JOURNAL of DESIGN THINKING

The Social Parameters of Sustainable Landscape Design in the Persian Tomb Garden (Case Study: Taj Mahal in Agra, India)

Honey Fadaie [1*]

[1] Department of Architecture, Roudehen Branch, Islamic Azad University, Roudehen, Iran. Email: dr.fadaie@iau.ac.ir

[*] **Corresponding author:** Honey Fadaie

DOI: 10.22059/JDT.2025.394116.1153

Received: *27 April 2025,* ***Revised:*** *26 May 2025,* ***Accepted:*** *7 June 2025,* ***Available Online*** *from 4 June 2025.*

Abstract

The Persian Garden had various types throughout history and in different lands, among which we can mention the tomb gardens, many examples of which were built during the Mughal rule in the Indian subcontinent, inspired by the Persian garden design. One of the most well-known tomb gardens is the Taj Mahal in Agra, India, which was built in the Iranian architectural style. Many factors have been involved in forming this historical space, including social interactions and views. Therefore, it seems necessary to study and investigate the social parameters of landscape sustainability in the design of the Taj Mahal as a valuable example of the Persian tomb gardens. The methodology of the present paper is descriptive-analytical, based on the data from the scholars' views in the field of social sustainability and the findings from the design features of the Taj Mahal Garden by studying the sources and observing its images and documents. First, it introduces the Taj Mahal Tomb Garden and explains the parameters of social sustainability in the landscape. Then, it analyzes the features of the Taj Mahal Garden based on the social sustainability factors and finally compares these features with the factors of social sustainability. The findings indicate that the Taj Mahal is a place with social sustainability features such as social interactions, participation, harmonious with the climate, comfortable, and has a sense of place, and the design of its natural and built elements was in accordance with the objectives of social sustainability.

Keywords

Persian Garden, Tomb Garden, Taj Mahal, Sustainable Landscape, Social Sustainability.

Introduction

Tomb gardens are a type of Persian garden which is surrounded by a tomb or a monument (Daneshdust, 2002). Based on Ferdowsi's Shahnameh, it can be said that the history of making tomb gardens in Iran dates back to before Islam (Sultanzadeh, 2000). After Islam, examples of Persian tomb-gardens have been observed in Iran, Pakistan, and India. These types of Persian gardens were popular in India during the Mughal era and have been known as Mughalian gardens by some scholars. The geometric structure in Indian gardens is the same as Persian garden (Jamshidyan, 2014). The gardening tradition of the Timurids in India is considered to be influenced by Timur. Their deep spiritual connection with nature in the gardens of Samarkand, which was influenced by Persian gardens, answered a kind of nostalgia hidden in their collective memory (Massoudi, 2009). The Mughals made the gardens as sites for their tombs. Babur named his first garden in Indian Mughal, which was built in 1526, Charbagh (Golombek & Koch, 2017). In the later period, after Humayun Shah became a refugee at the Safavid court. Shah Tahmasb supported him in regaining his kingdom, and a new era was born in the relations between these two nations (Iran and India). Subsequently, Iranian artists and architects in India during the Gurkan (Mughal) period became the origin of valuable works and magnificent buildings, and the Taj Mahal tomb-garden is among these architectures (Jamshidinazar et al., 2021).

Before the arrival of Persian gardens, there was a type of tomb in India. These new mausoleums were built as distinctive elements (memorials) and separated from the urban fabric. They were inextricably linked to urban uses such as the bazar (Kasravi, 2015).

The Persian gardens have changed after entering India. The changes that have been applied due to the political and social conditions of India, its geographical location, and the background of Indian culture and civilization (Jamshidyan, 2014). For example, the Persian garden is a place for the dominant presence of nature and the expression of this presence in the garden is the maximum perception of the natural elements of the landscape. While in Indian gardens, the geometry of the building dominates the entire garden and its natural area (Figure 1). In Indian Mughal gardens, the extension of the axis and the visual view of the main building of the garden can be well perceived in the entire site (Akbarian, 2014).

