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DOCTORAL THESIS

-SUMMARY-

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RESEARCH ON THE ANTHROPIC IMPACT OF MINING ACTIVITY IN THE JILȚ BASIN ON THE LAND AND POSSIBILITIES FOR THEIR REHABILITATION

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INTRODUCTION

In the period after 2000, the activity of exploitation through opencast mining of coal deposits in the Oltenia basins was subjected to extensive restructuring and reorganization processes of economic units (taking into account the decrease in their number by: closing the unproductive ones, merging, re-technologizing, adopting technologies in line with those used in developed countries, increasing production and productivity, etc.).

Opencast mining operations in the Oltenia basin developed in line with Romania's energy and economic requirements to the detriment of underground mining, due to the numerous advantages they present, among which are mentioned: complex and integral mechanization of technological processes, judicious planning and organization of production activity, achieving high production and productivity, in short terms and with low costs, etc. [29].

The opening, commissioning and continuation of the activity in the open pits, especially in the 1980s, have involved the opening of deposits with more difficult exploitation conditions (in terms of exploitation depths, discovery reports and complex hydrogeological conditions).

These increasingly difficult deposit conditions entail a series of exploitation-related problems as well as environmental problems that require solutions from specialists working in the field.

Current mining affects the environment, on the one hand, by modifying the landscape, and on the other hand, by the brutal intervention of the quarries in the natural processes and rhythms of ecosystems. All these effects have led to the emergence of a conflict of interests between the need to extract mineral raw materials and the requirements for environmental protection to such an extent that mining companies have begun to be viewed as “environmentally destructive”.

For this reason, in many countries environmental groups have called for limiting the activity in existing quarries and preventing the opening of new ones. All these restrictions have sometimes led to the impossibility of supplying some industrial branches with indigenous raw materials.

Although the negative effects of the current mining of lignite are significant and undeniable, this industrial branch has at its disposal multiple possibilities of minimizing the negative impact on the environment and, moreover, of reconstituting the affected areas.

For a long time, until about 20 years ago, priority was given to economic growth, to the exclusion of environmental protection issues. The serious forms of manifestation of the deterioration of the components of the environment have forced a change in this mentality.

The mining activity carried out in the quarry is characterized by a great influence on environmental factors – opencast mining occupies and modifies the geomorphological structure and makes it impossible, for a long period of time, to use or recultivate the land, and the tailings dumps occupy important agricultural and forestry areas, influencing the adjacent lands through morphological and hydrographic changes.

Discovery, preparation of the deposit and coal extraction constitute activities of a destructive nature, with a significant major impact by occupying important land areas, approx. 25% of the occupied areas are permanently removed from the agricultural circuit, being occupied

with social and urban constructions, communication routes or watercourses, and 75% is temporarily removed from the agricultural or forestry fund from 2÷3 years to 15÷20 years; destruction of topsoil and vegetation with repercussions on the habitat and local fauna [56].

The impact produced by open-pit coal mining activities on the soil and subsoil is local or zonal in surface and volume, long-term and refers to:

- the disturbance of the physico-chemical balance of the geological environment, produced by geological, hydrogeological and geotechnical prospecting through drilling, with insignificant, inevitable and irreversible effects on the soil and underground aquatic systems, on small surfaces and volumes and in a limited time interval;

- the impact on the soil and subsoil through the activity of building construction, roads, infrastructure and mining mass transport, etc.;

- the destruction of the natural geological environment.

The problems related to pollution and degradation of environmental quality led to the need to adopt general legislative measures as well as a series of sectoral regulations in the field of environmental protection.

Romania's new status as a full member state of the European Union also meant the harmonization of domestic legislation with European legislation (in some cases, the deadlines were proposed and forced, even by the political leaders of the relevant ministries), in this regard a series of directives and normative acts regarding environmental quality being transposed.

In this thesis, attention was focused on the Jilț mining basin and followed two main directions, namely:

- identifying and assessing the environmental impact induced by lignite exploitation activities through open-pit mining works in the two perimeters: Jilț Sud and Jilț Sud;

- and identifying the possibilities for ecological rehabilitation of the affected lands and the broad design of the works necessary to achieve this objective.

