THE IMPACT OF LIGNITE EXPLOITATION IN BERBEȘTI MINING BASIN ON THE ENVIRONMENT

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Abstract: *Romania, one of the most important coal producing countries in Europe, has a long tradition in the mining industry and has significant coal reserves that can ensure the continuity of production for more than 150 years. After 1989, coal production in our country almost halved, mainly due to the decrease of the mining activity and the reduction of the coal consumption, these aspects also affecting the exploitation in the Berbeşti Mining Basin. The exploitation of the lignite in the Berbeşti Mining Basin has a consistent environmental impact that needs to be properly identified and quantified so that appropriate measures can be implemented to ensure maximum exploitation in terms of quality and in assuring the implementation of the principles of sustainable development. The present paper presents the three active quarries in the Berbeşti Mining Basin, respectively West Berbeşti, Panga and Olteţ quarries, which in the present period exclusively provide the raw material for the operation of the Govora Thermal Power Plant. The identification and assessment of the impact of exploitation of the lignite in the Berber Mining Basin is based on the realization of an impact network and a matrix from which the main impact generating activities as well as the major changes they bring to the environment can be observed.*

Key words: *Berbeşti Mining Basin, mining, environment, soil, air, water, impact, energy production*

1. Introduction

Govora Thermal Power Plant operates on the basis of inferior coal (lignite) exploited in the Berbeşti and Alunu coalfields, approximately 40 km away. It also has the ability to function additionally on the basis of fuel oil, natural gas and occasionally biomass and other compatible alternative fuels.

CET Govora has the capacity to store 500,000 tons of crushed coal and 10,000 m^3 of fuel oil, as well as a minimum gas supply equivalent to 3% of the primary energy demand, respectively 1,500 Nm^3/h. The connection to the Transgaz network can ensure a maximum consumption of 66,000 Nm^3/h of natural gas [2].

For the production of electric and thermal energy, 2.1 million tons of coal from the Berbeşti-Alunu Mining coalfields (production of the quarries in 2017) is consumed annually, which represents 97% of the primary thermal energy and 30 million cubic meters of methane gas to support combustion or reserve fuel (fuel oil), accounting for 3% of the resource requirements [2].

Due to the restructuring of mining started in 1997, which led to the phased closure of all mines and micro quarries, the exploitation activities were concentrated in the quarries Ruget, Olteţ, Berbeşti Vest and Panga.

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2. Description of quarries belonging to Berbeşti Mining Basin

In Romania, the most important inferior coal deposits (lignite) are located in the Subcarpathians of Oltenia, in the area between the Danube and the Olt River. This perimeter occupies an area of approximately 4500 km^2, on the territory of three counties, Mehedinţi, Gorj and Vâlcea, as shown in Figure 1.

From a geological point of view, the Oltenia deposit belongs to the Pliocene formations (Dacian, Romanian and Pontian) consisting of 21 layers of inferior coal, lignite, with variable thickness and extension, limited by softer, slightly cohesive sterile rocks, among which the clayey and sandy ones predominate [3, 6]

At present, the following quarries are in operation in Oltenia: Roşia de Jiu, Pesteana Nord, Rovinari Est - Garla, Tismana I - II, Pinoasa, Jilţ Nord, Jilţ Sud, Lupoaia, Roşiuţa, Berbeşti Vest, Panga and Olteţ.

These last three lignite quarries: Berbeşti Vest, Olteţ and Panga in Vâlcea County belong to Berbeşti Mining Basin (MB) (Figure 2). It is located in the Getic Piedmont, along the parallel of 45° N latitude, at the border between Gorj and Vâlcea counties, being limited to the west by the Gilort River, and to the east by the Bistrita River [3].

With a length of more than 45 km and a slope of 2.5-5 km, the lignite deposit was divided into four mining perimeters. Within each perimeter there were several mining fields that were the object of underground mining or quarrying.

