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THE NECESSITY AND OPPORTUNITY FOR MULTIFUCTIONAL HYDROTECHNICAL PLANNING IN VIŞEU RIVER BASIN

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Abstract

Because of its geographical aspects, Vişeu river basin has a high potential of developing of a tourism based on water resources and hydro energy planning on the main water flows. Besides this potential, this area presents some disturbances like flood waves with significantly yearly damages and the lack of a suitable water suplly. This case study evaluates the necessity for hydrotechnical planning in Vişeu river basin based on the main flood waves datas, followed by a SIG analysis of the opportunities for hydrotechnical planning which could solve the disturbance – potential contrast, based on all the main aspects from the area.

Keywords: necessity, opportunity, water resources, hydrotechnical planning, contrast, Vişeu

1 INRODUCTION

In the current context of sustainable development based on preserving the natural habitats, ensuring proper and decent life conditions and strengthening the infrastructure of any kind, in many areas from Romania it is presented a zonal contrast between disturbance and potential.

Instead of designing a major plan of management, with huge investments, which can however have some results, by eliminating the disturbances in favour of the development and the enhancement of natural and anthropogenic potential, it is often chosen to approach the situations through some ways that, cumulated in time, cost a lot of money and they succeed in solving the problems that exist only temporarily.

It is also the case of the region that overlaps the Vişeu River Basin, a region that has a huge potential, which is, unfortunately, overtaken by the existence of some disturbances such as the high frequency of floods, the consequences of major mining activities, the poor infrastructure and the lack of an efficient water supply and of a sewage system.

2 GENERAL ASPECTS

2.1 Position

Geographically, the Vişeu basin is situated in the extreme north of Romania, occupying the central part of the Northen Group of Oriental Carpathians. Administratively, it occupies the eastern part of Maramureş county, overlapping the administrative unities Valea Vişeului, Petrova, Ruscova, Leordina, Repedea, Poienile de sub Munte, Vişeu de Jos, Vişeu de Sus, Moisei and Borşa (Figure 1).

The geographical coordinates of the basin are:

- the north - 47°57'35" north latitude
- the south - 47°33'12" north latitude
- the east - 25°03'24" east longitude
- the west - 24°08'40" east longitude

2.2 Natural environment

The Vişeu Basin has the maximum length of 60 km (NW – SE) and the maximum width of 36 km, being a component of Tisa Basin. It is bordered to the north by the basins of Tisa and Prut, located in Ukraine, to the west by Iza Basin, to the south by Someşul Mare Basin and to the east by Bistriţa Aurie Basin. The hydrologic basin is drained by the Vişeu River, a tributary of Tisa, which has as main tributaries the following: Ţâşla, Vaserul, Izvorul Dragoş, Ruscova, Izvorul Negru. The maximum altitude is of 2303 m, Pietrosu Peak from Rodnei Mountains, and the minimum altitude is of 330 m at the confluence with Tisa.

