The Runoff Features in the Periurban Area of Bistrița Town

Victor SOROCOVSCHI, Gheorghe ŞERBAN, Răzvan BĂTINAŞ
„Babeş-Bolyai" University, Cluj-Napoca, Romania

Introduction

The present study holds forth to address several basic problems: the annual and the multi-annual variation of the liquid runoff, the hydric balance of the area, the regime of the average monthly and seasonal runoff, the study of periods with high waters and flash floods and a brief analysis of the intervals characterized by low runoffs. To increase the accuracy of our results, we used data obtained from observations and measurements taken at the hydrometric stations inside our study area, as well as data from stations situated in its close proximity.

The analysis of the data revealed important information about the runoff's variation amplitude, the presence of some characteristic years (droughty or rainy), the delimitation of territories based on their runoff's surface-altitude ratio, the way in which the liquid runoff is influenced by the hydro-technical settings, the identification of the flows with some surpass probabilities, etc. Also, this study made it possible to determine the influence of each season over the annual runoff, by detecting the special types of regime specific to this area, as well as the characteristics of the maximal and minimal runoffs, together with the potential hazards associated with these components of the liquid runoff.

The potential of surface water drainage from the periurban area of Bistrița town has been established through some indicators, among which the most important are the way of organization, the density of hydrographic network and the parameters of stream-runoff. In order to offer a clear image about the best ways for usage of water resources offered by streams, the hydrological regime was analyzed, as well as a series of quantitative and qualitative features.

Average runoff and hydrological balance

Average runoff is the most general indicator of water resources from rivers. It offers the measure of river water potential from a certain region, being useful in all studies made to research the possibility of rational capitalization of the water for different social-economical aims.

Average annual runoff and its variation in multi-annual profile

In the analysis of the average run-off, the observation data from 7 hydrometric stations (table 2) has been used - which controls the hydrographical basins with an altitude that oscillates between 590 and 1.130 m, and the surface between 71 km ^{2} and 1.780 km ^{2} (table 1). From all 7 hydrometric stations envisaged, just two are situated in the perimeter of the region studied. The others five stations are placed outside the main area, but are used for the establishment of some correlations, which can facilitate the quantitative and the qualitative evaluation of the rivers water resources features. In order to choseb the period of average run-off, several criteria have been taken into account: the peculiarities of the hydrometric database, the need of an accurate cognition and the variability of the strings of data.

Comparing the rivers discharge flows for the three periods (1954-2003, 1970-2003 and 1985-2003), we can find some important differences, just for the rivers which have suffered the changes of river flow due to the setting up of Colibiţa reservoir and of the direct utilization of water resources from rivers (Bistriţa and Şieu downriver of Sărăţel village). In the crosssection of hydrological stations of Bistriţa Bârgăului and Bistriţa, Sărăţel and Şintereag, respectively on the Şieu River the corrected discharges and not the natural flows were taken into consideration.

The representative of the string of data has been analyzed on the strength of the flows determined on a period of 24 years and 50 years. Considering the criteria analyzed, which were mentioned above, we chose for the calculation of the average runoff, the period between 1970 – 2003, which presents several advantages: the length of the string of data is sufficient; the existing hydrometric data have a maximum value, including the most recent and secure ones; presenting the fewest errors of the average runoff and of the variation coefficients, between the admissible limits.

Table 1. Database regarding the multi-yearly average flow (1985 – 2003).

River	Hidro-metric Station	Surface (km ^{2})	Med. Height (m)	Q (m^3/s)	q ($l/s.km^2$)	V ($mil.m^3$)	Y (mm)
Bistriţa	Bistriţa	612	860	8,08	13,2	254,9	417
Bistriţa	Bistriţa Bârgăului	203	1.130	3,63	17,9	114,5	564
Budac	Jelna- Buduş	157	781	2,44	15,5	76,9	490
Şieu	Domneşti	151	590	1,26	8,3	39,7	263
Şieu	Sărăţel	1.085	747	13,24	12,2	417,8	385
Şieu	Şintereag	1.780	607	16,0	8,9	506,1	284
Straja	Mureşenii Bârgăului	71	997	1,40	19,7	44,2	622

The flows calculated for the 1970 – 2003 interval are higher with 8 -10% than those coresponding to the 1954 – 2003 period, accordingly to the admissible limits. Instead, the flows calculated for the 1985 – 2003 period are much lower, exceeding 10% (table 2).

Table 2. Data basis regarding the hydrometric station discharges taken into study.

River	Hidrometric Station	Period considered					
		1954-2003		1970-2003		1985-2003	
Bistriţa	Bistriţa	9,36	15,3	8,08	13,2	7,57	12,4
Bistriţa	Bistriţa Bârgăului	-	-	3,63	17,9	3,34	16,4
Budac	Jelna- Buduş	-	-	2,44	15,5	2,24	14,3
Şieu	Domneşti	-	-	1,26	8,37	1,15	7,60
Şieu	Sărăţel	-	-	13,2	12,2	10,4	9,58
Şieu	Şintereag	15,3	8,6	16,0	9,0	14,8	8,34
Straja	Mureşenii Bârgăului	-	-	1,40	19,8	1.36	19,1

Annual average runoff

In the quantitative description of average runoff several concepts are used: average water discharge (Q - m^3/s), runoff module or specific average discharge ($l/s.\ km^2$), the discharge volume (V - $mil.m^3$) and the thickness of the strata flow (Y – mm).