In order to achieve the first objective of the thesis, the work was prepared taking into account the legislation in force, namely the legal framework provided by O.U.G. 195/2005 [67] regarding environmental protection (approved by law 265/2006) as well as the guidelines drawn up in the activity of assessing the anthropogenic impact by H.G. 445/2009 [69].

Although the assessment of environmental impact has been a legally regulated activity for over 25 years (when the obligation of the environmental impact assessment procedure in the initial phase of projects was established by Order MAPPM 125/1996), a common characteristic of the normative acts mentioned above is the lack of establishment of a method(s) by which this assessment is carried out.

In the absence of publication of such methods, in Romania, a series of methods taken from Western Europe and the USA are currently used (impact matrices, impact networks, thematic maps, checklists, etc.), which can sometimes prove difficult to understand (especially if we consider public participation in the environmental impact assessment procedure) or can be used incorrectly [41].

- Environmental protection efforts, by developing non-polluting technologies in the field of coal extraction, are hampered by the considerable financial efforts they involve, but at the current stage of the development of the quarries in the Jilț mining basin, depending on the extraction methods and technologies applied, solutions must

be found to improve the affected environmental factors, including an anticipatory approach to resolving negative environmental impacts related to the prospect of closing/conserving certain mining objectives.

- The intervention to eliminate the impact generated by the lignite extraction activity is to rehabilitate the affected surfaces at the end of exploitation and consists of intervention measures for an optimal reuse destination of the area and obtaining maximum biological and morphological diversity, with the final goal of optimal inclusion in the territorial context, this being the second major objective of the thesis.
- The return of lands affected by opencast mining in the Jilț mining basin to the economic circuit represents, according to the legislation in force [67], an obligation for the holders of exploitation licenses (there are also situations when the economic operator is obliged by court decision to restore to the initial state, although it no longer holds a license) in accordance with the principles of sustainable development and with global trends, more precisely with the increasing care and attention paid to environmental protection and restoration.
- Following up from the design phase on aspects related to the return of tailings dumps and lands affected by opencast mining to the economic circuit is also related to the influence they have on the limits of the quarries, the overburden coefficient and finally on the extraction costs.
- Ecological rehabilitation requires special attention from the point of view of the legislative and regulatory framework, which allows for great flexibility in forecasts and the possibility of modifying the destination of land areas and which takes into account the attractions and characteristics of the territory based on a complex process of analysis of the built landscape, through the most modern working methods.
- The reconstruction and ecological rehabilitation of lands degraded by open-pit mining activities must be carried out in accordance with the political and economic objectives of the country. The main objectives of this activity are [40]:
- - long-term planning and conscious construction of a territory or portions of territory that meet the economic requirements and the material, cultural and aesthetic needs of the population;
- - restoration in the shortest possible time of degraded land areas, in order to achieve a high and stable income as a result of their use, which corresponds to local conditions and guarantees the restoration of ecological balance.
- Considering the aforementioned aspects, the second part of the thesis aims to be a complex study, offering solutions for the economic return of the lands affected by the activities carried out in the Jilț mining basin.
- To this end, the work pursues several objectives, namely:
- - description of the natural setting in which the two mining perimeters (Jilț North and South) are located;

- characterization of the way in which the activity in the two mining areas has evolved and is expected to evolve;
- description of how environmental components are affected by mining activity;
- global assessment of pollution, identification and assessment of environmental impact;

- establishing the level of intervention and identifying possibilities for ecological rehabilitation of the two mining perimeters;
- stability analysis of the area under study, taking into account important landslides that have occurred in the last 6 years;
- design of land development works affected by mining activity;
- design of land revegetation works.

In order to be able to respond to the above, a logical and systematic approach is needed. Thus, it is necessary to go through several stages, developed within seven chapters of the thesis, which ultimately lead to the formulation of clear conclusions regarding the analyzed aspects, to the development of a set of proposals regarding the improvement of the environmental quality in the studied area, as well as proposals regarding the possibilities of ecological rehabilitation of the lands degraded by the daily exploitation of lignite, synthetically presented within the last chapter.

The research methods consisted of field activities (taking samples from quarry slopes and dumps, collecting water samples, determining air quality, topographical measurements, etc.), comparisons between authorized laboratory analyses/specialized literature (analyses regarding the physical-mechanical parameters of the characteristics of the dumped rocks, computer modeling of situation plans, modeling of sections, analysis of the stability of the dumps using specialized software, etc.), documentation, bibliographic studies, the results of this research being presented within national and international scientific events as well as through articles published in specialized journals.

