THE WATER SUPPLY OF THE LOCALITIES IN THE ILIŞUA DRAINAGE BASIN

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Abstract – The water supply of the localities in the Ilişua drainage basin. The way in which the water is supplied to a locality represents a relevant indicator in assessing the quality of life and the economic development. The existence of a well developed water supply system is all the more necessary as the spatial-temporal distribution of the rainfall undergoes an enhancement of variation together with the increase of water requirement.

The 27 localities located in the drainage basin, with a population of more than 13,000 inhabitants, engaged mostly in primary activities need a water supply system with a quality source and a sufficient flow to induce an actual immunity in the context of present climate changes. In order to achieve this goal, one has to consider calculating the water requirement, analyzing the territory natural component in order to make possible the identification of the water supply sources and of the water uses territorial distribution.

Keywords: Ilişua Valley, basin, drinking water, water supply, water requirement, water source, water use, locality.

1. INTRODUCTION

The presence of water represents a sine qua non condition for the existence of life on Earth. It is a feature which dictates the spatial, dimensional and functional coordinates of human society. The importance of water (by this one has to understand first of all the drinking water), is all the more obvious in the present demographic and economic context, so as the world climate undergoes oscillations which reflect upon a frequency increase of the extreme natural phenomena (climatic, hydrologic etc.) during the last decades. This frequency increase induces a state of risk proportional to the vulnerability value of human communities. The surface of Romania is no exception to this general context. These phenomena are more or less specific to the spatial coordinates of the land they affect.

By its various uses, water represents a main evolution factor of human society, the reason of considering water supply as a development indicator of human communities. Romania experiences discrepancies in terms of infrastructure distribution in general and of the drinking water supply infrastructure in particular. While the urban areas are well supplied in this regard, the rural areas need major investments due to certain factors (localities texture, relief characteristics).

Besides the territorial distribution factor, the high cost of performing these works adds to this situation. Overcoming these obstacles is possible by the

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association of administrative-territorial units in order to facilitate absorption of governmental funds or other types of funds. In this regard, in Romania there are several initiatives such as: local initiative groups (GAL), micro-regions and other LEADER type partnerships. Some groups reach a level of organizational maturity and become community associations with legal entity status (ADI), while others dissolve after reaching their goal. Although some partnerships are working on the elaboration of local development strategies, many of them were not completed due both to the lack of financial resources and to the lack of information regarding the funding calls and the associated advantages.

The communes located completely or partially in the Ilişua basin administratively belong to the Western part of the Bistriţa-Năsăud county. Târlişua, Spermezeu, Căianu Mic, Uriu and Zagra, together with other neighbour communes belong to several such groups which propose to supply water to component localities. However, the authors consider that meeting the water and sewage requirements can only be performed by good cooperation of all stakeholders in the basin. This statement is confirmed by *Kenneth* J. G.'s assertion of 1973, cited by Stumbea (Tîrlă) Maria–Laura in 2011, which states that "the drainage basin is an excellent example, a basic unit due to its functional role within the fluvial processes and indirectly to geomorphologic and social-economic processes within the area subjected to study.

In order to achieve this goal (water supply and sewage systems), several logical stages need to be covered consisting in calculating the water requirement of each particular locality, indentifying possible sources, treatment means and location of the respective unit, as well as the transport to the consumers.

This paper intends to be a qualitatively better alternative to those chosen or to be chosen by the local authorities. This model is intended to be complex and comprehensive in order to accelerate the socio-economic evolution of the existing human communities.

2. METHODOLOGY

The space analysis scientific approach developed to identify the optimum solutions to meet the water supply need was performed according to the basic principles governing the geographic phenomena: spatiality, causality, integration and socio-economic principles. The development of this study presumed the passing through the specific research stages consisting in professional use of the investigation, knowledge planning or representation and exploration methods.