The average river discharge flows are different, depending on the geographical conditions and on the size of the hydrographic basins.

For the description of water resources from a territory and their comparisation with other geographical units the specific average discharge is used - which represents the amount of flow water on the ground unit (km^2) during a second (s). It is obtained as a ratio between the discharge flows in a river point given to its own basin. The values thus obtained were correlated with some morphometric elements of the catchments.

The most gathered correlations have been obtained for the average altitude, which had facilitated the territorial generalization of the values of yearly average runoff. For the 1970 – 2003 period, the output was a single line of correlation and for the 1985 – 2003, two lines of correlation (figure 1).

The increasing of average runoff values in relation with the altitude is done in different ways. The lowest gradients of runoff are met in the southeastern part of the region, an area which corresponds to Budac River catchment. The area mentioned has a favorable exposition against the humid air-masses advection from the west. The specific average runoff values corresponding to the validated areas for the relations q = f (Hm) is presented in table 4.

The increment of concomitant runoff with the growth of the landforms altitudes emphasizes also the different weight of the landform levels to achieving the average runoff volume (table 3).

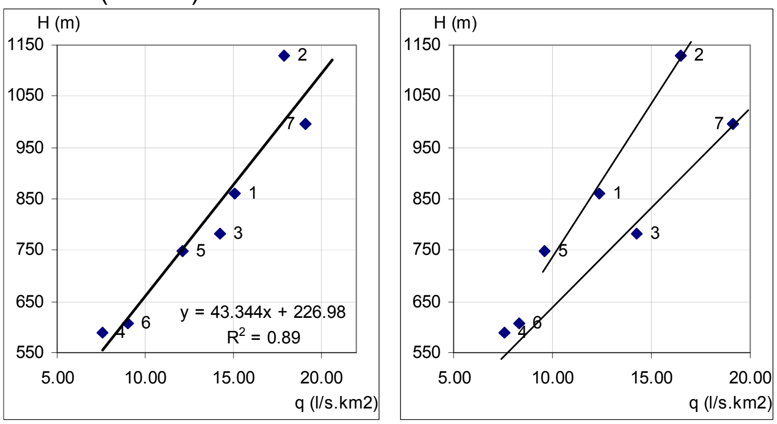

Figure 1. The relation between the specific average runoff (q-l/s.km^2) and the mean altitude of the catchments (Hm) (a -1970-2003; b - 1985-2003).

The analysis of the spatial distribution of the specific average runoff has facilitated the delimitation of territories with different potential of the ground runoff. Thus, the territories with an excess in water resources are corresponding to higher areas (over 600 m in altitude), from *Piemontul Călimanilor* and *Dealurile Suplaiului*, where the multi-yearly specific average runoff values are increasing from 10 l/s.km^2 on the landform between 650-700 m towards 21 l/s.km^2 for the areas situated at 1150-1200 m.

Altitude interval (m)	q (l/s.km^2)	Y (mm)
251-300	0,90	28
301-350	2,05	65
351-400	3,20	101
401-450	4,34	137
451-500	5,49	173
501-550	6,64	209
551-600	7,78	245
601-650	8,93	281
651-700	10,08	317
701-750	11,23	354
751-800	12,37	390
801-850	13,52	426
851-900	14,67	462
901-950	15,81	498
951-1.000	16,96	534
1.001-1.050	18,11	571
1.051-1.100	19,25	607
1.101-1.150	20,40	643
1.151-1.200	21,55	679
1.201-1.250	22,69	715

Table 3. The specific average runoff distribution on the altitude intervals using the following relation q=f(Hm).

The territories with moderate water resources are corresponding to lower types of landforms with an altitude between 400 and 600 m, namely Cetații, Trei Stejari, Măgheruşului and Ghindei Hills, where the multi-yearly specific average runoff values are maintained between 4 and 6 l/s/km^2.

The depressions of Budac, Bistrița-Livezile and Dumitra, as well as *Culoarul Şieului* represent territories with poor water resources (1 – 2 l/s.km^2), considerably below under the average country value (4,57 l/s.km^2).

Some of them are advantaged because they are crossed by important hydrographic arteries, which can bring considerably allochthonous water resources (Bistrița, Şieu and Budac).

Time variation of yearly runoff

The runoff variation is different from year to year, from a river to another and from a region toanother one. The amplitude of runoff variation is determined both by the climatic features and primarily by the degree of humidity, and also by the surface catchments, which can have an important role in the regularization of the discharge flow.

For the characterization of the runoff from one year to another the variation and asymmetric module coefficients were used. In the delineation of the areas with largest and lowest yearly average runoff the module coefficients of yearly average discharge flows have been used. Following the yearly variation flow during 1970-2003 period, almost a perfect synchronization between Bistrița and Jelna-Buduş hydrometric stations can be noticed (figure 2).