CONTEXT

To characterize the lands affected by the extractive activity in the Jilţ mining basin and adjacent areas, it is necessary not only to describe the soil. This description must include data on surface and groundwater, the climate in the area, the characteristic vegetation and fauna, the landscape, but also on human communities, practically speaking, we are talking about a description of the Jilţ mining basin area.

For the Jilţ mining basin, two exploitation perimeters have been delimited, namely: Jilţ North and Jilţ South.

The choice for applying an exploitation method must be related to the type of transport that will be used in the quarry and is justified based on the technical and economic comparison of rational exploitation methods possible to apply for the perimeter under consideration.

In the quarries in the Jilţ basin, the exploitation method with the transport of waste rocks to internal and external dumps and the technology of excavation, transport and dumping in continuous flow, by using excavation, transport and dumping complexes.

Considering that the exploitation works in the Jilţ Sud and Nord quarries have been analyzed and finalized since 1986, the problem of choosing a new exploitation method no longer arises.

The exploitation works consist of extracting coal from the 7 lignite layers.

The exploitation is done in parallel blocks, with a width of 40 ÷ 45 m.

The phenomena of land degradation, reversible or irreversible, are dependent on the techniques and technologies adopted for coal extraction, there being many similarities but also specific particularities for each quarry in the mining basins of Oltenia [10].

The organization of a mining unit, in the case of a quarry, requires the execution of specific activities - arrangement of access and communication routes, construction of social premises, auxiliary constructions, hydrotechnical arrangements, drainage works carried out in advance of the actual mining works - each of these constituting elements of disturbance, modification and interruption of the continuity of the environment [25]. The complexity of lignite extraction activities through open-pit mining works leads to the assessment that an assessment of the risk of triggering accidents or damages with a major impact on the health of the population and the environment must be the subject of specialized studies.

MOTIVATION AND OBJECTIVES OF THE RESEARCH

Mining activity developed in the region in two stages: the 1960s - 1970s by opening the first mining fields and the 1980s - 1990s by developing the existing mining fields.

The restructuring of the mining industry began by laying off personnel according to Ordinances no. 22/1997 and no. 9/1998, the effect of the restructuring being maximum for underground mining operations [3, 4].

The absorption capacity in the area's agriculture is limited, small and medium-sized enterprises are not sufficiently developed, so in the future new ways are being sought to support alternative socio-economic development.

In 1992, the active population employed in the economy of Gorj County represented 208.9 thousand people, of which 18% in the extractive industry compared to the current situation,

year 2025, when the percentage decreased significantly and reached a number of about 6 thousand active workers in the mining sector, within the Oltenia Energy Complex.

The main fields of activity in which the workforce is employed are, in order of the share held by: mining industry, electricity, thermal energy, gas; water; transport; storage; post and telecommunications.

The polarization of the workforce and its dependence on mining activity and its relational activities is, in the long term, a threat to the economic security of the local population. The young population (mostly female) represents a real potential for the development of activities in the tertiary and secondary sectors (through other forms of production), the demand for jobs being higher than the supply [3, 4].

The continuation of exploitation represents an extension of its life cycle, a period that contributes to achieving the development goals of the communities in the mining area of Oltenia and that makes the transition to closure slower, while preparing the community and the local economy. This way, social and economic shocks can be avoided and the risks associated with the closure and remediation of the site can be greatly reduced.

The potential impact of the continuation of the extractive activity on local economic conditions, the labor market, the dynamics of the unemployed

The Jilț mining basin was and is a mono-industrial mining area affected by the restructuring process in mining and as a result has severely diminished its economic potential, currently facing numerous processes of social disaggregation.

Agriculture is also an occupational alternative and a source of income for part of the local population. Arable land is cultivated mainly with potatoes. Pastures and hay ensure the growth of livestock (cattle and sheep). Local people also raise pigs and poultry.

Forms of social and economic impact can be classified into two broad categories:

Forms of direct impact - refers to the impact on land, property and people in the area of the extension of the works (within the limits of the approved license perimeters).

