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ATTRACTION OF MINING LANDS FROM THE JIU VALLEY BASIN IN PUBLIC AND PRIVATE UTILITY PROJECTS

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Abstract: *In the article, the authors report on the diversified perspective on the various aspects of the mining sector in Valea Jiului with reference to the attraction of mining land in new investment projects from those interested in the public and private sphere. It is stated that the mining lands offer opportunities for expansion of reserves or zonal development in the future; mining land can be attractive to investors because it offers prospects for long-term growth and profitability. The authors present data on the disposal of mining lands unloaded of technological burdens, make an updated inventory of mining lands in the Valea Jiului Basin available for expressions of interest in expropriation and inclusion in new zonal development programs. At the same time, a model is proposed for the recovery of the affected mining lands, practically analyzing the influence of the "mechanized felling" system to avoid surface subsidence. Details are given about the lack of mining security, land damage through subsidence, and it is recommended that each mining unit be equipped and operate with a distinct silting station, taking into account the objective requirement to protect against the loosening of the rock massif of the land up to date, above the exploitation perimeters.*
Keywords: *mining/post-mining, mining land, subsidence, land reuse, post-mining investment*
JEL: *L26; L32; O12; Q24*

1. Introduction

The attraction of mining land in public and private utility projects is a complex process from a technical, mining, legal, economic and social perspective.

The methods of realization depend on the specifics of each project, the legislation and the type of investment intention.

In all situations it is important that the process is transparent, fair and respects the legislation and standards, the rights of the land owners and the affected community, in the present case of the collectivity of the Valea Jiului Carboniferous Basin.

Equally, social and environmental impacts are taken into account during the development and implementation of projects.

Mainly, for the aspects of the Valea Jiului Basin, with the transition to restructuring (closing and greening of mines) and the disposal of mining lands for exploitation / post-exploitation, the following are considered:

- Expropriations and compensations (public authorities can expropriate mining lands, but the owners are compensated according to their market value);
- Voluntary negotiations and contracts (mining land owners are approached to negotiate the sale or lease of their land to allow development of projects);

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- Public-Private Partnerships (PPP) (partnerships can be entered into with the private sector to develop and manage projects, including those involving mining land);
- Mining concessions (mining concessions can be granted to private or commercial entities to explore and exploit coal resources, with the payment of royalties);
- Consultation and agreements with the local community (it is crucial to carry out appropriate consultations and reach agreements with the local community and other stakeholders).

However, the choice of mining land for investment depends on the economic potential of the Valea Jiului area, accessibility and available infrastructure as well as criteria such as: political and legislative stability, developed infrastructure, access to markets and easy transport, compliance with environmental and social standards, the potential of expansion and development.

Attracting mining land into the economic-productive circuit in the Jiului Valley through investment requires risk assessment, analysis of profitability, efficiency, feasibility and expected profit.

The technical, technological side of exploitation/mining post-exploitation, with respect to the framework extraction methods, proves to be essential for this process.

2. Review of specialized literature

The issue of re-introduction into the economic-productive circuit of mining lands is widely discussed in the specialized literature.

In particular, with the transition to renewable energy production and the restriction of the use of caustobiolytic fossil fuels generating anthropogenic effects and greenhouse gases, the evaluation of the potential for occupation with new investments of former lands (now mines) becomes current in the energy transition.

Essentially, it starts from the examination of surface land degradation under the influence of underground exploitation, [1], aiming to contribute to reducing the impact of developments in the ecosystems of mining areas. [2]

It is found that it is important to evaluate the post-exploitation use of the lands above the mining perimeters, [3; 4; 5], relying on the real possibilities of returning degraded lands as a result of mining activities to the economic circuit. [6; 7; 8]

In particular, emphasis is placed on research on the demands of the resident population in the conditions of the recovery and reuse of remaining voids on mining lands, [9], equally on the modern technologies used in the methods of tracking the movement of the surface of the land located in the mining areas. [10]

Important scientific works refer, as a case study, to the surface displacements under the influence of the underground exploitation of the deposits in Valea Jiului, [11], the impact of the exploitation of geological accumulations of useful mineral substances on the environment, [12], and the introduction of numerical methods used in stability analysis of mining excavations. [13]

