DRINKING WATER, A PROBLEM OF SUSTAINABLE DEVELOPMENT OF THE CITY WE LIVE IN. CASE STUDY

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Abstract:
The need of a more rigorous control of the quality indicators parameters is the subject of this study. The potential factors of pollution have decreased in number and intensity that does not mean that there is no need in controlling them. Firstly, I aim to highlight the fact that the drinking water supplied to the inhabitants of Suceava city, where I live, meets the quality standards imposed by law, according to the European legislation, and, secondly, I want to clarify some issues that raised questions in people's minds relating to water use, water quality supply in different areas.

Keywords: water, drinking water, sustainable development, pollution

JEL Classification: Q 53

WHY DO WE NEED WATER?

The water is a basic and indispensable constituent of the human body. Small changes lead to serious disorders and the insufficiency of water contribution is a lot less tolerated than the lack of other elements.

The percent of water in the human body varies depending on age: from over 97% at the 7 days fetus, and decreasing gradually at 80% at the new-born, 60-65 % at adults and 50-55% at old people. The water percentage varies depending on the intensity of the metabolic changes. This is reflected in the fact that water is spread differently in the human tissues: bone tissue 22%, knurled muscle 22%, liver 75%, kidneys 80%, brain (gray matter) 85%, sanguine plasma 90%, [5].

A man can resist up to 30 days without food, but only 4-5 days without water. Actually, the period of time depends very much on the state of health, age and physical effort etc., but first of all on the environment's temperature.

Why do we need water? While ONU stipulates a minimal consumption of only 50 liters of water per day that can be used for drinking, cooking, washing and sanitary use, billions of people around the world don't even have access to sources of drinkable or safe water that can be used for minimal sanitary use. In fact, a man needs around 100…200 liters of water per day: 4-4,5 liters for his basic

needs (2,5 liters to drink and 1,5-2 liters to prepare food), 13 liters to wash the dishes, 13-20 liters to wash laundry, 70-80 liters for sanitary needs (to wash your face and hands, shower, water to clean the toilet), [14].

The water problem can be handled in another way. Less than 0,007% of the Earth's water is drinkable. Even though 1/3 of the drinking water enters into our houses, it doesn't have as a point of destination its drinking. Millions of people have less than 15 liters of water per day, over a billion people don't even have full access to drinking water.

It is true that water covers most of our planet, but only 3% is soft water, which is mainly in the form of ice, and 97% of the Earth's water is marine water, too salty for human use. Out of the 3% of drinking water, 2% is in the form of icebergs and ice caps, thus leaving only 1% of water to be used by the population, [3].

In 1980 the problem of assuring the necessary level of drinking water for the worldwide population was officially solved: thus, Belgium 95%, Finland 79%, Sudan and Bangladesh 40%, Sri

Lanka 37%, Angola 28%, Paraguay 25%, Uganda 16%, Mozambique 9%, Mali 6%...The socialist countries pretended that their situation was the most favorable – Hungary 84%, Albany 92% and URSS even 100%(obvious overstatement).

The UNESCO report on water development (WWDR, 2003), from the Worldwide Water Evaluation indicates that,

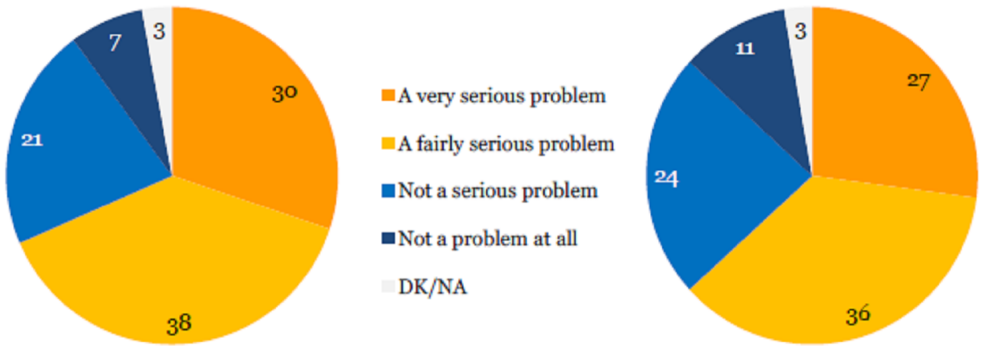


Figure 1.Perceived seriosness of water –related problems.
Flash eurobarometer on Water, [7]. a. How serious is the problem of water quality in your country? b. How serious is the problem of water quality in your country?

