ASSESSING THE SOMEŞAN PLATEAU WATER SUPPLY

VICTOR SOROCOVSCHI[1]

Abstract: Assessing the Someşan Plateau water supply. The sustainable development of the Someşean Plateau, a water-deficient region, requires solving the problem of ensuring the water supply for the population and agriculture. In this sense, in the present study, were analyzed a series of aspects related to: water supply sources (auththous and allochthous) of the localities; the amount of water distributed to consumers from the main subunits of the Someşean Plateau. Special attention was given to the evaluation of water needs (in four variants) at the level of localities, counties, hydrographic basins and geographical subdivisions. Finally, the optimization of water supply solutions for the localities in the studied region was analyzed.

Keywords: Someşean Plateau, Sources, consumers, necessary, optimization, Someşan Plateau.

1. INTRODUCTION

An integral part of the Transylvanian Depression, the Someşan Plateau represents its north-northwest compartment, representing one of the three major divisions of the Transylvanian Plateau. The geographical individuality of the Someşan Plateau is imposed by the unity of the fluvial system, by the particularities of the biopedogeographical envelope manifested by the predominance of the forest area - mainly preserved in the higher hills - and of the luvisols in different degrees of argillivation and by its predominantly rural character. Several subunits were delimited within the Someşan Plateau: the Cluj and Dej Hills, the Şimişna-Gârbou Hills, the Sălătruc Hills and the Purcăreţ - Boiu Mare Plateau.

The improvement of the quality of life, the valorization of local resources and the increase of agricultural productivity in the Someşan Plateau urgently require supplementing the local water resources with those of the neighboring regions, finding the optimal options for achieving this major objective and creating an adequate water supply system. Achieving this goal requires detailed knowledge of the quantitative and qualitative characteristics of local water resources, the current situation regarding the availability of water from non-

[1] sorocovschi@yahoo.com

native sources, the local and regional water distribution systems, as well as the water requirements required by all categories of uses. from the researched space.

1.1. The sources and water supply systems of the localities of the Someşean Plateau

Due to their quantitative and qualitative characteristics, local water resources are used only in local water supply systems, not being able to provide the water needed to create regional systems. Ensuring the water needs of the localities in the Someşan Plateau is achieved from allochthonous surface and local underground sources.

The main surface source is Someşul Mic River with the Gilău, Someşu Cald and Tarniţa accumulations. Another surface source was Someşu Mare.

The main underground source is the phreatic water accumulated in the terrace of Someşul Mic River between the Floreşti locality and the municipality of Cluj Napoca. This source consists of 98 wells and 2.6 km of drains. In 2001, the volume of water captured from the Gilău source was 68,895.5 thousand m^3, and that taken from the underground source was 13,103 thousand m^3. From a bacteriological point of view, the water of the lake falls within the limits of the I-a quality category, and as regards the eutrophication process, Gilău Lake falls into the category of oligo-mesotrophic lakes, with eutrophication tendencies. From the Someşul Mic surface source, in 2001 a volume of 357.98 m^3 was taken for industrial purposes.

From the Someşul Mare River surface source, the necessary drinking and industrial water for the municipality of Dej was ensured. In 2001, 11,119.9 m^3 of water was taken for industrial purposes and 6,911,582 m^3 for drinking purposes.

From the analysis of the water sources in the region bordering the Someşan Plateau, it was found that the amount available to supply the localities of the Someşan Plateau is about 285 l/s. The weight with which each system participates is different. Thus, the Someşul Mic system participates with 92.2% of the total availability of the sources bordering the Someşan Plateau, while the Someşul Mare system contributes only 7.8%. Of the two sources included in the Someşul Mare system (Beclean and Dej), only the Beclean source has an available capacity of 25 l/s.Depending on the water sources used and the affected space, two categories of water supply systems are distinguished: regional and local.