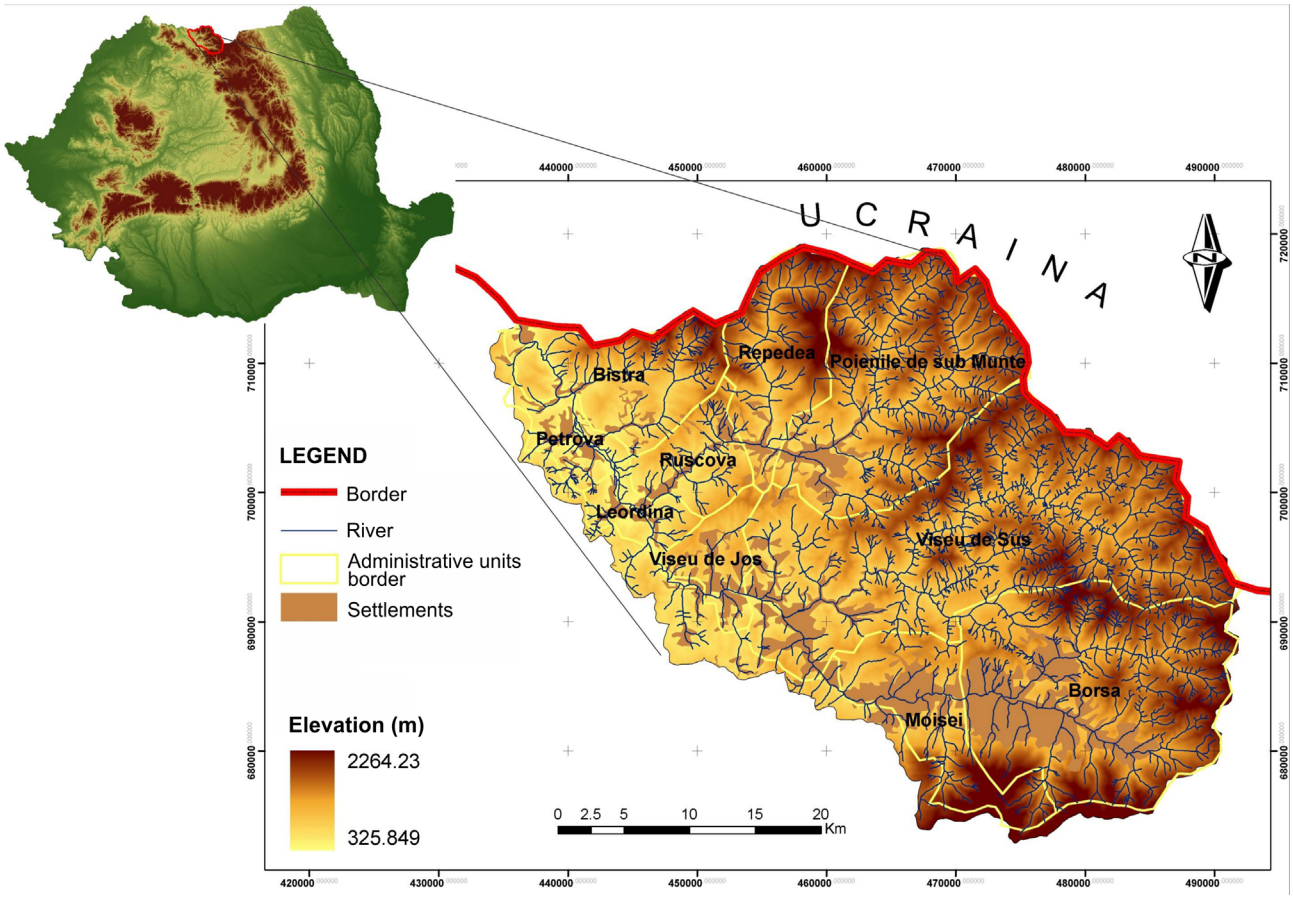


Figure 1. Position of Vişeu basin

2.3 The anthropogenic environment

From the administrative point of view, there are three major settlements: two small towns (Vişeu de Sus and Borşa) and a commune (Moisei), which count together a population over 50.000 inhabitants, developed in the meadows of Vişeu, Vaserul, Ţâslei, having a continuous territorial extension which gives the impression of a single locality. There are also the localities Valea Vişeului, Bistra, Petrova, Ruscova, Leordina, Vişeu de Jos and Poienile de sub Munte, the last one being located at the highest altitude, of 770m. The total population from the Vişeu Basin area is evaluated, according to the census from 2011, to 84,653 inhabitants, with a density of 66,484 inhabitants/km^2.

3 METHODOLOGY

We mention that the current case study is part of a broader study based on a large database that contains hydro-climatic data from the period 1970-2008, cartographic and topographic supports, reports of the Administration of the Someş – Tisa Basins and from the local and county institutions, and also information sampled from the field.

Through a thorough documentation, analysis and digital processing of data with different specialized software (ArcView, ArcGis, Excel, etc.) a number of steps have been developed which led to the achievement of the objective: to identify the needs, the opportunities and the favorability of the water planning with complex functions of the Vişeu basin. The steps that we followed in order to write this paper are the following:

- Analysis of the natural and anthropogenic environment.
- Analysis of the contrast between the disturbance and the potential within the basin.
- Identification of the basin needs according to this contrast.
- Identification of the opportunities of development and planning.
- Execution of a map of harnessing favorability of the studied area.

- Suggestion of solutions that are as efficient as possible.
  The results of these steps are presented below.

