

DETERMINATION OF AGGLOMERATIONS IN THE PRUT RIVER BASIN OF REPUBLIC OF MOLDOVA ACCORDING TO EU DIRECTIVE 91/271/EEC

Livia NISTOR-LOPATENCO, Associate Professor, Ph. Dr. in Engineering – Technical University of Moldova, livia.nistor@fcgc.utm.md

Alexandru TABACARU, PhD student, Academy of Economic Studies of Moldova (University), tabacarualex@yahoo.com

Abstract: *The purpose of this research consists in determining the Agglomerations in Republic of Moldova according to the EU Council Directive 91/271/EEC of 21 May 1991 for cities with populations between 2000 and 10000 P.E. The main topics presented in this paper are: 1) identifying the population dynamics; 2) spatial distribution of the settlements 3) identifying economic agents in the area. To achieve these objectives were used methods established already in the EU Council Directive 91/271/EEC of 21 May 1991.*

Keywords: *EU Directive 91/271/EEC, Agglomerations, Prut River of Moldova*

1. Introduction

Following the signing of the Association Agreement with the EU in 2014, the Republic of Moldova has the obligation to transpose the European Directives into Moldovan legislation.

Thus, has to be implemented the Directive 91/271 / EEC – on Urban Wastewater Treatment, which foresees the creation of Sensitive Areas and Urban Agglomerations - should be implemented to optimize spending and the efficiency of the wastewater treatment process. So far this Directive is not transposed yet and this article has the intention in contributing to its implementation.

In Republic of Moldova, the water supply network construction process in the last years has seen a substantial increase with the money from the Moldovan National Ecological Fund but also from external donors such as GIZ, SDC / ADA, Czech Development Agency and SlovakAid. In particular, there is a project undergoing between the SlovakAid and Water Research Institute from Bratislava where these Agglomerations are being identified. Unfortunately, this increase in water supply networks has not been followed by an increase in sewerage networks and waste water treating stations due to high economic costs. This research aims to determine geographic locations where these Agglomerations between 2000-10000 PE will be created to reduce the costs of implementing sewerage and wastewater treatment projects.

Thus, in Moldova, in 2013, the percentage of the sewage network per region is 60 %. The Scope of this research article consisted in the fact of identifying possible Agglomerations in the Northern Region of the Prut River Basin according to the EU Council Directive 91/271/EEC requirements for agglomerations between 2000 and 10 000 PE (Population Equivalent). The definition of the *Agglomeration* is "an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point";

The Objectives of this research are:

- Determining the population number change in the studied region.
- Identifying the distances of less than 500 m between different settlements that might compose an Agglomeration
- Identifying the presence of Water Supply and Sanitation infrastructure in each settlement and within which River Basin.

The expected results were to identify the Agglomerations according to Directive 91/271 / EEC – on Urban Wastewater Treatment in the Northern Area of Prut River Basin side from the Republic of Moldova’s territory.

2. Study area

The study area is the basin of the Prut River, which is the second largest basin in the Republic of Moldova, after the Dniester Basin [10].

