Assessing Visual Quality of Rural Highway Landscape Reclamation in Western Black Sea Region, Turkey

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ORIGINAL PAPERS

ASSESSING THE VISUAL QUALITY OF RURAL HIGHWAY LANDSCAPE RECLAMATION IN THE WESTERN BLACK SEA REGION OF TURKEY

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ABSTRACT

The purpose of this study was to assess the visual quality of proposed rural highway landscape reclamation of the new Bartın-Amasra highway via public perceptions and design approaches. The four objectives of this study were to: (1) analyze the study site's landscape to determine its characteristics, (2) evaluate three landscape reclamation concepts (open, semi-open, and closed) for eight research areas and generate 24 3-D simulations/visualizations, and (3) survey academic staff, public staff, students, and laypeople regarding their preferences of the new Bartın-Amasra highway. The study was conducted at eight sites where landscape reclamation is required on the highway. The survey sampled 300 highway users from four groups to determine their socio-demographic characteristics and use preferences. The data were analyzed by interpreting statistical correlations and frequency analysis. The results found that there were 75 plant species from 39 families in the eight sampled areas. Educational attainment was positively related to preferring to use the highway to watch the sea and scenery, although many highway locations were perceived as negative. The most striking remedies for mitigation were landscaping designs that counter noise and visual pollution and renewal of damaged vegetation. The most positive aspect of the highway was "having an open and closed scenery attribute."

KEYWORDS:
visual quality, rural landscape, highway landscape reclamation, visualization, user preferences, Bartın-Amasra.

INTRODUCTION

Highways are increasingly important landscape features [1] because transportation infrastructure interacts with surrounding landscapes and, thus, has a cultural dimension. In particular, highways are physical manifestations of social connections as well as the political and economic decisions that led to the land-use changes that created them [2]. Highways dominate our daily surroundings and are important to people's access to the visual landscape [3]. According to Box and Forbes [4], roadside vegetation has become a significant element of highway environments with which people regularly interact because of their increasing use of roads for transportation in modern life [5].

During the twentieth century, the construction and maintenance of highways have been the most widespread types of modification to the natural landscape [1, 6-8]. However, the effects of these activities on biological diversity and ecological processes have been studied only recently (e.g., [2, 9, 10]). These studies have resulted in the emergence of a new scientific discipline, highway ecology [11, 12]. Other scholars have proposed that the experience of a landscape is cognitive and personal; that is, an individual reacts to and experiences a landscape based on that individual's personal experiences [13]. From this perspective, an individual gives meaning to and interprets the landscape, and is stimulated by it. However, it is likely that the evaluation of our aesthetic experiences is determined by cultural as well as individual factors [14], in which the cultural aspect builds on individual capacities, experiences, and learning [15].

Scale, naturalness, human influences, topographical variations, the presence or absence of water, and openness or density [13, 16] are landscape characteristics that are important to people's evaluations of a landscape. Its character as open, forested, or varied influences people's driving behaviors (such as average speed, variation in lateral vehicle position, and steering wheel grasp frequency) because drivers' perceptions of driving situations are influenced by landscape characteristics [15].

Zube et al.'s [17] review of landscape perception studies and Lothian's [18] study on landscape quality assessments provided thorough overviews and structure of the literature in the field of landscape aesthetics. In this context, Tveit et al. [19] provided a comprehensive theory-based framework for analyzing the visual character of landscapes. However, the visual factors that were identified are not directly transferrable to highway projects. The ideas must be adapted to fit the nature of highways, which includes landscapes, landscape elements, and construction, with technical elements [20].

The National Cooperative Highway Research Program [21] evaluated methodologies used for visual impact assessments (VIA). The report is of broad interest to state, regional, and local planners, project development staff, and environmental staff. The report offered 10 criteria for evaluating VIA procedures that emerged from research findings. These criteria prescribe desirable overarching characteristics of VIA methods and procedures, as follows: objective, valid, reliable, precise, versatile, pragmatic, easily understood, useful, consistently implemented, and legitimate.

Landscape quality is important to quality of life [22, 23], although the landscape experience can be interpreted in many ways. Individual preferences for environments have been examined by environmental psychologists, who suggest that people tend to appreciate the visual experience of nature more than they appreciate city views [13, 15, 24].

Funderburg et al. [25] emphasized that the relationship between highway construction and urban development is an important research topic for modern regional planning [23]. Many ecological studies have assessed the ecological effects of highway construction [1, 23, 26-28].

The relationship between landscape and people’s behavior is studied in environmental psychological and human physiological research. Some studies first expose research subjects to videos or photographs of a variety of landscapes as seen from the road and then measure their reactions to assess the types of preferred landscape [13, 15, 29-32]. Ecological information is shared with the public and other stakeholders using visualizations. Some studies have examined the effects of visualization techniques. Landscape visualizations have been successfully used to communicate landscape issues and discuss planning decisions with experts, stakeholders, and the public [33].

Highways that pass through some areas degrade the natural environments and cause a variety of ecological problems. According to Trombulak and Frissell [1], all types of roads influence the terrestrial and aquatic ecosystems through which they pass in seven basic ways: (1) increased wildlife mortality from road construction, (2) increased wildlife mortality from vehicular impacts, (3) modification of animal behavior, (4) alteration of the natural environment, (5) alteration of the chemical environment, (6) spread of exotic species, and (7) increased human alteration and use of wildlife habitats. Highways often result in land-use conversions, loss of land cover, and fragmentation of remaining land cover into smaller and more isolated elements. Landscapes that are shaped by these elements likely have more and smaller habitat patches, decreased connectivity between or among patches, decreased complexity of patch shape, and higher proportions of edge habitat [27].

To minimize these effects, it is important to approach highway development by taking the natural assets of the proposed highway route and land-use developments into account at the planning stage [34]. According to Geneletti [35], a feature of road corridor planning is that plans assess a variety of alternatives based on well-defined territorial variables in the decision-making criteria [36]. Ecological management of highway corridors is important to the improvement of natural values and aesthetic appreciation as long as embankment management is linked to the management of the surrounding landscape [37].

One of the many efforts to enhance environmental quality is increased attention to taking advantage of the existing natural vegetation in urban and rural landscapes. However, regular maintenance of roadside plants can be ignored because it is costly, which is the case in Turkey. This problem can be partly addressed by taking advantage of the indigenous plants, which are relatively more suitable to the landscape design of sites that receive limited maintenance [38].

In 2000, the European Landscape Convention was adopted by the Council of Europe. The convention aims to promote “the protection, management and planning of European landscapes” [39] and it emphasizes the importance of exceptional as well as ordinary and degraded landscapes [20, 40].