In all situations, it is sought to obtain data, information, knowledge in general, with reference to the influences of mining exploitation on the surface, [14], the even temporary use of mining lands, [15], the possibilities of remediation of contaminated mining sites. [16]

Tailings dumps, including in Valea Jiului, are resources for increasing the areas affected by mining, [17], aimed at the occupation and ecological rehabilitation of the lands, [18; 19],

Therefore, the solutions for the reconstruction of degraded areas by mining activities, [20], are decisively related to the aspects of submergence-settlement of the land surface under the influence of underground exploitation. [21]

3. Methods, research methodologies

3.1. Availability of mining lands unloaded from technological loads

Within the concerns for the valorization of mining lands in the Jiului Valley, it is necessary to know as a matter of priority the amount of surfaces available for expressions of investment interest, their inventory, sizes, locations and physical geo-morphological characteristics.

Optimizing the expropriation of mining lands for public utility projects related to the Valea Jiului Mining Basin, must benefit from the organization/reorganization of the reality actually encountered in the area, compared to the industrial, economic and administrative practices carried out by owners and officials.

Before resorting to the classification-inventory for the Jiului Valley and by extension for the mining sector on a national level, it is necessary to standardize the terminology in the field.

As such, the proposal for the generalized use of the terms "restoration" and "rehabilitation" is advanced, since the recovery, restoration, development and revitalization of mining lands in specific regional situations are implicit.

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In order to include the mining lands in Valea Jiului in new projects of public and private utility, the search, identification and definition of the surfaces in question are carried out, with a number of objectives being reproduced in an inventory (2024). (table 1)

Table 1. Inventory of mining land in the Valea Jiului Basin available for expressions of interest in expropriation and inclusion in new regional development programs

Location	Descriptions / availabilities	Mining areas/ Perimeters
Uricani	- Mârşavoni quarry premises, Balomir; Balomir tailings dump; - The premises of the well no. 5, microquarry block IV south, the main area from Valea de Brazi; - The Poiana Mare landfill, Sesul Şerbanilor, Câmpu lui Neag tailings; - The premises of the old placement center and that of the Uricani preparation.	A total of 11 plots/ (758,442 m^2 the largest) transferred to the public administration by HG no. 1169/ 2004, along with the reduction of mining activity in the area.
Lupeni	- Mining areas Pilierul Est, Pomilor, leisure Lupeni Brăița, Lupeni Est, Keletti and Est DN 66.	A total of 6 lands/ (10 ha the largest) transferred to the public administration by HG no. 1169/ 2004, updated with the reduction of mining activity in the area.
Vulcan	- Precincts of the Paroşeni mine and the Electric Plant, - Lands in Crividia and Block in Crividia; - Jiu Paroşeni areas, near DJ 644.	A total of 6 plots/ 50,000 m^2 transferred to the public administration by HG no. 1169/ 2004, updated with the reduction of mining activity in the area.
Aninoasa	- The premises of the mine, the shaft, Vercului Hill, Aninoasa Nord, the aeration shaft, Piscu-Priboi from Iscroni.	A total of 6 lands transferred to the public administration by HG no. 1169/ 2004, along with the reduction of mining activity in the area.
Livezeni/ Dâlja	- Precincts of the Dâlja mine and the Livezeni Preparation Plant.	A total of 2 lands transferred to the public administration by HG no. 1169/ 2004, along with the reduction of mining activity in the area.
Petrila	- Funicular station at +840m elevation, - The cable car and tailings dump; - Precincts Auxiliary Well, Petrila mine, Jieț, Lonea Mine; - Cămin area, M. Sadoveanu and Știurț str.; - The perimeters of the Quarry and Halda Deforu; - Premises and tailings dumps from washing / preparation from the Preparation Plant.	A total of 9 lands transferred to the public administration by HG no. 1169/ 2004, updated with the reduction of mining activity in the area.
Jiu Valley	(Main delineations)	Total: there are 40 main lands, officially listed, transferred to the public administration by HG no. 1169/ 2004,/ updated/ with the reduction of mining activity in the area.

