

BRINGING THE QUARRIES IN THE HIGHWAY LANDSCAPE TO THE ECOSYSTEM

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Keywords

Biology
Highways
Landscape architecture
Ecology

To cite this article

Aydın İ.B., Kırpık, M.A.,
Altunoğlu, K., Bringing the
quarries in the highway landscape
to the ecosystem.
Commun.Fac.Sci.Univ.Ank.Ser.C
Biology, 34 (1) (2025), 48-57.
<https://doi.org/10.1111/communc.1616660>

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Abstract

The aim of this study is to reveal the current situation of 56 quarries in the provinces of Kars, Iğdır and Ardahan. In addition, after the function of supplying materials from the quarries is completed, the necessary landscaping repair works are carried out to determine what can be done to bring them into the ecosystem. In this study, a survey consisting of 16 questions was applied to a total of 150 people, 50 of whom lived where the quarries were located, 50 of whom lived in the city centre and 50 of whom were quarry technical personnel. In the study, quarries were examined on site and obtained data were analyzed statistically by SPSS programme. In addition, the environmental impacts of quarries, their damage to nature and their effects on users were determined. As a result of the study, in order to integrate quarries into the ecosystem in the highway landscape, methods of land use, planting and recreation without endangering traffic, life and property safety were suggested.

1. INTRODUCTION

Ecology, which analyses the interaction of organisms with the elements of their environment, is a branch of science that tries to provide the principles of nature conservation, the life bases of living things and the sustainability of the ecosystem [1]. The ecosystem, which consists of living and non-living elements and should be considered as a whole, creates suitable environmental conditions for living organisms to continue their lives and progeny. Factors such as ambient temperature, light, humidity, wind and edaphic factors such as soil composition determine ecosystem conditions. There are various ecosystems such as forest, lake, desert, mountain, reeds, river, ocean. The destruction of all components of the ecosystem (soil erosion, removal of the vegetative layer, reduction of water resources, increase in population, destruction or destruction of suitable habitats) causes the ecosystem to become unable to perform its basic tasks. Destruction of the natural balance of the ecosystem results in the extinction of many species.

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This situation causes the amounts of the food between living in the region [2]. Among the causes of destruction in the ecosystem are erosion caused by floods due to excessive rainfall, forest fires and industrialisation. Among these, industrialisation is the most important one. Iron, steel, cement industry and industrial wastes are some of the factors that destroy nature [3].

With the increasing population in our country and the world, the construction sector is growing day by day. One of the activities of the construction sector is the construction of highways that provide intercity transport. This situation creates a great need for raw materials for the construction of new transport networks, repair or expansion of existing ones [4].

Mankind has preferred to obtain its raw material needs from nature, which is generally seen as economical in the short term. While the process of obtaining raw materials destroys nature, urbanised spaces, concrete piles, degraded landscapes have brought harm to the values of our country. The sources of raw materials obtained from nature can be forest and agricultural products as well as soil and stone. These raw materials are processed and used firstly as infrastructure material for roads and then for other structures. The material prepared for use in this way has revealed the concept of quarry. The history of the use of quarries has been observed since mankind began to shape the stone. Stones obtained from these quarries have been used in many historical monuments that still exist today and Natural Protected Areas that contain stone structures.

The use and development of quarries date back to the Seljuk and Ottoman Empire periods. It is seen that the first legal regulation on quarries was made with the "Regulation on Quarries", which entered into force in 1887 and then in 1901 [5]. Structures such as bridges, caravanserais, mosques, churches, churches, clusters, healhouses and madrasahs were built with the stones obtained from quarry works, and they were also frequently used as ornamental stones [6].

Serious damages are caused to the environment during and after the use of quarries from which road construction material is taken. In addition to the damage to the ecosystem in general, serious damage to plant and animal species in natural life can be given as an example. People are also indirectly affected by these negativities.

