SUWANU
EUROPE

State of play analyses for Plovdiv-Bulgaria

Contents

Socio-economic characterization of the region

General

Bulgaria is divided into 6 planning regions (NUTS 2), 28 administrative regions (NUTS 3) and 264 municipalities (LAU 1). The agricultural sector is the main sectors in the country, where around 73 % of the total arable land is privately owned, 22 % is owned by municipalities and 5 % is state property (RDP, 2007). Plovdiv administrative region is chosen from South-Central planning region as a study region. The study region has a well-developed and constantly improving infrastructure: highways, railway stations and international airport.

Plovdiv region is characterized with very well-established irrigation system, but old and plundered infrastructure. The natural conditions (soil quality, weather, access to water resources, etc.) are very good for the cultivation of a wide variety of crops, orchards, vineyards and vegetables. Large percentage of farmland in the study region has ecologically clean and fertile soils. Most of the farmers are cultivated different types of intensive crops and actively participate in direct payments and in the rural development measures. They have easy access to resources from ground water and rely on their own water extraction.

The State supports producers who apply the national ecological and agricultural standards. There are many foreign investments, which are buying agricultural products for food and beverage processing. They are one of the key players for supporting farmers. In the region, there is established a new industrial zone, tech parks and logistics centres, which will provide a place where farmers might sell their agricultural products.

Location

The Plovdiv region is located in the central part of South Bulgaria covering 5,977.5 km^2, which is about 5.4 % of the whole country (Fig. 1). The region comprises of 224 settlements: there are 17 towns composing the largest part of the region and the city of Plovdiv that is the second most populated city in the country. Plovdiv region is part of the South-Central Planning Region (corresponding to NUTS 2 level) within the Region of Southwestern and Southern Central Bulgaria (NUTS 1).

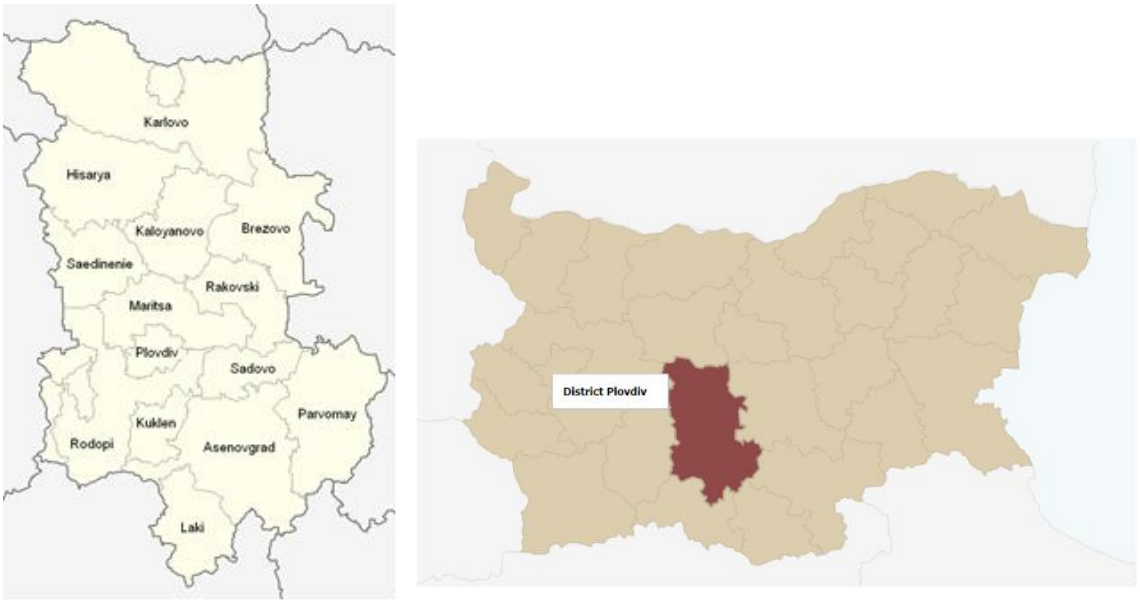


Figure 1. Location (left) and municipalities (right) in Plovdiv district.

The Southern-Central Region (SCR) for planning also includes the districts of Kardzhali, Pazardzhik, Smolyan and Haskovo. It covers 20.1 % of the territory and 20.08 % of the population of Bulgaria.

Plovdiv is the largest city in the SCR. It focuses on the main activities and sites in the areas of economy, health, education and science, culture, transport and communications in the area. Plovdiv is an educational, cultural, business and trade centre with a significance exceeding the level of the region. The International Fair with its spring and autumn exhibitions and dozens of specialized exhibitions make it an international business and economic centre of business. The agricultural areas occupy 57.8 % of the region, while the forest areas are 31.2 %.

Climate

The climate is transitionally continental, and the upland areas have a mountainous climate. Plovdiv region covers the western part of the Thracian lowland. The terrain is flat and predominantly determines accumulation processes, but erosion processes are very poorly expressed. The territory of this an agri-environmental area falls into the West part of the climatic region of Central Bulgaria, characterized by relatively mild winter and hot summer. The average annual temperature is around 12 °C, which varies from 1.70 °C in January to 22.5 °C in July. The vegetation period faced a very good thermal safety – temperature amount is about 3,800 °C, providing development of heat-loving crops such as rice, peanuts and others. The area has too low humidity. There is 550-570 mm of precipitation annually with significant evapotranspiration. The deficit in the balance of atmospheric humidity for the vegetation period is about – 400 mm (Sapundzhiev & Mitreva, 2016).

Geography

The northern part of the district is mainly flat with developed intensive agriculture. Southern part is mountainous with livestock farming, timber industry and tourism. Plovdiv region is famous for its natural and historical sights, resorts and spa centres such as the picturesque Valley of Roses, the Spa in Hisar, Narechen, Assen medieval fortress, Bachkovski monastery, Arapovo Monastery, tomb Starossel and others. The district covers the central part of Southern Bulgaria. On the North the district includes the southern slopes of the Balkan Mountains and the central part of the lower ridge of the Mountains. On the South, Plovdiv region includes the Rhodope Mountains' borders. Plovdiv is the centre of the South-Central region named the same way, which includes Plovdiv, Pazardzhik, Smolyan, Haskovo and Kardzhali.

Population

At the end of 2016, the population of the district was 671,573, or 9.4 % of the total population of the country. The administrative province of Plovdiv is the second region in Bulgaria in terms of population. The density is about 122 inhabitants per square kilometre (Fig 2) which is 70 % higher than the national average. 72.6 % of the inhabitants live in the towns and 27.4 % live in the villages (Statistical yearbook, 2017).

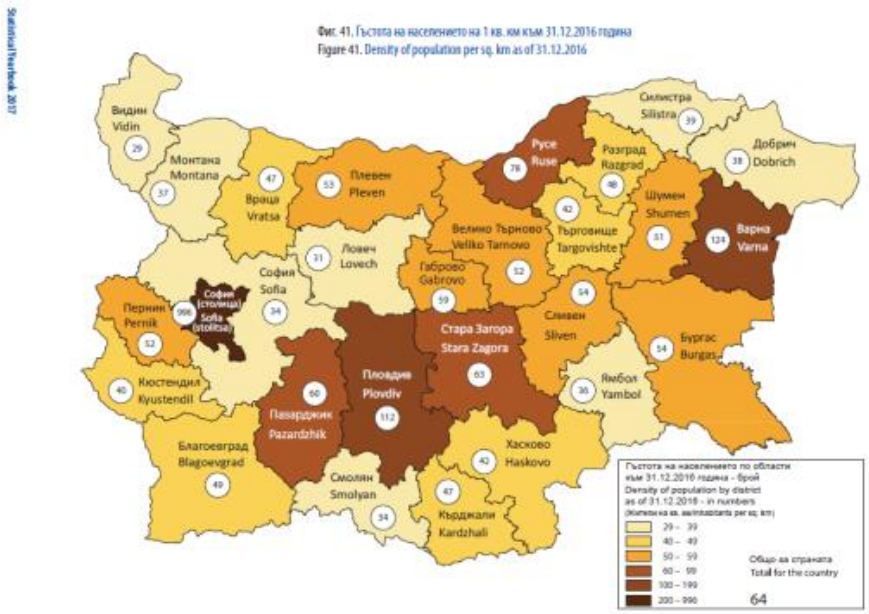


Figure 2. Population density of Bulgaria in the end of 2016.

Economic data

The Gross domestic product of Plovdiv district in 2016 was 7,546 mln. BGN (Table 1), while per capita it is calculated to 11,222 BGN (Statistical yearbook, 2017).

Table 1. Gross value added at current prices – 2016 by economic sectors (Million BGN)

Sector	***Agriculture and forestry***	***Industry***	***Services***	***Gross value added***
GVA	259	2,112	3,540	6,511

Urban structure

The biggest city of the region is Plovdiv. It is characterized by high- and middle-high buildings. Some neighbourhoods are of a rural type – family houses with a yard. There are many parks, as well as the pearls of the town – the hills that attract a lot of people with their vegetation, atmosphere and protected flora and fauna. Other towns with important population density in the region are Assenovgrad and Karlovo. The structure is similar to the Plovdiv', but the buildings are of medium and size. On the other hand, the rural settlements are characterized by existence of family houses.

Agriculture

The agricultural sector contributes to 6 % of the country's GVA and 18.5 % of the total employment. Certain traditional agricultural sectors (such as fruit growing and vegetables, and livestock) are underperforming and experiencing structural difficulties (Fig. 3). In addition to the need for technological modernization, there is a necessity to promote short supply chains, restructuring of small farms, and generation renewal in agriculture in order to ensure stronger productivity growth and the creation of new jobs.

In terms of the expected changes in rainfall patterns, a reduction in precipitation is likely, leading to a significant reduction of the total water reserves in the country. In this regard, projections

suggest a decrease in precipitation by approximately 10 percent by 2020, 15 percent by 2050, and up to 30–40 percent by 2080 (Fig. 4).

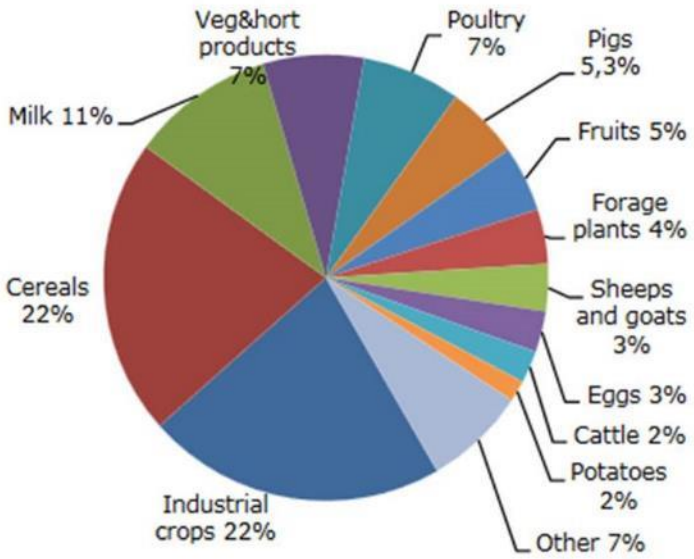
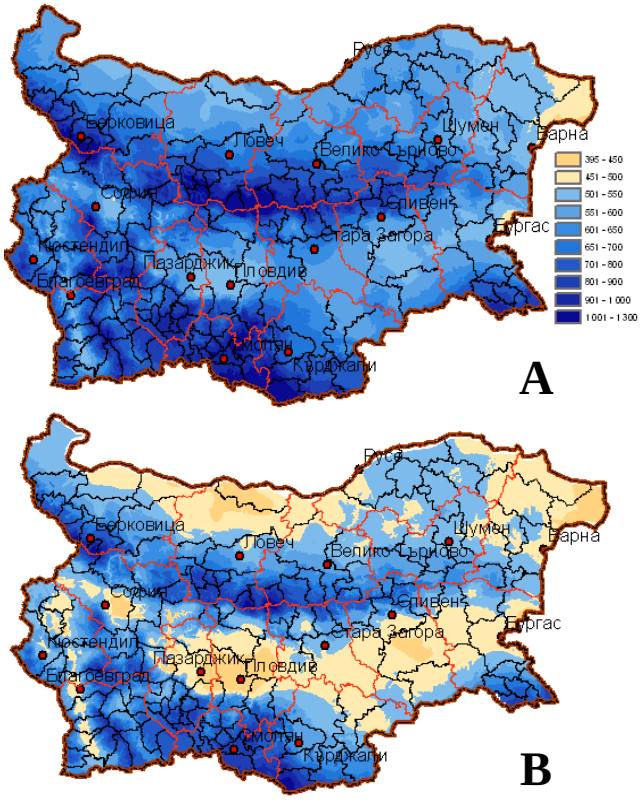


Figure 3. Structure of Bulgarian agriculture in last years.