Initially, a Cluj zonal system and three sub-zonal systems (Gherla, Dej and Huedin) were outlined, which were later taken over by the Someş Water Company. TO. (CAS.SA), which on July 1, 2006 becomes the first and largest regional operator in Romania that crosses the administrative borders of its own county. Thus, the foundations for the creation of the first regional water supply system are laid.The Cluj zonal system has Tarniţa Lake as its base source and Someşul Cald Lake as a reserve source located in the Apuseni Mountains. From

the treatment station in Gilău, the main connection to the towns of Cluj-Napoca and Gherla starts. From this highway branch off secondary intakes that serve several localities located mainly in the southern and eastern extremity of the Cluj and Deju Hills. The realization on May 7, 2009 of the raw water intake from Lake Tarniţa, the completion of the Tarniţa intake pipeline, as well as the improvement of the processes at the Gilău Water Treatment Plant have contributed to the increase of water quality and availability from this system.The extension of the highway from Livada to Dej also contributed to the possibility of extending the water distribution network to other localities in the Dejului and Şimişna-Gârbou Hills (Table 1).

Table 1. The localities of the Someşan Plateau that benefit from water supply or that will benefit in stages depending on the access to the necessary funds (year 2001).

No. crt.	Comunne	Beneficiary localities of supply with water now	The localities that will benefit from water supply in the future
1	Aghireşu	Aghireşu, Aghireşu, Fabrici	Leghia, Dinca, Ticu, Dorolţu, Băgara, Măcău, Inucu
2	Aluniş	Aluniş, Ghirolt	Vale, Pruneni, Corneni
3	Apahida	Câmpeneşti, Sub Coasta	
4	Aşchileu		Aşchileu Mare, Aşchileu Mic, Fodora, Derna, Cristurel
5	Baciu	Popeşti, Coruşu, Sălişte a Nouă	Suceagu, Rădaia, Mera
6	Bobâlna		Şomcutu Mic, Maia, Răzbuneni, Bobâlna, Oşorhei, Cremenea, Suaraş, Băbdiu, Vâlcele, Antas, Blidăreşti, Pruni
7	Bonţida	Răscruci	
8	Borşa	Borşa, Borşa Cătun	Borşa Crestaia, Satu Lung, Giula, Ciumăfaia
9	Chinteni		Chinteni, Deuşu, Feiurdeni, Măcicaşu, Pădureni, Vechea, Sălistea Veche
10	Cornești	Cornești, Stoiana, Lujerdiu, Morău	Bârlea, Tioltur
11	Dăbâca	Dăbâca, Luna de Jos	Pâglişa
12	Gârbău	Gârbău, Viştea	Turea, Cornești
13	Iclod	Iclozel, Orman, Livada,Fundătura	
14	Jichişu de Jos		Jichişu de Jos, Jichişu de Sus, Codor, Şigău, Tărpiu
15	Mintiu Gherlii		Buneşti, Nima
16	Panticeu		Dârja, Panticeu, Cubleşu Someşan, Cătălina, Sărata
17	Sanpaul	Sanpaul, Şardu	Mihăiesti, Topa Mica, Berindu
18	Vad		Vad, Cetan, Valea Groşilor, Bogata de Jos, Curtuiuşu Dejului, Calna
19	Vultureni		Vultureni, Fodora, Şoimeni, Băbdiu, Faureni
20	Lozna	Lozna, Preluci	
21	Letca	Letca, Lemniu, Topliţa	
22	Ileanda	Ileanda, Bizuşa	
23	Răstoci	Răstoci	

All of this contributed to greater security in the water supply of the entire serviced area with the possibility of taking over new localities, including from Sălaj County. As a result, the creation of a Cluj-Sălaj regional system is soon reached.

The regional water and wastewater infrastructure development project was implemented by CAS.SA proposes investments to modernize the water and wastewater systems in Cluj and Sălaj counties, continuing the water-wastewater infrastructure development programs previously run by the operator regional CAS.SA. and co-financed from funds available through European/national programs, respectively MUDP (1997-2002), SAMTID (2002-2006), ISPA (2000-2006) and POS Mediu (2007-2013). The project is co-financed by the European Union from the Coezione Fund of the European Union through the Large Infrastructure Operational Program 2014-2020. On August 30, 2019, the European Commission approved the "Regional project for the development of water and wastewater infrastructure in Cluj and Sălaj counties.

