The landscape reclamation alternatives of marble quarries as an example of a degraded site in Isparta

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The paper presents the selected example of reclamation in surface mining in Isparta region. The aim of the study was to determine different options of use for areas disrupted as a result of marble mining activities, as well as priorities and appropriate functions for these options. Managers of the area scored possible area usage types based on environmental suitability, economic suitability, social suitability and technical suitability. They (n=7) performed a preliminary elimination for projected usage options for the research area and four usage options (forest, agriculture, tourism-recreation, renewable energy) were determined for marble quarry. As a result of the first step of the assessment, it was determined that usage options of Forestry, Tourism-Recreation, Agriculture and Renewable Energy would be suitable, whereas the other usage types (Industry, Settlement, Solid Waste Landfill) were not found to be eligible for the area. In the second step of the assessment, functions were determined for the options and scored by experts (n=20) on the subject. The ordering technique was used to determine functions for the marble quarry example. Expert opinions were received to determine the most suitable area usage functions for these area usage options. Consequently, functions were found to be the most suitable for the Forestry option (vegetation for soil and water protection, maquis groves, agroforestry, pasture plants production area, greenhouse cultivation and seedling production and catch cropping) and Tourism/Recreation option (picnic and rest area, vehicle/pedestrian roads and parking area, outdoor sports area and playing field, wooden bungalows, natural camping area, pond and open-air marble museum).

Key words: Landscape reclamation, marble quarry, degraded site, Turkey.

INTRODUCTION

Planning/designing and managing landscapes disturbed or disrupted as a result of human activities or natural disasters to improve them in accordance with environmental, social and economic conditions (rehabilitation) and develop them for different purposes (reclamation) are referred to as landscape restoration.

In recent years, legislative actions on environmental issues have dramatically increased all over the world. The impacts of environmental legislation on the mining sector are quite significant (Damigos and Kaliampakos, 2003).

This study aims to present a participative methodology related to decision-making process for the landscape restoration type, the priorities and the most appropriate functions in marble quarries in the aftermath of the mining activity.

The main goal of quarry restoration is to convert degraded, unproductive areas into new, self-sustaining ecosystems that develop into highly natural environments (Gilardelli et al., 2016.)

Quarry management can play an environmental role, acting either as a disturbance for the surroundings or as a potential new ecosystem during and after the extraction. In this light, a sustainable use of quarry resources requires a trade-off between nature conservation and extraction activities. Quarry restoration is an explicit example of such a compromise. Restoration, which is not merely an attempt to mend an aesthetic
landscape scar, should lead, as soon as possible, to the reconstruction of plant communities (Boscitti et al., 2017).

Therefore, the main objective of landscape restoration works carried out in marble quarries must be ensuring that the disrupted ecosystem is reformed and improved (rehabilitation) or these areas are developed and used with an altered natural structure for different purposes (reclamation). For this reason, it is important to determine which usage options will be preferred as well as setting forth priorities of these options within the scope of landscape restoration in marble quarries.

The marble quarry permitted by law within the forest land is actually a part of the forest ecosystem and therefore the most rational approach is to determine the most suitable restoration and usage types and functions for sustainability of the forest ecosystem. Indeed, usage types and functions projected based on the results obtained are the most appropriate approaches for sustainability of the forest ecosystem.

The ultimate goal of reclamation work is to create a terrain relief under the plan of remediation and reclamation, which is supposed to be environmentally balanced and economically valuable as required by social needs (Mikolas et al., 2016).

The most favorable solution is based on the measurable evaluation criteria and the decision analysis. Evaluation criteria was selected to meet the assumptions of a sustainable development concept taking into account ecological, economical, and social aspects of the analyzed options (Wojciech et al., 2014).

In this study, managers of the area scored possible area usage types based on environmental suitability, economic suitability, social suitability and technical suitability. As a result of the assessment, it was determined that usage options of Forestry, Tourism-Recreation, Agriculture and Renewable Energy would be suitable, whereas other usage types (Industry, Settlement, Solid Waste Landfill) were not found to be eligible.

These four different usage types were assessed and Forestry and Tourism/Recreation was found to be the most suitable usage option as a result of the analysis performed. Opinions of experts were received once again to determine the most suitable area usage functions for these area usage options.