In most climate change scenarios, rainfall during the winter months is likely to increase by the end of the century, but significant decrease in rainfall during the summer months is expected to offset this increase (Advisory services, 2018).



Source: NIMH-BAS.

Figure 4. Precipitation per year for 1961–1990 (A); Precipitation per year for 2080, according to the pessimistic scenario (B)

The structure of agricultural farms concerning the irrigation type is presented in Tables 2-4 (Public census, 2011).

Table 2. Holdings and irrigable area by type of irrigation in Plovdiv region (Agri-environmental activities, 2018).

Total irrigated area		**Sprinkler equipment**		**Drip irrigation**		**Surface irrigation**		**Other equipment**	
Holdings (number)	Area (ha)	Holdings (number)	Area (ha)	Holdings (number)	Area (ha)	Holdings (number)	Area (ha)	Holdings (number)	Area (ha)
17,557	54,785.16	435	2,419.11	1,524	3,478.82	15,277	48,345.4	930	541.79

Table 3. Holdings by type of water source used for irrigation in Plovdiv region, 2010 (Agri-environmental activities).

Total (number)	**Type of irrigation sources**				
	Ground water	On-farm surface water	Off-farm natural water sources	Off-farm water from water supply networks	Other sources
18,258	10,634	108	1,481	6 020	15

Table 4. Irrigated area and volume of water used for irrigation in Plovdiv region.

Irrigated area (kitchen gardens and area under protective cover excl.)			Kitchen gardens and area under protective and glass cover			Total volume of water used for irrigation	
Holdings (number)	Area(ha)	Volume of water used for irrigation (hm^3)	Holdings (number)	Area(ha)	Volume of water used for irrigation(hm^3)	Holdings (number)	Volume of water used for irrigation(hm^3)
13,856	31,199	174.44	16,444	949,47	2.24	23,480	176.68

Twenty percent of farms in the area are raising cattle, 11 % sheep, 23 % pigs and 41 % poultry. Goats, rabbits and bee colonies are mainly grown on the holdings of individuals, as well as 93 % of the sheep. Seventy-five percent of cattle, buffalo and pigs are grown on the holdings of individuals, while 2/3 of the total number of birds are kept on holdings of legal entities, according data for 2013 (Table 5, Strategy Plovdiv, 2013).

Table 5. Number of animals breaded in Plovdiv district.

Animal species	**Number**	**Number of holdings**
Cattle	61,417	6,232
Buffaloes	1,035	102
Goats	19,503	4,726
Sheep	91,721	3,350
Pigs	19,647	6,966
Birds	975,472	12,404
Rabbits	16,546	1,393
Bee families	20,822	987

An Assessment of the Agriculture Sector, elaborated by Advisory Services on a National Climate Change Adaptation Strategy and Action Plan, august 17, concluded: The number of farms and farm sizes on a national level correlate with the type of production and irrigation intensity depending on the River Basin Directorate. The highest share of irrigated land is with the farms that manage less than 2 hectares (the average size of irrigated land is between 0.1–0.2 hectare per farm), that specialize on vegetable growing and are predominantly situated in the East-Aegean region (where 40 percent of Bulgaria's farms manage 27 percent of the UAA) and West Aegean region (endowed with the two main rivers, Struma and Mesta, thus showing the highest share of irrigated area: 10 percent). The Danube River Basin region encompasses nearly one-third of Bulgaria's farms (32 percent) that manage more than half of the agricultural land (53 percent). The predominant large farms in this region specialize in cereals and oil seeds and irrigation plays a marginal role (0.7 percent). The number of large agricultural enterprises has been constant during the previous decade and there is a growing tendency toward crop specialization, predominantly cereals and oilseeds. This in turn has accelerated the consolidation of farmland and growth of commercial companies.

Hydrological data

The water resources within the territory of Republic of Bulgaria are exclusive state property and their management is carried out at national and basin level regulated by the Water Act and many other national regulations, fully harmonized with EU directives. The Ministry of Environment and Waters (MOEW) is the responsible authority for the quality of the water resources at national level, while the four River Basin Directorates are engaged with river basin level. Plovdiv region falls within the boundaries of the East Aegean basin district with the centre of Plovdiv.

Compared to other European countries, Bulgaria has relatively significant freshwater resources, both in absolute terms as well as on per capita basis (MoEW and EEA 2016). However, the water resources are unevenly distributed throughout the country and by season. At river basin district level, it becomes apparent that the renewable water resources are unevenly distributed (Table 6). Two-thirds of surface water resources are generated in the East Aegean and Danube River Basin District, with 36 percent being generated in the East Aegean and some 33 percent in the Danube River Basin District. With nearly 19 percent, a significant portion of total runoff is generated in the West Aegean River Basin District, while the Black Sea rivers contribute just slightly over 10 percent.

Table 6. Renewable freshwater resources of Bulgaria by river basin, average runoff 1981-2015 (hm^3/year)

	Bulgaria	River Basin			
		Danube	Black Sea	East Aegean	West Aegean
Internal runoff	16.175	5.473	1.710	5.943	3.049
Actual external inflow	85.148	84.785	-	-	363
Total renewable fresh resources	101.323	90.258	1.710	5.943	3.412
Groundwater available for annual abstraction	4.793	2.399	423	1.731	240

Source: National Statistical Institute – Environment 2015.

The main drainage artery for the Plovdiv region is the Maritsa River and its tributaries. The Maritsa River is the largest river on the Balkan Peninsula. Its catchment area is located at the border of the Republic of Bulgaria and Greece and covers 21,992 km^2. Through the catchment of the river Maritsa, the waters of the area flow to the Aegean Sea. Maritsa has about 100 more significant floods, which are symmetrically situated to it. Of these, the largest water catchment area (1,395 km^2) and length (110.1 km) in the territory of the Plovdiv region is the mountain tributary Stryama. Other bigger medieval tributaries of Maritsa on the territory of the region are the Pyasachnik and Rahmanliyska rivers, and the Rhodope rivers are Vacha, Chepelarska (Asenica), Mechka and Kayalica. The influence of the Rhodope tributaries is more strongly influenced by the characteristics of the Maritsa outflow in the area.

The summer's low water pressure implies irrigation in the agricultural land. The average annual water withdrawals in the Maritsa basin are 6-7 l /s/km^2, and 8-11 l / sec / km^2 for the streams Stryama, Vacha and Chepelare. The water resources of the Maritsa River are used for electricity production (the Belmeken-Sestrimo-Chaira cascade), for irrigation of significant areas in the Upper Thracian Plain, for drinking and for industrial purposes. The so-called groundwater, which is concentrated in the flooded terraces and cone, is characteristic of its valley.

Maritsa River is of great importance for the South East Balkan economy – agriculture, industry, energetics and other human activities. In the last few years, 15.4 % (1,201.8 hm^3/y) of the total

amount of river water (about 7,786.2 hm^3/y) has been used for irrigation purposes (Report, 2015). The river is strongly impacted by anthropogenic activities as it passes through plenty of settlements, along industrial sites, farms and areas with intensive agriculture that discharge their wastewater into the river creating preconditions for deterioration of the water quality (Fig. 5) (National report, 2015).

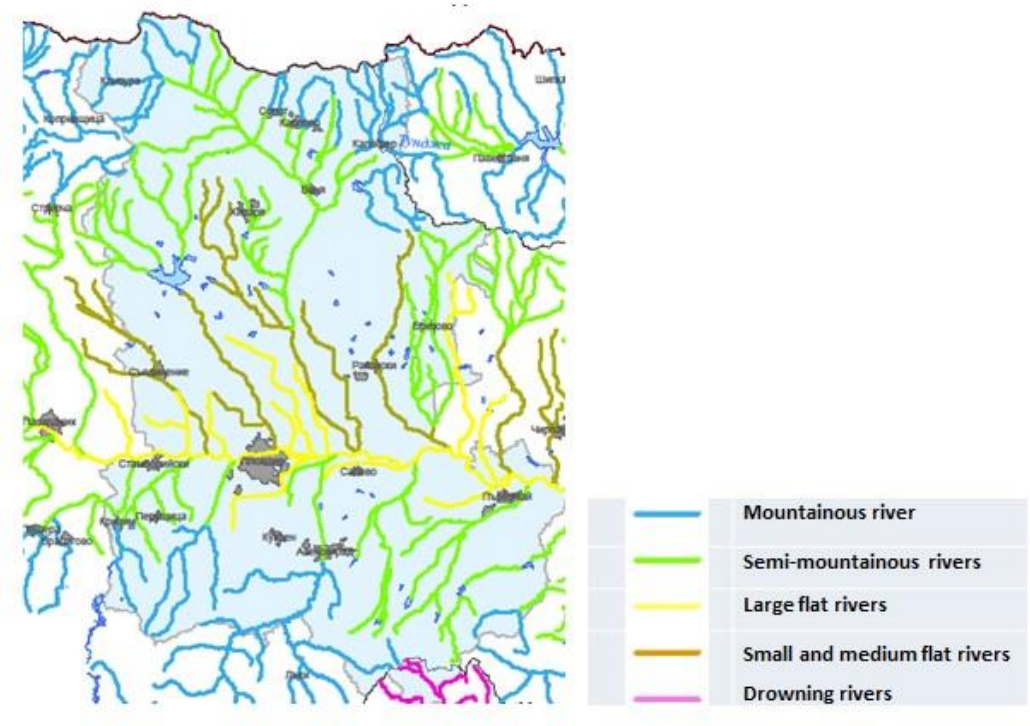


Figure 5. Categories of rivers in Plovdiv district according the Water framework directive.

Regarding the quality of the water resources, only nearly a third of surface water bodies meets the objective of a "good ecological" water status (River Basin Management Plans [RBMPs] 2016-2021, NIMH). The Black Sea River Basin has the lowest rate – 5 percent (Table 7).

Table 7. "Good status" objectives met for surface water bodies.

Surface Water Bodies/River Basin	West Aegean	East Aegean	Danube	Black Sea	At the national level
Overall	183	**311**	256	205	955
With achieved objectives (number)	60	**123**	104	10	297
With achieved objectives (percentage)	33	**40**	41	5	31

Source: RBMPs 2016-2021.

In all river basins the most common causes for failure to achieve a good ecological status are increased nitrogen and phosphorus concentrations, and high eutrophication of water. Discharge of untreated or insufficiently treated municipal wastewater, discharge of insufficiently treated industrial wastewater, and farming activities are the common reasons of surface water body pollution. There are some specific pollutants for each river basin, which is the reason for not achieving a good chemical status (Table 8).

***Table 8**. Specific pollutants with concentrations above the limits*

Surface Water Bodies/ River Basin	West Aegean	East Aegean	Danube	Black Sea
Pollutants	Cadmium, nickel and lead	Cadmium, lead, nickel and mercury	Nickel, cadmium trichloromethane	Mercury

Source: RBMPs 2016–2021

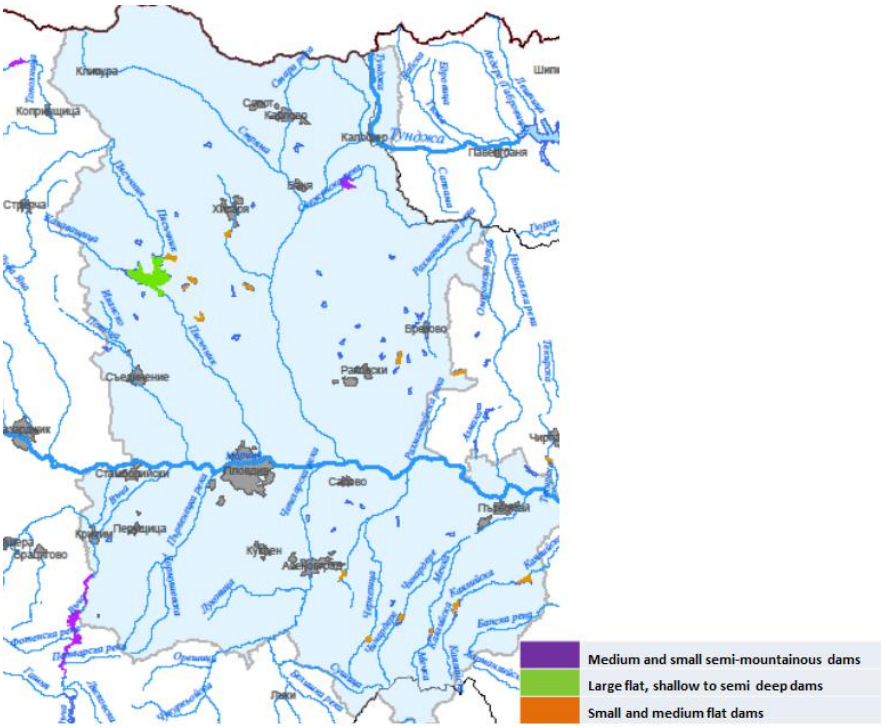


Figure 6. Categories of lakes (dams) in Plovdiv district according to the Water framework directive.

