

Noise Pollution Analysis of Reserved Areas: Case Study of the Isparta Ayazmana Promenade Area

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The sustainable landscape design is a strategic framework in city planning and urban recreational areas, important for the quality of life of an increasingly urbanized society. This study deals with a better understanding of visitors demand and noise properties of Ayazmana promenade area, located in Isparta city center, Türkiye. The approach in the study is an exploration one with a base in site observations, interviews and survey. However, the average noise levels of the area was measured between 43.1 to 58.1 dB(A) in Autumn and 50.2 to 62.0 dB(A) in Spring, respectively. The recreational characteristics of Ayazmana promenade area were further evaluated with survey methodology on total of 100 respondents. Moreover, majority of participants (79) reported to be visiting of that promenade area for cheating with friends, followed by 78 for traveling, 70 for walking, 65 for sitting in green open spaces and for picnic, 57 for listening music and 53 for sporting activities, respectively. It is noticeable that most of the respondents (92%) were described the Ayazmana promenade area is somewhat noisy. At the end of survey study, it was requested to assessed the Ayazmana promenade area with some suggestions by respondents.

Keywords: *Recreation; noise; Isparta; Ayazmana promenade area.*

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1. INTRODUCTION

Recreation is a combined latin word and meaning typically include having fun, resting, and renewing. However, promenade and recreation have usually carry similar meanings and used interchangeably which is a reserved place for people to benefit for their free time activities. Therefore, those reserved areas are usually designed with using some local characteristics, including recreational facilities, visitors needs and sporting units. The wider socio-economic and cultural values of these areas are increasingly being recognized, as are the important recreational services [1].

As a result of technological developments, the cities have become over populated and expanded in uncontrolled manner. In this sense, the need for green open spaces have become important issue for people to recover their vital needs which are social, cultural, and physiological activities with fun [2]. The recreational activities have become important topic for individuals to refresh their socio-cultural actions, and to renew himself sufficiently [3]. However, when a recreational event or meeting arranged in these specially designed reserved areas, uncontrolled sounds could be caused great discomfort to the visitors. In this context, the green areas are subject to increasing levels of pressure which cause environmental impacts associated with recreational activities. Typical impacts in parks are noise pollution and vandalism [4].

Sound waves that are physically random and do not have compatible frequency components are called 'noise' [5,6]. However, in a simple definition, the noise is an unwanted sound, is closely related to technological advancement. This conception holds especially true in places where, today, many machines are used to perform nearly all around the cities. It is also proposed that low frequency sound components are considered to have more severe adverse health effects compared with higher frequency components.

The sound quality management in national parks and other settings have been studied [7]. It was proposed that the presence of any anthropocentric noise-air traffic, ground traffic, or voices-negatively impacted environmental assessments, and more so at louder levels, while the natural soundscape had little to no effect on

assessments [7]. Additionally, the presence of uncontrollable loud significantly decreased participant ratings of serenity while also increasing ratings of hostility.

Some regulation on noise, which includes the establishment on limits with some precautions have already been regulated throughout world. In Turkiye, the first 'Noise Control Regulation' was published in 11 December 1986 in official gazette with numbered 19380 [8]. The aim of this regulation was to ensure a peaceful and tranquility environment for people that will be not disturbed their physical and mental health by noise. However, the noise regulations have typically covers the definition of noise and the principles for determining the limits which noise control could be applied. It was suggested, adverse effects from sources of sound with low frequency components may occur at levels below 30 dB. In this context, it has already proposed, the noise level of 55 dB and above is defined as a disturbing and precautionary sound. Moreover, above the limit level of noise could be caused considerably effects on human health, which can lead to deafness [9,10]. Some important noise related health problems could be given as; *brain injuries, difficulty in listening and understanding, distraction, hearing loss and tinnitus and concentration, stress, dizziness and irritability*. It could also be reduced cognitive performance and mental health, disrupt individuals physiological balances, reduce work performance, destroy the pleasantness and calmness [11,12].

Residential areas have potentially create high level noise environment that effects on surroundings including promenade areas. To adressing this challenge, the present study were conducted to evaluate following issues.

- a) To determine noise levels in Ayazmana promenade area, located approx. Two- km from city center of Isparta,
- b) To evaluate the measured noise values Leq dB (A) of Ayazmana promenade area, were determined from nine different selected points at two different seasons (autumn and spring). Thereby noise maps were prepared by using the measured values,
- c) To conduct a survey for visitors in order to evaluate respondents opinions on Ayazmana promenade area.

