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TERRITORIAL DISTRIBUTION OF WATER RESOURCES IN ROMANIA IN TERMS OF SOCIAL-ECONOMIC DEMAND*

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Abstract

La répartition des eaux par rapport aux exigences socio - humaines de la Roumanie. Les ressources d'eau de la Roumanie sont relativement modestes (elle occupant la position 21 parmis les états de l'Europe). En conformité avec les estimations, les ressources d'eau de surface des rivières internes représentent environ. 40,6 milliards m^3 par année (sauf le Danube) et les eaux souterraines offrent approximativement 9 milliards m^3 par année. La distribution spatiale au cours de l'année n'est pas uniforme. Les Carpates, qui couvrent 27,9% du territoire de la Roumanie, produisent 65,3% des ressources d'eau de surface; l'écoulement maximum se produit pendant le printemps (35-50%). La conséquence de cet état est la nécessité des dernières 40 années du XX^{ème} siècle de construire des lacs d'accumulation. Vers la fin de l'année 2000 les plus importantes 400 accumulations retenaient 13 milliards m^3 d'eau. Les besoins d'eau pour l'alimentation de la populations, de l'industrie, de l'agriculture, pisciculture ont sont augmenté de 1,4 milliards m^3 en 1950 à 20 milliards m^3 1989. Après 1990, comme conséquence de la destruction de la plupart de systèmes d'irrigations et la désaffectation des unités industrielles, le besoin d'eau a baissé à 10-11 milliards m^3 dans l'année 2002. Pour une bonne gestion des ressources d'eau au niveau du pays, bassins hydrographiques ou départements, a été promu en 1976 «Le Programme National de l'Administration des Bassins Hydrographiques de la Roumanie». Dans le cadre de ce programme on a promue la construction des lacs d'accumulation, le transfert d'eau entre les bassins hydrographiques, l'extension des systèmes d'irrigation, le monitoring de la qualité des eaux. Ces objectifs ont été relativement résolues, mais certains ont été abandonnés après 1989. Les événements hydrométéorologiques des dernières années (sécheresse, inondations) ont attiré l'attention des facteurs de décision de la Roumanie pour la nécessité de la réconsidération du programme, la recherche des finances, etc.

Keywords: water resources, territorial distribution, water balance, Romania.

Discussing water resources in Romania implies a twofold approach: water as a *sine qua non* of life itself and water as an important factor for the development of the contemporary society.

From the very beginning of economic and social organization, water was a paramount asset of the human communities. There are lots of evidence bespeaking of ancient civilizations that thrived or felt into decay because they had or not the necessary water resources and because they knew or not how to use them.

As human society kept developing so did its demand for water increase. As a result, at the end of the 20th century water as resource, together with energy and soil fertility became major issues, and they continue to list among the top priorities of the 21st century, too. The demographic explosion and the need for greater comfort are intimately connected with the presence of water, and its consumption /capita is an indicator of the degree of civilization.

High quantities of water are taken up by industry, some branches using it completely, without anything returning to the network, not as waste even. Intensive agriculture needs extended irrigation systems, that is ever more water in the conditions of temperate, Mediterranean, tropical and even Equatorial climates. Water is seen to undergo major changes when referred to human society. It decreases in quantity, as part of it is eliminated from the hydric circuit, and deteriorates in quality, with negative consequences for the environment and man's health alike.

Not so long ago, people were convinced that water is an inexhaustible source and they can dispose of it to their own liking. Today this view has been reconsidered, the states themselves being engaged in devising complex plans for the management of drainage basins and the judicious administration of water resources. Water is also a focal concern for world organizations like UNESCO and FAO, which have adopted long-term programmes for its conservation (e.g. the International Hydrological Programme).

Although in Europe the water circuit (evaporation-clouds-precipitation-surface waters) ensures the regeneration of this resource some l2.8 times/year, yet, there are regions in which quantities stay constant or are diminishing. In these conditions, states, world organization and the mass-media even, have radically changed their stance striving to secure the rational management of water and maintain its quality.

Major categories of water resources in Romania. Lying in a temperate zone, Romania's water resources are rather modest compared with other countries in Europe.