Forms of indirect impact - refers to all other effects that will occur due to the exploitation works.

The procedural scheme of an impact assessment represents a general scheme applied in the drafting of environmental impact studies, which does not depend on a specific project; following the same route through analytical and evaluation techniques, which can be adapted to any category of projects, even if they were designed for certain specific types of projects. Thus, checklists, matrices, impact networks, impact estimation models and various evaluation criteria are tools applicable within the impact assessment studies for any project [41].

The impact identification stage consists of a series of operations to identify certain or probable interactions between the elementary causal actions of the project and the environmental components characteristic of the reference area.Înainte de această operaţiune se descompun şi se selectează acţiunile elementare ale proiectului şi elementele ambientale semnificative pentru zona teritorială de referinţă, care constituie obiectul unor etape operative descrise anterior [41].
Some of the negative impacts identified in the checklist presented in Table 4.1 are inherent to open-pit mining activity and therefore cannot be eliminated (impacts related to land clearing, discovery and exploitation of the deposit, drainage works, etc.). Measures can be taken to reduce

emissions of sedimentary and suspended dust by wetting rocks during massif cutting (especially during periods of rainfall deficit).

The impacts identified in the checklist in Table 4.2, as well as the associated risks, can be limited or eliminated by adopting technical measures. For example, reducing noise by creating protective forest curtains or installing sound-absorbing panels. Impacts associated with negative geomining phenomena can also be limited or eliminated by strictly observing the rules for managing waste heaps (in particular, respecting the geometric elements that ensure their stability).

As we have specified in the checklist presented in table 4.3, associated with the ecological reconstruction activities of degraded lands, the impacts are exclusively positive and there is no question of their reduction or elimination.

In conclusion, the impact network method does not allow an assessment of the activities that generate the greatest impact or the environmental factors that are most affected, it only allows an identification of the impacts and the links that exist between different specific activities in the quarry and these on the one hand, and on the other hand it identifies the way in which different primary impacts interact, generating in turn secondary impacts.

IMPACT ASSESSMENT TECHNIQUES

Impact assessment is the phase in which one moves from an estimate of the predicted impacts on the various environmental components, to an assessment of the importance that the predicted value for that environmental component or factor has in a given context.

The question is asked whether the predicted value for the different indicators used in the description and forecast phases and for the different alternatives will produce significant variations in environmental quality and, to the extent possible, to indicate a size against a conventional scale (e.g. 1 -3) that allows the comparison of the magnitude of the different impacts and to establish a series of operations for the complex impact assessment [10].

In order to establish the type of rehabilitation of the two mining perimeters, the general and zonal urban plans of the localities in whose administrative territory the two objectives are located were consulted.

The most important conclusion that could be drawn after consulting these documents is that there is no common vision regarding the redevelopment and rehabilitation of these perimeters (or in some cases a concrete redevelopment option has not yet been established).

Mainly, within the development plans of the communities in the area of these quarries, the lands affected by the lignite exploitation activity are marked as being owned by the C.E.O. (Oltenia Energy Complex), and their ecological reconstruction, being the responsibility of the operator, is not very clearly defined. In practice, the complex is somewhat left free to choose the most appropriate rehabilitation option and to apply it both concurrently with the exploitation activity and in the post-closure period.

Variants of economic reuse of lands in the Jilt mining basin

Ex: Development of the lake in the remaining void of the Jilt Nord quarry

As stated in the thesis, the creation of a lake in the remaining void of the Jilț Nord quarry is envisaged. This lake will be bordered on the southern side by the final steps of the quarry, on the northern side by the steps of the tailings dump, and on the eastern and western sides by the twinning zone between the steps of the quarry, the dump and the surrounding land.

The lake will be designed to reach an elevation of +220 m, meaning the maximum depth will be 15 m (the quarry hearth is designed at an elevation of +205 m).

The decision to create this lake in the remaining void of the Jilț Nord quarry, beyond the diversification of the landscape and ecosystems in the area under study, took into account the observations made in the field, more specifically the fact that during periods of heavy rainfall there is a visible tendency for these waters to accumulate in the quarry pit (requiring works to evacuate them using high-capacity pumps) and the fact that an advection from the Jilț stream located in the vicinity of the quarry can be created relatively easily.