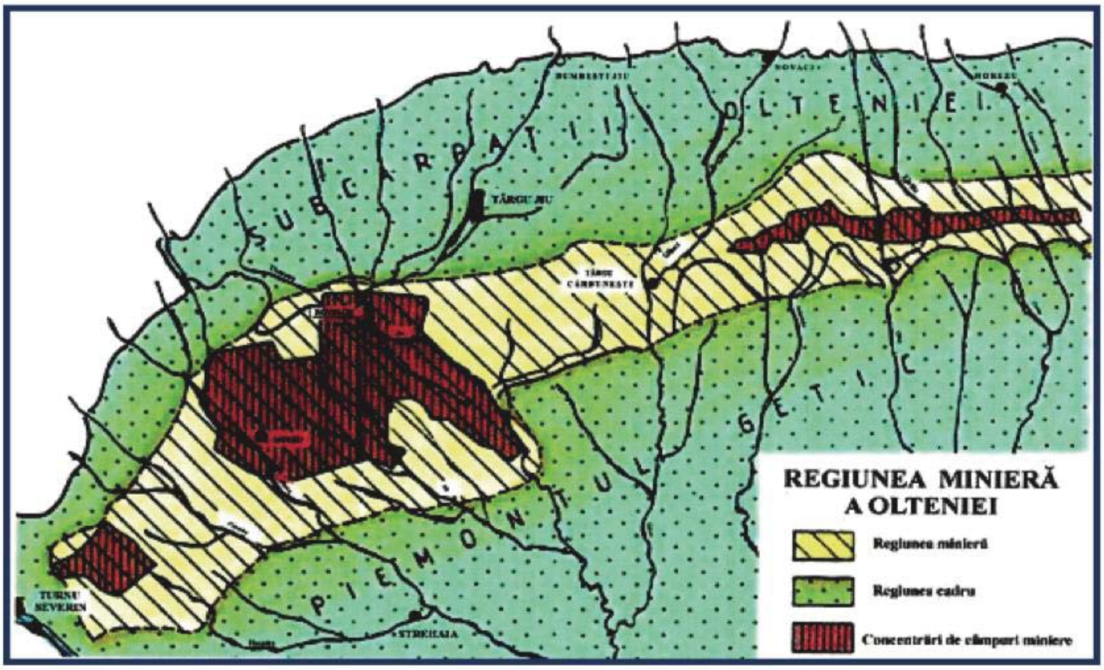

Fig. 1. *Oltenia mining area [3]*

Starting from the Upper Dacian and continuing with the Lower Romanian, there were favorable conditions for the development of a vigorous vegetation that led to the formation of nine lignite layers, with varying thicknesses and expansions, of which layers I, II, III and rarely IV present economic importance. Their calorific value varies between 1,803 and 2,428 kcal/kg [6].

The total quantity of coal extracted amounted 17.24 million tons of lignite, and the maximum production of 1.159 million tons was recorded in 1996 [3].

The three active quarries in Berbeşti, respectively Berbeşti Vest, Panga and Olteţ, which were formerly owned by the CE Oltenia, provide, at the present time, exclusively the raw material for the operation of the Govora Thermal Power Plant.

Fig. 2. *Berbeşti Mining Basin (underground mines, active and in conservation quarries, waste dumps) [6]*

At present Berbeşti MB operates with three sectors of activity, as follows [2]:

• Olteţ sector, which consists of four excavation lines, two dumping lines and a coal transport line;

• The Berbeşti Vest sector, which consists of three excavation lines, a dumping line and a coal transport line;

• The Panga sector, consisting of three excavation lines, two dumping lines and a coal transport line.

According to data obtained from CET Govora for 2018, the projected production capacity is the following [2]:

• Panga - 1,100 thousand tons/year;

• Olteţ - 1,200 thousand tons/year;

• Berbeşti Vest - 500 thousand tons/year.

According to the same source, the duration of activity at the projected capacity is the following [2]:

• Panga - 5.9 years;

• Olteţ - 18.9 years;

• Berbeşti West - 9.5 years.

Possibilities of extending perimeters of U.M.C. Berbeşti Vest - Olteţ perimeter extension [2]:

• Initially - 8,336 km^2;

• Extension - 2,653 km^2;

• Total perimeter - 10,989 km^2.

The access to the perimeter is made along the main valleys that cross the region, either from the north, from the Râmnicu Vâlcea - Horezu - Târgu Jiu national road, Milostea - Mateeşti - Berbeşti - Grădiştea road, which follows the Tărâia Valley or the Ciuperceni - Alimpeşti - Bodeşti - Igoiu – Alunu road, along the Olteţ Valley, or from the south on the same roads. It is also possible to access the perimeter on the Târgu Cărbuneşti - Albeni - Călugăreasa - Ruscana - Roşia de Sus and Jos - Alunu roads, coming from the west. Also the access to the perimeter is made by the railway Ramnicu Vâlcea - Băbeni - Berbeşti - Alunu, and for the Albeni - Ruget perimeter, Craiova railway - Târgu Cărbuneşti - Corbu.