The GIS methodology enables the elaboration of maps as a modern form of land analysis, illustrating actual facts, analyses and proposals. The elaboration of the data base would not have been possible without the numerous field introspections performed for the collection of data regarding the state of the physical-geographical and socio-economic setting. The topographical maps scale 1: 25 000 (from 1960) and 1: 200 000 (from 1996), geological and pedological maps scale 1: 200 000 set the basis for cartographic modelling.

3. THE WATER REQUIREMENT

Calculation of water requirement represents the first stage in developing the water supply system for a certain territory. The knowledge of its values is necessary both for developing the source and for sizing the water treatment plant and transport pipes. The study identified 27 localities in the drainage basin. These are organized in five communes (in case of the Zagra commune, Perişor is the only locality within the basin), totalling 13,163 inhabitants in 2011. Three of these already have water supply systems. These are the Southern localities: Uriu, Cristeşti-Ciceu and Ilişua, whose water requirement is provided from the Beclean source.

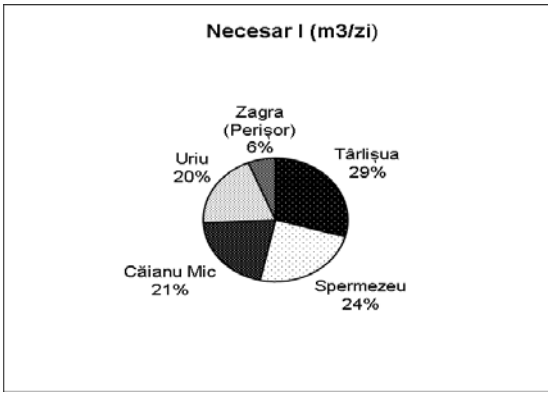

Fig. 1. Commune level water requirement distribution

When determining the water requirement of the population (public and domestic requirements), four options were considered, corresponding to the following specific consumptions: "40 l/inhabitant/day, 65 l/inhabitant/day, 110 l/inhabitant/day and 195 l/inhabitant/day. Regarding the water requirements of livestock, the following specific consumptions were considered: 50 l/day for large animals and 8 l/day for small animals, (*Sorocovschi, V., Imecs, Z., 1998*).

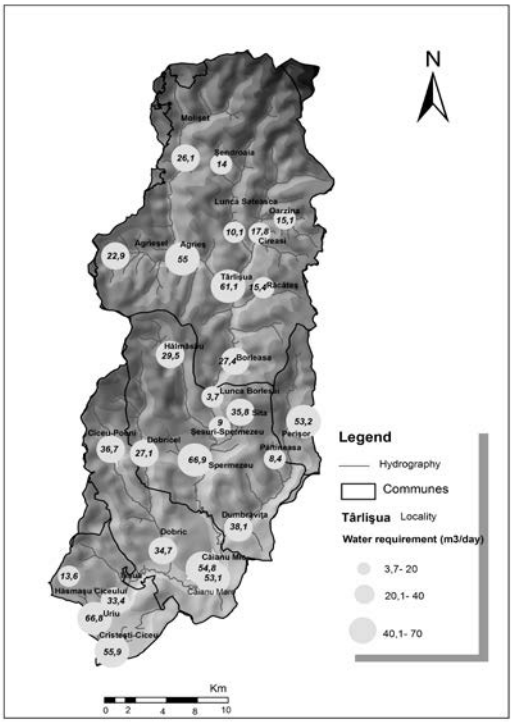

Fig. 2. Localities level water requirement distribution

The economic character of the area which infers the prevalence of primary sector activities: agriculture (breeding) and forestry as well as the development

perspectives which denote a possible touristic trend combined with ecological agriculture, set the basis for choosing the first option. Therefore, the authors believe that 864.9 m³/day (10 l/s) will meet the local needs.

The water demand in the administrative-territorial units is proportional to the demographic potential and the livestock (Fig. 1). Consequently, Târlişua and Spermezeu need 29, respectively 24 % of the total, although the demographic potential is inferior to that of the other two communes. This situation is explained by the large number of animals.

