RESEARCHES REGARDING ENVIRONMENTAL IMPACT OF OPEN PIT MINES

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Abstract: In order for a sustainable development there is the need to simultaneously maintain an economic development together with an environmental one, implying as well an environmental impact assessment in the beginning phases of all plans and programmes. The environmental impact assessment is one of the basic instruments of environmental policies and modern regulations. Practically there is a diversity of methods for developing environmental impact assessment. Out of all the methods used for an EIA, the following ones may be mentioned: the matrix method and the global pollution index one. These methods are applied in the paper for the area adjacent to the mines in Olt Coal Basin.

Key words: development, impact, methods, EIA.

1. GENERAL CONSIDERATIONS ON THE ENVIRONMENTAL IMPACT ASSESMENT

In order to have a natural balance between the environment its resources and man, a strategic development needs to be considered for the existence of a continuous stable proportion between the natural habitat and human population. The need to simultaneously support an economic development together with an environmental one implies an Environmental Impact Assessment (EIA) during the initial phases of all plans and programmes, for an environmental sustainable development according to the Governmental Decision no. 1076/2004 regarding the environmental impact assessment procedure for plans and programmes.

The EIA identifies, describes and correspondingly assesses, for each case, the direct and indirect effects of the project on the following factors: human beings, fauna,

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flora, soil, water, air, weather and landscape, material goods, cultural assets, as well as their interaction.

In order to reach the objective of a sustainable development, the authorities in charge with environmental protection use planning instruments where the EIA is also found. Considering the effects the initial phases of a project / investment have on the environment leads to an early identification and assessment of its possible impact. Therefore, measures for minimising the negative effects, even before they become irreversible, need to be considered.

In practices, there is a diversity of environmental impact evaluation methods. This aspect is being conferred by the objective of the assessment studies, the regulation and legislation considering their development, and by the components and competence of the assessing teams of experts.

The criteria involved in choosing the methods are presented, but in general they consider the following problems: opportunity, repeatability, consistency, assessment economy. Moreover, choosing the assessment techniques or methods depends on: time, logistics, and financial resources; purpose of evaluation; evaluation criteria; evaluation team.

Sometimes, the assessment may be reduced just to discussions and doesn't use technique or method. The methods viable during a certain period may lose importance sooner or later in different situations due to the environment, society and economy. Therefore, apparent real situations may be assessed differently or their evaluation methods may be different. The most used evaluation methods for the determination of human impact on the environment are the matrix method and the global pollution index one, both applied for the area considered in this paper.

2. ASSESSING THE IMPACT OF THE ACTIVITY IN A QUARRY ON THE ENVIRONMENT OF THE ADJACENT AREAS

The most used evaluation methods for the determination of human impact on the environment are the matrix method and the global pollution index one.

2.1. Impact Assessment Matrix Method

The matrixes may be used for the identification, systematic study visualisation and evaluation of most impacts on the environment.

The Simple Matrix

A simple matrix is a combination of two control lists, one of them describing the potential or existent impacts on the human activity / project (distributed on columns), while the other comprises environmental or socio-economic conditions which may be affected by this impact (distributed on rows). The simple matrixes may go beyond the point of identifying and systematising the impacts in opposition to more complex matrixes which may lead to the identification of indirect impacts.

Table 1 presents the simple matrix which assesses human impact on the

environment of the areas of the quarries analysed in the paper.

The lines of the matrix represent the actions the activities exert on the environment, respectively causal actions in which the brown coal exploitation activity was decomposed through open pit mining, directly productive activities and extra activities, while the columns of the matrix represent environmental indexes, analysed environmental components, category divided and grouped.

Table 1 **The simple matrix for the identification of environmental impact in the area adjacent to Roşia de Jiu, Peşteana North and Peşteana South quarries.**

No.	*Activities / Operations*	*Geophysical environment*				*Biologic Environment*		*Socio-economic Indexes*
		Soil	*Air*	*Surface Waters*	*Ground Waters*	*Flora*	*Fauna*	
	Direct Productive Activities							
1	Preparing the land for the mining activity	-3	-1	-3	-3	-3	-3	-3
2	Top soil removal	-3	0	-2	-3	-3	-3	0
3	Coal and waste excavation	-3	-2	0	-3	0	-3	-1
4	Waste and coal haulage – conveyor trajectory	-2	-2	0	0	-1	-1	0
5	Exterior waste pile formation	-3	-2	0	-1	-3	-3	-1
6	Interior waste pile formation	-1	-2	0	-3	0	-1	-1
7	Intermediate coal deposits	-2	-2	0	-2	0	0	-1
8	Central coal deposits	-2	-2	0	0	0	0	-1
9	Coal shipping – box car loading	-1	0	0	0	0	0	0
	Extra activities							
10	Thermal agent production inside quarries heating plants	-1	-2	0	0	0	0	1
11	Thermal agent production in Central heating plants for social consumption	-1	-2	0	0	0	0	1
12	Quarry water supply and waste water outlet	-1	0	-1	0	0	0	2
13	Social enclosures water supply and waste water outlet	-1	0	-1	0	0	0	2
14	Drainage works	-1	0	-3	-3	0	-1	1
Level 2 Value		**-1.78**	**-1.21**	**-0.71**	**-1.28**	**-0.86**	**-1.07**	**-0.07**

