Supplement To Skadar Lake Geogenesis, Its Inflow And Outlet Components And Background On Its Regulation Activities

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Basin geogenesis and background on previous activities

Formation of Zetsko-skadarska depression, phenomenon with specific forms in a wide region of Balkan Peninsula, is a very complex geological process that has not been studied all-inclusively so far, hence it is still unknown.

Regional data and data basis for genesis between Zetsko-skadarska depression and Skadar lake basin could be found in studies treating other issuses in this depression concerning region as a whole or its particular parts.

Therefore, the outlined review of Zetsko-skadarska depression genesis should be deemed as regional and general, and further explained by detailed analysis of available knowledges and comprehensions. We emphasize "available knowledges and comprehensions", because there are fully reliable data and data basis (factographies) for the review of of Zetsko-skadarska depression genesis, but there are also numerous processes and phenomena (in that part of lithosphere) that can be explained, more or less acceptably, only by means of specific theories /4/.

From the 50's years of the last century, data have been gatehred (by geophysical research methods), which, from a regionall point fo view, confirmed Vagener's theory upon movement of continents. This hypothesis is also known as "new global tectonics". By this hypothesis, the old continental platforms are confronted along fractions in lithosphere, where it comes to subduction - one plaque is pulled under the other, that is to say one comes across the other. In the subduction area, a block which is pulled under, sinks into the melted mant (astenosphere), and a block which is put on wrinkles (tears to pieces) and the pieces come across one another. This kind process developes in the Mediterranean zone, where North-Afric table is sinking under the European, thus causing permeation of geosinklinal area, and further formation of Dinaride mountain range, and in its continuation Skadar lake.

Quarter sediments of Zetsko-skadarska depression are represented by glacial-fluvial,l limnoglacial, eolith, lake and aluvial sediments. By so far researches of the tectonic structure of Dinarids, a number of regional geotectonic units being on our territory is separated by the resarchers of this region /4/:

Adriatic-Ion pine complex,
Pindos-Cukali area,
High karst area,
Durmitorska crown.

On the territory of Albania:

Merdita area and
Koraba area.

Zetsko-skadarska depression complex, including Skadar lake, belongs to the high karst area.

By another theory, advocated by eng. D.Dragovic, a doyen of Montenegrin hydrotechnics, whose presence at this meeting would be precious, the Lake appeared on a cite of former sea bay, which had been separated by elevation of rung "Taraboš-Rosaf", after what the salt water in it was repressed by fresh water. The Lake is covered with long-standing colmatage, through centuries, primary by waters of Moraca, then Drim and Bojana, and aslo its direct tributaries /2/.

The original bay was very deep, with a bottom on 600 m under the current Sea level. After the bay was almost covered by calyey and fine sandy materials, the Lake has started to form in a course of the last 100 000 years in the period of Virm glaciation. Being lower, the level of Adriatic sea enabled river Bojana to cut its riverbed which drained the Lake completely into the sea. /2/

According to historical records, in the period of Roman Empire, there is not a word found about Skadar lake, so it is assumed that river Moraca has flowed through current Skadar lake basin, further flowing by river Bojana, whose river mouth was jointed with river Drim in Zadrimlje, and flowing together into the adriatic Sea, near Ljes.

Not a single ancient geographer mentions Skadar Lake, but instead swamps (Palus Labeartis), that were formed by accumulation of deposits brought by water currents. Later, in the process of water elevation during the Lake formation period, these swamps were covered by water. There is a church near Bahceleka, with remains still portruding from the water.

The first historian to mention the Lake was Barlitius, a contemrorary of Skenderbeg, from a period of the Cnojevic dynasty governing. When reporting about a siege of the town of Skadar by Muhamed II in 1479, Barlitius describes beautiful, spacious and miraculous lake teeming with fish and reviving its surroundings of pretty downtowns and numerous villages with beautiful churches and monasteries.

The same historian writes that river Drim has flown in a direction of Ljes, which is later confirmed by a geographer Casimirio Fresco in his description in "Geographical Conditions of Dalmatia", in XVII century. Traveling writer Coquelle in his report "Traveling across Albania" describes river Drim, that flows through Zadrimlje in a direction of Ljes /3/.