This study had four main purposes. First, it analyzed landscapes to determine the characteristics of the area of interest, the new Bartın-Amasra highway. Second, it generated three landscape reclamation concepts (open, semi-open, and closed) and 24 three-dimensional (3-D) simulations/visualizations for eight study sites. Third, a survey was conducted to identify the socio-demographic characteristics of users of the new Bartın-Amasra highway. Fourth, the Semantic Differential Scale was employed to ascertain the visual quality values of the 3-D simulations/visualizations. The results yielded suggestions for future landscape reclamation projects along rural highways and contributed to sustainable regional development.

MATERIALS AND METHODS

STUDY AREA

The Bartın-Amasra highway is a transit route of the Black Sea tours organized by national tourism companies. The museum city of Safranbolu has been a UNESCO Cultural Heritage city since 1994. The historical, archeological, ancient port city of Amasra was added to the UNESCO World Heritage Center Tentative List in 2012. According to Sertkaya [41], Cengiz [42], and Çorbacı [43], Amasra is a center of attraction along the western Black Sea shore, with a current tourism potential that is national as well as regional in scale. The city of Amasra is located on the western Black Sea coast of Turkey in Bartın Province. The city is on a peninsula extending northward with bays on either side [42]. Bartın, located along the Safranbolu-Amasra highway route. Bartın is a city that shows an inner harbor characteristic with the Bartın River that passes through it and its traditional settlement texture [44, 45]. Because of these features, Safranbolu, Bartın, and Amasra attract attention to their cultural landscapes and they are on the tourism itineraries of the western Black Sea Region.

The Bartın city center access to the Amasra district is accomplished either from the old road or the new road. The old and new roads are one road from the Bartın city center to the Kaman Village detour (about 3.5 km), after which it divides into the old and new roads. The new road connection to the Amasra district is the Bartın-Amasra-Çakraz route, which is a 25-km section of the Zonguldak-Bartın-Amasra-Cide-İnebolu-Çatalzeytin-Ayancık-Sinop state highway. Amasra town center is reached about 9.5 km after the Kaman Village detour. The new Bartın-Amasra highway was completed in 2001.

The study sites are eight areas along the new Bartın-Amasra highway in the western Black Sea Region (between 5.6 - 16.6 km). The study area is in the Euxine (Eux) sub-region of the Euro-Siberian region [46].

The city of Bartın attracts attention to its forest and waters. About 56% of the city is forested and it has a shoreline of about 59 km, which attracts attention to the Bartın River. On the other hand, Amasra, a district of Bartın, is a typical coastal historical city with 3000 years of history. Historically, Amasra was ecologically (forest and water) oriented, but it is becoming a tourist destination and an industrialized region. Highway landscaping at the study sites is characteristically rural.

The region is dominated by the typical Black Sea climate. The Bartın summers are cool and its winters are rainy and mild. The highest measured temperature in Bartın was 42.8º C (in July) and the lowest recorded temperature was -18.6º C (in February). Annual average temperature is about 12.5º C. Rainfall in Bartın is highest in October, November, and December, and lowest in May, with an average of 1030 mm. Average annual relative humidity is about 78% [47]. The average annual temperature of 13.8° C is slightly higher in Amasra, average annual total precipitation is about 1035.22 mm, and average annual relative humidity is about 69.8%. The wind blows northeast between October 15 and March 15. Amasra also is exposed to winds from the north, southwest, and northwest [42, 48]. The geographic locations of the study sites are shown in Fig. 1.

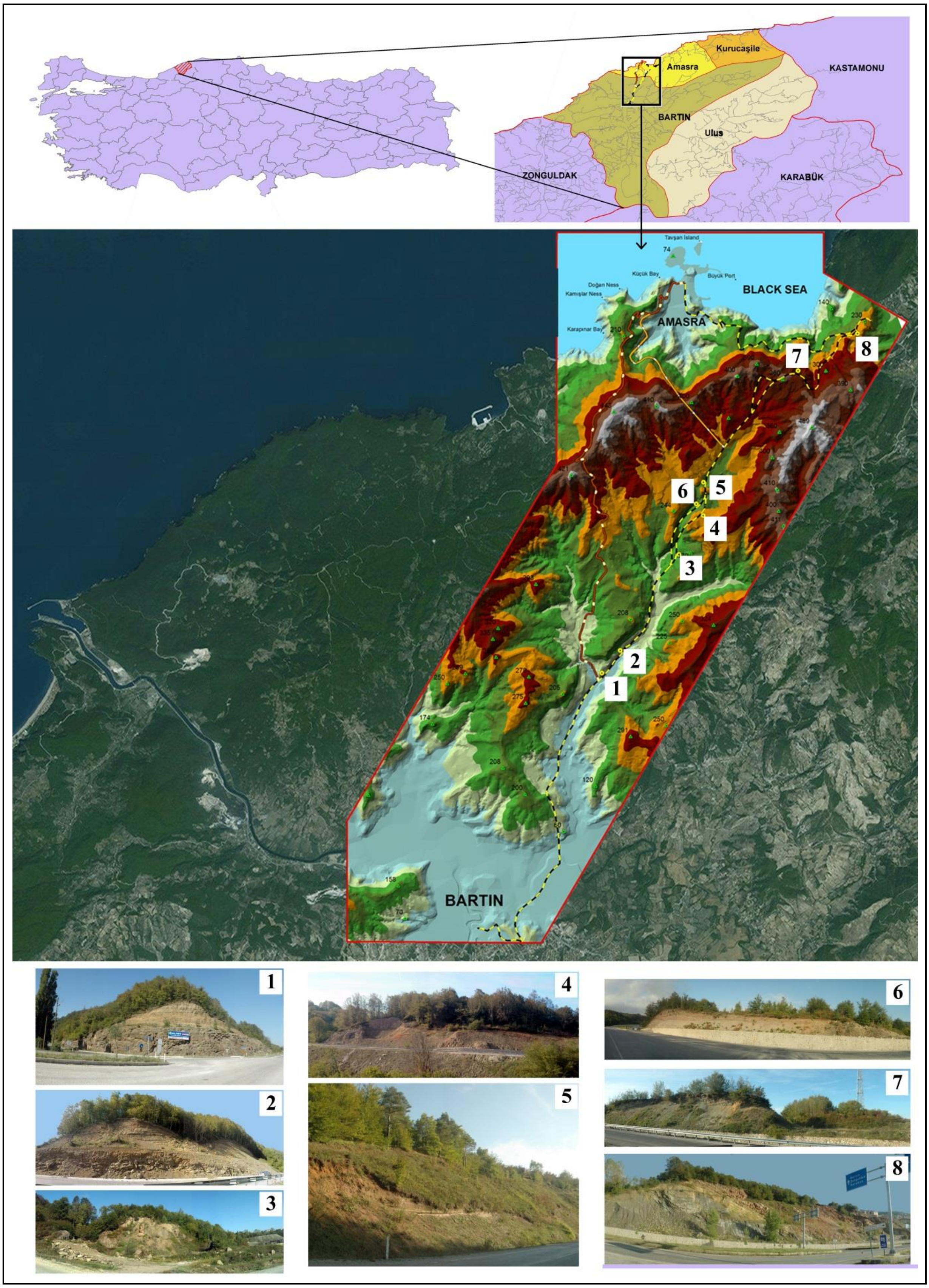

FIGURE 1
Geographical locations and close-up images of the study sites.