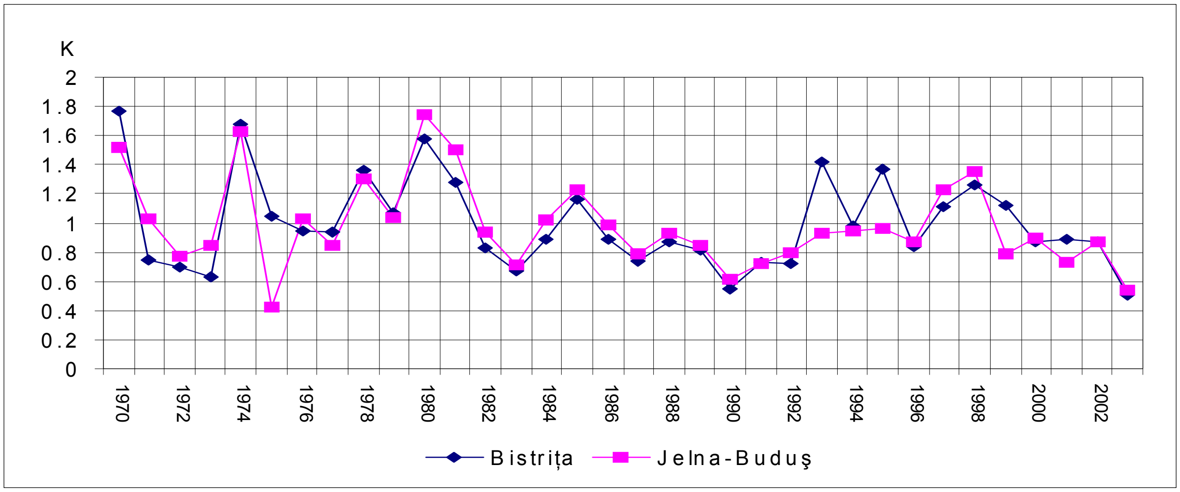

Figure 2. The chronological variation of annual runoff.

The spatial distribution of the years with poor runoff highlights a relatively uniform pluvio-genetic and runoff conditions for both stations (figure 3).

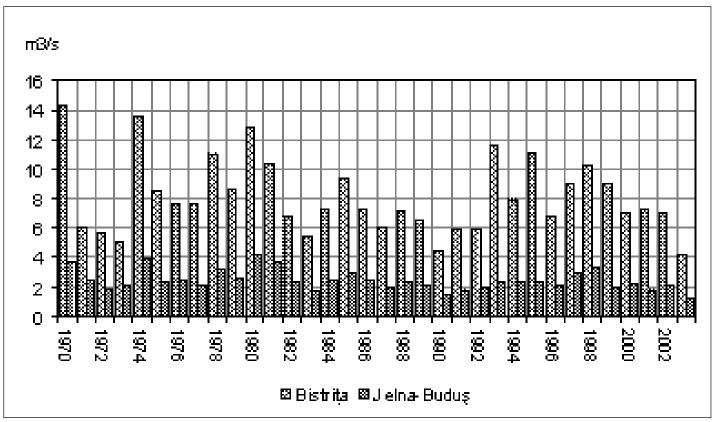

Figure 3. The variation of yearly discharges at Bistrița and Jelna-Buduş hydrometric stations.

The year with the highest runoff was 1970 on Bistrița River (14,3 m^3/s) and 1980 on Budac River (4,26 m^3/s). The flow discharges determined for the years mentioned are corresponding to a probability of 1%, respectively between 1 and 3%. The year with the poorest runoff was 2003, when the yearly flow discharges were almost at half of their mean value. Thus, the annual flow discharges were of 4,14 m^3/s at Bistrița hydrometric station and of 1,23 m^3/s at Jelna-Buduş station, values that are corresponding to a probability of 97%, respectively 99%.

The variation amplitude of annual runoff has been put in evidence with the help of the maximum and minimum module coefficients.

The values of maximum module coefficient were between 1,74 and 1,96 and of the minimum module coefficient between 0,44 and 0,54 (table 4). On Fizeş River, human influence is felt through the growth of maximum coefficients value.

Table 4. Characteristic data regarding the annual runoff variation.

River	Hydrometric station	K max	K min	C_v		Characteristical year			
				1954-2003	1970-2003	Dry	Very dry	Rainy	Very rainy
Bistrița	Bistrița	1,76	0,51	0,50	0,31	1990	2003	1974-1980	1970
Budac	Jelna-Buduş	1,74	0,54	-	0,28	1990-1991	2003	1974-1970	1980
Şieu	Sărățel	1,96	0,44	-	0,39	1990	2003	1970-1974	1981-1980

The variation coefficients of annual runoff were calculated on the strength of the whole string of data, with values between 0,28 and 0,39 (table 5). The annual runoff variation is higher on the rivers with sources in the hilly region, with small catchment's surfaces and different geographical conditions against the Allochthonous Rivers.

Table 5. Characteristical data regarding the annual discharges.