2. MATERIALS AND METHODS

2.1 Materials

The material of the study is Ayazmana promenade area where located in the southeast of Isparta city center (Fig. 1). This reserved area is covered approx. 18 Ha, next to Halikent neighborhood. Its altitude from sea is between 1030-1140 m. while the dominantly located in North side with average slope of 30%. Anatolian chestnut (*Castanea sativa Mill.*) trees have naturally grown throughout area and very important vegetation in the recreational units. However, this open space was designed with many facilities and sport equipments. Some of them are; parking lot, children's playground, open-air theater, cafes, restaurants, pergolas, ornamental pools, a small mosque, fountains, WC and sitting elements.

2.2 Methods

The Ayazmana promenade area is surrounded by high-density and low-density residential units

and a junction/busy roads with heavy traffic flow. Due to these locational properties, the noise arising from transportation vehicles, residential homes, commercial units and recreational facilities, could be considered when noise evaluations were made. In this sense, for determining noise distribution homogeneously in all over the area, it was measured at nine selected points for representing the recreation area. The points were approximately 20 m from each other (Fig. 2).

The PCE-NDL 10 sound meters, with data recording features were used. Measurements were made at two different seasons (October 2020 for Autumn and March 2021 for Spring) on different days of the week and at different times of the day. It was measured for 10 minutes of duration at each measuring time. During these experimental measurements, Lmin (Lowest Sound Level), Lmax (Highest Sound Level), Leq (Equivalent Noise Level) values were noted. After collecting noise values sufficiently, noise maps for the area were prepared.



Fig. 1. The location of Ayazmana recreation area

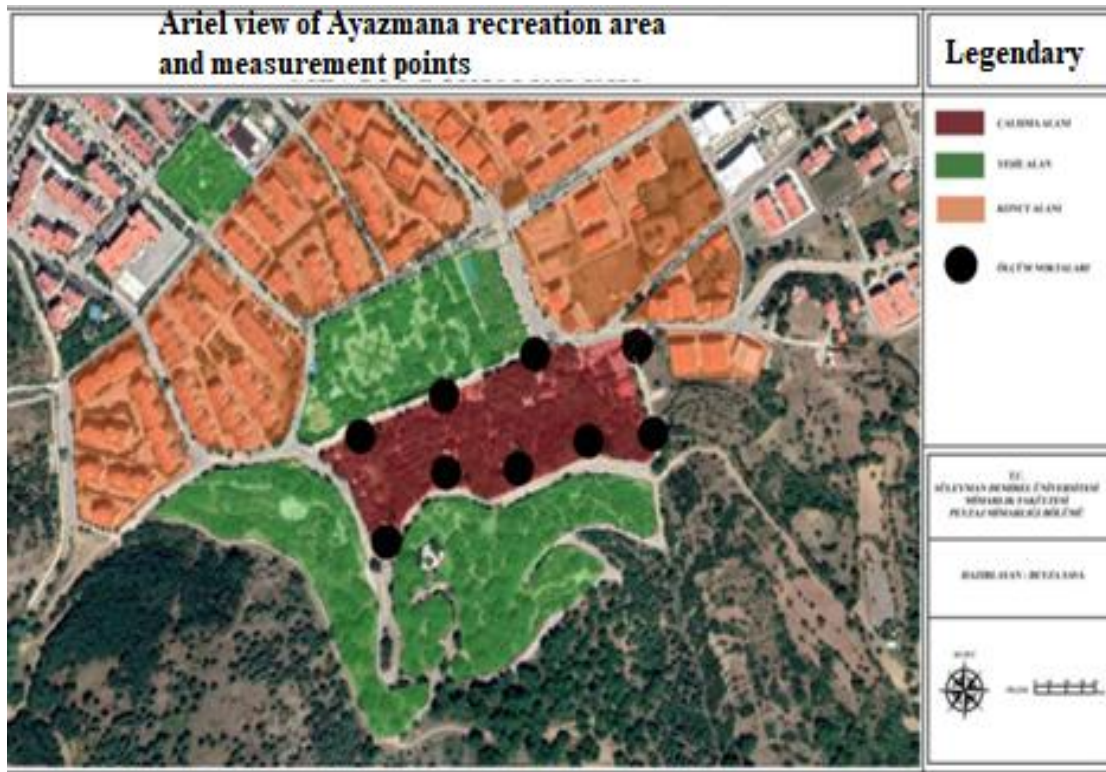


Fig. 2. The noise measurement points in Ayazmana recreation area

A questionnaire for Ayazmana promenade area was also prepared, with total of 10 questions (both type; open-ended and closed questions and some of which included personnel information). The respondents were randomly selected during visiting area. The survey questions were short and concise, but contain the information desired to be obtained correctly. It took the respondents about 5 to 10 minutes to answer in the questionnaire. They were also asked to state the perceived degree of effectiveness and noise levels of the area. These obtained data was carefully evaluated and some suggestions were noted for improving benefits to visitors.