Olteţ quarry is located in the western part of Vâlcea County and is located in the Amaradia-Tărâia perimeter and extends to the area of Roşia de Amaradia, Alunu, Sineşti and Berbeşti. Opening works began in 1980 and consisted in executing a trench in the northern area where coal strata had outcropped.

The projected production capacity of Olteţ quarry was of 0.3 million tons per year. The coal layers exploitable in its perimeter are: I, II and III, but on narrow surfaces, where the thickness of the layer permits the selection, layer IV is also extracted with good results.

The method of exploitation applied to the Olteţ quarry is "the method combined with the partial transport of the sterile to the inner dump, a second part to the exterior dump and the partial transshipment to the inner dump of the third part of the tailings", and the technology used is " continuous excavation, transport and conveyance" with high-capacity bucket-wheel excavators that alternately remove the overburden and extracts lignite [6].

The deposited coal is loaded into specialized FALS wagons with a capacity of approximately 55 tons each, which are weighed and then shipped to CET Govora (by trains of 25 wagons).

The railway, with a length of approximately 38 km, crosses three hills (one of the hills is pierced by a tunnel) and five water courses. Due to its use under the projected transit capacity, the maintenance of the railways is precarious and there are often derailment risks, counteracted by interruptions of the transport for embankment consolidation works.

The accumulated coal forms a solid fuel stack near the charging bands connecting the deposit to the boiler room where the lignite is taken up by a combined machine.

Berbeşti Vest quarry is situated to the west of Tărâia River (left tributary of Olteţ River), in Berbeşti-Alunu localities, part of the Amaradia - Tărâia mining perimeter. The relief is hilly and has altitudes between 350-470 m.

Berbeşti Vest quarry was designed with a production capacity of 0.5 million tons per year. Depending on the area's relief conditions as well as the vertical distance from the last exploitable coal deposits to the surface, the depth of existing quarries in the Berbeşti area varies between 40 and 110 m in the lower meadow areas and up to 180 m in hilly areas, the total overburden ratio of mining field is between 3.5 and 8.1 m^3 sterile/ton of coal [3].

Berbesti quarries apply the method of exploitation consisting in the transport of the tailings to the external waste dumps, this being the method used in the lignite quarries where the final depth of the quarry still has not been reached and therefore, the premises are not yet created to form the inner dump.

The exploitation method with tailings transport at internal dumps is currently only applied in the Panga quarry (currently the more used method is the one that uses in addition to the tailings transport, the transshipment of the tailings into the internal dumps).

In Berbeşti MB quarries have steps with heights of 15-25 m and slope angles of 60-65°, the lengths varying between 1000 and 2000 m. The overall pit angles vary between 12 and 20° depending on the nature of the rocks in the exploitation perimeter and applied technologies [1].

The quarry works are carried out with special bucket-wheel excavators, which can ensure the excavation of coal in steps up to 25 m. When cutting above the level of the vehicle is being used a slightly lower average height, of just 22 m.

The sterile resulting from the opening trenches in the Berbeşti area was transported and stored in external waste dumps located at an average distance from the exploitation perimeters.

Depending on the characteristics of the waste material (moisture, consistency, loosening coefficient, granulometry etc.) as well as expected heights for the external waste dumps, they were constructed at a general angle of inclination between 6° and 9°.

Panga quarry is located in the western part of Vâlcea County, on the left bank of the Tărâia Stream, located on the Berbeşti, Copăceni and Mateeşti localities in the Tărâia-Cernişoara mining perimeter.

The opening mining works consisted in the construction of a 600 meters long trench on the western side of the Berbeşti quarry with the help of the classical machinery, followed by a movement of the attacking entrances parallel with it.

At present, the Panga quarry provides the conditions for the storage of the tailings in the inner dump by means of the dumping machines.