Observations on the technical condition of the dumps and instability phenomena encountered

- In order to characterize the internal tailings dumps of the Jilț Sud and Nord quarries in terms of deformations that have occurred over time, a series of field trips were carried out. These trips aimed to visually analyze the current technical condition of the slopes as well as to perform topographic measurements to update the existing situation plans.
- Field observations regarding negative geomining phenomena allowed the following conclusions to be highlighted:
- in the spring of 2017, during the melting of snow and subsequently during periods of excess precipitation, as a result of the increase in rock humidity and the local manifestation of thixotropy and liquefaction phenomena, superficial landslides of the slopes of the dump steps (steps II, III and IV in the Jilț Sud quarry and step I in the Jilț Nord quarry) occur, without affecting their overall stability. These superficial landslides are small and are usually remedied as the dumping front advances;
- -observations made during the summer, especially on the berms of the last dumping steps, have highlighted the existence of cracks. These cracks may be tension cracks (they constitute a warning factor and also favor the occurrence of landslides) but they may also be generated by prolonged droughts during the summer manifested in recent years, which may favor the development of deep cracks in the case of clay rocks stored in the dumps..

Results, conclusions of the analyses and recommendations for ensuring long-term stability

As a result of the stability analyses for the Jilț Nord internal tailings dump in the designed situation, the following conclusions result:

- The stability analyses in the previous paragraph were performed for the designed conditions, the geometry considered for the analysis sections to be carried out at the end of 2023, according to the documentation received from U.M.C. Jilț;

- For most situations, the lowest values of the stability factor were determined by the Janbu procedure. The exceptions to this rule are represented by steps T4 – T7, for which the lowest value of the stability factor was obtained by the Fellenius procedure;

- There is only one situation for which, although the value of the stability factor is above unity, they are below the value of 1.3 recommended by the specialized literature for definitive slopes or with a long residence time. This situation is recorded for step T2 (Fs = 1.133). To increase the stability reserve, it is recommended to reduce the slope angle from 40° to 35°.

- As in the case of the slopes designed for the quarry steps, if the configuration of the slopes of the inner dump designed for the end of 2023 will also be the final configuration (i.e. in the event that the productive activity, and implicitly the tailings deposit, will be stopped) then, for reasons related to the ecological reconstruction of the land occupied by the Jilț Nord inner dump, a reduction of the slope angles will be required for each of the 7 steps, so that they allow access for the equipment and personnel involved in these works;

- For the rest of the analyzed situations (the rest of the individual slopes, different step systems and the general slope), the stability factor values indicate a satisfactory reserve, in accordance with the technical prescriptions and recommendations in the specialized literature.

Although the stability analyses do not indicate values that would indicate a real danger of landslides, we must bear in mind that these analyses were carried out taking into account values of the physical-mechanical characteristics determined under conditions of natural humidity of the samples taken from the field.

Thus, we must bear in mind that under conditions of saturation of the deposited rocks, areas of plastic failure may materialize in the body of the dump, which, in turn, trigger landslides that may involve large volumes of material. This type of phenomena, large-scale landslides preceded by local plastic failures, are quite common in the case of tailings dumps in the Oltenia basin, in this regard, the landslides of the dumps: external of the Roşia quarry (1995); external of the Ştiucani, Jilț Sud quarry (1992, 2001); external of the Valea Mănăstirii, Lupoaia quarry (2000); external Negomir Valley, Pinoasa quarry (2001); external Rogoazelor Valley, Roşiuţa quarry (2001 – 2008); Bujorăscu Mic (2007); external Berbești Vest (2017), etc. and the two detailed landslides.

I propose to carry out a geotechnical study on the landslide areas and associated risk through geotechnical drilling, after which the general designer (ICSITPML Craiova) of the Jilt Nord mining perimeter should initiate a Technical Project with the redesign of the working steps, berms, etc. and in which these surfaces should be delimited and the conditions of general balance of the massif and safe exploitation should be clarified. The implementation of a water

management program that should consider the efficient direction and evacuation of water from the affected area, by using pumps to evacuate water from the lake formed in the submerged area and the restoration of the evacuation channel at the base of the northern slope of the perimeter with the direction of water outside the quarry.

