



THE ANTHROPIC LAKES FROM THE HYDROGRAPHIC BASIN OF UPPER IALOMIȚA (ROMANIA)

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Abstract

The hydrographic basin of upper Ialomița has become an area of interest for hydrotechnicians beginning with the period between the two World Wars, due to its hydroenergetic potential estimated at around 1 500-2 000 KWh. In this sense, in time, a series of hydrotechnical arrangements have been made, behind which important water resources have gathered. In this geographical area, there are nine accumulation lakes (without taking into account the years when they were achieved), both on the main river and on its tributaries. They serve different purposes: to regulate the regime of the liquid flow in order to attenuate the high floods, water resource for downstream consumers, electric energy production etc.

Keywords: Ialomița, hydrotechnical arrangement, lakes, water resources.

1. INTRODUCTION

The arrangement scheme of *Ialomița River* begins to take shape beginning with the years 1929-1930. During that period, the scheme foresaw three steps: Bolboci - Scropoasa, consisting in the achievement of a dam and an accumulation lake, Scropoasa - Dobrești and Dobrești - Gâlma - Moroeni. The first stage consisted in the arrangement of the Scropoasa – Dobrești sector, on a 2.5 km length and a fall of 304 m. The installed flow of 7 m³/s, which goes over the 3 m³/s of the river in section, is assured by an adduction of 3.5 km from Brătei dam, which ensures the deviation of the water bearing the same name. By its installed power (16 130 KW) and production capacity (55 GWh/year), UHE Dobrești was the biggest hydroelectric power plant of the country until 1951-1960 (Gr. Pop, 1996).

During the period 1949-1953 is achieved the hydroelectric power plant *UHE Gâlma-Moroeni*, downstream of Dobrești. From the accumulation, the water reaches the

plant through a gallery, taking in on its way the waters of the valleys Rătei and Raciú. The hydroelectric power plant Moroieni has an installed flow of 8.5 m³/s and an installed power of 15 MW. As we have mentioned, the water necessary for the functioning of the hydroelectric power plant is assured by the rivers Rătei (Q_i = 0.4 m³/s), Raciú (0.8 m³/s) and a few more rivulets, with a Q_i = 0.3 m³/s. The yearly capacity of production of this plant is of 566 GWh.