3. Identification of the impact of lignite exploitation in the Berbeşti Mining Basin on the environment

In addition to the direct combustion of coal in thermal power plants, social and environmental costs also result from quarrying, transport and storage of inferior coal in the Berbeşti MB, which affects the air quality, the edaffic cover, the aquifer system and the terrestrial and aquatic ecosystems by modifying biodiversity in the mining area subject to the present study. Thus, the exploitation of the lignite in the Berbeşti MB has a series of remaining consequences, which manifests on all the components of the environment: air, soil and subsoil, water and ecosystems.

3.1. Impact on air

The exploitation of lignite in the Berbesti MB as well as the accumulation and storage of solid waste is a matter of high relevance and importance for the quality of the environment in terms of profoundly negative influences on all its components [1].

Air quality, one of the major environmental components, is negatively affected by mining but also by waste produced and stored in the waste dumps (because the air is the carrier of many pollutants, which it spreads easily on the surface of the land).

Due to wind turbulence (phenomenon of deflation/winding), ash discharges (20-30 per year) are the main negative effects of coal deposits, slag heaps and ashes, and which affect the perimeter and the surrounding areas of the waste dumps. Also, visibility is affected in these areas, the air becomes non breathable by generating unpleasant odors due to both waste as well as degradation processes. Buildings are destroyed, premature wear of electrical systems (overfill insulators and high-voltage poles), blockage of respiratory centers and diminishing crops in neighboring agricultural areas.

The effects of air quality change caused by quarrying are materialized by increasing the concentration of suspended particulates, gas and smoke particles from quarry activities at certain points of the mining perimeter. The most important points of interest are the excavation area (excavator bucket), deposition areas of tailings and coal, the front conveyor spill point, the connecting conveyors and the access roads [1].

Quarrying manifests itself as a source of pollution, especially with sedimentary dusts, particles larger than 20 μm, which do not diffuse into the atmosphere but are gravitationally deposited.

The analyses carried out on the powders in the quarry area, showed the predominance of carbon in the elemental form or in organic compounds. Amounts of silicon, iron, magnesium, zinc were also determined.

For the localities in the Berbeşti area, the level of pollution with sedimentary dusts from the Berbeşti MB is below the value allowed by the standards.

For summer periods, when dust is increased due to drought and dryness, mobile sources of watering are provided in the access and maneuvering areas for the machinery in the quarry.

A potential source of pollutants is coal self-ignition from deposits or from quarry steps. Due to incomplete combustion, carbon monoxide is released in the air as well as lower amounts of sulfur dioxide, light hydrocarbons and toxic substances (they do not reach concentrations that exceed the permitted limits)

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3.2. Impact on soil

The morphological modifications at ground level are caused by the quarrying of lignite deposits in the Berbeşti MB. The quarries primarily affect the surface layer of fertile soil as land use changes. Also, solid residues, or the amount of tailings dumped, resulting from mining operations, require large areas of land for storage.

The soil present in the Berbeşti MB is part of the category of heavily sub-soiled brown forestry soils, with the upper horizon with a luscious and sludge-like structure, as well as extended clayey soils.

Forest soils have a slightly differentiated profile, brown or yellowish color with darker shades in the A horizon due to the presence of humus. The structure of the A horizon is corrugated glomerular, and to the depth the structural elements gradually increase so that in the B horizon the structure becomes nut like or nut like-prismatic, following the structure of the base rocks.

In the area of the Berbeşti Mining Basin, the excavation of the overburden of the coal layers led to the removal of the soil layer from the entire surface of the quarries and the waste dumps. Taking into account the application of the ecological recovery program of the area, the discarded soil was preserved in fertile soil deposits for further use. Thus fertile soil is excavated, transported individually and deposited in the last step or on the final berms, and is then used to cover the surfaces to be plotted in the agricultural circuit with the premise of obtaining the best results, both quantitatively and qualitatively. Such a situation is not predominant, and therefore, the quantities of fertile soil recovered are small and fail to meet the need for full coverage of the areas that are plotted on the agricultural circuit.

Exploitation of the lignite in Berbeşti MB brings to surface lithological materials with different ages and different physical-chemical composition, distributed in a heterogeneous way, both horizontally and vertically [8]. Thus, a new category of soils called anthropic mining protosoil has been individualized. Most anthropogenic protosoils provide a sufficient edafic volume for the development of the crop root system, but they are devoided of microbiological activity (the essential feature of an evolved soil).

The tailings dumps are engineering constructions in which the waste rocks exploited from the quarry (with the useful lignite) are deposited. They are located on the grounds around the quarries. For the placement of the waste dumps one chooses the land that produces minimal impact on the environment and requires the lowest disposal costs.