River	Hydrometric station	Q_{med} (m^3/s)	Q_{max} (m^3/s)/year	Q_{min} (m^3/s)/year	Amplitude
Bistrița	Bistrița	8,08	14,3/1970	4,14/2003	10,16
Budac	Jelna-Buduş	2,44	4,26/1980	1,32/2003	2,94
Şieu	Sărățel	13,24	25,97/1981	5,88/2003	20,09

For a better image regarding the annual runoff variation were calculated the average flow discharges with different probabilities of excedeence (table 6). We can noticed the fact that during the very droughhty years, corrsponding to a probability of 95 to 99%, the flow discharges are decreasing very much, which makes impossible their use in different aims, and the smaller rivers with little catchment areas are often drained-up.

Table 6. The annual average flow discharges with different probabilities

River	Hydrometric station	Probabilities (%)							
		0,1	1	3	5	95	97	99	99,9
Bistrița	Bistrița	14,7	12,7	11,6	11,0	4,42	4,01	3,30	2,14
Budac	Jelna-Buduş	5,50	4,52	4,01	3,76	1,53	1,45	1,32	1,15
Şieu	Sărățel	17,3	15,5	14,5	14,0	6,71	6,29	5,35	3,74

During the 1970 – 2003 period on Bistrița River (at Bistrița station) and Budac River (Jelna – Buduş station) it is remarked an easy tendency of diminishing of annual runoff values (figure 4). This tendency of reduction of annual runoff has been induced by the water deficits which were specific to many years from the last decade of the past century.

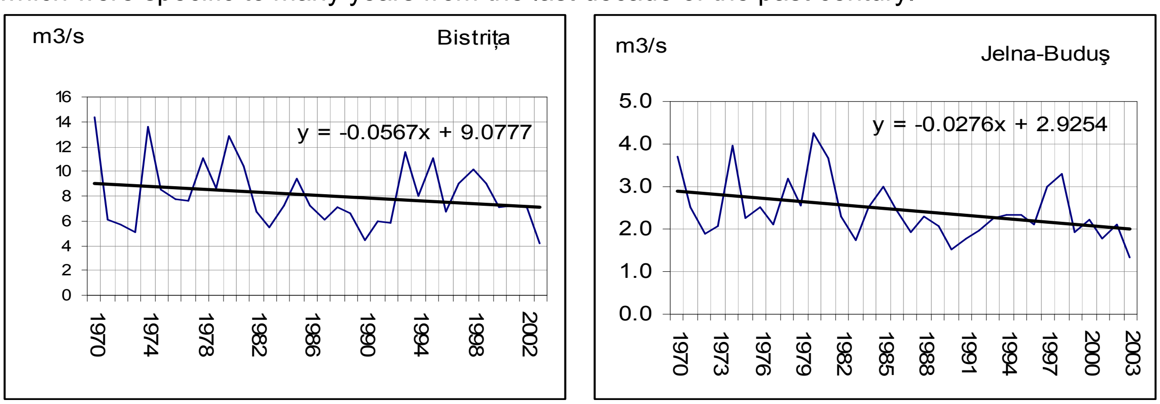

Figure 4. Annual runoff tendency between 1970 – 2003.

Hydrological balance

In the structure of the hydrological balance there are: precipitations (X), which are consumed during the process of ground runoff formation (S) and underground runoff (U) and through evapotranspiration (Z).

The water resources that remain in the catchments after ground runoff formation represent the global moisture of the ground (W = U + Z). Also, the ground- and underground runoff forms the global runoff (Y = S + U). The evaluation of multi-yearly average values of hydrological balance components has been made on the strength of the equation: $X_o = Y_o + Z_o$; $X_o = S_o + W_o = S_o + (U_o + Z_o)$ applied on the data resulting from measurements and determinations during the 1953 -1997 and 1970 – 2003 periods (table 7).

Table 7. The values of annual hydrological balance components (mm) at hydrometric stations: *X - Precipitations; Y – total flow runoff; S – surface runoff; Z – evapotranspiration; U – underground runoff; W- soil moisture.*

Hydrometric stations	Elements of hydrological balance (mm)					
	X_o	Y_o	S_o	Z_o	U_o	W_o
Jelna-Buduş	1.022	499	374	523	125	648
Bistrița	1.027	399	291	628	108	736

The hydrological balance components have a non-uniform distribution in time and in space, conditioned by the geographical peculiarities of the studied region. Thus the layer of global average runoff is maintained between 50 and 90 mm, on the lower landforms, with an altitude below 350 m, which correspond to the river meadow and the lower terraces of Budac, Bistrița and Roşua rivers. Together with the increasing of landform altitude towards the interfluves that separate the three depression areas, the global annual average runoff values are increasing, reaching 190 – 225 mm on the landforms steps corresponding to the hills of Ghinda, Cetății şi Măgheruşului. On the landforms from the north region which include the hills of Prislop and Făget, the global annual mean runoff values are growing gradually until 250 – 300 mm. In the *Piemontul Călimanilor* area the global average runoff layer is growing in relation with the altitude from 250 mm to 550 m, and 625 mm on the high lands (1100 m altitude).

The distribution of the superficial runoff layer (S_0) is subdued to the same laws of distribution mentioned above in the case of global runoff. Together with the increase of landform altitude, an increase of runoff layer from superficial sources of depression areas (70-90 mm) towards the higher landforms is highlighted, with altitudes between 500 - 600 m where the runoff layer reach a level of 200-250 mm can be highlighted.

