

Correlations between some small hydrographic basins of the Rivers' tributaries, from the forestry fund

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Abstract The aim of this work is the analysis of some parameters of the Crișul Repede and Crișul Negru's hydrographic sub basins, and of the Iadului Valley, Brățuța, Finiș, Tărcăița, Văratec and Crișul Pietros respectively, in order to value the water flow and its power in the forestry sector.

The characteristics of the studied hydrographic basins were determined through the exploitation of the space model of the area, starting from their topographical maps at a scale of 1: 50000, using the Map Sys and through measuring these characteristics using the facilities offered by the Surfer programme.

The surfaces of the studied hydrographic basins is between 31,07 km² for the Galbena Valley and of 215,10 km² for the Iadului Valley basin.

The linear correlations established between the average multi annual flow from the control section on one hand and the characteristics of the hydrographic basins on the other hand, meaning their surface, their perimeter and the total length of the hydrographic net, are distinctly significant from a statistic point of view.

The values of the correlation factors realized by the linear regressions show that the main contribution in the formation of the multi annual flows of the small hydrographic basins from the Crisuri (Rivers) belongs to the surface of the hydrographic basin (82,26%) followed by the total length of the hydrographic net (76,27%) and the perimeter of the hydrographic basin contributes with a reduced influence (73,6%).

The Crișul Repede River (The Quick River) springs from the Apuseni Mountains in the south east of the Huedin Depression at an altitude of 710 meters. It flows to the north west until it reaches Ciucea from where it heads to the west (towards Oradea). It has a longitudinal profile characterized through an average slope of 3‰ and it has a hydrographic basin with a surface of 2973 km².^[**1.]

The Crișul Negru River (The Black River) springs from the Bihor Mountains from an altitude of 1460 meters. It collects its water from the west slopes of the Bihor Mountain and from the slopes concentrated in the Beius-Vascau depression, from a hydrographic basin situated in the west part of the country, having a surface of over 4400 square kilometers and it drains, in its superior parts, the west slope of the Bihor-Vladeasa Mountains, the south-west slope of the Padurea Craiului Mountains (Lovelace's Forest Mountain) and a great part of the Codru Massif (The Wood Massif). The length of the basin is of 100 km and its width is of 70 km.^[1]

►The Iadului Valley (Hell Valley) river that divides the mountain massifs of Padurea Craiului (Lovelace's Forest Mountain) and the one of Vladeasa (vladeasa Mountain). This river has a length of 46 km

Key words

hydrographic basin, surface of the hydrographic basin, perimeter of the hydrographic basin, the length of the hydrographic net

from its springs (from Vladeasa Mountains) until it flows into the Crișul River (Quick River). It has an average slope of 22 ‰, a hydrographic basin's surface of 215 km² and the surface of the forestry fund is crossed by 13251 hectares.^[**2.]

►Brățuța Valley springs from the Pădurea Craiului Mountains. It has a length of 14 km and an average slope of 35 ‰. It crosses a forestry fund of 2020 hectares; it has a hydrographic basin of approximately 50 km² and it flows into the Crișul Repede River as a left tributary. It is a very appreciated touristic area.

►Crișul Pietros River has its spring from The Boga Spring and it has a length of 32 km until it flows into The Crișul Negru River being a right tributary of the latter ^[4.], in a basin that has a surface of 200 km². The longitudinal profile has an average slope of 36 ‰, and the average depth in the warm periods is of 0,4 m and the average width of the transversal profile is of 7m.

►The Aleu Valley springs from The Bihor Mountains; it is a right tributary of the Pietros River (The Stony River), it has a length of 12 km and it crosses a forestry fund surface of 2456 hectares. It has a hydrographic basin with a surface of almost 40 km²

and it is characterized through a longitudinal profile with an average slope of 95 ‰ and with natural slope breakdown.

► The Galbena Valley (The Yellow Valley) that drains the whole basin of Padiş-Cetăţile Ponorului starts through the Galbena Karstic Spring (The Yellow Karstic Spring) reaching an average altitude of 1077 m. It has a huge flow and a noisy stream course. The length of the valley is of 8 km, the average slope of 110 ‰, the surface of the hydrographic basin of 31 km² and the one of the forestry fund that it crosses is of 4087 hectares.