The land structure of the area changes significantly and loses its attraction, stability or fertility after marble extraction. The area is not suitable for vegetation due to graded and hard surfaces caused by mining activities. Moreover, it is absolutely impossible to restore the land structure (return it to its original), in other words, to create the same ecosystem, after marble extraction activities. For this reason, the main objective of landscape restoration works carried out in marble quarries is to ensure that the disrupted ecosystem is reformed and improved (rehabilitation) or to develop and use these areas with the altered natural structure for different purposes (reclamation). To this end, it is important to determine which usage options will be preferred, as well as priorities of these options within the scope of landscape restoration in marble quarries.

The objective in planning and design of landscape restoration is to come up with the most appropriate solutions, measures and techniques for its improvement, development, protection and maintenance in accordance with its restoration purpose. In this context, it is projected to achieve an ideal short-, medium-, and long-term synthesis as a result of a detailed analysis and assessment of the area based on purposes of the restoration. Areas disrupted or disturbed as a result of mining activities (especially marble and stone quarries) require landscape restoration and “Holistic Planning” since temporal and technical dimensions of production and restoration activities are different yet related to each other.

As in all mining activities, marble mining activities must be carried out where the reserve is located. For this reason, marble mining activities do not have an alternative in terms of location.

As a country rich in terms of underground and surface resources, Turkey is one of the top five countries in the world in terms of natural stone production and trade. Turkey has approximately 40% of world’s natural stone reserves (Onur, 2012).

A difficult part of quarry rehabilitation is the legacy of tall vertical rock faces that have little soil or water for vegetation (Jim, 2001). Making a choice among many different plans and area usages for marble quarry rehabilitation is a complicated and difficult task. Revegetation is not an effective and efficient choice for marble quarries since the areas abandoned when once material extraction is finished are often smooth and flat, which causes soil erosion. Because the area where marble was extracted now has a hard surface, it does not allow for adequate root development, which usually results in dead plants.

Landscape restoration approach is adopted to implement appropriate biological and technical measures for improvement, development, protection and maintenance of areas disrupted or disturbed naturally or as a result of human activities in a planned manner (Gorcelioglu, 2002).

Sustainable development requires improving the integration of three interdependent aspects of development, namely: (i) economical, (ii) social and (iii) environmental aspects. The challenge for planning is to ensure the efficient allocation and rational utilization of limited financial and human resources, which include nature and landscape, soil, water and air as well for achieving a balanced development. Since spatial planning envisages a long-term perspective by its nature, it is indispensable to incorporate important principles of sustainability into the methodological approaches tailored.
MATERIALS AND METHODS

The study area is a marble quarry run by Barla Marble Mining, Industry and Trade Co. since 2010 in the district of Eğirdir, Isparta, Turkey (Figure 1). The coordinates of the study area are 36°30′58.7″ E and 41°94′75.7″ N. It is approximately 1 km to the Isparta-Eğirdir roadway and can be seen from the roadway.

This study was performed to develop a methodology and road map for reclamation of marble quarries based on a model. On the basis of field research and analysis of the available sources and databases, the reclamation modes and post-mining terrains management were analyzed.

The Mediterranean region has large marble reserves. The province of Isparta and the district of Eğirdir located in the Mediterranean region have majority of these reserves. In the marble quarry, marble blocks are produced using the opencast mining method. Mining activities in the quarry area (Figure 2) are to continue for meeting factual local needs in order to ensure effective practices (Dericioglu and Gunduz, 2011).
until 2020 according to the contract. The site consists of 64,023 m² in total, quarry area (43,453 m²) + waste landfill area (15,248 m²) + site facilities (5,322 m²).

Landsat ETM+, ASTER, IRS and Worldview-2 satellite images (Figure 3) from 2002, 2006, 2010 and 2012, respectively were used to track the change in the marble quarry from past to present. The Landsat ETM+ satellite, which is equipped with an Enhanced Thematic Mapper Scanner, has an imaging frequency (temporal resolution) of 16 days. Panchromatic, multispectral and thermal bands on the satellite have a resolution of 15, 30 and 60 m, respectively. The spatial resolution of the panchromatic band of IRS (Indian Remote Sensing Satellites) is 5.8 m, whereas the resolution of the multispectral band is 23 m.