Historical records state that a torrent Kiri has influenced the Lake, east of Vran, where to reach the coastal line. Somewhat about 1750, Kiri has changed its mouth advancing towards Skadar and destroying its suburbs Rusi and Tofana. Yet, around 1760 the torrent Kiri has flown east of Skadar, with its mouth in river Bojana, south of the fortress on the hilll Rosafe.

Drim has its headwaters in Ohrid Lake. As a Crni Drim and south-west of Prizren, it receives Bijeli Drim in Metohija, then flows through deeplly cut canyon and appears between Prokletije and Miridit mountains, and finally around Vaudeis, sout-west of Skadar emerges in Skadar valley. Drim has permanently been changing its course for the last centuries, turning to Bojana at one time and to Zadrimlje and Ljes at Medue at another. Each time it turns to Bojana, a disturbance in Skadar lake water regime ensues, resulting in floods in disastrous proportions. As an immediate cause for this breakthrough of Drim appeared building of a great number of irrigation canals bringing water to water mills in Skadar.

The topographic map of Turkey by Franc Vajs, issued in Vienna, in 1827 notifies visible changes caused by Drim breakthroughs, showing numerous flooded villages in the middle of Skadar Lake and current Bay of Hum was once an area separated from the Lake.

Process of Skadar lake complex, Bojana and Drim forming had been intensive since great floods in 1848 and 1858, finally to November 1896, when Drim completely brokethrough into Bojana. This situation has remained. /3/

Bojana river bed capacity is not capable of receiving all the waters, hence there are frequent floods and reverse flow of Drim waters, by Bojana, into the Lake. In the floods in November 1896, the famous bridge over Drina by Mehemd pasha Sokolovic was sunken, and Drim waters were estimated to about 7000 m^3/sec. Some records say that at the same time Moraca flooded current Square of Ivan Milutinovic in the centre of Ppodgorica, which is due to nowdays perceptions, practically impossible. In this period Skadar lake waters grew for 3-5 m and reached maximum almost to the peak elevation, more precisely 9,86 in January 1963.

After accumulations were bulit, the situation improved, because Drim has finally been tamed by accumulations Globocica and Spilje in Macedonia, Vaudeis, Fierza and Komana in Albania, with useful area of about $2{,}8 \times 10^9$ m^3 of accumulated water, this being much greater than useful accumulation of Skadar Lake, which is somewhat about $1{,}57 \times 10^9$ m^3. These accumulations provide almost complete leveling of Drim waters. If its waters similar to those in January 1963, that were 5000 m^3/sec at Vaudeis appeared, they would not be greater than 2000 m^3/sec, which is very significant from the aspect of floods /1/.

Montenegro raised the question of Skadar Lake, Drim and Bojana regulation at the Berlin Congress, 1878. The Goverment of Turkey recognized its obligation to return Drim into its old river bed towards Ljes and to regulate Bojana. Some activities have undertaken from 1882 to 1884, based upon a project of eng. Lambert, predicting dam building where Drim penetrates in Drinjaca, and this way course of Drim towards Bojana would be diverted and turned into the old river bed towards Ljes. These buildings were not executed by the project and did not surrvive, so Drim completely destroyed them as uncompleted and unfinished, /3/.

Then, following directive issued by Govrment of Turkey, series of studies and research workes has started, among them being:

- Study of eng. Helinger, 1884,
- Project of eng. Pansijer, 1889,

- Project of Military Turkish Commission of eng. Rosnela, 1893,
- Project of eng. Ravoti, 1896,
- Report of Commission of eng. Mile, 1910,
- Study of eng. Brio, 1910, which above all prescribed deviation of Drim towards Zadrimlje, deviation of torrent Kiri north of Skadar, Bojana river bed deepening by dredging, with the planning of average "Oboti-Beljaj".

Navigation of smaller boats with a draft to 2 m was anticipated for Bojana. By perfroming these works, the Lake level would be reduced for 2,5-3 m. But, the Balkan wars hindered Turkish Government to fulfill its obligations towards regulation of Skadar lake, Drim and Bojana /3/.