DATA COLLECTION

The research proceeded through three stages: (1) field study, (2) landscape visualization, and (3) survey study.

Stage 1: Field Study

Study Site Selection. The field study was conducted in eight areas along the new Bartın-Amasra highway route. The process of selecting the sites proceeded in four sequential steps [49]. First, the areas of the highway that required landscape reclamation were identified. Second, the identified areas were organized based on similarities in landscape components. Third, distance zones were observed. Fourth, the sites were organized in terms of landscape composition, landform pattern quality, and suitability for simulations. The steps were accomplished using data on numerical topography, forest properties, soil, geologic maps, satellite images from Google Earth, and photographic images obtained during field studies. Images obtained during visits to the field were created using a Canon IXUS 55 digital camera between August of 2012 and November of 2012.

Identifying the Landscape Characteristics of the Study Sites. ArcGIS 10.1 was employed to identify the characteristics of the study sites (e.g., [50-54]). These were:

- The 1:25,000-scaled Topographic Maps produced by the General Command of Mapping [55] determined promontory groups, slopes, aspects, peaks, contour lines, water body types (dry or wet streams), and current settlements;
- The 1:25,000-scaled Geology Maps published by the General Directorate of Mineral Research and Exploration [56] determined geological structures and fault statuses;
- The 1:25,000-scaled Soil Maps published by the General Directorate of Rural Affairs [57] determined the land groups, the land-use capacity classes, and erosion statuses;
- The 1:25,000-scaled Forest Management Planning Map from the General Directorate of Forestry [58] determined the forest features (stand type, forest type or operating class, and forest crown closure); and
- Current settlements were examined using Google Earth satellite images.

The specific characteristics were identified in the field studies of the eight study sites to determine the accuracy of the acquired data. A Global Positioning System was used to determine the coordinates of each site, an altimeter was used to determine their elevations, a compass was used to determine the aspects, and an inclinometer was used to measure the inclines (slopes). Because forest plans do not provide information about forest sub-covers, plant samples were collected from each site during the field visits and identified.

Collection and Identification of the Plants. The observation period was during the 2012 vegetation and flowering periods, during which time plant types, other nearby plants, cultivation characteristics, and cultivation media were separately observed and noted. The method of collecting the samples, their drying, and the labeling procedures were conducted following plant inventory forms created by Yaltırık and Efe [59], Cengiz et al. [60], Bekci et al. [61], and Cengiz et al. [62]. In addition, archives were created of plant samples with detailed photographic images of their locations. Accurate identification of the collected plants was accomplished by comparing them to samples at the Kahramanmaraş Sütçüimam University (KSU) Department of Forestry, Forest Botany herbarium, using the identification keys prepared by Davis [63]. In addition, the collected plants were compared to photographic images taken in the natural cultivation areas and in the herbarium. Through this process, the plant existence inventory was developed. Table 2 presents the inventory of plants at the eight study sites.

Stage 2: Landscape Visualization

First, the landscape opportunities provided by the new Bartın-Amasra highway were considered and three landscape reclamation options were proposed: (1) open, (2) semi-open, or (3) closed. These options were proposed for each of the eight study sites; then, 24 3-D simulations/visualizations were generated for each area [15, 64]. The important aspect of the 3-D simulations is the intensive use of plants (high density) in the "closed" option, in which the plants are tall and roughly textured. The "semi-open" option has relatively low plant density and there are small trees and plants with few branches. The lowest plant density is in the "open" option, consisting of thin-textured ground cover. The design criteria proposed by Cengiz et al. [60], Robinson [65] and Leszczynski [66] regarding natural-style planting designs were used for each 3-D simulation/visualization and tentative illustrations were created as 3-D drawings using CS6 Photoshop, Google skechup, 3-D max, and Lumion.

Stage 3: User Survey

The preferences of people who use the new highway are important to the landscaping decisions that influence the driving experience. The socio-demographic characteristics and highway use preferences of users of the new Bartın-Amasra highway were investigated by means of survey data. A questionnaire was constructed to obtain information about users' preferences [67, 68]. The sample consisted of 300 users of the new highway, of which 50 were academic staff, 50 were public staff, 100 were landscape architecture students, and 100 were laypeople. The survey was conducted face-to-face and each questionnaire was completed in 48 minutes (average of two minutes for each project).

The data were analyzed using correlation analysis and statistics were assessed using Spearman coefficients (*r*) and statistical significance with SPSS (Statistical Package for the Social Sciences) 16.1 software. In addition, frequency analysis was employed. The Semantic Differential Scale method was used to assess the visual quality of the 24 simulations generated during the 3-D visualization stage [69, 70]. The questionnaire responses were analyzed in accordance with the Semantic Differential Scale to ascertain the ways that the respondents viewed the interactions among semantic properties, landscape elements, and space [64, 71]. Twelve pairs of opposing descriptive terms were selected to evaluate the visual quality of the 3-D simulations. These 12 pairs of term were:

- Beautiful/ugly: The respondent liked the space very much,
- Attractive/unattractive: The respondent was attracted to the space,
- Regular/irregular: The use of landscape planning and design criteria in the space,
- Relaxing/disturbing: The space provided the individual with an opportunity to comfortably move around,
- Safe/unsafe: The respondent felt safe in the space,
- Accessible/inaccessible: The respondent believed that the space was accessible,
- Practical/impractical: The respondent believed the space was practical for the users,
- Visible/invisible: Playing an effective role in the used space,
- Natural/artificial: The space was perceived as natural,
- Varied/monotonous: The space used a variety of plants,
- Rich in terms of species/poor in terms of species: Richness of plant species, and
- Sufficiently green/insufficiently green: Placement of plant material was in accord with the fullness/emptiness criteria.

