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ASSESSMENT OF THE DRINKING WATER DEMAND FOR WATER SUPPLY OF THE VILLAGES LOCATED IN THE AREA OF BARLAD HYDROGRAPHIC BASIN

Paula COJOCARU, Gabriela BIALI

"Gheorghe Asachi" Technical University of Iasi,
Faculty of Hydrotechnics, Geodesy and Environmental Engineering,
63-65, Prof. dr. docent Dimitrie Mangeron B, 700050, Iasi, Romania

Corresponding author email: paula.cojocaru@yahoo.com

Abstract

The paper consists of the calculation of drinking water demand for water supply of the villages from Barlad hydrographic basin. We took into account a total of 137 parishes in 6 counties (Vaslui, Bacau, Galati, Iasi, Neamt, Vrancea), 3 municipalities (Vaslui, Barlad and Tecuci) and two cities (Husi and Negresti). The total number was 647 735 inhabitants. The calculation of drinking water demand was done taking into account the distribution of the number of inhabitant for each parish, municipality and town according to the population census conducted in 2013 and also by respecting the Romanian standard STAS-SR 1343/1-2006 regarding to the calculation of drinking water demand for urban and rural areas. This yields to the following flow of drinking water demand for the resident inhabitants in the territory of Barlad catchment: Qzimed = 94575.57m^3/day, Qzimax = 135178.03 m^3/day, Qorarmax = 13963.91 m^3/day. The annual volume of drinking water demand is 34525.024 thousand m^3. During the calculus no account was taken of the water required for fire blow out.

***Key words**: drinking water, demand, Barlad catchment, inhabitants, flow.*

INTRODUCTION

Water is the planet resource that underlies the quality of life and its lack or pollution of water resources is a major concern worldwide.

Providing access to drinking water is a prerequisite for social and economic development and environmental protection (Sancin et al., 2015; Wang et al., 2014; Jain, 2012).

An overview of the factors affecting water quality was conducted by V. Goncharuk, 2014. He pointed out current issues in technology for the preparation of drinking water from centralized treated drinking water installations, role of natural organic compounds, he analyzed different technological modern measures of drinking water treatment and he evaluated the influence of the distribution system status towards the water quality.

In order to protect public health, natural resources and ecosystems, monitoring programs are required to provide relevant and timely information, spatial and temporal models of the contaminants and a number of screening strategies (Brands et al., 2008). There are also required risk management strategies for drinking water systems (Marsalek, 2009; Dore, 2014), and in some cases, new standards on requirements and water quality control (V. Goncharuk, 2014), new concepts to provide quality drinking water to the population (V. Goncharuk, 2008). Knowing the chemical situation of water from deep boreholes located in Barlad basin (Cojocaru et al., 2015) in this paper we propose to calculate which water supplies we need for supplying water to the residents of this basin.

MATERIALS AND METHODS

Barlad river basin has a total area of 7354 km^2. In this area there are a total of 137 parishes belonging administratively in 5 counties: Vaslui (70 parishes), Bacau (15 parishes), Galati (23 parishes), Iasi (18 parishes), Neamt (8 parishes) and Vrancea (3 parishes). To all these it must be added a number of three municipalities (Vaslui, Barlad and Tecuci) and two cities (Husi, Negresti). Population living in all these municipalities, cities and parishes comprises a total of 647 735 inhabitants.

Calculation of drinking water supply for these people was done taking into account the following legal, social and environmental impact prerequisites:

- data on the number of inhabitants, according to population census conducted in 2013;
- compliance of the Romanian standard STAS SR1343/1-2006 regarding the demand calculation of drinking water supply for urban and rural areas; it was not considered also the water demand for firefighting;
- a total demand associated with the actual stage (qg) as it follows:

- of 60 l/capita/day in the case of drinking fountain located in yards without a sewerage system;
- of 120 l/capita/day for the consumers with interior cold and hot water supply and a sewerage system, with individual preparation of the hot water;
- of 180 l/capita/day for the population that lives in a block of flats.

According to STAS 1343/2006 the drinking water demand N is calculated using the following relation:

$$N = U \cdot qg/1000 \quad (m^3/day)$$

where: U is the total number of people from the area in which we want to set up the centralized drinking water supply system; qg - the specific flow for people needs, with its values previous presented.

