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ASPECTS CONERNING THE WATER RESOURCES MANAGEMENT IN THE HYDROGRAPHIC BASIN OF RÂUL TÂRGULUI

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Abstract

The River Râul Târgului, whose springs are situated in the alpine area of the Iezer and Păpuşa Mountains, crosses the Depression of Câmpulung and, up to the point where it sheds its waters in the Argeş River, it gathers numerous tributaries, its hydrographic basin being more developed on the right side. The hydrological regime of this river is directly influenced by the physical-geographic conditions in which the hydrographic basin is situated namely: geological substratum, relief, climate, vegetation, soils. At the same time, the anthropic interventions in the landscape of the hydrographic basin of Râului Târgului generate some modifications in today's local hydrological conditions, which influence the natural flow regime. The Râuşor dam, arranged on Râul Târgului, meant to supply water for Câmpulung Muscel, to produce electric power, to irrigate 8500 ha in agriculture and to attenuate the high flood waves, causes some management problems at present.

Keywords: Râul Târgului, arrangements, flow, Râuşor

1.INTRODUCTION

Raul Targului, a second order tributary of the Argeş River and a first order tributary of the Doamnei River, springs from the Fagaraş Mountains, in the Southern Carpathians. The main course of Râul Targului appears following the confluence at Voina of the rivulets Bătrâna and Cuca, rivulets springing from the alpine area of the Iezer (Iezer Peak, 2462m) and Păpuşa Mountains.

The entire hydrographic basin covers an area of 1096 km^2, its average altitude is 801m and the length of Targului River is 76 km (Fig. 1). The springs are situated at an altitude of 2280 m; at the confluence with Doamnei River, the altitude goes down to 292m, the average basin slope being of 28‰. The shape of the hydrographic basin is very elongated along the N-S direction, and its sinuosity index is 1.15, the basin being forested (56,187 ha) from upstream down with species of coniferous and deciduous trees which meet at the altitude of 1000m, forming a mixed forest.

Râul Târgului crosses the Depression of Câmpulung and the town of Câmpulung Muscel on a length of about 7.5 km. The total length of this river is 72 km. The river's upper basin is located at altitudes ranging from 760 to 2,462 m (Iezerul Mare Peak).

Its tributaries on the right side are: Bătrâna, Văcarea, Valea Ursului, Râuşorul, Cetăţuia Bughea, Bratia,

Its tributaries on the left side are: Cuca, Valea Largă, Valea Calului, Valea Căluşului, Muşuroaiele, Dobriaşul Mare, Valea Poienii, Dobriaşul Mic, Pârâul Maricăi, Valea Rumâneştilor, Poenari, Ruda, Drăghiciul, Mănăstirea, Argeşel.

2.PHYSICAL-GEOGRAFIC CONDITIONS

The bedrock of the hydrographic basin consists in crystalline Paleozoic and Mesozoic schists (with a block structure) and metamorphic rocks made up of respectively consolidated and unconsolidated materials. These rocks have an acid character, being represented by granites, granodiorites, micaschists, gneiss, chlorite-sericite schists, grit stones, marls and conglomerates (lime stones and crystalline rocks).

The altitude varies from 760 m to 2,462 m, the average altitude being 1,611m. The relief has moderate slopes, partially in the sun; the average slope ranges from 5 to 55°, and the general exposure is to the south, the dominant exposures being the partially sunny ones (18 % sunny, 64 % partially sunny, 18 % shadowed).

The climate is a temperate-continental one, with alpine and hilly topoclimate variants; it is characterized by average monthly multiannual values that are highly variable from one climatic type to the next.

