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CONSIDERATIONS ON THE IMPLICATIONS OF THE POLLUTION PHENOMENON IN THE SANOGENESIS STATE OF THE URBAN ECOSYSTEM IN SĂRĂRIE-ȚICĂU DISTRICTS (IAŞI CITY)

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Key words: urban ecosystem, pollution, sanogenesis, GIS, Iaşi city.

Abstract. The urban ecosystem is marked by the presence of natural factors, with a supporting role, and anthropic ones, which are interdependent and ensure for their inhabitants a different qualitative standard of life. The aim of the study is to highlight the implications of pollution phenomenon, specific for any urban ecosystem, in its sanogenesis state in the analyzed area. For reaching this goal, there have been processed databases concerning the quality of air, water, amount of generated waste and green spaces; measurements of the noise level have been made and collective waste collection points have been inventoried. The results have been processed and graphically represented by the soft Arc GIS 9.3 and by open-source statistical processing: R. The analyzed area consists of two residential districts in which the pollution must be reduced in order not to influence the sanogenesis state of the urban ecosystem, there being notified some factors, especially of chemical ones, that emphasize the phenomenon and produce hazards of the environment at a micro-regional level, without influencing the sanogenesis state as a whole.

Introduction

The importance of knowing the functionality and dynamics of the city lies in the inaccurate perception over it, it being considered just a physical system of elements of diverse nature, minimizing the instable and complex social and political organization, facing a series of failures. Within it, the natural elements serve as an environmental support, but also as a factor contributing to the achievements of human society. Pollution phenomenon is specific for human settlements, through the concentration of a large number of people and a diversity of performed activities, from economical to recreational assets. Each environmental element is subject to pollution from diverse factors (physical,

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chemical, biological) (Bărbulescu A., 2007), from this reason after Romania's EU accession, the country's legislation in this field has been updated and includes a series of limit values not to be exceeded in order to improve the environmental quality and the sanogenesis state. Previous studies of the pollution phenomenon in the urban ecosystem have been done before, but applied on other urban ecosystems (Pătroescu M.), these being the first studies in this domain.

1. Materials and methods

The main utilized materials have been the topographic plans 1 : 5000, 1964 edition as well the aerial photos from 2005. The working methods have implied the delimitation of the study area, direct observations and sound level monitoring made in the field with Sound Level Meter - Quest Technologies, model 1400; acquiring database from the public reports of the Environmental Protection Agency, followed by the processing of the data thus obtained with Microsoft Excel, open-source statistical soft R and Arc-GIS software and the determination of the impact of their state on environmental quality and on sanogenesis. To establish the level of sanogenesis state, firstly for each analyzed factor were assigned marks between 1 to 3 depending on the values recorded (1 for low values, 2 for medium and 3 for high values close to upper limits), then based on a specific algorithm (for each point the final score have been made by summing individual mark, followed by GIS interpolation through the IDW method) the final sanogenesis state has been evaluated and spatial distributed.

2. Results and discussions

The sanogenesis state of the studied urban ecosystem is influenced by a series of factors which can be classified in three categories, as following:

2.1. Physical factors – microclimate, noise. An urban ecosystem is marked by landscape elements, due to theirs supporting role, like the relief for instance, which in addition to its suitability for constructions and infrastructure, by its morphology it influences significant climatic differences and among other factors it leads to the formation of microclimates. For the studied area, there have been identified several types of microclimate, given the land use, landscape morphology and type of performed activities, this being part of residential climate (Erhan E., 1971), marked by the absence of industrial activities, green areas are significant and have a higher altitude, which marks especially Sararie district, unlike Ticau district where the slope inclination and its orientation lead to a longer duration of snow and a more active movement of air masses, especially on Cacaina valley.

Another physical factor is represented by the noise level, it recording an exceeding of allowable values, which vary according to the technical category of

the street. The main problems occur close to traffic areas, which is the main source of noise in the area.

