

# *Some Aspects of the Water Crisis in Bulgaria*

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**Abstract.** The failure of providing reliable water supply with standard water quality to the households is seen as a specific aspect of the water crisis. In this study, the drinking water supply of the households in Northeastern region of Bulgaria (Varna, Shumen, Dobrich, and Targovishte districts) for the period 2010-2021 was studied and analysed. During the studied period, the relative share of population affected by lack of drinking water supply for over 180 days per year varies between 0.0% in 2011 to 0.7% in 2020 of the total percentage of affected population on national scale. For Varna and Dobrich districts, the share of the affected population from prolonged interruptions in the water supply does not exceed 1%. The most severely affected is the Targovishte district's population, where between 8.8% in 2010 and 24.3% in 2020 experience water supply regime with long, regular interruptions of water supply. In the municipality of Omurtag, approximately 80% of the population does not receive continuous water supply. Households in some of the villages in this municipality receive regulated water supply once every 480 hours. Based on the analysis, settlements with a regime of water supply and poor drinking water quality were identified, as well as the time intervals of supply interruption for the period studied. The main reasons for the manifestations of this specific aspect of the water crisis in Northeastern region of Bulgaria were identified. The shortage of water and the inability to provide households with the necessary water quantities with the required quality confronts Bulgaria with an ever-growing problem, the solution of which requires a complex institutional response, including from the water supply and sewerage sector.

**Keywords:** households, water crisis, water supply

## I. INTRODUCTION

The water crisis has many aspects- environmental, economic, health-related aspect. At the same time the water crisis is rooted simulations to the unequal distribution of freshwater resources and climate change on

one hand and to the constantly increasing water needs and water consumption of modern societies of the other hand. Increasing water scarcity is one of the major global challenges today. As the water demand from industry, agriculture, households and the ecosystems rise above available supply in many regions, the maintenance and further development of water infrastructure and governance over water resources become major issues to achieve water security at all levels, as it is shown in [1], [2]. The United Nations recognise the sustainable provision of population with clean water and sanitation as one of the 17 global goals for sustainable development, listed in the UNEP Agenda 2030.

Today, 780 million people still lack sustainable access to safe drinking water and another 2.5 billion lack basic sanitation. [3]. We see the failure of providing reliable water supply with standard water quality to the households as a specific aspect of the water crisis too. Even if the fair access to water can't be a matter of daily survival in Bulgaria, and 99.1-99.5% of the population benefits, being connected to public water supply system there still is a significant room for improvement.

The identification of changes related to water management involves not only the demand but also the supply of this resource. Water scarcity is an emerging threat, facing challenges requiring institutional reforms in the water sector. Considering the specifics of the regional distribution of water resources, the question "Who and when can use water equally and efficiently?" will contribute to the loss of local balance and the creation of a competitive environment, with severe consequences for many regions in the country [4]. The water crisis confronts the population with three main problems related to the quantity and quality of water resources, access and increase in freshwater consumption and water losses.

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The conservation and restoration of natural resources are the necessary steps in minimizing the effects of the global water crisis [5], [6], [7]. The use of innovative remote sensing methods, as in [8] and [9] could contribute to the registration of accidents, leaks and losses on the water supply network. At present, their use is limited to pilot projects.

## II. MATERIALS AND METHODS

To develop a comprehensive and clear analysis of the provision of water services, with a focus on public water supply, statistics from the National Statistical Institute of Bulgaria were used. The statistical data used in the analytic work data are based on annual statistics in the Water Supply and Sewerage sector and are derived from a comprehensive monitoring of the country's water supply for the period studied. In addition, publicly available data from official reports from water companies, municipal administrations, etc. was used. The data are based on annual statistics in the Water Supply and Sewerage Sector and are derived from a comprehensive monitoring of the country's water supply for the period studied.

The relative share of a population with a water supply regime is calculated as a share of the connected population with public water supply. The indicator covers the population with a water supply regime due to drought (water scarcity) [10]. The study adopted 2 categories with a water supply regime, in which the water regime is seasonal in nature and covers a period of up to 180 days a year and year-round over 180 days a year.

The survey was carried out using data on water supply in statistical regions. The analysis covers the statistical regions NUTS-2, according to the classification of territorial units for statistics, and for the statistical Northeastern region and at NUTS-3 level, which corresponds to an administrative territorial unit - district.

Of interest is the Northeastern region of Bulgaria, which includes Varna, Shumen, Dobrich and Targovishte Districts.