(Source: based on CEH/ CEVJ data, 2022-2024)

Researching the potential of the Jiu Valley with reference to the lands that can be included in investment / zonal development projects, it results that there are main locations, with a degree of significance and expression of interest for the public and private parties that are available for expropriation, concession or sale, avoiding remaining in a state of abandonment, of lack of use.

3.2. Proposed model for restoring affected mining lands in the Valea Jiului Carboniferous Basin

In the context, we can talk about a possible specific way of mining production activity, based on a new type of management and a new type of owner of rehabilitated expropriated lands (the one who receives the lands acts in the new investment projects with a productive - economic purpose for added value and utility in the area).

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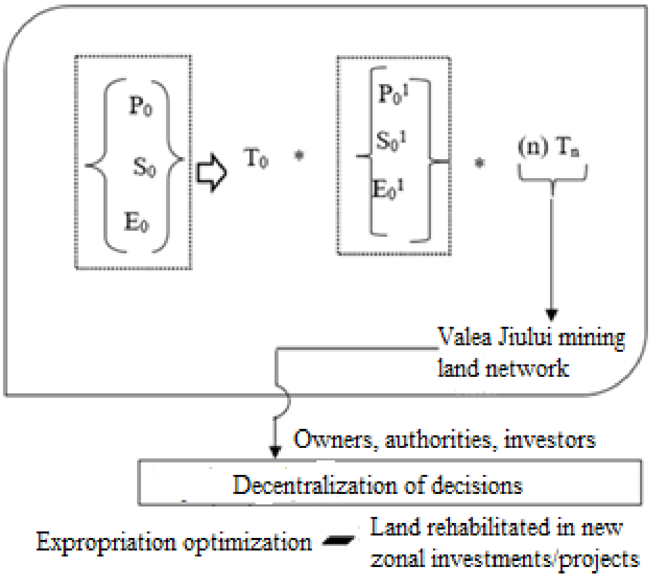
Currently, the regional authorities can find that the systems 1) "policy of the mining unit" (P_0), 2) "productive - economic results of the underground mine" (E_0) and 3) the social - corporate (in relation to labor resources, employees, miners and managers) denoted by (S_0) transform relationally, finding themselves distributed in networks of resources effectively resulting in rehabilitated and expropriated lands.

Within these networks, the dynamics of transformations manifest themselves emergently. (fig. 1)



T_0 = initial moments of decision for the rehabilitation of affected mining lands;
$(n)T_n$ = distinct moments of expropriations and the re-establishment of the multitude of rehabilitated mining lands, included in new regional investment projects in the Jiu Valley.

Fig. 1 The formation of regional development poles in the Jiu Valley through the introduction of expropriated lands in new investment projects

The conceptual elements related to the new vision aim at the fact that:

1) between the participants (mining units, underground mines in exploitation/post-exploitation, expropriators, investors, therefore decision-makers in general) there is a free cooperation, characterized by wide access to land;

2) The organization and management of land expropriation/transfer is carried out by decision-makers and investors appealing to the owners of mining lands, decisions in the conditioning relations of interest related to the respective hierarchies not being imperative.

Often, investors cite the lack of resources for the safe operation of processes and businesses on expropriated land.

From an economic perspective, in the Jiu Valley there are also situations with a relatively common destination of using rehabilitated mining land, overlapping activities with the exploitation and processing of coal, those of conservation and post-exploitation greening, all subordinate to the process of obtaining profits when reaching when *entering competitiveness*.

As such, denoting with (e) the element of a mass (M) of coal resources concentrated in a geographical area (ZG) such as Valea Jiului, by extension of the application it is observed that the establishment and operation of *"a class of companies / firms (mining operations) and interconnected institutions, - on the expropriated mining lands, which ensure maximum competitiveness"*.

Accumulations of coal-like substances (A_{sm}), for example, they can be exploited (E) and exploited (V) theoretically completely (C), up to the limit of total depletion (C_e).

As such:

$$\begin{cases} A_{sm} \xrightarrow{\Delta[(E)*(V)]} C_e(C) = 0 \\ e_i \in \{M\}_{ZG} \end{cases} \quad (1)$$

However, the dimensional and technological differentiation from exploitation/post-exploitation is manifested, because the elements (e_i) are used in order to gain competitiveness.