The groundwater runoff (U_o), as well as the other elements of the hydrological balance, denote a conditioned zonality by the growth of humidity and the intensity of the drainage from the axis of main valleys (50 – 60 mm) towards the higher landforms (100-125 mm).

The evapotranspiration value is relative due to lack of data which are influenced by local conditions specific to every sub-units (degree of afforestation, types of soil and cultures, the exposition and the declivity of slopes etc). The evapotranspiration values are oscillating between 450 and 650 mm.

The regime of river runoff

The distribution of runoff during the year, determines the economic value of the waters. Depending on the balance the runoff regime of rivers, the eficiency of the utilization is determined. The way in which the main feeding water sources are combined is reflected in the runoff distribution during the year.

The regime of seasonal runoff

The relatively few differences of the seasonal average runoff values calculated at the hydrological stations from the region studied are explained through the relative conditions of feeding water sources.

During winter, (XII – II), on the rivers from the region studied is about 20–22 % from the annual runoff volume (table 8) achieved. The highest runoff values have been recorded in the winter 1978/1979, when, during some favorable climatic conditions, the rivers were feed by great amount of precipitation, and also by the successively melting of the snow layer. The smallest values of runoff were registered during the winters of 1983/1984 and 1990/1991, featured by a severe anticyclonic regime with low amount of snow and freezing temperatures, causing the draining of several small rivers through total ice up.

Spring, (III – V), is the season with the richest runoff conditioned by the melting of the snow layer, by relative important quantity of rain and by little values of evapotranspiration. During this season on all the small rivers, the highest runoff flow is registered, representing about 38 – 42% from the annual average volume of water. The highest spring runoff flow has been recorded in 1970, and the lowest one in 1990.

Table 8. Seasonal runoff flow values in percentages (1968 – 1999).

River	Hydrometric station	Q (m^3/s)	% from annual runoff			
			Winter	Spring	Summer	Autumn
Bistrița	Bistrița	8,08	20,0	38,9	22,2	16,3
Budac	Jelna-Buduş	2,44	19,5	38,5	24,9	17,1
Şieu	Sărățel	13,24	21,1	39,8	22,6	16,4

Summer, (VI–VIII) is connected to the increase of air temperature and the development of the vegetation which can produce a certain growth of evapotranspiration, processes that are reflected by the significant diminishing of the runoff flow, from the earlier season. In the summer about 22 to 25% from the annual average runoff is registered, despite that the amount of precipitation is highest during the year. On Budac River, the summer runoff is higher than the one from Bistrița and Şieu (figue 5).

The highest summer flow has been recorded on Bistrița and Şieu in 1974 and on Budac river in 1998, while the lowest values have been recorded in 2003.

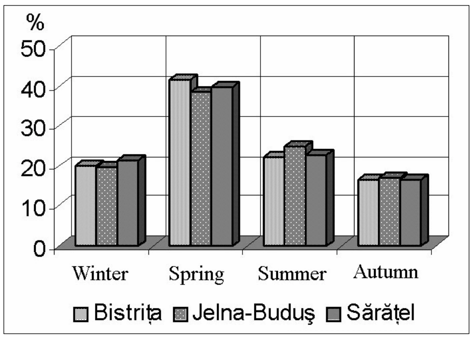

Figure 5. The seasonal runoff (percentages).

Autumn (IX – XI) has the lowest contribution to the annual average volume of water (16 - 17%), despite the fact that the amount of rain is almost double in comparison to those recorded during winter.

The highest runoff was recorded in 1980, when heavy rain was registered for a long period, which led to a significant hydrologic effect. The autumn runoff was smaller in 1983 and in 1987, being influenced by the exhaustion of the groundwater reserves and by the very long periods characterized by lack of precipitation.

By analyzing the seasonal variation coefficients we can notice that the largest values are corresponding to the summer (0,58 – 0,70), and the lowest ones to spring (0,34 – 0,46).

During spring and winter, the small values of the variation coefficients are reflecting the uniform state of the runoff distribution. Instead, during summer and autumn, when the variation coefficients reach the highest values, the territorial differences are much more pronounced. Thus, by following the seasonal runoff variation during 1970 – 2003, a near perfect synchronism can be noticed (figure 6).

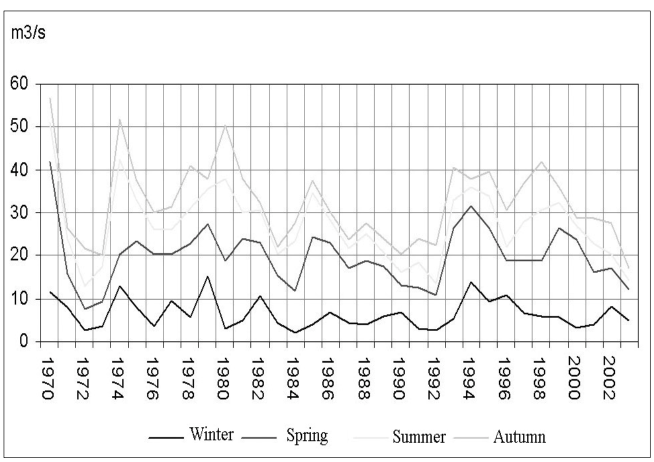

Figure 6. Seasonal runoff variation (1970-2003).