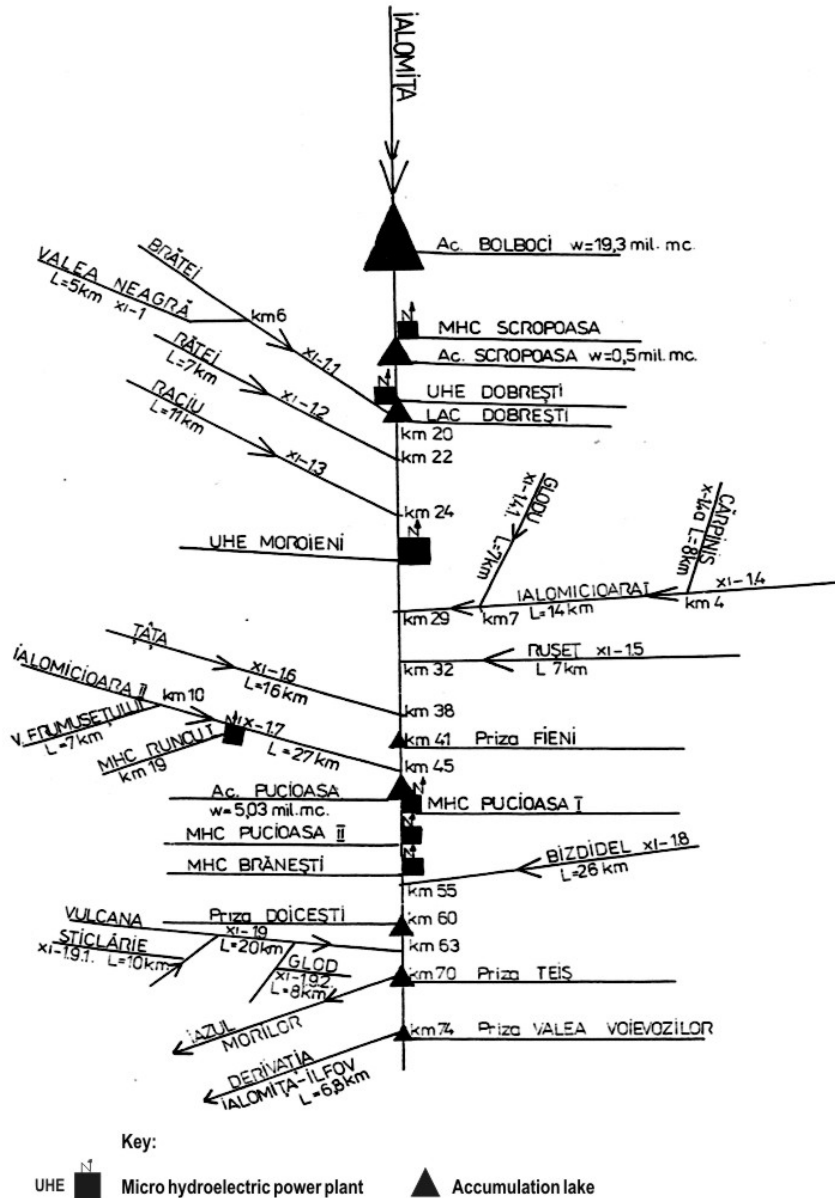


Fig. 1. The scheme of the hydrographic basin of upper Ialomița (from the source to Târgoviște) (Source: The hydrological station from Târgoviște)

In Fieni, in order to solve the need of electricity of the cement plant, the hydroelectric power plant *UHE Fieni I* was built, with a deviation dam, water gate and overflow of 1.5 m. The installed flow of 8.5 m³/s allows for a production capacity of 2.4 GWh/year.

In 1975, the hydroelectric power plant *UHE Pucioasa* began to produce energy; it is placed at the foot of the dam bearing the same name, it has an installed flow of 12 m³/s and an installed power of 2 MW.

In 1988, the last stage of the arrangement project for Ialomița River took place, when the dam and accumulation lake of Bolboci started to function. The dam includes a hydroelectric power plant with an installed power of 12 MW.

The accumulation lake of Bolboci is situated on Ialomița River, 10.75 km away from the source, upstream from Cheile Zănoagei, and downstream from the confluence with Bolboci River, the tail of the lake reaching as far as Cheile Tătarului. It began to be used in 1988. Behind the dam appeared a lake which is 2.2 km long and has a surface of 97 ha, summing up a useful water volume of 18 million m³ and a total volume of 19.4 million m³, with an installed energetic power of 12 MW.

Regarding the levels, the main parameters of the dam are: thalweg level - 1390 m DM; bottom emptying level - 1396 m DM; water taking level; 1400 m DM; minimum energetic level - 1404 m DM; NNR - 1435 m DM.

The synthetic characteristics of the high flood waves, for different degrees of insurance: 20% flow of 60 m³/s; 5% - 120 m³/s; 1% - 215 m³/s; 0.5% - 265 m³/s; 0.1% - 408 m³/s; 0.01% - 648 m³/s.

In the area of Bolboci dam, the overall hydrograph is characterized by a duration of 36 hours, with a coefficient $C_s = 0.28$ and a basic flow of about 10 m³/s.

Bolboci Lake has complex functions, being mainly meant for the alimentation with water of different downstream beneficiaries, and having a flow of 1.2 m³/s. If to all these is added the accumulation lake from Brătei, that gives a supplementary flow of 75 l/s, ensured for 1 million m³ of accumulated water.

In the sector *Scropoasa-Dobrești*, downstream from a series of narrow gorges and small basins, on a length of 2.5 km, with a fall of 304 m, was achieved a dam behind which, in the 1930s, appeared the lake *Scropoasa*, holding a water volume of 0.55 million m³, and ensuring the weekly regulation of Ialomița River. The lake, alimanted by Ialomița river, benefited of a flow of about 3 m³/s in section, and in order to reach the installed flow of 7 m³/s, an adduction of 3.5 km was achieved, coming from Brătei dam.