The general objective of the project is to improve the water and treated water infrastructure in the counties of Cluj and Sălaj by expanding and developing the microbiologically controlled drinking water supply service, in conditions of safety and health protection in localities with over 50 inhabitants and ensuring collection and purification of waste water for agglomerations of more than 2000 inhabitants.

Local systems use underground water resources, either through centralized distribution networks or directly from the source (wells, springs, wells). The first subtype includes a number of localities from the Şimişna-Gârbou Hills (Lozna, Rus Şimişna, Surduc, Zalha), from the Purcăreţ-Boiu Mare Plateau (Băbeni, Gâlgău, Letca, Topliţa, Lemniu, Ileanda, Bizuşa, Boiu Mare, Valea Chioarului , Vima Mică) and some of the Sălătruc Hills (Poiana Blenchii, Căşei). The second subtype includes localities where the water supply is made directly from wells and springs and partially through centralized systems. This subtype is very frequently found in the western part of the Dej Hills, in the Şimişna-Gârbou Hills, the Purcăreţ-Boiu Mare Plateau and the Sălătruc Hills.

1.2. The amount of drinking water distributed to consumers

In the period 2000 - 2008, the amount of drinking water distributed to consumers fluctuated between 2635 thousand m3 (2007) and 3909 thousand m3 (2007) (Fig. 2). Following the evolution of water consumption over time, a slight increase is noted from 2000 to 2005, after which there is a rather pronounced decrease until 2007. A slight increase in consumption is then observed (Fig. 1).

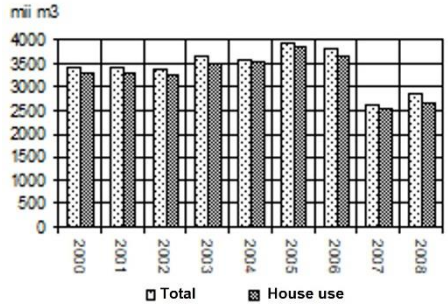

Fig. 1. Evolution of drinking water quantities of distributed to consumers

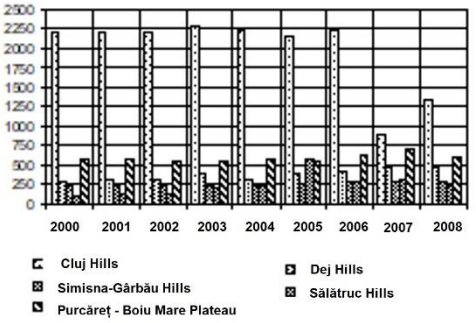

Fig. 2. The evolution of the quantities drinking water distributed on the subunits of the Someşan Plateau.

Of the total volume of water distributed to consumers in 2008, 92.6% returned for domestic use. The situations were almost identical in the rest of the analyzed years. Of the total amount of water distributed in 2008, almost half (46.1%) returned to the Cluj Hills. Purcăreț-Boiu Mare Plateau (20.5%) and Dej Hills (16.4% of the total distributed volume) follow in order. At a great distance are the Șimișna-Gârbou Hills (9.5%) and the Sălătruc Hills, with a much smaller population (Fig. 2).

1.3. Assessment of water needs

The main elements that were taken into account in the evaluation of the current water requirement were the number of inhabitants, large and small animals, the economic specifics and the social-building endowments of the localities.

In determining the water requirement for the population (public and household needs), four variants corresponding to the following specific consumptions were taken into account: 40 l/loc.day; 65 l/loc.day; 110 l/loc.day and 195 l/loc.day. In the assessment of the water requirement for animals, the following specific consumptions were taken into account: 50 l/loc.day for large animals and 8 l/loc.day for small animals. We consider that among the calculation options presented, for the current stage, the second one corresponds. For this variant, the water requirement of rural settlements in the Someşan Plateau was assessed at 66.4 l/s.

1.3.1. The water requirement calculated at the administrative level

For the four mentioned variants, the water requirement was calculated at the level of localities, communes and counties related to the Someşan Plateau.

The water requirement assessed at the level of the Someşan Plateau in the four calculation variants oscillates between 40.9 l/s (variant 1) and 199.4 l/s (variant 4) (Table 2).