The noise monitoring was conducted in October, in five hour intervals, for 30 points in different roads which fall into different technical categories: the 1st category (freeway) – Independence Blvd., the 2nd category (arterial) – C. A. Rosseti Blvd., the 3rd category (collector and distributor) – N. Balcescu Str., and the 4th category (local) – S. Barnutiu Str. Besides the technical categories a street fits, it is also important the type of asphalt: asphalted – 58%, concreted – 26%, graveled – 9% and unpaved 7%.

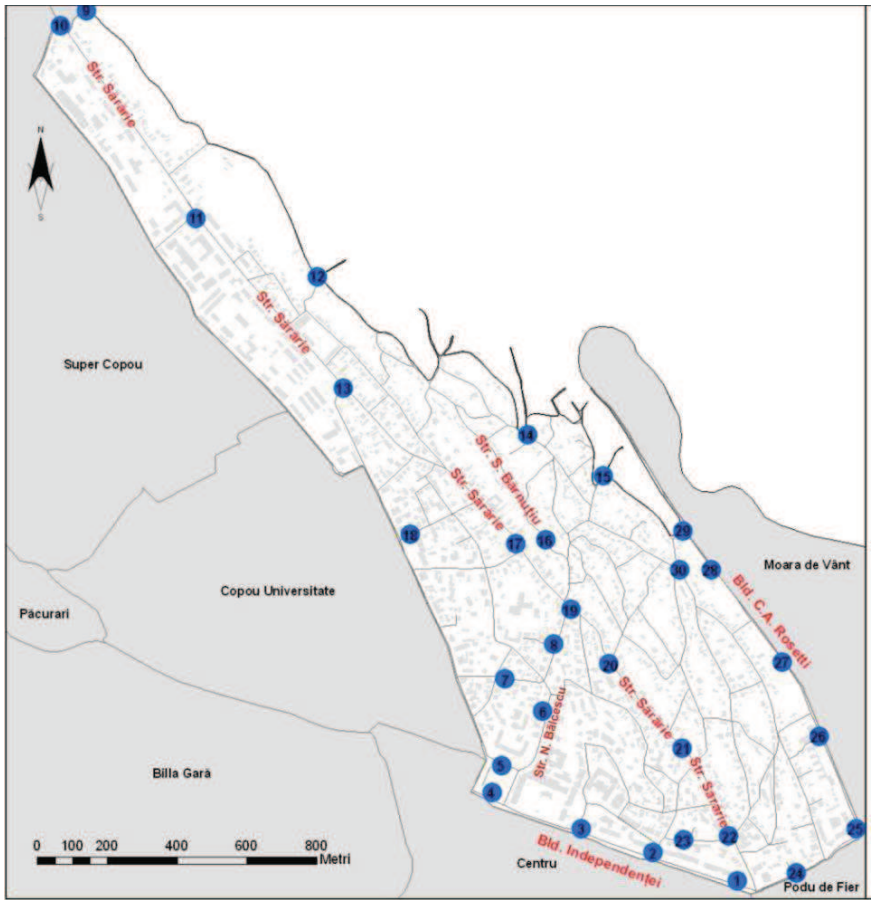

Fig 1 - Studied area and noise points monitoring location

The results reveal significant differences between working days and weekends: Independence Blvd. - during the week the average is 73.81 ± 2.88 dB, and in weekend it is 64.23 ± 2.8 dB, for C. A. Rosseti Blvd. it is 71.2 ± 2.1 dB, respectively 63.80 ± 1.9 dB. For the streets of lower categories the differences are smaller, due to the more homogenous traffic. Thus, for N. Balcescu Str. the average was 59.88 ± 2.3 dB during the week and 56.21 ± 1.72 dB in the weekend, and for S. Barnutiu Str. 51.02 ± 1.1 dB, respectively 48.37 ± 0.5 dB (fig. 2), but without exceeding the limits as high traffic roads are equipped with electric lights, and for some streets which fall into lower categories the traffic is ruled by road signs, that are one way.