So, the elements (e_i) in the set {M} retain their identity in terms of the use of expropriated mining lands introduced in new business, investment projects in the studied area.

4. Results, discussion

4.1 The influence of the "mechanized felling" system to avoid the subsidence of the mine land

From the modeling, mathematical perspective, the result indicators (expected values) are functional, realistic, assumed, recognized, validated results (orderable values) over time, especially in the process of underground mining that has final effects on surface mining lands perimeters/extractive fields.

These values depend on the set of uncontrollable, uncontrollable variables of stimuli, but also on the set of controllable variables, of reactions, of programmed, controllable values:

$$\{I\} = f\,(S_i;R_i) \tag{2}$$

with the notations {I} = indicators; f = function; R_i = reactions, controllable values; S_i = stimuli, uncontrollable values.

In the present case, a decision criterion represents a subset of the result indicators $\{I(R_i)\}$, taken into account when comparing the variants that ensure the production of programmed - ordered consequences, namely mining land unaffected by subsidence.

That is why, in a mining technological context, of underground extraction/excavation, the loosening of the unfilled exploited space transmits the deformations, disturbances (subsidence) on the land to the surface.

Mainly, the "mechanized felling complex" is the main unit generating anthropogenic effects on the land and, as such, it is modeled for the final value of the net recoverable coal cost (lei/t) including the costs for restoring the land. (fig. 2)

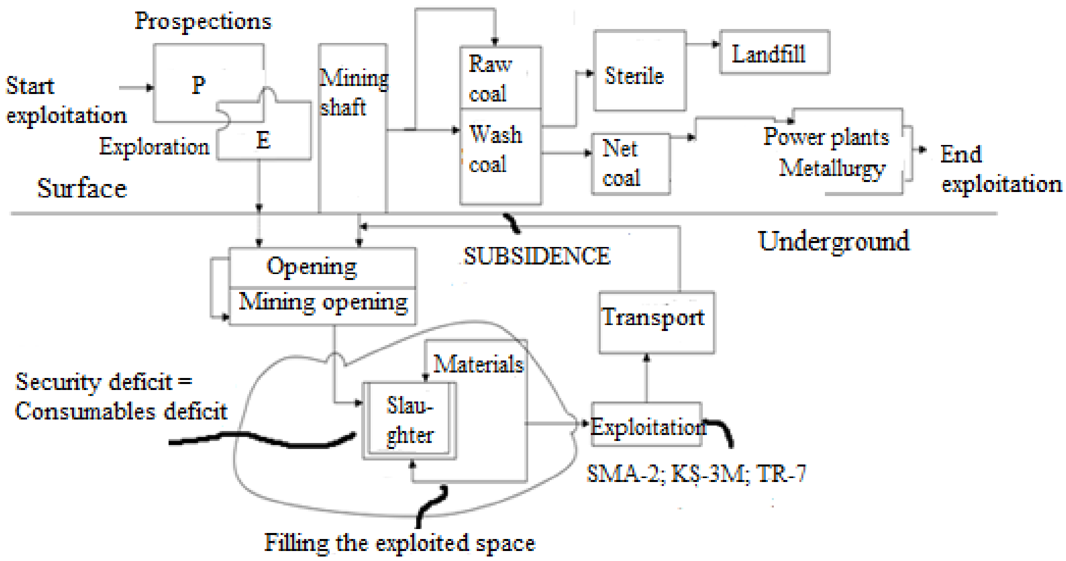


Fig. 2 Case study on hard coal mining with mechanized felling complexes and surface mine land damage

For the present case study, the *cost of the ton of coal* from the SMA-2 mechanized complex system is proposed as a programming indicator. [22]

However, a *function of the cost of the ton of coal* (hard coal) must be established, which has as variables the nodes in a graph through which the path of the variant d_I crosses and the values of the lengths of the cutting front L_{ab}.

Denoting with:

C = the total cost in slaughter over the 24-hour time interval;

C_{tc} = the cost of the ton of coal in the mechanized complex abattoir under study;

Q = the amount (production) of hard coal obtained in the studied abattoir over the 24-hour interval (considered production at maximum value);

then:

$$C = f\,(d_I, L_{ab}) \text{ și } C_{tc} = f\,(d'_I, L_{ab}) \tag{3}$$

where: d_I = the road from the variant generation graph, having the index (I);

L_{ab} = the length of the mechanized complex system front, in [m].