Table 2. Variants of the corresponding water requirement counties related to the Someşan Plateau

County	Variants of the water necessary (l/s)			
	I	II	III	IV
Cluj	26.796	43.543	73.689	130.630
Sălaj	11.755	19.101	32.325	57.304
Maramureş	2.344	3.808	6.445	11.425
Total	**40.895**	**66.452**	**112.459**	**199.359**

Regardless of the calculation option, the percentage values held by the three counties from the total needs of the studied region remain the same. Thus, in the first place is the county of Cluj with 66.5% of the needs assessed at the level of the Someşan Plateau, followed by the counties of Sălaj with 28.8% and Maramureş with 5.7% (Fig. 3).

The differences between the values corresponding to the extreme variants of calculating the water requirement at the county level are very large and can be ensured in stages. At the level of Cluj County, the difference between the mentioned calculation variants is 103.8 l/s, and for the localities belonging to Sălaj county, 45.6 l/s (Fig. 4).

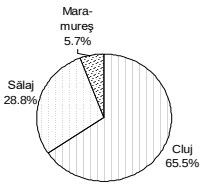

Fig. 3. The comparative situation of the water requirement at the level of the counties related to the Someşan Plateau

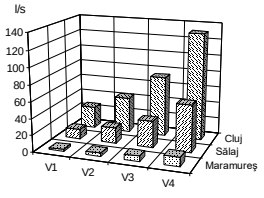

Fig. 4. The water requirement at county level evaluated in the four calculation options

Regardless of the calculation option, the percentage values held by the three counties from the total needs of the studied region. Analyzing the water requirement assessed at the level of the communes in the second version of the calculation, it is noted that out of the total of communes (39), only in two (Aghireşu and Baciu) the water requirement is included in the range between 5

and 6 l/s. Only one municipality (Căşeiu) is included in the requirement range between 3 and 4 l/s, and nine municipalities between 2 and 3 l/s, which represent 23.1% of the total. The most numerous municipalities are included in the requirement range between 1 and 2 l/s (56.4%, and those included in the range between 0 and l/s have a much lower percentage (Fig. 5).

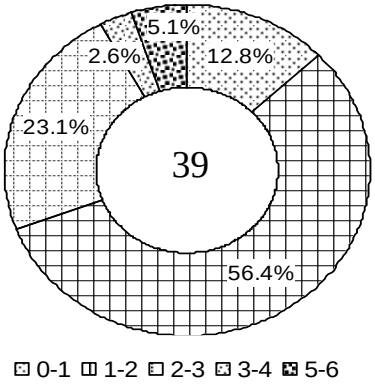

Fig. 5. The share of communes assessed on ranges of water requirements.

The weight of the communes on different requirement intervals was also evaluated at the level of the three counties related to the Someşan Plateau. Regardless of the calculation option, the weight that a commune holds in the water requirement of Cluj county is maintained between 0.02% (Apahida represented by - one locality) and 13.4% (Baciu). Of the water needs of Cluj county, large shares belong to the communes of Aghireşu (12.5%), Căşeiu (7.7%) and Chinteni (5.3%). Lower percentages between 4 and 5% are held by the communes of Chiueşti, Gârbău, Sânpaul and Câţcau, and between 3 and 4% by the communes of Vad, Bobâlna and Aşchileu.

Of the water needs of Sălaj county, the communes of Gârbou, Gâlgău and Ileanda each hold between 11 and 12%, and similar percentages are held by the communes of Surduc (10.9%), Letca (10.6%) and Băbeni (9.3%).). Somewhat lower percentages, between 5 and 7%, belong to the communes of Cristolţ, Şimişna, Poiana Blenchii, Zalha, Rus and Lozna (Fig. 6).

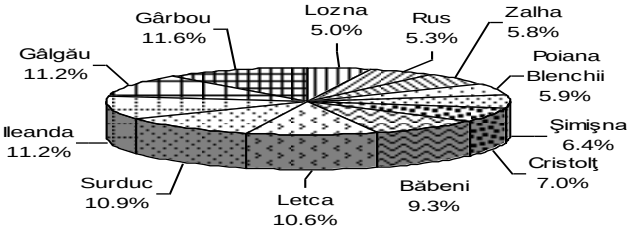

Fig. 6. The share that belongs to the communes in the water requirement evaluated at the level of Sălaj county.