Groundwater bodies have a better quality regarding good status objectives. At the national level 63 percent (106 over 169) meet the objective of 'good status' (described in Article 4 of the WFD and in Section 5 of the RBMPs). In the East Aegean River Basin, 18 groundwater bodies were classified as having poor chemical status due to higher concentrations of the following indicators: nitrates, ammonium ions, chlorides, sulphates, manganese, iron, calcium, sodium, magnesium, water hardness (general), permanganate oxidation, and phosphates (Table 9).

Table 9. "Good status" objectives met for groundwater bodies.

Groundwater Bodies/River Basin	West Aegean	East Aegean	Danube	Black Sea	At the national level
Overall	38	**41**	50	40	169
With achieved objectives (number)	32	**23**	28	23	106
With achieved objectives (percentage)	84	**56**	56	58	63

Hydrology

What are the other water resources on the territory?

The main state-driven mechanism through which water reaches the end-users (farmers) is through the company" Irrigation systems" Ltd. Many of the small farmers satisfy their needs of water supply on their own. The quantity of the consumed water from other water suppliers and the reclaimed water is exceptionally small and insignificant for the water use in the East Aegean River Basin Directorate (EAR BD). The hydromeliorative map of Plovdiv district is shown in Figure 7.

According to an analysis of projected water demand, Bulgaria is *not a water-stressed country.* Over 60 rivers flow through Bulgaria. The country is divided into 4 catchments regions: The Danube, Black Sea, Eastern Aegean, and Western Aegean. Annual river runoff is expected to decrease up to 14 % in the next 50 years and to be 20 % less at the end of the century due to current climate trends. An analysis of the projected domestic water consumption and internal water resource base suggests that Bulgaria is not a water-stressed country. Since 1990, abstractions for both agricultural and industrial purposes have fallen drastically, contributing to its overall low water stress. Yet, there are areas of Bulgaria that experience water scarcity and seasonal water scarcity in dry summers (Danube water program, 2015).

Bulgaria has a significant stock of hydraulic storage capacity, including 216 large dams (Fig. 6). The total storage capacity of 53 multi-purpose and significant dams amounts to 6,697.8 hm^3. Twenty-three dams are in the East Aegean region, representing a total storage volume of 3,105.5 million m^3. The main purpose of reservoirs is to store water for irrigation, electricity generation, drinking and industrial water supply including cooling, transport, fish farming, and recreation. The dams have an important function in river flow regulation. There are also many smaller dams, not listed in Annex No. 1 to Article 13, of the Water Act (Table 10). The dams are state or municipal property.

Table 10. Smaller dams, not listed in Annex No. 1 to Article 13, of the Water Act.

RBD	Number	Storage Volume (million m^3)
Danube RBD	724	444
Black Sea RBD	513	424
East Aegean RBD	1,068	523
West Aegean RBD	431	46

Source: The National Strategy for Management and Development of the Water Sector in Bulgaria 2012.

The subsector in numbers is presented below (Water Sector Strategy, Hydro-melioration Sector Strategy (Strategy Plovdiv, 2013), Irrigation Systems Company):

- Dams: The following state dams are part of the Irrigation systems:
  - 22 multi-purpose dams under Article 13, p. 1 of the Water Act
  - 146 irrigation dams
  - Total storage capacity of 3.1 hm^3 of water
- 168 irrigation pumping stations
- 6,435 km of open canals and 9,269 km pipe networks for irrigation
- The total length of drainage canals is 2,334 km; the total length of field drains amounts to 11,192 km
- Dykes with a total length of 487 km, 253 km of which are along the Danube river
- River corrections of 3,157 km

What is the hydrological context? (Water quality and Quantity)

A paper in the Fresenius Environmental Bulletin aimed to monitor the water quality of upper-middle course of Maritsa River using physicochemical and microbiological parameters and assess its suitability and applicability for irrigation (Kostadinova et al., 2012), in accordance with Bulgarian standard. In June and August 2014, Maritsa River water quality in upper (MP-1) and middle (MP-2) course of the river, assessed by 31 parameters, meets the requirements of Bulgarian standard with respect to 24 physicochemical parameters: T, oC, pH, EC, TH, Ca, Mg, DO, N-NH4 (except for June), N-NO3, SO4 2-, PPO4 (except for August), Cl-, COD, BOD5, SS (except for June), Mn, Fe, Cu, Zn, Pb, Ni, Cd, Cr and As. Deviations from the norms were established for all sanitary-indicator microorganisms (total coli titer, *E. coli* titer, *Salmonella* spp. and *Enterobacteriaceae*). The metal concentrations decrease in the order of Fe>Zn>Ni>Pb>Cr>Cu> As>Mn>Cd. Generally, the Maritsa water quality did not meet the requirements for irrigation of crops, which was confirmed by the PCA (Regulation No. 18, 2009).

At national level, about 90 percent of abstracted water comes from surface water bodies (Table 11). In the period 2007–2015 there was a steady reduction in the volumes of abstracted water. The volumes abstracted from surface water bodies declined more rapidly compared to those from groundwater. This trend is, however, mainly due to the decline of the population, set back in the industry, and destruction of irrigation systems, and not so much due to an increase in water-use efficiency. The observed minimum in 2014 is due to smaller volumes used for irrigation because of higher precipitation.

Table 11. Abstracted water by water sources (hm^3)

Abstracted water	2007	2008	2009	2010	2011	2012	2013	2014	2015
Surface water	5,560.02	5,809.64	5,536.46	5,403.39	5,840.35	5,149.44	4,910.18	4,828.72	5,070.75
Surface water including dams	2,434.73	2,370.30	2,356.80	2,253.24	2,544.49	2,289.54	2,349.21	2,164.48	2,423.17
Groundwater	641.77	615.75	584.27	556.70	544.74	565.61	558.04	546.84	558.35
Return water	1.86	29.58	5.57	9.10	30.36	20.49	9.11	16.40	1.25
Total abstracted fresh water	6,201.78	6,425.39	6,120.73	5,960.09	6,385.10	5,715.05	5,468.22	5,375.56	5,629.11

Generally, the data for Bulgaria show that there is low water stress. The projected total domestic water consumption of 3,340 million cubic meters in 2035 (excluding hydro energy and nuclear power plants) is much less than the multi-year average internal water resource of 18,547 million cubic meters (excluding the Danube River) for the period 1974–2008. Prior to 1990, Bulgaria was considered to be close to the threshold of a water-scarce country. Since then, abstractions have fallen drastically for both agricultural and industrial purposes, and today Bulgaria overall is non-stressed. Nonetheless, there are areas of Bulgaria that experience water scarcity, particularly seasonal water scarcity in dry summers. The most vulnerable areas with rainfall below 300 millimetres are: Vidin to Lom and Montana, Pavlikeni, and Sofia in the Danube region; Shabla and Varna in the Black Sea region; Sliven, Plovdiv, Sadovo, Pazardzhik, and Panagyurishte in the East Aegean Sea region; and Blagoevgrad, Sandanski, and Kyustendil in the West Aegean Sea region.

Monitoring of the water quality used for irrigation

The monitoring is carried out at the beginning of the irrigation season, according to the requirements of the Water Act, Ordinance No. 5 of 2007 on water monitoring and Ordinance 18. In cases where the values of the monitoring indicators for the transitional year do not exceed the limit values and no reason has occurred during the current year caused them to increase, the monitoring shall be carried out according to the indicators in short list of 22 parameters (Ordinance 18, Annex 2).

The monitoring points are defined as follows:

1. at the outlet of the water abstraction facilities - for surface and underground waters;
2. at the outlet of the wastewater treatment plants, respectively their waste collectors - for wastewater;
3. the mains channels at the point of diverting waters along the main distribution channels - case of danger of changing the water quality of water supply to the irrigation fields.

The frequency of monitoring is as follows:

1. at least once per irrigation season - for surface and sewage;
2. at least once every three years - for groundwater.

Owners or users that operate irrigation systems and facilities or supply irrigation water in order to ensure the provision to water users with irrigation water of a quality corresponding to the requirements of this regulation are obligated to carry out observations to detect adverse changes of the quality of water during the irrigation season on the organoleptic and physical properties of water such as specific odor, turbidity, sludge, gas release and others. When temporary irrigation is been carried out with water which does not meet the limit values indicators set in Regulation 18 -Annex 1 in exceptional cases (temporary deviation shall be admissible in case of drought, crisis and / or disaster within the meaning of the Disaster Protection Act.), the holders of permits for water abstraction carry out additional monitoring of irrigation water for the time until the recovery the quality of the irrigation water according to the requirements of Annex 1 is accomplished.

What are the other levers to face water scarcity (complementary or competition with water reuse)?

Compared to other regions in Bulgaria, Plovdiv is distinguished by its relatively large quantities of water resources both as an absolute volume and per capita. Generally, the country has one of the highest water abstractions per capita and relies mainly on surface water sources due to the big volumes of water used for cooling in the energy production.

Regulatory and institutional framework

Bulgaria's legislation is synchronized with EU policies. Several ministries take part in the water and wastewater sector management. Ministry of Regional Development and Public Works[1] is responsible for the implementation of state policy on spatial planning, coordinates the activities of central and local executive authorities, local authorities and local administration; further it is principal of WSS (water supply and sanitation) operators/companies with a state participation in the capital[1]. Ministry of Environment and Waters[2] is responsible for the integrated water

[1] *Ministry of development and public works (http://www.mrrb.government.bg/)*
[2] *Ministry of environment and waters (http://www.moew.government.bg/)*

management in the public interest – water quantities, permits for water abstraction and discharge, activity of waste-water treatment plants (sludge disposal)[2]. Ministry of Health[3] is in charge of the protection of public health[3]. Bulgarian Water Association[4] is a non-government organization, which members are the regional operators of WSS[4]. They have important and principal role in wastewater treatment and reclaimed water production.

Legal and institutional framework

The current legal framework in the water sector consists of Law on the Waters and Law on the Regulation WSS Services. Provision of water supply and sewerage services in Bulgaria is natural monopoly, subject of regulation by 4 state institutions - the Ministry of Regional Development and Public Works, the Ministry of Environment and Waters, Ministry of Health and the State Energy and Water Regulatory Commission (EWRC/State Regulator). The Council of Ministers has general competence on policy and strategy adoption. EWRC is responsible for approving the business plans of WSS-operators and the WSS services prices; performing off- and on-site inspections over the activity of WSS-operators and out court ruling on consumers complains against WSS-operator.

Currently there are 64 WSS operators, which cover 100 % of the market. All of them are subject of regulation and tariff approval by the Regulator – **Energy and Water Regulatory Commission (EWRC)** is a national regulatory agency and according to its statutes, exercises regulatory functions over 4 sectors: electricity, central heating, natural gas and WSS services.

Bulgaria joined the EU in the beginning of 2007. The national legislation corresponds to the Acquis Communautaire. The country started reform in the WSS sector with amendments of the Law on Waters in 2009 and the main characteristics of this reform include:

- Change in ownership of water infrastructure (public state and public municipal property);
- Change in the management of water systems and facilities: WSS Associations are created where the ownership of water assets belongs to more than one municipality; associations manage assets on behalf of owners and choose water operator;
- Water companies are converted from owners of assets to operators using the assets under contract conditions;
- WSS Associations should establish long-term contract with an operator for the provision of WSS services at the specified territory; they approved a regional master plan for WSS and ensure its implementation by the business plan of the WSS operator;

Regulator regulates WSS-operators based on their contracts with WSS associations and ensures implementation and sustainability of the water supply services.

Legal framework

Bulgaria doesn't have a single legislative act to settle the sector of hydro-meliorations. From a lawful point of view, the sector of hydro-meliorations is an inseparable part of the whole water sector which is additionally settled in some of the legislative and sub legislative normative acts. The basic legal regulation includes the Water Act from 2003 and the Irrigation Associations Act from 2001 together with their most resent amendments.