The respondents were asked to rate the 3-D simulations/visualizations with respect to each descriptive pair of terms by scoring them on a scale ranging from -3 to +3 [71]. The differences among the respondents in their assessments of the visual quality of the new Bartın-Amasra highway by group (academic staff, public staff, students, and laypeople) were analyzed using analysis of variance (AOV) and Duncan tests with SPSS 16.1.

RESULTS

CHARACTERISTICS OF THE STUDY AREAS

Table 1 shows the specific characteristics that were identified in the field studies of the eight study sites to determine the accuracy of the acquired data (see Fig. 2).

Table 2 presents the inventory of plants at the eight study sites. The 75 plant species recorded in the eight sampled areas belonged to 39 families. In order of frequency, the first three family groups were as follows: *Astertaceae* (10 taxa), *Fabaceae* (9 taxa), and *Rosaceae* (5 taxa) (Table 2).

TABLE 1
Locations, topographical characteristics, geological and soil features, and aspects of forests of the eight study sites.

Study site	Location		Topography			Geology	Soil			Forest		
	Coordinates	Round trip (km)	Elevation (meters)	Aspect[a]	Slope (%)	Geology[b]	Land groups[c]	Erosion status	Land-use capacity class	Stand type[d]	Closure[e]	Operational class[f]
I. Region	N: 41° 40’ 25’’ E:32° 21’ 54’’	16.1 return trip on the right	30	S	70.3	Ky	M	Modetate	IV	Z-5 MGnDy3	3	AA
II. Region	N: 41° 40’ 31’’ E: 32° 22’04’’	15.8 return trip on the right	43	SE	58.4	Ky	M	Modetate	IV	GnKsKn3	3	AA
III. Region	N: 41° 41’ 59’’ E: 32° 23’07’’	10.3 going on the right	136	SW	45.4	Ky	M	Modetate	IV	KnGn1	1	AA
IV. Region	N: 41° 42’ 21’’ E: 32° 22’52’’	11.3 going on the right	190	NW	57	Ky	P	Modetate	VI	Z-1	0	-
V. Region	N: 41° 42’ 37’’ E: 32° 23’31’’	11.2 return trip on the left	188	W	70	Ky	M	Modetate	IV	GnMKn3	3	AA
VI. Region	N: 41° 42’ 27’’ E: 32° 23’25’’	11.5 return trip on the right	179	SE	56	Ky	M	Modetate	IV	Kn3	3	AB
VII. Region	N: 41° 43’ 51’’ E: 32° 24’46’’	7.7 return trip on the right	320	S	44.4	Ky	P	Modetate	VI	GnKs3	3	AA
VIII. Region	N: 41° 44’ 15’’ E: 32° 25’38’’	5.6 return trip on the left	215	NW	74.3	Ky	P	Modetate	VI	Z	0	-

[a]N = North, NE = Northeast, E = East, SE = Southeast, S = South, SW = Southwest, W = West, NW = Northwest
[b]Ky = Yemişli Creek Formation
[c]M = Alluvial soils, M = Non Calcic Brown forest soils
[d]IV = Denoting land, where agriculture may be practiced under some restrictions, VI = Denoting land that should be allocated for forestry, settlement or industry type usage.
[e]MGnDy3 = Oak, Hornbeam; GnKsKn3 = Hornbeam, Chestnut, Beech; KnGn1 = Beech, Hornbeam; Z-1 = Agricultural field; GnMKn3 = Hornbeam, Oak, Beech; Kn3 = Beech; GnKs3 = Hornbeam, Chestnut; Z = Agricultural field
[f]1 = % 11-40 closure stands, 3 = Stands with more than 71% closure
[g]AA = Grove, AB = Grove-Coppice

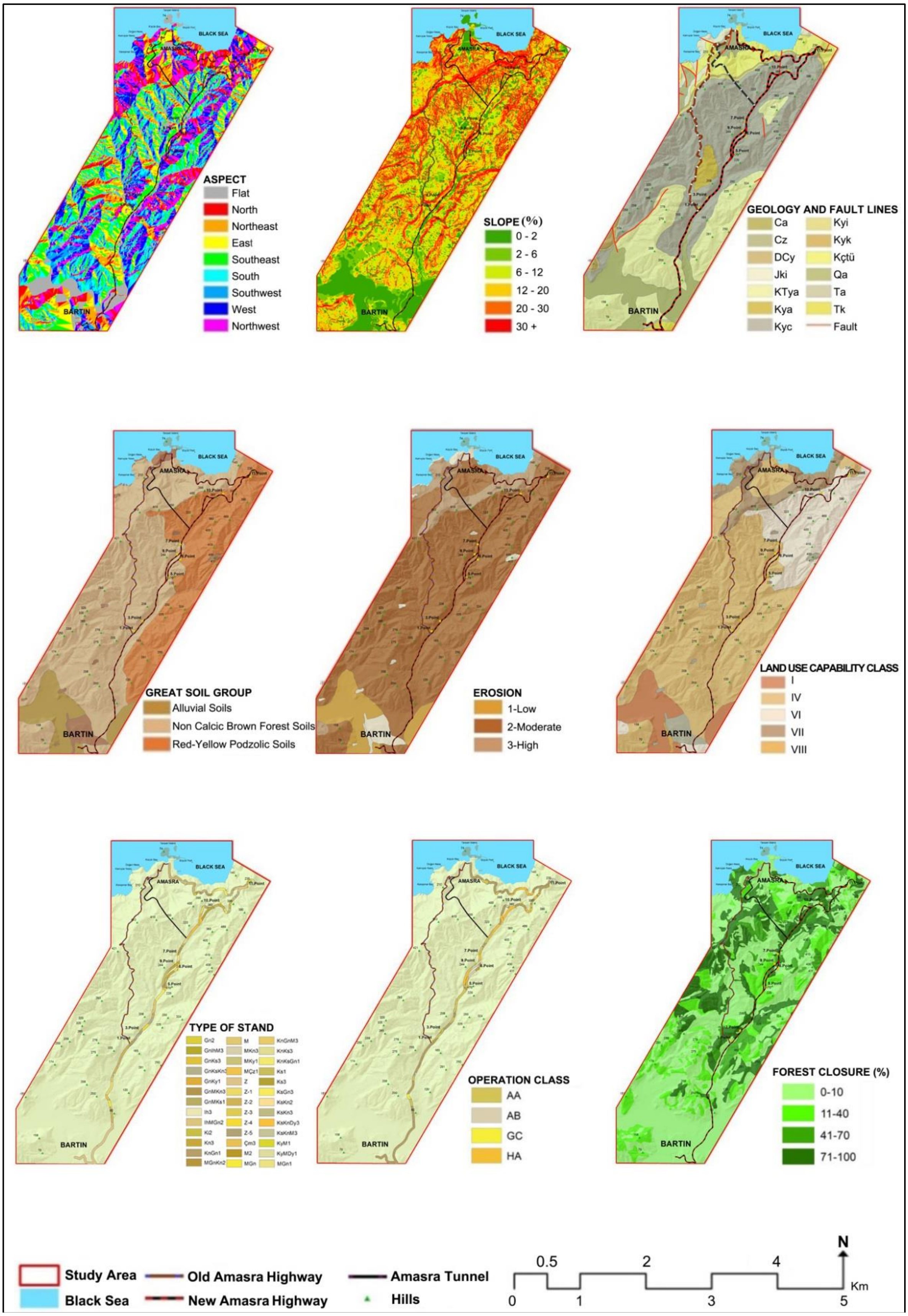

FIGURE 2
The important natural characteristics of the study areas.

