

INFLUENCE OF HUMAN ACTIVITIES ON WATER QUALITY OF RIVERS AND GROUNDWATERS FROM BRĂILA COUNTY

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Abstract: The article analyses the effects produced by the anthropic (pollution, irrigation and chemical processing) to water concentration from groundwater (concentration of nitrates, phosphates, dissolved oxygen). In Brăila county, the main sources of water pollution are the population which discharge untreated wastewater, a series of public and private companies but also pig complexes. The quality of the environment in Brăila county improved after were closed the enterprises and pollutant sections and the pig complexes from Gropeni, Brăila, Tichilești, Dedulești and Cireșu.

Key words: water, pollution, human activities, untreated wastewater

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INTRODUCTION

Brăila County was studied over time by many researchers, geographers, agronomists, biologists and hydrologists. The first wider reports concerning the Lower Danube are summarized in Tabula Peutingeriană and in the medieval period where new information about the Lower Danube in the work of historians such Idrisi and Abu Feda (XII-XIV centuries) (Andronache, 2008). The first high precision maps published in 1864, which were prepared on the orders of the ruler Alexandru Ioan Cuza. The problem of the influence of human activities on water quality in Romania and also, in Brăila County was discussed in scientific papers since the late nineteenth century; among those who studied the problems of Brăila county are: Morariu et al., 1966; Coteș, 1967; Roșu, 1980; Onea, 2002; Andronache, 2008; Ianos et al., 2010 and Strat, 2013. In the international literature the influence of human activities on water quality was studied by: Vitousek et al., 1997; Codd, 2000; Norman Doyle, 2005; Peters et al., 2006; Hudon & Carignan, 2008; Obire et al., 2008; Pathak et al., 2011. Direct discharge of untreated waters into rivers could contribute to microbial pollution and can have negative effects on the quality of water (Obire et al., 2008). In Brăila County are reported some problems of pollution of waters especially on the Danube and Buzău.

STUDY AREA

Brăila County is located in south-eastern part of Romania occupying the lower Siret valley, a part of the Plain of Bărăgan, small parts from the Plain Sălcișoara and the Plain of Buzău. In the east,

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Brăila County include the Great Island of Brăila. Brăila County's area represents approximately 2% of the entire country area (figure 1) (Costachie et al., 2014). Water quality decay, characterized by important modifications of chemical oxygen demand, suspended solids, nitrogen, phosphorous and so forth (Mvungi et al., 2003) are the result of wastewater discharge in rivers (Popa et al., 2012).

The geographical position of Brăila County is given by the following coordinates: 28 ° 10' east longitude - extreme point is Frecăței commune; 27°5' west longitude, extreme point is Galbenu commune; 45°28' north latitude, extreme point is Măxineni commune; 44°44' south latitude, extreme point is Ciocile commune (Gâștescu & Gruescu, 1973).

Overall, the relief is made up of large smooth areas interfluvial and fluvial terraces and meadows with great development. There are several subunits: Central Bărăgan Plain (Plain Călmățui), The North Bărăgan (Brăila Plain), Plain Râmnic, Siret Meadow, Buzău Meadow and Călmățui Meadow. Brăila County is located on the Precambrian and Paleozoic crystalline schists, located in the east at shallow depths, they are sinking in the west steps so that, in the riverbed Buzău, reaching a depth of 3500 m.

