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IMPACT OF THE HYDROTECHNICAL CONSTRUCTIONS ON SOME ENVIRONMENTAL COMPONENTS FROM THE RÂU MARE DRAINAGE BASIN-PRELIMINARY REMARKS

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Abstract

Impact of the hydrotechnical constructions on some environmental components from the Râu Mare drainage basin- preliminary remarks

The study area belongs to the catchment of the Râu Mare Basin with a total surface of 836 sq.km and a length of 65.8 Km.

In the first part of this study are presented elements of the landscape, some data about hydro facilities on the Râu Mare River and the purpose for which they were created. These data These data were obtained from bibliography studied in addition with the climate data (annual average flow rates, average annual precipitation) obtained from the hydrological station of Deva (Hunedoara County).

Based on field observations, impact studies obtained from Hidroelectrica SA Haţeg and bibliographic material, in the second part of this study, the impact of hydro facilities on some components of the environment (topography, climate, hydrography and vegetation) is examined.

Key words: Râu Mare Basin, hydrotechnical constructions, impact, enviromental components

Rezumat

Impactul construcţiilor hidrotehnice asupra unor componente ale mediului din Bazinul Râu Mare – studii preliminare

Zona studiată aparţine bazinului hidrografic al Râului Mare cu o suprafaţă a bazinului de 836 Km^2 şi o lungime de 65,8 Km.

În prima parte a acestui studiu sunt prezentate elemente ale cadrului natural, unele date despre amenajările hidrotehnice de pe cursul Râului Mare şi scopul pentru care au fost create, pe baza bibliografiei existente, dar şi a datelor climatice (debite medii anuale, precipitaţii medii anuale) obţinute de la Staţia Hidrologică Deva.

Pe baza observaţiilor din teren, a studiilor de impact obţinute de la Hidroelectrica S.A. Haţeg precum şi a materialului bibliografic, în a doua parte a studiului este analizat impactul amenajărilor hidrotehnice asupra unor componente ale mediului (relieful, clima, hidrografia, vegetaţia).

Cuvinte cheie: Bazinul Râu Mare, construcţii hidrotehnice, impact, componente ale mediului

INTRODUCTION

The hydrotechical activities began in our country in the first decades of the last century and consisted in reservoir building for regulating the river discharge and canal building which modified the rivers course. For energetic purposes, Romania has 110 reservoirs, with a water volume of around 4 billion m³ (CRISTEA et all., 1996).

Due to physico-geographical characteristics favorable to hydrotechical constructions, the Râu Mare drainage basin was subject to research, planning and hydroenergetic building activities. The first studies belong to the inter-war period, which were undertaken and completed in the seventh decade of the 21st century. Thus, in 1976 the activities began and consisted in reservoirs and plants building, and dams and galeries digging (POP 1996).

All these modifications have induced and are inducing several modifications on the environment components, such as: geomorphological, topoclimatic (e.g. temperature and precipitation modifications), hydrological etc.

In this study, we are going to analyse the hydrotechical constructions impact on relief, vegetation, microclimate and hydrography. Therefore, we used the information we obtained from Hidroelectrica S.A. Hațeg, Hydrologic Gage, Deva, from field research as well as the information included in bibliography.

DESCRIPTION OF THE STUDIED AREA

The studied area belongs to the Râu Mare drainage basin, with a total area of 836 sq. km and a length of 66,8 km. The Râu Mare is the main tributary of the Strei River. It has an average slope of 30m/km and an average discharge of 18m³/s.

It is formed at the confluence of three rivers: the Lăpuşnicul Mare (Area: 140sq. km, Length: 22km), the Lăpuşnicul Mic (Area: 38sq.km, Length: 9km) and the Râu Şes(Area: 91sq. km, Length: 25km). Its main tributaries are: the Netis (Area: 17sq. km, Length: 7km), the Galbena(Area:347sq. km, Length: 33km), the Râuşor (Area: 38sq. km, Length: 14km) and the Sibişel(Area: 72sq. km, Length: 28km) (UJVARI 1972)

Between Gura Apei and Clopotiva-Brazi, the Râu Mare drains a mountainous area with steep slopes over a distance of almost 25 km, having the characteristics of a narrow canion, with some basins in the confluence points, with stepped slopes, terraces, which can also be found on the Nucşoara, Râu Alb, Râuşor and Paroş valleys. Downstream Brazi, it drains the Hateg Depression over a distance of 18 km up to its confluence with the Strei. Its lower course was modified by building canals which have a linear course between the reservoirs built at Ostrovu Mic, Păclişa and Haţeg (GOȚIU & SURDEANU 2008).