Inland rivers included in the Water Cadastre of Romania (1992) span 78,905 km (referred only to the 4,864 codified watercourses) at an average density: 0.38 km/km^2 and an annual volume: 40.6 billion m^3, which means 1,765 m^3/capita. According to a recent UN statistical report, Romania lists at position 21 among the 34 European states. That is we stand pretty far off the countries with over 20,000m^3/capita/year (Finland, Sweden, and Norway), 5,000-10,000 m^3/capita/year (Austria and Switzerland), coming closer to those with 3,500-5,000 m^3/ capita/year (France, Poland and Germany), and even to some from the Mediterranean zone (Portugal, Spain, Italy, Greece and Cyprus). There is no doubt that the figure of 40.6 billion m^3/year produced by Romania's inland waters can be raised by adding the about 30 billion m^3/year discharged on the Danube (and even more with the 170 billion m^3/year which the river has at its entrance on Romanian territory, but this cannot be done one must maintain the level needed for navigation and abide by the conventions of the Danubian countries).

Ground waters. According to current knowledge ground waters are put at 9.62 billion m^3/year, of which 6 billion can be used in optimal technological and economic conditions. The distribution of these waters varies from one geographical unit to the other in terms of climate, rock structureand storage capacity. There are areas know to have a good aquiferous potential, capable to release significant flows. It is the case of the alluvial fans of the rivers Mureş, Timiş, Prahova-Teleajen, and Buzău; in the Someş Plain and the Făgăraş Depression, the karst waters (springing from the following montains: Postăvaru, Piatra Craiului, Vâlcan and Mehedinți, Cerna-Soarbele, Anina, Pădurea Craiului, Bihor, Codru-Moma and the Southern Dobrogea zone), the gravels from the Moldava floodplain at Timişeşti, etc. Aquifers at great depth with good possibilities of exploitation are found in the Frăteşti and Cândeşti Strata, the Dacian sands in Oltenia, etc. Ground water deficient regions are Central Dobrogea, the Transylvanian and the Moldavian tablelands. The ground water potential has been assessed by means of 4,500 hydrogeological drillings made throughout the country, where observations are underway.

The water resources of natural lakes are replenished from precipitation and springs water every year. These reserves are estimated at around 1 billion m^3/year and are of local importance for water management schemes.

The Black Sea (in the Romanian sector) could become a major source if sea water desalting could be economical.

Temporal and spatial characteristics of the hydrological regime. The time-and-space variation of the water resources of inland rivers have some particularities of their own.

In the physical- geographical conditions of the Carpathian-Danubian area, discharge on Romania's rivers is the outcome of the temperate continental climate. Climatic conditions are shaped by altitudinal zonation, the former being genetic factors of discharge; heavy precipitation, in their turn, are also involved in this process.

The main features of discharge are dependent on the seasonal climatic variation, on altitude which shapes the vertical zonation, on latitude, on the torrential character and on azonal factors.

Seasonal variations are connected with the intensity and frequency of climatic phenomena which shape the phases of the flow regime. So, on in winter, *shallow waters* are the rule; on the other hand, floods may occur in the west and south-west of the country triggered by inversions of warm Mediterranean air which cause sudden snowmelt. In *spring waters* are high, with floodwaves even, as snowmelt is associated with rainfall. *Summer waters* are shallow, because rain is scarce and the ground water reserves are exhausted; however, heavy rainfall may unleash summer floods. Autumn is a shallow water season, but floods may set in, obviously less robust than in spring or summer.

Mean specific discharge. At heights of 600-1,000m. alt., on the western side of the Apuseni Mts., the vertical gradient of discharge is of 5-6l/s/km^2 per 100m. At equivalent altitudes it shows a west-to-east decrease. Thus, from 7l/s/km^2 in Crişana Hills at 400m alt., it barely reaches 1.8l/s/km^2 in the Central Moldavian Plateau.

The *uneven distribution* of discharge within the year is reflected also by the share of season to the annual flow volume (35-50% in spring, 15-35%, in summer, 8-20% in autumn and 10-35% in winter). In view of it, building reservoirs to store the spring waters and use them in the droughtier seasons is imperative.

The maximum/minimum flow ratio registered and analysed at some hydrometric stations shows low values in rivers with a compensated regime and extremely high ones in those with a torrential regime. A minimum of 11.4 was found at Ceatalul Chiliei on the Danube, with a maximum of 76,000 at Bârlad Station on the homonymous river. This large variation interval raises special problems for the management and administration of river water both in the flooding stage, when economic units, traffic routes and settlements must be protected, and in the shallow-water stage when an adequately sanitary discharge must be ensured.