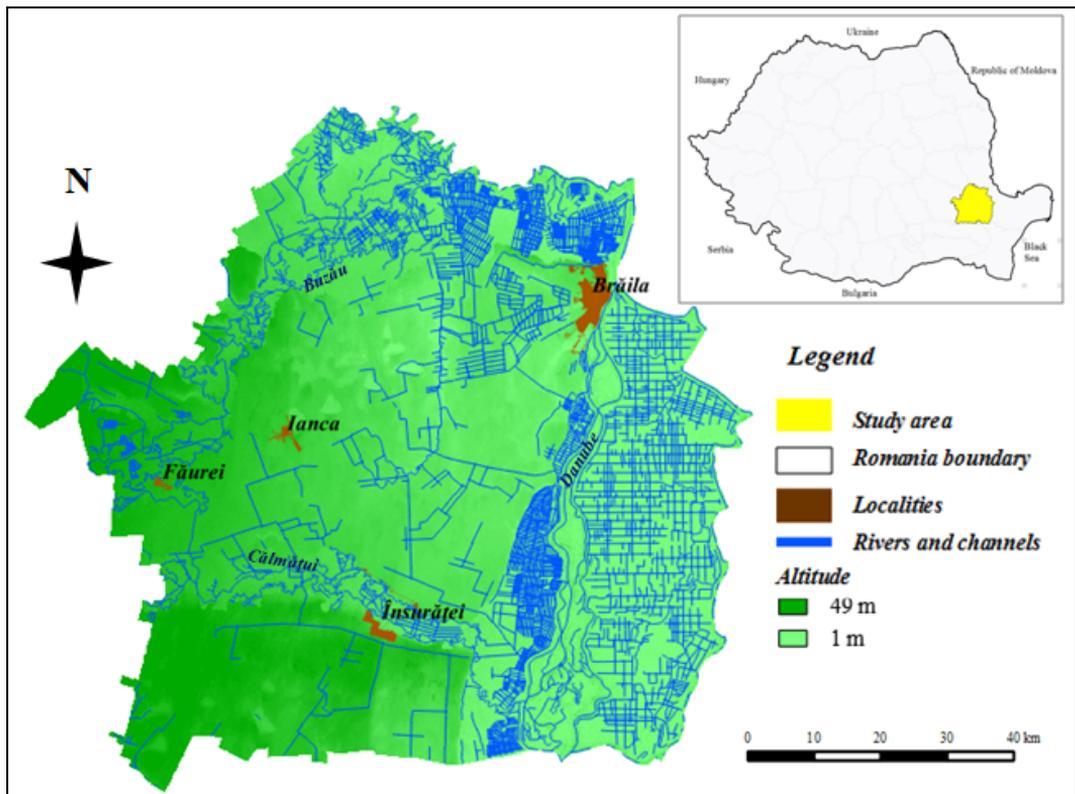


Figure 1. Brăila County location in Romania

Brăila County is characterized by a dry temperate continental climate with dry character. Summers are hot and dry because of high levels of solar radiation (125 kcal/cm²), and - low average (30 mm/year) rainfall with torrential and unevenly distributed (Sandu et al., 2008). There is little change in climate due to the uniform relief in the county of Brăila. Therefore, the climates are outlined by plant associations and extensive and permanent water areas (Andronache, 2008). The main rivers that are crossing the county are the Danube (length = 86 km) (Andronache, 2008), the Buzău river (length = 120 km), the Călmățui river (length = 90 km) and Siret river (length = 55 km).

Soils from chernozems class represents 75% of the soils from county of Brăila. In flat areas where water has stagnated due to increased hydrostatic level formed sloughing depression areas which meet the following classes of soils - gleysols, solonchaks and solonetz (Gâștescu & Gruescu, 1973).

DATA AND METHODOLOGY

For the study, were analyzed data concerning water pollution in annual environmental reports issued by the Environmental Protection Agency Brăila from te perioad 2007 – 2012 (Environmental Annual Report Brăila, 2007-20012, A.P.M. Brăila). In order to present the influence of human activities on water quality in the county of Brăila, the biological land general physico-chemical conditions have been analysed. Were analysed the rivers from county Brăila (Buzău, Călmățui, Dunăre) from hydrological point of view and from biological elements and physico-chemical conditions. The biological conditions are refering to benthic invertebrates, phytobenthos, macrophytes, phytoplankton and evaluation of biological elements. The general physico-chemical conditions temperature (°C) and pH, oxygenation conditions, salinity, nutrients and assessment of the elements general physico – chemical (Peters et al., 2006). It also have used the analyzes and studies on iodine concentration by V. Lepadatu and I. Andronache (Andronache, 2008). According to the dataset from the Environmental Protection Agency Brăila from 2007 – 2012, we make an analysis with the data to explain the variation of the concentration of nitrates, phosphates, dissolved oxygen, organic matter and ammonium in rivers mentioned above. For processing the cartographic raster data and for spatial representation of geographic on maps, were used several software, including: Quantum GISversion 2.6.1.Brighton, Corel Draw X5 (Andronache & Ciobotaru, 2013). It was used as the basis the digital model of relief, ASTER GDEM 30 m spatial resolution and terrain data (Ursuța, 2013). The data obtained were represented in the form of thematic digital maps (map iodine concentration in the ground water and the location of Brăila in Romania).