From the hypsometric point of view, in the Râu Mare drainage basin, one can distinguish:

- a mountainous step, represented by the Retezat, Țarcu and Godeanu Mountains; the highest altitude is 2509 m (Peleaga Peak);
- a piedmont plain, represented by the Haţeg Depression, with a low altitude of 285 m (confluence with the Strei River);

GEOLOGY

From the geological point of view, the Râu Mare drainage basin is included in the Retezat-Parâng geological window, characteristic to the western part of the Meridionali Carpathians and has a complex structure, consisting of several structural units bordered by fault and overthrust lines.

There are crystalline schists which belong to the Danubian domain (Lower Danubian and Upper Danubian Sheet), which are generally slightly metamorphosised and are included in several series. The oldest is the Rof series, which contains chlorito-biotitic schists and mica-schists. The next is the Râuşor series, between the Râu Mare and the Nucşoara, which consists of quartzitic schists, biotitic phyllites and graphitic, limy or quartzitic phyllites. In the depression area the chloritic schists of the Zeicani series appear.

The crystalline of the Getic Sheet (Sebeş-Lotru Series) appears on smaller areas and is represented by a combination of gnaises, mica-schists and amphibolitic rocks as well as rare lenses and phyllites of quartzo-amphibolitic pegmatites, the major tectonic element being represented by the overthrust plane from the getic-danubian contact plan.

The infragetic (the sedimentary of the danubian crystalline) is represented by quartzitic sandstones well developed on the Lăpuşnicul Mare valley, limy deposits, loamy depostits on the Lăpuşnicul Mare and Râu Şes, on the contact line between the Getic Crystalline and the Autochthonous.

The sedimentary of the Getic Sheet is represented by conglomerates with cleyey, grey cleys in combination with sands and white limestones.

The Quaternary deposits resulted from the action of the external agents on the geologic formations described above. They are not very spread. They are not present on steep slopes and valleys with high relief energy, where the erosion and transpotration processes are very active.

In the studied area, one can distinguish alluvial, proluvial and deluvial deposits. The rock debris covers the wolds with 2000 m altitude.

CLIMATE

The climatic characteristics are influenced by the solar radiation, general atmospheric circulation as well as the anthropic activities.

Temperatures:

In the studied area, there is an annual average temperature of 8-9°C in the piedmont plain. At Păclişa, at 318 m altitude, the average annual temperatures for the 1950-1990 period are: 8.5°C (POPA 1999), 6°C at the foot of the Retezat Mountains, -0.5°C at Țarcu Mountains (2180 m altitude) (URDEA 2000).

The average temperature of January has low values at all the stations. In the Hațeg Depression, it measures -2.6°C (POPA 1999) and in the mountainous area -3.8°C at 600m altitude, between -6.5°C and -3.5°C at 1600-1800m altitude, -9.3°C at 2100 and -10.9°C at over 2500m (URDEA 2000).

In summer, there are the highest temperatures. In the Hațeg Depression, in July a temperature of 16.6°C was measured and in August 16.8°C (POPA 1999). In the mountainous area, at elevations over 1000 m, during the same months the temperatures measured were under 10°C (7.8°C at Țarcu) (URDEA 2000).

Precipitations:

The precipitation regime is very important for using the natural river potential. In the Hațeg Depression, in the lower piedmont plain, the volume of precipitations is under 600l/sq.m. At Hațeg (325 m altitude), the multiannual average of precipitations, for the 1975-1990 period, is 535 mm (POPA 1999) and 575 mm for 2002-2004 period. In the mountainous area, at Gura Zlata (750 m altitude) the multiannual average of precipitations for the 2002-2004 period is 717 mm and 779 mm at Gura Apei (980 m altitude). Lately, it exceeded 900 mm (957,5 mm in 1989). At over 2000 m altitude, the quantity of precipitation exceeds 1000 mm (1177,7 mm at Țarcu) (URDEA 2000).

The rainiest month in the 2002-2004 period is July. In 2004, in July at Gura Apei the quantity of precipitation measured was 134.5 mm, at Gura Apei 154 mm and at Hațeg 111.5

mm. The average of the monthly quantity of precipitation is low in the cold season when the continental anticyclonar circulation predominates.

HYDROLOGY

The rivers form the Râu Mare drainage basin belong to the meridional-carpathian type, alpine varient (URDEA 2000).

The sources of the rivers (rain, snow melting) are differentiated according to elevation. Above 1800m altitude, the rainy- snow type dominates, between 1800-2100m the snow-rainy one and over 2100m the moderate type (60-70% snow). The source was considered moderate for all the rivers, representing 15-35% from the total annual discharge.

