# THE EVALUATION OF THE ENVIRONMENT QUALITY IN THE OZANA HYDROGRAPHIC BASIN IN THE MOUNTAINOUS SECTOR

**Alina Bistriceanu*, Costică Brânduş****

* University of Suceava, Faculty of History and Geography, University Street 13, 720229, Suceava, Romania, e-mail: alina.bistriceanu@yahoo.com
** University of Suceava, Faculty of History and Geography, University Street 13, 720229, Suceava, Romania, e-mail: brandus@atlas.usv.ro

***Abstract***

*The main sources of pollution in the Ozana hydrographic basin in the mountainous sector are: specific pollution sources of SC Mihoc OIL SRL Pipirig - Treatment of waste oil and stabilization of crude oil, the extraction of construction materials, craft activities and services, road transport, communal management activities. Evaluation of the environment quality has been achieved through a quantitative method of global quantification of the impact. The global pollution index is calculated on the basis of an indicator which is a result of a relationship between the ideal and actual value at a time of some quality indicators that are specific for the environmental factors analysed.*

**Key words:** pollution sources, global pollution index, Rojanschi, Ozana basin

## INTRODUCTION

At first sight, through the expressions “environment quality” or “life quality” one understands some of the satisfactory characteristics of some components of the ecological support. The notion “environment quality” must not reflect just characteristics of some components, usually positive ones, but engages to evaluation and adequate expression of the environment’s dynamics. In this acception, the notion of environment quality is still, much less used.

The assurance of an adequate environment quality and its protection represents an issue of major importance and certain actuality for the social evolution.

## MATERIAL AND METHOD

Pollution sources

The source of pollution is the direct place where the pollution phenomenon manifests through loss of vapors and also by cause, it represents all the elements and factors which contributed to the loss generating.

The phenamena through which air pollution takes place are:

Through pollutant emission one understands the elimination in atmosphere of some solid or gaseous pollutants from punctiform or surface sources.

Through imission, one understands the transfer of pollutants from the atmosphere to a receptor.

The atmosphere pollution sources of the Ozana hydrographic basin can be grouped in a number of categories. Let'say, first, the local natural and anthropical sources, then, the ones situated at long distance, transboundary pollution, background pollution. This kind of pollution, for the eastern side of Romania is surveilled by the altitude station from Poiana Stampei.

The natural sources inside the Ozana hydrographic basin in the montainous sector are a few, and we can mention here: the soil which, influenced by tempriture, precipiation and air currents spreads solid particules in the atmosphere; the plants and the animals.

The anthropical sources inside the Ozana hydrographic basin in the montaneous sector are:

Specific pollution sources of *SC Mihoc OIL SRL Pipirig – Treatment of oil waste and stabilisation of light oil,* are:

- by shape: punctual ones ( reservoirs, chimney, thermic station);

- by mobility: fixed (reservoirs, thermic station, ramp) and mobile ones ( the auto-tank for oil, ramp);

- by height: low ones ( the height of the thermic station chimney is smaller than 50m);

- by operating mode: intermittent ( the thermic station which only functions in the winter), continuous ( reservoirs, containing tanks), supervised ( burning process, reservoir valves) and diffuse ones (separatory pumps, flanges, oil wells for production);

- by the technological process: storage source (reservoirs), delivery source ( the ramp for filling the auto-tank)

Plus:

- **construction materials**, quarry stone (sandstone) is extracted from quarries located on Coasta Fagului and Domesnic peak;

- **cutting and processing of timber** and other craft activities and services which meet the requirements of residents, are also important sources of pollution. Of the 60 establishments in the locality, 22 are sawmills.

- **means of transport**. Road transport is a major source of pollution (due to the strong development of the internal combustion engines) and presents the greatest risk for the population. Of the reasons mentioned in the first place, the elimination of pollutants that are very close to the ground, in the area of human action; secondly, the emission of pollutants is distributed on the whole surface of the locality Pipirig, differences in concentration depending on the intensity of the traffic and the possibilities of dispersal, although there are no monitoring stations in the area; thirdly, noise and trepidations resulting from high tonnage machines. In the central area of the commune is maintained a heavy traffic because the national 15B road crosses longitudinally the Ozana hydrographic basin.