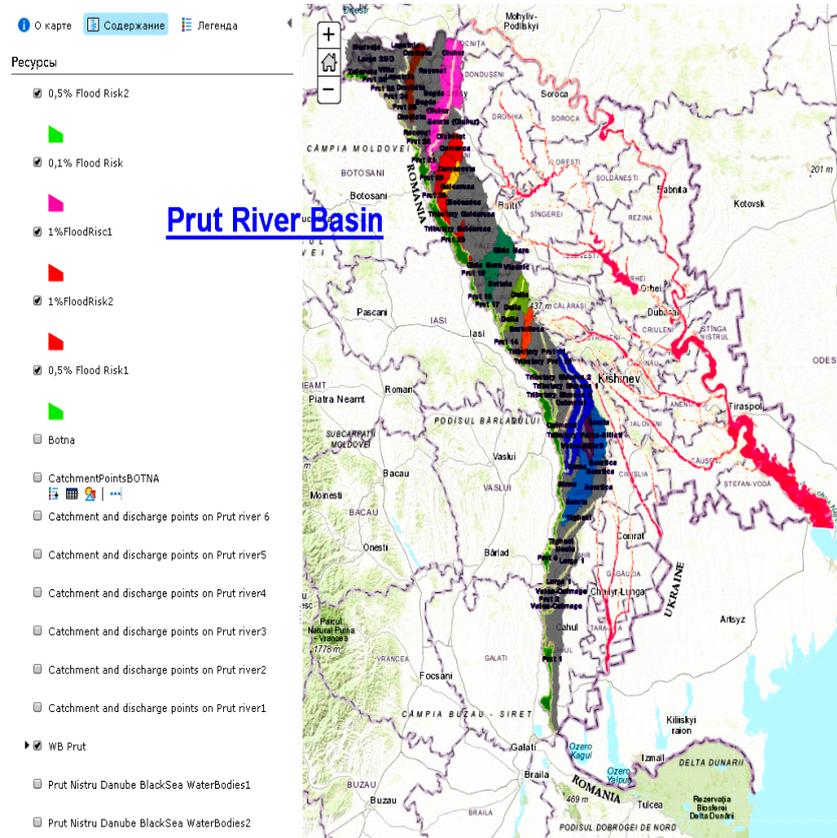


Fig 1. River Sub-Basins in Prut River Basin from Moldovan side. Posted by the author on- <http://dbga.md/siga.html>

The Prut River (Fig.1) is one of the largest rivers in Western Ukraine, the Republic of Moldova and Romania, also is one of the main tributaries of the Danube River. The Prut hydrographic basin is a crossing by three countries. Of the total area of the basin, 28% belongs to the territory of the Republic of Moldova, 33% in the territory of Ukraine and 39% in the territory of Romania. The Prut River springs from the south-western slope of Mount Hoverla, about 15 km south-east of the Vorokhta village, from the Cernahora massif of the Carpathian Mountains, and flows into the Danube River, south of the village of Giurgiulesti,

164 km from the mouth of the Danube. The Prut River has a length of about 967 km and the surface of the river basin is 27 540 km² [9].

3. Theory and methodology

The present research is based on recent analytical studies that were implemented in the Slovak Republic by the experts from the Water Research Institute in Bratislava according to the Council Directive 91/271/EEC concerning urban waste-water treatment [1].

The before mentioned experience was used in the Prut river Basin research that is presented in this research article.

The main methods, which are used in this study are: statistical, analytical, cartographical, Geographic Informational Systems as well as consultation with competent authorities in the field of assessing and managing of water resources. Statistical method was widely used in processing of statistical information on the population living in the settlements in Republic of Moldova as for 2004 and 2014. The analytical method was used for: a) to identify the population changes in the past decade; b) diagnosis of situation of the water sector projects financed by the National Ecological Fund;

The cartographical method was done by measuring the distance between the settlements which fall under the rule of the CD 91/271/EEC of less than 500 m distance between 2 different settlements. The tool for measuring the distances was www.geoportal.md and Google Maps.

The main informational and statistical support of this study included: 1) Population Census for 2004 and 2014 of Republic of Moldova from the National Bureau of Statistics [2]; 2) Annual Reports of National Ecological Fund of Moldova [4]; The study comprised the 2004-2014 years.

The cartographical method consisted in using ArcMap 10.2 GIS software for digitizing Orthophotos from www.geoportal.md with the analysed settlements.

3.1. The analysis of the population for 2004 and 2014

Was studied the municipalities in the Prut river basin with a population of between 2000 and 10,000 inhabitants. For this, the website www.statistica.md was analyzed and downloaded the existing data of the 2004 and 2014 population census. The difference between these years was then calculated to observe the localities where there was an increase in order to see the population trend.