The communes in the area related to Maramureş County are few and have weights between 8.8% (Valea Chioarului) and 36.2% (Coroieni) of the total water requirement. Weights between 26 and 30% belong to the other two municipalities: Boiu Mare (28.7%) and Vima Mică (26.2%).

The calculation of the water requirement at the locality level highlights a series of other spatial and quantitative peculiarities useful in the establishment of water supply systems at the level of the Someşan Plateau. Thus, from the total of 215 localities, in almost a quarter (22.3%) the assessed water requirement has values below 0.100 l/s, which can be ensured in most cases from own sources. Localities included in this category do not require their inclusion in the water supply systems. I make an exception only those that are situated in advantageous conditions compared to the main intakes. If we also take into account the fact that the localities with water requirements between 0.100 and 0.200 l/s (24.2% of the total) are located unfavorably to of the water intakes, then the water requirements requested by the rural localities of the Someşan Plateau are much reduced compared to the values established in the first evaluation stage. The number of localities with water requirements above 0.200 l/s have just over half of the number of rural settlements in Somesan Plateau (53.5 %). From the ranges of requirements above 0,200 l/s, percentage values above 5% belong to those included up to 0,600 l/s (Fig. 7).

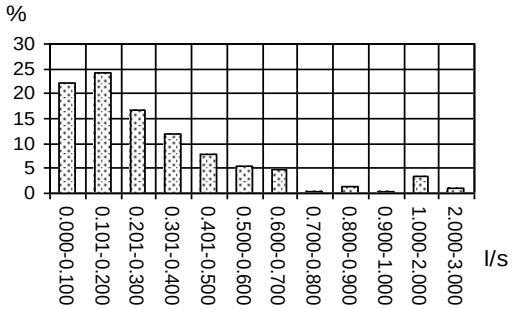

Fig. 7. Share of rural localities by intervals
of the water requirements established for the Someşan Plateau.

1.3.2. The water requirement calculated at the level of hydrographic basins

The water requirement for the four variants was calculated at the level of first-order hydrographic basins in relation to the main collectors (the rivers Someş, Someşul Mic and Lăpuş).

From the analysis of the total water requirement calculated at the level of the three important hydrographic basins, it is noted that out of the total of 66,391 l/s (variant II) which belongs to the Someşan Plateau, the Someş and Someşul Mic basins have approximately equal shares (48, 3%, respectively 48.6%), while the Lăpuş basin has a very low percentage.

Regardless of the calculation option, the weights remain the same, only the required values oscillate between 40,856 l/s (variant I-a) and 199,175 l/s (variant IV-a) (Table 3).

Table 3. The water requirement calculated at the level of the main basins hydrographics from the Someşan Plateau

Name of the hydrographic basin	**Variants of the water necessary (l/s)**			
	I	**II**	**III**	**IV**
Nadăş	9.657	15.693	26.558	47.080
Chinteni	1.018	1.654	2.798	4.961
Valea Caldă	0.048	0.078	0.132	0.235
Feiurdeni	0.153	0.248	0.420	0.745
Borşa	2.951	4.795	8.115	14.386
Luna	2.269	3.686	6.238	11.059
Lujerdiu	1.242	2.018	3.416	6.055
Mărului	0.763	1.239	2.097	3.717
Codor	0.632	1.028	1.739	3.083
Interfluvial surface	1.145	1.861	3.150	5.584
Someşul Mic water basin	**19.878**	**32.301**	**54.664**	**96.904**

Olpret	0.985	1.600	2.708	4.801
Sălătruc	2.973	4.831	8.176	14.494
Vad	0.667	1.083	1.833	3.250
Poiana	1.934	3.143	5.319	9.430
Şimişna	1.750	2.843	4.811	8.529
Iapa	0.539	0.876	1.483	2.629
Ileanda	1.014	1.648	2.789	4.945
Lozna	0.451	0.733	1.240	2.198
Cristolţel	1.256	2.042	3.455	6.125
Brâglez	2.206	3.584	6.065	10.752
Interfluvial surface	5.939	9.651	16.333	28.954
Someş water basin	**19.714**	**32.036**	**54.214**	**96.107**
Lăpuş water basin	**1.264**	**2.054**	**3.477**	**6.163**
TOTAL	**40.856**	**66.391**	**112.355**	**199.175**