Figure 1: *Taj Mahal, The domination of building over nature (UNESCO World Heritage Convention, 2009).*

The Taj Mahal is the result of the peak of architectural and gardening flourishing during the Mughal era of India, which displays a fusion of various landscape design traditions, including Iranian, Central Asian, pre-Mughal Indian, and Shah Jahan landscape architecture (Jamshidinazar et al., 2021). Often, gardens would function as pleasure gardens in the lifetime of the royalty and become tomb gardens on their death (Singh, 2011). The Taj Mahal, a completely new approach to *borrowed scenery* was adopted where the tomb garden was designed as a part of a larger complex that extended to enhance an entire river and the landscape beyond within its composition (Singh, 2011).

Today, the citizens and tourists utilize this tomb garden as a historical monument and public green space. Urban parks and green spaces are among the most influential factors in shaping the social sustainability and cohesion of urban spaces. Findings indicate that the emotions evoked by green spaces, especially parks, have a direct impact on psychological interaction, comfort, and daily life interruptions, all of which play a significant role in the quality of life, which is a key component of sustainable social development (Fathololumi & Mohseni, 2023). Therefore, it seems necessary to recognize the Taj Mahal Garden based on social criteria such as social sustainability. The expanding role of the Persian garden in India as a place of burial, which began with Humayun's tomb, indicates how the symbolic importance of the garden was necessary to increase in daily activities.

Initially, sustainable societies were associated with environmental issues, but their concept has grown over time to include other dimensions of sustainable development, such as social and cultural sustainability. In current literature, sustainable societies are related to a variable range of issues, such as social and environmental relations (Kosanovic et al., 2018). In order to further understand the dimensions of social and environmental sustainability in Iran's traditional tomb gardens, the present research aims to find these features in the design of the Taj Mahal as a valuable example of a Persian tomb-garden that is located outside the current borders of Iran.

Literature Review

In the studies of contemporary scholars about tomb gardens in India and the Taj Mahal Garden, Kasravi (2015) considers the geometric order, symmetry, and the way the building is placed in the middle of the garden as features that are completely inspired by Iranian architecture. According to him, the common existence of the tombs of the kings of India, which includes the distance from the organic urban fabric, the strict demarcation between the tomb complex and the adjacent urban fabric, indicate that the Indian tomb garden design is following the Persian garden geometry. While, Asher (2009) does not consider the origins of the Taj Mahal Garden to be taken from Persian gardens. She mentioned some scholars who believed the Taj Mahal design was inspired by Hindu and Buddhist beliefs. For example, overall appearance and plan of Taj Mahal is not found in Mughals own architectural tradition. Although Jamshidyan (2014) considers the garden design of Indian tombs to be influenced by the design of Persian gardens, believes that when faced with the Persian garden, Indians unconsciously involved their decorative spirit and tasteful atmosphere in their designs. This influence appears not in the construction and geometry of the garden, in the external surfaces, and in the miniature and decorative look of the garden elements. Still, the strong geometry and complete spatial organization of the Persian garden remain in force. Wescoat's study shows that the garden was an important part of the regional topographical and geographical program in the early Mughal period in India. However, at the end of that period, in the second half of the 16th century, it gradually lost this role, and the relationship between the garden and the land changed. Wescoat (1997) points out that the garden's expanding role as a burial site, which began with Humayun's tomb, shows how the garden's symbolic importance was necessary to increase its functional importance in the daily activity of the royal family. Massoudi's researches (2009) show that Timurid horticulture followed three important factors. First, the historical and cultural background of the Mughals, second, the cultural influences of the Iranians, and third, the climatic characteristics of India.

According to Maryam Akbarian, the climatic and social background of India as well as the taste and aristocratic character of the Muslim sultans of this period influenced the garden design of the Mughal period. She also points out the main axis of the garden in the comparison between Persian and Indian gardens, which is the place of connection with nature and human presence in nature in Persian gardens. However, in the tomb gardens of India, at the moment of entering, what dominates the view in front of the viewer is the grandeur of the building in it and the unlimited and vast view that exists with this building (Akbarian, 2014). Soltani (2014), comparing the Persian and Indian gardens, states that the built elements of Indian tomb gardens, compared to Persian examples, played a more important role in the landscape of the garden. Therefore, the extent of the hard surfaces and elements and their geometric order, along with the few garden

trees, make the Persian gardens in India more regular than other examples. In the studies about Chaharbagh, Porter (2016) believes that there are traces of four divisions known as *Chaharbagh* in funeral landscapes (tomb gardens) in pre-Mughal India, and the formation of tomb complexes was in the middle of this period. The period was directly related to the change of ceremony and its scale.

