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Water management works within the Barcău/ Beretyó River Basin

Buz Loredana[1], Peter Anna[2]

Abstract: The knowledge of water management works within the Barcău/Beretyó River Basin is especially needed in relation to flood risk management, their primary role being the flood control. The concept of flood risk management according to the 2007/60/CE Directive on the assessment and management of flood risks is highly illustrated in the transboundary areas, when two or more countries have to commonly manage the same situation, without disadvantages and the idea of „basin solidarity" must prevail.

Key words: embankment, regularization, defence line, permanent storage, non-permanent storage.

1. INTRODUCTION

The cross-border cooperation between neighbouring states constitutes one of the most ancient and most important aspects of the international relations. The nature of these relationships largely influences the issues related to peace, security and international cooperation. A good collaboration between neighbouring countries is an important condition for their progress.

Over time, in order to control certain eminent dangers of cross-border area, the states appealed to the fair understanding between neighbours, with no international agreements or treaties to govern these aspects.

In water management, the cross-border cooperation with the Hungarian Republic is carried on based on the *Agreement between the Government of Romania and the Government of Hungarian Republic on the cooperation for the transboundary watercourses protection and sustainable use*, signed on September 15th, 2003 in Budapest, and entered into force on May 17th, 2004.

2. GEOGRAPHIC INFORMATION FOR BARCĂU/ BERETYÓ RIVER BASIN

Barcău River springs from Apuseni Mountains, from the Plopiş Mountains base, and crosses the West Hills and the West Plane reaching the Hungarian territory in the East of the Alföld Great Plain and flowing into the Crişul Repede River. The Barcău River Basin is part of the Crişuri River Basin that is situated on the western side of the Romanian territory and on the eastern side of the Hungarian territory. On the Romanian territory, the north and north-east of the Barcău River Basin is limited by Someş River Basin, the south by Crişul Repede River Basin and the west by the Hungarian border. On the Hungarian territory, the north of the Barcău River Basin is limited by the Tisa River Basin, the west and the south-west by the Crişuri/ Körös River Basin, the south by the Crişul Repede River Basin and the east by the Romanian border.

Barcău River Basin is situated between 46º59' and 47º47' north latitude and 21º47' and 22º47' east longitude.

As structure, the Barcău River Basin is bordered to the north by the Viişoara hills and Şilindru-Carei Plain, to the west by Şimleu's Depression, to the south by Plopiş Mountains, the Hills of Oradea, Bihar Plain and Borş Plain, and to the east by the Alföld Great Plain.

3. BARCĂU/BERETYÓ RIVER BASIN HYDROGAPHIC CHARACTERISTICS

The Barcău River springs are located in Sălaj County, at the base of Plopiş Mountains of low altitude, on the Tusa territory.

In Simleu Depression, the Crasna and Barcău River Basin are split by hilly peaks below 400 m, from where Barcău meadow opens towards south and south-west.

On the eastern area, on the south-east of Rez Mountains, below Ponor Peak (779 m), the river beds of numerous low flow springs and flowing to north, they are forming a river bed named Barcău. Turning towards west-north-west, Barcău River bed is strengthened by Topliţa Valley and aims with the natural loops of the mountain valleys to Preoteasa. From here, crossing Subcetate, it reaches Valcău de Jos where enters to a larger river bed.

From Valcău de Jos to Boghiş it runs towards north, reaches Mare Valley after Iaz Valley, and from Bozieş aims to north-north-west. From here, it reaches Nuşfalău on north direction and leaves the valley and as Barcău River runs nearby Zăuan and Ip and gains

[1] Hydrologist, Crişuri River Basin Administration, Flood Defence Department, 35 Ion Bogdan Str., Zipp code 410125, Oradea, Bihor County, e-mail: loredana.buz@dac.rowater.ro
[2] Senior Advisor, Ministry of Environment and Forest, Water Management Directorate, 12 Libertăţii Blvd., district 5, Bucharest, e-mail: anna.peter@mmediu.ro

from south, from the northern slopes of Rez Mountains more important valleys as Groapa and Cerasei, reaching Marca on western direction.