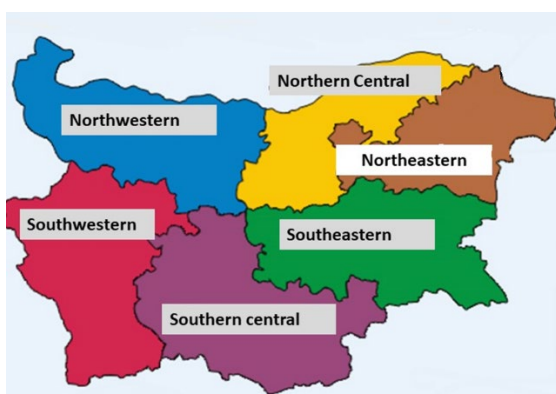


Fig.1. NUTS-2, Bulgaria

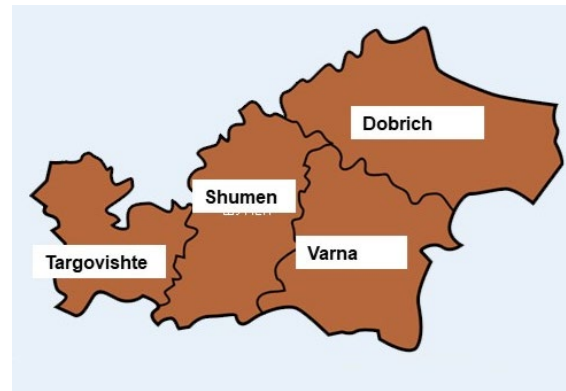


Fig. 2 NUTS-2, Northeastern region, Bulgaria

The reported data for analyses related to population density for Varna district is at 123 inhabitants per sq. km, while the national average population density is 63 inhabitants per sq.km. That makes Varna district the second most populous in the country. The other districts in the Northeastern region are significantly less populated: Shumen District - 51 inhab/km<sup>2</sup>, Targovishte District - 41 inhab/ km<sup>2</sup> and Dobrich District - 31 inhab/ km<sup>2</sup> (based on national statistics of 31.12.2022). Dobrich district contains 215 settlements – town and villages, Targovishte district - 194, Shumen - 151, and Varna – 159 settlements.

## III. RESULTS AND DISCUSSION

Irregularity of water supply is a long-lasting persisting problem in many districts in Bulgaria.

In the Northeastern region shows a specific feature regarding households' water consumption. Targovishte District persistently shows the lowest level of water used by households from public water supply on average per person in the country. Long-term levels of reduced drinking water use: from 58 liters per person per day, registered in 2010. to 72 liters per person per day in 2022, vs. the national average of 97 l/h/day in 2010. and 103 l/h/day for 2022, as it is presented in Table I.

For the studied period from 2010-2021. in Bulgaria, the population affected by lack of water supply due to drought ranged from 0.6% (45, 206 inhabitants) in 2014. to 6% (418,546 persons) in 2019. [10]. The percentage share for 2021. It accounts for 2.5%, equivalent to 171, 944 persons. Population with seasonal water supply regime formed between 0.5% (36,120 inhabitants) in 2014. to 5.8% (404,594. inhabitants) in 2019. of the total percentage of affected population for the country. By 2020. accounted for 3.3% (228 823 inhabitants) and in 2021. 2.4% (165, 065 inhabitants) of the total for the country share of population affected by a water supply regime. The influence of a population with a water supply regime of more than 180 days a year, which occupies between 0.0% in 2011, is negligible. to 0.7% (48,538 inhabitants) in 2020. [10] (Fig. 3).

TABLE I. AVERAGE HOUSEHOLDS' WATER CONSUMPTION, 2010-2022, L/PERSON/DAY

Year	Districts				Region	
	Varna	Dobrich	Targovishte	Shumen	Northeastern	Bulgaria
2010	97	73	58	74	82	97
2011	94	78	64	78	84	100
2012	95	80	64	81	86	102
2013	93	68	65	86	84	99
2014	90	75	67	79	82	96
2015	92	78	67	81	84	99
2016	94	78	69	80	85	100
2017	95	78	68	80	86	99
2018	94	78	69	78	85	99
2019	97	80	66	78	87	99
2020	101	84	68	76	89	102
2021	99	83	64	79	88	102
2022	105	90	72	83	95	103

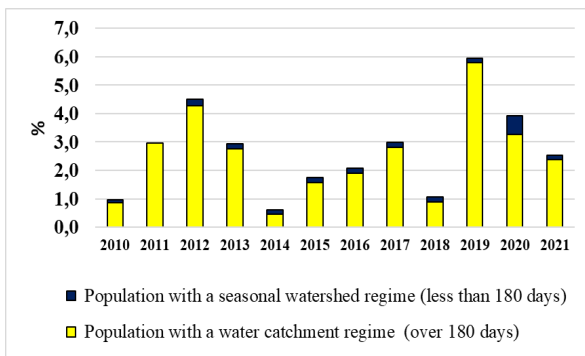


Fig.3. Relative share of population on water supply regime, Bulgaria, 2010-2021, [%.]

