Revista Minelor – Mining Revue
ISSN-L 1220-2053 / ISSN 2247-8590
vol. 30, selected papers from the 11th edition of
UNIVERSITARIA SIMPRO / 2024, pp. 129-140

SELECTION OF POST-QUARRYING LAND USES IN WESTERN MACEDONIA, GREECE, USING A HYBRID MULTI-CRITERIA METHOD

Chrisoula PAGOUNI[1], Francis PAVLOUDAKIS[2], Ioannis KAPAGERIDIS[3], Evangelos KARLOPOULOS [4]*

[1,2,3] Mineral Resources Engineering Department, University of Western Macedonia, 50150, Kozani, Greece
[4] Chemical Processes & Energy Resources Institute, Centre for Research and Technology Hellas, 50200, Ptolemaida, Greece

DOI: 10.2478/minrv-2024-0050

Abstract: *The region of Western Macedonia is rich in mineral resources. Over the past decades, it has been primarily focused on lignite mining, while also maintaining smaller-scale extraction activities for olivine, attapulgite, talc, calcium carbonate, dolomite, gypsum, marble, slate, and aggregates, which hold significant economic value. This study recorded active public, private, and municipal quarries as well as inactive public and municipal quarries requiring rehabilitation. Furthermore, a methodology was developed and applied for screening three of the inactive municipal quarries and selecting the more suitable land use for each one. For this purpose, the authors assessed opportunities and risks at the regional level and identified strengths and weaknesses specific to each quarrying site carrying out a SWOT analysis. Criteria for selecting between alternative land uses were then determined. An expert panel including geologists, mineral resource specialists, environmental engineers, regional and municipal officials, legal experts, chamber of commerce representatives, and quarry company board members was convened to evaluate these criteria, with weights assigned using the Analytic Hierarchy Process (AHP). Attributes with spatial variation were mapped using GIS, and the final ranking of land uses for each quarry site was determined using a simple algorithm. The scope of this study was to contribute to the development of communities located close to quarries by supporting the selection of the optimum post-quarrying land uses.*
Keywords: *Land management, Rehabilitation, AHP, SWOT, MCDA, Stakeholders' participation*

1. Introduction

Greece has had a history of intense quarrying activity since ancient times. Marble quarries from various regions in Greece provided the raw material for creating elaborate artworks that adorned nearly all buildings, some of which are exhibited in museums worldwide. In modern times, in addition to marble, other quarrying minerals such as natural stones and industrial minerals are extracted in large quantities, serving as raw materials for various production industries. Specifically, these quarrying minerals are categorized into four types: marbles, other natural stones, aggregates, and industrial minerals, all of which are found in almost every region of Greece [1].

Western Macedonia is one of the regions where significant mining operations are established. Since the decade of 1960, the region has produced more than 1.7 billion tonnes of lignite that were supplied to thermal power plants with a total installed capacity of more than 4,300 MW. Other mining activities involve extraction, processing, and trade of industrial minerals, primarily oriented towards export, and aggregates, which are exclusively utilized within the region's boundaries. Concerning quarrying sites in Western Macedonia, these are classified as public, municipal, and private. The types of quarry minerals and rocks extracted in Western Macedonia and their uses are presented in Table 1 [2].

Regardless of their ownership status, all quarries impact the environment and local communities. To mitigate these impacts, specific measures must be taken during their operation, such as minimizing soil and water pollution, reducing disturbances (e.g., noise and vibrations from blasting), and managing hazardous waste. However, land rehabilitation after quarrying activities cease is also necessary. Beyond typical

* Corresponding author: Mineral Resources Engineering Department, University of Western Macedonia, 50150, Kozani, Greece, fpavloudakis@uowm.gr; Tel.: +30-24610-68255

reforestation efforts aimed at partial ecosystem restoration and landscape aesthetics improvement, there is a growing effort to develop new land uses that bolster the local economy, create jobs, and improve living conditions for adjacent communities. Towards this direction, this study seeks to introduce a new methodology for assessing and selecting land uses for multiple small-scale quarries located within a relatively confined geographic area.