RESULTS

Analyzing the existing data, in the county of Brăila have identified some major sources of pollution: population of the municipality Brăila evacuate untreated wastewater largely through Aptercol (dominate pollutants: ammonium, nitrites, nitrates). The same thing happens at Făurei, Însurăței and Ianca where are sewage plants (total extractables, pollution with organic substances of the population). Enterprises and public and private institutions (SC Promex SA, SC Stx RO Offshore Brăila (metallurgical industry), SC Belromsase SRL, SC Centrottrading SRL (meat industry), SC Soroli Cola SA (food industry), SC Unita Turism Holding Lacu-Sărat (balneary treatment), SC Demopan SRL (bakery), SC Bona Avis SRL (poultry slaughterhouse), Emergency County Hospital, County Hospital obstetrics and gynecology, SC Agrimon SRL Oprisenești Ianca (growing birds powdered egg production), SC Cas SRL (milk products), SC Kaufland Romania (supermarket), SC Apan SRL (car wash) by suspended solids, biochemical oxygen consumption in water (CBO5), chemical oxygen consumption (CCOCr), phosphorus, residue filtered at 105°C, ammoniacal nitrogen, total phosphorus, substances soluble in organic solvents, detergents, phenols. Also, the pig complexes (Brăila, Tichilești, Gropeni, Dedulești and Cireșu) by livestock manure that are sources of organic pollutants, fixed residue, ammonium, total suspended matter, extractable substances (fats) and high oxigen consumption (Andronache & Lepădatu, 2001).

THE ECOLOGICAL CONDITIONS OF RIVERS

At the county level, E.P.A. Brăila conducted the monitoring of Călmățui river into two control sections: Cireșu (79 km from the source) and Berteștii de Jos (144 km from the source), Buzău river in the control section Racovița and the Danube in control sections: Brăila 1 (km 184), Brăila 2 (reserve for drinking water – km 183) and Gropeni (km 196). Analyzing the annual environmental reports in the period 2007-2012 from Brăila, the Buzău and Danube rivers showed

moderate quality and good chemical condition. In terms of phytoplankton saprobic index, Cireșu sector is characterized by a good (2007) and moderate condition (2008-2012), while the Berțeștii de Jos through a moderate condition in 2007-2012. Chemical status is determined in relation to the concentration of heavy metals fraction isolated. Heavy metals monitored by E.P.A. Brăila are: Zn, Cu, Ni, Fe and Mn. In both parts of the study were found suitable conditions for anthracene, naphthalene, fluoranthene and total cyanide (table 1).

Table 1. Water quality of major rivers from Brăila in the period 2007- 2012
(Data source: Environmental Annual Report in Brăila, 2007-20012, A.P.M. Brăila)

Watershed	The total length of the basin in Brăila County (km)	Monitored length (km)	Length distribution according to the evaluation of ecological condition			Length distribution according to the evaluation of chemical condition	
			Very good / Good	Moderate	Weak/ Bad	Good	Bad
			km	Km	km	Km	Km
Buzău	170	128	0	128	0	128	0
Dunube	100	83	0	83	0	83	0

According to the Order no. 161 from 16 February 2006 of Ministry Environment and Water Management, surface water crossing Brăila County must qualify as: Danube - category I quality, Buzău - category II quality and Călmățui - category III quality.

Danube water is under category II quality because of phenol limits. They do not originate from Brăila County but are present in the Danube because of its pollution-Vadu Oii Giurgeni upstream. The main indicators analyzed for surface waters are oxygen dissolved in water, chemical oxygen demand, biological oxygen consumption to 5 days. The values obtained for each indicator in assessing ecological status / ecological potential of rivers in Brăila are presented in the tables below (table no. 2, 3).

Table 2. Assessment of the ecological status / potential ecological and chemical status for Călmățui and Buzău rivers in the period 2007 – 2012
(Data source: Environmental Annual Report in Brăila, 2007-20012, A.P.M. Brăila)

Watershed	Biological elements	General physico-chemical conditions		Specific pollutants	Chemical status
	Benthic invertebrates, Phytobenthos, macrophytes, phytoplankton	Temperature (°C) and pH	Oxygenation conditions, salinity, nutrients, Assessment of the elements general physico - chemical	Specific pollutants (for the status / ecological potential)	Chemical status
Buzău	VG	VG	M	VG	G
Călmățui	VG	VG	M	VG	G

¹ VG – very good; G – good; M – moderate.

Regarding the biological quality of water sources is noted that the rivers from Brăila county falls into the category of mesosaprobic water because the Danube water has an average of the degree of cleaning of 78%, Buzău river has an average of degree of cleaning of 68%, Călmățui river has an average of degree of cleaning of 70.01%.