The water requirement, C, is calculates using the relation:

$$C = K_s \cdot K_p \cdot \Sigma N$$

where: K_s - coefficient that takes into account the technological needs of the installations, K_s=1.05, K_p - coefficient that takes into account the technically permissible water losses in the supply and distribution network, K_{sp}=1.15.

N - the water demand previously calculated;

D - the length of time that was calculated the water demand (s; day or month).

The calculus flow of the water supply system Qszimed, Qszimax si Qsorarmax have been calculated using the following relations:

$$Qszimed = C \quad (m^3/day)$$

$$Qszimax = Qszimed \cdot K_{zi} \quad (m^3/day)$$

$$Qsorarmax = K_o/24 \cdot Qszimax \ (m^3/hour)$$

where: Qszimin is the minimum flow of water requirement, calculated in the hypothesis of normal operation; Qszimed is the average daily flow of water requirement, calculated in the hypothesis of normal operation; Qsorarmax is the maximum hourly flow of water requirement, calculated in the hypothesis of normal operation;

24 - the total number of hours when there is water consumption;

K_s, K_p, N - have previously described meaning;

K_{zi}- ununiformity coefficient of the daily flow; as function of the type of water supply use the value of K_{zi} coefficient is: for areas with block of flats K_{zi} = 1.35; for areas with houses having interior installations for water supply and sewerage: K_{zi} = 1.4; for areas with houses having drinking water fountain without a sewerage system, K_{zi} = 1.8.

K_o - hour variation coefficient, K_o = 3.

RESULTS AND DISCUSSIONS

In Figure 1 we can see land demarcation of parishes and large localities located in Barlad catchment area and in Table 1 shows the distribution of the number of inhabitants on this site, according to the population census conducted in 2013.

Following the realized previously revealed calculus, it resulted the following flow rates of water requirements centralized presented in table 2.

It is noted that the total amount of water needed in a year (WNT) to supply water to all residents of Barlad catchment, is: W_{NT} = $34525 \cdot 10^7$ (m^3/year) the total daily maximum flow is: Qzimax = 135178.03 (m^3/day). The required flow for cities and municipalities represent 65% of the total flow. The highest rate from the total flow is assigned to Vaslui district (76093.46 m^3/day), followed by Galati district (32847.34 m^3/year) and Iasi district (12062.44 m^3/year). These flows depend on and are consistent with the number of inhabitants; Vaslui is the city with the most residents in Barlad catchment.