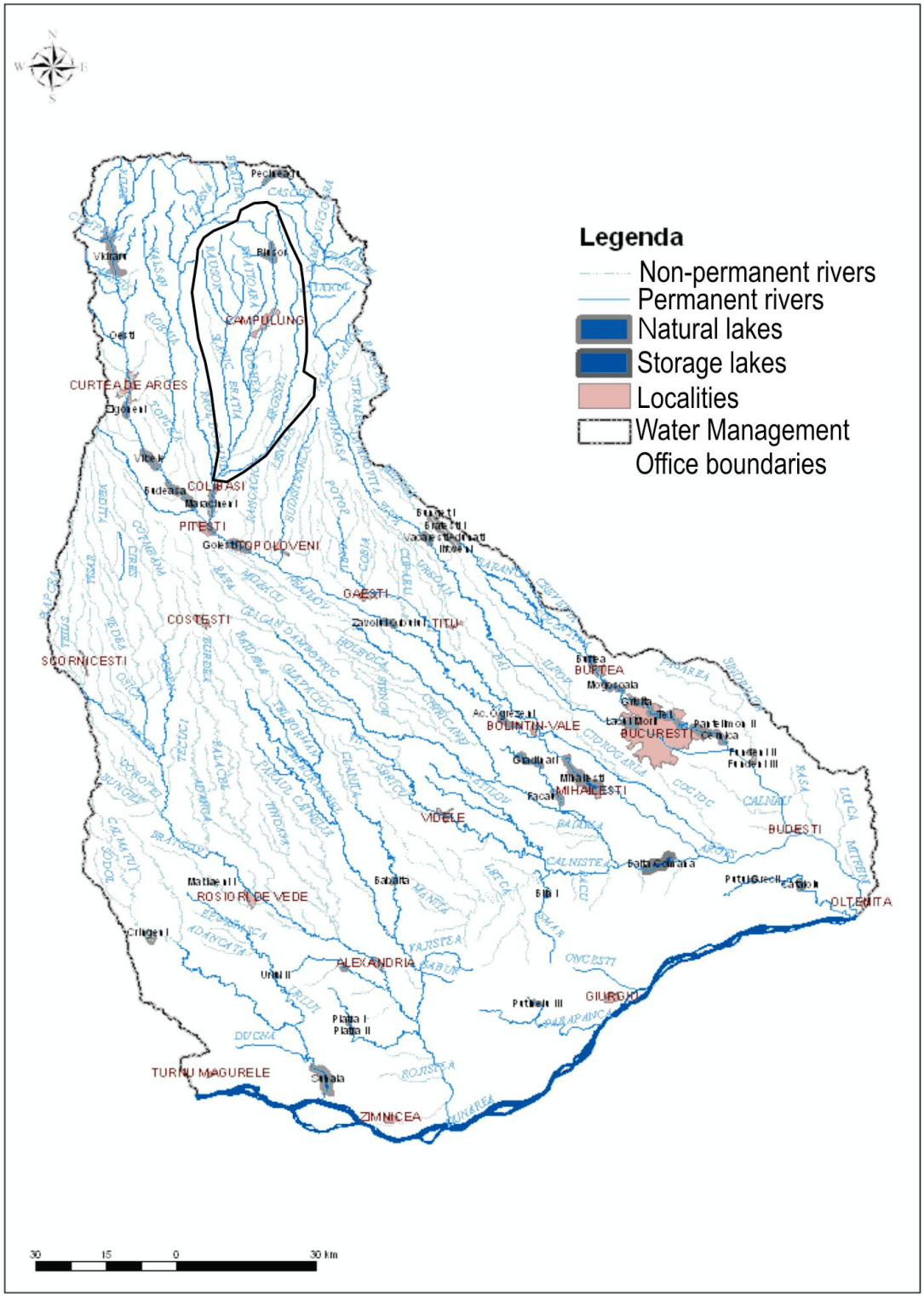

Fig. Geographic position of the hydrographic basin of Râul Târgului in the hydrographic basin of Argeş-Vedea

During the year, the values of the average monthly temperatures are significantly different: in winter, the average monthly multiannual temperatures have negative values, the lowest being recorded in January-February (under -2.5° C), in the hilly areas, and much lower in the high alpine area; in the summer, these temperatures frequently go over 20° C.