The importance of highway landscapes has emerged in reintroducing quarries to the ecosystem after their use. Roads and motorways, which provide intercity transportation, have a great negative impact on the environmental landscape as they cover a large area on the geography [7]. The highway landscape is a multidimensional system, both qualitative and quantitative [8]. According to Public Procurement Contracts Law of the Highways Law (4735/8), the material procurement conditions for road construction and the works to be carried out in the area afterwards are described [9]. The aim of this study is to determine the current situation of the quarries in Kars, Iğdır and Ardahan provinces, what kind and how landscape-repair works will be carried out after the material supply

function from the quarries is over, how they will be brought into the ecosystem and what can be done in this regard.

2. MATERIALS AND METHODS

In this study, the current conditions of 56 quarries located within the borders of Kars, Ardahan and Iğdır provinces between 2020-2021 were examined. In this study, a questionnaire consisting of 16 questions was applied to a total of 150 people, 50 of whom were residents of the quarries, 50 of whom were residents of the city centre and 50 of whom were quarry technical personnel. Photographs of the quarries and their surroundings were taken. According to the questionnaires, the current conditions of the quarries were determined and evaluated and the locations of the quarries were shown on the map (Figure 1).

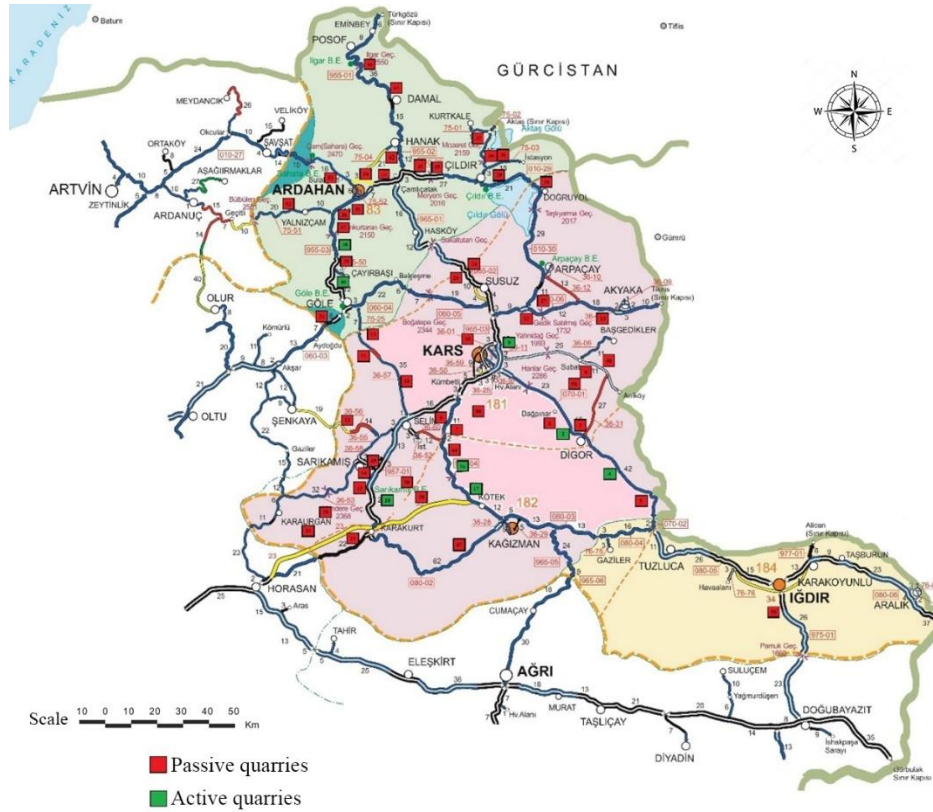


FIGURE 1. Current status of the investigated quarries on the map

3. RESULTS AND DISCUSSION

The study was conducted in 56 quarries located within the provincial borders of Kars, Ardahan and Iğdır.