► Crăiasa Valley crosses a hydrographic basin of 32 km and a forestry fund of 1873 hectares overlaid on a very appreciated touristic area (near the Bears' Cave), having a total length of 10 km.

► The Finiş Valley springs from the Codru-Moma mountains which it crosses on a distance of 25km in a basin with the surface of 85 km² and with a forestry fund surface of 2318 hectares [***4.] until it flows into the Crişul Negru River as its left tributary.

► The Tărcăiţa Valley is formed at the confluence of Şesuţa and Râpoasa Valleys from the Codru-Moma mountains. It has a length of 19km in a basin with a surface of 52 km² and it is approximately parallel with The Finiş Valley; the average slope of the longitudinal profile is of 26 ‰.

► The Văratec Valley, a left tributary of The Crişul Negru river, situated in the area of the Vaşcău Forestry Ward from the Oradea Forestry Department. This valley springs from the Codru-Moma mountains with altitudes between 600 and 1000 m, fragmented with steep and deep valleys, limestone plateaus, with beautiful karstic phenomena (dolinas, steepness, karstic springs).[***3.]

The main objective of this work is the analysis of some parameters of the hydrographic basins for the Crişul Repede and Crişul Negru Rivers and for the

Iadului, Brăţcuţa, Finiş, Tărcăiţa, Văratec valleys and for Crişul Pietros River in order to value the water flow and the water power in the forestry sector.

Material and Method

Many types of correlative links have been tested in order to establish the relations between the multi annual average flows (1991 – 2010) and the different characteristics of the respective hydrographic basins.

For the studied period the multi annual average flows have been determined in the control sections of the respective valleys and of the rivers, in hydrometric stations from the national net and the processed data come from the Romanian Waters – Water –Rivers Department data for which we would like to thank the above mentioned national institution.

The characteristics of the studied hydrographic basins have been determined through the exploitation of the space model of the area, starting from their topographic maps at a scale of 1 : 50000 using the MapSys programme and the measurement of these characteristics have been done using the facilities offered by the Surfer programme. (Drawing 1)

The multiannual average flow for the studied valleys are between 0,228 mc/s on Crăiasa Valley and 2,378 mc/s Crişul Pietros River (Table 1.)

Results obtained

The characteristics of the hydrographic basins determined with the help of the digital model of the area are the following:

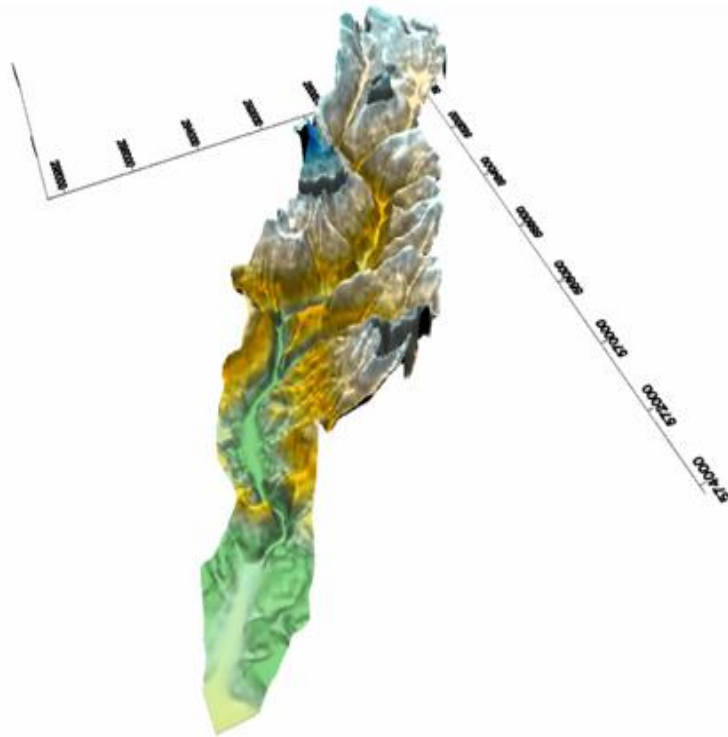
-The surface of the hydrographic basin (S_b) is the surface bound by the watershed and it is measured in square kilometers (km²) or in hectares (ha).