Whether discharge turns torrential or not depends on basin size, fragmentation grade, relief energy, extent of afforestation, etc.

Azonal variations of discharge are specific to karst areas, substantially involved in thoroughly modifying the flow regime.

The average water flow/year shows great vertical variation, from the Black Sea level to the Carpathian crests. The Carpathian Chain covers 66,302 km^2 of Romania's territory, the inland rivers accounting for 839.1m^3/s of the discharge. The periCarpathian regions (the Subcarpathian regions, the tablelands and the plains), which extend over 72.1% of the territory contribute only 447.7m^3/s to the average flow. However, as if to compensate for it, they host the largest rivers in this country (the Siret - 201 m^3/s; the Olt - 187 m^3/s; the Mureş - 185 m^3/s; the Someş - 125 m^3/s; the Jiu - 95 m^3/s; the Argeş – 60 m^3/s; the Ialomița - 46 m^3/s, etc.), collecting their waters from the mountains and running into the Danube, which is the mainstream.

River-water resources on the main relief steps. Looking at the territorial coverage of smountains, hills and plains and the water volume formed in the respective units, an obvious disparity emerges as a consequence of climatic conditions and of altitude levels which, in turn, influence the climatic variables. Precipitation increases by some 20 mm/100 m with the altitude, while temperature decreases by 0.5 - 0.6^{0}C/ 100m. Hence, the flow module grows with height, being therefore directly proportional to precipitation and inversely proportional to temperature.

Top discharge variation gradients with altitude (5-6l/s km^2/100 m) are recorded in the west and north-west of Romania, basically on the eastern slopes of the Apuseni Mts and the Căliman-Gurghiu-Harghita volcanic chain, due to the influence of the moist (oceanic) masses of air. In the east of the country, on the eastern slopes of the Eastern Carpathians, at equivalent altitudes, the flow module is 2-3 lower because of the continental air advections, on the one hand, and the influence exerted by the foehn upon the masses of air, on the other. It follows that the values of vertical gradients show territorial variations, having therefore but an orientational relevance for the all-country global analyses.

The water resources of the drainage network were calculated on the basis of the mean liquid flow map (scale 1: 500,000) worked out at the National Institute of Meteorology and Hydrology. The results produced a relevant picture of river-water resources in the major relief units (mountains, hills and plains)(Table 1) as follows:

Table 1 - River-water resources in the main geographical units of Romania.

Unit name	Surface		Discharge module (l/s km^2)	Flow volume (m^3/an m^2)	Flow rate (m^3/s)	Total volume	
	Km^2	%				billion m^3/an	%
Carpathians	66,702	27.98	12.6	399.4	839.1	26.48	65.3
Subcarpathians	16,509	6.90	6.8	214.0	111.2	3.51	8.7
Transylvanian Depression	25,028	10.53	3.4	107.1	84.9	2.68	6.7
Crişana and Banat Hills	12,210	5.14	4.7	144.1	55.8	1.76	4.4
Mehedinţi Plateau	785	0.33	9.3	293.0	7.3	0.23	0.6
Getic Tableland	12,942	5.45	3.7	116.0	47.5	1.50	3.8
Moldavian Plateau	23,088	9.75	2.1	67.1	49.1	1.55	3.8
Dobrogea Plateau	10,530	4.35	0.3	14.2	4.7	0.15	0.4
Banat and Crişana Plain	16,497	6.95	1.5	49.1	25.7	0.81	2.0
Romanian Plain	46,271	19.47	1.2	39.4	57.7	1.82	4.6
Danube lakes	3,322	1.40	0.5	18.1	1.9	0.06	0.1
Danube Delta	3,510	1.43	0.5	14.7	1.6	0.05	0.1
Razim-Sinoie Lake Complex	920	0.39	0.4	21.7	0.3	0.01	0.04
Mountain region	66,702	27.98	12.6	399.4	839.1	26.48	65.3
Hill region	101,092	42.41	3.6	112.9	360.5	11.38	28.0
Plain region	70,597	29.61	1.2	39.2	87.2	2.75	6.7
Total ROMANIA	238,391	100.0	5.4	171. 0	1286.2	40.61	100.0