With its installed power (16 130 KW) and its productive capacity of 55 GWh/year, the hydroelectric power plant *UHE Dobrești* was the biggest hydroelectric power plant in Romania until 1951-1960 (Gr. Pop, 1996).

At the entrance in Cheile Orzei, on Brătei River, there is *Brătei Lake*, at 1343 m altitudinal difference from the sea level, having a level difference of 84 m and a useful water volume of 0.15 million m³.

Beside its energetic importance, Scropoasa lake has as well the role to weekly

regulating the liquid flow.

In the Subcarpathian area there is a series of accumulation lakes, both on Ialomița river, and on its tributaries.

On the tributaries there are the lakes: *Ialomicioara I*, at 650 m altitudinal difference from the sea level, with a level difference of 75 m and a useful water volume of 0.15 million m³; *Runcu lake*, on Ialomicioara Leaotei, at 790 m altitudinal difference from the sea level and with a level difference of 76 m and a useful water volume of 0.10 million m³; *Bela lake*, on Bizidid River, at 460 m altitudinal difference from the sea level and with a level difference of 41 m and a useful water volume of 0.12 million m³.

On Ialomița river there are dams at *Moroeni*, *Pucioasa* and *Doicești*, and behind them appeared lakes of different sizes.

Moroeni lake, at 650 m altitudinal difference from the sea level and with a level difference of 75 m and a useful water volume of 0.40 million m³, was achieved for the hydroelectric power plant UHE Gâlma, where the water arrives via a gallery that catches on its way the waters of Râtei and Raciș river as well. The installed power of the hydroelectric power plant is of 15 MW.

Pucioasa lake is situated upstream from the homonymous locality. The accumulation lake began to be used in 1975. It has an elongated shape, its maximum length is of 2.3 km, its maximum width reaches 0.4 km and it has a surface of 90.54 ha, at NNR, and of 115 ha at maximum level. The lake's surface and the dam's height lead to the accumulation of an initial water volume of 10 764 million m³. This lake's main problem is the significant volume of alluvial deposits, as it holds most of the solid flow brought by Ialomița and its tributaries. The reasons that lead to this clogging situation are:

- the slope of the rivers changes as they pass from the alpine area into the hilly area;
- the river's erosion level was increased by the construction of the accumulation lake from 395 m (initially built at 410 m);
- the fact that it is situated downstream from the confluence with Ialomicioara Leaotei, whose hydrographic basin is developed mostly in the deforested Subcarpathian area made up of easily erodable materials. Consequently, from an initial water volume of 11 million m³ (in 1974), the lake volume decreased to 5 033 259 m³ in 1999 (48.9% clogged).

The water taking device placed on the left bank of the river ensures the taking of lake water and its redistribution in the river bed. Downstream of the dam are ensured the flows needed by the consumers and by the hydroelectric power plant *UHE Pucioasa* (Q_i of 12 m³/s). In this point there is also a water taking device for the trout fishery of Pucioasa (on the right side of the accumulation) and for the treatment station, with a flow of 125 l/s. Close to the exit from the Subcarpathians, in *Doicești*, was achieved an accumulation lake of small dimensions, with a dam only 2-2.5 m high. It provides the water needed for the functioning of the thermoelectric power plant of Doicești.

**Table 1 Morphometric elements of Ialomița River and its tributaries
in the dam sector of the water courses**

No.	River	Confluence Section	L km	F km ²	Average height m	Q amm mc/s	W am m mil. m
1.	Ialomița	Bolboci dam	10.75	54	1680	1.05	33
2.	Ialomița	Dobrești dam - water taking device	22	134	1634	2.85	90
3.	Ialomicioara I		14	75	1004	1.10	34
4.	Ialomița	upstream Ialomicioara	45	333	1223	4.88	154
5.	Ialomicioara II		27	95	903	1.09	34
6.	Ialomița	Pucioasa dam	54	448	1121	5.60	176