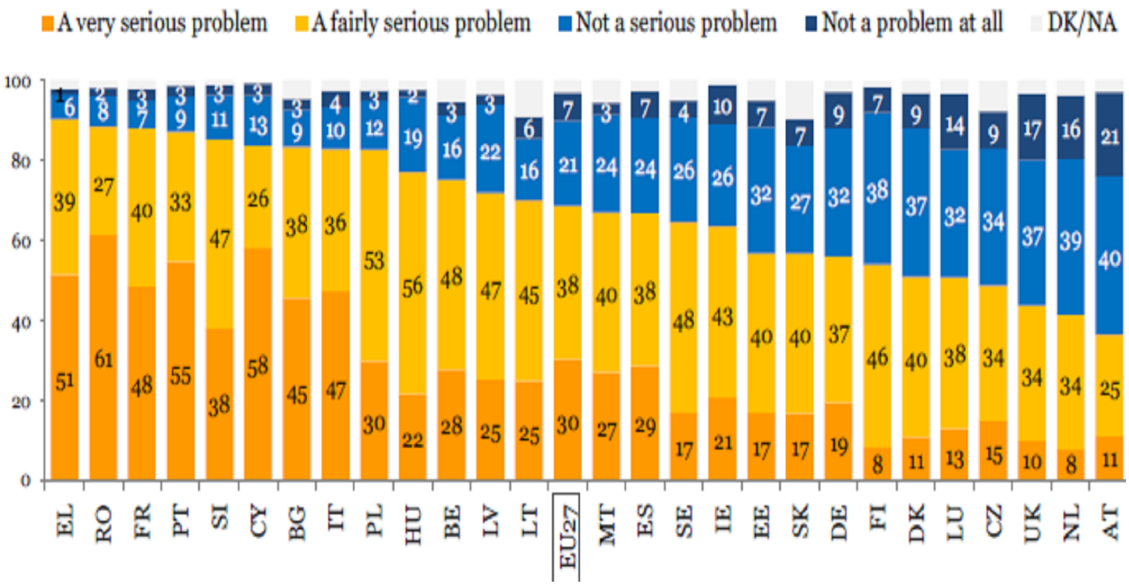


Figure 2- Seriosness of water –related problems, water quality.
Flash Eurobarometer on Water. Base all respondents % by contry, [7].