- In the mountain region, which occupies only 27.9% of the Romanian territory, 65.3% (26.48 billion m^3 from a total of 40.61 billion m^3) of the water is formed and regenerated every year;
- In the hill region, which includes the Subcarpathians, the tablelands and the piedmont hills, and occupies 42.4% of Romania's territory, only 28.0% of the water volume is formed (11.38

billion m^3), of which 8.7% (3.51 billion m^3) in the Subcarpathians and 19.4% (7.87 billion m^3) in the other two units;

- In the plain region, inclusive of the Danube Delta,which covers 29.7% of the country's territory, the water volume formed there is small (6.7%), because the discharge module is low: under 2 l/s km^2 in the Crişana and Banat Plain and around 1 l/s km^2 in the Romanian Plain.
- The biggest disparity shows the Dobrogea Plateau. It occupies 4.35% of Romania's surface area, but produces a water volume of only 0.4. It appears that the relief units located in the moisture- deficient area, where there is a great demand of water for irrugation, drinking and industry, are poor in surface resources (Fig. 1, Table 1).

Water resources by drainage basins. Similar to the main relief units, 1^{st}-order basins present quantitative disparities due to their distinct altitude location. Although must of them are found on all the altitude steps (mountains, hills and plains), yet their coverage is the highest in the hills and plains.

Depending on the percentage of drainage basins within the three relief steps and their exposure to the circulation of the air masses, one finds differences in the liquid flow value (liquid flow module: l/sec km^2) and ultimately in the water volume.

Drainage basins situated in the mountain region and exposed to the advection of west and north-west masses of air are, among others, the upper course of the Tisa (17.1l/s km^2) which, together with the Vişeu its tributary, reaches 20.8 l/s km^2 towards the junction area (Bistra Hydrometric Post), and the Arieş at Câmpeni (19.6 l/s km^2). Likewise is the Cerna basin with 17.5l/s km^2 at its mouth (Orşova).

There are other basins, outside the geographical area of influence of western air masses, which in some cases are only partly located in the mountain zone, but their discharge module is fairly elevated. For exemple, the Jiu at Iscroni registers 22.3 l /s km^2, the Râul Doamnei at Bahna Rusului, 25.6 l /s km^2, the Râul Târgului at Apa Sărată, 22.2 l /s km^2, and the Lotru at Gura Latoriței, 20.4 l /s km^2. When this analysis takes into account ever smaller basins situated in the mountain region the liquid flow value is seen to increase (over 20 l /s km^2).

