resources (Article 270, point 6). The amount of the variable fee for groundwater or surface water abstraction is determined as the product of the unit rate of the fee and the amount of groundwater or surface water abstracted, expressed in m³ (Article 272, point 1).

An entity using water services that abstracts surface or groundwater (Article 36, point 1 of the nPW) as part of water services is obliged to use measuring instruments that allow measuring the amount of water abstracted. Measuring instruments are to be provided by the State Water Farm of Polish Waters (hereinafter referred to as “Polish Waters”), which was obliged by the provisions of the nPW (Article 36, point 4) to equip entities in question with such devices. The measuring devices can also be purchased by the entities themselves (Article 36, point 5).

Water melioration devices are classified as water devices including: drainage, pipelines, pump stations, used exclusively for agricultural purposes, gravity hydration systems and pressure irrigation systems (Article 197, point 1). These devices are designed to regulate water relations in order to improve the production capacity of the soil and to facilitate its cultivation (Article 195). As of 1 January 2018, the records of land reclamation are conducted by Polish Waters (Article 196, point 14).

A water permit is required for special use of water, including irrigation of land or cultivation with underground water by means of a sprinkling machine. A water permit for special use of water is also a permit to produce the necessary equipment. This is an administrative decision, in which the purpose, scope and conditions of water use as well as obligations necessary to protect the environ-

ment and the interests of the population and the economy are established. Too intensive exploitation of underground waters may cause their total depletion or aggravate water relations on neighboring land. The application for the issuing of a water permit is submitted to the headquarters of the Water Management Station (it is an organizational unit of Polish Waters), which is appropriate to the place or nearest to the intended use of water services or water equipment or other activity requiring water law permit (Article 397 point 6). The application fee amounts to PLN 217. If at least two water law permits are issued in one decision, which are not identical in nature, this fee is multiplied by the number of permits issued in the decision. The permit includes water management instructions, when from the same source (river, lake or underground water), other entities, e.g. industrial plants or water companies, are supplied with water. The water abstraction for irrigation cannot affect the needs of other users and lead to an environmentally harmful lowering of the water level. A water permit becomes legally effective 14 days after its receipt. Water retention in ditches and the hindrance of water drainage from drainage facilities does not require a water-law permit. For the use of water services consisting in the collection of groundwater or surface water without a water permit, an increased fee is charged (Article 280 point 1) in the amount of 500% of variable fee for groundwater or surface water abstraction. The increased fee also applies to the use of water services consisting in the collection of groundwater or surface waters exceeding the conditions set out in the water law permit (Article 280 point 2) in the amount of 10 times the unit variable rate for water services for groundwater or surface waters abstraction.

If the entity obliged to pay fees for water services does not measure the quantity of surface water or groundwater abstracted or the instruments used for measurements has not undergone legal metrological control, it is assumed that the water abstraction conditions specified in the water permit were exceeded in the amount of water collected. In this case, the amount of surface water or groundwater abstracted with the exceedance is determined taking the maximum technical efficiency of the installations or equipment for water abstraction multiplied by the estimated time of their use (Article 282 (5) and (6)). In this case, the increased fee is determined by the competent authority of the Environmental Protection Inspection. Proceedings regarding the increased fee shall not be commenced if the anticipated amount of this fee does not exceed PLN 100. Table 4 presents the differences between the legislation in force and repealed related to the management of water for irrigation purposes.

Table 4. Comparison of obligations for farmers resulting from the repealed and currently applicable provisions of law¹ (authors' own study based on texts of the resolutions as well as Gruszecki (2016) and Piętowska et al. (2017))²

