DYSFUNCTIONS OF DRINKING WATER SUPPLY SYSTEMS AND SEWERAGE SYSTEMS IN THE LAND OF DORNA

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ABSTRACT. – Dysfunctions of drinking water supply systems and sewerage systems in the Land of Dorna. The aim of the present article is to study the drinking water supply systems and sewerage systems in the Land of Dorna. Following the analysis I noticed the uneven distribution of drinking water supply systems and sewerage systems, so the most developed axis of this view is the main axis that is oriented V-E. This axis connects the Land of Dorna with the neighboring regions, those of Transylvania, Maramureş and Moldova. The final part of the study consists of a series of proposed measures for the revitalization of the existing dysfunctions in the territory and to revive the repulsive areas (the north of the Land of Dorna and the northern part of the Călimani Mountains).

Keywords: drinking water supply systems**,** sewerage systems, water quality

1.INTRODUCTION

The existence of drinking water supply systems and sewerage systems is an essential condition for maintaining social, economic and territorial cohesion, that ultimately lead to the improvement of life in this territory. This article analyzes the existing dysfunctions of drinking water supply systems and sewerage systems in the Land of Dorna and proposes a series of measures to remedy them.

The Land of Dorna is situated in the north of Romania, between the alignments of the Maramureş, Suhard, Bârgău, Călimani, Giumalău and Obcina Mestecăniş mountains, occupying a tectonic-erosive depression (Donisă, I., 1968). From the administrative perspective, the studied area consists of Vatra Dornei town and nine communes: Cârlibaba, Ciocăneşti, Coşna, Dorna Arini, Dorna Candreni, Iacobeni, Panaci, Poiana Stampei, Şaru Dornei.

For the study were consulted several bibliographic and cartographic sources, were analyzed and interpreted data from NIS (National Institute of Statistics) for 1990-2010 interval. The range of social indicators that were analyzed consist of: the share of localities with access to the sewerage system, the age of drinking water distribution network, the number of wastewater treatment plant, the share of inhabitants connected to the drinking water supply system.

In the realization of the cartographic supports I have used topographic maps (1:50000), aerial photographs and appropriate programs – ArcView, ArcGis.

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2. DYSFUNCTIONS OF DRINKING WATER SUPPLY SYSTEMS AND SEWERAGE SYSTEMS

The geological structure of the territory has determined a distinctive hydrographical and hydrogeological potential, thus the networks surface water and underground (phreatic and depth) are developed.

The hydrographical network from the Land of Dorna converges to Bistrița river. The main tributaries from the studied territory are Dorna and Neagra Șarului (order VII and VI). According to Chiriță V. (2003), the hydrological regime of the rivers from the Land of Dorna is relatively uniform (Table 1) the periods of low flow rates that are analyzed are for winter, summer-autumn.

Table 1. ***Liquid medium flows for Bistrița, Dorna and Neagra Șarului rivers (1974-1994) (adapted after Chiriță V., 2003)***

River/ station (1974-1994)	I mc/s	II mc/s	III mc/s	IV mc/s	V mc/s	VI mc/s	VII mc/s	VIII mc/s	IX mc/s	X mc/s	XI mc/s	XII mc/s	∑ c/s	Mean mc/s
Bistrița /Cârlibaba	2	1,9	3,7	12,6	19,6	12	9,4	6,1	5,6	4,6	4,4	3	84,9	7,1
Bistrița/ Dorna Giumalău	3,5	3,3	7	19,7	27,8	18,4	15,5	11	8,7	7,3	6,7	4,7	133,6	11,1
Bistrița/Dorna Arini	8,3	7,9	18,9	49,1	57,6	40	32,4	23	18,7	15,3	15,1	11,6	297,9	24,8
Dorna /Poiana Stampei	0,6	0,4	1,5	4,7	5,8	3,8	3,1	1,9	1,5	1.4	1,2	0,8	26,7	2,2
Dorna/ Dorna Candreni	2,4	2,3	8,1	16,8	17,6	11,1	9,2	6,1	4,8	3,6	5	3,6	90,6	7,6
Neagra Șarului/ Gura Negrei	1,5	1,3	3,1	6,9	9.3	7,5	5,6	4,3	3,3	2.6	2,5	1,9	49,8	4,2

The groundwater aquifer layers accumulate in the upper horizons, in the terrace deposits and slopes, are fed from precipitation, from the surface drainage and from the presence of adjacent hydrogeologic units (Chiriță, V., 2003). The territory of the Land of Dorna is highly vascular, allowing the capture and use of water for drinking water supply systems.

The water's withdrawal is made from springs that appear at the contact of river meadows (everglade) with the terraces (the hearth of Neagra Șarului village, the slopes of Neagra Șarului valley, Dornei valley etc.), or from the waters of proluvial deposits billeted in cones of dejection of the main tributaries of Bistriţa, Dorna and Neagra Șarului rivers.