Within the tailings dumps at the Berbeşti MB, materials are generally good for soil formation. In fertile soils, colloidal clay ranges between 6.1-6.5%, while in the tailings the materials with a colloidal clay content of 15-30% predominate. The anthropic mining protosoils are poorly productive or unproductive, falling within the quality categories V and VI (OSPA Gorj). For the introduction of the anthropic mining protosoils into the productive circuit, ameliorative interventions are necessary for long periods of time. To the surface occupied by the waste dumps themselves is also added to the surrounding land which represents their area of influence [3].

Most of the waste dumps from Berbești MB are located on the slopes or along the valleys, with or without water courses. The land altitudes generally vary between 650 m in the valley axis and 750 m on the slopes. The angle of inclination of the slopes varies between 6° and 35°. In some cases, the dumps were built in such a way that they bordered valleys without permanent water courses, forming lakes from precipitations [1].

3.3. Impact on surface and underground water

The main damage caused by mining and waste dumps on the environment is, in addition to the unpleasant visual impact, the destruction of land plots covered with fertile soil and vegetation, air pollution with dust resulting from tailings discharges and waste gases from underground mines and surface and underground water pollution with dissolved chemical elements or suspensions of solid particles entrained from the waste dumps by rainwater or infiltrations.

The impact of coal mining activities from Berbești MB on waters is a local and regional one, both temporarily and long-lasting, and refers to changes in natural valleys, the disappearance of some streams through exploitation or dumping, the remodeling of watercourses (permanent changes through regularizations), sewage, dams, consolidations, course deviations, changes in the surface water quantity regime but also changes in the quality of surface water by the discharge of contaminated waters from exploitation mining activities, changes in the quality of surface water due to accidental spillage of fuels (oils, diesel, gasoline) from engines or by mishandling them.

To the water degradation in the coal extraction perimeters, the waste dumps from Panga, Olteţ and Berbeşti Vest also have a substantial role.

As regards groundwater, there is a change in the physical-chemical equilibrium, caused by drilling and pumping activities in the execution of water supply sources, hydro-geological, geological drilling, wells or other capture works. Underground waters are affected by ash and slag dumps and deposits, where huge amounts of alkaline salts, ammonium ions, are drained to the ground, making the water non drinkable. Deposition of sterile rocks requires the change of phreatic continuity and aquifers, as well as the change in physical and chemical balance of groundwater (pH decrease and increases in organic matter, NH_4, Ni, Fe, etc.) [7].

In the quarries areas, by changing the relationship between aquifers and the phreatic shed, there are disappearances of existing aquifers and the appearance of new ones.

The quality of the surface and underground waters is generally negatively affected by activities under the mining area as outlined above. However, there is a positive effect on the environment, with regularization and sewerage work, with the role of defending against floods.

The potential environmental impact is maintained throughout the exploitation period of the Berbeşti area, manifested by a permanent increase in the vulnerability of the underground and surface waters, the change of the natural physicochemical balance and the danger of pollution.

3.4. Impact on ecosystems

Quarrying operations, quarries and industrial dumps causes soil geochemical damage, erosion and hydrological changes on the site, as well as in the adjacent areas. All this leads to the destruction of the vegetation cover in the industrial space, the diminution of biodiversity and the installation of the so-called "industrial wastelands" [7].

The area of the Berbeşti MB, located at an altitude of approximately 400 m and interposed by hills whose height is less than 700 m, is characterized, from the point of view of the vegetation cover, by the presence of the forests alternating with meadows and agricultural lands.

The forest vegetation comprises the beech sub-zone, the sub-area of the mixed beech forests with the oak and the oak sub-area. Areas with higher humidity (where water is bleached) from the perimeter of the quarry or the waste dumps are favorable for the appearance of palustrian vegetation.

Locally, in the area of the mining basin, as a result of the overburden removal, the natural vegetation of the trees and floriculture was completely destroyed on the working surfaces.

In some places, especially on the dumps, there is a tendency to restore grass vegetation with common species, devoid of botanical value, but important in the process of enriching the soil with organic matter.