As a result, the following data was recorded in the Northern part of the Prut river basin:

- Glodeni district lost 9669 inhabitants, out of the 35 localities, there were only increases in Balatina (865 persons), Cuhnești (806), Camenca (668), Viișoara (261), the rest being recorded losses.
- The Singerei district lost 7339 inhabitants, out of 78 localities, there were significant increases in the population in Alexăndreni (4118 persons), Bălășești (581), Biliceni Noi (1036), Dumbrăvița (622), Grigorăuca (836) Pepeni (1179), Țambula (941).
- Rîșcani district lost 10228 inhabitants, from 61 localities, there were significant increases in the population in Costești (1260), Braniște (772).
- Briceni district lost only 998 inhabitants, out of 38 inhabitants, there were significant increases only in Bogdănești (660).

- Edinet district lost 8541 inhabitants, from 49 localities, there were significant increases in Bleșteni (569), Vancicăuți (1160), Cuconeștii Vechi (1860), Parcvoa (673), Zăbriceni (917).
- Falesti district lost 12062 inhabitants, from Ciolacu Nou (1753), Ișcălău (1349), Natalievca (1416), Sărata Veche (1158) from 75 localities.

In a summary, there is registered a decrease in the population living in the region which urges for National Stakeholders to take decisions to optimize the design of new sewage systems for the possible new agglomerations.

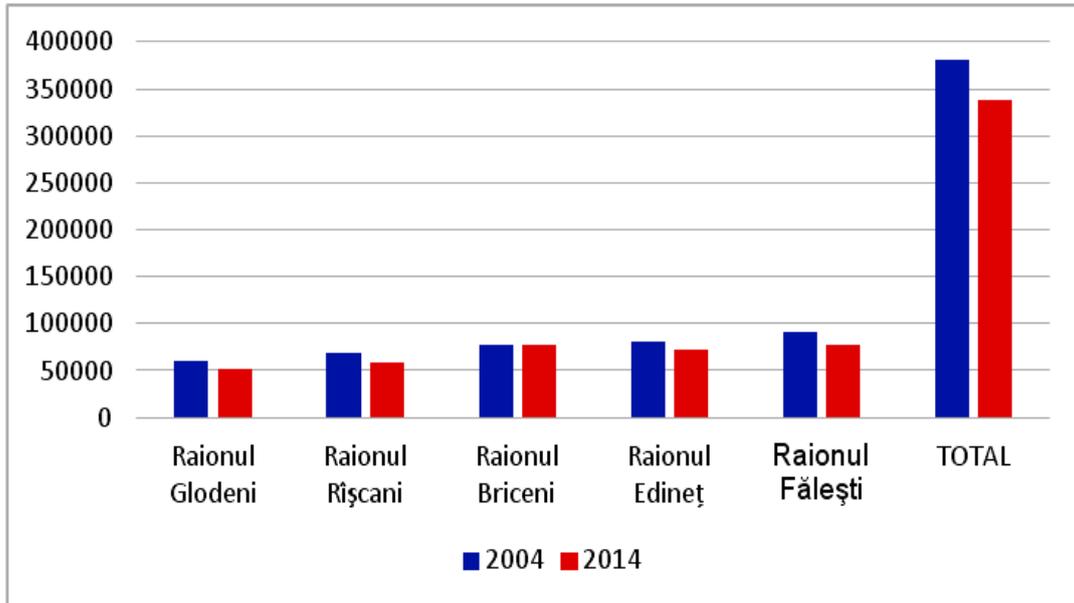


Fig 2. Comparison between the population change in the Northern Regional Development Agency of Moldova within the Prut River Basin for the years 2004 and 2014. Source: National Bureau of Statistics of Moldova [3]

At the same time in the central part of the Prut River Basin were discovered the following results:

- Hincesti district consists of with 63 settlements with a total population number of 103704 inhabitants, of which a negative trend of population dynamics was registered in 53 settlements. The villages with the biggest losses were: Draguseni (-1286), Cărpineni (-1596), Horjești (-956).
- Nisporeni district with 39 settlements and with a total population number of 53154 inhabitants. Nineteen out of 39 have registered a negative trend in population dynamics
- Ungheni district consists of 101064 inhabitants and 74 settlements. Seventeen villagshave registered a negative trend in the population dynamics.