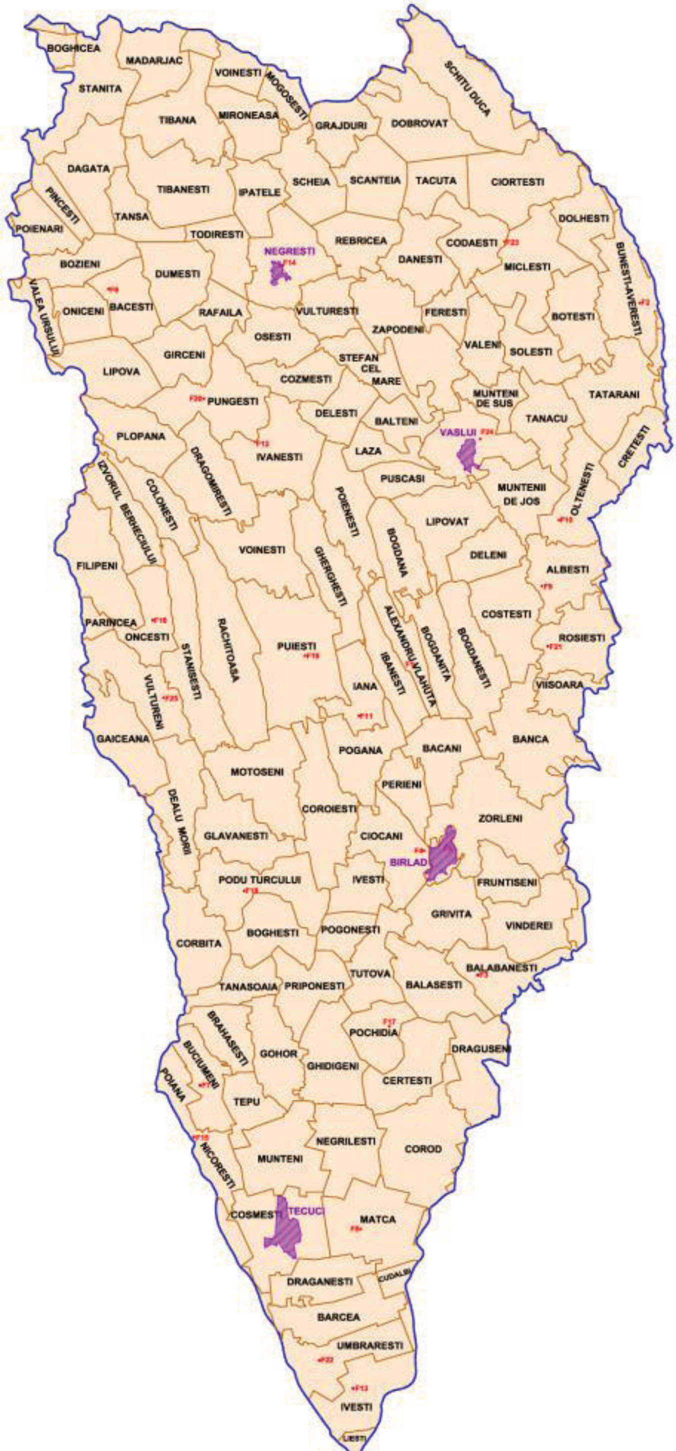

Figure 1. Land demarcation of parishes and large localities located in Barlad catchment area

Table 1. The distribution of the number of inhabitants located in Barlad catchment area

	District	Munic./Town/ Parish	No. inhabitants		District	Munic./Town/ Parish	No. inhabitants
0	**1**	**2**	**3**	**0**	**1**	**2**	**3**
1	VASLUI	Munic. Vaslui	55407	19	VASLUI	Costesti	2953
2		Munic. Barlad	55837	20		Cozmesti	2202
3		Oras Husi	26266	21		Cretesti	1790
4		Oras Negresti	8380	22		Danesti	2205
Total municipalities and cities district Vaslui			**145.890**	23		Deleni	2257
5	VASLUI	Albesti	2893	24		Delesti	2358
6		Alexandru Vlahuta	1550	25		Dragomiresti	4900
7		Banca	5389	26		Duda-Epureni	4397
8		Bacani	2814	27		Dumesti	3334
9		Bacesti	4107	28		Epureni	3081
10		Balteni	1523	29		Feresti	1897
11		Bogdana	1602	30		Fruntiseni	1795
12		Bogdanesti	3242	31		Gherghesti	2595
13		Bogdanita	1437	32		Girceni	2443
14		Botesti	2049	33		Grivita	3293
15		Bunesti-Averesti	2592	34		Iana	3870
16		Ciocani	1638	35		Ibanesti	1451
17		Codaiesti	4362	36		Ivanesti	4495
18		Coroiesti	2014	37		Ivesti	2409
38	VASLUI	Laza	3114	**Total parishes district VASLUI**			**203790**
39		Lipovat	3960	**Total for Vaslui district**			**349680**
40		Malusteni	2462	73	BACAU	Colonesti	2106
41		Miclesti	2636	74		Dealu Morii	2739
42		Muntenii de Jos	3584	75		Filipeni	2286
43		Muntenii de Sus	2763	76		Gaiceana	3069
44		Oltenesti	2515	77		Glavanesti	3321
45		Osesti	3157	78		Huruiesti	2578
46		Perieni	3536	79		Izvorul Berheciului	1537
47		Pochidia	1629	80		Lipova	2890
48		Pogana	2992	81		Motoseni	3505
49		Pogonesti	1561	82		Oncesti	1621
50		Puiesti	4661	83		Parincea	3588
51		Poienesti	2855	84		Plopana	3059
52		Pungesti	3223	85		Podu Turcului	4617
53		Puscasi	3328	86		Rachitoasa	5080
54		Rafaila	1835	87		Rosiori	2097
55		Rebricea	3451	88		Stanisesti	4514
56		Rosiesti	3151	89		Vultureni	2071
57		Solesti	3623	**Total parishes district BACAU**			**50678**
58		Stanilesti	5117	90	GALATI	Mun. Tecuci	34871
59		Stefan cel Mare	3160	**Total municipalities and cities district Galati**			**34871**
60		Suletea	2288	91	GALATI	Balanesti	2080
61		Tanacu	2040	92		Balasesti	2295
62		Tacuta	3248	93		Barcea	4957
63		Tatarani	2171	94		Beresti-Meria	3771
64		Todiresti	3214	95		Brahaiesti	8847
65		Tutova	3311	96		Buciumeni	2326
66		Vsleni	4022	97		Corod	7334
67		Viisoara	1909	98		Cosmesti	5196
68		Vinderei	4025	99		Cudalbi	6319
69		Voinesti	3757	100		Dragusani	4899
70		Vulturesti	2236	101		Draganesti	4852