Monthly runoff regime

Monthly average runoff distribution during the year, highlights that all the rivers from the region studied are recording a maximum in April and a minimum in August (figure 7).

In January, the precipitation are almost entirely solide and non-favorable melting conditions can led to a small runoff values, that represent about 5 to 6% from the average annual volume.

In February, we can notice an increase by 3% to 5% of the flow volumes against the earlier month. There are no obvious contrasts in the spatial distribution of runoff. In April, the highest runoff values from the whole year (14-16%) are registered, values that are validated for both stations: Bistrița and Jelna-Buduş.

Starting with May, a slight decrease of the flowed volumes in rivers until July can be noticed, fact explained by the quite important precipitation during the months of late spring and the beginning of summer.

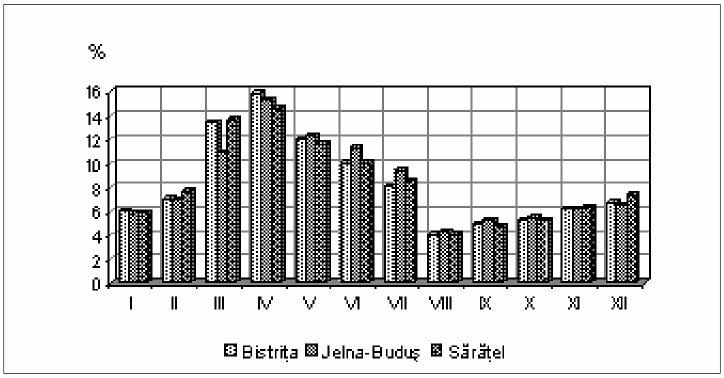

Figure 7. Percentage values variation of monthly average ruonff (1970-2003).

In August, an important decrease of rivers' runoff can be observed, which exceeds slightly with 4% from the annual average volume. The drastic reduction in precipitation quantities, the exhaustion of groundwater reserves and the highly values of evapotranspiration are leding to the diminishing of rivers runoff. Due to this fact, during this month, the lowest runoff flow is registered. In November, an increase of runoof generated by the autumn rains is notices. The average runoff flow from this month represents about 6 to 7% of the annual average volume.

In December, some territorial peculiarities appear in the region studied, regarding the percentage values of runoff on the Şieu river, much higher than those recorded at Bistriţa station (figure 8).

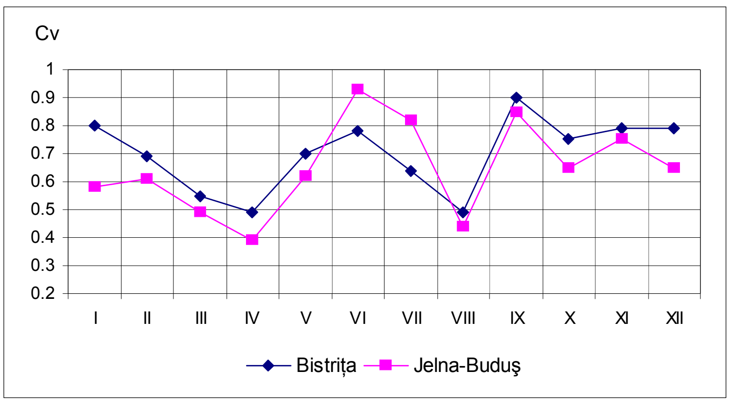

Figure 8. Monthly variation coefficients distribution during the year.

Monthly variation coefficients values are oscillating between 0,39 and 0,93. The minimum values for the variation coefficients are corresponding to April and August, and the maximum values are registered in September on Bistriţa and in June on Budac River. Following the monthly variation coefficients distribution during the year, we can notice a good synchronism between the values recorded at Bistriţa Jelna and those at Buduş hydrometric station.

Periods of high runoff

The periods of high runoff represent an important phase into the flow regime of rivers, because of their extreme character, and also through their possible effects over the components of the environment.

The phenomena from the high runoff periods ussualy occur as some impulses with different intensities, dimensions and durations, which will manifest in the rivers regime as high waters and floods. The high waters and the floods, as phases in the high runoff periods, are generated by the rains during May – November, due to the melting of snow during cold season or because of the overlaping of both processes during winter-spring period.

High waters

High waters have an increase frequence in spring, when their climatic conditions are at the most favorable time, imprinting them a certain regularity for their occurrence. They show spring arrival.

The high waters from the beginning of summer have a reduced frequency of occurrence and they are generated by frontal rains, which combine with those of convective nature. The high waters from winter are tipical for the rivers situated in the hilly region, with maximum occurence for the Budac River. The maximum duration has been recorded in the winter of 1979 and 1990, when the high water period has been maintained for about 25 to 30 days. In autumn, the high waters ocurs very rare, and are generated by the frontal rains from October-November (1980).

Floods

Regarding the genesis of floods, on the majority of the rivers, the maximum frequency is registered by the floods with pluvial origin followed by those mixed during winter time.

The monthly frequency of floods occurrence presents a maximum in April (22%), followed by those recorded in May and in March (each one with 13%). The minimum frequency is recorded in August – November period (figure 9).