In the Danube is found phytoplankton, diatoms, cyanoficee and zooplankton is composed of ciliates. In Buzău River the zooplankton is composed from ciliates and flagellates and in Călmățui River consists from diatom phytoplankton and zooplankton (ciliates, flagellates).

Table 3. The concentration of pollutants in rivers from Brăila county in 2007-2012
(Data source: Environmental Annual Report in Brăila, 2007-20012, A.P.M. Brăila)

Watershed	Control section	Nitrates N-NO ₃	Orthophosphate P-PO ₄ ³⁻	Ammonium N-NH ₄ ⁺	Dissolved oxygen	Organic matter	Water quality (ecological status)
Călmățui	Cireșu	0.238	0.197	0.143	9.18	31.95	moderate
Călmățui	Berteștii de jos	0.530	0.092	0.200	9.44	37.12	moderate
Buzău	Racovița	1.109	0.038	0.129	9.22	9.28	moderate

Water quality in terms of concentration of nitrate, orthophosphate and ammonium is moderate for both the control section from the Buzău Valley (Racovița point) and for control section Călmățui Valley (Cireșu and Berteștii de Jos). The highest value for nitrate concentration is recorded at Racovița (1.109 mg / l) and the highest concentrations of orthophosphate ammonium are recorded at Berteștii de Jos (figure 2).

Water quality is moderate in terms of the concentration of dissolved oxygen and organic matter for the control sections Racovița, Berteștii de Jos and Cireșu. The highest concentrations of dissolved oxygen (9.44 mg / l) and organic matter (37.12 mg / l) was recorded at Berteștii de Jos due to higher degree of eutrophication (figure 3).

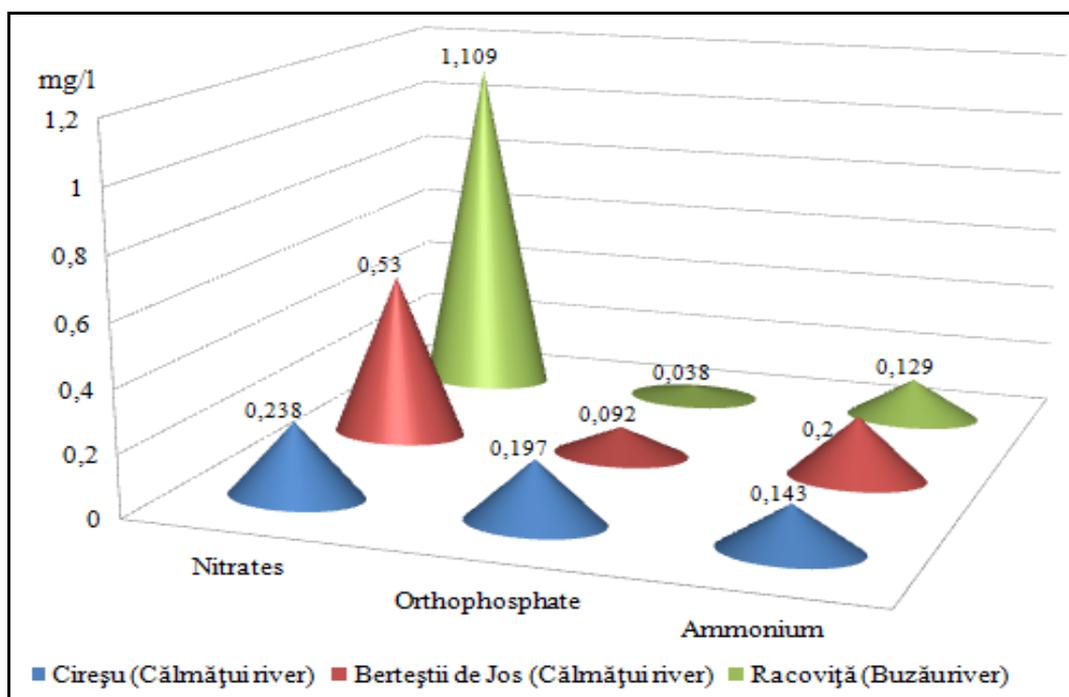


Figure 2. Concentration of nitrate, orthophosphate and ammonium in Călmățui and Buzău rivers in the period 2007-2012