A first step in the analysis of a system in order to assess the environment is constituted by the identification of the indexes characterising it.

The indexes used by the matrix representation may be grouped in either geophysical and biological environmental indexes or socio-economical ones. Environmental indicators refer to soil, air, surface waters, ground waters, flora and fauna. Socio-economic indexes are grouped in either social indexes or economic indexes.

Environmental, health and socio-economic factors represent level 2 indexes. Considering the level 2 indexes the basic indicators are defined, or level 1 indexes, i.e. those components playing a key part in the functionality of a system.

Measurement units and effective values for each basic unit are defined. The measurement units are both quantitative as well as qualitative when quantification is not possible using the productivity method.

The magnitude of the impact, i.e. the value given to level 1 indexes may have values comprised between 1 and 3 as follows: 1 – reduced impact; 2 – powerful impact; 3 – very powerful impact.

The type of impact is marked before each value, respectively: positive (+) and negative (-). If the impact is uncertain or insignificant for a certain causal action it is marked with 0.

The conclusion following the analysis of the information is that due to brown coal extraction activities in Roşia de Jiu, Peşteana North and Peşteana South quarries, environmental impact manifests itself on the level of all environmental factors especially on the soil and subsoil, air and ground waters.

2.2. Global pollution index method

A simple quantification of the degree of pollution of the environment, of a geographic area may be realised by the use of the global pollution index.

This method, also known as the productivity method or Rojanschi's method, is the most used one in procedural practices of EIA in Romania. The method is based on the estimation of environmental quality indexes depending on their productivity scale.

In general, it is considered that there is the possibility to appreciate the environment in one area in a given moment in time by determining the quality of air, water, soil, the health of the population as well as by being aware of the recorded plant and animal deficit.

A quality index is determined for each of the mentioned environmental factors obtaining a productivity factor, *Pf*, given according to the sampling results and environmental analyses.

A series of conclusions, allowing the situation of environmental factors within admissible limits established according to legislation (level limits 1, 2 and 3), result from the analysis of productivity. This method allows the determination of the global pollution index, *Gpi*, based on the simulation of the synergic effect of pollutants.

Therefore, by using the productivity factors for quality indexes attributed to environmental factors, a diagram is developed where the ideal state of the environment is graphically represented by a geometric figure. The resulted geometric figure might as well be an equilateral triangle, a square, a pentagon, or a regulate hexagon, depending on a series of analysed environmental factors.

The ideal state is graphically represented by these regulate geometric figures where their circumradius and those going through the tips divide in ten productivity units (numbering begins from the centre of the circle). By connecting the dots resulted from laying the values expressing the real state an irregular geometric figure with a much smaller circumcentered area in the regular geometric figure of the ideal state is obtained.

Assessing the global impact is based on expressing the quantity of pollution of the environment based on the global pollution index, *Gpi*. This index results from the proportion between the surfaces representing the Ideal State, *IS*, and respectively the Real State, *RS*, of the environment,

$$Gpi = \frac{IS}{RS}, \tag{1}$$

where *IS* represents the surface of the ideal state of the environment and *RS* is the surface of the ideal state of the environment.

The results obtained for the global pollution index, *Gpi*, allow the establishment and situation of human activity on a scale regarding environmental quality, resulting as well from tables 2 and 3.

Table 2 **Gpi values conversion scale in human effects on environmental quality**

Gpi value	*Activity effects on the environment*
1	It is a natural environment, unaffected by human activity
1-2	The environment is affected by human activity within admissible limits
2-3	The environment is affected by human activity inducing a discomfort state to all life forms
3-4	The environment is affected inducing disturbances to all life forms
4-6	The environment is affected by human activity being dangerous for all life forms
> 6	The environment is degraded, unsuited to all life forms

The advantages of this method are: that they confer a global image of the health and quality of the environment in a given moment; allows the comparison of different areas with the condition they are analysed according to the same indicators; it is based on the same chemical analyses. The disadvantage of this method is that the subjectivity index generated on the productivity scale.