Of the water needs assessed at the level of the Someşul Mic basin (regardless of the variant), almost half belongs to the Nadăş basin (48.6%). Next are the sub-basins of the Borşa and Lonea streams, which hold between 10% and 15% of the total water requirement (fig.8). The rest of the subbasins hold between 3 and 7% of the water requirement assessed at the level of the Someşul Mic river basin (Fig. 8). However, the water requirement for the Valea Caldă and Feiurdeni subbasins is insignificant (below 1%).

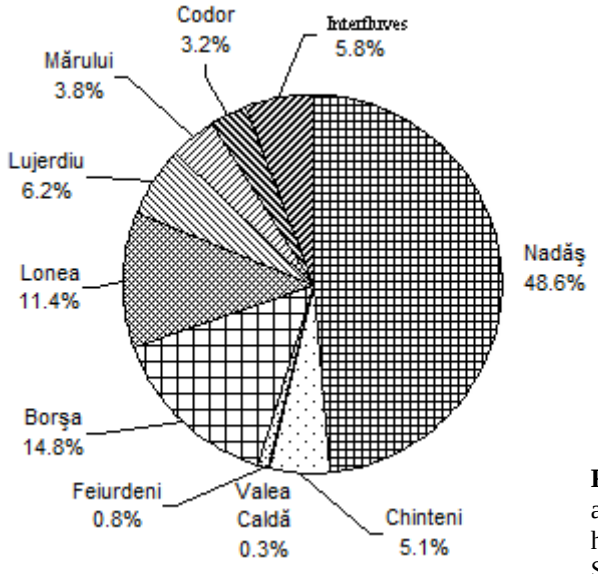

Fig. 8. The water requirement assessed at the level of the hydrographic basins related to Someşul Mic.

Of the water needs assessed at the level of the Someş Basin, the Sălătruc, Brâglez, Poiana and Şimiş-na subbasins hold larger percentages, between 9% and

15%. The rest of the subbasins have much lower percentages, between 3% and 6% (Fig. 9).

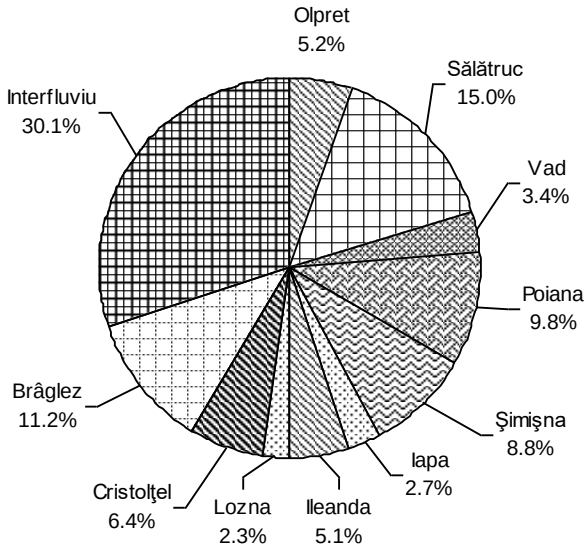

Fig. 9. The water requirement assessed at the level of the hydrographic basins related to Someş

The analysis of the water requirements for the four variants highlights the particularities mentioned at the level of the two main hydrographic basins (Fig. 10).