The spatial multiannual average flow has disparities according to elevation and the average quantity of precipitation. In the lower piedmont plain there are values of 2-4l/s/sq.km and at elevations over 1800m of 40l/s/sq.km.

The multiannual average discharges of the Râu Mare, calculated for 1960-2007 period at Gura Apei, upstream the reservoir are 3.81 m³/s, at Pădăşel 9.04 m³/s (Fig. 1).

The other tributaries have lower discharges: 3.01 m³/s- Râu Bărbat, 1.46 m³/s – Nucşoara, 0.97 m³/s- Râu Alb, 0.70 m³/s-Râuşoru, 0.35 m³/s-Paroşu (URDEA 2000).

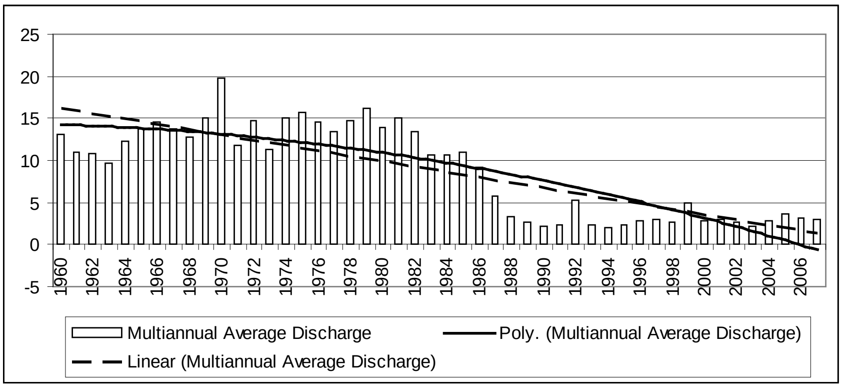

Fig. 1. The multiannual average discharges at Pădăşel Gage

From the data we have, we reached the conclusion that the highest average discharges are in May, because the water resulted from snow melting is associated with the water from rain, and the lowest in the winter months.

VEGETATION

Even if the natural ecosystems from the Râu Mare drainage basin have been affected by different activities (hydrotechical constructions, deforestation for pasture or agricultural purposes), they are still present on small areas.

In the hilly area, the vegetation is represented by alluvial plain forests and deciduous forests: at elevations lower than 300 m, common oak forests in association with beech and beech forests at higher elevations (400 m-500 m). In some areas, the forest has been replaced by crops. In the areas with excess of moisture, the grasslands can be found, and in some areas the natural grasslands alternate with crops.

The mountainous zone is well represented between 650-700 m and 1650-1700 m. Taking into consideration the dominant formations, the following sub-zones can be distinguished:

- lower mountainous zone represented by hornbeam, common oak, lime-tree, which can be found on the sunny slopes at 650-700 m altitude.
- Middle mountainous zone represented by beech forests (*Symphyto cordati-Fagetum, Festuco drymeae-Fagetum, Phyllitidi-Fagetum*), and beech associated with fir tree (*Pulmonario rubrae-Abieti-Fagetum*) and spruce fir (*Leucanthemo waldsteinii-Piceo-Fagetum*) between 750 m – 1300 m altitude.
- Upper mountainous zone (1300-1760 m) is well distinguished from the physiognomic and pedoclimatic points of view. Here, spruce fir forests (*Hieracio rotundati-Piceetum* and *Leucanthemo-Piceetum*) are spread. At the upper limit of the forest, several species of evergreen trees are present (*Pinus cembra*).

The subalpine zone stands out once the spruce firs of limit appear (*Pinus cembra*) and is represented by juniper tree bushes (*Rhododendro myrtifolii-Pinetum*), which cover the high peaks up to 2300 m altidude, like groups. Among the vegetal associations not very spread we can mention the alder tree bushes (*Salici-Alnetum viridis*) and rose bay bushes (*Rhododendro myrtifolii-Vaccinietum*).

The alpine zone between 2300 m-2500 m is characterised by the presence and dominance of common grasslands which belong to *Caricion curvulae* group (*Primulo-Caricetum curvulae*, *Oreochloo-Juncetum trifidi*, *Potentillo-Festucetum airoidis*) and some short bushes which belong to *Cetrario–Loiseleurion* (*Cetrario-Vaccinietum gaultheridoidis*) (POPOVICI IULIANA 1993).