[3] *Ministry of health (http://www.mh.government.bg/)*
[4] *Bulgariaan water association (http://www.bwa-bg.com)*

The main legislative and sub-legislative normative regulation active at the moment in the hydro-meliorations area in Bulgaria incorporates the following documents:

- WATER ACT (prom. SG. 67/27.07.1999). It settles the principles of ownership of the infrastructure for irrigation and regime of receiving permission for water abstraction. Water metering for permitted abstractions is obliged in Bulgaria. The duration of permits or authorisations in Bulgaria is for no more than 5 years from surface water source. In 2000 a charge on water abstraction was adopted with the regulatory document "Tariff of fees for the right to use water and / or authorized use of water bodies" and it was amended in 2012 with the title "Tariff of fees for water abstraction, water use and those that are subject to contamination". The charges were imposed with the main aim of preserving water resources to achieve sustainable water usage in the long-term.

- ORDINANCE No 1 of April 11, 2011 23.04.2007 on Water Monitoring (promulgated SG. 34/ 29.04.2011; enforced 29.04.2011, amended and supplemented No 22 of 05.03.2013, enforced 05.03.2013, amended No. 44 of 17.05.2013, enforced 17.05.2013);

- ORDINANCE No 2 from 08.06.2011 on issuing permits for discharging wastewater into water points and setting individual emission limits for local sources of pollution (promulgated SG. 47 of 21.06.2011, enforced 21.06.2011, amended, No. 14 of 17.02.2012, enforced 17.02.2012, supplemented No.44 of 17.05. 2013, enforced 17.05. 2013). This regulation provides the interpretation of the term "waste waters". These are waters, including rainwater, polluted by manufacturing processes, economic, agricultural and household activities, as well as the waters from the sewerage systems of settlements, residential and recreational formations. Regarding the quality of the waters which are discharged in compliance with the provisions of Ordinance No 2, the related responsibilities and obligations are of the holder of the Discharge permit. The control on the fulfilment of the requirements and the conditions contained in the Discharge permit is exercised by the Basin Directorate and the Regional Inspectorate of Environment and Waters.

- ORDINANCE No 3 from 16.10.2000 on the terms and conditions for research, design, approval and operation of sanitary protective zones around water sources and facilities for drinking water, and sources of mineral waters used for therapeutic, prophylactic, drinking and sewerage (promulgated SG. 88/2000)

- REGULATION No 6 from 9.11.2000 for emission norms for admissible content of noxious and hazardous substances in the wastewater. The Regulation settles the emission limit values of the permissible content of certain harmful and noxious substances in wastewaters, discharged in water basins. Outside the scope of the regulation remain the discharges of waste waters in underground waters.

- REGULATION No 7 from 14.11.2000 on conditions and procedure for discharge of industrial wastewater in the sewerage systems of residential locations: The regulation specifies the treatment of waste waters used in industry and production processes, discharged in the sewerage systems of residential locations and residential water treatment plants. The objective of the regulation is to prevent water from getting polluted with toxic, harmful and dangerous for the environment substances. Outside the scope of the regulation are the activities related to the discharge of industrial waste waters in water basins. The regulation specifies the conditions and procedures for the discharge of waste waters and identifies the admissible content of toxic, harmful and dangerous for the environment substances in the waste waters prior to their discharge. The limit quality values of waters intended for irrigation of agricultural crops are more

restrictive than the maximum admissible concentration rates of substances in industrial waste waters released in sewerage systems of residential locations or in residential water treatment plants.

- ORDINANCE No H-4 of September 14, 2012 on the characterization of surface water (promulgated SG, No. 22 of March 5, 2013, enforced March 5, 2013)

- ORDINANCE No 13 from 29.01.2004 on the procedures for carrying out the technical operation of dams and associated facilities (promulgated SG. 17/2.03.2004)

- ORDINANCE No 18 from 27.05.2009 on the quality of water for irrigation of agricultural crops. The reuse of wastewaters for irrigation of agricultural crops is legislatively acceptable after wastewater treatment, which will ensure achieving the irrigation water quality standards specified in Regulation 18.

The supply of irrigation water pursuant to the provisions of Ordinance No 18 is performed on the basis of a contract concluded between the owner of the hydrotechnical facility and the irrigation water user. The contract must include the requirements to the quality of the water upon its delivery and the obligations of the user not to deteriorate its quality during the process of water supply. The Ordinance determines the necessary quality and monitoring requirements for the water (surface, underground and waste waters) intended for agricultural crops irrigation on the territory of the Republic of Bulgaria. The document sets the criteria and indicators for irrigation water quality assessment, also aimed to prevent the damage caused by hydro-technical facilities engaged in irrigation related activities (possible adverse impacts of irrigation water or waterworks); rules for areas identified as vulnerable zones; maintenance of land and soil in good agricultural and environmental conditions. According to the regulation, functions of the competent authorities are as follows:

The *Basin Directorates* are responsible for the assessment of the actual condition of the quantity and the quality of the waters for irrigation maintaining records of permits for water abstraction and of water abstraction facilities for irrigation as part of the registers under Art. 182, para. 1, item 1, letters "a" and "d" of the Water Act and provision of data according to the Law on Access to Public Information;

The *Regional Inspectorates of Environment and Water* is performing control over the compliance with the regulatory requirements for the soil qualities and the registered ones changes due to irrigation; the actions or omissions of organs or persons leading to soil contamination due to irrigation; the protection of soils with regard to pollution by harmful substances, including radioactive substances, acidification, salinization, surface over-wetting and erosion in irrigation.

The *Regional Inspectorates for the Protection and Control of Public Health* are responsible for the control over the microbiological parameters of potable water according Annex 1, item D.

The *Directorate "Hydro melioration"* in the Ministry of agriculture, food and forests organizes and control the activities for carrying out the own monitoring of the waters for irrigation fed by systems and facilities built with state resources; create and maintain a register of the hydromelioration fund, built with state resources, including water sources for irrigation and containing water quality information for irrigation of agricultural crops; provide the necessary information for issuing permits for water abstraction; performs ongoing inspections for the irrigation season and the observance of the gross irrigated and irrigated waters irrigation norms by regions for the country; interact with the basin directorates through the regional directorates

of the hydromeliorations in the relevant area of activity, including data on water quality for irrigation; organize and participate in the development of the national water management plan and in the elaboration of the water and water economic balances of the country in their part related to irrigation and drainage.

The *National Agricultural Advisory Service* within the scope of their competence, provide the owners and users of agricultural land with information.

The *Ministry of Agriculture, foods and forests* through the natural and legal persons who: supply water for irrigation, provide landlords and landholders with official land irrigation water quality information as well as water banned for irrigation on the basis of official data of the Ministry of Environment and Water.

- *East Aegean Region River Baisin's management plan* (2016-2021), which is a main instrument for water management.

-The main legal act in the field of hydro-melioration is the *Irrigation Associations Act***,** which regulates the structure and activity of irrigation associations. The associations carry out the operation and maintenance of hydro-meliorative infrastructure, construction of new irrigation and drainage systems and facilities, supply and distribution of water for irrigation. According to the provisions of the aforementioned law, Irrigation Associations can acquire the right of using without compensation and subsequently rights of ownership over the hydro-meliorations' infrastructure of their territory, comprised in the property of the companies, whose capital is owned by the state. The conditions and order of acquirement and withdraw of the right of usage are regulated with a respectful Regulation. (SG, бр.21/26.02.2002 у.).

- *The Hydro-melioration Strategy* was approved in 2016. It identifies restoration of irrigation and land drainage infrastructure as a priority and analyses the sector in the context of climate change in the medium and long term. The strategy concludes that, if rehabilitated and modernized, the existing irrigation infrastructure will be a critical element in reducing the risks of climate change in terms of productivity, sustainable agriculture, and land management. Expected long-term droughts, combined with more frequent and more severe floods, will lead to growing insecurity in the agriculture sector in Bulgaria. Under these conditions, the irrigation infrastructure will be used to meet the growing needs of crop for water, while drainage and flood protection infrastructure as well as river corrections would provide protection for arable land against harmful impacts related to climate hazards. In this way, the irrigation sector will generate significant benefits for both the farming community and the wider society.

Authorisation procedures and formalisation (e.g. requirements for permits) are likely to depend on the quantity (of water) abstracted or the pumping capacity. Legal approval permits or licenses for water abstraction are then needed above a certain threshold or pumping capacity. Water metering for permitted abstractions is obliged in Bulgaria. The duration of permits or authorisations is for no more than 5 years from surface water source.

The reuse of water for irrigation of agricultural crops is legislatively acceptable after wastewater treatment, which will ensure achieving the irrigation water quality rates specified in Ordinance No 18. In compliance with the standards set by this ordinance where 31 parameters, characterizing irrigation water quality are determined, the frequency of water quality monitoring should be at least once for every irrigation season (June-August). For water sampling and sample preparation for analysis are used international references (ISO 5667-1, 2, 3, 6).

Standards

The suitability of water for irrigation mostly depends on the water quality, climatic conditions, physical and chemical properties of the soil, the salt tolerance of the crop grown and agricultural practices. The economic impact resulting from improving irrigation performance is not sufficiently investigated in Mediterranean region since a great number of factors influence them. One of the main factors is the level of irrigation, which directly corresponds to the yield and mineral nutrient content of crops. Another one is the quality of water for irrigation purposes.

The main water quality parameters that determine the suitability of water for irrigation are salinity, specific ion toxicity, trace elements, nutrients and pathogens. These parameters are introduced in FAO, WHO and USEPA guidelines for water quality for irrigation, which were complied with Bulgarian standard, accepted in 2009 by Ordinance No. 18 "Water quality for irrigation of agricultural crops". The suitability and applicability for irrigation is assessed by 31 parameters, characterizing irrigation water quality in accordance with Bulgarian Standards, presented in Tables 12 and 13:

Table 12. Parameters characterizing the water salinity, water infiltration rate, toxicity and physicochemical parameters.

Parameters	Unit	Standard Limit	Note about the assessment
Temperature (T)	°C	28	
pH	pH/units	6-9	
Dissolved oxygen (DO)	mg/L	≥2	*in situ*, with field Multi-340i/SET meter
electrical conductivity (EC)	µS/cm	2000	
Total hardness (TH)	mg eqv/L	14	By Bulgarian State Standard (BSS) 3775
Radium 226 (Ra 226)	mBq/L	150	
Total beta radiation (β)	mBq/L	750	
Sodium (Na)	mg/L	300	
Potassium (K)	mg/L	350	
Calcium (Ca^{2+})	mg/L	400	Content by ISO 6058
Magnesium (Mg^{2+})	mg/L	300	
Boron (B)	mg/L	1.0	
Chlorides Cl	mg/L	300	by ISO 9297
N-NH_4	mg/L	5.0	by BSS 3587
N-NO_3	mg/L	20	by BSS 3758
CO_3	mg/L	200	
HCO_3	mg/L	300	
SO_4^{2+}	mg/L	300	by BSS 3588
P-PO_4	mg/L	3.0	by EN 6878-1, using UV-VIS Spectrophotometer JENWAY 6705
Phenols (volatile)	**mg/L**	**0.05**	
Cyanide (CN) total	mg/L	0.5	
Petrol products	mg/L	0.3	
Detergents	mg/L	1.0	
Suspended solids (SS)	mg/L	50	by BSS 17.1.4.04
COD	mg/L	100	by ISO 6060 with a spectrophotometer

BOD_5	mg/L	25	by EN 1899-1, 2
Extractable substances with carbon tetrachloride	mg/L	5.0	
Manganese (Mn)	mg/L	300	
Iron (Fe)	mg/L	5.0	
Copper (Cu)	mg/L	0.2	
Cobalt (Co)	mg/L	0.05	
Zinc (Zn),	mg/L	2.0	
Molybdenum (Mo)	mg/L	0.01	
Lead (Pb)	mg/L	0.05	
Mercury (Hg)	mg/L	0.001	
Aluminium (Al)	mg/L	5.0	
Beryllium (Be)	mg/L	0.01	
Nickel (Ni)	mg/L	0.2	
Vanadium (V)	mg/L	0.1	
Cadmium (Cd)	mg/L	0.01	
Selenium (Se)	mg/L	0.01	
Chromium (Cr^{6+})	mg/L	0.05	by ISO 15586 with an AAS (Analyst/800 Perkin-Elmer)
Chromium (Cr^{3+})	mg/L	0.5	
Arsenic (As)	mg/L	0.1	
Fluorides (F^-)	mg/L	1.0	
Lithium (Li)	mg/L	2.5	

Table 13. Microbiological parameters that should be observed in case of using water for irrigation.