Five localities (Vatra Dornei, Dorna Candrenilor, Dorna Arini, Iacobeni, Șaru Dornei) from the Land of Dorna are connected to the drinking water supply systems and three of them to the sewage systems (Vatra Dornei, Iacobeni, Șaru Dornei).

The other communes ensure there water source from springs, fountains, wells, and the wastewater discharge is carried in septic tanks (often permeable) or directly on the ground.
Following these actions there is a danger for groundwater contamination which in some places are at small depth, about 2 m (Chiriță, V., 2003).

In order to identify the existing dysfunctions there were used the following indicators: the share of localities with access to the sewerage system, the age drinking water distribution network, the number of wastewater treatment plant, the share of inhabitants connected to the water supply system. The analysis of the social indicators revealed that 50% of all localities from the Land of Dorna are connected to the drinking water supply system, and 30% are connected to the sewage system, values that are below the European average (85% in the UE-Council Directive 98⁄83⁄EC). As for the share of inhabitants connected to the drinking water supply system this is 55% and for those connected to the sewerage system is 39% (it was calculated the number of inhabitants connected to the drinking water supply system and sewage system of the five localities, taking into account that not all households are connected to those systems).

The drinking water supply for the inhabitants of the Land of Dorna is made through the drinking water supply system, which in the last years had a marked increase, from 38,7 km (simple pipelines) in 1990 to 108,2 km (simple pipelines) in 2010 (the length of the drinking water supply system from all 5 localities). While the length of the sewerage system increased slightly from 21,6 km in 1990 to 38,2 km in 2010.

The communes that are not connected to the drinking water supply systems and sewage systems provide there water source from springs, fountains, wells or directly from the rivers. Wastewater discharge is performed improperly (directly on the ground or in the rivers) leading to groundwater contamination and it is a danger for the inhabitants which may lead to some disease (diarrhea, bacterial enterocolitis, typhoid etc.). Some diseases (endemic goiter, endemic fluorosis) are caused by the chemical composition of water, with unbalanced levels of iodine salt (according to the project *„Every Drop Matters"* U.N.D.P.[2] in collaboration with Coca-Cola).

Vatra Dornei has the largest share of population connected to drinking water supply systems (66%) and sewage systems (45%), from the Land of Dorna. Thus, the necessary of water is provided both through surface capture (from ground aquifer layers of Dorna river terrace of 40-50 m) and from depth capture (from the point called Moara Dracului, with the capacity of the tank of 300 m³).

The drinking water source from „Roşu" (the water is captured from Dorna river), after being disinfected and going through various processes, reaches in the Runc hill reservoirs with a flow capacity of 280 m³/h, and after the free fall is

[2] U.N.D.P. – United Nations Development Programme

distributed to consumers (according to *Local Agenda 21 – Sustainable development plan of Vatra Dornei*).

Compared to 1990 the length of drinking water supply system from Vatra Dornei has increased in 2010, from 33 km to 52,7 km, but the capacity of water production facilities remained constant (from 1990 to 2009 was 9500 m³/day, but after 2009 increased to 13152 m³/day) although the number of connected inhabitants increased. Household specific consumption is 89,7 l/person day from 152,20 l/person day of the total specific consumption, and the amount of water supplied decreased from 1360 thousands m³ (911 m³ for household use) in 2000 to 754 m³ (442 m³ for household use) in 2010, although the number of people connected is larger.

Decreased water consumption is also reflected in the debit of the wastewater treatment plant, so from 6912 m³/day in 1993 decreased to 2840 m³/day in 2004. The cleaning of the waste water is made through the mechanic-biologic purification station with a debit of 80 l /s.

The network distribution of drinking water presents a high wear, it dates from 1938 and some sections from 1960 (according to *Local Agenda 21 – Sustainable development plan of Vatra Dornei*).

Following the above, although the sewerage system of Vatra Dornei had grown steadily over the past 20 years (Fig. 1), it is unsatisfactory in relation to the length of drinking water distribution network and with the number of inhabitants.