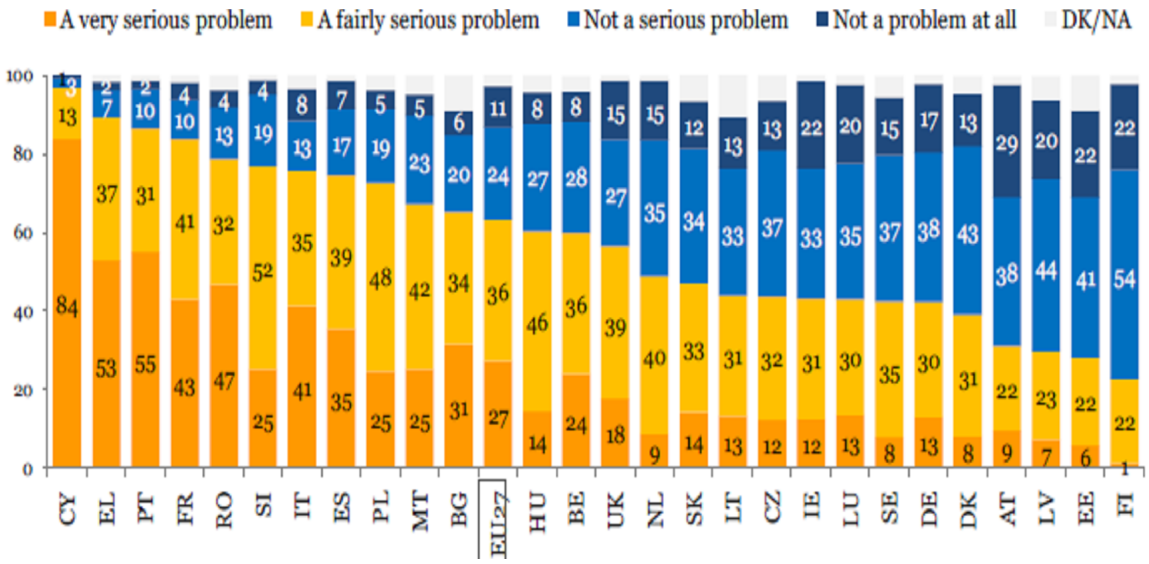


Figure 3. Seriosness of water–related problems, water quantity.
Flash Eurobarometer on Water. Base all respondents % by contry, [7].

in the next 20 years, the quantity of spare drinking water will decrease with 30%. 40% of the world's inhabitants don't have enough clean water for minimal hygiene. Over 2, 2 million people died because of the illnesses connected to infected water (over 2000) and because of drought. In 2004, an English organization called WaterAid, reported that a child dies every 15 seconds because of illnesses connected to water, that could easily be prevented, [5].

Together with this decrease in quantity, the deterioration of the water's quality constitutes another motif for the decline of spare water. Cholera, diarrhea, dysentery, E. Coli and salmonella contaminations, which are water transmitted, are known to be the reason for the loss of 5 million human lives each year in the developing countries, [3].

Water pollution could be the biggest user of water, by misspending this resource, disregarding the benefits it brings to the polluter. Even the purest water resources have become improper to consumption because the human activities and the industrial residual waters have become polluted and contaminated.

Taking into consideration the limited character of water resources in general, and of drinking water, in particular, the consumption becomes controlled.

Drinkable water comes from subterranean waters or from surface waters and less from other resources. This situation will be maintained, because there are objective factors. For example, 85% of Terra's soft water is in ice caps, but we can't touch them because their diminishing means catastrophic increases in the level of oceans and seas.

This information that appeared in specialized books, on the Internet, in different national or international reports, determined a case study on the issue of water quantity and quality in Suceava city.

ROMANIA - COUNTRY OF THE EUROPEAN UNION. THE PROBLEM OF DRINKING WATER

Romania's territory has all types of soft water resources (rivers, lakes and water from subterranean areas). Its largest soft water resource comes from the Danube and from the interior rivers. Natural lakes, even though there are many lakes in Romania (3450), have an insignificant contribution to the volume of soft water resources in Romania. The total of hydrologic water

resources of interior surface waters in normal climatic conditions has a total of about $42x10^9$ m^3/year and the ones that come from the Danube of $170x10^9$ m^3 /year (when entering the country), [14]

Out of 21 million people, only 14,7 million people in Romania benefit from drinking water that comes from drainage (68%), out of which 11,3 million people are from the urban environment (a figure that represents 77% of the population supplied with water and 98% of urban population) and 3,4 million in the rural environment (a figure that represents 23% of the population supplied with water and 33% of the rural population), [3].

A study done in January-February 2009 in many countries of the European Union indicates the people's preoccupation with the water's quantity and quality. Published in Flash Eurobarometer on water, this study underlines the increased interest that people have when it comes to drinking water, but also to water as an environmental factor, [7].

As it can be noticed, there are few people that consider themselves well informed, but there are also those that don't consider themselves informed when it comes to the water issue – rivers, lakes or coastal waters. Many people think they are well or not so well informed in this field, the percentage being different from state to state.

In Romania, as one can see, the situation is not so different. Only 6% of the people who answered the questions consider themselves very well informed, 53% consider themselves not so well informed, 24% consider themselves "well informed", and 16% consider themselves uniformed.

When it comes to the water's quality and quantity the citizens' perception is interesting; the percentage of those that consider that this is a problem in their country is pretty high, as you can notice in figure.1. Detailed on member states, it can be noticed the people's interest regarding this issue, figure.2.

It can be noticed that when it comes to
the water's quality, the Romanians are among the most worried European citizens (61%), figure.2; people are less concerned, but nevertheless concerned, about the quantity of water that we have, figure.3, [7].