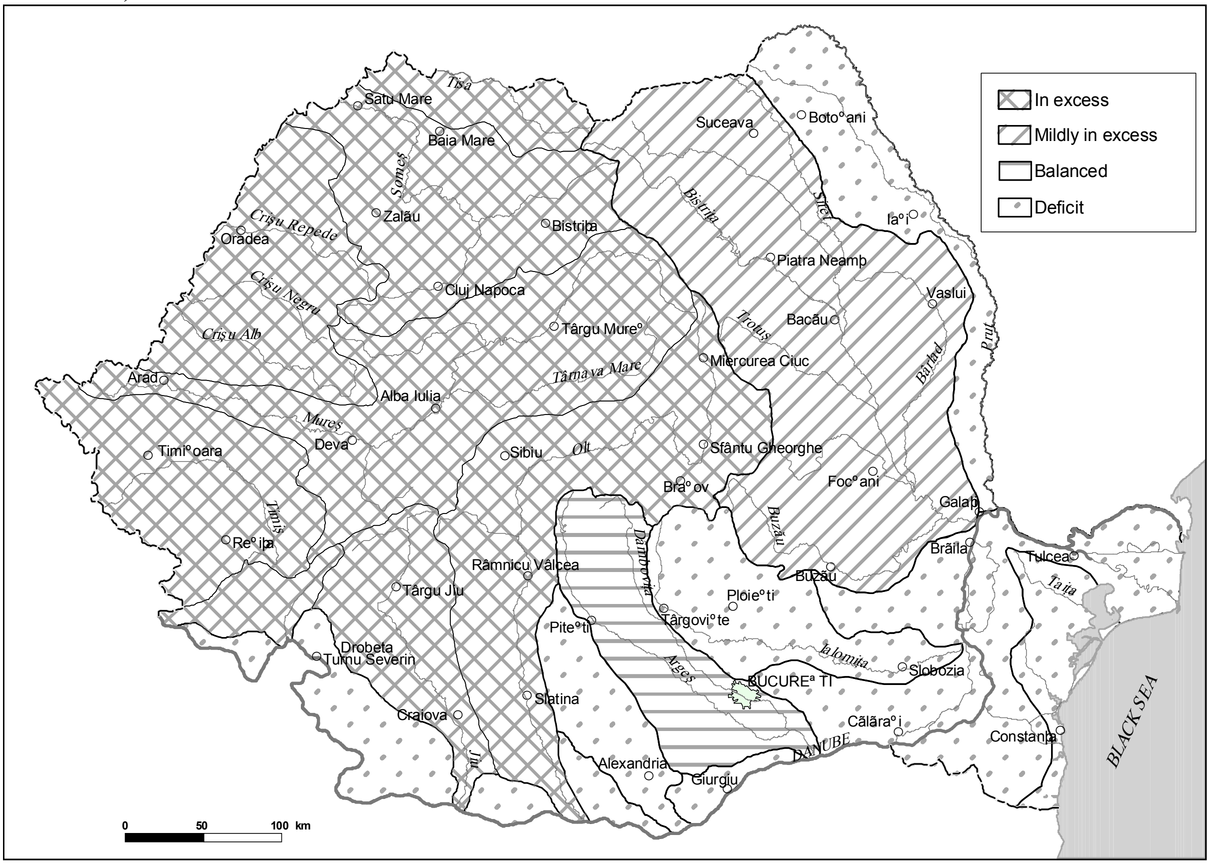

Fig. 1 - Water resources by hydrographic basins.

Table 2 - Water resources by drainage basins in terms of socio-human demand.

No	Basin name	Surface waters				Ground waters (mill m^3/year)	Total resources mil. m^3/an	No. Inh. (thous)/water volume (m^3)	Total demand (mill. m^3) / demand cap/y (m^3)	Water resources in terms of demand
		Area km^2	Annual mean volume mill.m^3	Annual mean discharge m^3/s	Mean specific discharge l/s.km^2					
1	Tisa sup.	4,540	2,509	79.5	17.5	132	2,641	300 / 8,800	120/400	in excess
2	Someş + Crasna	17,840	3,920	124.2	7.0	363	4,283	1,525/2,800	2,200/1,450	in excess
3	Crişuri + Barcău	14,860	2,957	93.7	6.3	832	3,789	1,100 / 3,444	1,300/1,182	in excess
4	Mureş + Aranca	29,390	5,898	186.9	6.3	776	6,674	2,450 / 2,720	4,300/1,755	in excess
5	Bega + Timiş + Caraş	13,060	2,187	69.3	5.3	765	2,952	1,000 / 2,952	1,600/1,600	in excess
6	Nera + Cerna	2,740	1,256	39.8	14.5	84	1,340	100 / 13,400	300/300	in excess
7	Jiu	10,080	2,944	93.3	9.2	706	3,650	1,200 / 3,042	1,900/1,583	in excess
8	Olt	24,050	5,832	184.8	7.7	1,137	6,969	2,400 / 2,904	3,500/1,458	in excess
9	Vedea	5,430	391	12.4	2.3	350	741	500 / 1,482	1,000/2,000	deficit
10	Argeş	12,550	2,313	73.3	5.8	1,017	3,330	3,100 / 1,074	3,200/1,032	balanced
11	Ialomiţa	10,990	1,515	48.0	4.6	634	2,149	1,100 / 1,954	3,000/2,727	deficit
12	Siret	42,890	7,420	235.1	505	1,618	9,038	4,325 / 2,090	6,700/1,618	mildly in excess
13	Prut[1]	10,990	577	18.3	1.7	214	791	1,100 / 719	1,400/1,272	deficit
14	Secondary tributaries in this Danube sector	33,250	789	25.0	0.7	2,848	3,637	2,300 / 1,581	10,500/4,565	deficit
15	Black Sea coast	5,480	63	2.0	0.4	209	272	500 / 544	1,500/3,000	deficit
16	Total	238,391	40,571	1,285.6	6.3	11,685	52,256	23,000 / 2,272[2]	42,500/1,850	mildly in excess

[1] Figures refer to the Prut Basin in Romanian territory
[2] Provided the whole inland river water (less the Danube water) and ground water are used

Large drainage basins with a balanced extension on the relief steps, have a specific discharge at the mouth, or on the borderline (if running into neighbouring countries) of 6-12 l/s km^2 (the Someş at Satu Mare – 8.6 l/s km^2, the Crişul Repede at Oradea – 12.0 l/s km^2, the Crişul Negru at Zerind – 11.9 l/s km^2, the Mureş at Arad – 6.8 l/s km^2, the Jiu at Podari – 10.2 l/s km^2, and the Olt at its mouth – 7.7 l/s km^2.