FIGURE 2. Kars Subatan Quarry

The current conditions of the quarries were determined, their negative and positive effects on the ecosystem were investigated and it was tried to determine whether the quarries that are still used and used by the highways are brought back to the ecosystem. In order to determine the current status of the quarries, a questionnaire was applied to 3 different groups. These groups are:

It was applied to a group of 50 people living close to the quarries and directly experiencing the negative impacts of the quarries.

It was applied to 50 people who personally work in quarries and are directly exposed to the negative effects of quarries.

A questionnaire was applied to 50 people living in the city centre where the quarries are located. It was tried to measure the level of knowledge about the positive and negative effects of quarries on ecosystem, environment, natural life and human life. As a result of the study, 3 different results were obtained from the questionnaires applied. Depending on the data obtained about these quarries in the study area, the quarries were divided into two large groups as active and inactive and shown on the map. It has been determined that 8 quarries shown in green on the map are active and 48 quarries shown in red are inactive. Eleven of the inactive quarries were surrounded by wire fences after the animals of the

neighbouring villages perished and they reported this situation to the relevant institutions.

According to the results of the research and questionnaire surveys, it was observed that the first thing that attracts attention among the environmental impacts of quarries is the damage to the visual landscape. It has been observed that the current state of the surface shapes has deteriorated and the visual quality has decreased. As can be seen in the inventory of the quarries, the majority of the quarries are located close to the roads. It has been determined that open pit quarries are located close to roads and settlements in order to transport materials more easily. Accordingly, road users and local people are exposed to this visual pollution. Quarries are huge abysses when evaluated on a human scale.

It was determined that the quarry areas in the study area are generally in pasture status. In addition, it was observed that meadow-pasture vegetation was intermittently regenerated in passive quarries [13].

One of the features to be considered when choosing plant species to be used during the reintroduction of passive quarries to the ecosystem is their ability to with extreme conditions (frost, drought, salinity, acidity, etc.). In one of the studies, the following species are recommended [13].

- *Pinus sylvestris* L. (Pinaceae): Afforestation, erosion and landscape repair works, especially in high areas, mountains and winter landscaping, space delimitation, snow curtain;
- *Juniperus oxycedrus* L., *Juniperus foetidissima* Willd., *Juniperus communis* L. var. *saxatilis* Pall. (Cupressaceae): Highway plantings, landscape restoration, erosion, rock garden, space delimitation and orientation, snow screen, noise prevention, winter landscaping;
- *Viburnum orientale* Pall. (Caprifoliaceae): For visual purposes with its flowers, fruits and autumn leaf colouring, for wildlife habitat with its fruits, for mid-refuge plantings and noise prevention;
- *Betula nana* L. (Betulaceae): Afforestation, erosion and landscape repair works, especially in high areas, mountain and winter landscaping, highway afforestation, aesthetic areas with trunk and autumn leaf colouring;
- *Vaccinium myrtillus* L. (Ericaceae): Fruit and flower in aesthetics and wildlife, erosion, slope stabilisation, rock garden;
- *Populus tremula* L. (Salicaceae): Afforestation, erosion and landscape repair works, especially in high areas, mountain landscaping, highway afforestation, aesthetic areas with trunk and autumn leaf colouring;
- *Salix caprea* L. (Salicaceae): Landscape repair works, highway afforestation, aesthetic areas with its flowers, stream banks, parks;
- *Sorbus aucuparia* L. (Rosaceae): For visual purposes with its flower, fruit and autumn leaf colouring, for wildlife habitat with its fruits, for mid-refuge planting and noise prevention;

- *Pyrus eleagnifolia* Pall. (Rosaceae): In parks and gardens for visual purposes with its flowers, fruits and autumn leaf colouring, in wildlife creation with its fruits, erosion and slope stabilisation;
- *Rosa pimpinellifolia* L., *Rosa dumalis* Bechst. subsp. *boissieri* (Crep.), *Rubus fruticosus* (Rosaceae), *Ribes grossuloria* L. (Grossulariaceae): Flowers, fruits and autumn leaf colouring in parks and gardens, wildlife habitat with its fruits, mid-refuge planting and noise prevention, erosion and slope stabilisation and hedge formation;
- *Euonymus latifolius* L. Mill. (Celastraceae): It can be frequently used in parks and gardens with its beautiful flowers [10].