Table 1. Categories and types of quarry minerals extracted in Western Macedonia

Categories	Rock types	Uses	Regional units
Marbles	Rocks of various colours, quarried in blocks, amenable to slab cutting, grinding, and polishing	Decoration of buildings, floors, sculptures, monuments, road construction, paving of sidewalks and squares	Kozani
Natural stones	Slate and limestone slabs, and ornamental rocks		
Aggregates	Rocks of various size distributions produced after crushing	Road construction, production of concrete and cement products (pipes, tiles, etc.)	Kozani, Grevena, Florina, Kastoria
Industrial minerals	Olivine	EBT filler, foundry, sandblasting, etc.	Grevena
	Olivine	Manufacture of medium to high-strength basic refractory materials	Kozani
	Attapulgite, other clay minerals	Pet hygiene products, soil improvers, etc.	Grevena
	Quartz	Glass objects and surfaces, sanitary ware, silicone & building materials, cables, etc.	Florina
	Quartz sand	Building & decorative applications, etc.	Kozani
	Huntite, Hydromagnesite	Polymers' filler, flame retarder, etc.	Kozani
	Dolomite, Calcite	Filler in the building, chemical and composite industries, etc.	Kozani

2. Legal framework of quarry land rehabilitation

The years 1986, 1990, 2011, and 2018 mark significant milestones in environmental legislation concerning mining and quarrying activities. Framework Law for the Environment 1650/1986 first introduced the goal of environmental reclamation. Ministerial Decision 69269/1990 was enacted to introduce specific measures for the implementation of the previous law. In this context, it established the requirement for environmental licensing concerning the exploitation of mineral resources. Law 4014/2011 permitted quarrying activities contingent upon following the environmental licensing process. Law 4030/2011 allowed the installation of excavation, construction, and demolition waste treatment plants in inactive quarries, regardless of ownership status. Law 4512/2018 mandated quarry operators to restore the sites they operate in, setting conditions and requirements for completing these procedures, such as the requirement of reforestation in cases of quarries located within areas characterized as forests [1, 3-6].

The Regulation on Mining and Quarrying Operations (RMQO) sets forth rules for rational activities and steps for the restoration of each quarry site. It specifies that the final form of restoration must harmonize with the broader environment. In public, municipal, or communal lands, provisions are made for meeting local needs and for special land uses, according to the Regional Government's and local authorities' written guidelines [7]. Additionally, mineral resource exploitation projects must comply with specific legislative frameworks that govern extractive activities.

In the study area, the Regional Framework for Spatial Planning and Sustainable Development of Western Macedonia, set priorities for the protection, preservation, and promotion of natural heritage and landscapes, while also ensuring the productive use and conservation of natural resources. Specifically for mineral resources, special priority will be given to comprehensive landscape restoration programs and the identification of alternative uses for exhausted mineral extraction sites, in a manner that considers the functions of the natural and human-made environment in their vicinity. Basic guidelines will be provided for the extraction zones

located in various areas across all regional units. Restoration programs and alternative use plans for exhausted mineral extraction sites will be developed, taking into account the functions of both the natural and human-made environments in their nearby areas [8].

3. Current quarrying activities in the region of Western Macedonia

In the context of this study, records for public, municipal, and private quarries that are operating in the region of Western Macedonia were used. Moreover, for inactive (abandoned) public and municipal quarries that require ecological restoration and/or land rehabilitation data relevant to the location, acreage, and current stage of rehabilitation works was found. However, due to a lack of updates in the archives of the supervisory authorities, some quarries may have been omitted.

3.1. Public quarries in the region of Western Macedonia

Active public quarries

As indicated by the activity reports, idleness reports, and the surety bonds submitted to the Decentralized Administration of Epirus and Western Macedonia, Directorate of Technical Inspection, Natural Resources Office, the quarrying activities in Western Macedonia within the period 2018-2022 exhibited large fluctuations. This fact is indicative of the lack of investment interest due to the uncertain economic environment and the prolonged crisis of the construction sector for over a decade. Table 2 presents the evolution of the number of quarries operating in Western Macedonia from 2018 to 2022.

Table 2. Number of active quarries in Western Macedonia (2018-2022)

Category of products	2018*	2019*	2020**	2021*	2022**
Industrial minerals	17	13	8	14	8
Slate	7	5	2	4	2
Marble	7	5	4	8	3
Aggregates	8	7	6	8	6
Total	39	30	20	34	19

Source: *[3], **[9]

Although quarrying operations were dispersed across all regional units, Kozani exhibited the highest level of extraction activities in terms of the number of quarries and the variety of extracted quarry products. Specifically, olivine, quartz sand, marble, dolomite, and slate were produced in the regional unit of Kozani, quartz in the regional unit of Florina, and mixed bentonite clays in the regional units of Grevena and Kozani. The map of Figure 1 depicts the active public quarries by regional unit for the year 2021.