4 ASPECTS RELATED TO THE NECESSITY OF THE BASIN PLANNING

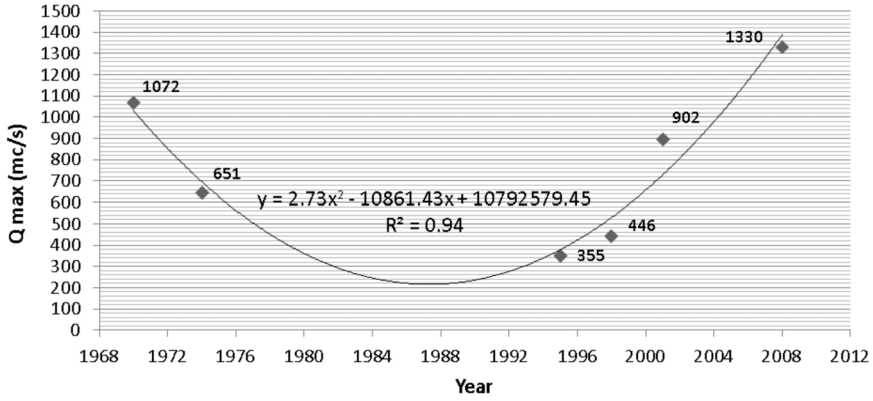
After a detailed analysis of the natural and anthropogenic environment of the Vişeu basin, it has been tried to establish the disturbance and the natural and anthropogenic potential as described in the table below (Table 1.).

Table 1. The contrast of disturbance - potential

Disturbance	Potential
High frequency of floods/flood waves in the whole basin and their consequences: • casualties • damages of millions of Euros • landslides • erosion of the riverbed • damaged infrastructure Infrastructure: • poor road infrastructure • poorly developed rail infrastructure • lack of an efficient water supply and sewage system • presence of residential infrastructure in the flooding river beds' area insufficient riverbeds planning Intense deforestation activities Presence of wood remains after the deforestations from the riverbeds Misuse of land. Effects on the environments of a mining industry, currently inactive.	Tourism potential: • the natural setting of the complex relief and the landscape diversity • hydrography rich in waterfalls, gorges, moors, lakes, swamps, mineral springs. • presence of Maramures Mountains National Park and Rodna Mountains National Park • presence of mixed communities and cultures (Romanians, Ruthenians, *ţipţeri*, Hungarians, Hebrews etc.) • existence of unique sights (the railroad train called "mocăniţa", wooden churches, the gates of Maramureş, etc.) • possibility of developing the rural tourism and rearranging the forest ranges deallocated for tourism. Economic potential: • possibility to develop the tourism infrastructure • possibility to build a hydroelectric power plant (favorable topographic and hydro-climatic conditions; legislative authorization) • wood exploitation and processing.

These aspects show that the cause of most problems within the basin is represented by the water risks induced by the floods/flood waves and their effects on the area. Analyzing the string of floods from 1970 until now, it can be observed a significant freshet frequency: one flood wave each 4.25 years in the last 17 years (Figure 2.). Between 1995 – 2012, it can be observed a tendency of increasing the maximum water flows recorded, this leading to severe repercussions on the environment.

Figure 2. Frequency of special flood waves 1970 - 2012.



Most damage in recent years have been recorded during the historic freshest from July 2008 when, in a very short time, a pluvial freshet occurred Vişeu basin, due to the torrential rainfall that exceeded the annual average. With a maximum flow of 1330 m / s and a total volume of 149,158 mil. m / s, recorded at the hydrometric station Bistra on Vişeu, the freshet affected in that area houses, extensions, households, agricultural land, road network, county roads, bridges and culverts, economic targets, causing the death of 5 persons. Therefore it is mandatory to analyze and combat by any possible means such extreme fluid phenomena.

Combating the water risks can be done using structural and nonstructural methods. The most effective measures are the structural ones, more precisely the hydrotechnical arrangement of the basin, which is expensive but clearly superior and more effective than the other existing measures. Once the water risks are controlled with a hydrotechnical planning, it entails a lot of direct and indirect benefits, to a local level but not only, during and after the planning process. (Table 2.).

Table 2. The advantages of the planning process

During	After
Improving local infrastructure. Creating new jobs for local population	Solving the problem of flooding in large areas downstream. Public safety. Complex infrastructure (modern access roads) Possibility of developing a modern water supply. Full exploitation of the major riverbed. Developing a new type of tourism due to the presence of the storage lake. New funds from the production of electricity and tourism etc. Investing funds in the environmental protection and sustainable development of the area.

It is normal that the extent of this planning could damage the environment but as long as the situation before the planning is considerably more harmful for the natural and anthropogenic environment, the planning could be achieved by implementing some serious impact studies and by using new techniques of execution, avoiding in this way an environmental disaster.

5 PLANNING OPPORTUNITIES

In order to identify the opportunity of basin planning, it was necessary to analyze in detail all natural and anthropogenic conditions within the basin. We started by sharing the basin as relevantly as possible in major smaller basins. Using specialized software (ArcMap, Excel) there were analyzed the smaller basin, from a qualitative and quantitative point of view, being taken into consideration certain criteria that are essential for this hydrotechnical planning. Each small basin was noted with indices from 1 to 10 according to the analyzed criteria (Figure 3, Table 3).