After World War I, studies towards regulation of Skadar Lake, Bojana and Drim were resumed.

In 1923, eng. Kado from Ministry of Buildings in Tirana, submitted to the Albanian Government a report suggesting measures for enabling navigation by Bojana and land reclamation measures at the edge of Skadar Lake. He suggested: deviation of Kiri into Skadar lake, dredging of Bojana for navigation enabling, Lake level reducing, current maintaining in the catchment areas of Drima and Kiri, building of a high dam on Drim at Vaudejs, in order to withold flood waves and deposits of the used water powers.

Following directives of former Water Head Office of former Yugoslavia, eng. Zivkovic from General Water Inspection, with main office in Split, wrote a study in 1923, forseeing numerous variants concerning regulation of Skadar lake, Drim and Bojana, with the following actions:

- draining one part of the Lake into the sea, by building outlet tunnels;
- draining ground along the Lake, by building defensive embankments and
- land along the Lake reclamation with regulation of Drim and Bojana.

Research studies of eng. Znidarsica in 1923 were foundation for negotiations between Governments of Yugoslavia and Albania by the end of 1925, precising the following attitudes:

Previously plan and determine a definite Project by means of a single common Commission and submit it to both Governments for their approval;

After approval is obtained, both Governments should establish a common Commission, which will prepare the Project realization from the administartive, legal and financial apsect.

Yugoslav Government of that time suggested to Albanian Government making beforehand decisions upon general principles of works execution:

- each state should participate in work execution with acapital corresponding to future benefits,
- each state should maintain the executed works on its territory, yet the expenditures should be divided to realized profit accordingly,
- method of work execution should be precised and
- single common Commission should monitor and control work execution and maintanance.

At the beginning of July 1926, the Albanian Government replied that one joint commission should examine on spot the submitted proposals and deliver Report which will be a base for the final decision. The Yugoslav Government approved of this proposition for the establishment of the joint Commission, and accepted to execute general works in field and gather relevant data of technical and economical nature, for own account. For this purpose, Scadar section of former Water Head Office was established. The Section has executed basic geodesic works and recording (triangulation, leveling, sounding and photographing of the Lake, Bojana, Drim and Moraca), organized Hydrographic service and executed hydrometric measurings, gathered all the relevant data for the area of Skadar lake about agriculture, fishing, traffic and navigation, trade and industry, hygienic and social conditions of population etc, from 1928-1929. Upon this data basis, teh Secton has prepared foundation for planning of general project for regulation of Skdar Lake, Bojana and Drim with land reclamation. This Section basis was delivered for inspection to experts of Governor's Administration in Cetinje, in 1933. Among Albanian experts, there were Italian engineers, whic were very inetersted in solution of this problem /3/.

During 1939 the Italian company "Cidinio" from Rpome has shown an interest in contribution to solvation of this problem, issuing a report regarding navigation by Bojana to Skadar and to Sea, for vessels of capacity to 600 t, in order to enable Skadar to overtake its leading role of once trade and commercial centre of the region. However, It is evident that the Italians were more inetested in using Bojana as an approach to their military vessels, because they occupied Albania in August of that year.

Due to well known situation of Yugoslav Kingdom capitulation in 1941 and the beginning of World War II, further operations were suspended.

The activities were resumed in 1947 and Goverments of Albania and Yugoslavia establish join Commission for restoring documentation concerning regulation of Skadar, Drima and Bojana. The activities were suspended once more due to events in 1948, when Infobureau Resolution was issued. During 1956 godine an agreement was signed between Governments of SFRJ and Albania towards waterpower engineering issues. Based upon this agreement, Yugoslav-Albanian Commission was formed, for the purpose of solving the opened questions of waterpower engineering between two countries. The long/standing representative of Montenegro in this Commission was eng. Dusan Dragovic. The Yugoslav-Albanian Commission, on its Second Special Meeting, held in 1962 formed a permanent Yugoslav-Albanian Subcommission for regulation of Skadar Lake, Drim and Bojana. On the same occasion, a permanent Yughoslav-Albanian Subcommission for confining was also formed. The Commission has determined a task for subcommission to prepare technical documentation for regulation of Skadar Lake, Drim and Bojana, to choose optimal variants with a proposal of expenditure disposition on both sides, concerning interests of both Yugoslavia and Albania. The technical documentation concerning these problems was prepared in versions of few design companies, among those from opur side we stand out the following:

- Preliminary project of Bojana regulation, designed in 1968 by Institute of Waterpower Engineering "Jaroslav Cerni", Belgrade,
- Preliminary project "Protection from floods and Skadar lake coastal area reclamation", designed in 1971, by Agroplant 13 jul – Podgorica, OOUR and Agroeconomic institute in cooperation with UN organization FAO and OECD.
- Plan project of regulation of Skadar lake, Drim and Bojana, designed in 1973 by Waterpower Engineering Organization "Zeta", Podgorica.

According to this documentation \nd all the previous projects, the common note is breakthrough of average "Oboti-Beljaj" for Bojana deviation and the most probable choice of optimal elevation peaks from 4.5 to 6.5 mnm, with seizing of cultivating areas of 12500 ha on the side of Montenegro and 1500 ha on the albanian side. Further reducing of elevation peaks of the Lake would be harder to justify from an economic aspect, due to a sudden enlargement of physical scope of works /3/.

Global review of inflow and outlet components of Skadar Lake surface waters

Skadar lake complex with Moraca, Drim and Bojana seizes an area of nearly 20.000 km^2, and total flow rate on that territory is estimated at 630 to 670 m^3/sec. The Lake with the belonging catchment area and other tributaries seizes an area of 5490 km^2 , out of which 4460 km^2 (about 80%) belongs to Montenegro and 1030 km^2 (or 20%) to Albania, while 2/3 of lake area belongs to Montenegro and 1/3 to Albaniji. The lenght of the Lake is 44 km from Crnojevic river, to the end of Bojana at Skadar, and its width on line Moracnik - Kamenica is about 14 km /2/.

Literature often cites Skadar Lake as the largest lake in the Balkans. This is correct when reffering to water surface, but when concerning volume of accumulated water, the Ohrid Lake is much larger, because its average depth is even more than 80 m, while depth of Skadar lake is somewhat around 7 m.

The Zeta plain surface area is around 200 km^2 above the elevation peak, including surfaces of limestone hillocks that portrude above the plain level. The south parts of Zeta plain are periodically flooded and swamp terrains with surface area of about 100km^2. Particular parts of Zeta plain have their specific names, like: Doljansko polje, Momisko polje, Tolosko polje, Ljeskopolje, Cemovsko polje, Dinosko polje, Rogamsko polje, Tusko polje, Kadrabutansko polje ect. /4/

Along the edge of north-west and west part of Zeta plain flows river Moraca, and as right tributaries receives waters of river Zeta at the elevation peak 29 mnm, then canal from Mareza river mouth and river Sitnica at the elevation peak 20 mnm, and from the left side waters of river Ribnica at 25 and Cijevna at elevation peak 12 mnm. Except for groves and southern parts, Zeta plain is made of fluvioglacial sands and gravel, with a large size parts that are mostly disconnected, and of carbobnate origin, with thickness to 100 m. The thickness of these sediments determined by drilling is 94 m. The groves are made of lymnoglacial and different sandy clayes.