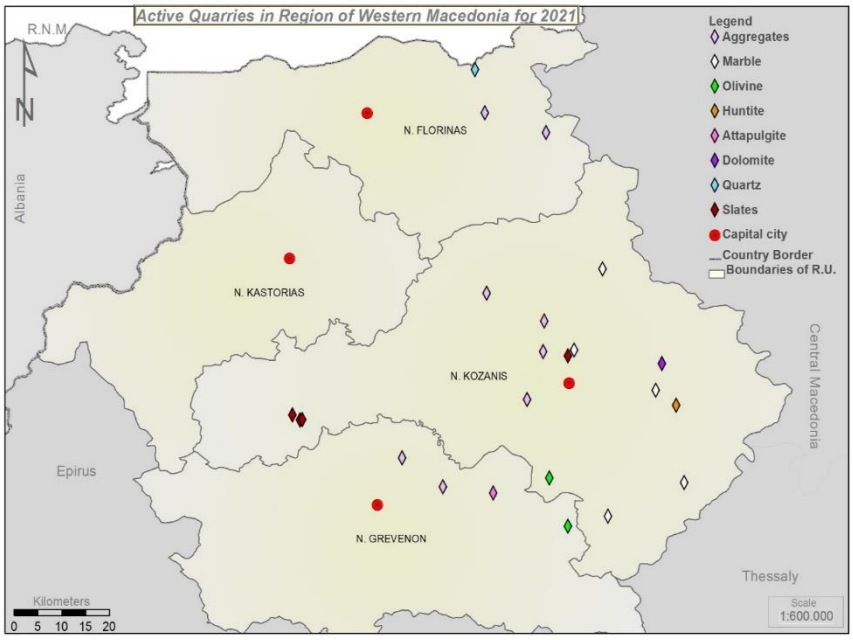

Fig. 1 Map of active public quarries in the four Regional Units of Western Macedonia Region (year 2021)

In the regional unit of Kozani, almost all categories of quarry products that exist in Western Macedonia are mined. The largest percentage is the exploitation of marbles by 35%, followed by mixed Bentonitic clays and aggregates, both with a percentage of 17%. Moreover, the Municipality of Kozani hosts the most quarries in the Regional Unit of Kozani. Specifically, in the Municipality of Kozani are located two quarries of mixed Bentonite clays, two of Olivine, two of Dolomite, three out of four of aggregates, one out of four of slate, and two out of eight of marble [9].

Abandoned and rehabilitated public quarries

According to the current records of the Decentralized Administration of Epirus and Western Macedonia, Directorate of Technical Inspection, Natural Resources Office, sixteen public quarries need ecological restoration and/or rehabilitation. These quarries are either abandoned or the operators have relinquished all administrative responsibility. Of these, twelve are located in the regional unit of Kozani and four in the regional unit of Grevena. Nine public quarries require restoration, while partial restoration has been performed at one quarry (the site has been backfilled), restoration is in progress at another quarry, and at five quarries there are no visible excavation works and the current condition has not been clearly described.

3.2. Private quarries in the region of Western Macedonia

Western Macedonia region hosts four active private quarries, one in each regional unit. Two are extracting aggregates and the other two are extracting industrial minerals.

3.3. Municipal quarries in the municipality of Kozani

As far as the municipal quarries are concerned, the following section refers to the quarries located within the boundaries of the Municipality of Kozani, where the present study is focused.

Active municipal quarries

According to the Department of Primary Sector of the Directorate of Local Economic Development of the Municipality of Kozani, ten active municipal quarries have been recorded. For 2021, the business entities in the Municipality of Kozani that submitted Activity and Inactivity Reports and mining activity occurred were twelve. Figure 4 shows the geographical distribution of business activity based on the submitted Activity and Inactivity Reports where mining takes place in the Municipality of Kozani [3].