3. RESULTS AND DISCUSSIONS

The autumn noise level measurements was carried out in October 2020, and the spring noise level measurements was carried out in March 2021 at selected nine points. One way to understand and explain the noise distribution in Ayazmana promenade area, which could be the basis for controlling conditions. The noise

properties of L_{min} , L_{max} and L_{eq} values were recorded and average values are given in Table 1.

When the average noise values are compared in terms of L_{eq} values, it could be seen, there is a higher L_{eq} dB (A) values in Spring season in all measuring points compare to Autumn measurements. However, it was found to be average L_{eq} value in range between 43.1 to 58.1 dB(A) in Autumn and 50.2 to 62.0 dB(A) in Spring, respectively. Moreover, the highest noise value of 58.1 dB(A) was found in VIII. Measuring point while 68.5 dB(A) in V. measuring point for Autumn and Spring, respectively.

Numerous studies has already conducted on similar topic [6,13,14]. Urban parks in the downtown area of Curitiba, surrounded by roads and commercial activities were evaluated [13]. It was reported, the most noise-polluted parks in Curitiba were the Public Walk Park and the Botanical Garden Park, with measured $L_{(eq)}$ of 64.8 dB(A) and 67 dB(A) [13].

Table 1. Measured noise values in Ayazmana promenade area

Noise measurement points	Lmax dB(A)	Lmin dB(A)	Leq dB(A)
Autumn (October 2020)			
I. point	52.6	39.5	43.1
II. point	66.5	37.2	49.9
III. point	52.2	39.4	41.3
IV. point	54.6	38.3	44.4
V. point	52.0	38.5	44.7
VI. point	47.7	36.7	41.2
VII. point	58.2	40.2	47.4
VIII. point	65.7	38.1	58.1
IX. point	69.8	38.2	55.2
Spring (March 2021)			
I. point	73.0	42.6	59.4
II. point	66.3	39.4	50.2
III. point	66.8	42.6	50.8
IV. point	70.9	45.4	58.5
V. point	74.3	46.3	68.5
VI. point	71.5	45.5	59.8
VII. point	70.0	43.9	54.3
VIII. point	77.0	43.2	62.0
IX. point	71.6	50.9	61.2

The European Directive 2002/49/EC on the management of environmental noise requires the drawing of noise maps of communities with more than 100.000 inhabitants [7]. In this regards, with using these measured values, two different noise maps, in terms of seasonal noise distribution in Ayazmana promenade area, were prepared for better compare results (Fig. 3). It appears that Spring noise level of area has considerably higher than Autumn regardless of measured places. However, it is also noticeable that the noise level distribution was also different for each measured points. For Autumn measurements, the highest noise values are measured at VIII.- (58.1 dB), followed by IX.- (55.2 dB), II.- (49.9 dB), VII.- (47.4 dB), V.- (44.7 dB), IV.- (44.4 dB), I.- (43.1 dB), III.- (41.3 dB) and VI.- (41.2 dB), points, respectively. For Spring measurements, the highest noise values are measured at V.- (68.5 dB), followed by VIII.- (62.0 db), IX.- (61.2 dB), VI.- (59.8 dB), I.- (59.4 dB), IV. (58.5 dB), VII.- (54.3 dB), III.- (50.8 dB) and II.- (50.2 dB), points, respectively.

The differences between seasonal noise level distribution is probably related to people and transportation activity in the area. However, the noise pollution was reported to be more than 50 dB(A) during weekends and 40 dB(A) on weekdays because the traffic passing by the parks and absence of tree plantations, Allahabad region in India [15]. Moreover, the parks could be

classified as either acoustically polluted or unpolluted when the evaluating Leq values systematically [16]. In our study, it could be summarized that Ayazmana promenade area could be classified as acoustically polluted during spring and unpolluted during Autumn.

For evaluating visitors opinions and demand for the study area, survey conducted on 62 females and 38 males in total of 100 participants. The questionnaire were organized in two parts. In first part, it was aimed to determine socio-economic characteristics of the respondents (e.g. income, age, education). In the second part, some specific questions directed to participation for determining their preferences and demands for Ayazmana promenade area and other recreational places. It has assumed this methodology is one of the way to collect information on individual recreational preferences and could be explained much of the demands on recreational sites.