The basins extending mostly in the hills and plains, regions occasionally influenced by the east-continental advections, register a specific discharge under 6 l/s km^2 (the Argeş at its mouth – 5.8 l/s km^2, the Ialomița at Slobozia – 4.99 l/s km^2 and the Siret at Lungoci – 5.57 l/s km^2).

The basins situated in hill and plain areas have the lowest specific discharge – under 3 l/s km^2 (the Bega – 2.9 l/s km^2, the Vedea – 2.1 l/s km^2, the Drincea – 1.4 l/s km^2, the Desnățui – 1.2 l/s km^2, the Călmățui – Brăila – 0.9 l/s km^2, the Bârlad – 0.9 l/s km^2, and the Jijia – 1.01 l/s km^2).

Values in the Dobrogea Plateau run under 1 l/s km^2 (the Telița – 0.8 l/s km^2, the Taița – 0.6 l/s km^2, the Casimcea – 0.7 l/s km^2 and the Slava – 0.6 l/s km^2).

A relevant image of water resources in drainage basins was obtained by referring them to the number of inhabitants and comsumption / capita in the year 2000. The results represent estimative figures varying from one year to the other in terms of demographic increases or decreases, the inclusion or elimination of some water comsumers from the system, the modernisation of drinking water supply systems and of technological processes.

Calculations concerning total resource and demand had in view both surface waters and ground waters.

Besides, estimations took into account all resources not only those having a technological and economic management potential. What was left out from these calculations was the River Danube and its 30-70 billion m^3, usable under conventions concluded with the riparian countries. A classification of drainage basins is feasible by looking at the hydrological parameters, at resources and demand (Table 2, Fig. 1) and referring the overall resource /capita to demand/ capita. This ratio may take on the following values: excessive, mildly excessive, balanced and deficitary.

In view of the above criteria, the map of 1st-order drainage basins offered two important conclusions:

- first, drainage basins facing the west have resources in excess of present demand, therefore the surplus can by shifted to another basin which is, or may become, deficitary in this respect;
- second, labelling a basin in excess of or in deficit of demand depends on the degree of human and technological load, that is, on the demand for water which shows temporal variations.

As a result, some basins located in the east of Romania, eg. the Siret, fall into the category of resources mildly in excess of demand. Obviously, this grouping also depends on how reliable the information concerning the water consumers, mainly the industrial and agricultural ones, actully are. Even a general, all-country assessment of the resource/ demand relation which is mildly excessive, has in our opinion but a relative, orientational value (Table 2 and Fig. 1).

Water resources by county. Assessing the resources of water in these administrative units is more difficult than estimating them in the big relief steps and in the drainage basins.

While calculations for the big relief steps focused on the mean specific discharge in surface waters (flow module) when it came to counties, the highlight fell on the autochthonous hydrographic basins and their fluid discharge. In the case of dranaige basins that extent into several counties (which is the ordinary situation), calculation look into account only a certain quantity supposed to form on the territory of the respective county.

The approach was pretty similar to the ground water resources one, namely only the quota pertaining to the respective county was taken into consideration from the maps of water structure and the flow module.

Water is an important part of the counties' economic and social development. Sufficient water resources are considerably diminishing investments to fetch it from a longer or shorter distance. In the case of ground water, there are situations when the distance to the supply point is fairly long. In Craiova city, for example, water is brought from the karst springs, as far as 115 km away; in the city of Iaşi water is pumped in from the gravels of the Moldavia floodplain at Timişeşti, that is 80 km away, and the string of examples could continue.

However, a slight compensation between surface and subsurface water resources does exist. If the mountain zone has plenty of surface waters, tablands and plains (the Romanian Plain-Dobrogea) have significant ground water resources.