Abandoned and rehabilitated municipal quarries

According to the Primary Sector Department of the Directorate of Local Economic Development of the Municipality of Kozani, at least seventeen inactive quarries with a total area of 345,866.77 sq. m. have been recorded on municipal land. In addition, a systematic inventory of the restored municipal quarries around the city of Kozani was carried out and it was found that the Municipality of Kozani has restored two of the quarries located at the boundary of the residential area. One of them has been configured as an open-air theatre, while the second is a transfer station and parking area for the waste collection trucks of the Municipality (ed. these are two different quarries in the same area). For all the other quarries, the restoration works that had been carried out before their closure were incomplete and did not comply with the legislation and the environmental permit [10]. Based on the above, it is necessary to implement projects for the rehabilitation of abandoned quarries, especially for the municipal unit of Kozani, where four quarries are located, corresponding to 62% of the quarry areas of the Municipality of Kozani, and the municipal unit of Ellispontos, where nine small-scale quarries with a total area of 118,322sq.m. are located.

4. Implementation of the land use selection methodology

Figure 2 shows a graphical representation of the land use selection process applied to this paper. The following paragraphs explain the individual steps of the process.

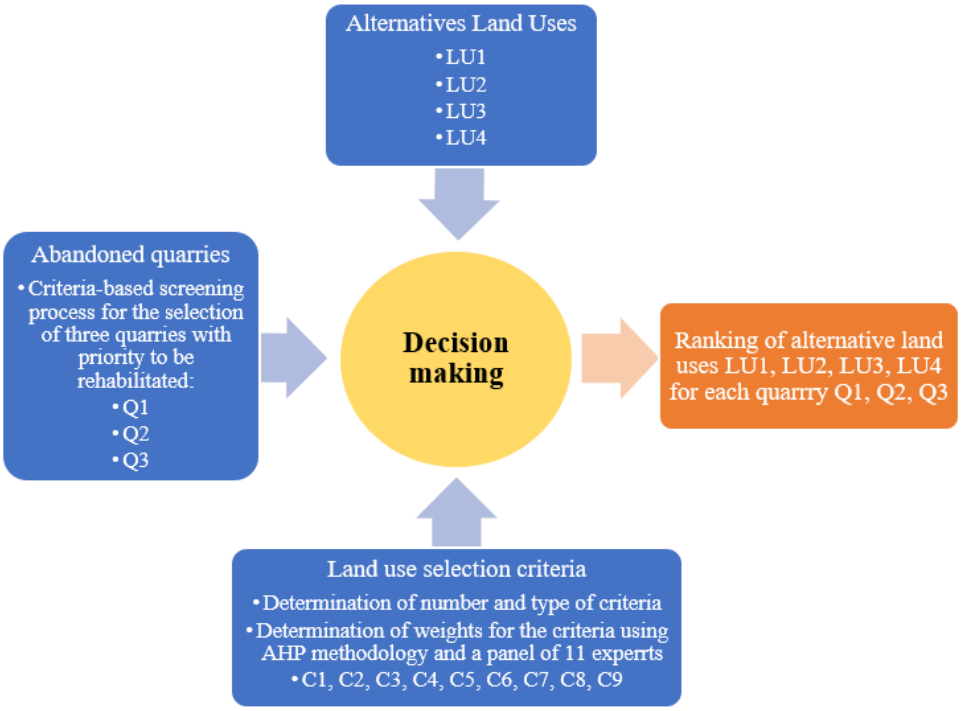

Fig. 2 Schematic description of the multi-criteria (C) decision-making procedure for post-quarrying (Q) land use (LU) selection

4.1. Screening the quarrying sites that require rehabilitation

To assess the efficacy and applicability of the proposed land use selection methodology for quarry sites, the authors assumed the role of a task force that coordinates and implements the entire process. Initially, the task force identified three quarries within the Municipality of Kozani, which require rehabilitation and will be used as case studies in the framework of this study (Figure 3). The selection criteria that guided the screening process for the inactive quarries are detailed in Table 3.