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On this basis it is obtained:

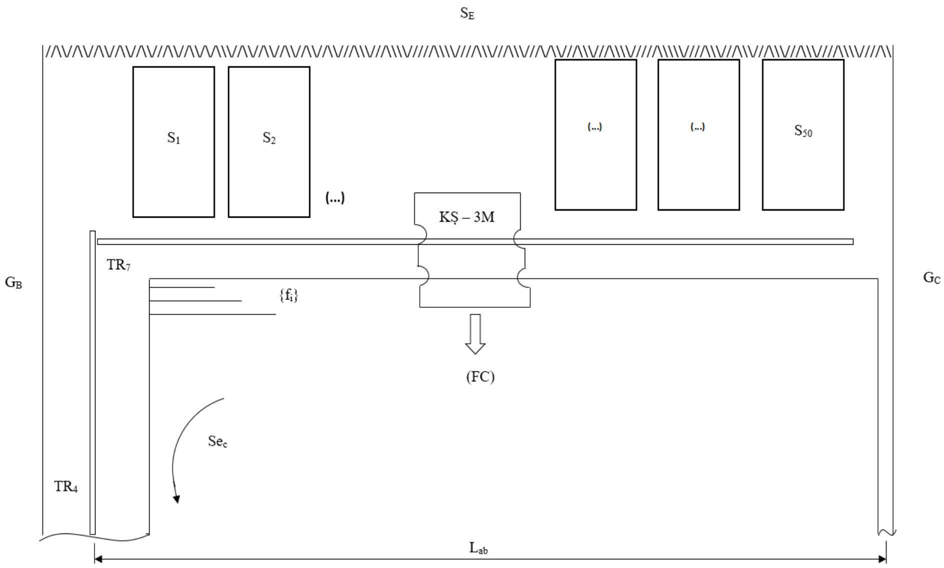
$$C_{tc} = \frac{C}{Q}\ ;\ [\text{lei/t}] \tag{4}$$

Simultaneously:

$$Q = L_{ab} \cdot g \cdot L_f \cdot \gamma \cdot n_c :\ [\text{tons/day}] \tag{5}$$

with the meanings:
g = thickness of the coal layer; [m]
l_f = width of the cut strip in the slaughter front; [m/cycle]
γ = volumetric weight of coal (oil); [t/m3]
n_c = maximum number of strips cut in 24 hours in the mechanized complex slaughterhouse; (maximum number of cycles); [no. cycles/day].

From the general scheme of exploitation and valorization of coal in the mines of Valea Jiului, the exploitation unit of the "abataj" type is delineated. (fig. 3)



S_1, S_2, .., S_{50} = mechanized support sections SMA –2;
(FC) = coal front (coal layer);
L_{ab} = cutting length (m);
G_B = base gallery, G_c = galeria de cap;
TR – 7 = conveyor with scrapers, for slaughter;
TR – 4 = scraper conveyor, exhaust;
SE = exploited (collapsed) space;
KȘ - 3M = slaughter combine;
$\{f_i\}$ = the amount / number of cut strips;
S_{ec} = the discharge (transport) direction of cut coal.

Fig. 3 The exploitation unit of mechanized complex type of slaughterhouse which transmits land subsidence

Relationships are found, such as:
- diagrams are always needed - graphical relational explanation block of the structural constitution of the process, phenomenon, operations or complex of operations for the field subject to scientific investigation;
- recourse is made to the symbolic mathematical formalization of relationships, reports, causalities and effects in the studied system / sub-system;
- the non-controllable values (*inputs*), the transformations (technologies) and the controllable values (*outputs*) are highlighted, which represent targets, objectives, ordered, programmed sizes (optimal allocation of resources that must be spent / consumed in the slaughterhouse in order to comply with the framework method and counterbalance the deficit of mining security);
- the objective function of each category of elements (machinery, equipment, materials, labor resources) is accompanied by *stimuli* and *model restrictions*.