In the southern part of the Prut river basin:

- In Cahul district there are registered 55 settlements with a total number of population of 105324 inhabitants. Twenty two have registered a negative trend.
- The Cantemir district 52115 has inhabitants and 51 settlements. Corpesti and Sadici have a negative trend in population dynamics. Thirteen have registered a negative trend in the population dynamics.
- Leova district has 40 settlements and 44702 inhabitants. Tigheci settlement has registered a negative trend in population dynamics.

3.2. Analysis of the money allocated from the National Ecological Fund of Moldova for the period 2011-2017

The next step was the analysis of localities with a water supply and sanitation network. For this, the website of the National Ecological Fund (FEN) was accessed and localities were analyzed on the districts where investments were made in the construction of the networks.

In the northern part of the Prut river basin:

- Thus, in Falesti it was found that 44 localities out of 75 had a project implemented in the field of Water Supply and Sewerage.
- In Edineț district, out of 50 localities, 29 had any project implemented in the field of Water Supply and Sewerage.
- In Briceni district, out of 39 localities, 22 had a project implemented in the field of Water Supply and Sewerage.
- In Rîșcani district, out of 54 localities, 32 had any project implemented in the field of Water Supply and Sewerage.
- In Singerei district, out of 70 localities, 44 had any project implemented in the field of Water Supply and Sewerage.
- In Glodeni district, out of 35 localities, 13 have had a project implemented in the field of Water Supply and Sewerage.
- In the central part of the Prut river basin:
- Hincesti district consists of with 63 settlements, 24 had any project implemented in the field of Water Supply and Sewerage.
- Nisporeni district with 39 settlements, 8 had any project implemented in the field of Water Supply and Sewerage.
- Ungheni district consists of 101064 inhabitants and 74 settlements, 22 had any project implemented in the field of Water Supply and Sewerage.
- In the southern part of the Prut river basin:
- In Cahul district there are registered 55 settlements, 6 had any project implemented in the field of Water Supply and Sewerage.
- The Cantemir district 52115 has inhabitants and 51 settlements, 4 had any project implemented in the field of Water Supply and Sewerage.
- Leova district has 40 settlements, 6 had any project implemented in the field of Water Supply and Sewerage.

3.3. Sewage system availability in Moldova

In Moldova, there is a big difference in the availability of sewage system between Chisinau and the rest of the country: In big cities such Chisinau and Balti the percentage is of 96.7 % and in rural area is slightly above 41 %, which is twice less. For more details, please check the table below.

Table 1. Equipping of households with aqueduct, hot water and sewage system in Moldova, by statistical areas, %, 2013

	Chișinău	North	Center	South
Public water supply network	96.5	39.2	46.7	68.2
Sewer system	96.7	41.3	46.9	55.2

Source: <http://statbank.statistica.md/pxweb/Dialog/Saveshow.asp>

4. Determination of Agglomerations using Geospatial technology

Using Google Maps, the distances between human settlements with a population of 2000-10000 inhabitants have been calculated. Thus, according to Council of Europe Directive 91/271 / EEC on waste water treatment, the distance between human settlements should not be more than 500 m, if we are to consider in creating Agglomerations.

Thus, the following *Agglomerations* were proposed in the northern part of the Prut river basin:

- Agglomerations identified in the Central part of the Prut river basin;
- Agglomerations identified in the Northern part of the Prut river basin.

In Glodeni district 10 Agglomerations, in Riscani district 8 Agglomerations, in Briceni 12 Agglomerations, in Edinet 7 Agglomerations, in Falesti 8 Agglomerations. More detailed information is available in the Annex 3.

The first proposed Agglomerations for the detailed economic analysis are located in the Falesti district, close to the Romanian border, which consists of the settlements of Calinesti, Hincesti and Chetris with a total population of 5012 inhabitants in 2014.