Ownership structure

The study area is a state-owned forest located in sections 228 and 229 of Eğirdir Department of Forestry, Isparta. Figure 4 shows the boundaries of sections where the study area is located.

Methodology

Preliminary elimination of area usage options and determination of appropriate options

After material extraction is completed in marble quarries, it is possible to develop different usage types such as Forest, Agriculture, Renewable Energy, Tourism-Recreation, Industry, Settlement, Natural Protection, Solid Waste Landfill using biological and technical methods for landscape restoration. To this end, a preliminary elimination was deemed appropriate for the determination of suggested area usage options considering that the study area is located in a forest area.

In this context, four main factors were developed based...
on factors suggested by Riddle and Sweigard (1978), Ramani et al. (1990), Tüzün (1992), Unal et al. (1992) and Akpınar (1994) in order to determine different area usage alternatives once the marble mining activity is finished in the area.

(a) Environmental Suitability: Suitability with prior usage type, suitability with existing and possible environmental conditions, suitability for increasing visual landscape effect.

(b) Economic Suitability: Cost efficiency, administrative (maintenance, protection, etc.) cost efficiency, suitability for generating added value or profit.

(c) Social and Cultural Suitability: Suitability for meeting multiple needs of locals, suitability for being accepted by locals, suitability for creating employment.

(d) Technical Suitability: Suitability with applicable legislation, suitability with ownership status (forestry land, public property, private property, etc.), suitability with assessments and preferences of owners of the area, suitability for land size.

Since the study area was a forest land, we received help from managers (n=7, Isparta Department of Forestry) in charge of the area to perform a preliminary elimination in order to determine area usage options in accordance with economic, social, cultural, environmental and technical aspects of the area.

Expert assessments are important sources of feedback on a specific subject. Experts on the subject can be chosen from academicians and those with vast experience in the field. Using this method allows to obtain opinions of individuals from different disciplines. Receiving opinions from a small number of experts rather than a large number of non-experts provides better feedback. This effective method presents the opportunity to obtain information directly from individuals who have vast knowledge and experience in the field. Expert assessment is carried out using question-answer techniques.

Weighted Scoring Method

Weighted scoring is a technique for putting a semblance of objectivity into a subjective process. Using a consistent list of criteria, weighted according to the importance or priority of the criteria to the organization, a comparison of similar “solutions” can be completed. If numerical values are assigned to the criteria priorities and the ability of the product to meet a specific criterion, a “weighted” value can be derived. By summing up the weighted values, the product most closely meeting the criteria can be determined.

The scoring method is used to compare alternatives based on the weighted scoring system. Scoring models also allow you to digitize different options that use multiple criteria.

To find the total score, each measure is multiplied by the weight score and the values found in all the criteria in the project are summed.

The formula is: \[ Total \ Score = \sum_{i=1}^{n} W_i C_i \]

Where \( W_i \) = weight score; \( C_i \) = criterion score; \( 0 < W_i < 1 \)

The managers in charge of the study area gave suitability scores (1 point: not suitable, 2 points: less suitable, 3 points: moderately suitable, 4 points: suitable, 5: very suitable) to area usage types to perform the preliminary elimination. To this end, factors of environmental (ecological) suitability, economic suitability, social and cultural suitability and technical suitability were assigned with weight scores. Total points given to each factor were multiplied by the weight score of the factor to obtain the net score. Area usage types with high score (those above 10% of the total score) were chosen using this method.
and the remaining were eliminated.

Determinations of functions for projected/determined options in the study area

Possible usage options for the study area and appropriate functions for these options were scored (1 point: not suitable, 2 points: less suitable, 3 points: moderately suitable, 4 points: suitable, 5 points: very suitable) by academicians and industry experts (n=20; 5 Landscape Architects, 5 Forest Engineers, 5 Agricultural Engineers, 5 Tourism Experts; Tables 3 and 4).

Appropriate functions were determined for the three zones (quarry area, waste landfill area, site facilities) in the area in accordance with options determined by experts.