THE HYDROTECHNICAL PLANNING

The physico-geographical characteristics of the studied area (high quantities of precipitation and high discharges, steep slopes) favour a hydroenergetic potential (Fig. 2).
The scheme of the hydrotechical planning comprises:

- The Gura Apei dam, which began to be built in 1975 at Tomeasa at 915 m altitude; the rock-fill dam, with clay core, having gravels and sandy marginal filters, of 163 m height, reaches 1078.5 m altitude. Through its dimensions, it is the first in Romania and one of the biggest in Europe.
- Gura Apelor Reservoir, formed behind the dam, has an area of 420 ha, maximum depth of 80 m and the acumulated volume of 210 mil. mc.
- Secundary catching beginning with the Râu Bărbat and following with the Râu Alb, Paroş, Nucşoara, Râuşor, Zlata, Zlătuia and Radeş, with a total length of 32.7 km.
- The main underground culvert, on the left side of the Râu Mare, with a length of 18.4 km
- The chamber overflowing surge, 152.5m high at Valea Jurii.
- The Retezat hydroelectric, underground built at 18.5 Km downstream Gura Apei, next to Brazi.
- The tail race at the end of the derivation on the Odovaşnița canal.

Downstream, in the area where the Râu Mare drains the Hațeg Depression four reservoirs were built: Clopotiva, without having its own acumulation and using Gura Apei acumulation, Ostrovu Mic, Păclişa and Hațeg with the powers included in the dams of the reservoirs (Ostrovu Mic, area: 89 ha, Păclişa, area: 98,8 ha, Hațeg, area: 124 ha) and 6 powers on the sluices (Ostrov, Cârneşti I, Cârneşti II, Toteşti I, Toteşti II, Sântămăria- Orlea) (Photo 1).

The total installed power of the hydrotechnic constructions from the Râu Mare is 483 MW (almost reaching the one of the Lotru main hydroplant), and the energy production, in normal conditions of precipitation and discharge, it reaches 836,2 Gwh/year (POPA 1999).