Among the localities that stand out, Perişor with 52 m³/day, together with the commune centres and other two localities: Căianu Mic and Agrieş, account for the water requirement by the population and livestock number (Fig. 2).

Excluding the three localities which already have water supply, there is still a 708.8 mc/day requirement still uncovered, which equals to 7.8 l/s.

4. THE ROLE OF THE TERRITORY NATURAL COMPONENT IN WATER USE DISTRIBUTION

The natural characteristics of the land are decisive both for water courses management and for water use distribution. The second aspect is of special interest to this paper.

Undoubtedly, the spatial distribution of the water uses represents the element most affected by the features of the natural setting, but it is not the only one. The materials used in the development and function of the component elements are in a similar situation. This paper briefly analyzes the elements leading to the proposal of a model regarding the water supply of the basin localities.

The characteristics of the geological substrata form into favourable inhibiting elements for the coordinates of water uses (location, building materials and building mode etc.).

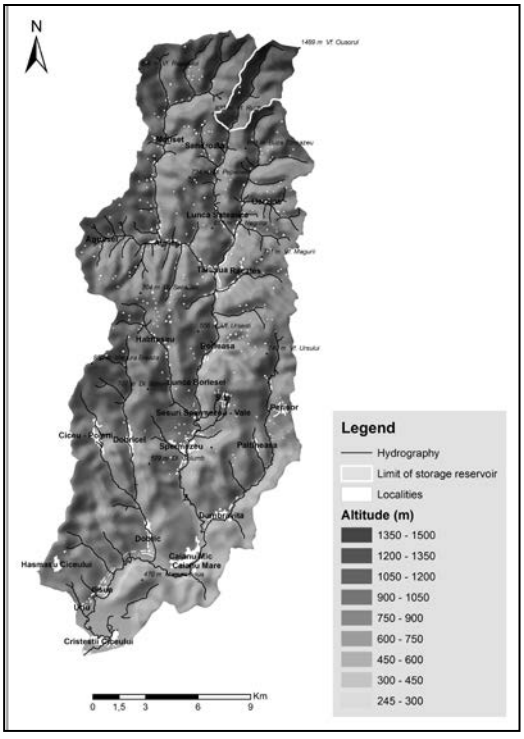

Fig. 3. Hypsometric map of the study area

The sedimentary deposits are highlighted, with a descending age from upstream to downstream. Eocene deposits have been identified in the North as

massif sandstone layers with thin marls and clays seams. The area defined by the presence of this type of deposits proves to be the most favourable to the location of a water retaining structure, all the more so as the existing rocks may be used for its construction.

Two types of relief are found in this drainage basin: a folded relief with "obcine" (saddles) (Obcinele Ţibleşului), in the North or with diapiric folds in the South - East and a monoclinal structural relief (Fig.3.). The first type of relief may facilitate the building of a dam in the mass of its interfluves. The lack of landslides represents another favourable element, while the second type of relief (structural monoclinal) may cause damages to the water transport network by its steep slopes corresponding to the prevailingly consequent valleys.

From the climate point of view, the authors are particularly interested in rainfall, as these dictate the runoff values. These show a quantitative evolution from South to North, thus highlighting the altimetry inference in their distribution, as well as in the direction of land surfaces. Therefore, the rainfall values are about 750 mm in the Southern part, while in the North they exceed 900 mm.

The drainage network, the response of climatic inputs, displayed regionally in a dentritic manner is composed of the Ilişua River (tributary on the right of the Someşului Mare River) and its tributaries.

Although hydrometrical measurements are performed only in the vicinity of the junction, the Izvorul tributary is clearly identified as favourable for the development of a water retaining structure.

The pedogenetic element, by the districambisoils present in the upper basin, proves to be favourable both in terms of its characteristics (satisfactory drainage), and the vegetation it sustains (broad-leaved and mixed vegetation) which covers a significant percent of the upper basin surface.