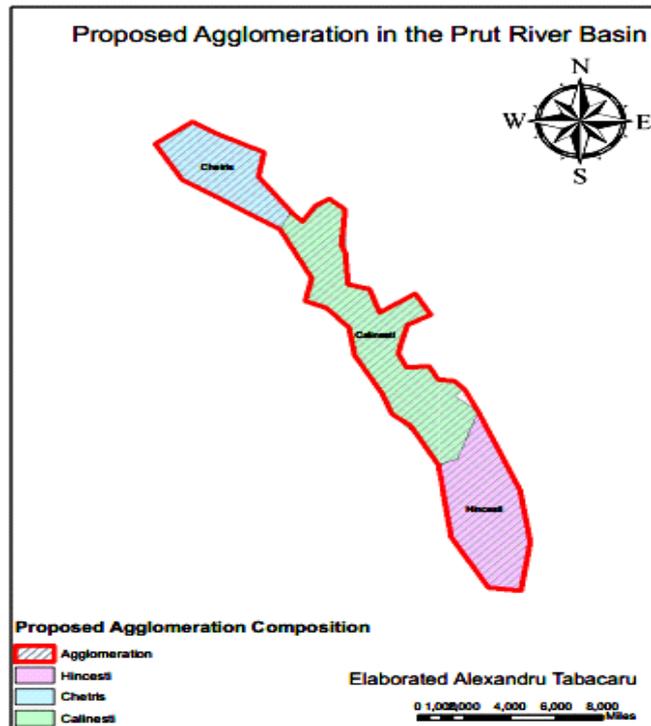


Fig 3. Proposed Agglomeration consisting of Settlements of Calinesti, Hincesti and Chetris Elaborated by the author from the www.geoportal.md

This proposed agglomeration is located in the Prut cross-border hydrographic basin and the Camenca sub basin. Next to a Forest reservation.

According to the table below, it can be noticed that in this proposed agglomeration there is already a water supply, sewerage system and a sewage treatment plant that has been granted with the financing from the National Ecological Fund of Moldova.

Table 2. Characteristics of the first proposed Agglomeration

River Basin	Sub basin	Name of Settlement	No. of inhab. 2004	No. of inhab. 2014	Difference 2014-2004	Composition of agglomeration	Note
Prut	Camenca	Hîncești	1155	1009	-146	Hîncești/ Călinești-20 m	Water suppl. Contract No.3/4227 - 5144
Prut	Camenca	Călinești	2821	2521	-300		Water supply...sewage...Contract No..2/3688 - 5164, 3/3560 - 4973
Prut	Camenca	Chetriș	1697	1482	-215	Chetris/Călinești-50 m	Water supply, sewage, treatment Contract No.3/3830-5280, 4/4063 - 5420, 1/3326 - 46431/3326 - 4643, 3/3556 - 4938

Elaborated by the authors. Sources: www.statistica.md, www.geoportal.md, Environmental Fund

Second proposed Agglomeration proposed, situated in the Riscani district and consist of the settlements of Saptébani, Malaiești, Galaseni with a total population of 3741 inhabitants and slowly increasing.

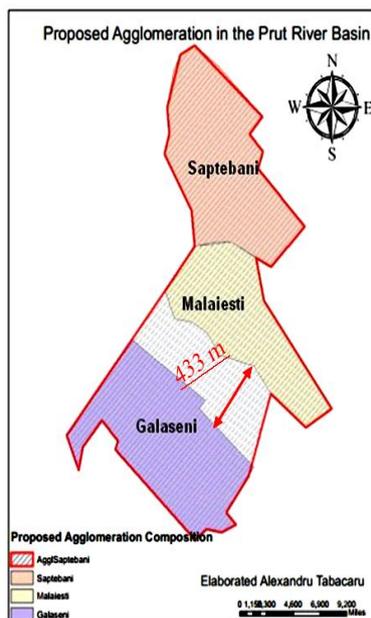


Figure 4. Proposed Agglomeration consisting of Settlements Saptébani, Malaiești, Galaseni settlements. Elaborated by the author from the www.geoportal.md and Google Maps.

According to the National Ecological Fund, these settlements have water supply and sewage system, but no treatment plant. They all are situated in the Camenca Sub Basin, Prut transboundary river basin.