The most efficient measure for the rehabilitation of the Berbeşti waste dumps is the biological recultivation (agricultural, forestry, agricultural and forestry). Global and national research in this area shows that forest re-cultivation is the most advantageous, as it requires a minimum of works compared to agricultural recultivation, improves the local landscape and contributes to the reintroduction of a part of the total amount of carbon emitted by the thermal power plant [4].

Locally, small areas are cultivated and the agro-systems are represented by corn and potato crops, and on limited areas there are fruit orchards and vineyards.

By substantially modifying the vegetation cover, over time, society through its activities has exerted a powerful action on fauna, which had the effect of changing its natural conditions on large surfaces. Sewage sludge and desertification have resulted in the disappearance of invertebrate fauna or vertebrates, adapted to this living environment. The deforestation, the destruction of the vegetation layer, resulted in the disappearance of some species, or the migration of others to areas that would ensure the living conditions and the climate specific to the species. Thus, both the living conditions and the old composition and spread of fauna have changed.

Fauna in forest areas is characterized by the presence of the squirrel, typical of the beech forests and some of the oak trees. Also, forest rodents, nocturnal or diurnal birds, such as the

Asio otus, the common shrimp, *Accipiter gentilis* can be found. Also from this biocenosis are typical forest birds such as *Dryobates major pinetorum*, *Gecinus viridis*, pigeon, cinnamon, finches, cuckoo etc. [3].

Among the species of interest can be mentioned: the collar pigeon, the sitter and other species able to adapt to various conditions in different geographical areas, such as hedgehogs, common weasels, common ferrets, foxes, wild boars, wolfs, rabbits etc. [1].

Terrestrial fauna has undergone important quantitative changes, with animal density being low in the dumps and quarries area due to poor pedological conditions and lack of food. The works in the area, the presence of large numbers of people, the agitation, the noise of the equipment, on the one hand, the deforestation, the destruction of the meadows, the pickling of the soil on the other hand, caused the migration of the vertebrate fauna from the site and its immediate vicinity.

The mammals around the quarries have disappeared, retreating to other areas with the same valences of the trophy niche. The main species present in the area are wild boars, rabbits and foxes.

Birds have suffered much from mining and dumping. The deforestation affected their habitat, which resulted in their disappearance from the area. The least affected were the birds living near the localities (sparrows, pigeons). Although there are reforestation programs, especially with acacia, of the affected areas, there are minimal chances that these forests will be quickly populated with birds because acacia does not have any pests.

In the meantime, mining dumps become true landscape constructions (of the third generation) being integrated into the environment where often new wet or dry biotopes have been set up to help ensure the living environment and the protection of many plant and animal species [1].

3.5. Impact networks

Impact networks make it possible to highlight the side and indirect effects of multiple or concomitant relationships of causes and the accumulation of their effects, taking into account the temporal dimension [5, 7].

Classic examples of impact networks used in identifying environmental components and impacts are the methods developed by Sorensen and the Bereano for assessing alternative technologies. The Sorensen method uses a two-dimensional matrix system to identify primary impacts (correlation between related actions and project elements with changes introduced by them in the environmental systems) and impact networks for analyzing top-level impacts and correlating them with mitigation measures [7].

The Bereano method, instead, uses three different impact networks to assess the effects of the environmental impact of different orders generated by the construction elements of the project, its operation and project-related activities, and the probable or predictable incidents [5, 7].

The impact network elaborated for Berbeşti MB (figure 3) considered the exploitation of the lignite, from which specific actions were branched out, such as the pickling of the soil cover, the excavation of the land and the appearance of the mining quarries, the accumulation of the tailings in the form of waste dumps, air and surface water and groundwater pollution, biodiversity degradation, landscape changes and socio-human activities, each of which continues with other primary impacts on natural environment components and secondary impacts.

Major changes can be observed in the morphology due to the deep development of the quarry by excavating the land for the exploitation of lignite.

It results in topographic negative forms and the appearance of waste rocks deposited in the form of dumps, in this situation emerging positive relief forms, on the surface of which the phenomena of sinking, landslides and ravines may intensify, or substrate and slow subsidence can occur, fact demanding an ecological redevelopment of the dumps and their reintroduction into the agricultural circuit [4].

4. Assessment of the impact of mining activities in Berbeşti Mining Basin

From the analysis of this matrix, Table 1, which reflects the environmental impact generated by the mining activities from Berbeşti MB, it can be emphasized that the cumulative values of the impact of the activities on the environment (by summing of the impacts on the individual environmental components) decreased to -144 as a whole, while the positive value at +is registered for the economic and social component.