The report of the noise map for the Iasi city reveal that in the studied area are people exposed at noise level, that exceed the limits (70 dB) for the protection of the habitants with more than 5 dB, being located along the streets: C. A. Rosetti, Independenței.

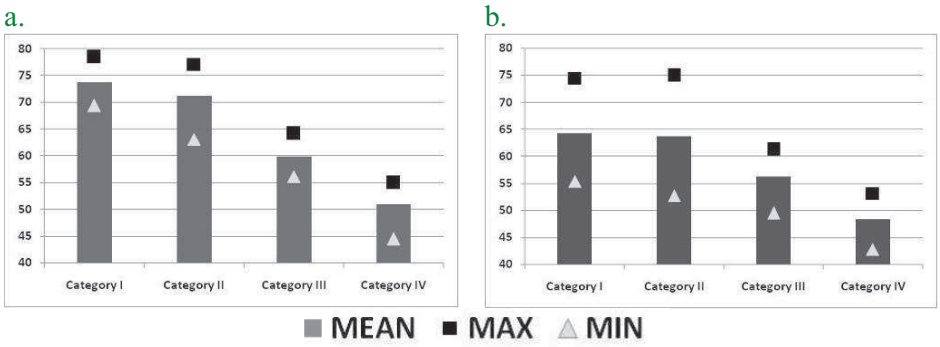

Fig 2: Noise level variation on October: a. Monday to Friday;
b. Saturday and Sunday

2.2. Chemical factors

2.2.1. Air pollution. Although the studied area is a residential one, here are sources of pollution, such as: traffic and public transport, heating systems for houses and waste removal and treatment. Analyzed data are obtained at the nearest air monitoring station, Iassy 4 – Copou Sadoveanu station, which in addition to air pollutants also measure some meteorological parameters.

For the whole temporary interval, the average (fig. 3 - a, b, c) is between 9.15 ± 3.02 µg/m3 for NOx (LV – 30 µg/m3), the highest values being recorded in the transitional and cold season, more precisely the months from November to February, SO_2 with values between 5.52 ± 2.03 µg/m3(LV – 20 µg/m3), respectively CO (LV – 10 µg/m3) with 0.12 ± 0.1 µg/m3, the highest values being recorded in the cold season, but without exceeding the limit values (LV). The

higher values in these temporary intervals can be assigned to the reduced activity of vegetation and the increasing use of cars and public transport by a large number of inhabitants, plus the heating systems of houses, predominantly the individual ones, as boilers or stoves, for which one cannot take efficient measures to reduce the released pollutants, especially if they use as fuel materials that evacuate toxic components (PET, rubber).

Another analyzed parameter with a major importance in air quality and consequently in sanogenesis state is tropospheric O_3 (fig. 3 - d), with the average of 59.55 µg/m3 (LV – 120 µg/m3), resulting from photochemical processes involving nitrogen oxides and hydrocarbons, in the atmosphere of low altitude the peak values have been recorded during the warm season, when there are favoring factors for its occurrence.

Nevertheless, there are no records of exceeding the speed limit, air quality being strongly influenced by the presence of public and private green spaces, plus the presence of Brânduşa-Ţicău-Cârlig forest, with an important role in the sanogenesis state of the analyzed ecosystem. Add to this the presence of individual homes and high altitude, which favors a higher dynamics, thus being realized the dispersion of pollutants.