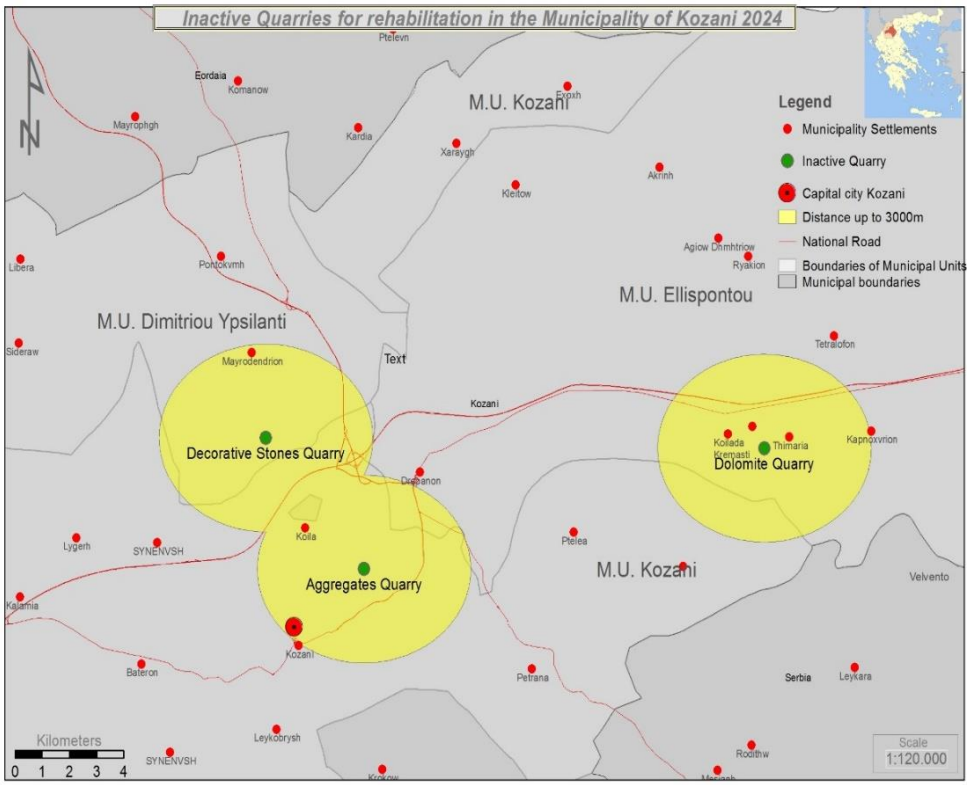

Fig. 3 Map of selected quarries produced using GIS: the buffer zones indicate the communities located at a distance of less than 3km from the quarries

Table 3. Screening criteria of inactive quarry sites that must be rehabilitated

Screening criteria	**Preferable values**
Quarry location	Municipality of Kozani
Product mined	Priorities: 1. Aggregates, 2. Natural stones, 3. Industrial minerals
Health risks	Illegal waste disposal
Accident risks	High slopes, landslides, no or destroyed fences, etc.
Visual impacts (aesthetics)	Quarry site and infrastructures visible from nearby communities and main roads
Environmental impacts	Disturbance of fauna and flora
Area occupied	>20.000 sq. m
Topography	Mountainous terrain that favors erosion and soil instability phenomena
Distance from communities	< 3,000m from the nearest building of a city or village
Proximity to other economic activities	Preferable values depend on the type of activity and the synergetic or antagonistic effects concerning the planned land uses
Distance from public utility networks	Short distance
Access	Easy access to the quarry site

The three quarries selected are briefly presented below.

Case study 1: The 'Koiniarika' aggregates quarry (figure 4) today is located very close to the city of Kozani, at the boundary of the urban plan, and occupies an area of 143,181.33 sq. m [11]. However, when it began to operate, fifty years ago, it was located at least two kilometres from the nearest limit of the city. During its operation, it supplied the regional units of Kozani and Grevena with aggregates.

Case study 2: The quarry is located within the land area of the local community of Mavrodendri, in the municipal unit of Demetrios Ypsilantis (figure 5), and started its operation in the 1960s. Natural decorative stones and serpentines were mined, which were used in the manufacture of mosaics, as well as in other decorative applications due to their intense green cypress color. After the abandonment of this quarry, a deep hole remained in the mining area, which was filled with rainwater over time, creating a lake that exists until today. The quarry occupies a total area of 45,702.70 sq. m [11].

Case study 3: The Dolomite quarry is located near the local community of Kilada in the municipal unit of Hellespontos (figure 6). The area had an inflow of foreign exchange from exports of this material. The quarry occupies a total area of 27,538.72 sq. m [11].