Table 3 - Water resources by county

No.	County name	Surface area (km^2)	No. inhabitants (1999)	Ground water (mill m^3/y)	Surface water (mill m^3/y)	Total water resources	Water resources/ capita (m^3/y)	County picture of water resources
1	Alba	6,242	397,713	107.4	1,349.9	1,457.3	3,664.2	mildly in excess
2	Arad	7,754	476,624	539.8	774.5	1,314.3	2,757.5	balanced
3	Argeş	6,826	673,153	141.0	1,785.2	1,926.2	2,861.4	balanced
4	Bacău	6,621	750,777	245.6	1,052.3	1,297.9	1,728.7	mild deficit
5	Bihor	7,544	621,760	401.2	1,899.7	2,300.9	3,700.6	mildly in excess
6	Bistriţa-Năsăud	5,355	325,879	41.1	1,801.4	1,842.5	5,653.9	in excess
7	Botoşani	4,986	462,976	56.2	1,324.4	1,380.6	2,982.0	balanced
8	Braşov	5,363	630,744	267.6	1,238.7	1,506.3	2,388.1	mild deficit
9	Brăila	4,766	387,070	522.2	64.9	587.1	1,516.7	mild deficit
10	Buzău	6,103	505,280	278.7	928.5	1,207.2	2,389.1	mild deficit
11	Caraş-Severin	8,520	355,664	159.2	2,727.6	2,886.8	8,116.6	in excess
12	Călăraşi	5,088	331,368	562.5	215.3	777.8	2,347.2	mild deficit
13	Cluj	6,674	422,891	63.5	1,158.8	1,222.3	1,690.8	mild deficit
14	Constanţa	7,071	745,954	354.3	19.7	374.0	501.3	deficit
15	Covasna	3,710	230,542	117.8	729.3	847.1	3,674.3	mildly in excess
16	Dâmboviţa	4,054	552,271	252.4	497.8	750.2	1,358.3	deficit
17	Dolj	7,414	745,204	833.3	356.6	1,189.9	1,596.7	mild deficit
18	Galaţi	4,466	642,943	322.5	121.6	444.1	690.7	deficit
19	Giurgiu	3,526	295,401	497.3	206.0	703.3	2,380.8	mild deficit
20	Gorj	5,602	395,099	219.1	1,691.4	1,910.5	4,835.4	mildly in excess
21	Harghita	6,639	342,128	144.6	875.3	1,019.9	2,981.0	balanced
22	Hunedoara	7,063	526,834	64.5	2,750.7	2,815.2	5,346.6	mildly in excess
23	Ialomiţa	4,453	304,690	437.3	215.3	652.6	2,141.8	mild deficit
24	Iaşi	5,476	833,388	127.7	194.5	322.2	386.6	deficit
25	Maramureş	6,304	531,786	82.1	2,883.0	2,965.1	5,575.7	in excess
26	Mehedinţi	4,933	323,486	327.7	586.9	914.6	2,827.3	balanced
27	Mureş	6,714	601,552	152.3	1,484.2	1,636.5	2,720.4	balanced
28	Neamţ	5,896	585,746	180.7	971.3	1,152.0	1,966.7	mild deficit
29	Olt	5,498	510,137	705.2	531.4	1,236.6	2,424.0	mild deficit
30	Prahova	4,716	857,761	232.7	908.8	1,141.5	1,330.7	deficit
31	Satu-Mare	4,418	390,704	334.4	612.4	946.8	2,423.3	mild deficit
32	Sălaj	3,864	256,856	40.9	503.6	544.5	2,119.8	mild deficit
33	Sibiu	5,432	443,622	96.7	890.2	986.9	2,224.6	mild deficit
34	Suceava	8,553	715,228	141.0	2,874.6	3,015.6	4,216.2	mildly in excess
35	Teleorman	5,790	459,529	477.2	236.1	713.3	1,552.2	mild deficit
36	Timiş	8,697	687,377	763.9	828.8	1,592.7	2,317.0	mild deficit
37	Tulcea	8,499	264,175	503	20.8	523.8	1,982.7	mild deficit
38	Vaslui	5,318	465,008	129.7	219.9	349.6	751.8	deficit
39	Vâlcea	5,765	431,328	163.8	2,433.5	2,597.3	6,021.6	in excess
40	Vrancea	4,857	391,205	392.5	614.7	1,007.2	2,574.6	balanced
41	Ilfov+ Bucureşti	1,821	2,286,129	204.5	106.5	311.0	136.0	deficit
Total		238,391	22,460,042	11,695.1	40,685.0	52,380.1	2,332.1	mild deficit

Yet, for all this compensation, the territorial spread of water resources is anything but balanced. Therefore the construction of storage-lakes to allow the distant supply of some localities (we would refrain from saying of the whole county) is still a necessity and a topical issue.