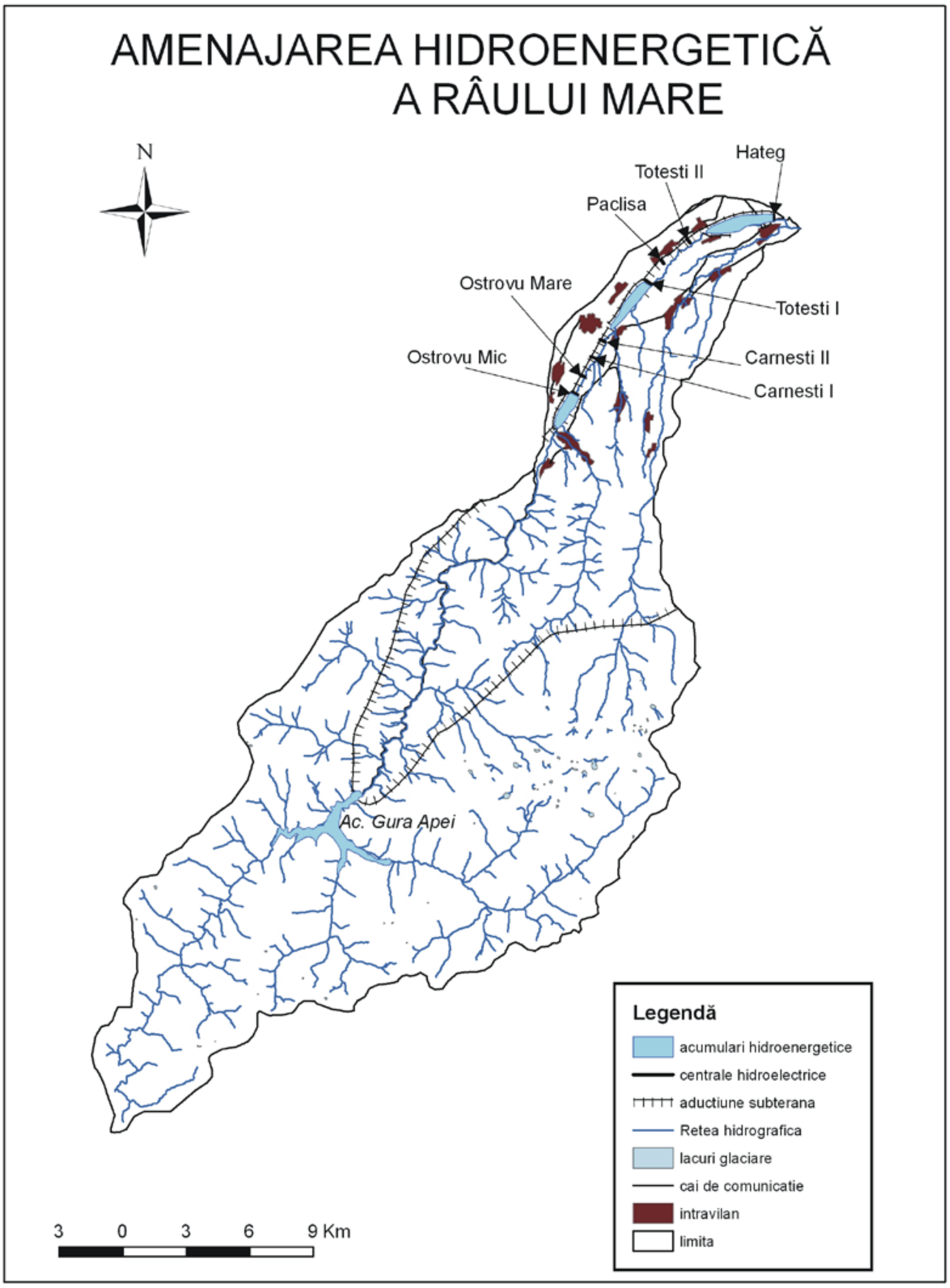

Fig. 2. The map of the hydrotechnical buildings in Rau Mare Basin

THE AIM OF THE PLANNING

The planning has mainly energetic aim, the Râu Mare drainage basin being appreciated by specialists as representing 20% of the total potential of the Mureş drainage basin (POPA, 1999).

There were other aims as well, such as: the regularization of the Râu Mare channel and eliminating the unplaitings in the Ostrovu Mic- Sântămărie Orlea area; draining surfaces with excess of moisture so as to be introduced in the agriculture circuit, expending the irrigated areas, the regularization of the courses and bank consolidation, supplying with drinking and industrial water the places crossed, especially Haţeg.

HYDROTECHNICAL CONSTRUCTIONS IMPACT ON RELIEF

The change of the geological natural equilibrum due to the modifications induced by the hydrotechical constructions and by other buildings (technological roads, colonies for workers etc.) led to the change of the local relief, local slope instabilities, infiltrations in the slopes and faults, siltings both during the constructions and after compliting them.

After building the Gura Apei dam, it is appreciated that the left slope was disturbed in its sensitive area, which under natural equilibrum conditions stabilized in a long period of time but the extra measures adopted stabilized the slopes. The instability phenomena of the slopes due to excavations (landslides, slides) have affected the right slope too, next to the dam in the area of the road (1078 m) and up the outlet structure where activities of stabilizing the slope with concrete ties have been executed. (Photo 2, 3)

Upstream the dam, one can see slight traces of abrasion. Bank erosion and sliding processes take place in the areas where the level of the water varies. The eroded material deposits at the basis of the slopes forming outfall fans, below the surface of water, especially at the mouths of the torrents.

The erosion processes of the slopes in the area of level variation will contribute to the silting of the reservoir (Photo 4). Trying to anticipate the Gura Apei reservoir silting, we did not have either recent information regarding the solid discharge (the existing data belong to 1958-1967 period) or an evaluation of the alluvial deposits from the slopes affected by instalility phenomena.

Taking into consideration the annual quantity of alluvia of 160.000 m^3/an to a quantity of water of 263 mil. mc./year and the volume of the reservoir at NNR which is of 209 mil. mc., we apperciate that the Gura Apelor reservoir does not pose, in the first 50 years special exploitation problems regarding its volume reduction.

Downstream the volume we noticed:

- Channel shortening due to discharge reduction;
- Erosion in the channel area over 50 m length and 2/3m depth induced by the water discharged by the bottom discharge;
- Almost complete retention of alluvia;
- At the confluences of the streams with the dry channel appeared outfall fans;

We mention the fact that such processes can also be noticed in the case of the other reservoirs interrupting the longitudinal profile of the river.

Through underground works, CHE Retezat together with the main catching, side drift, tail race and secondary catching races, the stability of the slopes was not affected because the rock allows water circulation through faults and pressure discharge in the slopes, but the appearance of the springs led to the formation of areas with erosions and sliding along the slope, having a local character, giving birth to landslides like the one on the right slope of the Lăpuşnicul Mare (next to Gura Apelor chalet) and the one on the left slope of Râu Mare, downstream the confluence with the Neagra stream.

Other changes on the relief structure, especially with consequences on slopes morphology, appeared due to the excavations for the quarry on the Valea Netişului at around 2 km downstream Gura Apelor, consisting of granites; its slope is formed in a field of stones, but in the early stage the clay quarry (clays, sandy clays, sands) form the Glămeia Hill, situated in the eastern part of Râu de Mori, used to the dam, the clay quarry near Pui, on the left slope of the Strei. (Photo 5, 6, 7)

To these, we add the excavations for the techological roads which ensure the access to the Haţeg- Gura Apelor (50 Km), Haţeg- Râuşor (34 Km), Haţeg- Nucşoara (20 Km), Haţeg- Râul- Alb catching (37 Km), Haţeg- Râu Bărbat catching (48 Km), forming at their basis cones of debris, disaggregation being the main agent. (Photo 8).