TABLE 2
Plant species found in the study areas.

Family Name	Plant Name	Study Area	Plant Species
ADOXACEAE	*Sambucus* sp.	2, 3	Bush
APIACEAE	*Daucus carota* L.	1	Herbaceous
ARALIACEAE	*Hedera helix* L.	2	Ivy
ASPIDIACEAE	*Dryopteris filix-max* (L.) Schott	3	Herbaceous
ASTERACEAE	*Anthemis* sp.	4	Herbaceous
	Anthemis tinctoria L. var. *pallida*	7	Herbaceous
	Eupatorium cannabinum L.	7, 8	Herbaceous
	Matricaria sp.	5	Herbaceous
	Petasites albus (L.) Gaertner	2	Herbaceous
	Lactuca saligna L.	2	Herbaceous
	Pulicaria dysenterica (L.) Bernh.	1	Herbaceous
	Conyza canadensis (L.) Cronquist	6, 7	Herbaceous
	Taraxacum sp.	2	Herbaceous
	Xanthium strumarium L.	3	Herbaceous
BETULACEAE	*Carpinus betulus* L.	2, 3	Tree
	Alnus glutinosa subsp. *glutinosa*	5	Tree
	Ostrya carpinifolia Scop.	5	Tree
BORAGINACEAE	*Cynoglossum creticum* Miller	2	Herbaceous
	Cynoglossum sp.	5	Herbaceous
BUXACEAE	*Buxus sempervirens* L.	6	Bush
CONVOLVULACEAE	*Convolvulus cantabrica* L.	1	Herbaceous
CORNACEAE	*Cornus mas* L.	1, 2, 3, 5, 7	Shrub
	Cornus sanguinea L.	2, 5	Herbaceous
CORYLACEAE	*Corylus avellana* L.	2, 4	Shrub
CRASSULACEAE	*Sedum* sp.	2	Herbaceous
DENNSTAEDITACEAE	*Pteridium* sp.	5	Herbaceous
DIPSACACEAE	*Scabiosa atropurpurea* L. subsp. *maritima* (L.) Arc.	1	Herbaceous
ERICACEAE	*Erica carnea* L.	1, 3	Bush
	Rhododendron ponticum L.	3, 5, 8	Bush
EUPHORBIACEAE	*Euphorbia chamaesyce* L.	1	Herbaceous
EQUISETACEAE	*Equisetum* sp.	7	Bush
FABACEAE	*Medicago lupulina* L.	2, 4	Herbaceous
	Melilotus officinalis (L.) Desr.	7	Herbaceous
	Psoralea bituminosa L.	7	Herbaceous
	Argyrolobium biebersteinii P.W. Ball	4	Herbaceous
	Robinia pseudoacacia L.	6, 8	Tree
	Lotus sp.	5, 8	Herbaceous
	Fagus orientalis L.	2, 8	Tree
	Castanea sativa Miller	2, 3, 5, 8	Tree

	Quercus sp.	1, 3	Tree
JUGLANDACEAE	*Juglans regia* L.	1	Tree
LAMIACEAE	*Salvia* sp.	1, 4	Herbaceous
	Clinopodium vulgare L.	2	Herbaceous
	Calamintha sp.	3	Herbaceous
	Menthaspicata L. subsp. *tomentosa (Briq.) Harley*	1	Herbaceous
LAURACEAE	*Laurus nobilis* L.	6, 7, 8	Shrub
MAGNOLIACEAE	*Magnolia x soulengeana* Soul.–Bod.	8	Shrub
MORACEAE	*Ficus carica* L.	7	Tree
OLEACEAE	*Phillyrea latifolia*	2	Bush
OXALIDACEAE	*Oxalis corniculata* L.	3	Herbaceous
PHYTOLACCACEAE	*Phytolacca americana* L.	2	Shrub
PINACEAE	*Pinus nigra* L.	1	Tree
	Pinus pinea L.	6	Tree
	Pinus sylvestris L.	4	Tree
PLANTAGINACEAE	*Plantago lanceolata* L.	1	Bush
PLATANACEAE	*Platanus orientalis* L.	1	Tree
POLYGONACEAE	*Polygonum aviculare* L.	2, 8	Herbaceous
	Polygonum persicaria L.	3	Herbaceous
	Rumex crispus L.	8	Bush
RANUNCULACEAE	*Clematis vitalba* L.	2, 6	Bush
ROSACEAE	*Crataegus monogyna* Jacq.	1, 3, 5	Shrub
	Malus sp.	1	Tree
	Rosa canina L.	4	Bush
	Rosa sp.	7	Bush
	Pyracantha coccinea Roemer	1	Bush
	Rubus sp.	3, 7	Bush
SALICACEAE	*Populus alba* L.	3, 6, 7	Tree
	Populus nigra L.	1	Tree
	Populus tremula L.	2	Tree
	Salix alba L.	3	Tree
SCROPHULARIACEAE	*Verbascum* sp.	5	Bush
SIMAROUBACEAE	*Ailanthus altissima (*Miller) Swingle	1	Tree
SOLANACEAE	*Solanum* sp.	1	Bush
ULMACEAE	*Ulmus minor* Miller	1, 5, 6	Tree
VIOLACEAE	*Viola* sp.	2	Herbaceous

VISUALIZATIONS OF RURAL HIGHWAY LANDSCAPE RECLAMATION AREAS (ALTERNATIVE DESIGN PATTERNS)

Fig. 3 illustrates the important differences among the 3-D simulations in the intensive use of plants. In the "closed" option, the plants are tall and rough textured, the density is low in the "semi-open" option (which consists of small trees and plants with few branches), and the lowest plant intensity is the "open" option, where the plants are thin-textured ground cover.