RESULTS AND DISCUSSION

Projected land usage type, operating conditions and existing environmental, social and economic conditions are the most basic data used to determine restoration type and functions for a disrupted landscape. A preliminary analysis was performed using suitability factors for options and components of these factors to determine different usage types for the marble quarry area once the mining activity is completed.

During the last decades of the 20th century and early 21st century we can notice higher ecological concerns, less bureaucratic interference into the proposals and also higher emphasis on the complexity of reclamation work (Mikolas et al., 2015).

Preliminary analysis for usage options in the study area

There are two main methods for restoration of post-mining sites: (i) spontaneous revegetation and (ii) technical reclamation (Sebelikova et al., 2016). In this study for technical reclamation, it was projected that usage types such as Forestry, Agriculture, Renewable Energy, Tourism-Recreation, Industry, Settlement, Solid Waste Landfill could be possible within the scope of landscape restoration once the marble production activity is finished in the study area. Since the study area was a forest land, we received help from managers (n=7; Isparta Department of Forestry) in charge of the area to perform a preliminary elimination in order to determine area usage options in accordance with economic, social, cultural, environmental and technical aspects of the area.

Managers in charge of the study area gave suitability scores (1 point: not suitable, 2 points: less suitable, 3 points: moderately suitable, 4 points: suitable, 5: very suitable) to area usage types to perform the preliminary elimination. In this regard, factors of environmental (ecological) suitability, economic suitability, social and cultural suitability, and technical suitability were assigned with weight scores. Total points given to each factor were multiplied by the weight score of the factor to obtain the net score. Area usage types with high score (those above 10% of the total score) were chosen using this method and the remaining were eliminated.

Suitability scores given by managers for the preliminary elimination of usage options and weight scores of these suitability factors can be seen in Table 1. As shown in the table, environmental suitability had the highest priority with a weighted score of 0.34.

Each post-mining landscape is unique and that its recovery requires balanced relationship between social, economic and ecological components. Development of such sites entails involvement of various professions, with architectural and artistic aspects as prevailing professions in the analyzed examples. This indicates the fact that their development requires avant-gardism and creativity, and that the process of recovery should be inclined towards innovative solutions and new possibilities (Gasparovic et al., 2009).

Managers scored the projected options for preliminary elimination according to suitability factors and factor components and the following was found according to % weight scores:

1. Forestry (28.1%)
2. Tourism/recreation (27.9%)
3. Agriculture (12.6%)
4. Renewable energy (11.0%). Other usage types were not found to be suitable for the study area since their total suitability score remained under 10% (Table 2).
Table 2. Determination of possible usage types for the study area by managers through preliminary elimination.