As in the case of roads and quarries negative aspects are dimmed by support works (walls of concrete or stone) and by the vegetation development.

With direct effects on the relief is the sterile resulted and deposited after the excavations under the form of waste dumps (Bârlii waste dump, Ciurila waste dump, Râuşor waste dump, Nucşoara waste dump), torrential waters eroding their bodies. This is not the case of Netiş (the material form Valea Jurii reached Râului Mare channel). Nowadays, all the waste dumps are partialy covered with vegetation and there is a high potential of recovery.

As far as the workers colonies are concerned, some of them have been changed into places for developing tourism (Brădățel colony and partialy Brazi and Râuşor), while others have been demolished and the land is used for grazing (Photo 9).

HYDROTECHNICAL CONSTRUCTIONS IMPACT ON MICROCLIMATE

The elements of the plannning with effects on the microclimate are the reservoirs. As a consquence of the appearance of the reservoirs and implicitly of the large surfaces of water the evapotranspiration is intensified in the area, influencing the local climate by increasing air humidity and reducing its temperature.

From the estimations made, it results that after reaching the normal retention of the reservoir form Gura Apei, the water surface of around 4 sq.km, it can lead to an intensification in the area of the average annual air humidity from 80% to 83%. This leads to an extra use of heat whose effect is the reduction of the average multiannual temperature with 0.33^{0}C.

Also, because the reservoirs cool slowlier, the effects of the "cold reservoirs" do not take place during the winter (FILIP, 2002) and the temperature inversions reduce due to the combination of air over the aquatic and land surfaces.

Fog formation is possible when the water temperature is higher than the one of the air, and the relative humidity of the air must be over 90%. Under such circumstances, it was estimated that after reaching the normal retention, early in spring and late in autumn, fog will appear over the reservoirs, favoring the appearance of thaw localy.

Snow and sleet are frequent phenomena which can occur fairly early in autumn due to the humidity surplus generated by the reservoirs in contact with the cold mountainous air and pretty late in spring, under atmospheric instability, with sudden variations of warm air in contact with the cold air mass over the reservoirs and from the slopes.

The climatic modifications (by increasing the humidity and reducing the temperature) on long term can induce vegetation modifications appreciated by the lowering of the vegetation limit with around 50 m-60 m in the sub-alpine and alpine zones.

HYDROTECHNICAL CONSTRUCTIONS IMPACT ON HYDROLOGY

As a result of the creation of the reservoirs, water deviation as well as other uses for which they were created (water supply), the natural regime of the rivers was changed. We want to state de fact that the uses of the water from these reservoirs will be the subject of another study.

In the case of the Râul Mare, the highest levels and the flood waves are reduced by their retention in the reservoirs. The discharge of the Râul Mare was artificially modified by the deviation of the upper courses of some rivers towards the Gura Apelor reservoir, and downstream, it was highly reduced, the river channel being dry almost up to the first tributary (POPA 1999). The building of the secondary Râul Bărbat –Gura Apelor reservoir catching caused the decreasing of the discharges on these valleys. It can give birth to drought phenomena. Their influence can be noticed at low levels when the discharges are very decreased and may appear drought phenomena.

The discharge modifications as a result of the hydrotechnical constructions induced modifications of the phreatic regime as well. Near the Gura Apelor reservoir- Clopotiva plant, an underground water bed appeared in the alluvia from the channel, the phreatic level being influenced by the river level. The discharge decreasing of the rivers as a consequence of the Gura Apelor reservoir induced a lowering of the phreatic level in the alluvial bed, the area of influence being restricted to the channel area. After the studies carried out in the area, it was appreciated that the lowering of the phreatic level in the channel and on the slopes of the adjacent area will be of 0.1- 1.2 m, which caused the decreasing of the moisture, which affected the existing vegetation.

On the other hand, the building of the three reservoirs in the depression area (Ostrovu Mic reservoir, Păclişa reservoir, Haţeg reservoir) brought notable modifications on the hydrographic network local configration. The about which are said to have been created by man during the Roman times. At present they are controlled and evolve in derivation regime, some tributaries being reoriented. New reports between the surface waters and the underground ones have been created. These resulted in the rising of the phreatic level which near the surface(0.5-4.2m) and with the modification of their tendancy of discharge.