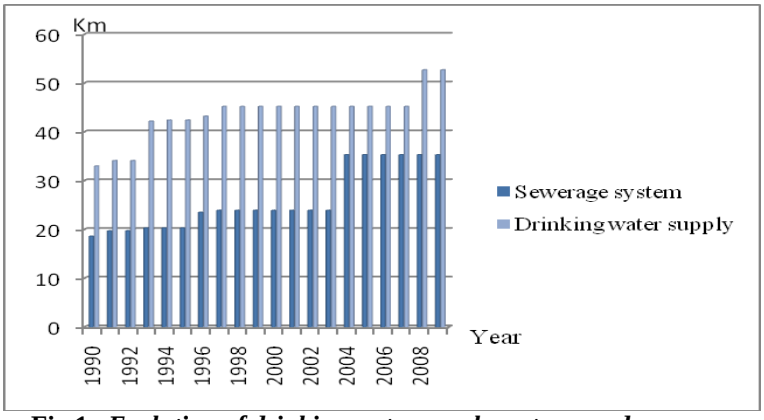

Fig.1. ***Evolution of drinking water supply systems and sewerage systems in Vatra Dornei (1990-2009)***

Dysfunctions outlined for Vatra Dornei city refers to the degree of connection of inhabitants to the drinking water supply system, sewerage system and to the degree of wear of the networks and of the wastewater treatment plant.

For the rural localities the situation is more delicate, because from 9 communes just 4 are connected to the drinking water supply systems (Dorna Arini, Dorna Candrenilor, Iacobeni, Șaru Dornei) and 2 are connected to the sewerage systems (Iacobeni, Șaru Dornei). We have to take into account that not all households from the analyzed communes are connected to the two systems (eg.

from 827 households from Iacobeni just 547 are connected to the drinking water supply system and 404 to the sewerage system) (according to *The strategic plan 2007-2013 of socio-economic development of Iacobeni locality*).

From all the 4 communes connected to the drinking water supply system, Dorna Arini is an atypical case because the drinking water supply system is private, there are no public networks. The network was created by the association of some households who have created their own water distribution network (from the capture of water from springs, to the storage of water into concrete tanks and to the distribution networks). The length of drinking water supply system in 2010 was 18,2 km. The commune is not connected to the sewerage system, thus the waste water is discharged into septic tanks that are at every household that is connected to the drinking water supply system.

The households that are not connected to the drinking water supply system ensure their water needs from wells, springs, or from the river, and the wastewater discharge is made on the ground or in some cases into the river courses.

For water demand in case of fire, they have made access ramps at the water courses (those with a constant flow throughout the year) (according to *The strategic plan 2007-2013 of socio-economic development of Dorna Arini locality*).

The wastewater treatment plants which serve the rural areas are located in Iacobeni and Neagra Şarului (both are not modernized), another one is located in Dorna Candrenilor but it is not finished. For the two wastewater treatment plants there are projects for upgrading them using E.A.F.R.D.[3] and N.R.D.P.[4] programs.

The increase length of drinking water supply system and sewerage system was mainly due to accessing of European funds.

Şaru Dornei commune has made projects for the expansion of the drinking water supply systems, sewerage systems, upgrading of the wastewater treatment plants and of the water supply systems (capture and distribution of water) in Gura Haitii, Sărişor, Sărişoru Mare, Şaru Bucovinei, Şaru Dornei localities through Measure 322[5] (E.A.F.R.D.) (ongoing); Dorna Candrenilor commune had accessed European founds using N.R.D.P. to achieve the wastewater treatment plant and the sewerage system which will be connected to 120 households (ongoing); Iacobeni commune through Measure 322 accessed European founds to achieve the drinking water supply system, the sewerage system and the upgrading of the ones that exists (Ciotina-Ionascani-Dandoaia, Mestecăniş area, the Civic Center and Minelor street) and for upgrading the existing wastewater treatment plant and to achieve a new one (ongoing).

An european project for the training and awareness of population on the importance of water, of its use and the implications regarding the existence of a modern drinking water supply system and a sewerage system, was conducted in

[3] E.A.F.R.D. – European Agricultural Fund for Rural Development

[4] N.R.D.P. – National Rural Development Programme

[5] Measure 322 - "*Renovation and development of villages, the improvement of basic services for the rural economy and population and the protection and conservation of the rural heritage* " frames under **Axis III –** *„Quality of Life in rural areas and diversification of the rural economy"*

Coşna and Dorna Candrenilor commune by U.N.D.P. and Coca-Cola, project that lasted one year. The result of this project was the achievement of a pre-feasibility study for both communes, projects that will be oriented to accessing eligible European founds (to achieve the drinking water supply system and the sewerage system) through European Agricultural Fund for Rural Development (according to *„Every drop matters"*).

The indicators analyzed in the study describe in the first place the exclusion of population from adequate housing conditions. The dysfunctions regarding the drinking water supply system and the sewerage system are more pronounced in rural areas where the percentage of people connected to these systems is below the European average.

3. MEASURES PROPOSED FOR THE REDUCTION AND REMOVAL OF THE EXISTING DYSFUNCTIONS

For the improvement of the existing dysfunctions regarding the drinking water supply systems and the sewerage systems in the Land of Dorna, first of all is necessary achieving the

drinking water supply system and the sewerage system in the localities that are not connected to this systems: Cârlibaba, Ciocăneşti, Coşna, Panaci, Poiana Stampei.