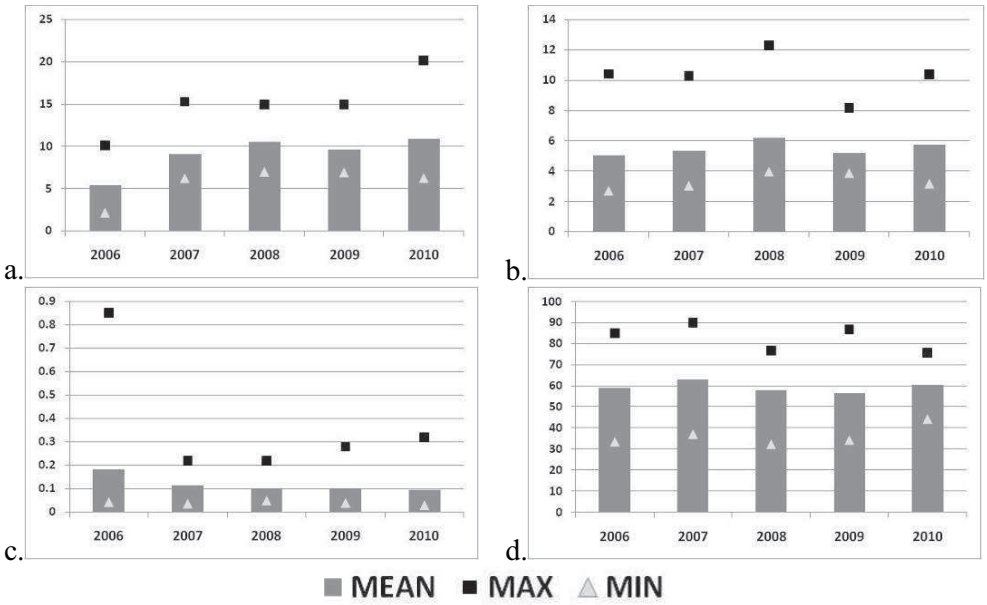

Fig. 3 - The main air pollutants (µg/m3) variation (2006 - 2010):
a. NOx; b. SO_2; c. CO; d. O_3 (Source: APM Iaşi)

Indicator	*Year*	*Independentei Reservoir*	*Mijlociu Reservoir*	*Păcurari Reservoir*	*Limit values*
Temperature	2008	17.7	15.39	16.62	-
(^oC)	2009	16.5	15.05	17.25	
	2010	17.2	15.54	16.41	
pH	2008	7.63	7.62	7.55	6.5 – 8.5
(pH units)	2009	7.51	7.43	7.44	
	2010	7.33	7.39	7.27	
Turbidity	2008	0.46	0.75	0.78	Max. 5
(NUT)	2009	0.52	0.25	0.48	
	2010	0.34	0.38	1.28	
Hardness	2008	13.2	13.45	14.73	Min. 5
(^oGe)	2009	13.9	14.24	15.17	
	2010	13.6	13.64	15.82	
Chlorides	2008	25.2	21.58	24.33	Max. 250
(mg/L)	2009	21	21.9	20.87	
	2010	21.9	20.13	18.71	
Oxidability	2008	0.83	0.63	0.55	Max. 5
(mg O_2/L)	2009	0.8	0.56	0.61	
	2010	0.8	0.78	0.72	
Alkalinity	2008	4.1	4.19	4.51	-
(ml HCl 0.1 N)	2009	4.3	4.41	4.75	
	2010	4.1	4.17	4.85	

Fig. 4 - The main drinking water indicators variation (2008 - 2010)
(Source: APAVITAL Iaşi)

2.2.2. Water pollution. In an urban ecosystem, water resources are extremely important because there are many sources of pollution that can lead to their degradation, especially if there are involved drinking water supplies. However, in the studied area, there are no more wells from which water is consumed, so the quality of distributed drinking water in centralized system is monitored. The distribution network has two types: ringed and branched network, the pipes being made of different materials such as concrete, cement, PVC, steel, iron, located at various depths, below the frost limit and resistance of the material it is made of, in

conjunction with the position they hold in the network. The water that is distributed to inhabitants comes from Timisesti source, it being framed in the upper area for the northern part and the middle one along Sararie Str.