- **communal management activities**. At the level of the entire village Pipirig is apparent that relative to the number of inhabitants and surface, units of service are insufficient in number. Also, there are no units of waste collection and storage facilities, water and sewage network should be expanded and there is a necessity of a wastewater treatment station.

- **agricultural works and their role in soil pollution**. Main crops developed in the area are influenced by climatic factors, thus the dominant culture in the basin is the maize, followed by vegetables and potato, mangold; fruit is represented only at the level of households. Having a large area of land represented, mainly, of pasture and meadow, and lack of other economic activities, animal husbandry has become a core activity of the inhabitants, and overgrazing, a problem. For greater productivity, modern methods and means to improve the soil are used (chemical and natural fertilizers).

**The main pollutants** are in great number in the Ozana hydrographic basin, of which the most common are:

- aerosol solid particules, derived from Diesel engines, domestic flues;

- oxygenated derivatives of sulphur (SO2, SO3) from refined petroleum products, motor vehicles, etc.;

- volatile organic compounds (harmful process gases contained in crude oil) which together with nitrogen oxides lead to the formation of the oxidants in the atmosphere, of which the most important is the ozone;

- carbon oxide is the most widespread pollutant of the air and it comes 60% from motor vehicles;

- metals are spread in the air, in form of powders, drops of solutions, vapours of salts and organo-metallic compounds. Lead, pollutant specific to gasoline engines at the rate of 80% is eliminated through the exhaust pipe in the form of aerosol made of lead halides that once inside the atmosphere have a great environmental and organism nocivity (Mioara Surpățeanu, 2004).

- the source of solid residues deposited on the banks of the rivers or floating in the water. The majority of the inhabitants throw away vegetable waste from the household in the meadow of rivers during the so-called “spring cleaning”, which, at the time of flow growth of the rivers Ozana and Pluton, are transported on long or small distances and become to others sources of pollution.

- nitrates, phosphates, detergents, insecticides, which have become almost indispensable to human life and yet 75% of them are pollutants.

## RESULTS AND DISSCUSIONS

**The evaluation of the environment quality with the Rojanschi illustrative method in the Ozana hydrographic basin in the mountainous sector.**

This is a quantitative method for the global quantification of the environmental impacts of anthropogenic activities (Rojanschi, V. and colab., 2002).

The global pollution index is calculated on the basis of an indicator which is a result of a relationship between the ideal and a certain time value of some quality indicators considerred specific for the analysed environmental factors.

It is a quantitative analytical method based on the global pollution index (GPI), resulting in the ideal ratio between the ideal state (natural) and the actual condition (polluted).

• Graphic representation. The ideal and the actual condition are graphicly represented resulting in a diagram included in a circle with a radius of 10 units of reliability, whose form depends on the number of environmental factors analysed.

• The ideal status (IS): it is graphicly represented through a regular geometric shape shown in a circle with a radius of 10 units of reliability.

• The actual status (AS): is an irregular geometric figure obtained by merging the points which represent the equivalent value of the quality index in the reliability scale and enroll in the regular geometric figure of the ideal state.

Global pollution index: GPI - is derived from the ratio between the surface which represents the ideal status (IS) and the actual status (AS).

$$\mathbf{GPI} = \frac{IS}{AS}$$

**GPI = 1 - there is no pollutin**

**GPI > 1 - There are modifications of the environment quality**

*Table 1*

Quality scale

| | |
|---|---|
| GPI = 1 | - natural environment is not affected by human activity |
| GPI = 1...2 | - the environment is subject to the effects of human activity within limits allowable |
| GPI = 2...3 | - the environment is subject to human activity, causing disconfort to forms of life |
| GPI = 3...4 | - environment is affected by human activity, causing disorders to forms of life |
| GPI = 4...6 | - the environment is seriously affected by human activity, dangerous to forms of life |
| GPI > 6 | - environment is degraded, unsuitable for the forms of life. |

**Determination of global pollution index**

For determining the global pollution index, it is necessary to determine for the components of water, air, soil and flora the grades of reliability from 1 to 10, which results will be represented graphically by using the Rojanschi method. GPI will be used in determining the environmental quality status in the hydrographic basin of the Ozana river in the montainous sector.

For the environmental factor air, the influence of three quality indicators has been studied, of sulphur dioxide, nitrogen dioxide and particulate matter in suspension, which have direct adverse effects on vegetation and human life.