Parameters	Unit	Standard Limit
Aerobic mesophilic microorganisms	CFU/mL	-
sanitary-indicator microorganisms		
coliforms,	CFU/mL	-
Escherichia coli	CFU/mL	-
Enterobacteriaceae	CFU/mL	Not allowed
***Salmonella* spp.**	CFU/mL	Not allowed
Total Coli titer	CFU/mL	<0.1
***E. coli* titer**		<1.0

Even when the water meets the requirements for irrigation with respect to Ca and Mg content, it should be noted that low-salt water, (determined indirectly by the EC values), can dissolve and leach more of the soluble minerals, including Ca, from the surface soil. So, the very low levels of Ca and Mg in irrigation water are not acceptable, because they reduce soil fertility.

It should be mentioned that during the hot seasons the accumulation of minerals from the crops is more rapid than in cooler seasons, although the content of trace elements in Maritsa River water is well below permissible thresholds. Those findings are important for the countries in Maritsa River basin, because the irrigation of crops in them is carried out in the summer, i.e. during the hot part of the year.

Some quality assessment of river water as a source for irrigation showed that the values of all microbiological parameters did not meet the requirements of Bulgarian standard. The established values exceeded 100 times the permissible limits for total coli titer and 100 to 1000 times for *E. coli* titer. Salmonella spp. and Enterobacteriaceae, which are intestinal pathogens and Enterobacteriaceae are not allowed in irrigation water. The reason for this restriction is that

these organisms can infect soil and plants and retain their viability for long periods of time (for *E. coli* and *Salmonella* sp. up to 16-35 days in water, up to 150-200 days in soil and up to 180 days in plants). The standard allows the use of such water for irrigation only after decontamination which is not always possible and economically justified.

In terms of organic products: There are no specific officially regulated requirements for irrigated water in organic farming. In Bulgaria, the requirements of the national legislation in this regard depend on the control body or the controlling person, which will check. In general, there must be no risk for residues in the final product, although it is already claimed at EU level that pure product is not available and cannot be available. In Bulgaria the possible presence of pollutants, irrespective of their origin, leads to the withdrawal of certification.

Since 2015, Bulgarian Institute for standardization (BIS) is selling the international standard ISO 16075:2015, established by Technical Committee ISO/TC 282 – Water Reuse in several sections. It provides guidance on the design and implementation of wastewater treatment projects including design, materials, construction and results, covering many aspects such as water quality, irrigation, related risks and key elements (pipelines and tanks). The standard consists of several parts:

Table 14 - Water Standards

Standard nomenclature	Aspect	Use
ISO 16075-1: 2015	Part 1: "Basics of Reuse in Irrigation Projects" – contains guidance on all elements of a project on the use of purified irrigation wastewater.	Guidelines for the use of treated wastewater in irrigation
ISO 16075-2: 2015	Part 2: "Project Development" – includes requirements such as design criteria and quality specifications.	
ISO 16075-3: 2015	Part 3: "Elements of the Irrigation Re-use Project" – covers the elements of the system required for the use of the treated wastewater for irrigation purposes.	
ISO 16075-4:2016	Part 4: "Recommendations regarding: monitoring the quality of treated wastewater (TWW) for irrigation; irrigated plants; the soil with regard to salinity; natural water sources in neighbouring environments; the quality of water in storage reservoirs". It puts emphasis on sampling methods and their frequency.	Monitoring

The ISO 16075:2015 is still not introduced / synchronized as Bulgarian national standard. Every member of ISO can purchase the new standards through the BIS.

Other institutional aspects

According to the specialists in the water sector, treated water in Bulgaria could be used in the agriculture for irrigating. The main obstacle is that in the farming work the water is used cyclical – during the vegetative period of the varied crops, and for the rest of the time the treated wastewater would not be recovered unless suitable water basins regulating the flow and water consumption are provided. According to Prof. Roumen Arsov (UACEG, Faculty of Hydraulic Engineering, Department *Water* Supply, Sewerage, *Water* and *Wastewater Treatment*, retired), there is no single state strategy and public attitude towards finding a comprehensive solution to the problem.

Identification of key actors

A tentative list of target groups of actors includes Administration, Local Authorities, Universities, Research Centre, RTDs, Organizations, Associations, Other Bodies.

Table 15 - Key actors

ORGANIZATION	ROLE DESCRIPTION
ADMINISTRATION (National or regional level)	
East Aegean River Basin directorate – Plovdiv	The Basin Directorate is a state administration at the Ministry of Environment and Water that provides a technical activity and performs activities for the administrative servicing of citizens and legal entities. Basin Directorate Plovdiv is a competent body within the meaning of Article 3, paragraph 2, of the WFD Water Management in the East Aegean River Basin District issuing permits for water use, use of surface waterbodies for discharging reclaimed water, etc.
Regional Water Association – Plovdiv district	The regional water association is a structure on regional level where municipalities and the state-owned utility company "Water supply and sewerage Plovdiv" SJSCo, participates under the supervision of the district Governor (as representative of the Government). It manages the water and wastewater issues at regional level – maintainment, development and modernization of water and sewerage systems and utilities. The association role is to manage, planning and building the water and sewerage systems and utilities and to control the company's activity. "Water supply and Sewage" Plovdiv SJSCo oversees water supply, sewage and wastewater treatment in most of the municipalities in the region of Plovdiv. The water supply, which the company provides as operator is 95 % of the pumped water. To a small extent, mainly in the Plovdiv area, it is provided by surface water sources. The company maintains 478 km of sewerage network in Plovdiv and 765 km in the regions. The main channel of Plovdiv is formed by 7 main collectors. The scope of its activity includes exploitation, maintenance and repair of water and sewage systems, sampling and testing of water for drinking and household purposes, underground, industrial, surface-run and wastewater treatment and wastewater treatment. The company is structured in several main directions including Wastewater treatment plant Plovdiv and Laboratory-test complex.
National Agricultural Advisory Service (NAAS), branch Plovdiv	The NAAS conducts its business within the state agrarian policy, providing farmers current information, specialized counselling, and expert assistance for the implementation of efficient and competitive agriculture in accordance with approved by the EU standards. Their functions are: i) extension assistance to farmers, cooperatives, associations and other structures related to agriculture. - provides free of charge advices, information, training and other services in agriculture; ii) assists with the transfer of scientific and

	practical knowledge into agricultural practice; iii) makes chemical analyses of soil, plants and forages, irrigation water and fertilizers and makes recommendations.
MUNICIPALITIES	
Plovdiv	The town of Plovdiv is the mayor town in the district and mayor producer of reclaimed water. Plovdiv is beneficiary for implementing the project "Integrated water cycle of Plovdiv". The project is submitted pursuant to the invitation to apply under procedure №BG16M1OP002-1.006 "Implementation of the early water supply projects" under the EU Operational programme: Innovations and Competitiveness.
Maritsa	Located in the Upper Valley, the municipality occupies a central position within the territorial scope of the Plovdiv region possessing an area of 34,256.8 ha. Maritsa Municipality includes 19 settlements. The amount of arable agricultural land (24 371.8 ha, 85.6 % of the agricultural land on the territory), the appropriate climatic conditions and the use of irrigation creates a framework for the development of successful plant-growing. There is a trend towards gradually overcome the fragmentation of the arable land, increasing the size of individual holdings. If this trend is maintained in the future, this will allow farmers to stick more strictly to good agricultural practices, to observe the agro-technical requirements for alternation crop rotation, as well as environmentally friendly fertilization using plant waste.
PRIVATE SECTOR	
ENVOTECH OOD	The main activity if the company is Water and wastewater treatment engineering, design and supply solutions for industrial and civil wastewater, as well as drinkable/primary water treatment plants and purification systems. They have particular know-how in the treatment of wastewater in all industrial sectors, both food (dairies, bakeries, slaughterhouses, meat processing, wine producing and distilleries) and non-food industries (aeronautical, mechanical, textile/dyes, chemical, pharmaceutical and paper mills). http://www.envotech.bg
ECO – TECH OOD	The company deals with facilities for water and wastewater treatment and quality equipment for design, manufacture, installation and commissioning of municipal and industrial wastewater treatment plants. The company is on the Bulgarian market since 2002. In the past few years, the company has become one of the leaders at the water sector and proved to be a reliable partner in dealing with architects, investors, construction companies and customers. In the country, the company operates with its service groups thus we manage to cover all points of Bulgaria. https://ecotechbg.com/en/
RESEARCH CENTRES/UNIVERSITIES	

Agricultural university – Plovdiv	DEMONSTRATION CENTER FOR NEW TECHNOLOGIES IN AGRICULTURE The demonstration centre for new technologies in agriculture is a joint initiative of 'Saint Demetrius of Thessaloniki' Faculty of Agronomy and 'America for Bulgaria' Foundation. The Centre was constructed with funds from the Foundation and organizationally structured by the Decision of the Academic Council of AU of 17 January 2014. It provides opportunities for the academic community and companies developing technologies and equipment for agriculture, to exhibit their latest achievements before students and teachers from different universities, experts on national and local levels, farmers and amateur gardeners.
University of Architecture, civil engineering and geodesy – Sofia	The university was founded as a Higher Technical School in 1942 in 1945 it was transformed into a State Polytechnic. For the duration of its existence, the University has prepared more than 5,700 architects and 25,000 engineers. In five faculties – Architecture, Civil engineering, Hydraulic Engineering, Geodesy, Transportation Engineering and 33 departments senior executives are educated for the following majors: Architecture, Urban Planning, Structural Engineering, Transportation Engineering, Water Supply and Sewerage, and Geodesy.
ASSOCIATIONS/COMPANIES	
Agricultural Cooperative "Edinstvo"	The cooperative is registered in 1992, located in Kostievo village and operates in the region of Maritsa Municipality situated 10 km from Plovdiv. The main activity of the cooperative is production and trade of different types of agricultural products as well as providing mechanized services in every field of farming and agriculture. The cooperative is cultivating 1,735 ha arable lands with total production exceeding EUR 1,5 mln . The crop structure is as follows: wheat (durum and common wheat), barley, rape, sunflower, corn, rice, soybean.
Golden Rose Ltd, Zlatosel village, Municipality of Brezovo	Distillery for obtaining mainly rose essential water, but also lavender and chamomile. They have more than 500 ha of crops that are surface irrigated with reclaimed water. The distillation process is strictly and technically prescribed by the Bulgarian State Standard. The rose water is a natural obtained distillation mixture of water and essential rose oil and does not contain artificial colouring and fragrance.
Green Tech	GREEN TECH is a registered farmer. The company processing areas over 300 ha own and rented land. The main crops grown by the manufacturer are corn for energy needs, triticale and wheat. A large part of the crops is aimed at their application as a main raw material in the production of electricity from biomass, a significant part of them being grown under irrigation conditions. It also has about 120 ha of pastures. The farmer has experience also in animal husbandry.

	For the current agricultural year, the company grows over 450 livestock – cows and calves.

Networks/projects	
"Investing in refurbishment of the MRDPW infrastructure from irrigation systems"	The Operational program "Rural areas and development program 2014-2020" envisages 100 mil BGN for a hydro-melioration construction work, but they would be enough for no more than 30 companies. According to data from the adopted strategy the Bulgarian HM (hydro-meliorative) infrastructure is seriously damaged. The incomes are hardly enough for basic maintenance. Only about 8% of the areas, that the state company irrigation systems manage to maintain, are actually irrigated. Pursuant to the strategy's authors prolonged dry periods are expected, in combination with more frequent and more severe floods, which will lead to growing insecurity in the Bulgarian agricultural activity.
INVESTORS (National or regional level)	
Irrigation Systems EAD – branch Maritsa	Irrigation Systems EAD is a 100 % state property company as its head is the Minister of Agriculture, forestry and Foods. The territorial structure of the company consists of a central management in Sofia and network of 14 regional representations throughout the country, having branch status. Irrigation Systems EAD, Maritsa Branch, provides the upkeep of the sites on the territory of the city of Plovdiv and its neighbouring municipalities – the Municipality of Maritsa and the Municipality of Rodopi. Branches are formed based on a technological principle (river valley) and are directly subordinate to the Executive Director. They provide with water for irrigation, industrial and drinking water supply, drainage and protection from flooding of agricultural lands, industrial sites, settlements and others. Some branches are registered as agricultural producers and farmland. IS EAD is responsible for supply and sale of water for beverages, distribution of water to "Water Supply and Sewerage" companies; industrial water supply; filling fishponds and other needs, including ameliorative and agricultural construction. This group of activities has a commercial character. The cost of a "water supply" service for irrigation is determined by the next watering season, with an order from the Minister of Agriculture and Food issuing with an approved price for the service.