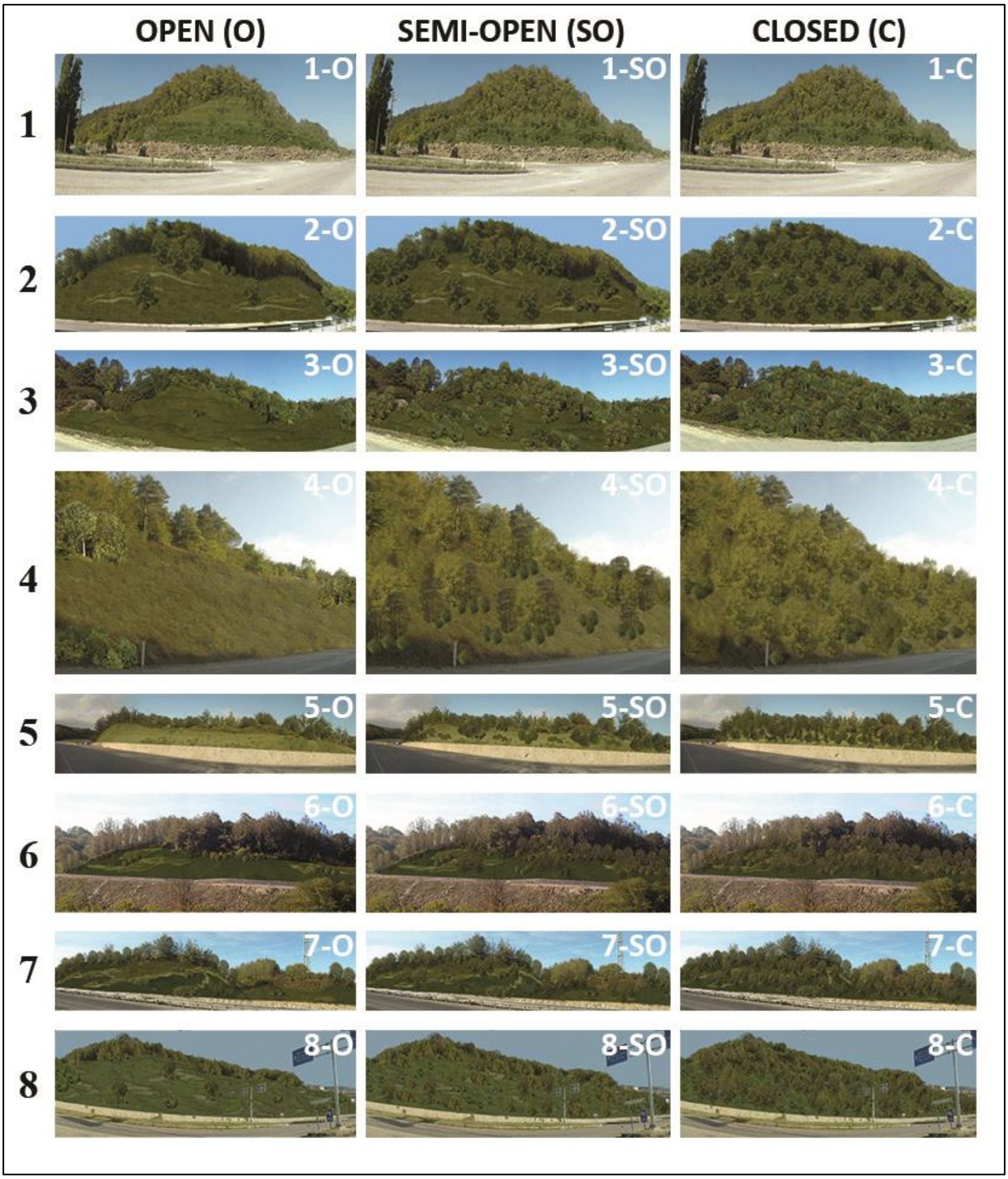

FIGURE 3
Vegetation management alternatives (3-D visualizations of rural Highway Landscape Reclamation Areas).

RESPONDENT EVALUATIONS OF THE NEW HIGHWAY

Respondent Preferences. The socio-demographic characteristics of the respondents were assessed and correlated with each other. The results of the zero-order correlations are presented in Table 3. Gender was positively related to education, income, and occupation, but negatively related to survey group. The male respondents reported higher educational attainment and higher incomes. Age was negatively correlated with education, but positively correlated with income, occupation, and survey group. Age was negatively related to the use of the new Bartın-Amasra highway for work, using it at least a few times every day or week, and negative issues. Higher educated respondents preferred the highway more for watching the view of the sea and landscape, reported many negative aspects of the highway, and suggested planting designs that counter noise and visual pollution and the reformation of the damaged vegetation to mitigate the problems.

Income was positively related to using the new Bartın-Amasra highway more for work and because it is safer for everyday use. Income also was related to the respondents' beliefs that the hard rock quarries and concrete construction sites are negative aspects of the highway. Whereas the academic staff and public staff who used the highway for work believed that there is nothing negative about the highway, they stated that the visual pollution of hard rock quarries and concrete construction sites should be removed. Respondents who reported using the road about once a year reported enjoying the scenic spots and seasonal changes in plants. The respondents suggested planting design and stream remediation to offset the damage done to the dry and wet riverbeds and to counter the noise and visual pollution. The respondents stated that the negative effects of the highway could be reduced by planting designs and landscape reclamation.

A frequency analysis was performed to assess the differences among the types of users (academic staff, public staff, students, and laypersons) regarding landscape reclamation proposals. Table 4 presents the percentages regarding positive aspects, negative aspects, and solutions by group. Regarding the positive aspects, all of the groups except the students were most likely to choose "closed and open scenic views." The students ranked "scenic lookout points" first (26%) and "closed and open scenic views" second (23%). All the groups were similar in their ranking of the negative aspects as well, choosing "hard rock quarries and concrete construction sites" as the most negative aspect of the highway. The negative attitudes toward the quarries and construction were reflected in their suggested solutions in that all of the groups were most likely to choose the removal of the visual pollution caused by hard rock quarries and concrete construction sites as their highest ranked solution.

Visual Quality Analysis Results. The respondents were asked to review the landscape reclamation proposals on the study sites. They reviewed proposals for open, semi-open, closed, and current status. Differences between the 12 descriptive pairs of terms used to differentiate between the alternatives were statistically significant ($n = 800$, $p < .01$). Table 5 shows the results of the analysis of variance. There are no statistically significant differences among the groups. Therefore Duncan test was applied to the study.