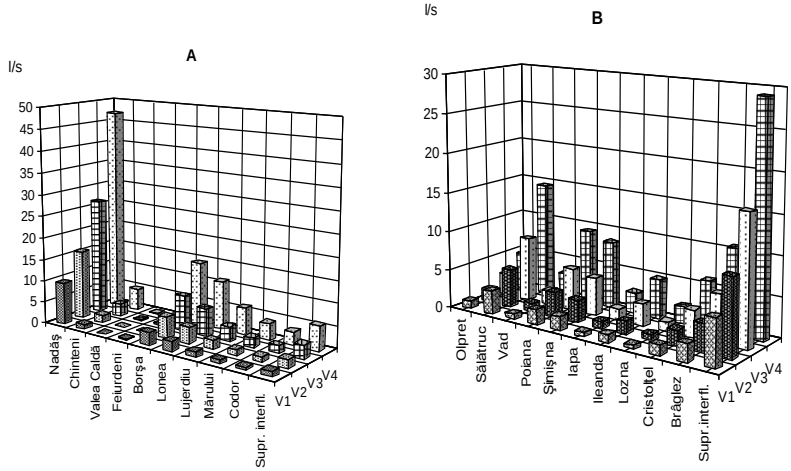

Fig. 10. Comparison of the water requirements evaluated in the four variants at the level of the hydrographic basins related to Someşul Mic (A) and Someşului (B).

1.3.3. The water requirement calculated at the level of geographical subunits

Knowing the water requirement required by rural localities at the level of geographical subunits is useful in the research carried out by specialists who deal with the development of regional studies in order to develop them sustainably. the requested water depends on the area of the region, the density and the size of the localities. Thus, the localities in Dealurile Clujului, which have the largest area in the Someşan Plateau, regardless of the calculation option, request the largest amounts of water, between 13.8 l/s (variant I) and 67.4 l/s s (variant II/a). Someş Corridor ranks second in terms of the amount of water required, although it occupies a smaller area than the other subunits, but it has a much higher density of settlements. Thus, the water requirements requested by the rural localities in the Someş Corridor were evaluated at values between 7.9 l/s in the first variant and 38.6 l/s in the second variant.

The smallest amounts of water are requested by the localities in Dealurile Sălătrucului, which has the smallest surface, and many of the settlements have a small number of inhabitants. As a result, the requested water requirement is between 2.6 l/s, in the first variant and 12.6 l/s, in the fourth variant (Table 4).

Table 4. The water requirement calculated at the level of the main geographical subunits of the Someşan Plateau

Name of the geographical subunits	Variants of the water necessary (l/s)			
	I	II	III	IV
Cluj Hills	13.8	22.5	38.0	67.4
Dej Hills	7.0	11.4	19.3	34.3
Şimişna-Gârbou Hills	5.5	8.9	15.1	26.7
Someş River Corridor	7.9	12.9	21.8	38.6
Purăreţ-Boiu Mare Plateau	4.1	6.6	11.2	19.8
Sălătruc Hills	2.6	4.2	7.1	12.6
Total	**40.9**	**66.5**	**112.5**	**199.4**

Irrespective of the calculation option, the weight that comes from the total water requirement of each geographical subunit of the Someşan Plateau oscillates between 33.8% (Cluj Hills) and 6.3% (Sălătruc Hills) (Fig. 11).

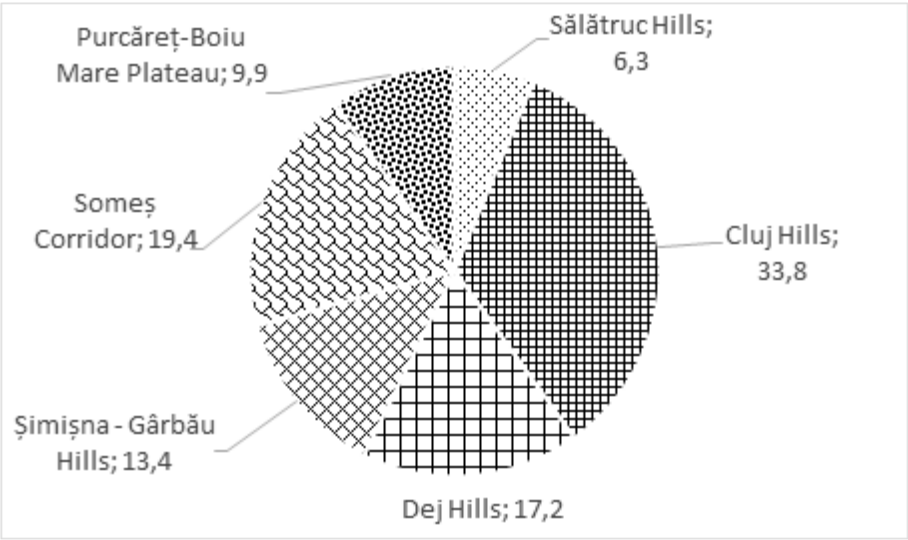

Fig. 11. The share held by the geographical subunits in the water needs of the Someşean Plateau