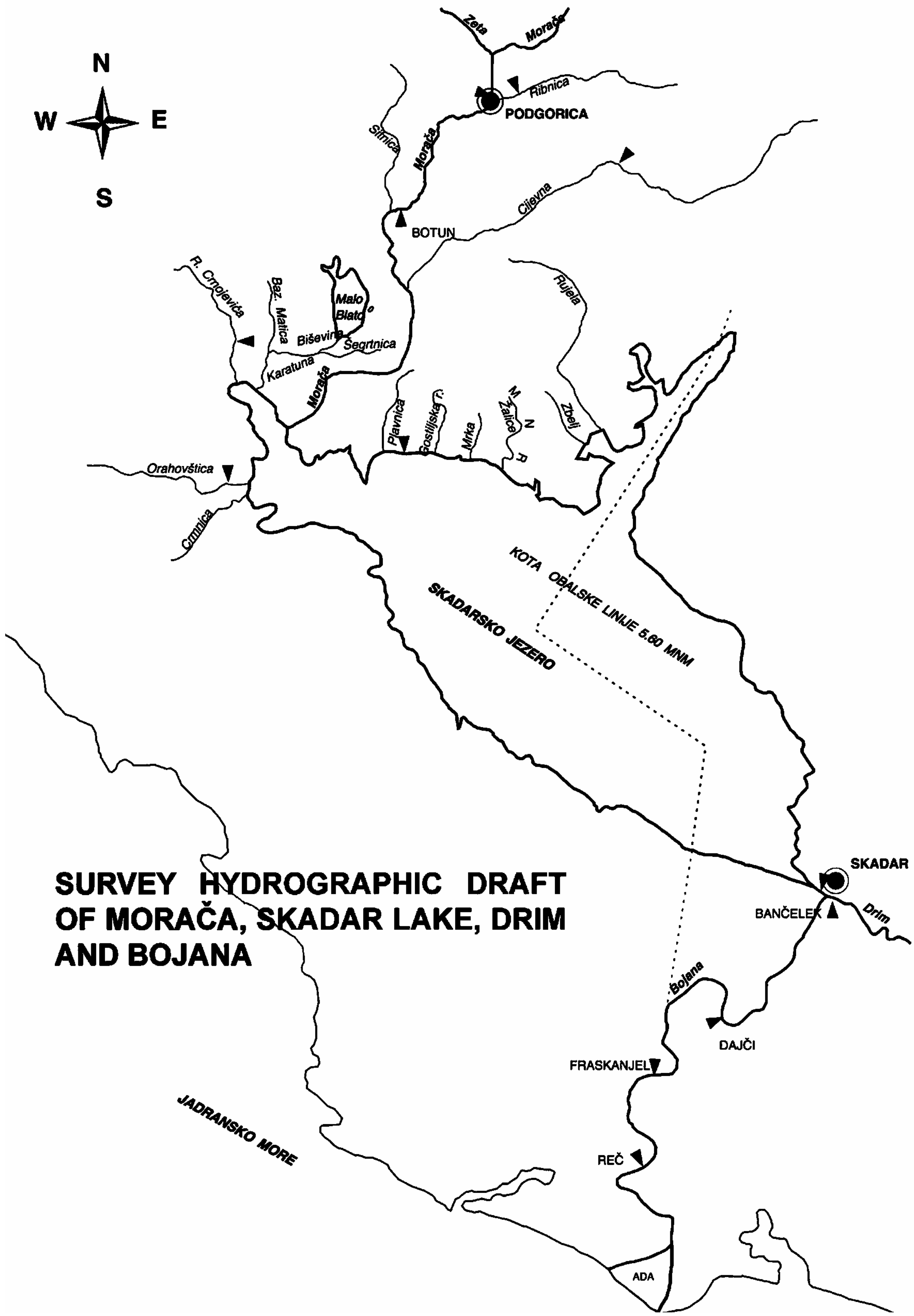

Figure 1

Data analysis at rain gage stations along the edge of Skadar lake or on the evry Lake: Ckla, Djuravci, Komarno, Ostros, Podhum, Crnojevic River, Tuzi i Virpazar, indicated average precipitations quantity of 2398 mm or 2,4 m per year. Average extreme minimum precipitation are about 1590, ad average maximum precipitations are 3030mm, with an unevenness indicator of 1,91. This results in even more uneven flow rates. When concerning the Lake area at its average long-standing peak elevation of 6,46 mnm, where average area covered by water is 472 km^2, then direct precipitations contribution to the Lake will be:

$Q = F \times P = 472x10^6 \times 2,398 = 1.131,86x10^6$ m^3 annual volume, at average it is $1.131,86x10^6$: $31,5x10^6 = 35,9$ m^3/s. This is taken to be gross income, if we adopt annual average evaporation of 45%, than an effective inflow from precipitation would be 35,9 x 0,55 = 19,8 m^3/s /6/.