Most of the respondents (74) were between the ages of 21-30 while 40 of them were student. It was noteworthy that the 72 of the respondents were single and majority of (58) lived with their families. However, only 26 of the respondents have noted to be monthly income of 4501-6000 TL and rest from lower than these level. It is also interesting to note that 55 of repondents reported to be lived in Isparta city for 1-5 years. Moreover,

approx. 40% of respondents were residence of three neighborhood of Isparta city center (17% in Fatih-, 13% in Modernevler-, and 12% in Çünür neighborhood).

Table 2 shows a general preference of respondents in terms of recreational activities. It was found that 79 of respondents are preferred recreation fields for cheating with friends, followed by 78 for traveling, 70 for walking, 65 for sitting in green open spaces and for picnic, 57 listen for music and 53 for sporting activities, respectively.

When visiting frequency and spend time evaluated, 31 of respondents was found to be

visited once a month to Ayazmana promenade area. However, 25, 32 and 27 of respondents stated that they spend in the Ayazmana promenade area for 1-2 hours, 2-3 hours and 3-4 hours, respectively.

The question of 'what is your primary aim for visiting Ayazmana promenade area?' was directed and answers were summarized in Table 3. The 78 of respondents stated for sitting on green fields, 77 of stated for having a picnic, 53 of stated for walking, 32 of stated for sporting activities, 15 of stated for reading newspaper-magazine and only 13 of stated for using playground for their children.

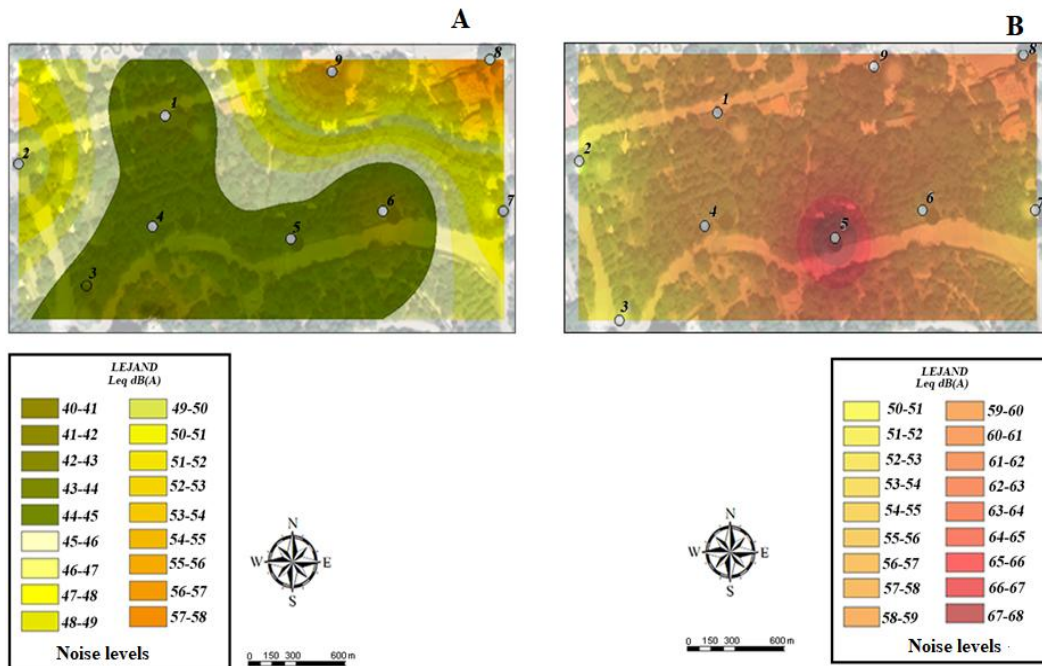


Fig. 3. The noise maps of Ayazmana promenade area (A: Autumn, B: Spring)

Table 2. Recreational preferences of respondents (multiple answers, number of respondents)

Type of activity	Count	Type of activity	Count
Chatting with friends	79	Playing games (cards, okey)	43
Traveling	78	Shopping	42
Walking	70	Gardening	41
Sitting in the green area	65	Artistic pursuits	39
Having a picnic	65	Watching TV	38
Listen to music	57	Going to cinema	34
Sporting	53	Attending courses	31
Using social media	49	Joining tours	27
Sleeping	48	Watching sport games	27
Reading newspaper-book	45	Worship	27

Table 3. The aim for visiting Ayazmana promenade area (multiple answers, number of respondents)

Activities	Count
Sitting in green area	78
Having a picnic	77
Walking	53
Sporting activities	32
Reading newspaper-magazine	15
Using playground	13

When the question of *'what is barrier for attending recreational activities for you?'* directed to respondents, the majority of participants (62) declared as *'economic factors'*, 50 of declared as *'individual preferences'*, 27 of declared as *'family related'* and 24 of declared *'health'*.