Fig. 4 Inactive quarry of aggregates near the city of Kozani (case study 1)

Fig. 5 Inactive quarry of natural stones near the village of Mavrodendri (case study 2)

Fig. 6 Inactive quarry of dolomite near the village of Kilada (case study 3)

4.2. SWOT analysis

The opportunities and risks at the regional level and the strengths and weaknesses, separately for each one of the three quarrying sites under investigation, were identified and assessed carrying out a SWOT analysis. For this purpose, all the environmental, economic, and social components that affect the quality of life of local communities were investigated. Table 4 presents the main parameters that shape the internal and external environment of the land rehabilitation projects of the inactive quarries under investigation.

4.3. Determination of the land use selection criteria

This stage of the study includes the elaboration of a methodology for selecting the optimal land use based on society, economy, employment, natural environment, quality of life, and priorities and potential of the area by applying multicriteria analysis. The main criteria involved in the land use choice were determined based on a literature review conducted by the authors and are summarised in Table 5 [12-18].

4.4. Determination of the selection criteria weights

To determine the weights of the selection criteria, a panel of eleven experts was assembled, including a mineral resources engineer, an environmental engineer, a land planner, a legal expert, a Director of the regional development company, a representative of an environmental NGO, two officials from the regional authority of Western Macedonia and the Municipality of Kozani, two representatives from the technical and economic chambers, and a member of the board of directors of a quarrying company. Using the Analytical Hierarchy Process (AHP), the experts carried out pairwise comparisons of the selection criteria. For this purpose, a Microsoft Excel-based program developed by Klaus D Goepel was used [19-20]. The methodology prioritized the nine criteria comparing each one against the others. Each criterion's relative importance over another was rated on a scale from 1 to 9. The results of this procedure are summarized in Table 6.

According to these results, the criteria of environment, governance, and economy were assigned the highest weights, indicating that environmental protection, national and governmental policies, legislation, and cost of rehabilitation significantly influence the choice of post-quarrying land uses. The weights of these three criteria were about 50% higher than the weights of four other criteria that are following, namely geoethics, regional development, quarry site characteristics, and technical aspects. This fact highlights that the restoration of the ecosystem and the employment opportunities that can be created, both during the rehabilitation phase and afterward, are highly significant and greatly influence land use choices. Moreover, the experts did not ignore the role of technical aspects and limitations arising from site-specific characteristics in the final choice of feasible and self-sustained land use. The quarry's distance from settlements, roads, utility networks, and neighbouring economic activities, the potential for new business creation, the possibility of reusing quarry facilities (buildings, infrastructure, etc.), the orientation of the quarry, the physical properties of the quarry's components, and the morphology of the terrain greatly shape the opinions of authorities, experts, and citizens regarding quarry rehabilitation.

4.5. Land use selection

The alternative land uses proposed by the task force are the following:

- *Reforestation (RF).* The legislation mandates the reforestation of quarries operated within a forested area [5]. In general, reforestation is considered by the extractive industry and the supervisory authorities as a land use that can be successfully developed in mining and quarries with low to moderate cost.
- *Recreational activities (RA).* Quarries located close to settlements that lack open spaces, and the few available within their plans for similar activities are intended for residential purposes due to their high economic value. Additionally, quarries that cover a large area and are close to roads ensure unobstructed user access. Furthermore, existing utility infrastructure reduces the cost of construction and connection to these networks.

Table 4. Results of SWOT analysis

	Strengths	**Weaknesses**
Internal environment	**Aggregates quarry** • Large area, suitable for uses that require many acres of land • Non-visible from nearby communities • Non visible from roads • Easy access • Short distance from main roads • Proximity to utility networks	**Aggregates quarry** • High slopes • Steep slopes of quarry benches • Illegal waste disposal • Disturbance of fauna and flora • Short distance from the city
	Natural stone quarry • Proximity to future industrial area • Proximity to airplane models' runway • Non-visible from nearby communities • Non visible from roads • Easy access	**Natural stone quarry** • Insufficient area for various uses • Active quarry in the same area • Steep slopes of quarry benches
	Dolomite quarry • Moderate area occupied • Easy access • Short distance from main roads • Proximity to utility networks	**Dolomite quarry** • Visible from nearby communities • Visible from main roads • Illegal waste disposal • Mountainous terrain • Proximity to many small communities • Disturbance of fauna and flora • Steep slopes of quarry benches

External environment	**Opportunities**	**Threats**
	• Legal framework • Land planning • Financial support available • Social demand for the rehabilitation of inactive quarries • Interest already expressed by private enterprises • Numerous successful stories known all over the World • Numerous studies have already been conducted • Subject within the scope of the University of Western Macedonia	• High rehabilitation cost • Land use conflicts • Delays in decision-making • Fear of political costs • Bureaucracy • Lack of consultation between interested parties.