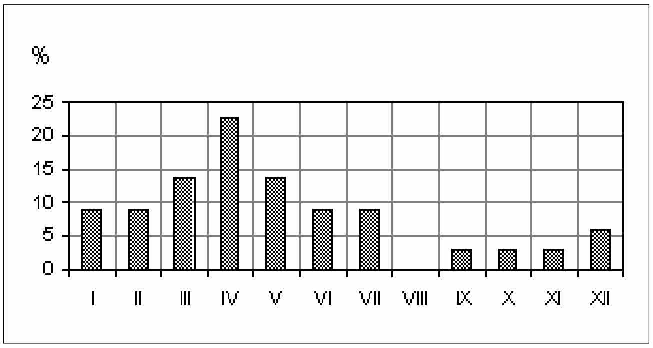

Figure 9. Floods monthly frequency on Bistrița river at Bistrița station (1970 -2003).

Analyzing the seasons, the maximum occurence is achieved in spring (48%), and the lowest one during autumn (9%).

In winter, the floods from Bistrița at Bistrița station, have a higher frequency than the ones recorded during summer time (figure 10).

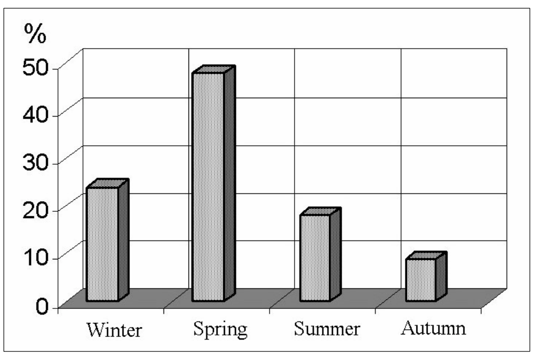

Figure 10. The seasonal frequency of floods on Bistrița river at Bistrița station.

Another important flood hydrograph element is the extent in time (duration of flood), which the size of the effects they can generate depends on. The total duration of the floods on the rivers of the region studied has oscillated between 5 and 101 hours. The territorial differences have been imposed by the precipitation characteristics (duration, intensity), the size of the catchments and their geographical patterns.

Another characteristic of the floods is the maximum discharge flow that is the moment when the danger of flooding the fields is at the highest level (figure 11).

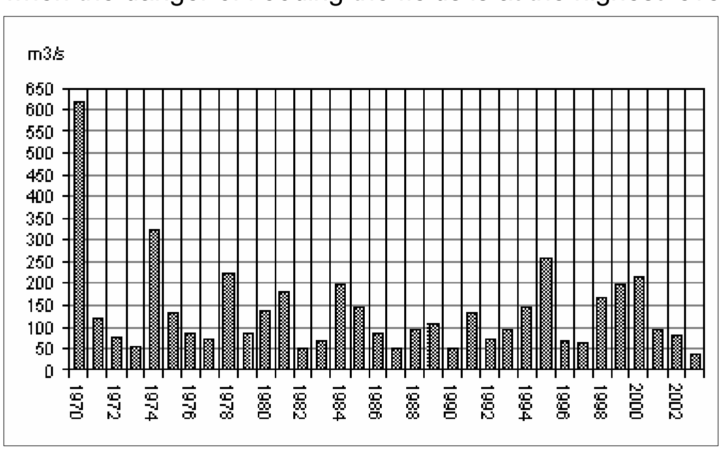

Figure 11. The maximum discharge flow of the floods produced on the Bistrița river at Bistrița station.

The multiannual maximal discharges have oscillated between very wide limits, depending on a great number of factors, from which a determinant role will be played by the climatic conditions and the surface of catchments.

The maximum flow discharges determined at Bistrița station, during 1970 – 2003 flood events have reach values between 34 and 618 m^3/s. The maximum discharge flows are oscillating during the year, due to geographical patterns of catchments and to its size. Human factor also has an important role. In the case of rivers with influenced regime of runoff (Bistrița, Şieu downriver of Sărățel), the highest discharges have been recorded at the end of spring, being generated by exceptional flash floods, which have a high frequency in this season. The high values of maximum runoff also occur at the begining of spring, in March, being generated by floods with mixed origin, which are produced in this period (figure 12). Rains of convective and frontal nature are generating floods with catastrophic effects, creating high discharge values during summer months (June and July).

In winter, the sudden melt of snow, due to some anomaly warm periods or due to liquid precipitation can generate very high discharges, more frequent in December.

On the rivers with un-influenced flow regime (Budac), the maximum discharge flow has higher values during May-June period.

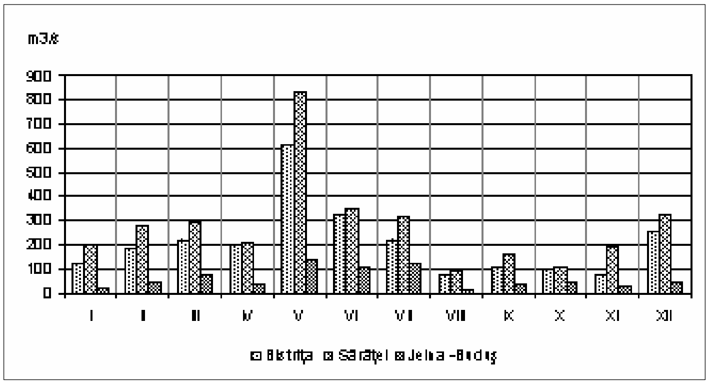

Figure 12. Maximum discharge variation during the year.