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Systematizing the characteristics of the model construction presented, it is mainly found that the formula, the relationship of *the cost of the ton of coal*, as it is formalized, allows the interpretation of the decision variables (criteria, multicriteria) related to the allocation of resources that produce / generate causes, effects and influences *the cost per ton* at the slaughterhouse level.

This aggregate influence is elaborated / depicted for the deposit conditions (geo-tectonic situations that condition the cutting speed of the felling by cutting the coal from the coal seam) and the felling technology (mechanized complex with cutting with a felling combine).

There are constant expenses per ton of coal mined, namely:
- amortization of machinery / equipment with a value dependent on the length of the cutting front;
- expenses for materials and spare parts in complex mechanized slaughter (through their optimal and normal allocation) are also dependent on the length of the slaughter front;
- the expenses for the electricity consumed in the operation of the slaughterhouse (electric motors of the conveyors, pressure pump, aeration, etc.) depend on the technical-functional configuration of the slaughterhouse front.

In the same context, there are also expenses *inversely proportional* to the length of the cutting front, namely: 1) the increase in the length of the cutting front requires an increase in the size of the depreciation of machinery / equipment with a value independent of the length of the cutting front; 2) the reduction / decrease in expenses with materials and spare parts is independent of the length of the front; 3) it is possible to resort to the reduction / decrease of living labor expenses (salaries, additions and increments).

So, the composite resource allocation model for the "abataj" type extractive unit represents the basis for the formalization of the vision and understanding of the functioning of the respective system / sub-system, which ensures application probabilities in terms of modeling / simulation for optimization and efficiency of the productive process / phenomenon- economically investigated, so that by complying with the exploitation framework method, the damage to the mining lands on the surface is avoided/improved.

4.2. Mining security deficit and land subsidence damage

The above assertions are translated into practical testing by:
- the list of the main components of the "complex mechanized demolition" operational system that were included in the set of operations, activities, extraction processes, machines, equipment, materials for the underground work fronts is established;
- the categories of variable and fixed costs are defined;
- define the volume / absolute value in which the elements in question are found according to the exploitation framework method;
- of decisive importance is the lack of mining security for the inventoried elements;
- starting from the established deficit, the consequences on the subsidence/affecting of mining lands on the surface are delimited. (table 2)

Table 2. Factors generating subsidence/ damage to mining lands on the surface starting from the basic unit "Complex mechanized felling" underground

No.	Components of the operational system "Complex mechanized slaughter"	U.M.	Variable costs	Costs	Volume / absolute value according to the frame method	Volume / value registered, practiced	Mining security differences / deficit (%)	Consequences on subsidence / impact of surface mining land
1.	Mechanized support sections SMA-2	48 piece		x	100.00	100.00	000.00	000.00
2.	Slaughterhouse combine KȘ-3M	1 piece		x	100.00	100.00	000.00	000.00
3.	Slaughter conveyor TR-7	91 m		x	100.00	100.00	000.00	000.00
4.	Head gallery support TH-4	20 m			100.00	62.00	38.00 (-)	x
5.	Core gallery support TH-4	20 m			100.00	84.00	16.00 (-)	x
6.	Supporting the SMA-2 intersection with the base gallery (TH-4 and hydraulic pillars)	12 m + 22 piece metal poles			100.00	82.00	18.00 (-)	x