Meeting the water demand in a satisfactory manner could be achieved by inter-basin transfer, that is, from the rich hydrographic networks to those with a lower discharge.

Another method used in some countries is to inject into rock (sands, gravels) some water volumes in excess, or formed in periods of maximum discharge (eg. high spring waters) and have them available for consumption. The map and table of water resources by county indicate a heterogeneous relation between major relief units and their hydrological potential, given the distinctively different number of inhabitants, which accounts for the greater or lesser demand of water for drinking, industry, irrigation and other uses. One would hardly find water - deficient counties in the Carpathian and the Subcarpathian zones, or in the west of Romanian for that matter. Deficits or mild deficits are common to the counties situated mainly in the east and the south of Romania (Iaşi, Vaslui, Galați, Constanța, Brăila, Ialomița, Călăraşi, Dolj, Olt, Teleorman, and Giurgiu), but also Prahova and Dâmbovița, which dispute location in the mountain, hill and plain region, and have a numerous population. A similar situation have Bucharest and Ilfov County it lies in, which for all the rich subterranean resources, have a deficit because they, too, have a very large population.

A special case makes the county of Botoşani, bordered on the west and east by two major drainage basins: the Siret and the Prut. Moreover, compared to other counties, it has a lower, largely rural, population. Summing up, we would say that the situation of water resources by county has only orientational relevance, it reflecting the current state-of-the-art and providing some ideas for projects focusing on prospective solutions to the water demand (Fig. 2 and Table 3).

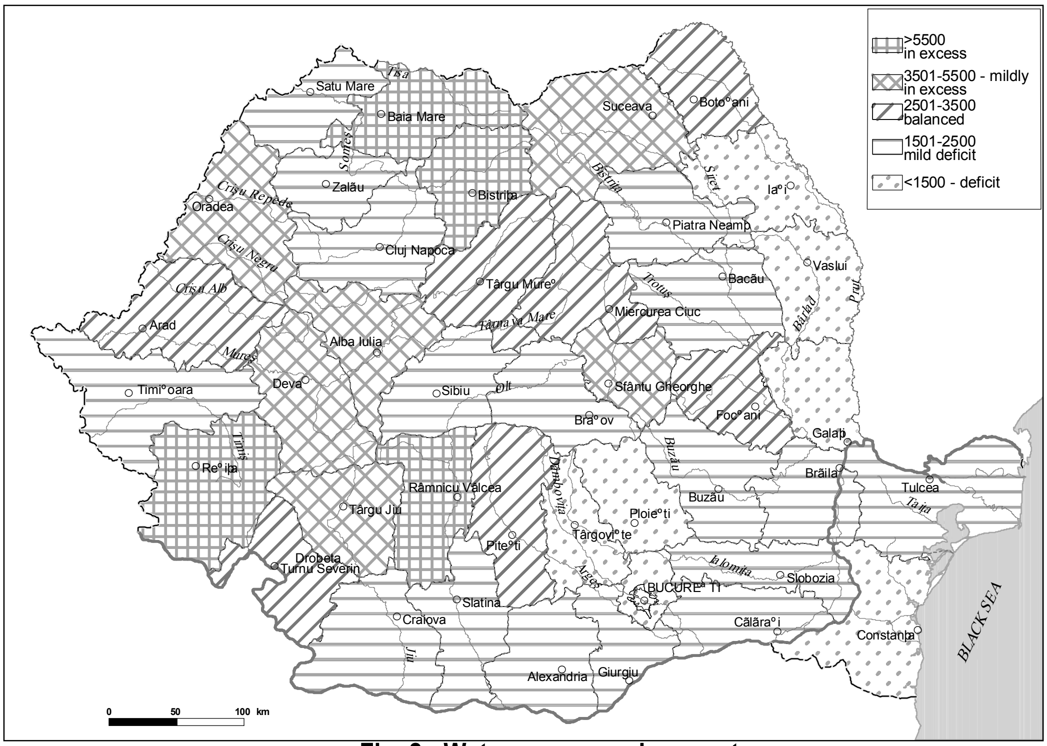

Fig. 2 - Water resources by county

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