There are monitored a number of quality parameters: physical parameters – temperature, turbidity, and chemical parameters: pH, hardness, alkalinity, oxidability and chlorides, to which the limit values are not exceeded (fig. 4), due to some modernization works and the monthly controlling of these parameters and online publication of results. To these, it is added the compliance of a principle that involves the avoidance of intersection between the distribution network and sewage, cesspool or absorbent wells.

Not all the habitants are connected to the public water system, but they use water from the fountain, only for domestic use, because for drinking and food preparing they use water from the people who are already recorded to the distribution network.

2.2.3. Soil pollution. *Hygiene and sanitation function.* In an urban ecosystem, following to the performed activities and habitation, there are generated a series of waste of various nature, which must be removed to ensure their functionality. In the Iasi city, the generated quantity per capita varies over time, about 392 kg/inhabitant/year for municipal waste, which will be considered for the analyzed area as well because there are no other units to produce other types of waste.

Before being removed, their collection is required, which is different depending on the type of housing in the area: thus, for areas in which housing blocks are dominant, collection points are settled, and for areas where individual housing is prevalent, the collection is made in different days from each house, under the condition of paying for it, in correlation with the number of people generating it. Collection of waste produced by population is differently made corresponding to the served area type, so that at houses the collection is weekly made, out of the 110 liters bins given by the service providing firm – known as *door to door collection*, and for areas where apartment buildings dominate the collection is made in containers with a capacity of 1100 liters – *collection points.* Depending on the number of served population, the number of containers varies between 3 and 5, plus one container for paper and one for plastic, which helps to selective waste collection, which is necessary for compliance with frame-Directive for waste that implies the waste sorting at the production place in recyclable and non-recyclable components.

*The impact on the environment and sanogenesis state.*The existence of a system of waste collection does not solve the problem of waste, especially in the studied area in which a low-income population also lives and removes the waste produced in the house in improper places, such as Ticau Forest, here being stored from household waste, plastic, to demolition waste (fig. 5).

Fig. 5 - Uncontroled waste deposition – Țicău forest (2010)

In Ticau Forest there is also a recreational space, close to the ski slope, which attracts many inhabitants and leads to the generation of a significant amount of waste that is collected, but also uncontrolled stored.

This fact creates many problems including: groundwater pollution, changes in air quality through engaging light waste and particles from demolition waste and pestilential odors. In addition to aesthetic pollution, these illegal deposits are suitable places were many pests live: insects, rodents.

2.3. Biological factors – green spaces

Green spaces in urban ecosystems have several functions: supplying the deficiency of natural habitats as a result of territorial occupation with various buildings, insuring population's psychic comfort, meeting the aesthetic requirements, but they also have a role in maintaining the sanogenesis state. Public green spaces are reduced in size, but the private ones are well-kept and occupy a significant area, because private houses with gardens predominate, especially in Sararie district.

Although they don't cover a significant surface (fig. 6), their arrangement is satisfying, and their location is favorable, because the statue park of Independence

Blvd. serves both the area inhabitants – living in collective housing and the patients and their visitors from the health units in the area (Great Clinic, St. Spiridon Hospital, D.S.P. etc), being an oasis of greenery in an intensively urbanized and circulated area.