Also, for sizing the correct volume of water and the sewerage capacity is required a forecast about the evolution of population so we can ensure the water needs for a 20-25 years horizon (according to *Order no. 161 of 15 / 02/2005 for the approval of the technical regulation "Guidelines for design, construction and operation of water works and sewerage in rural areas", indicative GP 106-04*, published in Official Gazette, Part I no. 338 of 21/04/2005).

Viable technical infrastructure projects involve certain studies to determine the vulnerability of the drinking water supply systems, sewerage systems to various events that could threaten their ability to achieve specific goals. This can be achieved by modeling the future drinking water supply systems and the sewerage systems using specialized software to simulate certain scenarios: emptying the tanks, minimum⁄maximum pressure, low speed⁄high maximum allowable, the action of endogenous and exogenous factors, transit flows etc.

Another essential component to ensure water requirements represent measures aimed at quality of water. Ongoing monitoring of surface water quality is achieved according to I.M.W.S.R.[6] Bistriţa river falls into the I category (STAS 4706/1988) regarding the next indicators: CCO-Mn, O_2, fixed residue. Regarding the metal indicators (manganese, iron, zinc etc.) the river falls into the III category, due to the Tolovanu mining and the specific composition of the substrate. Dorna river fall into the first category for all the parameters.

[6] I.M.W.S.R. - Integrated Monitoring Water System in Romania

The main source of water pollution in the Land of Dorna have been mining targets (exploitation from Călimani Mountains, Iacobeni, Gura Haitii etc.) currently activities are suspended.

Another measure to be enforced is the rehabilitation of existing networks, that are physically degraded, through works of re-lining, reconsolidation, making of new locks, parallel disposal of some networks etc. (these actions are included in the objectives within the social-economic development strategies of Vatra Dornei, Iacobeni, Dorna Arini).

In figure 2 we can see the current situation regarding the drinking water supply system and sewerage system as well as the proposals for these systems. The used symbols for the proposal part refers to all the villages that are not connected to the two systems, but for the readability I only put symbols in the shared centers.

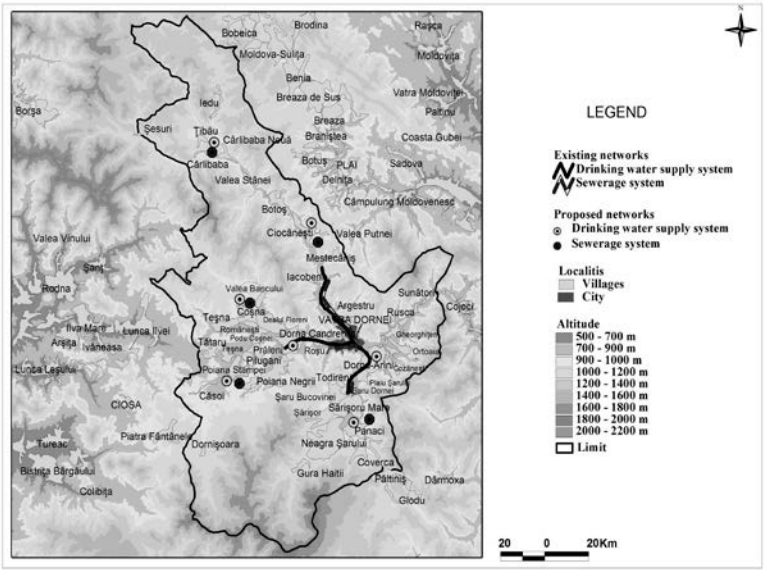

Fig. 2: ***The map of the drinking water supply systems and sewerage systems from the Land of Dorna***

4. CONCLUSIONS

Distribution of drinking water supply systems and sewerage systems in the Land of Dorna is uneven. The analysis shows that the V-E axis is the most developed in this regard. Thus, the northern and southern areas of the territory have major dysfunctions regarding the drinking water supply systems and the sewerage systems.

It requires some measures on improving drinking water supply systems and sewerage systems in the localities that already have such systems and their implementation in the 5 communes in which there are not.

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11. *** P.N.U.D. – Programul Naţiunilor Unite pentru Dezvoltare, [U.N.D.P. – United Nations Development Programme].
12. *** Măsura 3.2.2. „Renovarea, dezvoltarea satelor, îmbunătățirea serviciilor de bază pentru economia și populația rurală și punerea în valoare a moștenirii rurale" încadrată în axa III „Calitatea vieții în zonele rurale și diversificarea economiei rurale", [Measure 322 - "*Renovation and development of villages, the improvement of basic services for the rural economy and population and the protection and conservation of the rural heritage* " frames under Axis III – „*Quality of Life in rural areas and diversification of the rural economy*"].
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