The Ministry of Environment organized on the March 18th 2009, the National Conference *"We invest in waters, we believe in the future"*. The members wanted to emphasize improvement solutions of the water infrastructure through the implementation of environment projects carried out in the main intervention fields – Priority Axis 1 ("Expansion and Modernization of water and used water systems") and Priority Axis 5 ("Improving the infrastructure that prevents natural risks in high risk exposed areas"), [15].

CASE STUDY. DRINKING WATER IN SUCEAVA

Subterranean waters have a quality that allows their direct use as drinking water, without adaptation. Water that comes from other sources, like surface waters, needs to be adapted in order to make it potable. This implies a complex of processes named currently preparation or water treatment.

Here are the conventional methods of water treatment: deposition, congealment, filtering (physical or biological), and then disinfection. There are also used optional processes like: mineralization, demineralization, deactivating, mechanic flocculation.

Advanced methods of water treatment comprise the following: adsorption, aeration, filtering receptacle, electro dialysis, reverse osmosis, distillation, freezing, ultra filtering, ultra-violets.

There are no practical applicable methods to purge a certain substance. That's why we have to purge without discriminating entire classes of water components, not only the toxic ones, fact which leads to the removal of needed substances, higher costs and a lot of work, high consumption of reagents, frequent change of filters etc.

It is suggestive the fact that Suceava's oldest image, that was identified on tile from the XVth century (un-annealing tile, discovered in a house near Curtea Doamneasca), reflects accurately, by presenting a scenery specific for a medieval court, but a fountain also, sign that water wasn't missing from the premises.

And Suceava's Chair Citadel was provided with water from a basin (the so-called "tank", discovered in the citadel's inner court by Karl Adolf Romstorfer); archeological researchers found fragments of ceramic conduct, fact which proved that the citadel was supplied with water.

In 1836 a *"fountain with pomp was installed in the market of cereal fair"*, and later on the town hall started to become interested in the acquisition of various "*pump projects*". In 1906 Suceava's city hall made a contract with the firm "Theim und Sohne" from Leipzig in order to create an urban network for drainage and water supply. Within the same project, which ended after four years, the building contractor Georg Rumpel built the first "water plant" that had as a source of water supply (through electrically activated pumps) the Suceava river, fig. no. 4. A few years later, in 1914, the books wrote about the existence of a number of "30 public fountains with pumps" (with a network of conducts that had 24 kilometers), which "pumped everyday 1246mc of water". Until the beginning of the '60s the town's water supply was made through this abstraction, with 20 water wells dug in Suceava River's meadow, with a filtering and water treatment station that was pumped in a 600 m.c. reservoir. From 1960 the town used the 40 water wells abstraction from the Moldova river's bed, which was spread over 28 kilometers (Berchisesti – Suceava area), and in the industrial area we can find a new purge station.

Because the consumption of cold water expanded its metering and because some economic agents stopped their activity, the volume of sold drinking water indicates a decreasing tendency from year to year. The data published by the County's Institute of Statistics are presented in table no.1 entitled: the evolution of the volume of drinking water distributed to consumers.

Until the year 2008, the Suceava city was supplied by three water sources:

- *Berchisesti* – subterranean water source, situated at 26 kilometers from the town, with a capacity of 785 l/s. This source supplied at that moment 60% of the water consumption from Suceava and it was a very good water.

Table no.1. The evolution of the volume of drinking water distributed to consumers,[1].

City Suceava	Drinking water distribute to consumers	
	Total	out of which:
	(10^3 m^3)	for domestic use
2000	27689	12134
2001	24852	11872
2002	19928	9809
2003	21765	10138
2004	20945	9703
2005	19395	9649
2006	18913	9382
2007	17589	9290

Figure 4. Suceava's old water plant.

Figure 5. Water plant Mihoveni (decanter basin), [1].

- *Dragomirn*a – surface water source from a reservoir , situated at 8 kilometers from the town, with a capacity of 2390 l/s; the water is pumped by the local water supplier from the Suceava river into the Dragomirna reservoir.
- *Mihoven*i – surface water source, situated at 5 kilometers from the town, with a capacity of 320 l/s.