Average long-standing flow rate of Moraca in Podgorica (1948-2002) for a measuring period of 55 years is 160 m^3/sec. At the down-stream water gage station Botun, we adopt average long-standing flow rate of 170 m^3/sec, for the period with its observing and measuring being too short.

For the 40 years measuring period at the hydrological station Trgaj, situated on river Cijevn, average long-standing flow rate is 25,2 m^3/sec /6/.

Average long-standing flow rate on Crnojevic River is estimated at 6 m^3/sec, for the period of own measurings being too short. This flow rate for river Sitnica is 7, for Orahovšticu 3 m^3/sec, and that is to say all regarding measuring profiles.

We have to mention that the hydrological station Botun was situated immediately above river mouth of Sitnica, and in the mid-catchment area of Moraca, and it covered waters of Ribnica and Ljeskopolje Canal, as well as pouring waters of Mareza source /6/.

Following bellow are other minor tributaries of Skadar lake on the side of Montenegro, possessing no measuring data:/4/

- River Crmnica, which has its headwaters in a district of Gluhi do, south-west of Virpazar, at peak elevation 11 mnm
- River Seljanstica, south of Komarna, which has its headwaters in dolomits called "Zaljcina".
- River Segrtnica, which is formed of sources from quarter sediments of Ponari village district, and which further with Bisevin constitutes Karatuna.
- River Plavnica, which receives waters from quarter sediments at peak elevation 10 mnm at the south edge of part of Donja Zeta (Lower Zeta), called Vinogradina.
- Gostiljska river, which receives waters from quarter sediments called Zgurlic, at peak elevation 7,5 mnm, and periodically from even northern part of Donja Zeta, called Lisovc, at peak elevation 8,4 mnm
- River Pjavnik, which receives waters from quarter sediments of a part of Donja Zeta, called Dijanice, below the peak elevation 10 mnm.
- Rivers Mala and Velika Mrka, which receive water from quarter sediments of parts of Donja Zeta, called Balince, Ćurici i Siekave below the peak elevation 10 mnm.
- River Masove Zalice, known as Raicevica and Nikalovica Zalice, which receive waters from quarter sediments of a part of Donja Zeta, called Adzinice, eatern part of Mataguskog grove i Lokava, at peak elevations below 8 mnm.
- River Zbelj, with a down-stream part called Grabovica, which receives waters from quarter sediments from numerous sources (five) from a part of Donja Zeta belonging to southern part of Kadrabutanskog field.
- Periodical river called Rujela, starting as periodical karst springs in the Miljes village district, and further down-stream from a periodical karst spring from a water hole Krevnica in the Vuksan Lekic village district.

Catchment areas of all these rivers belong to the territory of Montenegro, except for source part of river Cijevna catchment area that is a part of Albanian territory.

From the Albanian territory the Lake receives waters from several rivers and strams, among which the most famous are Vraka i Reliska. For them we do not possess available ballance, but if we grant them 10 m^3/sec for a rough estimation, we will have:

For Moraca - Botun, Sitnica, Cijevna, Crnojevic River i Orahovstica 170 + 7 + 25 + 6 + 3 = 211 m^3/sec.

If we grant the counted minor water currents $\sum_{1}^{10}$ 10 m^3/sec for rough estimation of average long-standing flow rate we will have 221m^3/sec on the side of Montenegro, meaning 231 m^3/sec for Vraka and Reliska on the Albanian side, with estimated 10m^3/sec.

If we add to this contribution from precipitations on the very Lake, we will get amount of surface inflow with precipitations contribution of 231+20 = 251 m^3/sec.

Proportion of water availibility of a total period 1948-2002 and period 1949-1967 for Moraca in Podgorica would be 160 : 167 = 0,96.

Therefore, by rough analogy towards Moraca, the long-standing period flow rate 1948-2002 for Bojana in Skadar would be 317 x 0,96 = 304 m^3/sec.

Thus the contribution from springs and wells would indirectly be 304 - 251 = 53 m^3/sec. V. Radulović /4/ evaluates this contribution to 60 m^3/sec, which is not inconsistent with here obtained.