From a climatic perspective, the large thermal amplitudes (over 50°C) reflect the marked continentalism of the area in the summer months.

The highest values of the air's daily temperature are recorded in the summer (July-August), going over 30°C, following the invasion of tropical air, and the lowest are recorded in winter (-15° C in January), in the high area, and even lower, being a consequence of the arctic or continental cold air invasion.

The frosty days vary between 100 and 120 per year.

The average amplitude of the annual temperature varies between 23°C in the low areas) and 19.3°C (at the boundary of the forest vegetation). The average annual temperature is 1.7°C for the upper alpine area, 4.9°C in the middle-low alpine area and 8.1°C for the pre-alpine (high hills) area. The average temperature of the month of January is – 5.1°C, and that of the month of July: + 18.4°C.

The average annual precipitations are around 1,100 mm in the alpine area and 861 mm in the high hills area. During the period of April-September, over 60 % of the total annual precipitations are recorded, the values increasing with the altitude, respectively from 442 mm to 632 mm.

The average monthly values for the precipitations present a maximum in June; the minimum is realized in February (at altitudes under 1000m) and in November (at altitudes over 1000m). In February, the average precipitations are of 42.7mm, and in June they reach average values of 141.8 mm.

The dominant wind direction is NE-SW, with an average speed of 9-10 m/s.

The vegetation consists largely of forests, made up of: spruce fir, fir and beech. There are also areas with herbaceous vegetation, which can be used as fodder for the animals.

The lawns consist in graminaceae, and there are clover and Spanish trefoil cultures set up by the owners of these lands.

In the natural hayfields, the most common graminaea species are: *Poa palustris*, *Poa pratensis*, *Festuca pseudonima*, *Festuca rubra*, and also other species with a lower fodder value, such as: dandelion (*Taraxacum officinale*), *Sanus asper*, bindweed (*Convulvulus arvensis*), yarrow (*Achillea panonia*) and also species with no fodder value such as: *Rumex acetosa*, *Capsela bursa-pastoris*. The soils are tiered, according to the climate and vegetation, and are represented by podzolic soils in the alpine area and cambisols in the hilly area, the most common being the brown-reddish ones, in different levigation states.

3.HYDROLOGICAL CONDITIONS

Under these natural circumstances, the average multiannual flow of Râul Târgului grows from upstream down, from 2.48m^3/s at the Voina station, to 4.29m^3/s at the Voineşti station and 8.28m^3/s at the Piscani station (Tab. 1).

Table 1 Hydrological regime features

No.	Raul	Hydrometric station	River length (km)	Area (km^2)	Average multi-annual flow (m^3/s)	Average monthly flow with certainty level (m^3/s)			Q_m/Q_M (m^3/s)
						80%	90%	95%	
0	1	2	3	4	5	6	7	8	9
B.H. ARGES									
6.	Targului	Voina	8,00	65	2.48	0.64	0.5	0.41	0.338/75.0
7.	Targului	Voinesti	22,0	156	4.29	1.38	1.23	1.27	0.030/32.6
8.	Targului	Piscani	76,5	843	8.28	3.25	2.9	2.6	0.160/54.3

However, given the small area of the hydrographic basin there are variations as far as the average annual flow is concerned, so that at the Voina station, the average annual flow ranges between 1.11m^3/s, in the year 1991, and 3.45m^3/s, in 1975, while at the hydrometric station from Piscani, at the confluence with Râul Doamnei, the average annual flows were comprised between 4.28 m^3/s in 1994 and 13.05m^3/s, in the year 1972. Yet, due to the development of the upper course in the alpine area, the values of the variation coefficient are low for the hydrometric station of Voina: Cv=0.32.

As far as the maximum flow is concerned, the highest flow value recorded at the hydrometric station of Voina was of **61.7 m^3/s**, on June 17, 1998, and, at the Piscani station, the maximum value was of **278.0 m^3/s**, being recorded in July 1991.