Existing situation of wastewater treatment and agriculture

Characterization of wastewater treatment sector:

Identification of wastewater treatment plants

At present, 13 urban WWTPs are operating in the territory of Plovdiv district. Much of them are built with European funding. By 2023, another 16 WWTP should be built to meet the requirements of the UWWTD for wastewater treatment of the settlements. Only 2 urban wastewater treatment plants have been built and operated in the area until 2010, that possessed secondary treatment. They serve the city of Hissarya and the city of Plovdiv with a total population of about 370,000 people. Separately, there are more than 70 local wastewater treatment plants of industrial sites and outlying settlements. In 2013 the new sewage treatment plant in Sopot was opened. It was part of a project for a complete renovation of the city's water and wastewater sector and its capacity is of 25,000 p.e. The construction of the new facility, which is one of the most modern in the Balkans, has invested BGN 18 mln. The water purification efficiency at the station's exit is 98 %. The project for the water sector in the town of Hissarya, reconstruction and modernization of the WWTP of Hissarya as well as construction of a sewerage network" was realized with a total value of more than BGN 18 mln. To improve the quality of surface water it is imperative to build (refurbish), reconstruct and modernize sewage treatment plants in the area.

Wastewater treatment plant of Plovdiv (WWTP Plovdiv)

UWWTP Plovdiv is situated in the southeast part of town, about 1.5 km outside the city limits, at an area of 23 hectares. It treats wastewater from industry and the population of Plovdiv (as well as 80-100 m^3 of infiltrate per day from the "Tsalapitsa" landfill). The waters treated at UWWTP are discharged into the Maritsa River through an open channel with a length of 2.6 km.

WWTP Plovdiv is designed for treatment of domestic and industrial wastewater from Plovdiv. Until 2008, the WWTP treated wastewater only from the southern part of town (about 70% of the total flow of town). Wastewater from the north were collected and discharged directly into the Maritsa River without treatment. Currently, all wastewater is collected through a combined sewage system and enters the UWWTP for treatment. (In July 2008 a pumping station and a main north collector entered into service to bring wastewater from the northern part of town to UWWTP).

The existing UWWTP Plovdiv has a design capacity of BOD_5 35.78 t/day 596,333 p.e. and a flow rate of 0.21 hm^3/d (daily average water quantity).

The plant is designed for mechanical and biological treatment for removal of carbon up to the requirements for treated water to meet the Bulgarian standards for discharge into category III receiving water, the Maritsa River. The process scheme and the existing facilities are not intended for a higher level of wastewater treatment in terms of nutrients (N and P). The wastewater volume treated in UWWTP Plovdiv amounts between 145,000 and 202,000 m^3/d, i.e. it does not currently exceed the design capacity (1984) – 213,000 m^3/d (daily average water quantity). The proposed dimensional water quantities in the UWWTP Plovdiv project are Qday av. = 200,000 m^3/day (level 2038 $Q_{day\ av.}$ = 173,937 m^3/day – forecast). UWWTP performs self-monitoring. The laboratory at UWWTP Plovdiv performs daily laboratory analyses of pH, dissolved oxygen, suspended solids, BOD_5, COD, NH_4 and PO_4 before and after the mechanical step and after the secondary settlement tank before the point of discharge. The total nitrogen and phosphorus are analysed each month, and heavy metals – every three months.

The wastewater from UWWTP Plovdiv will be treated up to the requirements for discharge into the receiving water and will not adversely affect the aquatic ecosystem in the area.

The Water Cycle Project of Plovdiv is currently being implemented. The project consists in reconstruction and extension of existing UWWTP Plovdiv by construction of new facilities, such as replacement of morally and physically obsolete equipment in some technological units, increasing the degree of purification in terms of nutrients N and P, upgrade of sludge management facility by commissioning modern equipment for anaerobic stabilization of the sludge, generated in the process of treatment and subsequent dewatering. The expected results from project realization include: suggestions for effective management of the sludge from UWWTP, achieving treated water parameters that meet the requirements of the permit for discharge into the Marishki Collector water body (South outflow channel), reducing the conditions for eutrophication, improving the quality of irrigation water and ensuring compliance with the regulatory requirements, ensuring sustainable development of the aquatic ecosystem of Maritsa water body achieving good emission status of the waters, and raising the self-purification ability of the Maritsa river and creating a positive effect on its cross-border impact, respectively.

The implementation of the project will ensure also optimal removal and treatment of wastewater collected in sewer networks that are currently discharged without appropriate purification that meets the goals set by Directive 91/271 / EEC requirements. This project includes the following measures concerning wastewaters: replacement of 13.428 km secondary sewerage network in order to improve the transportation and reduce the infiltration flow; rehabilitation of main collector VII and construction of a new collector with length of 2.746 km to ensure sufficient hydraulic capacity of the system. The approved project for reconstruction, modernization and completion of the WWTP – Plovdiv will reduce the flow of pollutants and biogenic elements in the receiving waterbody.

WWTP – Asenovgrad

"Project for rehabilitation of water supply and sewerage network and construction of WWTP, Assenovgrad, Bulgaria" is being implemented in the town of Asenovgrad in 2016. The project is planned to overcome the problems associated with existing water and wastewater infrastructure in the city of Asenovgrad and ensure environmentally sound water purification and discharge of domestic wastewater. The main activities envisaged under the project are:

1. Rehabilitation of water supply network with an expired service life, located in the sewerage network track

2. Rehabilitation of the combined sewer network with an expired service life. Expansion of the existing sewer network to the future construction of WWTP, closing the discharges of wastewater into the river and replacement/ rehabilitation and expansion of the existing sewers in the urban area as hydraulic future needs.

3. Construction of WWTP for 65,500 p.e. with mechanical and biological stage and degree of purification, including technical infrastructure in accordance with the requirements of Directive 91/271 / EEC.

The estimated population to be served by the rehabilitated water supply infrastructure is 2,645 permanent residents, while the population to be served by the rehabilitated mixed system is 49,626 permanent residents.

Identification of municipalities without any treatment

Despite the construction of several WWTP during the last years, Plovdiv district has towns without any WWT. They are mainly with small populations (under 5,000 inhabitants). The population is more than 50,000. Data concerning settlements without any WWT are presented in Table 14.

Table 16 - Important parameters and WWTPs which will be constructed till 2023 in the Plovdiv district.

Settlements	P.E.	Urban Area (ha)	Q at an average (m^3/d)	Total load inputs (kg/d)		Required degree of treatment (%)
Banya	3 718	126.3	1 116.35	BOD_5	223.08	87.49
				COD	446.16	68.72
				TSS	260.26	74.26
				N	40.90	59.06
				P	6.69	66.64
Brestovitsa	3 307	126	1 148.51	BOD_5	198.42	85.53
				COD	396.84	63.82
				TSS	231.49	82.64
				N	36.38	68.43
				P	5.95	61.41
Gradina	2762	nd	nd	BOD_5	165.72	79.38
				COD	331.44	48.46
				TSS	193.34	75.26
				N	30.38	32.52
				P	4.97	45.02
Kalofer	2 665	152.5	1 157.68	BOD_5	159.90	81.90
				COD	319.80	54.75
				TSS	186.55	78.28
				N	29.32	40.70
				P	4.80	51.73
Kalekovets	2 553	126	1 148.51	BOD5	153.18	81.26
				COD	306.36	53.14
				TSS	178.71	77.51
				N	28.08	38.65
				P	4.60	50.01
Laky	1 379	74.4	718.48	BOD_5	82,74	78.29
				COD	165,48	45.73
				TSS	96,53	73.95
				N	15,17	43.16
				P	2,48	42.11
Manole	2 732	215	1 328.99	BOD_5	163.92	79.73
				COD	327.84	49.33
				TSS	191.24	58.30
				N	30.05	33.67
				P	4.92	45.95
Rogosh-Skutare	5 340	200	1 316.85	BOD_5	320.40	82.55
				COD	640.80	56.39
				TSS	373.80	85.05
				N	58.74	42.91
				P	9.61	53.48
Rozino	4 360	119.5	835.87	BOD_5	261.60	92.01
				COD	523.20	80.03
				TSS	305.20	83.57
				N	47.96	73.86

				P	7.85	78.70
Sopot	8195	-	743.20	BOD_5 COD TSS N P	491.70 nd 573.65 90.15 14.75	nd nd nd nd nd
Saedinenie	6 259	-	2 869.43	BOD_5 COD TSS N P	375.54 751.08 438.13 68.85 11.27	80.90 52.24 60.70 37.48 49.06
Tsalapitsa	3 561	300	1 251.62	BOD_5 COD TSS N P	nd nd nd nd nd	85.35 63.39 82.43 68.05 60.95
Topolovo	3 304	-	1 624.07	BOD_5 COD TSS N P	198.24 396.48 231.28 36.34 5.95	79.52 48.80 75.42 32.97 45.38

An economic scenario for water sector development in the future is presented below (Tables 15-18). The scenario applied is assuming that the funding will be available at 100 % and the beneficiaries possess the administrative capacity to use the corresponding funds. According those estimations the total investment needs is 1,403.3 mln. BGN for the entire sector, dividing the funds between EU (217.1 mln. BGN), national contribution (170.5 mln. BGN) and internally generated funds of WSSC (1,019.7 mln. BGN). In that way the compliance with the UWWTPD will be reached in 2023.

Table 17. Plovdiv investment scenario (in case of 100 % funding) plus debt, increased efficiency and individual appropriate solutions (Strategy, 2014).

Type of investment (mil BGN)	Investment needs
Water supply	749.5
Abstraction	18.2
Water treatment	0.0
Transmission	308.3
Distribution	422.9
Wastewater	656.2
Wastewater collection	491.4
Wastewater treatment	164.9
Other	1.7
Transport and plant	1.6
Business systems	0.1
Total investment	1,407.3

Table 18. Plovdiv investment scenario plus debt funding, increased efficiency and individual appropriate solutions – funding sources, Mil BGN (Strategy, 2014).

Period	EU grant	WSSC

	Investment needs	Investment financed	Inv. cost of debt	Grants from EU funds	National contribution	Government grant	Internally generated funds	Loans
2014-2023	671.5	671.5	-	217.1	170.5	-	283.8	-
2024-2028	245.3	245.3	-	-	-	-	245.3	-
2029-2038	490.6	490.6	-	-	-	-	490.6	-
Total	**1,407.3**	**1 407.3**	**-**	**217.1**	170.5	**-**	**1,019.7**	**-**

Table 19. Plovdiv investment scenario plus debt funding, increased efficiency and individual appropriate solutions – key indicators (Strategy, 2014).

Key indicators	2011	2024	2028	2038	Target 2039
NRW %	59.9 %	48.0%	43.3%	31.5 %	30.0 %
population connected to WWC; % of water supplied population	66.0 %	76.1%	76.1%	76.1 %	76.1 %
population connected to WWT; % of water supplied population	49.2 %	76.1%	76.1%	76.1 %	76.1 %
compliance with UWWTD, year: 2023	Last year of deferred investments: -				
Compliance with UWWTD; % of target	64.6 %	**100.0%**	100.0%	100.0%	100.0%
water supply (savings) / additional costs; MBGN since 2013	NA	(1.31)	(1.88)	(2.81)	NA
wastewater collection (savings) / additional costs; MBGN since 2013	NA	0.01	0.01	0.00	NA
wastewater treatment (savings) / additional costs; MBGN since 2013	NA	2.54	2.56	2.60	NA

Table 20. Characteristics of potable water supply and monitoring of Plovdiv district.

RHI	Plovdiv		
No water sources for supply of drinking water			228
Of them: open water sources	**Number**		17
	with treatment facilities		17
Number of stations of the water supply network			228
Monitoring	**Number of samples under the continuous monitoring**		386
	Of them: complying with Ordinance № 9		345
	Number of samples under the periodic monitoring indicators		243
	Of them: complying with Ordinance № 9		220
Analyses conducted	**under the SHC**	**All tests conducted**	15249
		Number of samples under the indicators	11253
		Of them: complying with Ordinance № 9	11218
		% non-compliant	0.31%
		Number of samples under the microbial. indicators	1 389
		Of them: complying with Ordinance № 9	1 338
		% non-compliant	3.67%
	Up on requests		2607

Quantification of wastewater produced, e.g. m^3/year (treated and non-treated)

The reclaimed water supply on the territory of Plovdiv region by the urban WWTP is shown in Table 19.

Table 21. Potential of reclaimed water supply and current use in Plovdiv district.