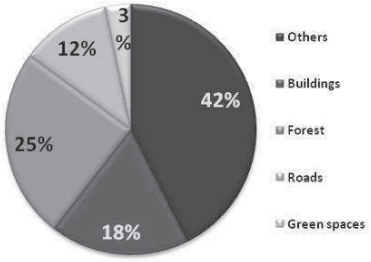

Fig. 6 - Land use in the study area

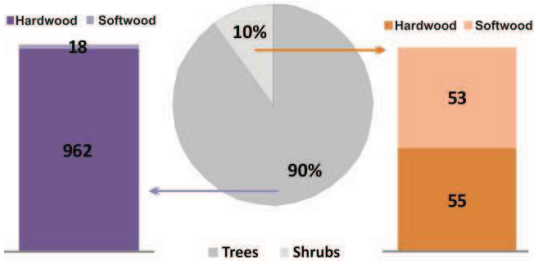

Fig. 7 - Type of vegetation in green spaces

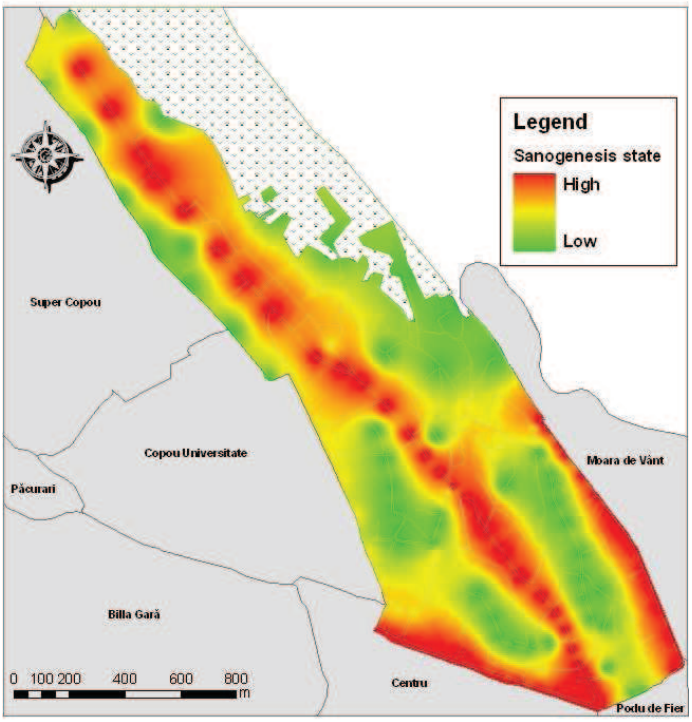

Fig. 8 - The sanogenesis state on the districts space

The trees are predominant (fig. 7), especially hardwood ones that are adapted to the climate in the area, shrubs being planted for ornamental purposes, being considered the trees in the parks and also the ones included in the alignment of streets, about 1088 trees and shrubs of different essences being inventoried.

Major benefits are generated by the presence of Ticau Forest, which has numerous functions: stabilizing the eastern slope of Copou hill, affected by landslides, leisure and recreational function for the population in the entire city, through the arrangement of barbecue places in warm season and skiing slope in cold season.

The environmental protection is not a domain very well managed by the public institutions, but there are made many checks, including life environment and the problems related to the water and waste management, by department of Public Health Iasi. The population is sensitive at environment quality and when an accidental pollution happen or a limit value is exceeded, the inhabitants affected make a complaint, most of them being associated with waste water management, noise level, waste deposition, animal growth, etc.

The analysis of sanogenesis state for the districts space (fig.8) reveals the areas with low sanogenesis state is located along the high traffic streets (the noise levels, the car emissions and waste collection points fit into the third category) while the high sanogenesis state areas are located inside of the districts.

Conclusions

The analyze of the implication of the pollution phenomenon in the sanogenesis state of the studied area highlight the following:

- The results for noise level monitoring reveal significant differences between working days and weekends without exceeding the allowable values for the type of street, but there area exceeded the limits (70 dB) for the protection of the habitants with more than 5 dB, being located along the streets: C. A. Rosetti, Independenței.
- The chemical factors have not important influence in the state of sanogenesis, because it fit in the limit for the air and drinking water, except the waste management, with a negative impact, especially in the Ticau forest area
- The biological factors are represented by green spaces that have several functions and bring major benefits, creating a specific type of microclimate that improve the environment quality and sanogenesis state.
- The spatial distribution of sanogenesis state on the studied area represent 35 % low state, 20.3 % medium and 44.7 % high sanogenesis state, that means two thirds of area represent a good and medium sanogenesis state, while the rest correspond to the low sanogenesis state.

Acknowledgements

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