Thus, the annual average concentration for the air in the hydrographic basin of the Ozana river in the montainous sector, corresponds to 7,2 (Table 3) reliability grade, where have been taken into account the values of maximum permissible concentrations (MPC) for each indicator (Table 2).

*Table 2*

Reliability scale for air and the maximum permissible concentrations

| Reliability grade | $SO_2$ ($\mu$ $m^3$) | $NO_2$ ($\mu$ $m^3$) | Particules in suspension ($\mu$ $m^3$) |
|---|---|---|---|
| 10 - natural quality air | 0-10 | 0-5 | 0-5 |
| 9 - clean air level I | 10-25 | 5-15 | 5-10 |
| 8 - clean air level II | 25-50 | 15-30 | 10-25 |
| 7 - affected air level I | 50-100 | 30-60 | 25-50 |
| 6 - affected air level II | 100-250 | 60-100 | 50-75 |
| 5 - polluted air level I | 250-300 | 100-120 | 75-100 |
| 4 - polluted air level II | 300-350 | 120-150 | 100-125 |
| 3 - downgraded air level I | 350-400 | 150-200 | 125-150 |
| 2 -downgraded air level II | 400-450 | 200-250 | 150-200 |
| 1 -unbreathable air | > 450 | >250 | >200 |
| MPC | 250$\mu$ $m^3$ | 100 $\mu$ $m^3$ | 75 $\mu$ $m^3$ |

*Table 3*

Average values of the atmosphere emission,
the treatment of waste oil and crude oil stabilisation

| | Polluting elements analysed | | | Reliability values given | | | |
|---|---|---|---|---|---|---|---|
| Years | $SO_2$ (μ $m^3$) | $NO_2$ (μ $m^3$) | Particules in suspension (μ $m^3$) | $SO_2$ (μ $m^3$) | $NO_2$ (μ $m^3$) | Particules in suspension (μ $m^3$) | Reliability values |
| 2007 | 65,55 | 151,5 | 1,77 | 7 | 4 | 10 | 7 |
| 2008 | 58,67 | 150,2 | 2,79 | 7 | 4 | 10 | 7 |
| 2009 | 35,98 | 149,9 | 27,3 | 8 | 4 | 7 | 7 |
| 2010 | 20,15 | 141,2 | 1,41 | 9 | 4 | 10 | 7,6 |
| MPC | 250μ $m^3$ | 100 μ $m^3$ | 75 μ $m^3$ | Final reliability grade | | | 7,2 |

Source: APM-Neamț

For every point of sampling of the analysis there has been given a reliability grade, concerning the quality of the water in the river Ozana, grades which will be used in the Rojanschi graphic method in the Table 4. The average concentration corresponds to the medium reliability grade **5,46** (Table 5).

*Table 4*

The reliability grades and the value classes for the water quality index.

| Indicators | Reliability grades determined according to the classes of value | | | | | | | | | | Classes of value | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | I | II | III | IV | V |
| $CBO_5$ | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-13 | 13-20 | >20 | 3 | 5 | 7 | 20 | >20 |
| $CCO_{Mn}$ | 0-2 | 3-3,5 | 3,5-5 | 5-7,5 | 7,5-10 | 10-15 | 15-20 | 20-35 | 35-50 | >50 | 5 | 10 | 20 | 50 | >50 |
| $CCO_{Cr}$ | 0-5 | 5-10 | 10-15 | 15-20 | 20-25 | 25-35 | 35-50 | 50-85 | 85-125 | >125 | 10 | 25 | 50 | 125 | >125 |
| Ammonium | 0-0,1 | 0,1-0,2 | 0,2-0,4 | 0,4-0,6 | 0,6-0,8 | 0,8-1,0 | 1,0-1,2 | 1,2-2,4 | 2,4-3,2 | >3,2 | 0,01 | 0,03 | 0,06 | 0,3 | >0,3 |
| Nitrates | 0-0,5 | 0,5-1 | 1-1,5 | 1,5-2 | 2-3 | 3-4 | 4-5,6 | 5,6-7,5 | 7,5-11,2 | >11,2 | 1 | 3 | 5,6 | 11,2 | >11,2 |
| Phosphorus | 0-0,05 | 0,05-0,1 | 0,1-0,15 | 0,15-0,25 | 0,25-0,4 | 0,4-0,6 | 0,6-0,75 | 0,75-1 | 1-1,2 | >1,2 | 0,15 | 0,4 | 0,75 | 1,2 | >1,2 |
| Oil prod. | 0-0,1 | | | | 1-2 | | | | 2-5 | >5 | fond | 100 | 200 | 500 | >500 |