Turning round about Curat Mountain (361 m) at Marca, and hollowing out a narrow river bed between it and Cocale (394 m) and Papur (330 m) Mountains slopes, the river reaches Suplacu de Barcău undertaking Borumlaca Valley on the left and then, within a larger valley, it runs to north up to Balc. At the Săldăbagiu de Barcău, the river receives on the left side the Săldăbagiu Valley. From here, the river runs directly to west nearby Săldăbagiu de Barcău, Ghida and Satu Barba, from where turning up to north-west, it reaches Marghita through Cohani and Abram. At Marghita, the river undertakes the Înot Valley on the right river side, and the Bistra Valley on the left river side. Here the flowing direction changes towards south-west up to Sălard. Between Marghita and Sălard it undertakes on the left river bank the Tria, Fânețelor, Almaș and Vițeilor valleys and on the right river bank Făncica and Sânicolau Valleys. From Marghita to Roșiori, where reaches the plain area, it flows through low hills. Between Sălard and the state border, it undertakes on the left river bank the Fâneața Mare Valley.

An interesting aspect of the Barcău River flowing is that from the hilly area, on the right bank, between Valcău de Jos and Nușfalău, no valley flows into it. Their water courses run towards north-east in Crasna. On its way further, Barcău River is supplied by right river bank valleys. So at Ip, the Ip Valley runs into it, at Balc, Bucmer and Camăr, and at Abram, Iteu.

When Barcău River flows in the plain area, Ier River flows into it at Pocsaj. From here, the river runs in south-west direction and between Pocsaj and Berettyóújfalu undertakes on the left River bank the Crișul Mic main channel. Nearby Bakonszeg on the right bank, the main channel Kálló flows into it. At Szeghalom, the Barcău River undertakes on the left bank, the main channel Kutas, and after Szeghalom, it flows into Crișul Repede.

Barcău River flows into Crișul Repede River in its 14.5 km section. On the Hungarian territory, its length reaches 74.35 km, and on the Romanian territory its length is of 134 km, the total length being of 208.35 km.

The total area of the Barcău River Basin including the Ier River Basin is of 6,095 km^2 with 2,694 km^2 on the Hungarian territory and 3,446 km^2 on the Romanian territory.

The maximum altitude of the Barcău River Basin is 882.1 m (Merișorului Peak). The spring altitude is of 585 m. The minimum altitude of the Barcău River Basin is 85 m around Szeghalom area.

The River Basins of the most important tributaries are:

- Mare Valley: 113 km^2;
- Înot: 124 km^2;
- Bistra: 169 km^2;
- Fânețelor Valley: 170 km^2.

The total area of the Ier River Basin is 1,563 km^2, with 123 km^2 on Hungarian territory and 1,440 km^2 on Romanian territory.

The total area of the Crișul Mic River Basin is 116 km^2, with 70 km^2 on Hungarian territory and 46 km^2 on Romanian territory.

The total area of the Kálló River Basin is 1,279 km^2, with 1,272 km^2 on Hungarian territory and 7 km^2 on Romanian territory.

The total area of the Kutas River Basin is 782 km^2 with 745 km^2 on Hungarian territory and 37 km^2 on Romanian territory.

The total area of the Szeghalom main channel basin is 267 km^2.

Table 1. The hydro-meteorological stations on the Barcău River

Hydro-meteorological station	River Basin area (km^2)	The average height of land (m)	River slope (%)
Valcău de Sus	74	523	0.65
Nușfalău	269	435	0.35
Marca	404	380	0.04
Balc	580	335	0.4
Marghita	823	292	0.15
Sălard	1,686	254	0.06
Pocsaj	3,502	98	0.0003
Berettyóújfalu	3,712	91	0.0002
Szeghalom	6,095	85	0.0001

4. WATER MANAGEMENT WORKS ON BARCĂU/ BERETYÓ RIVER BASIN

4.1. EMBANKMENTS

The Barcău River regularization started in 1855. The largest regularization works included the construction of an artificial river bed of 14 km from Sălard to Kismarjá and of 20 km between Bakonszeg and Szeghalom. At the beginning, the Barcău water emissary was Crișul Triplu not Crișul Repede, flowing over Nagy – Sárrét.

Between Kismarjá and Bakonszeg there have been realized several river bed cuts that improved the river slope conditions. Because of the inauspicious soil conditions, the depth of the river bed between Bakonszeg and Szeghalom is unsatisfying even today. At a 30-35% flood factor, the river flows over the average river bed and due to ice formation and flow it becomes particularly unpleasant.