7.	SMA-2 junction support with head gallery (TH-4 and hydraulic pillars)	4 m+ 12 metal poles			100.00	73.00	27.00 (-)	x
8.	Metal felling beams GSA-1.25 (total)	42 piece		x	100.00	91.00	9.00 (-)	00.00
9.	Metal mesh (for the version with slices under the artificial ceiling)	800 m^2/ 10 m advancement	x		95.00	32.00	63.00 (-)	00.00
10.	Backfilling of the exploited space	22.000 m^3 mud introduced on 10 m advance of the front line			100.00	00.00	100.00(-)	x
11.	The length of the slaughter front	92 m	x		79.00	72.00	7.00 (-)	00.00
12.	Coal layer thickness;	3,80 m average			84.00	53.00	31.00 (-)	x
13.	The width of the cut strip in the slaughter front	0,80 m average	x		81.00	49.00	32.00 (-)	00.00
14.	Maintenance of opening galleries	1,90 km			100.00	00.00	100.00(-)	x
15.	Maintenance of exhaust galleries	216 m			100.00	00.00	100.00(-)	x
16.	Electricity consumption	Kw /day, average	x		80.00	89.00	9.00 (+)	000.00
17.	Maintenance of transitory bunkers	3 locations	x		50.00	00.00	50.00 (-)	000.00
18.	Transport by wagons	6-8 transport cycles	x		45.00	42.00	3.00 (-)	000.00
19.	Transport on well 5 South	72-84 wag. / day P. 5 Sud	x		45.00	42.00	3.00 (-)	000.00
20.	Capital costs Gr. I	%	x		100.00	79.00	21.00 (-)	000.00
21.	Costs of machines / equipment Gr. II	%	x		95.00	81.00	14.00 (-)	000.00
22.	Machinery / equipment costs Gr. III	%	x		95.00	82.00	13.00 (-)	000.00
23.	Material and spare parts costs	%	x		80.00	10.00	70.00 (-)	000.00
24.	Live labor costs/ salaries and allowances gr. Labor I (managers, employees)	%	x		92.00	82.00	10.00 (-)	000.00
25.	Number of positions (workers)/ slaughterhouse	44 pers.	x		95.00	51.00	44.00 (-)	000.00
26.	Energy / total	kw	x		80.00	98.00	18.00 (+)	000.00
27.	Mine wood	m^3			100.00	5.00	95.00 (-)	x
28.	Oils	l	x		68.00	32.00	36.00 (-)	000.00
29.	Industrial explosives	%	x		82.00	82.00	00.00	000.00
30.	Mining ventilation	%		x	100.00	92.00	8.00 (-)	000.00
31.	Expenditure/ton of coal mined	%			98.00	121.00	23.00 (+)	x

(Source: statistical data, CNH/ CEH, 2023)

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In essence, from the 31 main components of the operational system "Complex mechanized slaughter" inventoried from the actual practice in the field, it is found that a number of 10 are directly involved, affecting the mining lands on the surface of the former exploitation perimeters.

These refer to: 1) backfilling of the mined space, 2) supporting the TH-4 head gallery, 3) supporting the TH-4 base gallery, 4) supporting the SMA-2 intersection with the base gallery (TH-4 and hydraulic pillars), 5) supporting the intersection of SMA-2 with the head gallery (TH-4 and hydraulic pillars, 6) the thickness of the coal layer, 7) maintenance of opening galleries, 8) maintenance of preparation galleries, 9) mine timber and 10) expenses/ ton of extracted coal.

It is deduced that, in general, the damage to mining lands by the way the underground mining of the coal deposit is carried out is significant, because in the present case 32.29% of the total disturbance process comes from basic operations from the operation of the mechanized complexes of slaughter.

5. Conclusions

The main conclusion from the research is that the predominant influence on the mining lands comes from the lack of filling of the exploited space following the advance of the front line, respectively of the remaining gap behind the mechanized support sections.

At the same time, it is observed that the non-compliance with the reinforcement mongraphs at the intersections with the head and base galleries, the non-maintenance for the opening and preparation works, the operation with the standard lack of mine wood for additional reinforcement, all of these imply regional mining security deficits.

In the geological-mining engineering sense, the mentioned elements, missing or being reduced compared to the consumption standards, do not contribute to reducing the loosening of the massif of covering (surrounding) rocks and thus deformations are transmitted to the surface.

As such, we recommend paying special attention at least to ensuring the allocation of material resources through priority financing of exploitation activities in the formula of compliance with the framework method, their implementation with priority, so as to reach the consolidation of the cover rock deposit (a massif) and the corresponding counteracting of the deformations, which are taken over by the technologically filled exploitation spaces.

Equally, silting of the mined space contributes to protection against self-ignition (mine fires), elimination of voids that predispose to accumulations of explosive gray gas in dangerous concentrations, general stability, protection of working personnel and the deposit and last but not least to avoiding irrecoverable losses of fossil fuel deposit.

In this framework, taking into account the objective requirement to protect the mining faces (land above the mining perimeters), we recommend that each mining unit (underground mine) build, equip and operate a distinct silting station.

It is a good opportunity for these stations to also ensure the silting of the spaces behind the dykes, of other different underground infrastructures, in the main galleries, when the mining unit goes into liquidation or greening.