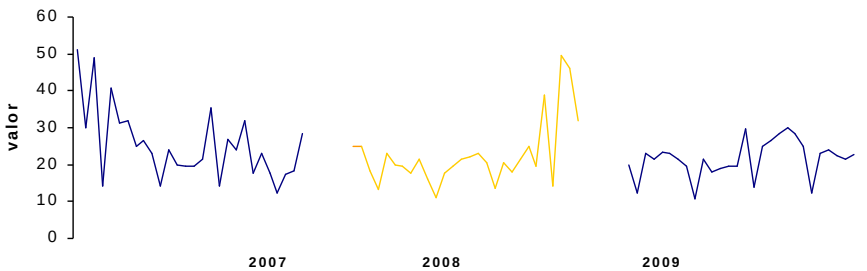
Starting with April 2008, the supply with drinking water from the Dragomirna water plant was has been stopped. Practically, now, the town Suceava is supplied with water from two sources: Mihoveni and Berchisesti.

The quality of the drinking water distributed in the town's network of water supply is verified, according to the law, both in S.C. ACET S.A Suceava laboratories and by the Suceava Public Health Directorate (DSP) that monitors the activity of the supplier. From this perspective, the following parameters are being monitored: chlorides, the pH, nitrite, ammonium, organic substances, and the free and cohesive residual chlorine – chemical parameters, escherichia coli and enterococcus – microbiological parameters and parameters indicators – coliformis bacteria, number of colonies at 22ºC and number of colonies at 37ºC [11].

The physical-chemical analyses department effectuates analysis on brute water (river water in the case of the Mihoveni source), decanted water, filtered water, drinking water and drinking water from the supply network. The results of the analyses from this laboratory dictate how the filters function, how the chlorine dosage is adjusted, as well as the water monitoring in the network supply.

The bacteriology laboratory effectuates bacteriological analyses of the drinking water and of the water from the supply network. The results of these analyses indicate if the installations need to washed or disinfected, as well as if the level of residual chlorine has to be changed in order to assure the quality of effectual regulations.

The results of the physical-chemical and bacteriological analyses form the basis of the efficiency calculations of the technological
process, with treatment points, as well as the
monitoring of the water's quality in the supply network. This is consigned to the analyses registers that are archived for certain periods of time. The frequency of analyses is increased every time it needs to be increased, both in the case of the number of analyses and in gathering places from the technological flow and the supply network.
The method of work used is the one with filtering membranes.

Source type	Parameter – chlorides [mg/l]
Surface water	

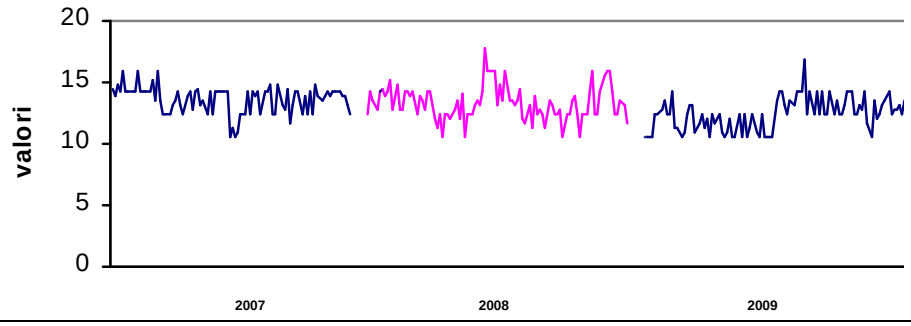
Subterranean water	

Figure 6. Content of chlorides variation in March of 2007,2008, 2009.

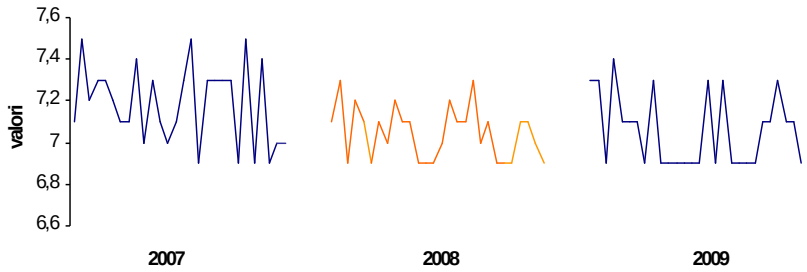
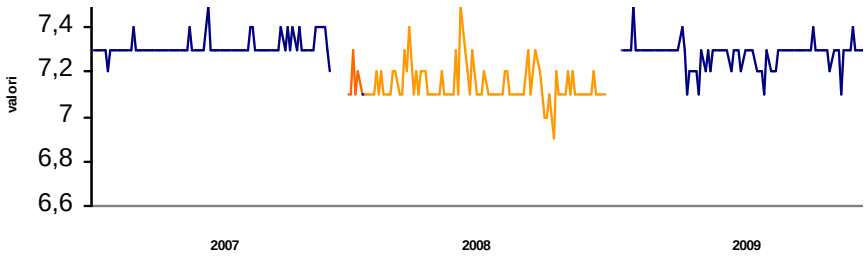
Source type	Parameter - pH
Surface water	
Subterranean water	