According to literature data /5/ average long-standing rate flow of Drim on profile Bahcelek in a period 1949-1967 was 282 m^3/sec, if corrected to long-standing period 1948-2002 it would be 282 x 0,96 = 270 m^3/sec. Data for Drim balance cause suspicion because the total rate flow of Bojana with Drim could be found in literature 630 and even up to 670 m^3/sec. This dilemma should be explained by data of Drim balance on the profile Dajci, about which nothing could be found in the existing literature. This impressive balance launches Bojana to the 4th place among rivers of former Yugoslavia, after Dunav, Sava and Tisa, and preceding Drava, Drina and Neretva. This fact was overlooked tacitly. Additionaly, by water quantity come Morava, Kupa, Una, Moraca and Vardar, hence two rivers from Montenegro are among 12 argest rivers of former Yugoslavia /2/.

Reduced to total common period 1948-2002:

Table 1. Water quantity of Montenegrin rivers

Territory of Montenegro	
Moraca - Podgorica	160 m^3/sec
Moraca - Botun	170 m^3/sec
Cijevna - Trgaj	25 m^3/sec
Crnojevic River. - Brodska Njiva	6 m^3/sec
Orahovstica - Orahovo	3 m^3/sec
Sitnica - Podgorica	7 m^3/sec
Area of uncontrolled imput Σ (1 - 10)	10 m^3/sec
Precipitations on the Lake	20 m^3/sec
Total surface inflow	**241 m^3/sec**
Territory of Albania	
Bojana - Skadar	304 m^3/sec
Drim Bahcelek	270 m^3/sec
S Bojana with Drim	574 m^3/sec
Vraka and Reliska	10 m^3/sec
Total surface outlet	**584 m^3/sec**

Being the key hydrographic facility of this complex, Skadar lake deserves more sophisticated analysis. It is being based upon 55 years of water level observation at hydrologic station Plavnica, 1948-2002. Characteristic water levels are as indicated Table 2.

Table 2. Characteristic water levels at hydrologic station Plavnica, 1948-2002.

The lowest registrated water level at HS Donja Plavnica	4,54 m above the sea level
Low waters average level	5,15 m above the sea level
Lake waters average level	6,45 m above the sea level
High waters average level	8,47 m above the sea level
The highest water level within the anlyzed period	9,86 m above the sea level
Maximum amplitude of water level variation	5,32 m
Average amplitude of water level variation	3,32 m

These data should be compared with the Lake observation data identified on the Albanian territory. As far as we can remember, the difference between states leveling was once earlier determined to be somewhat about 9 cm.

The Lake useful amplitude between the average peak elevations of maximum and minimum waters is 3,32 m, and maximum amplitude of lake water change between the extreme peak elevations is 5,32 m.

These peak elevations have corresponding surface areas and volumes of lake water (Table 3).

Table 3. Surface areas and volumes of Skadar Lake water

	SURFACE AREA	VOLUME
For average level of max water level	$514x10^6$ m^2	$3,57x10^9m^3$
For average lake water level	472 $x10^6$ m^2	2,57 $x10^9m^3$
For average level of min water level	421 $x10^6$ m^2	2,00 $x10^9m^3$

Comparative analysis of change of low, middle and high Lake water levels, after the Fjerza accumulation activation are shown in Table 4.

Table 4. Comparative analysis of change of low, middle and high Lake water levels, after the Fjerza accumulation activation

Meters above the sea level	PERIOD 1948-1980	PERIOD 1981-2002	PERIOD 1948-2002	ΔH (m)	DEVIATION(%)
Low water levels	5,20	5,06	5,15	0.14	2,72%
Middle water levels	6,63	6,20	6,46	0.43	6,66%
High water levels	8,68	8,14	8,47	0.54	6,38%

According to the above outlined data, conclusions are as indicated below:

- Expectations that upon the construction of series of accumulations on Drim, influenced by its now deposits-free waters, the river bed of Bojana would be deepened and low water levels of Bojana reduced have failed, meaning that the currentl state has remained unchanged.
- When concerning middle and high water levels of the Lake, they have also remained without any significant changes, and the identified differences could be regarded as changes in the water availibility period, due to the well known fact that the last 20 years are generally dry.
- Expectations that there would be significant changes in the regimes of Bojana and Skadar due to and adequate water management in the accumulations on Drim, have failed. The smallest changes are in low water levels, than in the high and the greatest changes are in the middle water levels, as an o result of obvious change due to the last dry period.