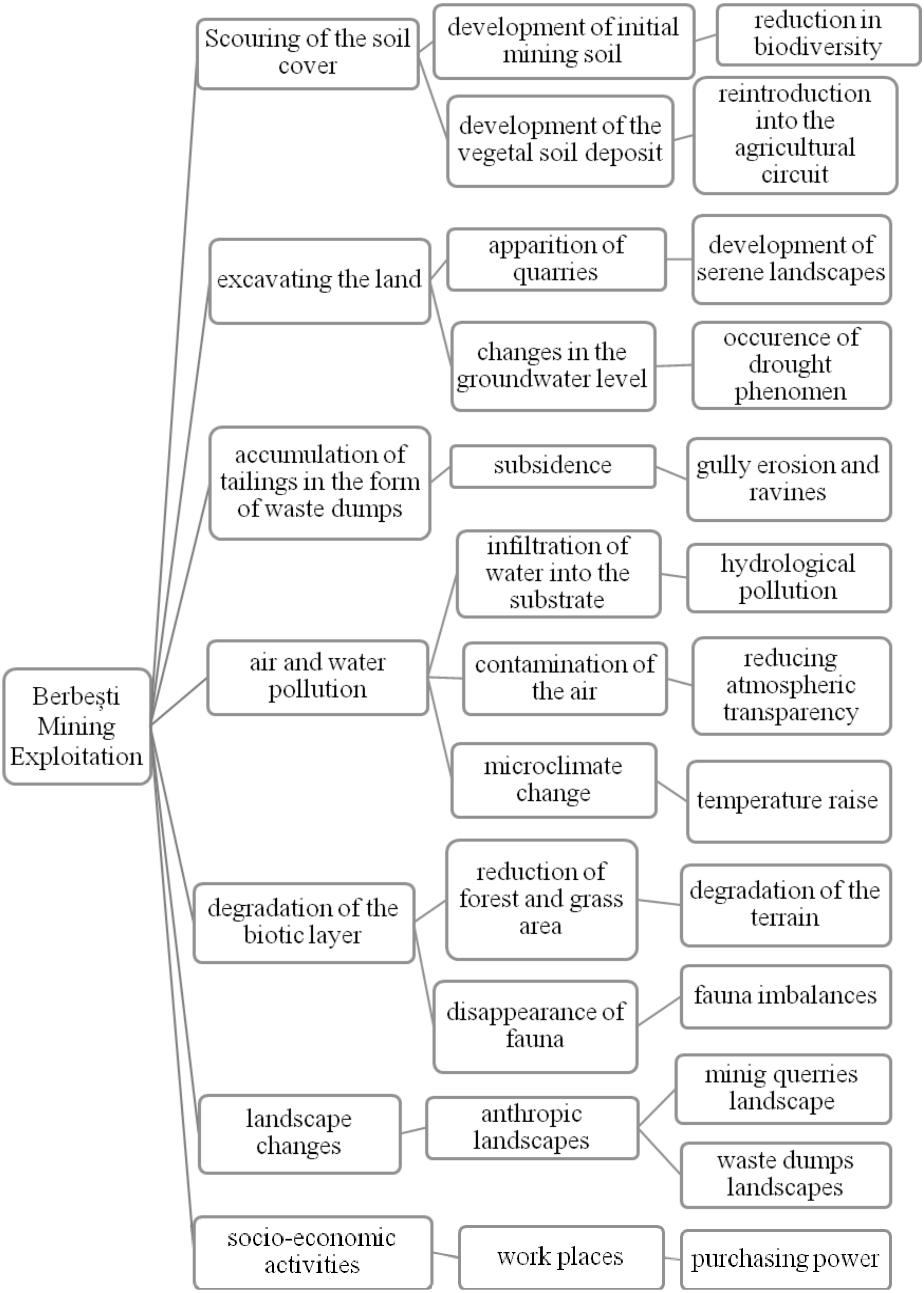

Fig. 3. *Impact network – Bereano method*

Table 1. *Impact matrix for lignite exploitation in Berbești Mining Basin*

Environmental issues	Berbești Mining Basin									
	Generation of gaseous pollutants (SO2, NOx, CO2)	Release of solid particles (dust, ash, slag)	Utilization of raw water and waste water disposal	Transport and storage of raw material (coal, fuel oil, gas)	Production of electricity and heat in cogeneration	Removing the vegetal soil cover	Deforestation of forest and grass vegetation	Development of anthropic landscapes (industrial)	Sound pollution (noise and vibration)	**Cumulative impact on environmental factors**
Air quality	-	-2	-1	-2	-	-1	-1	-1	-1	**-9**
Microclimate	-	-2	-	-1	-	-1	-1	-1	-	**-6**
Atmospheric nebulosity	-	-2	-1	-2	-	-1	-1	-1	-	**-8**
Presence of plant soil	-	-2	-	-2	-	-2	-2	-2	-	**-10**
Compaction of soil	-	-1	-1	-3	-	-1	-1	-1	-	**-8**
Surface water	-	-1	-1	-1	-	-1	-1	-1	-	**-6**
Oxygen dissolved in water	-	-1	-1	-	-	-	-	-	-	**-2**
Groundwater	-	-1	-1	-1	-	-1	-1	-1	-	**-6**
Turbidity	-	-1	-1	-1	-	-1	-1	-1	-	**-6**
Changing vegetation	-	-2	-1	-1	-	-2	-2	-2	-	**-10**
Change of fauna and ichthyofauna	-	-1	-2	-1	-	-1	-2	-1	-1	**-9**
Ecosystems	-	-2	-2	-1	-	-2	-2	-2	-1	**-12**
Morphology of the bed	-	-	-	-1	-	-	-	-1	-	**-2**
Soil processes	-	-	-	-1	-	-	-1	-	-1	**-3**
Landscape quality	-	-2	-1	-1	-	-1	-1	-1	-1	**-8**
Land degradation	-	-1	-1	-2	-	-1	-1	-1	-	**-7**
Occupy the space	-	-1	-1	-2	-	-2	-2	-2	-	**-10**
Socio-economic activities	-	-2	-2	-2	+3	-1	-1	-1	-1	**-10**
Risks	-1	-3	-2	-2	-	-1	-1	-1	-1	**-12**
The cumulative impact of activities on the environment	**-1**	**-27**	**-19**	**-27**	**+3**	**-20**	**-22**	**-21**	**-7**	**-144 +3**

Matrix analysis shows that the activities generating a consistent impact, of -27, are the release of solid particles (dust, ash, slag) and transport and storage of raw material (coal, fuel oil, gas). These activities have a negative influence on most of the environmental components, but the highest values of reliability are recorded for ecosystems, -12 and on the soil cover, of -10, being the environmental components that have the most to suffer.