Consequently, the lower parts from some places (Ostrovu Mic, Ostrovel, Ostrovu Mare, Păclişa, Sântămăria Orlea) are affected by excess of moisture, the basements of the buildings becoming unfunctional and the wells being frequently flooded due to the fact that the floodings have intensified.

HYDROTECHNICAL CONSTRUCTIONS IMPACT ON VEGETATION

The hidrotechnical planning induced a series of modifications of the landscape as a whole, and of the vegetation in particular. The main form of vegetation which is influenced and which in its turn influences the ecosystem is the forest, the grasslands as well as the juniper trees (occupy around 3000 ha, 1200 ha respectively) are under a reduced influence of the reservoirs. The forests which are in our focus of interest belong to two planning units of the Retezat Forestry District (Râul Şes 3rd production unit with an area of 2687 ha and Retezat National Park 5th production unit which has 286 ha).

As a consequence of the building of the Gura Apei dam and the creation of the reservoir as well as the organization of the construction site, 640 ha have been excluded from the stock of wood (400 ha the area occupied by the reservoir, 145 ha of forest has been extra cut , 30 ha the area occupied by the dam, 20 ha access roads). Out of these, 40 ha have been reintroduced in the forestry and 600 ha are lost for ever.

After the deforestation it was noticed that all forest types are well represented on both banks of the reservoir, except the riverside coppices. In conclusion we can say the biodiversity has not suffered a lot.

An area which attracts our attention is that downstream the dam on the first 3 km, where the river does not have water, being almost dry due to the fact that the hydrotechnical planning was not built with a serving discharge (Photo 10).

These modifications consist in early drying of the spurce trees(1-5%), on the whole left slope of the Râul Mare up to 300-400 m height from the water level and the middle of the slopes. This phenomenon is outstanding and it has an increasing tendancy in the adjacent area of the channel, too.

According to the way in which the tree dryings take place, from the top by reddening and leaf loss as well as by the position in the relief of the phenomenon, the main cause is the stress caused by de pedo-climatic defficit, by the modification of the hydrographic networks associated with a long term drought.

The floristic diversity is not very high, but there are many species, their presence is due to the influence of the anthropic factors (Table 1).

On the of slope of the platform from the diversion tunnel, the vegetation is very mature because it was not disturbed by the activities which followed the building activities and is ocupies 90- 100%, with the exception of the surfaces where there are high blocks of concrete left behind. These are ocupied by vegetation specific to rocks and rock debris, too. The trees and the bushes have higher densities and the species identified (*Alnus incana*-seedlings, *Agrostis capillaris*, *Betula pendula*, *Fragaria vesca*, *Picea abies* – seedling, *Ranunculus repens*, etc.) resemble the natural composition of alders of *Alnus incana*, in early status.

The species are mainly herbaceous and their extention depends on the microrelief. They follow the Râul Mare course up to the confluence with the Văgăuna Neagră. This vegetation which appeared because of the low discharge is affected by leakages of residual water in the river.

As far as the herbaceous flora from the mountainous area is concerned, it has disappeared being found in other mountainous alluvial plains from the adjacent areas, and upstream the dam it was completely lost because of the appearance of the reservoir.

Table 1. Species of plants present on the bank
of the Râul Mare- the platform in front of the diversion tunnel

NR.CRT	TAXA	2006
1.	Achillea distans	+
2.	Agrostis capillaris	+
3.	Agrostis giganteea	+
4.	Angelica sp.	+
5.	Arctium lappa	+
6.	Artemisa vulgare	+
7.	Calamagrostis arundinacea	+
8.	Centaureea phrygia	+
9.	Cirsium sp.	+
10	Cirsium candelabrum	+
11	Cirsium vulgare	+
12	Daucus carota	+
13	Leontodon hispidus	+
14	Medicago lupulina	+
15	Melilotus alba	+
16	Mentha longifolia	+
17	Origanum vulgare	+
18	Plantago media	+
19	Prunella vulgaris	+

20	Salix silesiaca- puieți	+
21	Senecio sp.	+
22	Taraxacum officinale	+
23	Telekia speciosa	+
24	Trifolium pratense	+
25	Trifolium repens	+
26	Tussilago farfara	+
27	Urtica dioica	+

CONCLUSIONS

Following preliminary observations we find that the hydropower works on the Strei River Basin have not a significant impact on the environmental components.

To make us sharper more detailed, study is required for each environmental component part.

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Literature cited

BADEA L. & COLAB. 2001. Unitățile de relief ale României, I, Carpații Meridionali şi Munții Banatului, Ed. Ars Docendi, Bucureşti, 151 p.