Table 1
Multiannual average flows (m³/s) in the control sections of some valleys from the forestry sector (1991-2010)
(after Romanian Waters – Waters-Rivers Department)

Critical number	Valley	Annual average flows		Multi annual average flow
		Maximum quantity/Year	Minimum quantity/Year	
1.	Iadului	2,346/1994	1,606/2006	1.954
2.	Brăţcuţa	0.395/2005	0.218/2009	0.313
3.	Crişul Pietros	2,655/2010	1,983/1999	2.378
4.	Aleu	0.472/1999	0.353/2005	0.424
5.	Galbena	1.605/1994	1.367/2002	1.485
6.	Crăiasa	0.260/2001	0.181/2010	0.228
7.	Finiş	0,644/1994	0,523/1999	0.588
8.	Tărcăiţa	0,515/1992	0,355/1997	0.421
9.	Văratec	0,402/1998	0,295/2001	0.352



Drawing 1- Satellite image of the Tărcăița hydrographic subbasin (source: www.google.earth.com.)



Drawing 2 - Space model of the area in the Tărcăița hydrographic subbasin

-The perimeter of the hydrographic basin (P_b) is represented by the dark contour of the highest quotas from the basin's surface and it separates the latter from the neighbouring basins; it is also called the watershed and it can be traced on the topographic maps in which the relief is represented with the help of the level curves and it is measured in km.[3.]

-The total length of the hydrographic net (net length) is given by the cumulated sum of the main water course's length and of the sum of the tributaries' length.[5.]

The value of these characteristics is synthetically represented in table 2. The surfaces of the

hydrographic basins are between 31,07 km² for the basin of the Galbena Valley and of 215,10 km² for the basin of the Iadului Valley. In what the perimeter is concerned we can notice that the value of the proportion maintains itself in the sense that it has the highest values and also the lowest ones for the same basins. But the situation changes in the case of the total length of the net where, as it can be noticed in table 2, the hydrographic basin of The Crișul Pietros River has a longer net although it has a smaller surface so, as a consequence it has got a higher density.

Table 2

The length of the parameters for the studied hydrographic basins			
Hydrographic basin	S_b	P_b	Length of the net
Valley	Square km	km	km
Iadului	215.10	94.25	164.89
Brăteuța	50.97	33.99	21.52
Crișul Pietros	198,69	80,22	189.05
Galbena	31.07	24.85	21.25
Aleu	36.19	25.60	34.23
Crăiasa	32.51	37.50	37.39
Finiș	85,86	52,40	112.5
Tărcăița	52,13	40,60	54.56
Văratec	58,09	39,50	62.14

The influences produced by the surface of the hydrographic basins, their perimeter and the length of the hydrographic net over the multi annual average flows have been tested in order to notice the formation of the flows from the small hydrographic basins belonging to the forestry fund of the Rivers' hydrographic basin.

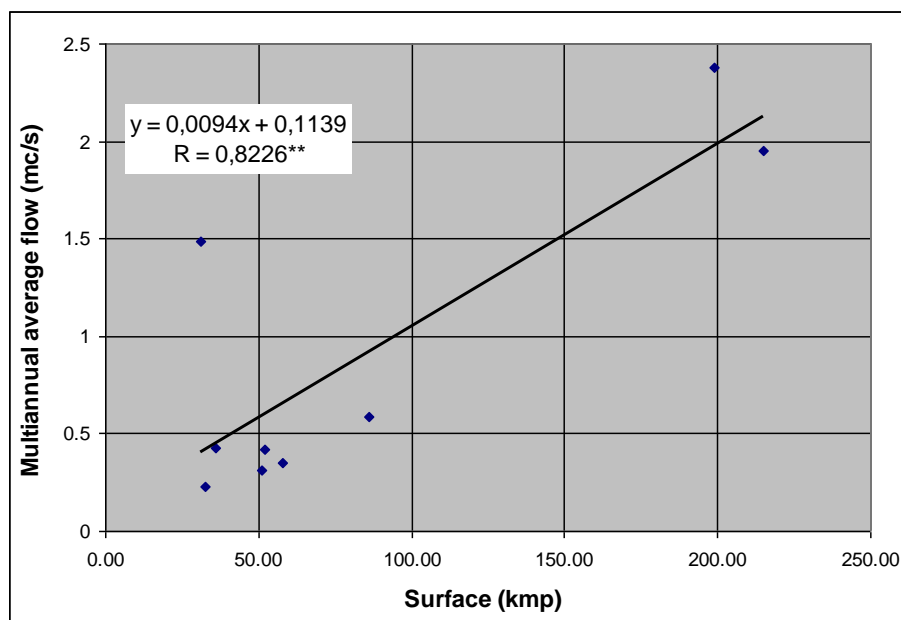
The influence of the hydrographic basins' surface upon the multi annual average flows from the linear type is distinctly significant from a statistic point of view, the correlation factor being $R=0,8226$. (Drawing 3.)