Active quarry operations cause irreparable damage to settlements or various agricultural areas. When deciding to open an area as a quarry, the fact that the area is a stony rocky land ensures that it causes the least damage to the environment and accordingly, the objections of the local people are prevented [13].

In a study in the International Journal of Environmental Research and Public Health;

- Of the individuals living in areas close to open pit mining, 98 per cent stated that their houses were exposed to dust, 85 per cent stated that the site was disturbed, 97 per cent stated that the leaves of plants were covered with dust, and 92 per cent stated that crops could not be grown.
- The dust released by the quarries covers the plant leaves and prevents the leaves from respiration and photosynthesis. During the flowering season, it is also observed that fruit formation decreases by preventing fertilization.
- The noise caused by the work machines used in open pit mines is at a level that can cause hearing loss to those working in the environment.
- High eye and nose allergies were observed in 22% of people in dusty environments, chest tightness in 17%, and chronic cough in 9% [13].

Published in 2010 in the official gazette, the "Regulation on the Restoration of Lands Disturbed by Mining Activities to Nature" protects these areas and determines the necessary procedures and principles [13]. Within the scope of the ecosystem restoration of the quarries located in the highway landscape, the study area was selected, and after determining the boundaries, the environment was analysed from many aspects and the environmental effects of the quarries were determined by surveys and on-site inspections. These determinations contributed to the results of the study.

4. DISCUSSION

Large funds are used for the construction and maintenance of highways, which have an important place in passenger and freight transport. For this reason, in order to prevent the deterioration of the local ecology, ecosystem and all kinds of natural balance, highway works should be in harmony with the natural environment where the construction is carried out. Technical support should be obtained from landscape architects starting from the route determination stage. Along the route, factors such as the natural flora and fauna of the area, cultural heritage, socio-economic structure should be taken into consideration. It should not be forgotten that these studies have negative effects on global warming and climate change.

The results of surveys should be utilised when making land use decisions for quarries that have been restored to the ecosystem, and the new area designed should be built in accordance with the demands of users and human ergonomics. The quarries consist of 80 to 120 meter high cliffs and artificial hills where the extracted and unused materials are accumulated. This situation should be compared with the human scale and landscape areas should be designed to tolerate this difference.

While restoring the destroyed areas to the ecosystem, planting works should be carried out by taking into account the determining features of the region such as climate, altitude, natural vegetation. Since the soil structure of passive quarries is disturbed, experiments should be carried out on the soil structure of the areas to be planted. In areas where heavy metals are detected, hyperaccumulator (species that can accumulate heavy metals and are not adversely affected by this) or phytoremediation (plants that can clean heavy metal pollution) plants should be used according to the needs of the area.

Care should be taken to ensure that the plant species to be used are species that absorb noise and pollution. *Pittosporum tobira* (Thunb.) W.T. Aiton and *Thuja orientalis* L. are some of these species [14]. In quarries located on the edge of highways, plants that do not disturb the visibility angle or endanger the safety of road traffic life and property by attracting too much attention should be selected. After the planting works, these areas should be regularly checked and the needs of the plants should be met. In areas where vegetative interventions cannot be made, economical and ergonomic non-living materials (urban furniture such as pergolas and benches) should be used and peace and security should be ensured in areas opened to public use.

In the new landscape designs to be made within the scope of ecosystemisation studies, the spaces created in the area should attract the attention of the users and the change of the created spaces over the years should be taken into consideration. It should not be forgotten that the natural resources in the area are not unlimited, and the resources should be opened to use in this direction.