The minimum flow for Râul Târgului and in its hydrographic basin has values ranging between **0.33** m^3/s, at the Voina hydrometric station, in the year 1976, and 0.16 m^3/s in 1992, at Piscani. In the case of its tributaries, the situation is similar. For instance, for Argeşel River, the minimum flow was recorded in the year 1983 and was of 0.02 m^3/s at the Nămăieşti station and 0.03 m^3/s, in the year 1994, at the hydrometric station of Mioveni, while for the rivers Bughea and Bratia, the values were of 0.04 m^3/s in the year 1992, at the hydrometric station of Bughea de Jos, and 0.10 m^3/s at the Râuşor Pod station, in the year 1997.

The lithological and biopedological features directly influence the alluvial flow, a fact indicated by the low solid flow values in the upper basin: 1.14 kg/s, namely 5.5 t/ha/year, at the Voina station, and 27 kg/s, namely a specific flow of alluvial deposits in suspension of 10 t/ha/year, at the Piscani station.

At the exit from the alpine area, the storage lake of Râuşor was arranged, to produce electric power. It covers a 160 ha area, having a length of 5.5 km, a maximum depth of 102 m and a volume for normal natural retention of 52.4 mil. m^3; the dam is made of rocks stabilized together, with a clay core.

Up to its mouth, the river gathers the waters of numerous tributaries, both on the right side (Bughea and Bratia) and on the left side (Poenari, Ruda, Drăghici, Mânăstirea and Argeşel), the hydrographic basin being more developed on the right side.

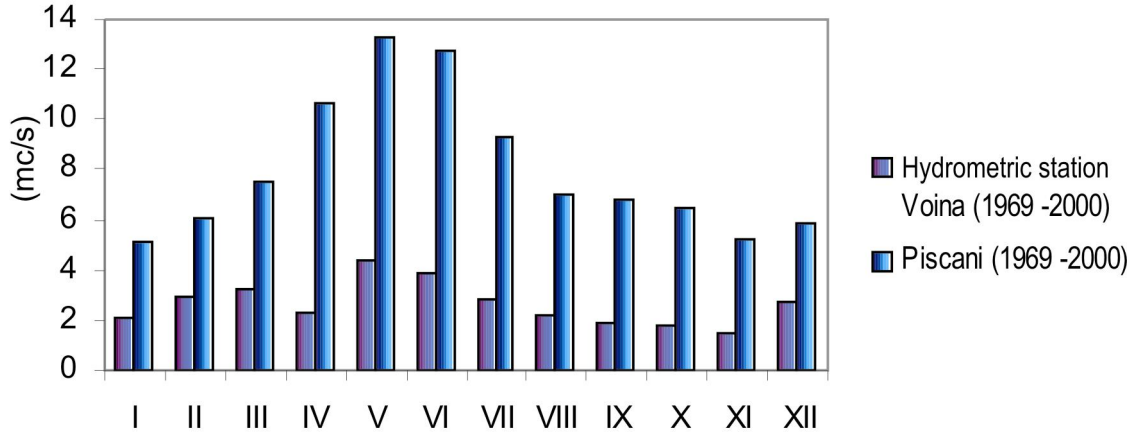

Fig. 2 The hydrograph of the average monthly levels at the hydrometric stations of Voina and Piscani during the period 1969-2000