At the same time as the regularization was made, the defence embankments were constructed on both banks of the river between Szeghalom and Sălard. During the regularization, the minimum width of the dike – bank area was established at 120 m, but even today a dike - bank area of 75 m width can be found. Along the whole Hungarian sector the narrow dike – bank area is set to be maintained free of vegetation (afforestation is strictly prohibited in the dike – bank area).

a. Embankments on the Romanian territory:

On the Romanian territory, the defence line on the left bank is continuous from the state border to Sărsig, while the defence line on the right bank is continuous from the state border to Marghita. From

these points to the spring, the defence lines on both banks are local dikes (longer or shorter).

The total length of the dikes on the Barcău River left bank is 39,300 km.

The total length of the dikes on the Barcău River right bank is 58,820 km.

a.1. Embanked sectors on the Barcău River left bank:

134 + 000 – 128 + 850	5 + 150 km
128 + 820 – 120 + 000	8 + 820 km
117 + 200 – 110 + 100	7 + 100 km
109 + 800 – 108 + 100	1 + 700 km
105 + 900 – 97 + 500	8 + 400 km
90 + 300 – 88 + 000	2 + 300 km
87 + 600 – 83 + 600	4 + 000 km
47 + 000 – 45 + 170	1 + 830 km
Total:	39,300 km

a.2. Embanked sectors on the Barcău River right bank:

134 + 000 – 114 + 100	23 + 900 km
113 + 950 – 100 + 050	13 + 900 km
100 + 000 – 88 + 000	12 + 000 km
80 + 200 – 79 + 100	1 + 100 km
72 + 650 – 66 + 050	6 + 600 km
48 + 420 – 47 + 100	1 + 320 km
Total:	58,820 km

b. Embankments on the Hungarian territory:

The defence line on the left and right bank of the Barcău River starts from 14 + 013 right bank section of Crişul Repede River with 0 + 000 km landmark and increasing up to the state border.

The total length of the Barcău River left bank defence line is 72,365 km.

The total length of the Barcău River right bank defence line is 73, 220 km.

b.1. Embanked sectors on the Barcău River left bank:

0 + 000 – 51 + 447	51,447 km
53 + 360 – 72 + 365	19,005 km
Total:	70,452 km

b.2. Embanked sectors on the Barcău River right bank:

0 + 000 – 34 + 490	13,177 km
35 + 225 – 52 + 500	17,275 km
54 + 245 – 67 + 400	13,155 km
67 + 730 – 73 + 220	5,490 km
Total:	49,097 km

4.2. STORAGES

a. On the Romanian territory*:*

The storages from the Romanian territory of the Barcău River Basin are presented by Table 2:

Table 2 The storages from the Romanian territory of the Barcău River Basin

No.	Name	Capacity mil. m^3	Water course	Type of storage
1	Andrid	17,5	Ier	non-permanent
2	Becheni	0,54	Becheni V.	permanent
3	Săuca	0,03	Râtului V.	permanent
4	Zimoiaş	0,42	Zimoiaş V.	permanent
5	Diosig	1.26	Ierul Îngust	permanent
6	Sântimbreu	2,018	Roşiori	permanent
7	Sălacea	1,20	Făncica	permanent
8	Fegernic	2,864	Almaş	permanent
9	Steluţei	0,720	Pârâul Instelat	permanent
10	Viţeilor	1,930	Viţeilor V.	permanent
11	Popii	0,95	local valley	permanent
12	Şilindru	0,707	Şilindru	permanent
13	Şimian II	0,267	Salcia	permanent
14	Şimian I	3,66	Salcia	permanent
15	Galoşpetreu	3,968	Rât	non-permanent
16	Reghea	0,108	Reghea	non-permanent
17	Dania	0,375	Dania	non-permanent
18	Înot	0,400	Înot	non-permanent
19	Păgaia I	0,08	local valley	non-permanent
20	Boianu Mare	0,325	Boian	non-permanent
21	Săldăbagiu	0,720	Dolea	non-permanent
22	Iertaş	0,250	Almaş	non-permanent
23	Polder Sălard	15,0	Barcău	non-permanent
24	Valea Cerului	0,25	Borumlaca V.	non-permanent
25	Egher	1,74	Cheţ V.	non-permanent
26	Ciutelec	4,2	Bistra	non-permanent
27	Cristur	3,63	Făncica V.	permanent
28	Sânicolau	3,84	Sânicolau V.	non-permanent
29	Uileacu de Munte	3,4	Fâneaţa Mare V.	non-permanent
30	Paleu	2,23	Comorilor V.	permanent
31	Dacia	0,37	Lacului V.	permanent
32	Budusläu I	0,33	Vărgatului V.	permanent
33	Budusläu II	0,07	Vărgatului V.	permanent
34	Loranta	0,78	Loranta	non-permanent
35	Orvişele	0,96	Orvişele	non-permanent
36	Corbeni	0,84	Corbeni V.	non-permanent
37	Olosig	0,17	Sânicolau V.	permanent
38	Cubulcuţ	0,15	Sânicolau V.	permanent
39	Ianca	0,61	local valley	permanent
40	Săcăşeni	0,045	local valley	permanent
41	Tiream I	0,047	Vetijgat V.	permanent
42	Tiream II	0,48	Barnod V.	permanent
43	Ianculeşti	0,065	Barnod V.	permanent
44	Petreşti I	0,03	Morii V.	permanent
45	Petreşti II	0,015	Morii V.	permanent
46	Petreşti III	0,025	Morii V.	permanent
47	Cehal I	0,10	Orbău V.	permanent
48	Cehal II	0,038	local valley	permanent
49	Blaja	0,08	Cean	permanent
50	Pir	0,09	Pir	permanent
51	Galoşpetreu II	0,42	Rât V.	permanent
52	Curtuişeni	0,08	Ganoş	permanent
53	Văşad	0,64	Ierul Morii	permanent
54	Mouca I	0,96	Mouca V.	permanent
55	Târguşor	0,023	local valley	permanent
56	Cadea	0,29	Local valley	permanent
57	Suplacu de Barcău	15,0	Barcău	permanent