The elements of a landslide help us, firstly, to recognize on the ground and to map as accurately as possible the area of the slope affected by the landslide, and secondly, their usefulness is very high in choosing schemes and calculation methods for estimating the stability of slopes or slopes. Ignorance of the elements of a landslide can lead to erroneous assumptions in choosing calculation methods, to results that do not express the real state of stability or instability of the slope or slope, to unfounded conclusions regarding the measures to ensure stability.

In the upper part of the landslide, in the direction of the landslide, tensile forces predominate, which lead to the formation of transverse cracks, and in the lower part, compression forces predominate, which lead to the formation of longitudinal cracks.

Taking into account the history and the affected surface, with the appearance of precipitation, the landslide can reactivate at any time.

Signal analysis is based on studying the settlements and displacements measured on topographic markers placed on the body of the earthen structure or on the slopes of the land, reported to fixed points in the surrounding terrain. The position of the markers, the number and the distance between them are established by the geological engineer and the topographic engineer following field observations.

Deformation measurements are made at different time intervals, intervals that are established depending on the speed of deformations and the extent of the instability phenomenon.

Landslide research can also be based on the use of aerial photographs. Aerial photographs can be of great help in drawing up the research program. On the photograms, areas with landslides appear with different colored mantles.

Establishment of vegetative species

Although over time, research, field experiments and actual ecological rehabilitation works of the lands affected by mining activities in the Oltenia basin have demonstrated that a number of species can adapt to the pedoclimatic conditions in the area, as well as the fact that good results can be obtained within these works with complex planting schemes that create mosaics of species, the best results were obtained when extensive areas of land were rehabilitated with trees of single species.

As we have specified in the previous chapters, on important areas of the dumps of the two quarries (inner and outer) freed from technological loads, acacia plantations were successfully established. These are areas that have reached the designed elevations and which in fact represent their upper platform.

Given that the execution of the ecological rehabilitation works is intended to be progressive (starting with 2020), as specified in Chapter 5, in the first stage, the upper parts of the two inner dumps will be gradually freed from technological loads, so that the final slopes of the dumps, the

definitive slopes of the quarries and the remaining void will be available for ecological rehabilitation works after 2028 for the Jilț Nord quarry, respectively 2030 for the Jilț Sud quarry.
Within the ecological rehabilitation project of the quarries and inner tailings dumps of Jilț Sud and Nord, for the forest area, biotic interventions are related only to the procurement of biotic elements (acacia and ash saplings), their planting and the necessary works for crop maintenance (fauna will settle spontaneously after year IV when practically anthropogenic interventions related to reforestation cease).
Based on the specific pedoclimatic conditions of the location area of the two quarries and the exposure of the slopes, it is proposed to afforest the area of 605.22 ha related to the upper platform of the Jilț Sud inner dump, in the period 2020 - 2030, as well as the area of 362.32 ha related to the upper platform of the Jilț Nord inner dump, in the period 2020 - 2028, with the forest species Robinia pseudocacia (black locust), the species with the best behavior in the characteristic conditions of the location.

Own contributions

Within the doctoral thesis, following documentation activities, field and laboratory research, comparisons with accredited laboratories, I managed to make a series of personal contributions regarding the presentation of the location area of the Jilț mining basin; the evolution of exploitations in the next period, taking into account the strategy and plan of the European Commission regarding the Oltenia Energy Complex Company - Jilț Quarry Mining Unit and the current situation of the two mining perimeters studied; the description, identification and assessment of the environmental impact; establishing the modalities for reintroducing degraded lands into the economic circuit, contributions presented synthetically as follows:

1. Detailed description of the location area and supplementing existing data with current data obtained through field documentation campaigns, student practice (field visits since 2013 and in other perimeters when the Pește ana Sud (June 2015 cessation of activity), Rovinari Est and Gârla (2020 cessation and withdrawal of equipment) mining perimeters were in operation;
2. Collaboration and exchange of ideas/opinions with local communities/specialized structures within the mining units in the area;
3. Characterization of the two quarries in terms of the existence of mining equipment/high-capacity conveyors (taking into account the current practice of relocating them from one perimeter to another, within the Branch, depending on the pressing needs) and their current configuration;
4. Objective description of the impacts generated on the environment by mining activity based on field observations and determinations and laboratory analyses;
5. Identification of environmental impacts through checklist and impact network methods;
6. Assessment of environmental impacts through impact matrix and global impact index methods, as well as identification of environmental impacts and risks through the integrated method;
7. Analysis of the dynamics of occupation and return to the economic circuit of land areas affected by mining activity in the Jilț basin;
8. Analysis of the possibilities of environmental recovery of the territory occupied by quarries and dumps in the Jilț mining basin, taking into account the fundamental principles of ecological planning;