According to official statistics on the number of the population in the country for the studied period, the uneven trend with a decrease in the percentage of population affected by the water supply regime is accompanied by a decrease in the urbanization of the country.

As the main cause of a population with a water supply regime of seasonal type is determined by the type of feeding and the balance of river systems. Thus, the uneven distribution of water resources in the country determines the uneven distribution of a population with a water supply regime.

Household water use is only 5-6% of the total water used. The highest use values were 271.01 million m<sup>3</sup> recorded in 2012 and the lowest were 250.48 million m<sup>3</sup> in 2019. The quantities of water used vary within a narrow range for the whole studied period. Since 2014 until 2019 there is a decline in water consumption in the household sector. These results reflect a stable water use in the segment over the past decade. The general trend is towards a slight decrease in the water use from households.[11]

When considering regions in the country by territorial distribution, the results are identical. The Northwest region accounted for 0.2% in 2018. to 23.9% in 2019. of the total percentage share. For the North Central region, data vary between 0.7% in 2014. to 5.8% in 2012. For the Northeastern region ranged from 1.1% in 2011. to 5.6% in 2020. The Southeastern region accounted for between 0.0% in 2015 and 2016. and 4.5% in 2020. For the South-East region, % ranged between 0.0% in 2014. to 5.5% in 2020. For the South Central region, the relative percentage share is between 0.1% in 2014. to 1.5% in 2020. [12] (Fig.4). Of interest is the Northeastern region, which includes Varna District, Shumen District, Dobrich District and Targovishte District, shown in Fig. 5

During the studied period, the percentage share of Varna and Dobrich districts was insignificant, not exceeding 1%. Shumen District accounted for 0.0% in 2010 and 2011. to 12.5% in 2020. (21 473 inhabitants) of the total % for the region. The most significant percentage of population with a water supply regime is in the district of Targovishte, where in 2010 according to data they were 8.8% (11 249 inhabitants), and in 2020. reaches 24.3% (or 26 272 inhabitants).

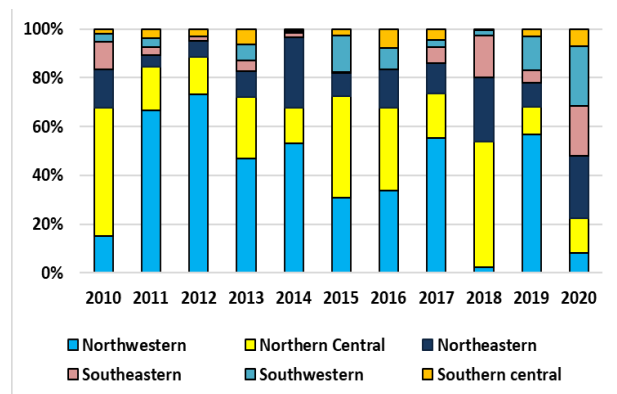


Fig. 4. Relative share of population on water supply regime by NUTS-2, Bulgaria, 2010-2020, [%.]

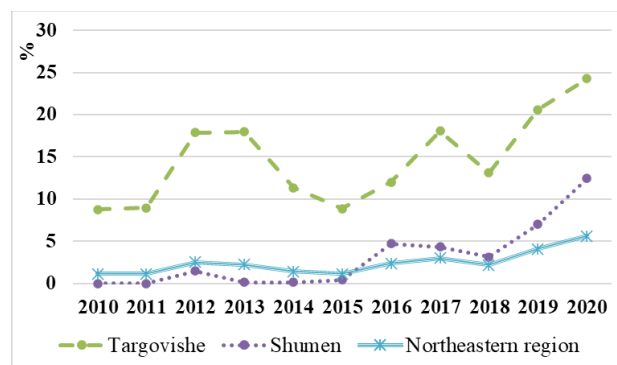


Fig. 5. Relative share of population on water supply regime, Northeastern region, Bulgaria, 2010-2020, [%.]

Targovishte District's water supply system serves 5 municipalities (Targovishte, Omurtag, Opaka, Antonovo and Popovo) and includes 134 urban water supply zones. A total of 746km external water mains and 1375 km of internal water mains were built to supply the settlements in the district. The condition of the water supply network is severely deteriorated. The total water losses, Northeastern region, for the studied period, vary from 59 to 61% of the total water supplied.

Targovishte region is poor in water resources - more than 95% of the more than 300 water sources have a flow rate of less than 5 l/sec. and are dependent on rainfall, with some of them drying up in years with poorer rainfall which limits the normal water supply. In the region rainfall is below the average annual rainfall amounts for the country, with a summer maximum in June and a winter minimum in February. The snow cover lasts for about 44 days. The rivers are low-water, with small catchment areas. River flow is erratic. All rivers have a snow-rain regime. Karst springs in the area have a small flow rate and their importance is related only to the water supply of some smaller settlements. Almost all catchments and drains are shallow subsoil and their flow rates are rapidly influenced by atmospheric conditions [13].