**Table 2 Hydrological data of Ialomița river in the area of the accumulations
and of the water taking devices**

No.	Section	Q needed (mc/s)	Characteristic flows (m ³ /s)		
			minimum	average	maximum
1.	Bolboci dam	1.2	0.10	1.05	22.3
2.	Dobrești dam –water taking device	7.5			
3.	S.H. Moroeni		0.10	5.16	293
4.	Pucioasa accumulation	useful 1.65 derived 3-5			
5.	Valea Voievozilor water taking device	5.0	0.14	9.35	563

**Table 3 The characteristic hydrograph of the high flow waves
in the main dammed sections**

Accumulation lake	Overall hydrograph				Maximum flows for different levels of insurance (m ³ /s)						
	Q max. (m ³ /s)	T cr. - hours	Tt	γ	20%	10%	5%	1%	0.5%	0.1%	0.01%
Bolboci	112	10	36	0.28	60	112	120	215	264	408	648
Pucioasa	410	9	65	0.26	-	-	-	410	-	775	-

A special importance goes as well to the regularization of the liquid flow on Ialomița river. At the entrance in Bolboci lake, the module flow of the incoming water is of 1.15 m³/s, and the diffluent flow is of 0.81 m³/s. The average monthly flow records its highest values during the period May-June (56%), while the lowest values are recorded in the interval November-March (5.97%). At the exit from the lake, the diffluent waters record their highest values in January-March (35.34%) and August-September (32.57%), while their lowest values are recorded in April-May (6.46%). This is because of the higher need

of water of the downstream consumers during the above-mentioned periods and the refilling of the water stock during the period of maximum alimentation.

At Moroieni, the module flow of Ialomița river is of 6.88 m³/s, at Pucioasa the diffluent waters decrease to 5.58 m³/s and then they increase again, thanks to the tributaries, at Târgoviște, to 7.97 m³/s.

In the same context, the liquid flow in the Subcarpathian area has high values during the interval April-June (39.63%), and also in the months of August (8.85%) and February (8.23%). This thing might be explained by the penetration of warmer air masses in the area of Ialomița Valley, which leads to the melting of the snow, and in August to short-term torrential precipitations. The lowest rates of the liquid flows are recorded in the months of October-November and January (4-5%).

The influence of the accumulation lake from Pucioasa is felt in the average monthly flow regime, as it presents approximately equal values for the interval April-August (8-14%) and December (9.31%). During the other months of the year, the liquid flow oscillates in the interval 4-6%. This can be explained by the role that the lake has in the regulation of the hydrologic regime of Ialomița river, in the attenuation of the high flood waves and the alimentation with water of Pucioasa town and of the socio-economic units situated around it.

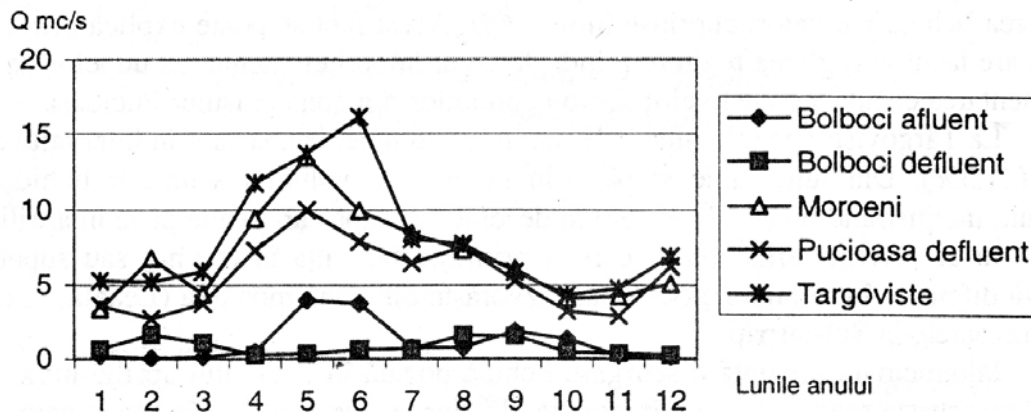


Fig.2. Hydrograph of the average monthly flows on Ialomița River (1961-2007)

The water of the anthropic lakes mentioned previously is used as well in fishery, in a natural regime, having as well tourist and leisure functions (especially the lakes Bolboci and Scropoasa).

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