b. On the Hungarian territory:

b.1. Kutas non-permanent storage

It is located on the territory between the Barcău River left bank and the right bank of the Kutas main channel nearby Szeghalom. It was flooded by ice the ice flood of Barcău River on February 9th, 1966. Therefore the National Water Office has designated it as non-permanent storage on March 14th, 1966, the dikes were rebuilt and the area is divided by a subdivision dike at Kórósszíget (Kutas I - Kutas II).

It has an area of 38.96 km^2, and its capacity is 36.5 million m^3. In order to protect against the danger of dike breaking at the sliding event on the Crişul Repede River from the Foki Bridge, on June15th, 1970 the box below was filled (Kutas I). There are no filling or emptying works and the filling is done by breaching the defence dike.

b.2. Halaspuszt non-permanent storage

It is located on the „halaspuszta" area from Szeghalom on the territory bordered by the defence dike on the right bank of the Crişul Repede River, the left bank of the Barcău River, the existing storage dike and the location dike from „halaspuszta". The idea of using it came together with the flood from 1970, when the location dike construction began. In 1973, it was declared as non-permanent storage aiming to mitigate the floods.

The area of this storage is of 21,75 km^2, and its capacity is 35,0 mil. m^3. On July 26th, 1980, the storage began to operate. There are no filling or emptying works and the filling is done by breaching the defence dike.

b.3. Ier non-permanent storage

It is placed nearby Pocsaj and Kismarjá localities on the territory bordered by the defence dikes from the Barcău River right bank and the Ier main channel left bank, respectively the state border.

Starting with 1973, the storage operates as non-permanent storage.

It has an area of 13,52 km^2 and a capacity of 12,2 mil. m^3. Up to the present, there was no need to operate this storage, there are no filling or emptying works and the filling is done by breaching the defence dike. In case of storage there is a need of agreement on transboundary water.

CONCLUSIONS

1. The storages located on the Barcău River tributaries from the Romanian territory have a positive influence on the flood mitigation.

2. The efficiency of the Ciutelec storage from Bistra River is notable for the flood mitigation on this tributary, excepting the case when on the rest of the Bistra River Basin up to the flowing into Barcău River heavy rainfall is registered.

3. In addition to the role of downstream flood mitigation through the decrease of the flood maximum flows and the increase of the flood defence embankment and regularization works safety, on the Almaşu Mic - Sălard sector, the storage Suplacu de Barcău supplements the drinking and industrial water flows for Marghita town, supplies the flows for drinking water centralised systems in rural areas from Suplacu de Barcău and for the oil industrial units in the area - Balc, Abram and Abrămuţ.

4. The floods formed in the hilly area of the Ier upper River Basin are mitigated by the Andrid storage.

5. Under the backwater influence of the Körösladányi dam, the river bed and the dike – bank area have been clogged nearby Szeghalom leading to high levels both in emergency and normal conditions.

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