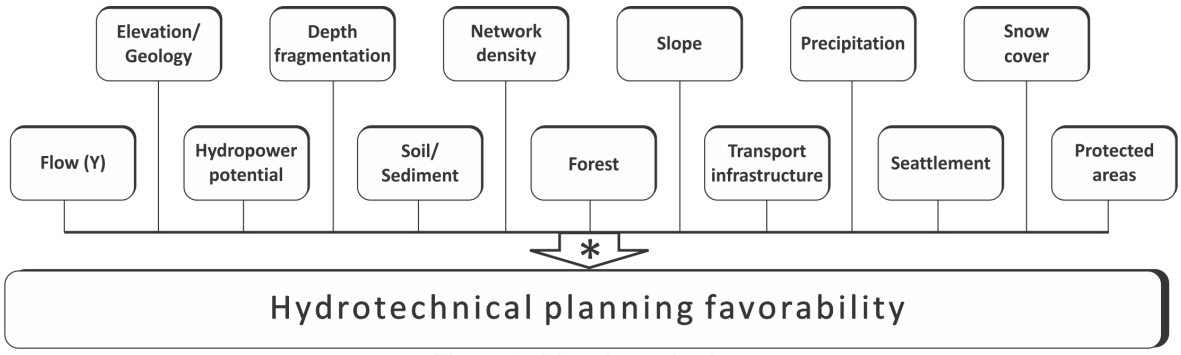


Figure 3. Planning criterias.

Table 3. Basin clasification according to favorability indices

Nr. Crt	Evaluation criterias of the basins / Basins	Elevation / Geology	Depth fragmentation	Network density	Slope	Precipitations	Snow cover	Flow (Y)	Hydropower potential	Soil / Sediment	Forest	Transport infrastructure	Seattlement	Protected areas	FAVORABILITY (Cat.)
1	Bardi	9	6	4	5	5	5	5	1	8	7	5	10	7	V
2	Frumuşeaua	8	6	3	5	4	4	4	2	6	7	5	9	8	V
3	Izvorul Dragoş	10	6	4	5	7	7	7	2	8	5	1	10	2	VI
4	Novăţ	7	5	5	5	4	4	4	4	8	8	4	10	10	IV
5	Novicior	9	6	5	5	5	5	5	1	9	9	6	10	10	III
6	Repedea	10	7	3	6	7	7	7	3	9	4	3	8	4	IV
7	Repedea (Chiroi)	10	6	3	5	6	6	6	4	10	8	4	10	7	II
8	Ruscova inferior	6	5	3	4	3	3	3	4	7	5	5	8	10	VI
9	Ruscova superioara	10	6	4	5	6	6	6	10	10	8	7	10	8	I
10	Ţâşla inferior	8	5	4	5	5	5	5	2	8	4	10	7	10	IV
11	Ţâşla superior	10	6	4	5	7	7	7	3	10	8	10	10	9	I
12	Vaser inferior	8	6	4	5	4	4	4	4	8	8	9	9	9	III
13	Vaser superior	10	6	5	5	6	6	6	10	10	9	6	10	9	I
14	Vişeu inferior	6	4	3	4	2	2	2	6	5	4	8	8	10	VI
15	Vişeu superior	7	4	3	4	4	4	4	9	7	3	7	6	9	V