The use of this method makes a global evaluation of the impact in Rovinari, Fărcăşeşti, Bâlteni, Urdari, and Plopşoru areas.

Based on studied documents, environmental characteristics in the area, quality parameters and environmental factors, data obtained from the Gorj Environmental Protection Agency, results obtained through the development of networks and impact matrix, personal direct observations in Rovinari coal basin, an analysis was carried out considering environmental components and identified polluting sources.

The most difficult step of this study is to estimate the effects. The basis of their estimation is their size, which is determined considering the level of several characterising indicators. The size of the effects is always in proportion to certain reference admissible levels, standards and intervals.

The environmental factors considered for the analysed area are soil, water, air, population health, vegetation and the position of the population.

Table 3 **Productivity factors given by Rojanschi's method**

Productivity Factor	*Activity effects on the environment*
10	- Unaffected environment
9	- Environment affected within admissible limits - Level 1 - Increased positive influences
8	- Environment affected within admissible limits - Level 2 - Average positive influences
7	- Environment affected within admissible limits - Level 3 - Reduced positive influence
6	- Environment affected over admissible limits - Level 1 - Negative effects
5	- Environment affected over admissible limits - Level 2 - Negative effects
4	- Environment affected over admissible limits - Level 3 - Negative effects
3	- Degraded Environment - Level 1 - The effects are harmful at long periods of exposure time
2	- Degraded Environment - Level 2 - The effects are harmful at average periods of exposure time
1	- Degraded Environment - Level 3 - The effects are harmful at short periods of exposure time

Figure 1 represents the graphic representation of the average of productivity factors for all six environmental factors considered by the study.

The Global pollution index Gpi = 1.61 results from the analysed data and graphic representation in Figure 1, leading to the conclusion that the environment of Roşia de Jiu, Peşteana North, Peşteana South and quarries and their adjacent areas is affected by human activity within admissible limits.

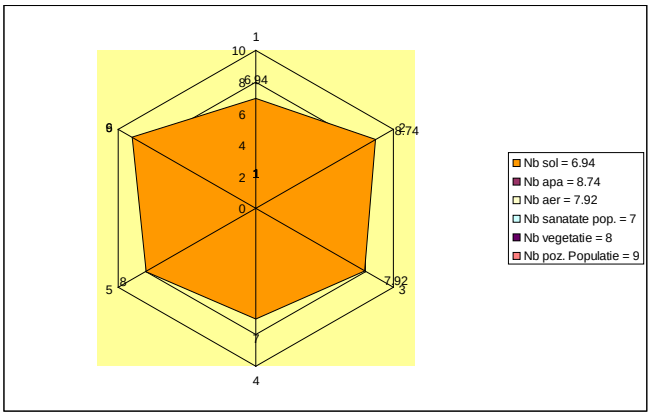

Fig. 1. Graphic representation of productivity factors attributed to environmental factors

Approaching this type of Environmental Impact Assessment, a global general image on the environmental state is presented as well as the dynamics in time of the area.

Following the analysis of the impact matrix and obtained results following the estimation of the Gpi, a general conclusion may be stated, that the impact on the environment in the adjacent areas of the studied quarries caused by brown coal mining manifests on the level of all environmental factors respectively, water, air, soil and consequently vegetation, fauna, human settlements and population.

3. CONCLUSIONS

The objective of this paper is to determine the quantity and quality, using different procedures, of the impact human activity in open pit mines has on the adjacent areas of Roşia de Jiu, Peşteana North and Peşteana South quarries.

The environmental impact assessment correspondingly identifies, describes and evaluates, for each and separate case, the direct and indirect effects of the following factors: human beings, fauna, flora, soil, air, water, climate, landscape, material goods and cultural assets, as well as the interactions of the mentioned factors.

The most used evaluation methods for the determination of human impact on the environment are the matrix method and the global pollution index one.

Following the matrix analysis, broken down for the mentioned quarry and for waste piles, the richness and negative effects of the open pit mines on all

environmental factors including on human collective in the adjacent areas of Roşia de Jiu, Peşteana North and Peşteana South quarries are noticed. The negative items are three times more than the positive ones resulting in the need to rationally organise in order for the taken measures realise the wanted impact reduction.

Global impact assessment in the Rovinari, Fărcăşeşti, Bâlteni, Urdari and Plopşoru area lead to a global pollution index of 1.61 proving that the environment of Roşia de Jiu, Peşteana North, Peşteana South quarries and their adjacent areas is affected by human activity within admissible limits.

Comparing the values obtained following the determination with maximum admissible values regulated on a global scale and by the Romanian standards lead to the idea that gas emissions substantially exceed the admissible values.

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