The most severe is the water supply regime for the municipality of Omurtag, where about 80% of the population does not receive continuous water supply [14]. The municipality of Omurtag has a total population of 20674 and is supplied with water from 29 water supply zones, 12 of which distribute water below 10 m<sup>3</sup> per day, 16 zones distribute water from 10 to 100 m<sup>3</sup> per day, and only one is a large water supply zone "Kipilovo".

The town of Omurtag and villages of Veselche, Zmeino and Pticevo are supplied with water from a captured spring BG2G00000K2033 Kipilovo", located in the village of Kipilovo, Kotel municipality, Sliven district, part of the Kotel Karst Basin [10]. The main quantitative features of the underground water body are presented in Table II.

TABLE II. DISTRIBUTION OF WATER QUANTITIES UNDERGROUND OF WB BG2G00000K2033, 2014 - 2022, [L/s].

Year	Free water quantities	Permitted water quantities	Available water resources
2014	718.12	39.88	758
2015	714.36	57.64	772
2016	730.94	57.64	792
2017	693.11	95.47	792
2018	743.35	95.63	842.4
2019	660.32	95.66	759.4
2020	662	96.98	762.4
2021	656.07	94.91	754.4
2022	660.07	94.91	758.4

Water losses along the route from the water source to the town and in the internal network are significant which is why the city is on regime water supply. The internal water supply network of the town of Omurtag is 25 km long. The plumbing diversions are constructed of galvanized pipes, which are subjected to rapid corrosion. All this leads to daily accidents, large losses, and impaired water supply of the population.

According to the Targovishte Water Supply and Sewerage Company, the reasons for the water crisis in the area are due to water shortages in the water source, interrupted power supply to the "Kanino" PS and a

compromised water supply and internal water supply network [11].

The water crisis affects the town of Omurtag with a year-round water supply regime, as well as many settlements in the municipality. Some of the villages are supplied with water from other water sources but nevertheless the population suffers from water supply irregularity. Households in some villages in this municipality receive regulated water supply once every 480 hours, for others there is no water supply due to water scarcity in the water source. The affected population of lack of water varies between 30-430 people, depending on the settlement. During the winter months (December and January) the population of town of Omurtag has access to drinking water for only 2 hours every 72 hours. During the summer months (August) the water supply is limited to 3-4 hours in every 20 hours [15]. The situation worsens in an accident on the water supply network, after its removal the water travels 11 hours on the extremely long route. This also changes the water supply planned by the water supply to the settlements. Priority is given to educational and social institutions. The hospital in the city has the tanks with the help of which the hospital serves patients. The water crisis affected 4,002 people in the town.

There is an alternative solution to use water from the Yastrebino dam. The conducted preliminary analyzes regarding water quality show that there are no deviations from drinking water standards. The location of the Yastrebino dam shows a promising section for a new water catchment for the needs of the local water supply company, but it would also significantly reduce drinking water losses along the route. Currently, regional studies are being carried out - pre-investment studies for the entire region.

#### IV. CONCLUSIONS

We define the inability of providing reliable water supply to the population with clean drinking water in many regions in Bulgaria as a specific dimension of the water crisis in the country. From the data presented, it is clear that in the Targovishte district, and more specifically in the municipality of Omurtag and other small settlements, the seasonal and year-round subjugation of the population to the water supply regime is a significant, persistent problem.

The deepening of the problem in the Northeastern region has continued in recent decades, with the relative share of the population affected by systemic interruptions in water supply continuing to increase from 1.1% in 2011 to the 5.6% in the end of the study period (2021). The manifestation of the crisis in the Targovishte district is extreme, where the affected population has grown more than twice (from 11,249 inhabitants in 2010 to 26,272 inhabitants in 2020). This cannot be explained only by the prolonged seasonal droughts, reflecting on the capacity of the water sources from which the supply of drinking water is provided. The total water losses throughout the country are huge, as their main component is the real water losses. The Targovishte water supply system in particular are in a deplorable state and needs immediate rehabilitation and/or replacement and real losses drastic reduction.

In addition, the low flow rate of the spring Kipilovo, the difficult-to-access terrain to the water source contribute to the serious water insecurity of the town of Omurtag. One possibility to eliminate the interruptions of water supply and to limit the effects of drought is to expand the range of water sources used for water supply and further development of water supply and sewerage infrastructure. For more than 10 years, the potential of the Yastrebino dam has remained unused, which demonstrates a lack of adequate timely actions on the part of water supply and sewerage companies, in order to ensuring water supply safety and security.

To eliminate the manifestations of the water crisis, coordinated actions by the state and the water supply and sanitation sector and change of water resources' management at all levels and are needed.

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