POTENTIAL supply of reclaimed water in the target region	Plant Number	Volume (hm^3/y) Coastal (hm^3)	Inland (hm^3)	BOTH (hm^3)
Number of WWT Plants	13	No		
Number of WWT Plants [> 150.000 p.e.]	1	No	40.86	
Number of WWT Plants range [10.000 pe to 150.000 p.e.]	8	No	8.04	
Number of WWT Plants range [2.000 pe to 10.000 p.e.]	2	No	0.12	
Number of WWT Plants range [<2.000 pe]	2	No	0.04	
CURRENT Supply of reclaimed water National/REGIO level	Number	Coastal (hm^3)	Inland (hm^3)	Coastal (hm^3)
Number of WWT Plants	1	No		No
Number of WWT Plants [> 150.000 p.e.]		No		No
Number of WWT Plants range [10.000 pe to 150.000 p.e.]	1	No	1.4	No
Number of WWT Plants range [2.000 pe to 10.000 p.e.]		No		No
Number of WWT Plants range [<2.000 pe]		No		No

NOTE: hm^3 = 1 million m^3

Although concerning the water reuse regulation still does not exist in Bulgaria, there are some practical cases that demonstrate the need of additional water supply and the acceptance of use of reclaimed water in agriculture.

Identification of wastewater treatment plants with existing reuse practices

WWTP-Hisarya discharges reclaimed water in Blue river dam

WWTP-Hisarya is operating from 2011. It consists of:

- three aeration basins SBRs
- aerobic stabilization of sludge
- dewatering machine (centrifuge) and conditioning with lime

Design values of the performance of the plant are as follows:

- load 25,000 p.e.,
- wastewater dry weather flow 7,250 m^3/d
- wastewater wet weather flows up to 2,000 m^3/h
- daily treatment volume in wet weather 1,080 m^3/h
- organic load as BOD_5 up to 1,500 kg/d
- total nitrogen load 275 kg/d
- total phosphorus load 45 kg/d

The sewage sludge is subjected to composting with wood chips and straw in the same plant. Annual discharged quantity of water is 1.4 hm^3. The reclaimed water is discharged in the dam of "Blue river" which is used for irrigation in the region by "Irrigation systems" EAD. Different kinds of fishes (carp, silver carp, grass carp, white fish, etc) are breed in this lake. Parameters of water analyses are shown in Table 20.

The water given by the distribution system and channels and paid by the end-users is for irrigation of permanent crops: maize, vegetables (tomato, watermelon, etc.). According official source, the price of urban wastewater treatment is 0.596 BGN/m^3, while industrial wastewater with "level of contamination 3" is treated at price of 1.3488 BGN/m^3.

Table 22. Analysed parameters of the water of "Blue river" dam.

Parameters	2013	2017
pH	8.39 ± 0.03	7.30 ± 0.03
Electroconductivity (µS.cm^{-2})	588 ± 20	655 ± 18
Dissolved substances	387 ± 5	416 ± 13
SS	4.0 ± 0.3	50 ± 1
BOD_5	<2	20 ± 1
COD	19 ± 2	116 ± 5
$N\text{-}NH_4$	0.62 ± 0.06	0.52 ± 0.04
Orto-phosphates	0.030 ± 0.003	<1.5

Delikates-2 Ltd, village of Zhitnitsa, Municipality of Kaloyanovo (Plovdiv region).

Meat processing Company of the village of Zhitnitsa has a Permit to use a water body for discharging its waste waters. The company's activities form domestic and industrial waste waters are treated in a local treatment plant with an automatic mode of operation including mechanical, physico-chemical and biological treatment. Part of the reclaimed water (0.026 hm^3) from May to October is used for irrigation of poplar crops on an area of 1.6 ha owned by the factory. The sludge from WWTP after dewatering is used for fertilization.

Ai Ti Pi Bulgaria Ltd.

Plant for the processing of essential oil crops in the village of Otets Paisievo, Kaloyanovo municipality, Plovdiv district – rose blossom, lavender, common balm (Melissa officinalis), chamomile. This activity results in wastewater production– cooling and rose marc. Cooling water circulate continuously in a closed loop, the excess part is used for watering of their own rose massifs – 100 ha. The boiled rose marcs pass through a screw separator and are transported to a site. The contaminated water is collected in an unattached marc lagoon. After cooling to reach suitable parameters and mixing with clean water it is used to irrigate rose plantations. The oiled rose blossom, chamomile waste, common balm and lavender are used to fertilize the plantations.

Company Golden Rose, Zlatosel village, Municipality of Brezovo.

Distillery for obtaining mainly rose essential water but also lavender and chamomile. It is a complete private initiative where hot water and pink flowers are placed in the distillation apparatus. The mixture is heated with the steam to 110 °C for 150 min, and then the marc is drained to the receiving shaft where a separating screw press is fitted. The screw press separates the liquid water from the rose marc, which is juice, and is transported through a pump to a

concrete tank for cooling. Once cooled, it is transported by another pump via the hose or tank to the rose lands. For one day, 46.8 m^3 of marc juice and 18 t of marc are released, while for the whole rose campaign the wastewater generated is about 700 m^3. The crop that is irrigated with the reclaimed water is the rose (*Rosa damascena*). The irrigation is performed gravitationally over 48 ha of own crops around the distillery. The marc is also applied in the field as fertilizer.

The rose water is obtained by water-steam distillation of fresh rose blossoms during the crop season of Rosa -end of May, beginning of June. The distillation process is strictly and technically prescribed by the Bulgarian State Standard. The rose water is a natural obtained distillation mixture of water and essential rose oil and does not contain artificial colouring and fragrance.

Identification of needs of further treatment to extend water reuse

Regardless of the prevalence of high - quality soil resources in Bulgaria with above average water capacity, most summer crops do not survive without additional irrigation. The average annual reference evapotranspiration (ET_0) in the northern part ranges between 750-810 mm and between 750-840 mm in the south Bulgaria. Especially during the summer months (June, July and August), the monthly evapotranspiration (ET_0) exceeds monthly precipitation. In next table is shown the net requirement for irrigation of corn in "medium" year regarding raining. In Plovdiv regions the requirement is between 280 and 310 mm.

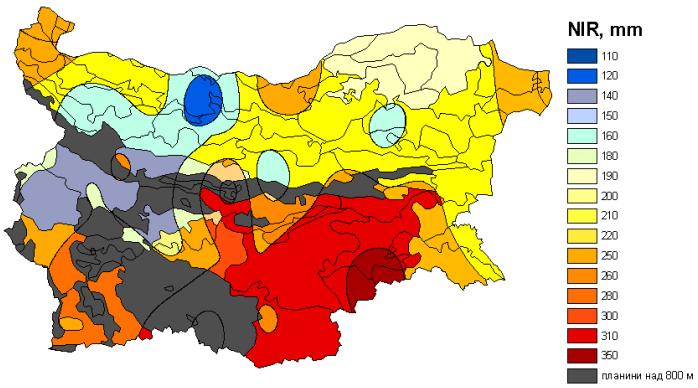


Figure 7. Net requirement for irrigation of corn in "medium" year regarding raining.

Although the climatic conditions in Bulgaria and in particular in Plovdiv district are favourable, there is a need of serious water quantities for watering the traditional crops. In recent years, as a result of climate change, the need of enhanced water supply has been increased. On the other hand, the adaptation to them is a prerequisite for changing the structure of crops grown in the region. This trend will deepen in the long term but also in the medium term due to forecasts of the effect of climate change on average and poor annual rainfalls (Figure 7).

Characterization of agricultural sector:

General description of the agricultural sector in the region.

According to the statistical report of the Ministry of agriculture and food for 2018, agricultural land in Plovdiv district is 308 174 ha, of which 296 690 ha is utilized agriculture area (49.7 % of total area of the region and 5.9 % of the country) (Results and analyses, BANSIK, 2018). The utilized agricultural area consisted of arable land (200 830 ha), permanent crops (20 350 ha), permanent grassland (74 550) and kitchen gardens (907 ha). In Table 21 is presented the distribution of crops grown on arable land, while the soil types are shown in Figure 8.

Table 23. Distribution of crops grown on the arable land in Plovdiv district.

Arable land	Cereals	Oleaginous crops	Grassland and annual fodder (excl. maize)	Vegetables and greenhouses	Fallow land	Industrial crops
Area (ha)	97,419	51,278	18,436	13,600	14,104	6,045
Percentage (%)	48.50	25.53	9.18	6.77	7	3.02

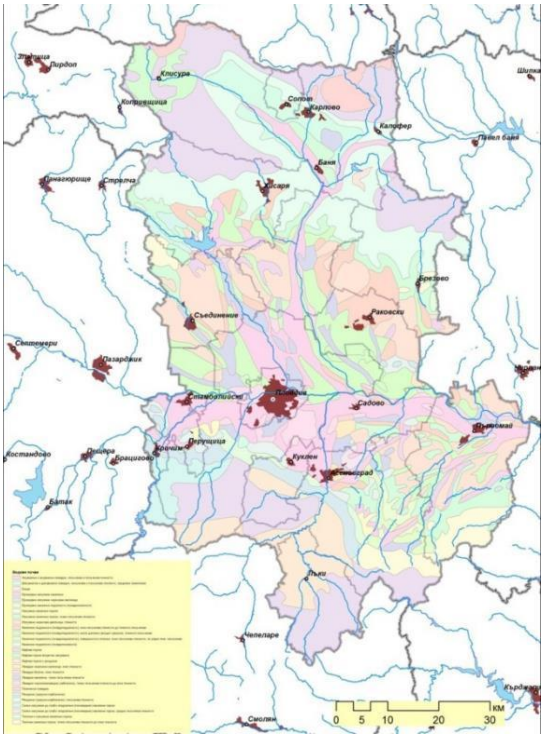


Figure 8. Soil types distribution in Plovdiv district.

Quantification of the water demand ("Irrigation systems"):

The main way for centralized water supply is through the water quantities contracted with the state company *Irrigation systems*. In the Table 22 are presented data related to the water quantities supplied in 2018 and the surface covered. As could be seen, most of the water supply is for the rice as one of the most important crops, but also because of the regulations of the Ministry of agriculture that give the priority to it. Thus, the rice in the region did not suffer of water shortage. The situation is different concerning the other agricultural crops. At this stage the shortage is overcame by self-water abstraction (Table 22).

Table 24. State gravity water supply in the region of Plovdiv by Irrigation systems (average of 2016-2018).

Crop	**Number of hectares**	**Water supplied (hm^3/year)**	**Water demand (hm^3/year)**	**Water shortage (hm^3/year)**	**Existing use of reclaimed water (hm^3/year)****
Rice	7,250	173.05	174	0.95	1.0
Maize	2,187	2.95	7.87	4.92	0.018
Tabaco	526	0.86	1.8	0.94	

Vegetables	111	0.33	0.5	0.17	0.018
Permanent crops	213	0.18	0.72	0.54	0.015
Watermelon, tomatoes	56	0.11	0.16	0.05	0.005
Other crops	286	0.31	1	0.69	-
Roses****	148	-	-	-	0.002
Alfalfa*	15.5	0.014	0.065	0.051	-
Poplar trees***	1.6	0.026	-	-	0.026

NOTE: hm^3 = 1 million m^3

** The crop was not supplied for 2018.*

*** Data related to the water supply from the dam "Blue river"*

**** Case of Delikates-2, village of Zhitnitsa*

***** Private initiatives of rose growing and oil distillation*

Although the use of reclaimed water is not regulated in Bulgaria, there aren't any prohibitions on it. The unique regulation is related to the Ordinance No 18 on the quality of water for irrigation of agricultural crops that establish certain restrictions. Based on that different companies apply reclaimed waters resulted by their own activities (Table 22).

Description of the cost for the service "Supply of water for irrigation" through the branch network of Irrigation Systems EAD

The supply of irrigation water through the branch network of Irrigation Systems EAD is carried, based on individual contract, between provider and users of the service supply of water for irrigation. Normally, the contracts are concluded for one year and, under certain conditions, for more, but not more than 10 years. The extended term is a new option.

The price of the service: "Supply of water for irrigation" is cost- oriented and regional – it is fixed up, according to the location of the areas each branch of the IS serves. The price is calculated, based on the costs of "Irrigation Systems" EAD related with the activity - Supply of water for irrigation and profit.

According to the European Parliament's Regulation (EU) 2016/679, two components are cumulatively included in the price: the price of a delivered volume of water and price per unit area. The proportion of components in the total price is determined by the supplier for each irrigation season.