Air quality and space occupancy have a total sum of -9 and -10 respectively. Changing air quality is due to the significant amounts of dust and slag released into the atmosphere, which reduces transparency, disturbs air temperature and precipitation, creates favorable conditions for the development of condensation nuclei and produces orographic rainfall.

The area under consideration is affected by morphological changes due to the excavation of the land through the exploitation of the lignite and the deep development of quarries and the occurrence of waste dumps.

Fertile soil is eliminated, vegetation and fauna coverings are degraded, and the original natural landscapes are replaced by mining landscapes, so it is important to have plans for land management in mining areas and to optimize space requirements for various post-mining uses.

5. Conclusions

Romania is currently confronted with a complex situation in terms of environmental pollution, because the industrial development has not taken into account that the progress of human society depends not only on the goods it offers but also on the shortcomings caused to the environment.

In order to maintain coal in the national energy mix, the operation of solid fossil fuel power plants must integrate into the requirements of sustainable development, especially because this resource, coal, is a strategic energy reserve, useful both in times of warmth as well as in droughts, but also because Romania has coal for another 30-40 years.

The impact of pollutant emissions on the environment of the Govora Thermal Power Plant is directly influenced by the quality of burned coal in boiler outlets, so we recommend an increased attention to the quality of the raw material used, the purchase of low sulfur and ash fuels, the installation of modern capture facilities the ashes.

As demand for electricity increases and in the next period it can even reach double consumption, in the present decade our concern can focus on existing power plants, which, although are sources of massive pollution, are installations that can be fitted with new technologies and procedures that could provide economic recovery, CET Govora being one of the few thermal power plants that still operate in the south of our country, although the situation is difficult, with the company going bankrupt since 2016.

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