Figure 7. Ph variation of the water from the supply network in March of 2007,2008,2009.

To make the microbiological analysis, the samples that need to be analyzed must reflect the existent microbiological conditions in the moment of the gathering.
The samples' gathering is done in an aseptic environment, by using sterile utensils, containers for sterile collection, thus avoiding any external contamination.
It can be noticed that the variation of the
chloride content is much more abrupt on the surface water than in the subterranean water because of the climatic change, but it doesn't come anywhere near the maximum standard limit for this parameter, of 250mg/l. The values of the variation interval for surface water are between 15 and 50 mg/l, and for subterranean water the values are around 10-15 mg/l, figure 6, [1].

Source type	Parameter- oxidability(mg/l)

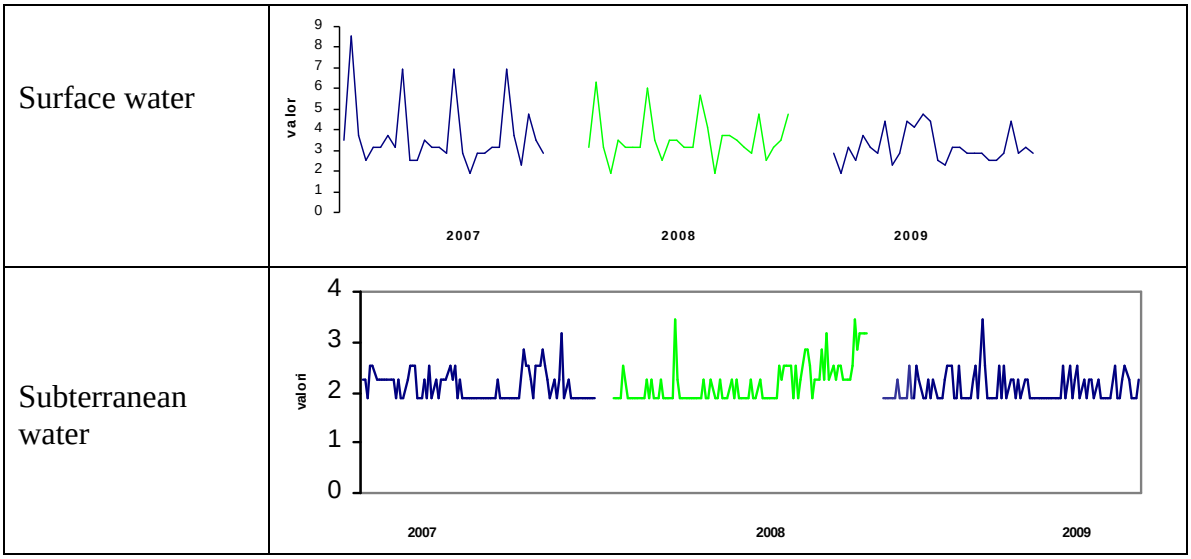


Figure 8. Evolution in time of the content of organic substances in March 2007,2008, 2009.

If for surface water the Ph variation is between 6, 9 and 7, 5 Ph unities (the standard limits are 6,5 and 9,5), the Ph for subterranean water presents intervals of constant values, together with small interval variations, 6,9….7,5 with emphasis on the 7,1 – 7,3 interval, figure 7, [1].

Similar to chlorides, the oxidability parameter presents different variations, depending on the type of water source. The variation interval for the values of water surface is between 2 and 8,5 mg/l – the maximum value permitted by the standard is of 12 mg/l, and for the subterranean is between 1,6 and 2,5, values which are well under the maximum limit, figure 8, [1].