<table>
<thead>
<tr>
<th>Suitability Factors</th>
<th>Factor Components</th>
<th>Forestry</th>
<th>Tourism and Recreation</th>
<th>Agriculture</th>
<th>Renewable Energy</th>
<th>Industry</th>
<th>Settlement</th>
<th>Solid Waste Landfills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Suitability</td>
<td>Suitability with prior usage type</td>
<td>35</td>
<td>35</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Suitability with existing and possible environmental conditions</td>
<td>35</td>
<td>35</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Suitability for increasing visual landscape effect</td>
<td>35</td>
<td>21</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>105</td>
<td>91</td>
<td>22</td>
<td>23</td>
<td>21</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Weight coefficient (0.34)* Total</td>
<td>35.7</td>
<td>30.94</td>
<td>7.48</td>
<td>7.82</td>
<td>7.14</td>
<td>7.14</td>
<td>7.14</td>
</tr>
<tr>
<td></td>
<td>Cost efficiency</td>
<td>26</td>
<td>28</td>
<td>21</td>
<td>15</td>
<td>7</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Economical Suitability</td>
<td>Administrative (maintenance, protection, etc.) cost efficiency</td>
<td>34</td>
<td>28</td>
<td>14</td>
<td>15</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Suitability for generating added value or profit</td>
<td>21</td>
<td>35</td>
<td>21</td>
<td>28</td>
<td>7</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>81</td>
<td>91</td>
<td>56</td>
<td>58</td>
<td>21</td>
<td>21</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Weight coefficient (0.22)* Total</td>
<td>17.82</td>
<td>20.02</td>
<td>12.32</td>
<td>12.76</td>
<td>4.62</td>
<td>4.62</td>
<td>7.48</td>
</tr>
<tr>
<td></td>
<td>Suitability for meeting multiple needs of locals</td>
<td>22</td>
<td>35</td>
<td>21</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Social and Cultural Suitability</td>
<td>Suitability for being accepted by locals</td>
<td>28</td>
<td>34</td>
<td>28</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Suitability for creating employment</td>
<td>22</td>
<td>34</td>
<td>28</td>
<td>14</td>
<td>7</td>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>72</td>
<td>103</td>
<td>77</td>
<td>42</td>
<td>21</td>
<td>35</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Weight coefficient (0.20)* Total</td>
<td>14.4</td>
<td>20.6</td>
<td>15.4</td>
<td>8.4</td>
<td>4.2</td>
<td>7</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Suitability with applicable legislation</td>
<td>35</td>
<td>30</td>
<td>7</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Suitability with ownership status (forestry land, public property, private property, etc.)</td>
<td>35</td>
<td>35</td>
<td>7</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Technical Suitability</td>
<td>Suitability with assessments and preferences of owners of the area</td>
<td>35</td>
<td>21</td>
<td>14</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Suitability for land size</td>
<td>35</td>
<td>35</td>
<td>14</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>140</td>
<td>121</td>
<td>42</td>
<td>44</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Weight coefficient (0.24)* Total</td>
<td>33.6</td>
<td>29.04</td>
<td>10.08</td>
<td>10.56</td>
<td>6.72</td>
<td>6.72</td>
<td>6.72</td>
</tr>
<tr>
<td>Final Total</td>
<td></td>
<td>364.26</td>
<td>101.52</td>
<td>45.28</td>
<td>39.54</td>
<td>22.68</td>
<td>25.48</td>
<td>25.54</td>
</tr>
<tr>
<td>Weight Score (%)</td>
<td></td>
<td>28.1</td>
<td>27.9</td>
<td>12.6</td>
<td>11.0</td>
<td>6.3</td>
<td>7.1</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Developing functions for determined options

Possible usage options for the study area and appropriate functions for these options were scored (1 point: not suitable, 2 points: less suitable, 3 points: moderately suitable, 4 points: suitable, 5 points: very suitable) by academicians and industry experts (n=20; 5 Landscape Architects, 5 Forest Engineers, 5 Agricultural Engineers, 5 Tourism Experts; Tables 3 and 4).

According to assessments by experts, the most suitable functions for the Forestry option are as follows:

1. Vegetation for soil and water protection (14.3%).
2. Macquis groves (13.8%).
3. Agroforestry (12.8%).
4. Pasture plants production area (11.6%).
5. Greenhouse cultivation and seedling production (8.2%).
6. Catch cropping (7.5%).

According to assessments by experts, the most suitable functions for the Tourism/Recreation option are as follows (Table 4):

Table 3. Suitability scores and averages of functions projected for the Forestry option.

<table>
<thead>
<tr>
<th>Forestry option</th>
<th>Suitability scores</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marble quarry area (surface mining area)</td>
<td>Waste landfill and storage area</td>
</tr>
<tr>
<td>Natural protection</td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td>Macquis groves</td>
<td>132</td>
<td>118</td>
</tr>
<tr>
<td>Industrial forestry</td>
<td>32</td>
<td>50</td>
</tr>
<tr>
<td>Vegetation for soil and water protection</td>
<td>136</td>
<td>139</td>
</tr>
<tr>
<td>Agroforestry</td>
<td>110</td>
<td>92</td>
</tr>
<tr>
<td>Energy forest</td>
<td>54</td>
<td>78</td>
</tr>
<tr>
<td>Wild life reproduction and development area</td>
<td>58</td>
<td>32</td>
</tr>
<tr>
<td>Catch cropping</td>
<td>74</td>
<td>84</td>
</tr>
<tr>
<td>Freshwater fishery</td>
<td>57</td>
<td>32</td>
</tr>
<tr>
<td>Greenhouse cultivation and seedling production</td>
<td>85</td>
<td>38</td>
</tr>
<tr>
<td>Pasture plants production area</td>
<td>132</td>
<td>86</td>
</tr>
<tr>
<td>Botanical garden or Arboretum</td>
<td>36</td>
<td>54</td>
</tr>
<tr>
<td>Total</td>
<td>871.3</td>
<td></td>
</tr>
</tbody>
</table>

(1) Picnic and rest area (12.4%).
(2) Vehicle/pedestrian roads and parking area (11.8%).
(3) Outdoor sports area and playing field (11.3%).
(4) Wooden bungalows (10.9%).
(5) Natural camping area (10.8%).
(6) Pond (10.7%).
(7) Open-air marble museum (10%).