Public institutions and organisations carrying out inspection duties on the subject should meticulously examine the compliance of active and inactive quarries with existing laws and regulations.

Quarry employees and supervisors should be trained on the subject, this issue should be discussed in the local and national press and the public should be informed about this issue.

This study will be a guide for the authorities who are in charge of supervising the quarries, both private and public, which have been opened and will be opened to provide material for road construction. In addition, it is thought that this study will be a determinant and source for reducing the negative contribution to global warming and climate change, preventing erosion, sustainability of natural ecosystems and less damage to biodiversity.

In Central Park, which was designed by the famous landscape architect Frederick Law OLMSTED in the 1850s and which many people visit today, it is seen that an extremely large land is used as a park. Frederick Law OLMSTED predicted that the city would spread over the whole land in the future and the area he designed would be the only landscape that the public could see. For this reason, while designing the area, he evaluated a very large area as a park [15].

If recreational use is to be made while the quarries, which are passive in our country, are being restored to the ecosystem;

- Areas for the protection of resources
- Horse riding
- Hiking trails or bird watching towers

If agricultural areas are to be designed;

- Conditions favourable for the cultivation of agricultural
- Conservation, storage or reuse of water resources

If urban areas are to be designed;

- Regularised solid waste landfill
- Passive parks
- Cycling tracks
- Areas to meet the need for rest
- Observation terraces
- Picnic areas
- Fields for children's games
- Camp sections
- Different alternatives such as artificial ponds should be considered.

Many professional disciplines such as Landscape Architects, Biologists, Lawyers, Environmental Engineers, Agricultural Engineers, Ecologists, Geologists, Landscape Architects, Biologists, Lawyers, Environmental Engineers, Agricultural Engineers, Ecologists and Geologists should come

together and try to produce solutions in order to restore the natural balance of areas such as quarries to the ecosystem. The process should be well planned and executed before the works are started. While these studies are being carried out, landscape restoration, good design of the use of the area, re-naturalisation of the resources that have lost their naturalness, improvement of the problematic areas and monitoring and maintenance of the new area should be evaluated together [16].

The purpose and objective of the final land use plans should be determined in advance in order to prevent disruptions in restoration works and to avoid economic and time loss. The final land use plans should be decided from the beginning in order to obtain compatible, economic and appropriate plans for open pit mining and landscape restoration activities [17]. There are many benefits from the reuse of defunct quarries, such as reducing steep slopes, reducing high steps, levelling gaps, creating suitable soil depth conditions for flora, as well as reducing erosion, restoring proper water regime and drainage.

The study area is located in the close vicinity of the expanding provinces and is expanding and concretising day by day. City centres are expanding towards the outskirts of the city. The need for recreation areas in the study area and its immediate surroundings has been identified through surveys and questionnaires. The main design decisions for the ecosystem of passive quarries should take into consideration the economic and social objectives of potential users.

When implementing highway landscaping applications, the vegetation around the relevant highway, historical values, use of the area, socioeconomic status, providing users with a colourful and pleasant travel opportunity, the presence of elements that attract attention in the area, hiding places with ugly appearance in the field and the harmony of the road and the surrounding appearance should be taken into consideration [18].

Acknowledgement We would like to thank the 18th Regional Directorate of Highways, which provided the data needed for this study, and Assistant Professor Gül Esma Akdoğan Karadağ, who provided technical support throughout the study.

Author Contribution Statements In this study, all authors contributed equally to the research process and the article-writing phase.

Declaration of Competing Interests The authors declare no conflict of interest.

Ethical Statement This research did not involve human participants or animals. Therefore, no ethical approval was required.

Use of Artificial Intelligence No artificial intelligence-based tools or applications were used in the preparation of this study. The entire content of the study was produced by the author(s) in accordance with scientific research methods and academic ethical principles.

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