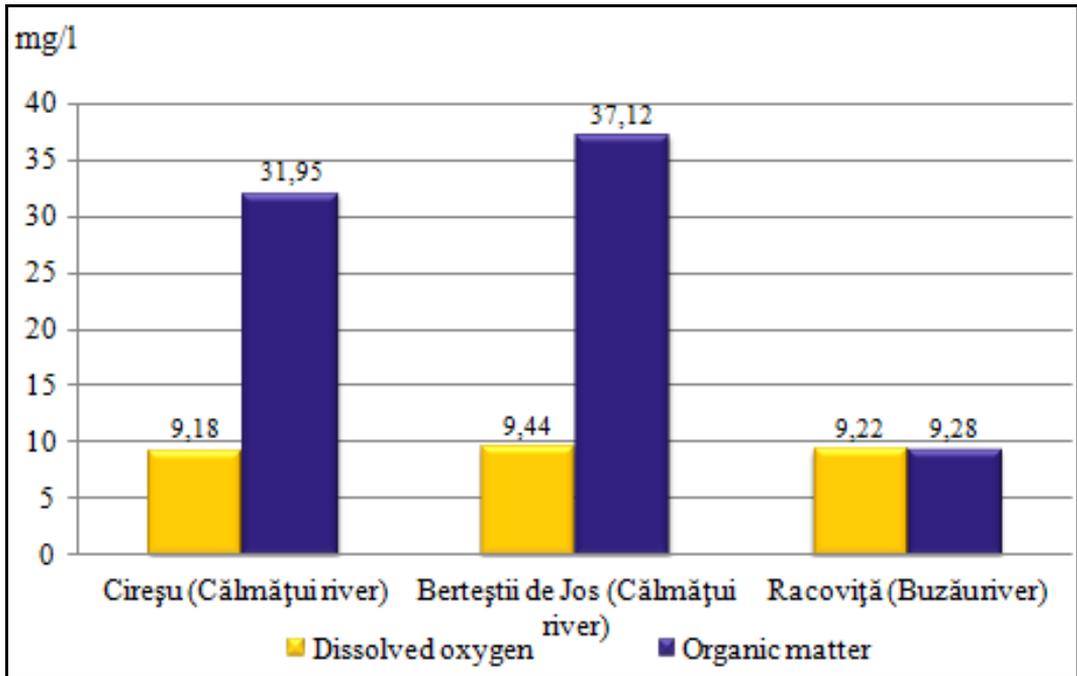


Figure 3. The concentration of dissolved oxygen and organic matter in the river Buzău and Călmățui in the period 2007-2012

To determine the environmental status of lake water quality were monitored the quality indicators by physical and physico-chemical determinations on water samples. Values of the concentrations determined in most of the indicators were classified the quality standards (especially for items that have exceeded salinity group) which represent an ecological status less good of the lake water. So, the Sărăt Lake from Brăila has a bad ecological status due to very high salinity. The biological elements are suffering because they have not favorable conditions for development. In the situation of Jirlău lake, Movila Miresii lake, Ianca lake the ecological status it is moderate because the physico-chemical conditions (temperature and pH condition) are very good and moderate for the oxygenation conditions. General assessment of the biological elements reflect moderate conditions encountered in lakes: Jirlău lake, Salt lake Movila Miresii and Ianca lake. These results correlate with the sediment samples from lakes: test results indicating an organic matter content below 10%, while the indicator values determined did not exceed the limit values by O.M. 161/2006. Even if the limit values are exceeded in the case of the indicators of salinity group in the case of sediments, after classification criteria these values are substances of natural origin and does not indicate pollution.

Ecological state groundwater

In the period 2007-2012, for the groundwater, were monitored by the Water Management System Brăila 34 of hydrogeological drilling and 33 are drilling supervision. In terms of physico-chemical indicators, groundwaters from Brăila County are mostly inadequate, recorded exceedances of limits for: total hardness chloride, iron, nitrate, and organic substances. These exceedances are due to the influence of surface water by their anthropogenic loading and by the discharge of insufficiently treated or untreated waste water. Because through the epidemiological studies been shown the emergence of a new clinical entity "crop plain" was analyze the samples taken and the concentration of iodine and selenium. In the county of Brăila the average iodine concentration is 0.058 mg / dm³ (critical value is 0.005 mg / dm³) (figure 4).

By analyzing the iodine concentration of the groundwater aquifers at an interval of 15 years, there is a accentuated decrease reaching values up to 70% less in the meadow of Buzău river and in the sector with sands from Brăila Plain.