Conforming to current status on the area, the question of *'what should be reorganized or improved for Ayazmana promenade area?'* was directed to respondents and their answers were given in Table 4. However, the majority of respondents equally stated, should be further sitting and trash box elements (58). The 54 of respondents were reported the security should be increased. It is important to note that 48 of respondents are disturbed by noise and should be reduced. Moreover, 47-, 45- and 33 of were also reported, insufficient of lightning elements, parking capacity and infrastructure facilities, respectively and need to be improved, for better utilization of area.

For evaluating respondents opinions on the noise level properties of Ayazmana promenade area, a large majority of the respondents (92) were described the area was somewhat noisy, 82 of described it as moderately noisy and 10 of

described as highly noisy but only 8 of the participants stated there was no noise problem in the area.

When the question of *'what is source of noise in Ayazmana recreational area?'* was directed to participants, their answer on that question is given in Table 5. Their opinion for noise source mainly motorized vehicles (52) and people related (51), followed by cafe, restaurants and sales unit related noise (46) and children related (44). However, it has already hypotheses that motor vehicles as main source for noise pollution in the towns [17]. Our findings are also consisted with these information.

The 77% of respondents aware of noise is an environmental problem and 98% of them are opinions on that high level of noise could be a negative effects on health of individuals.

For further evaluating noise related problems on people, the question of *'is noise cause health problems for individuals?'* was directed to participants in order to determine respondents' opinions on noise based health problems. However, a large majority of the respondents were actually aware for noise related health problems and noise could be contributed to one of the eight disorders given in Table 6. The 79 of respondents were stated noise could be caused irritability, 74 of stated destructibility, 54 of stated decreasing working productivity, 42 of stated temporary hearing loss, 38 of stated insomnia, 27 of stated fast heartbeat, 24 of stated permanent hearing loss and 22 of stated fear, in that order. According to perception survey conducted in similar topic, high noise could be caused high prevalence of head aches, lack of concentration and sleep discomforts [18].

Table 4. Respondents opinions on Ayazmana promenade area (multiple answers, number of respondents)

Current status on Ayazmana promenade area	Count
Increasing sitting elements	58
Increasing trash box	58
Increasing the security of the area	54
Noise reduction	48
Increasing lighting elements	47
Increasing the parking capacity	45
Insufficient infrastructure facilities	33

Table 5. The noise source in Ayazmana promenade area (multiple answers, number of respondents)

The noise source in Ayazmana recreational field	Count
Motorized vehicle related	52
People related	51
Cafe, restaurants and sales unit related	46
Children related	44

Table 6. The noise cause on health disorders (multiple answers, number of respondents)

Health disorder	Count
Irritability	79
Distractibility	74
Decreased workingr productivity	54
Temporary hearing loss	42
Insomnia	38
Fast heartbeat	27
Permanent hearing loss	24
Fear	22

It appears that noise level is a problem for visitors of Ayazmana promenade area. However, many literature reports suggest that the noise pollution can be significantly reduced by establishing green barriers (zones) with plant material around the parks [15-17]. The similar improvements could be suggested for Ayazmana promenade area.

4. CONCLUSIONS

There are numerous literature information could be found on urban reserved areas. However, evaluating visitors demands and opinions on the recreational fields are quite complicated. In this regard, a site observations, noise level measurements and survey analyses were conducted. To minimize the environmental degradation associated with Ayazmana promenade area may require appropriate land-use zoning, regulation and surveillance of access and activities, direct physical protection of particular areas.

Besides physical activities, mental refreshing and personalization are necessary for urban people to relax and to do something they may engage in, to communicate and to chat, to create a fun atmosphere. However, recreational activities in reserved area (e.g. promenade area) are one of the great ways to be active and out of the home, and a great opportunity to spend time with fun and enjoy. After careful observations, interviews and survey analyses on Ayazmana promenade area, it could be suggested the careful reorganization of that area with providing

lowering noise levels and outdoors time in a safe place for users. These could be done by using landscape approach to redesign and use further elements to be more attractive an promenade area. Moreover, project management of large scale noise mapping requires since several public and private entities have to work together to provide accurate and detailed input.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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