Table 3. Characteristics of the second Agglomeration consisting of Gălășeni, Mălăiești and Șaptebani

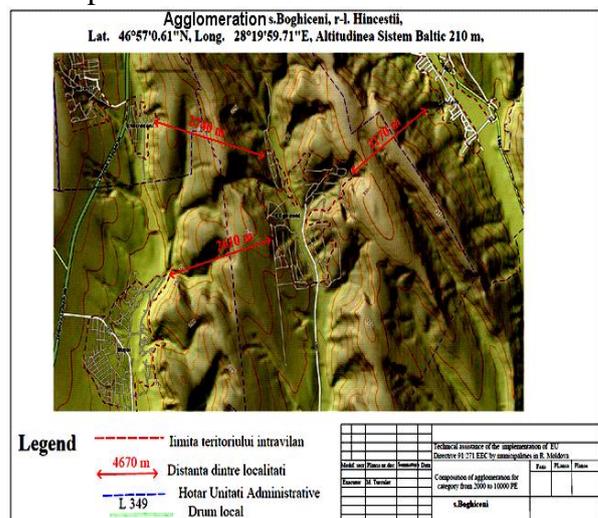
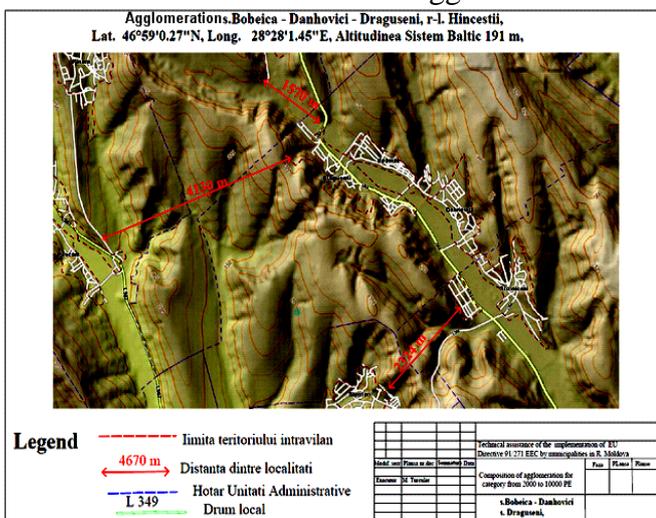
River Basin	Sub basin	Name of City (villag)	No. of inhab year 2004	No. of inhab year 2014	Difference 2014-2004	Composition of agglomeration (distance km)	Note
Prut	Camenca	Gălășeni	1075	1533	458	Gălășeni/Malaești-433m	Water supply..Contract No.3/3592 - 4914
Prut	Camenca	Mălăiești	743	743			
Prut	Camenca	Șaptebani	1740	1465	-275	Gălășeni/Șaptebani-0m	Water supply and sewage...Contract No.5/3178 – 4502
TOTAL				3741			

Elaborated by the authors. Sources: www.statistica.md, www.geoportal.md, Environmental Fund

In the above table nr.3 one can see that the population of the proposed Agglomeration was of 3741 habitants in 2014, they all are situated in the same River Sub-basin of Camenca and the distances between them was less than 500 m, also they had Water Supply and Sanitation which was provided by the National Environmental Fund of Moldova.