Table 5. Land use selection criteria and attributes

Criteria	**Attributes measured or considered**
Economy	Cost of land rehabilitation and new land use development
Society	The welfare of local communities
Culture	Traditions Aesthetic values
Environment	Soil, water, and air quality
Technical aspects	Distance to residential areas, roads, public utilities, etc.
Mine site characteristics	Surface topography
Governance	Legal and regulatory framework
Regional development	New economic activities Employment Promotion of regional climate change policies
Geoethics	Ecosystem conservation

Table 6. Results of the pairwise comparison of the nine selection criteria and criteria weights

Criteria		**Economy**	**Society**	**Culture**	**Environment**	**Technical Aspects**	**Mine Site Characteristics**	**Governance**	**Regional Development**	**Geoethics**	**Weights**	**+/-**
		1	2	3	4	5	6	7	8	9		
Economy	1	1	2	2 5/9	7/8	1 1/4	1 4/9	1	1 4/9	1 1/3	14.22%	1,3%
Society	2	1/2	1	1 4/5	1/2	5/7	4/5	5/9	2/3	6/7	7.90%	0,8%
Culture	3	2/5	5/9	1	1/2	4/9	2/5	1/3	4/9	2/5	4.96%	1,1%
Environment	4	1 1/7	2 1/7	2	1	2	1 3/7	1 1/8	1 1/2	1 1/2	15.71%	2,5%
Technical Aspects	5	4/5	1 3/7	2 1/4	1/2	1	1 1/8	1/2	7/8	1	10.00%	1,4%
Mine Site Characteristics	6	2/3	1 1/4	2 1/2	5/7	8/9	1	1/2	4/5	1 2/9	10.13%	1,8%
Governance	7	1	1 4/5	3 1/6	8/9	2	2	1	1 1/2	1 1/7	15.47%	2,6%
Regional Development	8	2/3	1 1/2	2 2/9	2/3	1 1/7	1 1/4	2/3	1	3/4	10.66%	1,2%
Geoethics	9	3/4	1 1/6	2 1/2	2/3	1	5/6	7/8	1 1/3	1	10.96%	1,9%

Construction & Demolition Waste (C&DW) Processing Unit. According to legislation, the installation of these units is permitted in inactive quarries to restore the natural landscape and environment, regardless of their ownership status.

High-disturbance production facilities (HD). Plants of renewable energy sources, with or without energy storage facilities, industrial facilities, professional workshops, craft facilities, transport terminals, offices, research centres, and business incubators are paradigms of installations allowed in sites characterized as high-disturbance production facilities [21].

For each of the three abandoned quarry areas, the above-described alternative land uses were given a score against the nine selection criteria (Table 7) and were ranked (Table 8) based on a final score calculated using the following formula:

$$S_n = \sum_{c=1}^{9} W_c Sn_c \quad (1)$$

where W, the weights, Sn, the score of each criterion (0< <10), c, the criteria, and n, the land uses.

Based on the ranking of the alternative land uses for each one of the examined inactive quarries, the following comments are noticed: In Quarry No. 1, located near the city of Kozani, the possibility of hosting high-disturbance production facilities (HD) has a slight lead over the construction of recreational facilities or a construction, demolition, and excavations waste treatment and/or disposal unit. The proximity of the quarry site to the urban fabric creates the conditions to be utilized in various ways, taking into account the lack of plots of this acreage in the greater area and the cost of land purchase or rent. In Quarry No. 2, the development of recreational activities is a top priority because of the existing lake of the final pit, which has already attracted the interest of local cultural and environmental organizations. The scores of the three alternative land uses are less than half of the one given to recreational activities. Finally, regarding Quarry No. 3, it is also clear that reforestation is by far the most suitable land use. The mountain area, where the quarry is located, was forested long before the dolomite extraction. According to the legal framework in force, reforestation is the main option for restoring the ecosystem functions and reducing the visual impacts, which are high because of the close distance of the quarry from three communities and a national road.