The maximum runoff values amplitude is lower than the one recorded on Bistrița river. Following the maximum discharges variation in multiannual profile, a general reduction of the values for the past two decades can be noticed. In the case of watercourses with modified runoff regime the situation is explicable by the atenuanting surges and by the retention of large volumes in Colibița Lake.

The significant reduction of un-influenced rivers discharges can be related to the crossing of a dryer cycle, which has started in the second part of the 1980-1990 decade.

The maximum exceptional discharges were in recorded in 1970, 1974, 1978, 1980-81, 1991 and in 1995, with a mixt genesis on spring (1970), at the beginning of winter (1995) or pluvial ones during summer (1974).

Periods of low runoff

The periods with low runoff values are specific for summer, autumn and winter seasons, having a less occurrence in the spring.

The summer-autumn minimum runoff period is the consequence of the low frequency of precipitation from August and September, due to the high values of temperatures and intense evaporation and also to the maximum exhaustion degree of the groundwater reserves. The frequency of this period is almost annually.

The minimum runoff from winter is related to the long dry periods from autumn, to solid precipitations and to negative air temperatures, that can maintained for a long time, being favorable to the development of ice phenomenon or even of the total frost of the rivers.

The minimum average runoff value of the autochthone rivers is oscillating between 0,1 and 0,5 l/s.km^2. The rivers with small catchments have an intermittent flow.

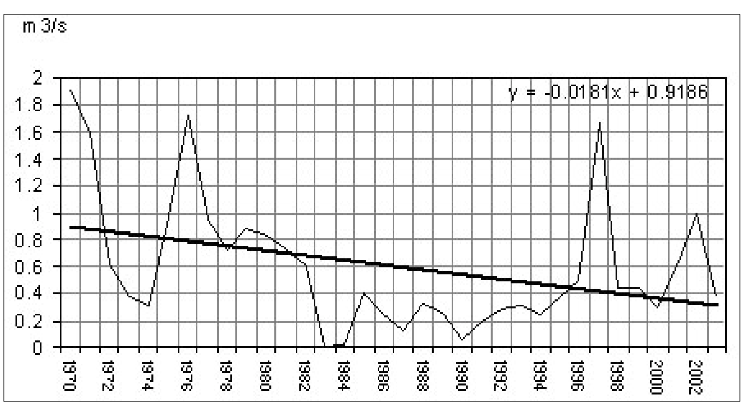

Figure 13. Annual minimum discharges variation at Bistrița station (1970-2003).

At Bistrița hydrometric station, the annual minimal flows have oscillated between few tens of l/s to 1,9 m^3/s (figure 13).

The smallest values of minimal runoff are recorded in cold season, being much lower than those recorded during summer months.

Conclusion

The development perspective and the spatial expand of Bistrița town enforces some complex studies, carried on to facilitate a precise diagnosis of the existing situation, but especially to estimate the neighbouring area potential, in relation to the expansion of the area of influence of the town and the increase of its needs. Nevertheless, water will play a major role in its development, and the quantitative and qualitative evaluation of water resources reprsent as a commanding need.

The location of Bistrița town in the neighborhood of Călimani and of Bârgău Mountains opens important opportunities from a quantitative point of view, but also from a qualitative one, in water supply of the whole area, taking into account that many watercourses are draining the Western versants of the mountain region and the piedmont area. If, at present, the water intakes are made directly on the important courses (Bistrița source), a great investment is considerd to be the use of Colibița reservoir for the development of a vast water supply system.

The present study intended to follow some basic problems: the annual and multi-annual variation of liquid runoff, the hydrological balance of the area, the seasonal and monthly average runoff regime, the study of high runoff periods (high waters and floods) and a short analysis of low runoff periods. We have used the strings of data obtained from the observations and measurements registered at the hydrometric stations from the region studied and from around the neighborhood, in order to increase the precision degree in information processing system.

From the data analysis we obtained important informations regarding the variation amplitude of the runoff flow, the presence of a characteristically years (droughty and rainy years), the delineation of the territories with different surface runoff potential in relation to altitude, the degree of influence of the liquid runoff by the upriver hydrotechnical plants, the settlements of the discharges flow with different probabilities of exceedence etc. Also, settling the contribution of each season to the annual runoff was possible to find, by identifying the regime types of the area, as well as the maximum and minimum runoff features, with the potential risks that may occurr through this components of liquid runoff.

Bibliography

Pop, P., Gr. (2001), *Depresiunea Transilvaniei*, Editura Presa Universitară Clujeană, Cluj-Napoca.
Ujvári, I. (1972), *Geografia apelor României*, Editura Ştiințifică, Bucureşti.
******* *Arhiva Consiliului Județean Bistrița-Năsăud.* Bistrița.
******* *Arhiva R.A. „AQUABIS“.* Bistrița.