As a result of analyzing the natural component of the territory, the upper course of the Izvor tributary stands out as the favourable location for the development of a water retaining structure, which is the reason for continuing our analysis exclusively on this water course.

5. THE SUPPLY SOURCES CAPACITY

Only three of the localities within the basin have a water supply system. These are Uriu, Cristeşti - Ciceu and Ilişua. The supply comes from the Beclean source and has a present capacity of 75 l/s of which 25 l/s represents the capacity available for the rural area. This capacity (total and that intended for the rural area) could be doubled if the water supply system is upgraded (Sorocovschi, V., Imecs, Z., 1998).

This source could meet the requirements of the localities in the study area (10 l/s) provided that upgrading and resizing investments are developed, and new structures are added in order to facilitate the distribution at localities level. The requirements are nowadays "covered" by the associated catchment of several existing local springs or by means of some wells in the flood plain area. The latter option has certain disadvantages such as the presence of many septic holes where domestic wastewaters are discharged. Due to the fact that these are located in the proximity of wells and that they are not insulated, seepage through the Holocene deposits composed of sands and gravels and the contamination of drinking water sources are possible.

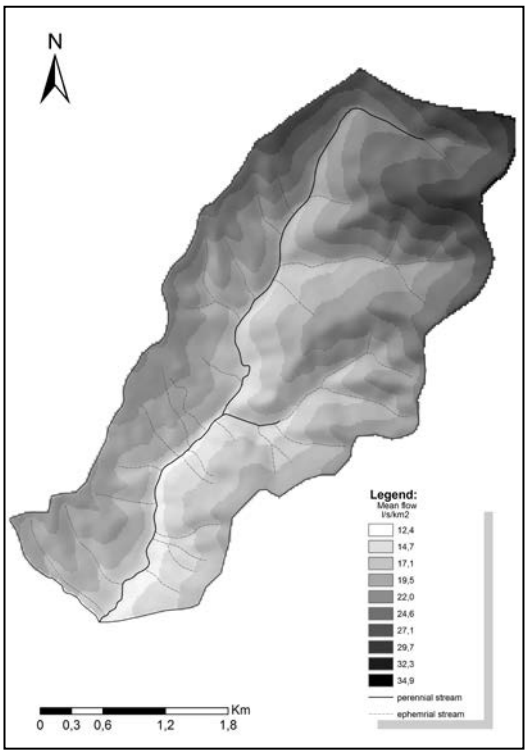

Fig. 4. Map of mean specific runoff distribution in the drainage basin of the proposed water retaining structure

Considering the manner in which the water supply is currently performed, as well as the results obtained after the analysis of natural component of the land, the authors consider that the development of a water retaining structure on the upper course of the Izvor tributary is possible and necessary, with the main objective of meeting the water requirement of the localities in the basin (Fig. 3, 4). The development of this source is welcomed all the more so as the local authorities have chosen inefficient solutions such as the catchment of underground springs from a clearly instable low flow area and the catchment of the main water course which is compulsorily followed by a complex treatment.

In order to identify the median effective runoff potential, calculations were performed based on the values obtained by Sorocovschi and Mocrei in 1994 regarding the median specific runoff on altitude intervals in the South of the Ţibleş Mountains.

A 239.81 l/s specific mean runoff was found in the 11.78 sq km basin surface where the proposed water retaining structure would be developed (Tab. 1). This flow exceeds the 8.2 l/s requirement for the compliance with the socio-economic requirements, while the difference may be used to produce hydro-electric power.