Among the studies on the Taj Mahal, Sultanzadeh (2000) investigates the spaces, design orders, and constituent elements of the Taj Mahal. Janick and his colleagues (2010) have studied plant species in gardens and tomb decorations. Sparavigna (2013) discussed the planning of the Taj Mahal gardens and their orientation with sunrise/sunset azimuths on solstices. Patil (2023) has analyzed the concepts of mathematics like geometry, the golden ratio, line symmetry, etc., on the Taj Mahal. Singh (2011), while analyzing the architecture of the Taj Mahal, explains the changes applied to the garden in the period after the British colonization. According to Begley (2014), the layout of the Taj Mahal complex and the apocalyptic images that include Quranic inscriptions strongly indicate that this monument is a broad allegory of the Day of Judgment. Finally, Vij (2019) has addressed the damages of the Taj Mahal from an environmental view. In Table 1, the studies conducted on the Taj Mahal are briefly explained.

Table 1: *The Studies of contemporaries' scholars on the Taj Mahal and Tomb Gardens.*

No	Scholars, Year	Fields of Study
1	Sultanzadeh, 2000	Describe the spaces & elements of the Taj Mahal
2	Asher, 2009	The origins of the Taj Mahal
3	Masoudi, 2009	The factors of creating Mughal gardens
4	Wescoat, 1997	The evolution of Mughal gardens throughout history and their relationship with the land
5	Janick et al., 2010	Plant species and tomb decoration of the Taj Mahal
6	Singh, 2011	The transformations and changes of the Taj Mahal
7	Sparavigna, 2013	The Taj Mahal orientation with the sun rise and set azimuth
8	Akbarian, 2014	The reasons for creating Mughal gardens
9	Begley, 2014	Study on Taj Mahal decorations
10	Jamshidyan, 2014	The origins of the Taj Mahal
11	Soltani, 2014	The comparison between Persian and Mughal Indian gardens
12	Kasravi, 2015	The geometry and origins of the Taj Mahal
13	Porter, 2016	The origins of Chaharbagh
14	Vij, 2019	Identification of environmental damage on the Taj Mahal
15	Patil, 2023	Analysis of the Taj Mahal from a mathematical viewpoint (golden ratio…)

The previous studies show that most of the research has been descriptive in explaining the spaces and elements of the Taj Mahal. Only a few scholars have investigated the origin of this garden and the effective factors in garden formation. Some others have also studied its decorations. Considering the importance of sustainable development in landscape design, unfortunately, no research with this approach has been conducted on the Taj Mahal as a valuable historical landscape example. Thus, this paper studies the principles of social sustainability in the design of the Taj Mahal.

Methodology

The present study is carried out by focusing on and adapting social sustainability parameters on the Taj Mahal Mausoleum Garden in Agra. The main purpose of this research is to recognize these parameters and to determine whether the design method of the Taj Mahal is the design of the Persian garden or not. It also seeks to answer this question: *What criteria and principles of social sustainability have been used in the design of the Taj Mahal Tomb Garden?* The research method of this paper is in the context of library studies is descriptive-analytical, which, according to the type of research, review and collection of information are done in two parts of library studies, document observation and analysis.

1. *Data Collection Method*

The data of this research is prepared through documentary studies and viewing pictures and maps related to the Taj Mahal. The data collection steps are as follows:

- Documentary review: scientific resources related to social sustainability in landscape design and extracting the views of experts in this field. These sources are used to develop a theoretical framework and identify parameters of social sustainability in landscape design. In addition to the parameters of social sustainability, information about the architecture of the Taj Mahal is obtained from related sources. Since the Taj Mahal is a historical space that has undergone many changes throughout history, it is important to see the documents of old pictures, used decorations, and written sources with a historical approach to understand it.