The Duncan test results are shown in Table 6. In the overall sample, the landscape reclamation proposals (open, semi-open and closed) and the images differed with respect to the descriptive pairs or terms' scores. Although the groups' responses to these questions were homogenous within each group (Table 6), all of the groups were most likely to be positive about designs using the "closed" option, which use the highest quantities of plants. The adjectives that were used in the evaluations included beautiful, attractive, regular, relaxing, safe, accessible, practical, visible, natural, varied, rich in terms of species, and sufficiently green. These alternatives were the most successful "closed" option was applied according to the Duncan test result. The photos of the current status of the highway were least positive in the evaluations by all of the groups, followed by their evaluations of open and semi-open vegetation management alternatives (Table 6).

DISCUSSION

INTEGRATING VISUAL PREFERENCES INTO LANDSCAPE RECLAMATION APPLICATIONS

The results of this study on the integration of visual preferences into landscape reclamation applications for designed alternative proposals suggest that complex patterns of vegetation are needed to strengthen structural and functional connectivity and people's visual preferences regarding landscape. Reclamation design alternatives were based on open, semi-open, and closed landscape patterns.

Public participation in this study was accomplished during highway landscape reclamation work. In addition, as put forth by Blumentrath and Tveit [20], The European Landscape Convention stated that people's landscape perceptions should be central to landscape planning and management. The results of this study are useful for the assessment of the visual quality of roads because the study adapted public landscape perceptions to highway landscaping issues. Highways are increasingly important in people's daily exposure to landscapes and new planning tools that comply with the requirements stated by the Convention are needed. According to the results of this study, respondents who used the new highway once a year appreciated its aesthetic features, such as its scenic points and seasonal flora transitions, whereas respondents who used the highway every day of the week or intensively during the week were more aware of the negative aspects of the highway. Thus, the group of respondents that more frequently used it responded more negatively to it. The results suggest that those who use the highway relatively more frequently are better positioned to identify the problems and provide suggestions for solving problems.

TABLE 3
Relationships between the socio-demographic properties of the Bartın-Amasra new highway users and the new highway.

	Variable	1b	1c	1d	1e	1f	1g	1h	2a	2b	2c	2d	2e	2f
Sample characteristics	1a) Gender	.101	.117*	.211*	.265**	.084	.047	-.121*	-.108	-.113	-.068	-.029	-.034	.010
	1b) Age		-.158**	.538**	.516**	.039	-.085	.127*	-.125*	-.122*	-.076	-.075	.151**	-.070
	1c) Education			.223**	.027	.214**	.123*	-.583**	.175**	-.102	-.031	-.024	-.331*	.146*
	1d) Income				.738**	.164**	-.025	-.170**	-.125*	-.221**	-.051	-.150**	-.053	-.044
	1e) Occupation					.043	.027	-.026	-.165**	-.156**	-.031	-.113	.032	-.060
	1f) Rural residence						-.113	-.153**	.123*	-.004	-.018	.036	-.022	-.030
	1g) Local residence							-.070	.053	.040	-.016	-.040	-.101	-.030
	1h) Survey group								-.131*	.090	-.060	.034	.249**	-.116*
Defining the Bartin-Amasra Highway	2a) Uses									.028	.052	.089	-.074	.151**
	2b) Frequency of use										.121*	-.002	.088	.036
	2c) Most positive aspects											.013	-.008	.054
	2d) Most negative aspects												.094	.371
	2e) Negative aspects													-.527**
	2f) Solutions													-

TABLE 4
Respondents' evaluations of the new Bartın-Amasra highway.

	Percentages			
	Academic staff (*n* = 50)	Public staff (*n* = 50)	Students (*n* = 100)	Laypersons (*n* = 100)
What are the positive aspects that attract you the most?				
Rural landscape character	12	22	20	12
Vegetation types	10	14	6	15
Closed and open scenic views	36	36	23	32
Rural settlements	16	6	7	12
Experiencing the seasonal changes of the plants	20	20	17	4
Scenic outlook points	6	20	26	25
What are the negative aspects that attract you the most?				
Hard rock quarries and concrete construction sites	38	50	31	26
Areas that are subject to erosion	20	24	8	19
Damage to the topography as a result of excavation and digging works	20	12	27	19
Damage to the vegetation	8	18	18	20
Damage to the dry and wet river beds	4	2	2	5
Noise pollution and visual pollution	10	12	14	11
What are your suggestions to solve these problems?				
Removal of the visual pollution caused by hard rock quarries and concrete construction sites	44	64	46	50
Planting design for erosion control	14	22	15	17
Landscape reclamation on roadside slopes	24	8	21	16
Renewal of the damaged vegetation	6	12	10	10
Carrying out river reclamation	2	2	2	2
Planting design against noise and visual pollution	10	10	6	5

In this study, scenario techniques were used to simulate alternative rural highway landscape reclamation designs. The 3-D visualization method (e.g. [15, 33, 72-74]) has been successfully used in the past in a consultative planning approach to identify the preferences and perceptions of users through exposure to suggested alternative designs. Therefore, these results could be integrated into highway landscape reclamation applications. Our results found that respondents preferred the "closed" option among the simulations offered for the reclamation of the damaged natural areas due to stone quarries. As shown in Table 4, the aspects that the respondents reported as the most negative were the quarries and construction works. Thus, to improve people's perceptions, landscape reclamation applications should remove and/or decrease the ecological problems and visual pollution caused by these activities. In addition, activities should be pursued in line with the "closure" option to increase the likelihoods that the sites return to their original natural states and the rural characteristics of the areas are maintained. The respondents' suggestions for mitigating damaged vegetation were planting designs that mitigate noise and visual pollution and landscape reclamation proposals on the roadside slopes.

The descriptive pairs of terms used in this study related to visual quality are in accord with those used by Blumentrath and Tveit [20] and Roth [75]. Blumentrath and Tveit [20] defined 12 visual characteristics: coherence, imageability, simplicity, visibility, maintenance, naturalness, integration, contrast, variety, aesthetics of flow, legibility, and orientation. The terms diversified, beautiful, and natural, defined by Roth [75] in an online visual landscape assessment study, are similar to the terms used in the present study. Table 6 demonstrates that during the landscape reclamation proposals being conducted on the highway at the time of the survey were not liked by the respondents.

TABLE 5
Analysis of variance test results of the differences among types of respondents regarding pairs of descriptive terms with respect to the new Bartın-Amasra highway.