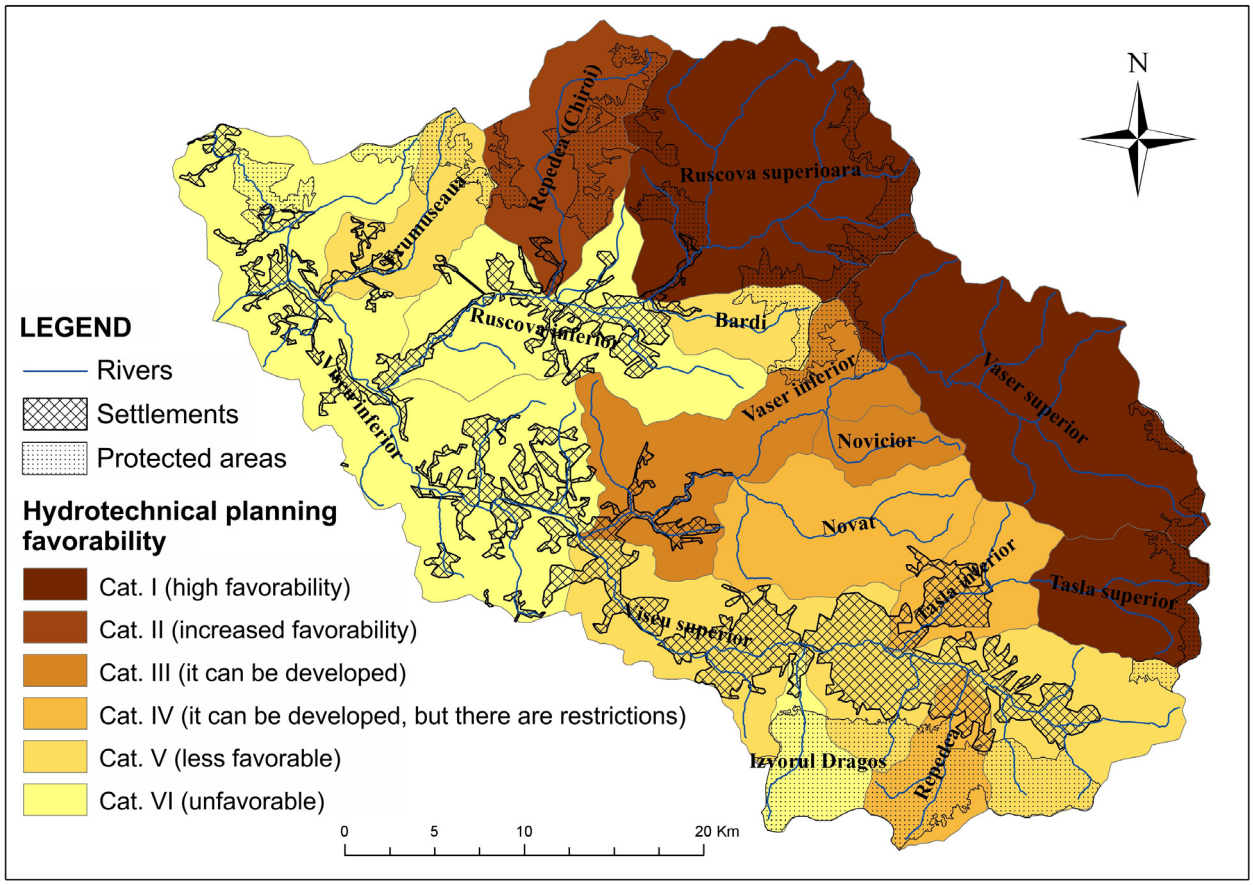


Figure 4. Hydrotechnical planning favorability map of Vişeu basin.

According to the results obtained after modeling all favorability indices there were established six categories of favorability:

• Cat. I – maximum favorability
• Cat. II – increased favorability
• Cat. III – it can be developed
• Cat. IV – it can be developed, but there are restrictions
• Cat. V – less favorable
• Cat. VI – unfavorable

Each small basin was analyzed after a total of 13 topographical, geological, hydroclimatic, biologic and pedologic, anthropogenic criteria etc. When the criteria were selected, it was taken into consideration the fact that some areas overlap the protected areas from the Maramureş Mountains Natural Park and Rodna Mountains National Park. This aspect is highlighted by the position of the small basin Spring Dragoş (Cat. VI) and small basin Repedea (Cat. IV) in the lower category despite many aspects clearly superior to other basins.

In the table of favorability indices it can be observed a resemblance between the columns of the hydro-climatic criteria of the basin, this aspect being explained by the quantitative dependence of the analyzed parameters (drain layer, precipitation, snow cover) on the basin elevation.

By creating a modeling based on as many relevant criteria as possible, some very precise favorability maps could be obtained, which will be helpful to determine the location and the size of potential reservoirs and hydraulic structures, that are in fact indispensable for the Vişeu Basin. According to the needs and priorities of the studied basin, the functions of the future accumulations are the following:

- mitigation of flood waves
- regulation of the annual water flow from Vişeu and its main tributaries
- water supply in all areas of settlements and economic units in the entire Vişeu Basin
- electricity
- improve tourism/recreation

6 CONCLUSIONS

This current study highlights an important necessity and opportunity of Vişeu river planning, a necessity due mainly to the high frequency of the water risks and an opportunity accentuated by the big potential of the natural and anthropogenic environment from the studied area. The most suitable areas for planning are the upper coursers of the rivers Ruscova, Vaser and Ţâşla. By the advantage offered by the lack of settlements from the superior basins, by the hollows that do not overlap the protected area, and by a modern approach of the construction methods with a minimum impact on the environment, the hidrotechnical planning with complex functions can be developed within the Vişeu river basin.

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