Projected functions with a percent suitability score of 10% or higher in Tables 3 and 4 were determined as the most suitable functions.

As a result, functions of vegetation for soil and water protection (14.3%), macquis groves (13.8%), agroforestry (12.8%), pasture plants production area (11.6%), greenhouse cultivation and seedling production (8.2%), and catch cropping (7.5%) were found to be the most suitable functions for the Forestry option, whereas picnic and rest area (12.4%), vehicle/pedestrian roads and parking area (11.8%), outdoor sports area and playing field (11.3%), wooden bungalows (10.9%), natural camping area (10.8%), pond (10.7%), and open-air marble museum (10%) were found to be the most suitable functions for the Tourism/Recreation option (Tables 3 and 4).

Agroforestry, a function of the development concept, is a very beneficial area usage type in regions where the soil is not suitable for agriculture and forest resources are disrupted or infertile. Agroforestry allows benefiting from...
land in multiple ways (agriculture, livestock and forestry). Agroforestry is one of the important fields of study frequently referred in our country's agriculture and forestry industry.

This anthropogenically affected landscape is successfully integrated back into the surrounding environment through reclamation and restoration processes. These processes support the creation of new land designated for improving the ecological and environmental stability of the area, and also for recreational purposes (Vrablik et al., 2017).

Since the recreational area is an active usage area, it allows bringing more functions to the area. The recreational area combines an open-air marble museum, a biological natural pond, rest area equipment and a sloping area. It also includes artificial walls up to 40 cm, which softens the view. The recreational area includes a parking area nearby as well.

The camping area is projected to combine bungalows, an observation terrace and a visitor center. This area is located at the top of the study area and therefore in an ideal position for the observation terrace. Bungalows were planned here since it is both at the top of the study area and in an isolated position. The area includes a parking area and a visitor center as well.

Outdoor sports areas and playing fields are projected to have outdoor activity area for people from all age groups. Outdoor sports include all sports activities performed outdoors with or without equipment. Walking and obstacle tracks with knit ropes are designed for adults, whereas open-air playgrounds are intended for children.

Natural and cultural areas are used by individuals for wrong purposes and disrupted and destroyed due to lack of awareness. It is a vital responsibility to restore and develop these disrupted areas so that we can ensure a clean environment for next generations. However, it may not be possible for a disrupted or disturbed area to regain ecological balance and restore itself when it is left to its own devices or it may take a lot of time. It is absolutely necessary that people provide technical intervention and assistance to restore such areas.

Conclusions

This study was conducted to determine which usage types would be suitable for a marble quarry once the material extraction activity is finished. Priorities and functions for usage types were determined based on expert opinions.

Reclamation and restoration processes are important tools for sustainable development since they take into consideration the ecological, economic and social potential of an anthropogenically affected landscape.

The most effective solution for such areas is to come up with different usage alternatives which will make a social, cultural and economic contribution to the region. The most significant problem encountered in material quarries is not during extraction of material from the quarry, but after the quarry is closed. This problem is the rehabilitation of the quarry area and officials, locals, mining companies and nature itself are involved in this process.

There is no legal or practical method or road map in Turkey for reclamation of marble quarries operated with the opencast mining technique as natural sites. In any event, it is not really possible to reclaim such areas as natural sites due to the type of mining activity and the final form of the disturbed area.

Therefore, this study aims to present a participative methodology related to the decision-making process for the landscape restoration type, the priorities and the most appropriate functions in marble quarries once the mining activity is finished in the area.

In conclusion, it should be accepted that it is necessary to restore or improve all disrupted or disturbed areas which have natural and cultural significance by adopting a holistic, participative, environmentalist and ethical approach in terms of legal, corporate, planning, implementation and administrative aspects.

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REFERENCES