The regression slope of the straight line is 0,0094 fact which shows that if the surface of the

hydrographic basin increases with 1 square km then the flow unloaded in the control section increases with $0,0094 \text{ m}^3/\text{s}$.

The influence of the hydrographic basin's perimeter over the multi annual average flow measured in the control section of the valley, and being of the same type with the previous one, is only significant from a statistic point of view the correlation factor being $R=0,7360$. (Drawing 4.)

In this case an increase of the hydrographic basin's perimeter with 1 km corresponds to an increase of the multi annual average flow measured in the control section of the valley, a flow of $0,0248 \text{ m}^3/\text{s}$.



Drawing 3 - The influence of the hydrographic sub basins' surface over the multi annual flows in the control section

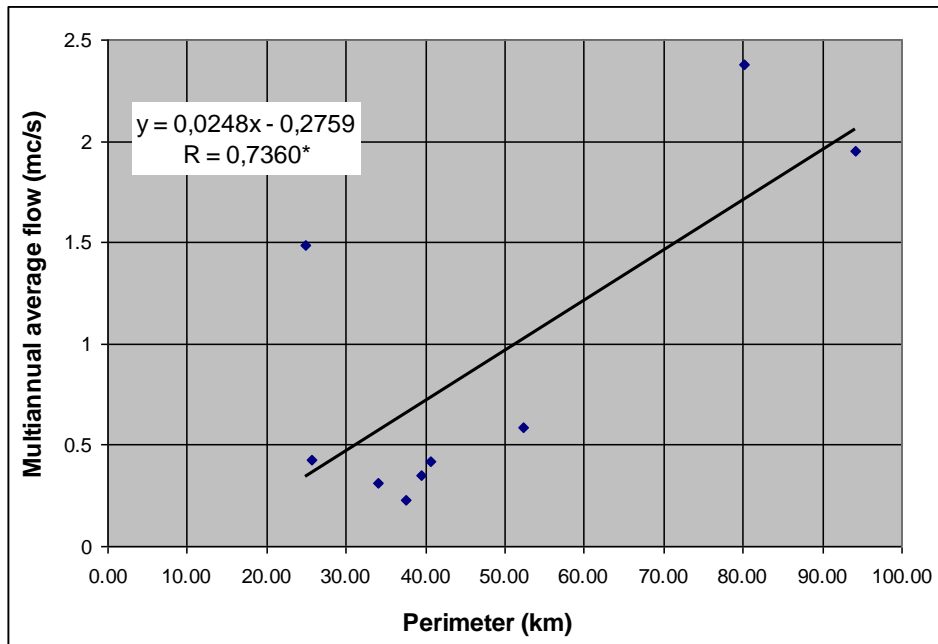
The correlation between the total length of the water transport net from the hydrographic basin and the multi annual average flow is linear with statistic significance $R=0,7627$. (Drawing 5.)

If the total length of the hydrographic net increases with 1 km we obtain an increase of the multi annual average flow from the control section, we obtain a flow increase of $0,0098 \text{ m}^3/\text{s}$.