71		Zapodeni	3724	102		Ghidigeni	5821
72		Zorleni	8595	103		Gohor	3193
104		Ivesti	8441	127		Schitu Duca	4354
105		Liesti	8902	128		Scheia	3067
106		Matca	11605	129	IASI	Tibana	7273
107		Movileni	3269	130		Tibanesti	7119
108		Munteni	6791	131		Voinesti	6815
109		Negrilesti	2405	**Total parishes district Iasi**			**63426**
110		Nicoresti	3602	132		Bara	1680
111	GALATI	Poiana	1686	133		Bozieni	2716
112		Priponesti	2223	134		Gadinti	1983
113		Radesti	1490	135		Oniceni	3388
114		Tepu	2399	136	NEAMT	Pancesti	1350
115		Umbraresti	6628	137		Poienari	1453
116		Valea Marului	3894	138		Stanita	1966
Total parishes district Galati			**125225**	139		Valea Ursului	3874
117		Ciortesti	3979	**Total parishes district Neamt**			**18410**
118		Dagata	4599	140		Boghesti	1680
119		Dobrovat	2515	141	VRANCEA	Corbita	1793
120		Dolhesti	2638	142		Tanasoaia	1972
121		Grajduri	3563	**Total parishes district Vrancea**			**5445**
122	IASI	Ipatele	1865	**Total Municipalities and Cities**			**180761**
123		Madarjac	1587	**Total Parishes**			**466974**
124		Mironeasa	4521	**TOTAL BARLAD CATCHMENT AREA**			**647735**
125		Mogosesti	5242				
126		Scanteia	4289				

Table 2. Flow of water requirement for residents located in Barlad catchment area

District	Qzimed		Qzimax		Qorarmax		Total volume of drinking water requirement (thousands m^3)
	m^3/day	l/s	m^3/day	l/s	m^3/day	l/s	
Vaslui	53685.10	621.36	76093.46	880.71	7180.48	1994.58	19600
Bacau	6608.92	76.49	9638.01	111.55	1204.75	334.65	2412.255
Galati	22899.24	265.04	32847.34	380.18	3503.79	973.28	8358.224
Iasi	8271.38	95.73	12062.44	139.61	1507.80	418.83	3019.055
Neamt	2400.85	27.79	3501.24	40.52	437.65	121.57	876.310
Vrancea	710.08	8.22	1035.54	11.99	129.44	35.96	259.180
Total	**94575.57**	**1094.63**	**135178.03**	**1564.56**	**13963.91**	**3878.87**	**34525.024**

CONCLUSIONS

Following the evaluation of drinking water requirements for the population in Barlad catchment, we have reached to the following conclusions:

- it is necessary to secure a total average flow of Qzimed = 94575.57 m^3/day and a total maximum flow of Qzimax = 135178.03 m^3/day for the inhabitants from Barlad catchment area;
- the total volume of drinking water requirements per year is $W_{NT} = 34525 \cdot 10^7$ m^3/year;
- the highest flow is required to secure for the inhabitants of Vaslui district (880.71 l/s) and the lowest flow for the inhabitants of Vrancea district (11.99 l/s).

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