The regulation of Bojana in the current situation is quite complicated issue, above all due to great quality of water of over 3500 m^3/sec that should be lead to the Sea, along with relatively small deleveling of just 6,5 m and very small canal drop of just 0,1™. The width of flow rate profiles at the bottom would be 150-200 m, with slope incline 1:2 and relatively deep water depth 8-10 m. The alternative represents construction of a dam predicted for the downstream flow of Bojana, somewhere on profile "Sveti Nikola - Puljaj" or at the contrary minimal water levels would drop too low, and there is also a problem of salting by salt waters. Any possible solution of this regulation complex worths a lot, but costs respectively, so this can be the main reason for the solution being unperformed.

Skadar lake water acquisition from ground waters, spring / wells and bottom spring waters

Scadar lake water acquisition from ground waters, springs (wells) and spring waters of its bottom and edge, is a very complicated and issuficently studied complex, giving no or rare information about genesis, morphology, size, form, water abundance, process regime, physic-chemical water characteristics etc. Not only that there are no informations about the Lake water acquisition from waters of its edge sides an bottom, but this way of water acquisition is not rarely neglected, what is a mistake. We emphasize that waters from springs, in some parts of the terrain, are hardly distinguished from spring waters of Lake bottom and side and vice versa. This being the consequence of form, water abundance and genesis of a spring and the concerned surface area size. Intentional and systematical researches and examinations of the Lake, its springs and bottom areas where springs emerge, have not been performed so far. As far as we are informed, there is a lower number of identified springs and spring areas on the Albanian territory.

Springs across the Skadar lake bottom are categorized into the following areas:

- Along the south-west edge of the Lake, viewing from mouth of Crnojevic River towards south-east up to river Bojana.15 springs is identified in this area. We would outline a spring "Raduško oko", with a depth determined to be over 80 m, and believed to be even 100 m. The depth of the rest of the springs is between 12 and 25 m.
- Along the north-west edge of the Lake, starting from mouth of river Crmnica, encompassing area across Crnojevic river, Bazagurska matica and Malo blato, and finishing with Moraca mouth into the Lake.It is believed that there are about 48 springs of different depth and water abundance on this line. The depth of sprouting is from 4 to 28 m, and for most of the springs these data are unknown due to their insufficient exploration. Here, we would undeline spring "Karučko oko", with a depth of 28 m below the Lake level.
- Along the north edge of the Lake, in the area Humsko blato-Hotski zaliv. There are 11 springs identified in this part of the Lake, with depth from 6 to 20 m. The most famous among these springs is "Ploce" with depth of 20 m.

It can be inferred that the springs of the south-west edge of the Lake are the deepest. Although their depth is over 80 m under the sea level, waters are beyond an impact of salt waters. The Lake waters are fresh waters. Water aboundace of these springs, as it is outlined in the previous section is indirectly estimated to be 53 m^3/sec.

Certainly, the strongest evidence of spring waters, besides one that can be seen with the naked eye, can be obtained by water temperature differences in the areas of water sprouting, compared with the Lake water temperature on the open lake or where these occurences do not appear.

As a conclusion, directing of Drim waters towards Ljes has lost its current interest, first of all because Dream waters are completely tamed by the construction of series of accumulations on the river, and further because Montenegro could not deny its sovereignty over the half of Drim waters. This situation has been maintained for almost 108 years, so it would be praiseworthy to finally receive its regulation. If the previous century can generally be called the century of oil, the new one, pursuant to numerous forecasts, could be the century of water - fresh, non-degraded, and even drinking one. Complex of the system regulation includes: regulation of Moraca downstream flow, regulation of Skadar lake and Bojana up to its flowing into the Adriatic Sea.

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