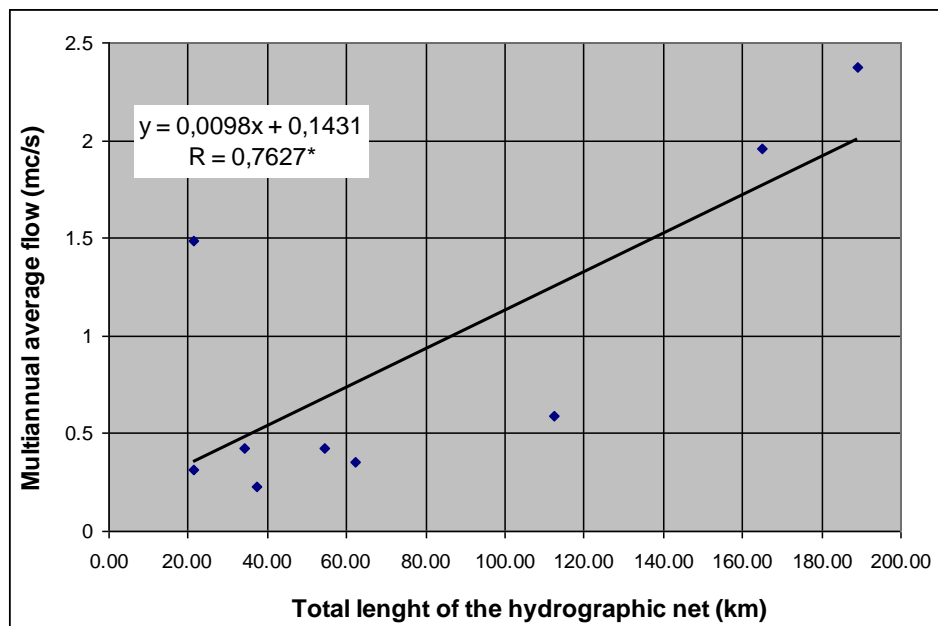
Having studied the values of the correlation factors realized by the linear regression presented previously we can conclude that the main contribution in the formation of the multiannual flows measured in

the control sections of the small hydrographic basins of the Rivers' forestry fund is given by: the surface of the respective hydrographic basin (82,26 %) followed by the total length of the hydrographic net (76,27 %) and by the perimeter of the hydrographic basin (73,6%) (the perimeter has got a lower influence).

The first two previously mentioned characteristics of the studied hydrographic basins define the density of the hydrographic net from the respective basin, density that can be considered as having the highest influence in the formation of the multiannual flows.



Drawing 4 - The influence of the hydrographic sub basins' perimeter over the multi annual average flows



Drawing 5 - The influence of the total hydrographic net length over the multi annual average flows

Conclusions

For the studied valleys the multiannual average flow is of 0,228 m³/s on Crăiasa Valley and of 2,378 m³/s on The Crișul Pietros River.

The surfaces of the hydrographic basins are of 31,07 km², for the basin of the Galbena Valley and of 215,10 km² for the basin of Iadului Valley.

The influence of the hydrographic basins' surface over the multiannual average flows from the control section is of linear type, distinctly significant statistically, the correlation factor being R=0,8226.[2.]

The influence of the hydrographic basin's perimeter over the multi annual average flow is of the same type with the previous one, this one being only significant statistically, the correlation factor being R=0,7360.

The correlation between the total length of the water transport net from the hydrographic basin and the multi annual average flow is linear having statistis significance; in this case R=0,7627.

The main contribution in the formation of the multiannual flows measured in the control section of the small hydrographic basins from the Rivers' forestry fund is provided by : the surface of the hydrographic

basin with a percent of (82,26 %) followed by the total length of the hydrographic net with a percent of (76,27 %). These define the density of the hydrographic net from the respective basin, density which can be considered as having the highest influence in the formation of the multiannual flows.

Bibliography

1. Bîdiliță Florina.,2009 - Bazinul Crișului Negru – studiu de geomorfologie cu privire specială asupra reliefului fluvial și fluvio-denudațional- Teză de doctorat-Universitatea din Oradea Facultatea de Istorie, Geografie și Relații Internaționale Departamentul de Geografie, Turism și Amenajarea Teritoriului, p10

2. Giurgiu V.,1972 - Metode ale statisticii matematice aplicate în silvicultură, Editura Ceres, București, p227

3. Man T.E., Sabău N.C., Bodog M.,2010 - Hidroameliorații, Editura Aprilia Print, Timișoara, p112

4. Teoran A.A.,2010 - Din minunățiile naturale ale Bihorului, Editura Arca, Oradea, p43

5. Zăvoianu I.,1978 - Morfometria bazinelor hidrografice, Editura Academiei, R.S.R., București, p88

*** 1 Atlas Cadastral, Apele Române, Direcția Apelor Crișuri

*** 2 Amenajamentul O.S. Remeți

*** 3 Amenajamentul O.S. Vașcău

*** 4 Amenajamentul O.S. Codrii Beiușului