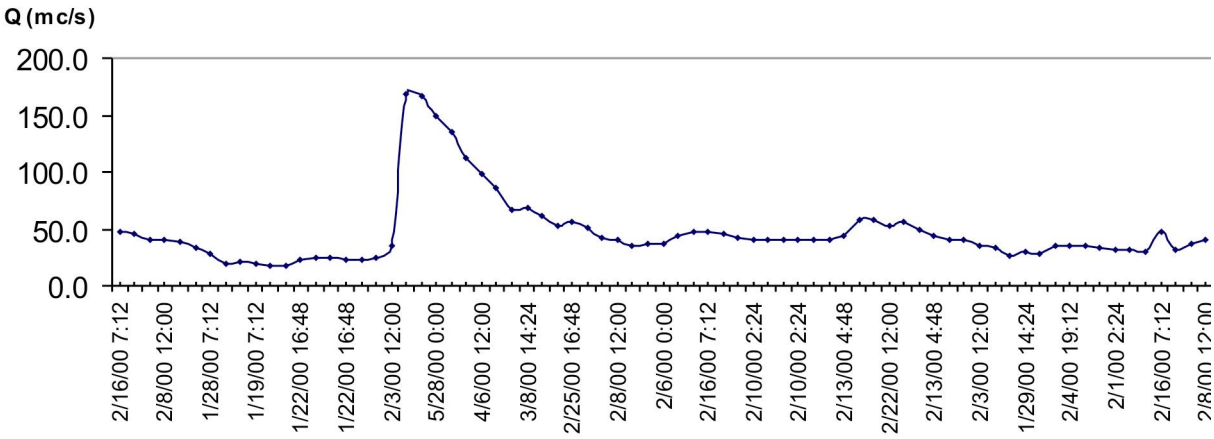

Fig. 3. The maximum flow at the Piscani hydrometric station in 03-05 July 2010

4. RÂUŞOR LAKE is situated along Râul Târgului, 7.5 km away from Lereşti Village and 14 km away from Câmpulung Muscel Town. It covers a 160 ha area, its length being of 5.5 km and its maximum depth of 102 m.

The dam is situated right downstream from the confluence of the Râuşor Rivulet with Râul Târgului, forming the storage lake bearing the same name, meant to supply water for Câmpulung Muscel Town and its surroundings, to produce electric power, to irrigate 8,500 ha of land used in agriculture, to reduce flood waves and, in a more remote perspective, to improve the water supply conditions of Bucharest City.

The morphological shapes in the storage lake and the dam area are influenced by strong erosive actions that have carved deep valleys and ravines, generally narrow and asymmetric. The bedrock is made up of crystalline schists, its geo-mechanic features being less marked on the right side, because of the marked fragmentation.

The dam is tightened by a central clay core, having a volume of 500,000 m^3 and a maximum height – according to the construction parameters – of 118 m; the material it is made up of has a rich content of particles under 0.005 mm (25-50%).

The high water discharger has a maximum dischargeable flow of 280m^3 /s.
The hydro power station of Lereşti has an installed flow of 15m^3/s, supplying a Francis turbine of 19 MW. The hydro power station functions for about 15 hours per week, of which on Saturday and Sunday just one hour during the evening peak.

The Râuşor dam on Râul Targului at the confluence with Zănoaga River

5.THE WATER SUPPLY FOR CÂMPULUNG MUSCEL TOWN

The water supply for Câmpulung Muscel Town is realized both from underground sources (Lereşti, Topliţa, Lereşti Pojorâta), and from surface sources (Voineşti), the water being stored in several large tanks, from where it is then distributed by means of pumping stations into the water supply network.

The water supply network providing potable water for the population sums up over 200 km, of which 17 km represent reception networks and 193 km distribution networks.

The water is distributed to the population after having been previously treated using five pumping stations (Grui, Marcus, Valea Mare Pravăţ and Valea Romaneştilor), whose total capacity adds up to 61 m^3/s.

The town's sewerage system includes a sewage network realized along both sides of Râul Târgului, on the left side being developed the sewage network for meteoric waters and on the right side, the mixed one. These sewerage networks sum up about 64 km, of which the length of the network for the domestic used waters is of 45 km, and that for the meteoric waters of 19 km. Unfortunately, the age of the network makes it present a high wear degree, of about 50%, a higher wear degree being recorded where the network is older and made up of concrete, cast iron, and a good condition being recorded where it is made up of poly-propylene. The treatment station has a capacity of 450 l/s, being endowed with a mechanic-biological step, and in the future, a further enhancement is to be made available, namely a tertiary chemical step.

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