Descriptive pair of terms	User	Sum of squares	Sum of squares	F value
Beautiful	A	3897,545	1299,182	967,997
	B	4490,667	1496,889	908,990
	C	5841,446	1947,149	983,627
	D	6789,076	2263,025	1,209E3
Attractive	A	3919,597	1306,532	1,010E3
	B	4534,010	1511,337	935,634
	C	6082,964	2027,655	1,049E3
	D	6962,985	2320,995	1,185E3
Regular	A	3844,612	1281,337	901,780
	B	4480,285	1493,428	902,683
	C	6394,343	2131,448	1,052E3
	D	6886,172	2295,391	1,194E3
Relaxing	A	4055,047	1351,682	967,793
	B	4450,637	1483,546	870,794
	C	6539,576	2179,859	1,095E3
	D	7158,023	2386,008	1,281E3
Safe	A	3402,955	1134,318	779,394
	B	4170,465	1390,155	772,328
	C	6428,901	2142,967	1,130E3
	D	7007,821	2335,940	1,537E3
Accessible	A	2962,542	987,514	614,764
	B	4095,972	1365,324	756,154
	C	4130,428	1376,809	634,384
	D	4954,373	1651,458	838,609
Practical	A	3343,447	1114,482	753,217
	B	4130,392	1376,797	754,869
	C	5301,218	1767,073	862,795
	D	5622,421	1874,140	961,715
Visible	A	2747,152	915,717	536,114
	B	4069,035	1356,345	729,158
	C	3435,249	1145,083	465,968
	D	3339,023	1113,008	494,813
Natural	A	3274,365	1091,455	657,437
	B	4280,377	1426,792	777,690
	C	5453,478	1817,826	747,982
	D	6669,836	2223,279	1,072E3
Varied	A	4011,077	1337,026	987,505
	B	4384,605	1461,535	844,969
	C	6789,911	2263,304	1,046E3
	D	7592,628	2530,876	1,257E3
Rich in terms of species	A	4250,965	1416,988	1,026E3
	B	4516,295	1505,432	878,469
	C	7595,846	2531,949	1,250E3
	D	7949,956	2649,985	1,409E3
Sufficient green	A	4667,602	1555,867	1,146E3
	B	4642,372	1547,457	889,515
	C	8094,814	2698,271	1,277E3
	D	8734,211	2911,404	1,804E3

User type: A = Academic staff, B = Public staff, C = Students, D = Laypeople

TABLE 6
Duncan analysis values for the landscape reclamation proposals (open, semi-open, and closed) suggested for the new Bartın-Amasra highway and the descriptive pairs selected regarding the present status of the highway

Adjective pairs	Projects[a]	n	Subset for alpha = 0.05															
			Academic staff				Public staff				Students				Laypeople			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Beautiful	1	300	2,0900				1,7700				2,2875				2,3925			
	2	300		4,0975				3,7550				4,3938				4,0588		
	3	300			5,2075				5,0200				5,1788				5,2812	
	4	300				6,3150				6,3100				5,8962				6,3000
Attractive	1	300	2,0425				1,7625				2,1612				2,1750			
	2	300		4,0625				3,7425				4,2438				3,8325		
	3	300			5,2450				5,0375				5,1438				5,1600	
	4	300				6,2475				6,3175				5,8238				6,0975
Regular	1	300	2,0300				1,7625				2,0925				2,0638			
	2	300		4,0625				3,7300				4,3450				3,8912		
	3	300			5,2450				5,0500				5,2275				5,2050	
	4	300				6,1800				6,2775				5,8088				5,9200
Relaxing	1	300	1,9450				1,7700				2,0775				2,1388			
	2	300		4,2000				3,7500				4,3938				3,8300		
	3	300			5,2550				5,0325				5,1762				5,2212	
	4	300				6,2275				6,2800				5,8762				6,0912
Safe	1	300	2,2000				1,8575				2,0350				2,1938			
	2	300		4,2775				3,7850				4,3738				4,0300		
	3	300			5,2625				5,0600				5,2288				5,2350	
	4	300				6,1100				6,2075				5,7300				6,1488
Access-ible	1	300	2,4225				1,8850				2,4750				2,3350			
	2	300		4,3725				3,7775				4,4812				3,9862		
	3	300			5,2525				5,0575				5,0638				5,0312	
	4	300				6,0850				6,1925				5,4088				5,6088
Practical	1	300	2,2025				1,8850				2,1612				2,1588			
	2	300		4,2525				3,7800				4,3850				3,9812		
	3	300			5,2475				5,0925				5,0788				5,0688	
	4	300				6,0725				6,2000				5,5000				5,6350
Visible	1	300	2,6500				1,9275				2,9700				2,8350			
	2	300		4,3775				3,8100				4,6075				4,1062		
	3	300			5,4025				5,0775				5,2804				4,9738	
	4	300				6,1425				6,2250				5,6862				5,5462
Natural	1	300	2,4800				1,8850				2,5875				2,2962			
	2	300		4,3175				3,7475				4,4950				3,9638		
	3	300			5,3775				5,0950				5,3338				5,2788	
	4	300				6,3350				6,2850				6,0900				6,1175
Varied	1	300	2,2075				1,8375				2,2588				2,1012			
	2	300		4,0725				3,7050				4,1975				3,9150		
	3	300			5,4325				5,0775				5,3175				5,3288	
	4	300				6,4300				6,2900				6,1450				6,1638
Rich in terms of species	1	300	2,1125				1,8175				2,0938				2,0750			
	2	300		4,0175				3,6750				4,1212				3,8712		
	3	300			5,4750				5,0975				5,3488				5,3488	
	4	300				6,4350				6,3300				6,1900				6,2312
Sufficient green	1	300	2,0450				1,7800				2,0662				2,1262			
	2	300		4,1475				3,6925				4,3562				4,0500		
	3	300			5,6225				5,1475				5,4788				5,5600	
	4	300				6,5725				6,3450				6,2962				6,4925

[a]1 = Current, 2 = Open, 3 = Semi-open, 4 = Closed

NATURAL PLANT USE IN RURAL HIGHWAY LANDSCAPE RECLAMATION

The plants that were idenified in the study area (Table 2) should be used in landscape reclamation applications and they should be widespread. The natural plants of the area have significant ecological, aesthetic, functional, and economic importance to the feasible and economic landscaping of the areas that require landscape reclamation. The importance of indigenous flora was previously emphasized by Cengiz et al. [60] and Yılmaz and Irmak [76]. In addition, planting designs developed by using natural plant species will contribute to the sustainability of the rural highway landscape. Lange [74] emphasized that the landscape contributes to the visual and ecological value of the area. As a result, landscape planners have new opportunities for improving the visual and ecological value of landscapes with the proposal of new structural elements.

CONCLUSION

In conclusion, this study contributes to our knowledge of sustainable regional development and helps to guide rural highway landscape reclamation proposals aimed at sustaining the rural quality of the new Bartın-Amasra highway. The results of this study show that users prefer the highway for its scenic properties (forest and sea as well as rural character). Because users prefer this highway's scenic attributes, landscape reclamation proposals will attract their attention.

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