Law in force until the end of 2017	Law in force after 2017
<p>Fees for using the environment in terms of water abstraction and discharge of sewage to waters or to the soil. The entity determined the amount of the due fee on its own and transferred it to the account of the marshal office competent for the place of using the environment (Article 284 para. 1 of the Environmental Protection Act). The fee should have been paid to the bank account of the Marshal's Office if the total fee for water abstraction was above PLN 800.</p>	<p>Fees for water services for using the environment in the field of water abstraction. Groundwater or surface water intake is included in water services. Exemptions from fees (for the use of the environment) for water abstraction, <i>inter alia</i>, for irrigation were liquidated. The amount of the fee for water services depends on the amount of water collected and on whether surface water or groundwater was taken, the purpose of water use, its average low-flow (SNQ) and available groundwater resources, respectively.</p>
<p>The amount of the fee for water abstraction depended on: the type of water collected (surface or underground) and the amount of water taken from a given borehole. The rates of fees applicable in a given accounting year are available on the website of the Marshal's Office.</p>	<p>Fee in the form of variable fee for water groundwater abstraction for irrigation of land and crops purposes, collected using pumping equipment.</p> <p>The introduced fee will apply only to farms that artificially collect water in quantities exceeding 5 m³ per day (on an annual average basis). Water charges do not apply to farmers who only use water supplied by waterworks and who already pay the fee. Farmers who have planned rain water storage, drainage systems and natural land irrigation do not pay for the use of water, if it does not involve artificial irrigation and mechanical water intake. The amount of variable fee for groundwater abstraction is determined as the product of the unit fee and the amount of groundwater collected, expressed in m³. Determining the amount of groundwater collected will be based on the reading of measurement devices or on the basis of data from measurement systems made by an employee of Polish Waters. To determine the amount of groundwater collected, measuring instruments subject to legal metrological control are employed².</p> <p>In the case of regular use of water for the needs of a small farm in quantities not exceeding 5 m³ per day of non-returnable water abstraction, no fees were provided.</p>

Law in force until the end of 2017	Law in force after 2017
<p>The farmer himself calculated the water abstraction fee on the basis of the data collected by him, for example: the volume of water intake, the quantity and quality of discharged sewage, and then without any notice, he transferred the fee to the account of the competent Marshal's Office</p> <p>An administrative fine was imposed for exceeding or violating the conditions of using the environment outlined in the water law permit. For water intake without the required permit, a fee increased by 500% in relation to a basic fee (the basic fee had to be multiplied by 6). Fees and fines for using the environment were the main revenue item of the National Fund for Environmental Protection and Water Management and voivodships funds for environmental protection and water management. They are also income for the budgets of communes and poviats.</p> <p>The water permit was issued by means of an administrative decision by the Marshal or Poviate Governor on the application of the person interested in using water or water devices for a definite period (20, 10, 4, 5 years). The water permit was not required, <i>inter alia</i>, for the consumption of surface or underground water in an amount not exceeding 5 m³ per day</p>	<p>Entities will no longer themselves be calculating fees resulting from the Water Law. This obligation was adopted by the new legal entity created on 1 January 2018 by the State Water Farm of Polish Waters. After determining the amount of fees, Polish Waters will transfer them to entities in the form of information along with the method of calculating the fee.</p> <p>Increased fees are charged in the absence of the required permit, but also in the event of exceeding the conditions set out in the permit. The user of water services shall pay a higher fee in the case of groundwater intake without the required water law permit or integrated permit or exceeding the conditions specified in the water permit or integrated permit. The amount of the increased fee is 5 times the variable fee in the case of using water services and no obtaining of permits, and 10 times the variable fee in relation to exceeding the conditions specified in the permits. The increased fee is paid regardless of the variable fee for water services. When establishing the amount of the increased fee, the quarterly settlement period is taken into account. The amount of the increased fee is determined by Polish Waters and passed on to obliged entities to pay the increased fees in the form of information.</p> <p>As of 1 January 2018, issuing water permits, accepting water-legal applications, carrying out water-legal assessments and issuing decisions is the competence of the State Water Holding – Polish Waters. The water permit is not required, <i>inter alia</i>, for the consumption of surface or underground water in an amount not exceeding 5 m³ per day.</p>
<p>¹ The analysis referred to the provisions of the Environmental Protection Law (Journal of Laws 2001 No. 62 item 627 and Journal of Laws 2001 No. 62 item 627 as amended) and Water Law (Journal of Laws 2001 No. 115 item 1229 and Journal of Laws 2017, item 1566</p> <p>² The requirement to use measuring devices to measure the water taken in will be in force since 31 December, 2020, until then Polish Waters (Wody Polskie) will provide the entities obliged to pay fees for water services with the aforementioned devices.</p>	

CONCLUSIONS

There are several options for water intake for irrigation e.g. from wells, watercourses, lakes, ponds or retention reservoirs. Their selection will be conditioned by the size and shape of the area, distance to the field, type of crop, type of soil and access to electricity. Each of these factors should every time be taken into account to ensure the efficiency of the intake at a level so that the irrigation system meets the water needs of plants.

From the point of view of the farmer's interests, it is necessary to know the provisions introduced in the new legal conditions which are related to financial changes and administrative obligations related to the water intake for irrigation of arable land. Only if the aforementioned law is obeyed, can the tasks be performed in accordance with the law and a farmstead is not exposed to financial losses that could result from the possible payment of increased fees for not having a valid water permit or for exceeding the conditions specified in the permit.

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