Table 1. Percentage and value distribution of the specific mean runoff in the basin to be developed

Altitude interval (m)	Specific mean runoff (l/s/sq km)	Surface (sq km)	% of the territory	Recorded runoff (l/s/sq km)
500-600	12.4	0.57	5%	7.07
600-700	14.7	1.56	13%	22.89
700-800	17.1	2.59	22%	44.24
800-900	19.5	2.36	20%	45.98
900-1000	22	1.64	14%	36.12
1000-1100	24.6	1.02	9%	25.02
1100-1200	27.1	0.93	8%	25.28
1200-1300	29.7	0.69	6%	20.52
1300-1400	29.7	0.36	3%	10.56
1400-1500	32.3	0.07	1%	2.13
Total		**11.78**	**100%**	**239.81**

6. WATER TREATMENT AND TRANSPORT

Despite the lack of a pollution source in the area of the complex proposed development, the treatment stage cannot be omitted. In this regard, the authors have proposed the location of a wastewater treatment plant at approximately one km downstream. In this wastewater treatment plant, the water would be treated so that it corresponds to the drinking quality level.

Transport will be performed by means of a main pipe (approx. 31 km) with multiple branch pipes (approx. 99 km) to comply with the needs of the localities not situated near the main water course. These will accompany the transport lines downstream of the Doric commune, with expansion possibilities in order to connect the locality Hăşmaşu Ciceului to the established network (Fig.5)

After analyzing the probable situation, the authors have identified the incapacity of meeting the water requirement in the localities Sita (Spermezeu) and Perişor (Zagra), due to altitude higher than 500 m, as the dam is to be built at 510 m absolute altitude.

Under these circumstances, the likely pumping in a basin located on the Sitei peak (705 m), over 610 m altitude, is necessary. The energy used will come from the micro-hydroelectric power plant located at the foot of the dam. The same energy can be used to supply the other component localities of the Zagra commune.

7. CONCLUSIONS

The analysis performed on the Ilişua drainage basin in terms of water supply reveals several significant conclusions.

Twenty four of the 27 localities do not have a water supply system, which means that 10,234 inhabitants drink daily undrinkable water.

According to the present situation and the development perspectives of the area, the water requirement reaches the 708.8 mc/day value, equivalent to 8.2 l/s;

The analysis of the territorial component reveals the favourable character of the Izvor valley upper course for the location of the water retaining structure whose features are to be decided after several specialty studies.

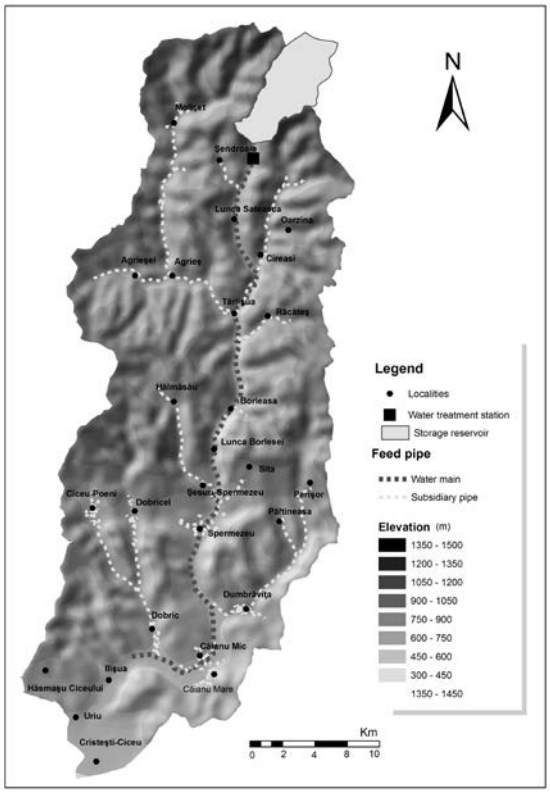

Fig.5. Water use proposals

Similar procedures will be conducted to add auxiliary functions (generation of electric power).

In order to facilitate the accession of funds for the development of this project, which should mandatorily consider the development of the sewage network, a Planning Territorial Unit should be formed, to include the five mentioned territorial-administrative units.

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