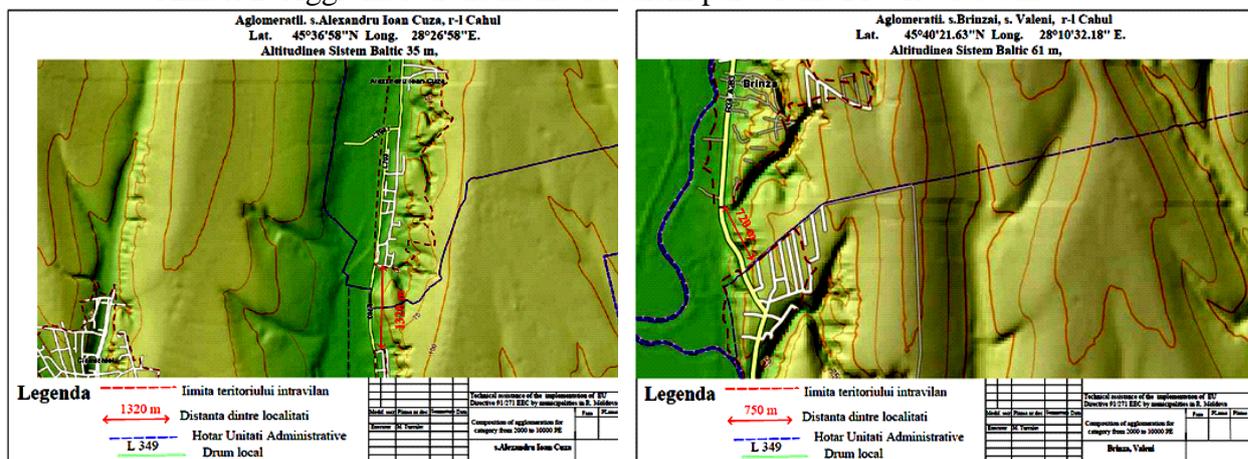
- Agglomerations identified in the Central part of the Prut river basin. In Hincesti district 18 Agglomerations, in Nisporeni 7 Agglomerations, in Ungheni 10 Agglomerations.
- The maps with the Agglomerations detected in the Central part of the Prut river basin are presented in the Annex 1.

Annex 1. Agglomerations in the Central part of the Prut river basin



- Agglomerations identified in the Southern part of the Prut river basin. The maps with the Agglomerations detected in the Southern part of the Prut river basin are presented in the Annex 2. In Cahul district were identified 9 Agglomerations, In Cantemir 9 Agglomerations, in Leova district 6 Agglomerations.

Annex 2. Agglomerations in the Southern part of the Prut river basin



5. Conclusions

The agglomerations which were first defined in “Directive 91/271 / EEC – on Urban Wastewater Treatment“ represent a useful tool in order to optimize the expenses on water supply and sanitation system in Moldova because of the big financial lacks. Especially when it is noticed a decrease of the population number in the past 15 years and with the trend continuing in the same direction. This information is very useful for a number of reasons, which are obvious; first of all, in order to design the water supply and sewage systems, one needs to know the diameter and the extension of the pipes, also it is desirable to know how many people would be interested in getting connected to these systems, because not everybody can afford to do so because of many reasons.

It was also taken into account the river catchment factor, which resulted to be important because “The best model for a single system of water management is management by river basin - the natural geographical and hydrological unit - instead of according to administrative or political boundaries” [7], also because it is easier to assess the pressures that have an impact on each water body.

This article, represents only the beginning in transposing the “Directive 91/271 / EEC – on Urban Wastewater Treatment“ into Moldovan legislation and represents a process that will take many years until it will be finally implemented by the authorities when it comes to planning of the water supply and sewage networks.

6. References

1. *The Council Directive 91/271/EEC concerning urban waste-water treatment* <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31991L0271;>
2. <http://dbga.md/districtprut.html> (consulted on 03-01-2018);
3. [http://www.statistica.md/;](http://www.statistica.md/)
4. <http://mediu.gov.md/index.php/serviciul-de-presa/noutati/79-categorii-in-romana/despre-minister/institutii-subordonate/72-fondul-ecologic-national;>

5. http://www.statistica.md/public/files/publicatii_electronice/Note_analitice_teritorial/Nota_Canalizare.pdf (consulted on 03-03-2018);
6. www.geoportal.md (consulted on 03-03-2018);
7. http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm (consulted on 29-03-2018);
8. www.apemoldovei.gov.md (consulted on 29-03-2018);
9. *Rapoartele anuale privind calitatea factorilor de mediu și activitatea Agențiilor și Inspecțiilor Ecologice (2007-2016)*;
10. *Danube River Basin Management Plan on: www.icpdr.org/main/publications/danube-river-basin-management-plan.*