Where :
10 – drinkable water, 9 – water category I (a), 8 – water category I (b)
7 – water category II (a), 6 – water category II (b), 5 – water category III,
4 – categoriy III – degraded level I, 3 – category IV – degraded level II,
2 – category IV – used water level I, 1 – category V – used water level II

*Table 5*

Reliability grades of the water quality in the river Ozana

| Nr. crt. | Indicator | Determined concentration mg/l | | | Reliability grade | | |
|---|---|---|---|---|---|---|---|
| | | Boboieşti | Pipirig | Leghin | Boboieşti | Piprig | Leghin |
| 1 | $CBO_5$ | 1,8 | 44 | 1,5 | 9 | 1 | 9 |
| 2 | $CCO_{Mn}$ | 3,6 | 63,38 | 6,8 | 8 | 1 | 7 |
| 3 | $CCO_{Cr}$ | 10,5 | 83,50 | 5,9 | 8 | 1 | 9 |
| 4 | Ammonium | 0,02 | 0,5 | 0,7 | 9 | 7 | 6 |
| 5 | Nitrates | 3,05 | 4 | 4,29 | 5 | 4 | 4 |
| 6 | Phosphorus | 0,02 | 2 | 1 | 10 | 1 | 3 |
| 7 | Oil products | - | 2,8 | 2 | - | 2 | 3 |
| Final reliability grade: 5,46 | | | | | 8,1 | 2,42 | 5,95 |

Source: SGA „Siretul Neamţ"

At the ground component the determination of the reliability grade was carried out by the use of tests conducted near the refinery and oil depot. The determination method and giving the reliability grades is similar to water and air components, medium concentrations corresponding to the reliability grade **9** (Table 6;7) .

*Table 6*

Reliability grades depending on the content of heavy metals in the soil (mg/Kg)

| Reliability grade | Cr | Cu | Mn | Pb | Cd |
|---|---|---|---|---|---|
| 10. natural state soil | 0-30 | 0-20 | 0-900 | 0-20 | 0-1 |
| 9. clean soil | 30-50 | 20-40 | 900-1100 | 20-40 | 1-2 |
| 8. little affected soil | 50-70 | 40-70 | 1100-1300 | 40-70 | 2-2,5 |
| 7. strongly affected soil | 70-100 | 70-100 | 1300-1500 | 70-100 | 2,5-3 |
| 6. polluted soil | 100-150 | 100-150 | 1500-1800 | 100-150 | 3-5 |
| 5. strongly polluted soil | 150-200 | 150-200 | 1800-2100 | 150- 300 | 5-7 |
| 4. downgraded soil | 200-300 | 200-300 | 2100-2400 | 300-500 | 7-10 |
| 3. strongly downgraded soil | 300-400 | 300-400 | 2400-2700 | 500-1000 | 10-20 |
| 2. modified soil | 400-500 | 400-500 | 2700-3000 | 1000-2000 | 20-30 |
| 1. irrecuperable soil | >500 | >500 | >3000 | >2000 | >30 |

*Table 7*

Reliability grades given for the soil quality in the Ozana hydrographic basin in the mountainous sector

| Nr. ctr | Elements | Determined values (mg/kg s.u.) | | | | Reliability grade | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2007 | 2008 | 2009 | 2010 | 2007 | 2008 | 2009 | 2010 |
| 1. | Total chromium | 19,46 | 15,30 | 13,1 | 15,12 | 10 | 10 | 10 | 10 |
| 2. | Copper | 29,2 | 18,91 | 22,6 | 20,23 | 9 | 10 | 9 | 9 |
| 3. | Manganese | 679 | 762 | 38,6 | 28,77 | 10 | 10 | 10 | 10 |
| 4. | Lead | 54 | 20,06 | 20,8 | 14,25 | 8 | 9 | 9 | 10 |
| 5. | Cadmium | 1,09 | 1,08 | 1,97 | 1,89 | 9 | 9 | 9 | 9 |
| Final reliability grade : 9,4 | | | | | | 9,3 | 9,6 | 9,4 | 9,6 |

Source:

Vegetation was compared according to the fotosintetic yield of the trees which faced in the Ozana hydrographic basin in the mountainous sector, a reduction of 15% and increasing losses of trees 10-30%, resulting in a reliability grade of 8.