The shares of the total water needs assessed at the level of the Someşan Plateau by the localities of Dealurile Dejului (17.2%) and Culoarul Someşului (19.4%) are close. Next in order are the Someș Lane and the Şimişna - Gârbou Hills (Fig. 11).

The water requirements of the towns in the Purcăreţ - Boiu Mare Plateau are relatively low, representing 9.9% of the total requested at the level of the Someşan Plateau. The explanation lies in the fact that the Purcreţ-Boiu Mare Plateau, although it occupies a fairly large area, still the density and population of the settlements are low.

1.4. Optimization of water supply solutions

In relation to the temporal and spatial needs, it is necessary to create a "Podisul Someşan Regional System" for monitoring and directing the available water from the neighboring areas. There are several variants of possible solutions for the water supply of the Someşan Plateau differentiated at the level of localities, locality systems and geographic areas and sub-areas.

The locality level is rated by four control factors: morphological and positional, local resources, financial costs and demographic decline. The relief and position factor led to the isolation of some localities in a valley basin, in a

basin suspended by erosion or in a belt, etc., which determines the unprofitability of a water supply from a general system. The local resource factor removes the others. If a locality has safe local availability and with special qualities, then the supply from these sources becomes a priority. The economic cost factor can lead to the non-acceptance of connecting a locality to the water supply network. The high supply costs exceed the economic value of the water, either because of the high energy of the relief, or because of the distances from the network. The demographic factor through the too small number of inhabitants or through decline influences and even determines the development possibilities of a water supply system in a certain territory. In such areas, the maintenance of traditional forms of water supply gains priority in relation to a new (otherwise expensive) infrastructure.

The constitution of locality systems. Apparently this problem is simple, but look at the facts: territorially, dimensionally and economically, optimization models must be developed. From a territorial point of view, we distinguish: locality systems with a high degree of dispersion of households, which involve exorbitant costs in infrastructural arrangements; systems of localities with axial, longitudinal development along the valleys and communication routes, which can easily support the costs for the water supply networks; systems of interfluvial or catchment settlements, easily fed from catchment adductions; systems of localities on the slopes ordered according to the lines of the springs, which can be fed in their own way by such collections.

From a dimensional point of view, based on the number of inhabitants, we separate the following types of locality systems, for which the optimization solutions are specific: locality systems with a population between 100 and 150 inhabitants, generally extended, with a high degree of dispersion, located at watersheds or on slopes, for which local supply is optimal; systems of localities between 150 and 300 inhabitants with a relative concentration: either at the base of some slopes, or along the circulation arteries, for which the solutions are alternative from local sources, or a common network on a restricted system, or from the major networks but with possible directions on well-marked alignments; systems of viable localities (300-500 inhabitants), but with close and direct spatial connections, for which water supply from major networks remains the only viable solution; systems of localities with over 500 inhabitants, but with a fairly low concentration of settlements, located either in the vicinity of the major water supply networks of the Someşan Plateau, which can be easily connected, or at a great distance, when they can constitute local nodes with possible branches to other smaller but neighboring localities.

Optimizing regional water supply solutions. In relation to the geographical divisions of the Someşean Plateau, the practical zoning based on the needs and possibilities of water supply will take into account: water sources (external,

internal), the differentiated requirements of the geographical subunits, the accessibility of the territory, the climatic and hydrological regime of the different compartments, the chances of socio-economic development. As a result, several specific zones and subzones can be distinguished for the territory of the Someşan Plateau: the Cluj and Dej Hills with two subzones; Şimişna-Gârbou Hills; The Purcăreţ-Boiu Mare Plateau and the Sălătruc Hills with two sub-areas.

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