CONCLUSIONS

Water quality control has been developed in the last century. Focused primarily on disinfection and filtering, this field was revolutionized in the last 30 years, when, because of public pressure, the chemical analysis became more complete and complex.

The last decades have underlined a great success in the development of procedures and technologies that allow the solving of the characteristics of the water's quality by assuring a balanced quality complex for drinking water, disregarding the pollution of resources. Also, the effectual regulations (The Directive of the European Economic Commission 98/83; the guiding values of the Worldwide Health Organization; Law no. 458/2002 concerning the quality of drinking water) want to assure a flexible, transparent legal frame by imposing both rigorous values for the quality indicators of drinking water and also a minimal control scheme that allows the achievement of consistent and comparable results. The pursued parameters are grouped into quality categories: organoleptic; physical-chemical; inorganic and organic, pesticides, disinfectants and disinfectants' sub-products.

The city-hall of Suceava takes interest in water management and the quality of water delivered to the public. The project "*The rehabilitation and modernization of the water supplies systems and used water in Suceava*" has as a main target the issue of water supply and the purge of used water in Suceava city. This project is financed through the ISPA program (Instrument for Structural Politics of Pre-Adhesion), which takes place from 2007 to 2011, [32].

The project's main objectives in Suceava city are the following:

- Coverage area increase of the water supply system for the inhabitants from Suceava, from 75%, in the present, up to 85%;
- Interface connection at the drainage system for about 13.000 inhabitants from the Burdujeni and Itcani neighborhoods.
- The purge of urban used waters has to be within the standards of the European Directive Commission no.91/271/CEE.

In this article we have tried to underline the fact that the drinking water delivered in a system centralized for the inhabitants of Suceava puts into effect the quality standards imposed by the effectuated legislation, legislation that has to be tuned in with the European regulations, due to Roamnia's integration into EU at January 1st, 2007. The production capacities of drinking water are continuously modernized and reengineered, in order to rehabilitate the water's supply networks and to assure an efficient control of the water's quality, through the on-going or project-based investment programs.

If things are analyzed from the perspective of the durable development of Suceava city, we can say that the efforts of the local administration have as a main objective the improvement of the inhabitants' living standards under sustainable conditions.

The increase of the number of substances with polluting potential for water consumers imposes a modernizaed technique for their detection and also, the re-thinking of treatment flows so as to provide the inhabitants with adequate water for either human or industrial use.

REFERENCES

1. Gaspar, G.D. 2009**,** Cercetări privind folosirea apei potabile în municipiul suceava (Research Regarding the Use of Drinkable Water in Suceava City), Dissertation, USV.
2. Goudie, A., 2006, *The Human Impact on the Natural Environment. Sixth Edition*. Blackwell Publishing.
3. Voda, P.,2010, Apa potabila devine o mare problemă, EcoMagazin, 03.10.2010, http://www.ecomagazin.ro/apa-potabila-devine-o-mare-problema/
4. *** http:// apa potabila, ecoaqua, www.greenagenda.org/eco-aqua/potabil.htm
5. *** Apă potabilă, http://ro.wikipedia.org/wiki/Ap%C4%83#Utilizarea_apei_de_c.C4.83tre_oameni.
6. *** Directiva cadru privind apa-contribuţii la aplicarea ei; Centrul regional de mediu pentru Europa centrală şi de est, Biroul local România.
7. *** 2009, Flash Eurobarometer on Water, FlashEb no. 261 www.europa.eu/public_opinions/flash.
8. *** 2009, Forumul mondial al apei, www.greenagenda.ro.
9. *** 2002, Legea 458/2002, publicată în Monitorul Oficial nr.552 din 29 iulie 2002.
10. *** 2008, Raport SC ACET SA Suceava, www.primariasv.ro.
11. *** 2009, Water in a changing world, Raport prezentat la Forumul mondial al apei, Instanbul,Turcia, http://en.wikipedia.org/wiki/World_Water_Forum.
12. *** www.apmsv.ro
13. *** www.dspsv.ro
14. *** www.mmediu.ro
15. *** www.primariasv.ro