Depending on how the water is delivered and the type of crop, the price for the delivered volume is determined for:

- gravity-supplied water for arable crops;
- pumped water supply for arable crops, with maximum permissible prices for rise - up to 50m, over 50m and under 100m, over 100m; / bound to the pressure of the pumping water supply and how many steps it is. The Maritza Branch has only one step;
- gravity-supplied water for rice;
- pumped water for rice;

The constant price per hectare/per unit area/ is determined by dividing the corresponding part of the expenditure into the estimated area in hectares.

The cost of water supplied/per cubic meter/ is determined by dividing the respective part of the cost into the estimated volume of water (m^3) for the respective irrigation season. It is paid after each irrigation, based on volumes of water used in cubic meters;

Irrigation Systems EAD and water users with no obligations/owes to them and with areas over 500 hectares, can negotiate trade discounts of 8 % of the water price.

The prices determined by the Board of Directors of Irrigation Systems EAD tailored with respect to Methodology approved by the Minister of Agriculture and Forestry by letter No. 70-1851 / 04.05.2018 and remains unchanged for 2019 are as follows:

-Permanent price per decare of irrigated area rice	BGN 48/ha
-Gravity-supplied water for rice	BGN 0.02 /m^3
-Pumped water for rice	BGN 0.026/m^3
-Permanent price per hectare area of arable crops	BGN 70/ha
-Gravitationally supplied water	BGN 0.11/m^3
-Pumping supplied water 1st step	BGN 0.18/m^3

Total price for irrigation per customer**,** is the sum of the constant price per decare, multiplied by the irrigated hectares, and the price per cubic meter (m^3), multiplied by the volume of water delivered.

In the public discussion about applying the Tables (Annex 1 and 2 from Methodology approved by the Minister of Agriculture and Forestry by letter No. 70-1851 / 04.05.2018, it is found that the calculated price for water supply is not corresponding to the activity of irrigation – meaning large amount for constant price for decare in the first and each subsequent irrigation and extremely low price of the delivered volume of water.

Although the supply service is oriented towards WATER and considering the different water consumption norms (*water need of a particular crop according to the way of water supply in the property with indicative irrigation standards once by dripping - 30 cubic meters/decare, by sprinkling - 70 cubic meters/decare and by gravity –110 cubic meters/decare*), it does not matter how is irrigated, because the total value of the service was almost the same.

The approaches over the years have been on a similar principle, with the main aim to cover the expenditures. Profit is not calculated in the price - it is a result of the forecast. The estimation of the expected costs is a result of a careful calculation, on the basis of prognosis for planned farming, past periods and practical experience.

After price analysis is noticeable that in recent years, despite the changes that have been made in regulatory terms, the size of the price, as expense for the farmer is kept in the same range without abrupt changes, which is an important mechanism for preservation of agriculture in the region of Plovdiv, and a prerequisite for its development.

Description of water shortage risks and how this can affect to agriculture production

According to an analysis of projected water demand, Bulgaria is not a water stressed country. Over 60 rivers flow through Bulgaria, the Danube, is the longest one with 470 km within Bulgaria.

The identified risks which can affect agriculture production are:

- Increase in periods of heavy rainfall putting drainage systems under stress, leading to more frequent and more severe flooding.
- Heavy rains and muddy streams interrupting the functioning of pumping stations that are part of the irrigation systems
- Continuous dry periods and soil shrinkage causing the formation of expansion gaps in the earth and deformation of the hydro-melioration canals
- Hotter, drier summers leading to increased irrigation needs that, in combination with less water stored in dams, can lead to water shortage (Generation and discharge of wastewater, 2018).

Non-irrigated sector in the region

The entire irrigation system branch Maritsa's network was set up to serve 108,181 ha of agricultural land by gravity irrigation. Only 73,703 ha are currently supplied through the company's network. The remaining 34,478 ha of irrigation systems have to be restored because they have been compromised over the years, and the respective areas are officially under non-irrigable crop cultivation. Therefore, there are areas in the region of Plovdiv, for which the IS cannot provide any water quantities due to lack of water resources or reduction over the years, lack of infrastructure (dams) – almost whole the territory of the municipalities Karlovo, Sopot and Asenovgrad.

In the irrigation priority is given to feed the rice cells with water and to keep the full quantity of water necessary for its growing in the 4-month season - 0.024 hm^3/ha and then for the other crops. Number of rice farms in Plovdiv region is 51 and the rice areas are more than 7,250 ha. Water needed for their use is 174 hm^3/season (year) (Rice production, 2018).

Agribusiness_description

Structure of agrifood firms (average size)

The market for agrifood products in Bulgaria is quite fragmented. Sixty percent of the products for this sector comes out of small and medium-sized companies. The sector is expected to consolidate in the near future. The sector has a strong export orientation.

Food industry structure and stakeholders

The food and beverage industry are boosted by the rapidly developing farming sector. Production is carried out by about 5 500 companies with almost half of them located in the South-Central and South-West region. Region of Plovdiv is one of the main centres of fruits and vegetables processing (fruits and vegetables canning and drying), where are located some of the top companies in the food industry with international importance.

International trade

The contribution of the agri sector to the country’s external trade is quite significant. About 72 % of Bulgarian exports of agricultural produce went to the EU, while Russia, Ukraine, Turkey, and the Arab countries recovered their former position as major export markets.

Competitiveness of Agri-business sector

The food industry ranks first in the territory of the Plovdiv region with about 30% of the total production in the region. The main problem in development of the agricultural sector is the competition of imported products which leads to negative trends and demotivation of producers.

International Fair Plovdiv organizes over 40 exhibition events per year. Among them is the only Balkan mega forum for agribusiness, food, wine and tourism, which brings together six exhibitions, related to agriculture, manufacturing and supply of food, wines and spirits. Each year, over 8,000 exhibitors from 60 countries and 250,000 visitors from Bulgaria and Europe take part in the business forums, representing about 250 sectors.

R+D support institutions

The state administration has assessed Plovdiv's need for a new economic cluster related to the integration of agricultural production and food technologies, which will fundamentally change its economic profile. Thus, the concept of creating a high-tech cluster with the name “Agro Food Tech” was set up in the city.

"Agro Food Tech" is a high-tech park, representing an administrative, business, logistical, scientific and production centre of the national cluster of food and food technologies. The Park is a cluster initiative bringing together companies, laboratories and agencies from all areas of agriculture and the food industry. The park is a combination of innovation and entrepreneurship that covers the territory of several municipalities - Plovdiv, Maritsa, Rodopi, Saedinovo, Karlovo, Kaloyanovo, as well as municipalities from neighbouring areas such as Pazardzhik and Stara Zagora. It is a territory where all kinds of agricultural produce are developed; there are key agricultural education units and several scientific institutes. At the same time, this territory has extensive experience in the storage, distribution and development of varieties for agricultural production.

Water user associations, role in water distribution and structure

Currently there are eight Irrigation associations (IA) existing on the territory of "Irrigation Systems" – Maritza Branch with total Serving area of 6,944.9 ha and water demand for irrigation of 13.89 hm^3/year. These associations represent landowners in the respective region and use natural water sources on their territory after the corresponding permit issued by the Basin Directorate EARB for autonomy of the irrigation method.

None of the Irrigation Associations (IA) in the territory of "Irrigation Systems" EAD - Maritsa Branch (IS) uses the irrigation infrastructure facilities of the IS company. The state company IS providing only water supply for water tank for irrigation of one of the IA, called “Water Paradise”.

Existing related initiatives

This section should extend the information provided in section 5 about networks and projects.

Name of the network/project	Purpose	Leader/coordinator and relevant organizations involved.
WATenERgy CYCLE	The overall objective of WATenERgy CYCLE is to optimize the integrated water supply management regarding sustainable long-term water demand & resources (water/energy) availability & water supply systems efficiency related to climate change & socio-economic aspects. The	Municipal Water Supply and Sewerage Company of Larissa, GR; Bulgarian Water Association, BG; Joint Stock Company Water Supply and Sewerage Korce, Albania; Ministry of Environment and Energy, GR; Municipal Enterprise for Water

	project aims at increasing the level of adaptation to resources efficiency & climate change resilience measures up to 0,25%.	Supply and Sewerage of Kozani, GR; Public Communal Enterprise Water Supply and Sewerage – Prilep, Republic North Macedonia; University of Thessaly, Department of Civil Engineering, GR; Water Board of Nicosia, CY;
PROAKIS	PRO AKIS had the following objectives: Develop a conceptual framework for the assessment of AKIS Provide an inventory of the AKIS institutions & interactions in the EU-27 as a searchable database Using case studies, investigate challenges around: - small-scale farmers' access to relevant & reliable knowledge - bridging scientific research topics & farmers' demands - offering appropriate support for diverse rural actors that form networks around innovations in agriculture & rural areas - Reveal successes, strengths & weaknesses of the specific knowledge systems through comparative analyses & assessments of these case studies - Develop policy recommendations for strengthening European agricultural innovation systems	Katrin Prager, James Hutton Institute, UK University of Hohenheim, Germany Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) e.V., Germany Institut National de la Recherche Agronomique (INRA), France Universidade de Trás-os-Montes e Alto Douro (UTAD), Portugal Uniwersytet Rolniczy im. Hugona Kollataja w Krakowie (UAK), Poland Agricultural University – Plovdiv (AUP), Bulgaria Videncentret for Landbrug (VFL), Denmark
ENABLING	Europe bears a significant potential to create, develop, manage and exploit innovative supply chains in the field. Knowledge and innovation capacities are there. However, such potential lies unexploited due to a lack of "enabling conditions" within the regional or national contexts. The main goal is to support the spreading of best practices and innovation in the provision (production, pre-processing) of biomass for the BBI (Bio-Based Industry). In particular, ENABLING aims at creating appropriate conditions for the development of efficient biomass to BBPs (Bio-Based Products and Processes) value chains.	Giorgia Noaro, Federunacoma, IT; Bulgarian Biomass association, BG ENABLING is the initiative of 16 partners in 13 EU and associated (IL, NO) countries.

	ENABLING is based on the consortium's vision that the biomass to BBPs value chains can enhance economic growth, a sound management of natural resources and positively contribute to job-creation in the regions and countries where they can be deployed.	
Sustainable water reuse	Municipality of Plovdiv implemented a site development project for *Collecting and management of rainwater* with the purpose of building a recreation area of 1000 m^2 from the northern tunnel under the Ancient Theatre. It includes 500 m^2 of green areas, the care of which is provided from a newly built sustainable irrigation system with rainwater and the water used for cleaning the same area. The project includes a 7 m^3 irrigation tank in which it is captured and stores rainwater from two sites. Water is collected by means of linear drains and a sewerage system. The facility includes a shaft settler, infiltration tank, submersible pump and overflow for excess water connected to sewerage network. At the exit the rainwater is taken to terminals to which drip hoses are mounted.	Municipality of Plovdiv

Discussion and conclusion remarks

At country level, there is no annual water resource deficit. The seasonal flow variations of surface water bodies are regulated by enough numbers of reservoirs. However, there are regions, suffering from water shortage for water supply needs in the summer months. The East Aegean River Basin is with highest amount of available water resources except the Danube River Basin, because of its huge external inflow. In addition, two-third of the groundwaters and one-third of the surface water bodies are in a good ecological status. The Black Sea River Basin has the smallest percentage of achieved objectives (5 percent) for surface water bodies and the highest number of groundwater bodies in “poor condition”.

Bulgaria has a significant stock of hydraulic storage capacity, including 216 large dams. The total capacity of 53 multi-purpose and significant dams amounts to 6,697.8 hm^3. Twenty-three of them are in the East Aegean Region, representing a total storage volume of 3,105.5 hm^3. In the period 2007–2015 there was a steady reduction in the volumes of abstracted water (decline of population, irrigation, and industrial use). Surface water resources are used mainly for industrial needs (cooling and energy production), while groundwater resources are used mainly for domestic water supply.

Despite the highest improvement dynamics in this subsector, in general till now the biggest part of the infrastructure is outdated as well as designed and operated without climate change considerations. On the other hand, future investments in the urban WWT sector is a good prerequisite for reclaimed water use in case of right planning.

The melioration infrastructure is either destroyed or in poor condition. Insufficient maintenance and monitoring related to engineering safety have created a situation, which represents risks to the population, settlements, agricultural land, and the infrastructure. In view of climate change, the probability of these risks increases.

There are good interconnections between different players in water sector that is a premise for future development in the field of reclaimed water use. The use of reclaimed water in Bulgaria is not regulated. In Plovdiv district there are several private initiatives related to the use of reclaimed water for irrigation of crops. Stimulation measures (financial and legislative) are needed to push the development of the sector.

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