Whereas the catchment area of the Ozana river under study is situated in a mountain area and the nearest urban locality is situated at 30 km away, in the model, the health factor has not been taken into account.

The index of global pollution (GPI) results from the ratio IS / AS in accordance with the methodology presented.

The value IS (ideal state) results from the regulate geometric figure having the surface:

IS = 200 square km

The value AS (actual state) – results from the irregulate geometric figure inscribed in the regulate geometric figure of the ideal state and built through the unification of the points resulting from the placement of the values RG (reliability grade) for every environment factor taken in considerration.

The RG value is obtained for every environment factor from the reliability scale depending on the value of the pollution index and it serves for the graphical representation , as a method of simulation of the synergic effect.

The graphical relation( Fig.1), between the RG calculated for 4 elements of the environment, is a square made with the values:

RG for AIR: 7;
RG for WATER: 5;
RG for SOLE UNDERGROUND: 9;
RG for FLORA: 8

Having the surface: $S_r$ = 105square km

$$\Rightarrow \quad GPI = \frac{IS}{AS} = \frac{200}{105} = 4,1$$

The value of the global pollution index is:

**GPI = 4,1**

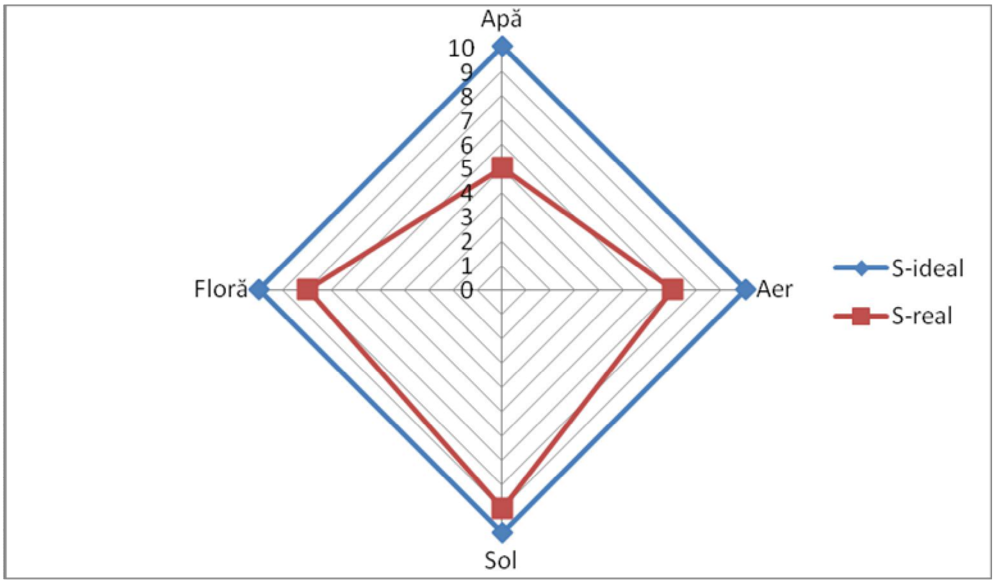

Fig. 1 The graphic for the calculation of the global pollution index

**CONCLUSIONS**

For the extraction and refining of crude oil, which took place normally, the index of global pollution state GPI is 4.1. By comparison with the scale proposed by V. Rojanschi and colab., 2002, **the environment is seriously affected by human activity, dangerous for the forms of life.**

To sum up, the environment of the Ozana river basin in the mountainous sector, being seriously affected, it is required the implementation of a series of measures for the ecological reconstruction.

This method of quantification of the impact of an activity on the quality of the environment has a number of advantages but also disadvantages such as:

- can provide an overview of the quality of the environment at a given time;
- allows a comparison of the quality state within the Ozana river basin in the mountainous sector, in time, while pursuing the dynamics of the environment state evolution for a certain period of time.
- the lack of a monitoring system of the environmental factors at european standards which would provide the data necessary for the application of the method.

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