CRISTEA V. & COLAB. 1996. Ocrotirea naturii şi protecția mediului în România, Ed. Cluj University Press, Cluj- Napoca, 365 p.

GOȚIU DANA, SURDEANU V. 2008. Hazardele naturale şi riscurile asociate din Țara Hațegului, Edit. Presa Universitară Clujană, Cluj-Napoca, 336 p.

GRUMĂZESCU CORNELIA 1975. Depresiunea Hațegului-Studiu geomorfologic, Ed. Academiei Republicii Socialiste România, Bucureşti, 148 p.

FILIP D. 2002. Impactul amenajărilor hidrotehnice de pe Râu Mare asupra mediului înconjurător, *Geis*, **7**: 76-81, Ed. Casei Corpului Didactic, Deva.

LAZĂR ZOIA 1995. Rețeaua hidrografică a Depresiunii Hațegului, *Referate şi comunicări de geografie*, **1**: 101-106, Ed. Casei Corpului Didactic, Deva.

LAZĂR ZOIA 1995. Observații climatice în Depresiunea Hațegului, *Referate şi comunicări de geografie*, **2**: 21-26, Edit. Casei Corpului Didactic, Deva.

LAZĂR ZOIA 1995. Lacurile şi amenajările hidrotehnice din Depresiunea Hațegului, *Referate şi comunicări de geografie*, **2**: 27-30, Edit. Casei Corpului Didactic, Deva.

IELENICZ M.& COLAB. 1999. Dicționar de geografie fizică, Edit. Corint, Bucureşti, 503 pag.

MĂRCULEȚ I.& RUSU B. 2005. Impactul lacurilor de acumulare din Munții Teleajenului şi Buzăului asupra reliefului – Observații preliminare, *Comunicări de Geografie*, **9**: 103-106.

POPA N. 1999. Țara Hațegului- potențialul de dezvoltare al aşezărilor omeneşti, Edit. Brumar, Timişoara, 455 pag.

POPOVICI IULIANA (editor coordonator). 1993. Parcul Național Retezat – Studii ecologice, Edit. Eus, Chişinău.

POP P. GR. 2006. Carpații şi Subcarpații României, ediția a-II-a revizuită şi adăugită, Edit. Presa Universitară Clujană, Cluj – Napoca, 260 p.

POP. P. GR. 1996. România- Geografie hidroenergetică, Edit. Presa Universitară Clujană, Cluj-Napoca, 237 p.

POP. P. GR. 1996. Amenajări hidroenergetice în nordul Grupei Retezat-Godeanu şi Depresiunea Hațegului, *Studia Univ. Babeş – Bolyai, Geographia*, Cluj-Napoca, **38**(1): 37- 42.

RĂDOANE MARIA, RĂDOANE N. 2007. Geomorfologie aplicată, Edit. Universității Suceava.

UJVARI I. 1972. Geografia apelor României, Edit. Ştiințifică, Bucureşti, 577 p.

URDEA P. 2000. Munții Retezat-Studiu Geomorfologic, Edit. Academiei Române, Bucureşti, 272 p.

XXX. 1987. Geografia României, III, Edit. Academiei Republicii Socialiste România, Bucureşti, 655 p.

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Foto 1. Hidropower

Foto 2. Right side of the embankment Gura Apei (reinforced)

Foto 3. The embankment Gura Apei

Foto 4. Lake of accumulation Gura Apei

Foto 5. Rockfill quarry on Netişului Valley - Field training of stones in the slope

Foto 6. Rockfill quarry on Netişului Valley

Foto 7. Clay Quarry at Râu de Mori; the vegetation was reinstalled

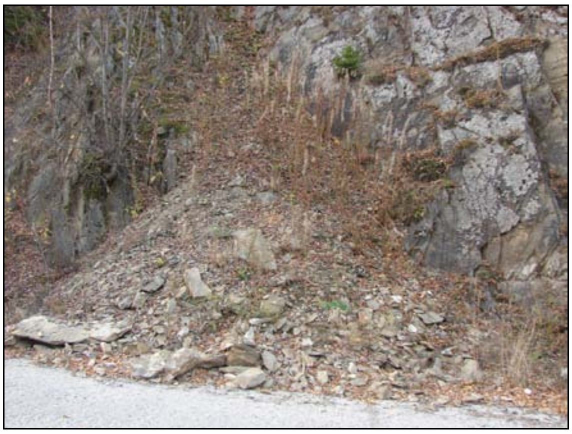

Foto 8. Debris cone with reinstalled vegetation

Foto 9- Brazi Hotel

Foto 10. Downstream of embankment Gura Apei