Table 7. The scores of the alternative land uses for each one of the selection criteria

		Quarry 1 (Kozani)				**Quarry 2 (Mavrodendri)**				**Quarry 3 (Kilada)**			
Land Uses / Criteria	*Weights*	**RF**	**RA**	**C&DW**	**HD**	**RF**	**RA**	**C&DW**	**HD**	**RF**	**RA**	**C&DW**	**HD**
Economy	*14.22*	5	6	6	6	1	6	5	6	9	6	2	3
Society	*7.90*	2	5	5	7	1	3	1	1	9	5	2	2
Culture	*4.96*	4	6	5	8	4	6	1	1	9	4	2	2
Environment	*15.71*	2	7	8	5	3	5	1	2	9	1	3	1
Technical Aspects	*10.00*	1	6	5	9	1	6	4	3	9	1	1	1
Mine Site Characteristics	*10.13*	1	9	5	8	1	9	4	1	9	1	1	1
Governance	*15.47*	6	6	6	7	2	9	1	1	9	9	9	9
Regional Development	*10.66*	7	7	7	7	7	7	7	7	7	7	7	7
Geoethics	*10.96*	1	9	5	8	1	3	2	1	9	1	1	1
Final scores	*100*	3.4	6.8	6.0	**7.0**	2.3	**6.2**	2.9	2.7	**8.8**	4.0	3.5	3.3

Table 8. Ranking of alternative land uses based on their suitability for rehabilitating the three quarries under investigation

Quarry / Land Uses	Quarry 1 (Kozani)		Quarry 2 (Mavrodendri)		Quarry 3 (Kilada)	
	Total	**Rank**	**Total**	**Rank**	**Total**	**Rank**
Reforestation (RF)	3.4	4	2.3	4	8.8	1
Recreational activities (RA)	6.8	2	6.2	1	4.0	2
Construction & Demolition Excavation Waste Unit (C&DW)	6.0	3	2.9	2	3.5	3
High-disturbance production facilities (HD)	7.0	1	2.7	3	3.3	4

5. Discussion and conclusions

The rehabilitation of lands following the cessation of operations in surface mines and quarries has been a point of contention between mining companies and local communities for many decades. Today, legal and regulatory frameworks bind mining companies to carry out restoration projects, while the best available techniques known to industrial partners, consultants, and the scientific community facilitate the design of optimal interventions.

The digital and energy transitions are causing upheavals in traditional sectors of the economy that affect regional development. This is particularly true in regions such as Western Macedonia, with a long history of large-scale mining operations and a strong dependence on the primary sector, in general. In this framework, the choices regarding mining and quarry land rehabilitation methods and the selection of new land uses must go beyond the restoration of ecological functions, creating new economic activities and employment.

In areas where numerous inactive quarries exist, the regional authorities are called upon to decide on the future utilization of these abandoned sites, especially if the quarry operators have relinquished any jurisdiction. For these cases, the present study proposes a methodology applicable for simultaneously selecting land uses across multiple abandoned quarries located within the same geographic unit. This methodology was tested in the Municipality of Kozani, the capital of the Western Macedonia Region, Greece.

The methodology started with a screening procedure based on 9 criteria, in order to select the quarries to be rehabilitated as a priority. This first phase is necessary, since the available financial resources may not be sufficient for the simultaneous rehabilitation of all 17 inactive quarries of the Municipality of Kozani.

The selection process for optimal land use per quarry area, which followed, was characterized by the following:

- It relied on SWOT analysis and AHP methods, proven in multiple cases to be straightforward, effective, and reliable in application.
- It allowed stakeholders to express their opinions through a process of determining weights on land use selection criteria.
- It maintained complete control over the entire process through a task force composed of the authors of this study, thus avoiding delays and conflicts among stakeholders.
- It produced results that were clear and understandable to decision-makers, both in the form of ratings on a 0-10 scale and in the creation of a ranking of alternative land uses based on their suitability for each quarry area.

Based on the above, the proposed methodology for selecting land uses is considered capable of contributing to regional development by choosing sustainable solutions that enhance social cohesion and prosperity.

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