Low concentrations of iodine in groundwater, were determined by its depletion from the soil under the influence of increased anthropogenic pressure in the last 50 years, especially through the use of nitrogenous fertilizers. They have generated high levels of nitrites and nitrates in the soil which favored the development of bacterial flora based on iodine. Decreased soil iodine correlated very well with the decreased concentrations of iodine in groundwater, cereals, wood of trees and cows milk. It was noted that the trees of over 60 years is a concentration of 0.54 mg iodine / kg, while for those aged 30 years in the same area 0.33 mg iodine / kg.

An important role in reducing the concentration of iodine has the pollution of the Danube knowing that fluorine, chlorine, nitrates and heavy metals can react with iodine. The Danube River waters annually transports 551 kt nitrogen, 48 kt phosphorus (in Romania are 121 respectively 12.7 kt), 4 kt lead, 1kt chromium, 0.9 kt copper and 60 t mercury.

Iodine deficiency from the diet of animals and human hypothyroidism generates negative influence on metabolism. Decreased of concentration of selenium in groundwater accentuates the risk of thyroid pathology because iodothyronine deiodinases T4 - T3 is done using selenium (T3 is the active form of thyroid hormone). Into the groundwater and in rivers can accidentally get pollutants (lead, mercury, cadmium) with negative effects on the circulatory system, digestive system and the skeletal system.

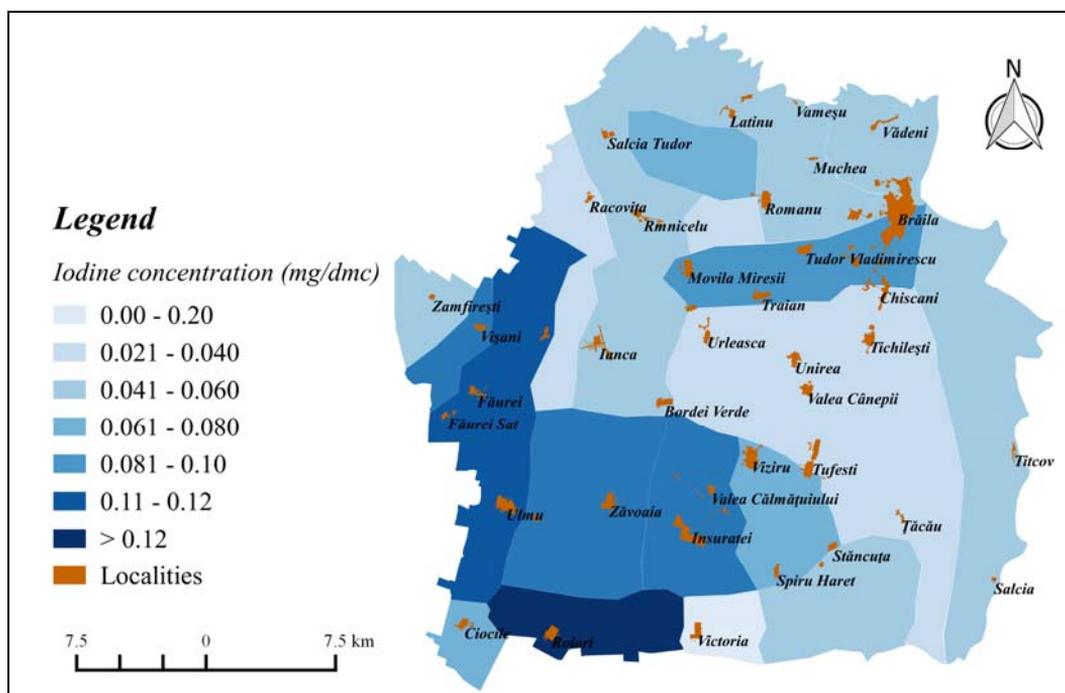


Figure 4. Map of iodine concentration in Brăila County

CONCLUSIONS

Due to the closure of several companies or departments polluting, planning the landfill of domestic and industrial Gropeni, the decrease amount of chemical fertilizers and some retrofitting, the water quality has improved in Brăila County. In the Brăila County it is required to establish some indicators of environmental quality in water (and associated in soil) according to observed

trends and their follow through pilot stations (some chemical elements such as nitrates, iodine, heavy metals from water and soil). Some measures must be taken to promote environmental norms of behavior among the population and to encourage the private initiative to recycle household waste through competitive activities in which to provide quality services at reasonable prices. Brăila County location in an area with potential for developing new activities it's appropriate to lay down criteria for its sustainable development.

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