References

[1] **Onica I., Cozma E., Goldan T.**, 2006
Surface Land Degradation under the Influence of Underground Mining. Bulletin AGIR, nr. 3.

[2] **Riti A.**, 2012
Contributions to Reducing the Impact of Developments in the Ecosystems of Mining Areas. Ed. Politehnica, Timişoara

[3] **Limpitlaw D., Briel A.**, 2014
Post-Mining Land Use Opportunities in Developing Countries - A Review. Journal of the Southern African Institute of Mining and Metallurgy, 114.11: pp. 899-903

[4] **Mborah Ch., et al.**, 2016
Evaluating Alternate Post-Mining Land-Uses: A review. Environment and Pollution, 5.1: pp.14-22

[5] **Sonter L.J., et al.**, 2014
Processes of Land Use Change in Mining Regions. Journal of Cleaner Production, 84: pp. 494-501

[6] **Cîşlariu E.M., et al.**, 2006
Possibilities of Returning Degraded Lands as a Result of Mining Activities to the Economic Circuit, Geocologia, ISSN 1842 – 4430

[7] **Worden S., et al.**, 2024
Regional Post-Mining Land Use Assessment: An Interdisciplinary and Multi-Stakeholder Approach. Resources Policy, 89: 104680

[8] **Worlanyo A., et al.**, 2021
Evaluating the Environmental and Economic Impact of Mining for Post-Mined Land Restoration and Land-Use: A review. Journal of Environmental Management, 279: 111623

[9] **Apostu I.M., Lazăr M., Faur F.**, 2021
Research on the Demands of the Resident Population under the Conditions of the Recovery and Reuse of the Remaining Pits of the Quarries. Mining Revue, 24.4: pp. 20-24.

[10] **Bălă F.**, 2005
Modern Technologies Used in the Methods of Tracking the Movement of the Land Surface Located in the Mining Areas. Universitaria SIMPRO, Petroșani:43

[11] **Ortelecan M.**, 1997
The Study of Surface Displacement under the Influence of Underground Exploitation of the Deposits in Valea Jiului, Eastern Area, University of Petroşani

[12] **Onica I.**, 2001
The Impact of the Exploitation of Deposits of Useful Mineral Substances on the Environment, Ed. Universitas, Petroşani

[13] **Onica I.**, 2001
Introduction to Numerical Methods Used in the Stability Analysis of Mining Excavations, Ed. Universitas, Petroşani

[14] **Fodor D., Georgescu M.**, 1989
Influence of Mining on the Environment and Land Recultivation. Revista Minelor, 40.8: pp. 354-367

[15] **Keenan J., Holcombe S.**, 2021
Mining as a Temporary Land Use: A Global Stocktake of Post-Mining Transitions and Repurposing. The Extractive Industries and Society, 8.3: 100924

[16] **Coman M., et al.**, 2009
Possibilities of Remediation of Some Contaminated Mining Sites in Romania. ProEnvironment, Promediu, 2.4

[17] **Mocanu R., et al.**, 1995
Tailings, a Resource for Increasing Land Surfaces in Agriculture. Annals of the University of Craiova: Biology, Agronomy, Horticulture, 26: p. 66

[18] **Fodor D., Lazăr M.**, 2006
Occupation and Ecological Rehabilitation of Land in the Oltenia Area. Bulletin AGIR, 3: pp. 27-31

[19] I**rimia G.I., et al.**, 2011
Assessment of the Impact on the Environment Generated by Tailings Dumps (Case study: Lupeni coal mine, Jiu Valley). ProEnvironment, Promediu, 4.7

[20] **Mărăcineanu F., et al.**, 2000
Solutions for the Reconstruction of Areas Degraded by Mining and Energy Activities in the Jiu Valley. Ovidius University Annals, Constanza. Series Civil Engineering, 1.2: p. 111

[21] **Onicioiu G.**, 1997
On Some Problems of Submergence-Settlement of the Land Surface under the Influence of Underground Exploitation. Mining Magazine, nr. 3

[22] **Șevciuc T.**, 2010
Considerations on How to Calculate the Cost of Mining Products. Accounting, Vol. 27