9. Identification and presentation of solutions for the recovery of degraded lands in the Jilț mining basin;
10. Establishment of the optimal variant for the rehabilitation of degraded lands in the Jilț mining basin taking into account the characteristics of the area, the principles of ecological planning and regional development plans;
11. Observations on field regarding the deformation phenomena and the displacements that affected the material in the tailings dumps;
12. Analysis, monitoring and sampling of the last two landslides at the Jilț Nord quarry (the first in 2019 with smaller effects and the one in 2021, where the breakdown of the stability balance of the excavation steps blocked the quarry for 6 months, meaning great material, financial and reserve losses) [80];
13. Comparison of the two landslides in the Jilț Nord quarry with the largest landslide that occurred in the quarries in Oltenia, namely the landslide of August 8, 2024 at the 'neighboring' Pinoasa quarry, where four mining equipment (2 rotor excavators) were destroyed/overturned/buried, meaning immense material damage, reduced coal production, insufficient supply of s.m.u. to the Thermal Power Plant Rovinari, relocation of personnel, etc.;
14. Carrying out stability analyses for the final slopes of the quarries and the dump slopes using specialized software (Slide) and interpreting these analyses; Using 3D design programs.
15. Designing and presenting in detail the necessary redevelopment works for the Jilț Sud dump;
16. Establishing the necessary land improvement and fertilization works and establishing fertilizer doses;
17. Distributing and analyzing over 50 questionnaires to test local public opinion, regarding land use options, impact assessment, recommendations, crop selection, environmental protection, actions taken in this regard, the tendency to leave the area affected by the energy lignite extraction process;
18. Identifying the optimal forest species for carrying out the designed works;
19. Establishing planting schemes and the method of planting and maintaining forest and vineyard crops;
20. Proposed solutions regarding land development through examples from former mining quarries (Poland, Czech Republic);
21. Presentation of a methodology for monitoring the designed works at all stages.

PROPOSALS AND FUTURE RESEARCH DIRECTIONS

The issue of assessing the impact of opencast mining on the environment and that of the ecological rehabilitation of the lands affected by them is a very complex one and for this reason it allows these research topics to be approached from different perspectives.
For this reason, I believe that, based on the works developed so far, the articles presented, the visits undertaken in most opencast perimeters in Oltenia, of course also taking into account the results obtained so far, it would be useful to develop a guide to good practices in the field. Such a guide should present the best techniques and tools for identifying and assessing impact, because, as I have shown in this paper, by applying two different methods significantly different results can be obtained, which can cause difficulties for people reading such a study.

Another proposal, which can also be seen as a future research direction, in relation to impact assessment is related to the establishment of a methodology through which the impact area of a project can be clearly delimited. Not infrequently, impact studies include data collected in the immediate vicinity of the analyzed project and data collected/measured at distances of several km or even tens of km, data that are usually not relevant to correctly establish the effects on the environment.

The second part of the guide must refer to the clear establishment of the stages that must be followed in the ecological rehabilitation process and the order in which they must be completed.

Also, based on the work carried out, the "most successful" rehabilitation options can be established starting from the location of the objective, the natural characteristics of the area, the type and severity of the degradation to which the land has been subjected, of course taking into account the demands and needs of the resident population.

Such a guide would constitute a tool with real utility for all those involved in what means the assessment of the environmental impact of mining areas and their ecological reconstruction.

As a main research direction for the near future, I would mention the completion of this study, given the extension of the validity period of the exploitation licenses and the expansion of the exploitation perimeters by concessioning new land areas and transforming it into a financeable project (not only from the mining operator's own sources but also from local, county, national or even European sources).

In general, I propose to continue research in the two directions, the impact assessment and ecological rehabilitation of areas affected by mining, understanding by this also the transposition into practice in Romania of solutions experimented and validated by results in other countries [81].

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