2. *Data Analysis Method*

Content analysis is done qualitatively and comparative analysis as follows:

- The theoretical framework of social sustainability parameters is based on the views of scholars, where things such as social interaction, security, harmony with nature, sense of place, etc., are selected as the basis of analysis. Furthermore, recognizing the design patterns and elements of the Taj Mahal tomb garden, which includes natural elements (water and plants) and built elements (tomb space).
- The assessment and evaluation table that shows the compliance of elements of the Taj Mahal with parameters of social sustainability using visual coding (black squares for compliance and white squares for non-compliance).

Results

Introduction of the Taj Mahal and assigning it to the Persian Garden

In the 15th century, during the time of Timur, the gardens were in the form of square walls, divided into four parts by intersecting water channels and forming Chaharbagh, which is famous for its landscape architecture in Iran and Central Asia. This method of construction was followed in India during the time of the Mughals (Golombek & Koch, 2017). Chaharbagh derives from the fact that the easiest way to irrigate a piece of land is by dividing it into squares (Singh, 2011). The Taj Mahal is an example of Persian Chaharbagh Gardens in the Mughal period. It was built by Emperor Shah Jahan for the tomb of his Iranian wife Mumtaz Mahal in the 17th century in Agra, India. Agra district is located in Uttar Pradesh, lying between latitudes 26°44' and 27°24' North and Longitudes 77°28' and 78°54' East. The most distinct feature of the district's topography is the Yamuna River's presence, along with its tributaries, the Chambal and the Utangan. The climate of Agra is semi-arid, lying in a subtropical humid climatic zone (Mukherjee et al., 2024). Despite some claims that deny the influence of the Taj Mahal from Persian gardens, the quadripartite geometry and planting system in this garden are similar to Persian chaharbagh gardens. The main garden plan is divided by walkways and flowing water, which is typical in Persian gardens. We can find walkways on each side of the cypress strips. The Babur introduced such Persian chaharbagh (Four section gardens) to the Indians (Janick et al., 2010).

According to Golombek and Koch (2017), Timurid architecture shows innovation in every aspect of the practice if we compare it with its predecessors. However, this innovation was built upon earlier progress in the technology of domes and vaults. This knowledge arrived in Timurid Central Asia with master artisans, brought by Timur from Iran. Besides, the plant motifs are also proof of the impact of this space on Persian gardening and horticulture. These motifs became the main elements of decorating plinths in the architecture of Shah Jahan. In general, the use of plant motifs was a return to architectural decorations from the exaggerated visual aspects of the previous periods to artistic methods that were following Islamic laws (Jamshidyan, 2014).

For instance, the external and the internal walls are profusely ornamented with bas-reliefs and stone inlays of flower and plants the combine Persian, Indian and western flowers. These plants that make up the floral imagery of the mausoleum are indigenous to India and the Middle East, and represent plants frequently illustrated in Persian paintings and rugs (Jamshidyan, 2014). Moreover, the main motif of flowers in inlaid colored stones is narcissus, roses, and tulips. These are the flowers that have been used in Persian mystic poetry to describe the features of the beloved (Kumar et al., 2018). For this reason, the influence of Iranian art and architecture in the design of the Taj Mahal seems inevitable.

Taj Mahal consists of five main parts, including Darwaza (main gateway), Bageecha (gardens), Masjid (mosque), Rauza (main mausoleum), and NaqqarKhana (rest house) (Sai Kishore & Chandramoudi, 2021). Most Mughal chaharbagh (gardens) are rectangular with a tomb or pavilion in the center. Based on research and observations, except for the Taj Mahal, which is located at the end of the garden, most of the Indian tomb-gardens are based on the design of a main building (pavilion) with a huge scale in the middle of a vast garden. The Taj Mahal Garden is unusual in that the main element, the tomb, is located at the end of the garden. However, historical studies show something else. With the discovery of Mehtab Bagh or *Moonlight Garden* on the other side of the Yamuna, the interpretation of the archaeological Survey of India is that the Yamuna River itself was incorporated into the garden's design and was meant to be seen as one of the rivers of Paradise (FUSD, 2021). The plan of the Taj Mahal is located on an axis whose extension can be seen in Mehtab Bagh on the other side of the Yamuna River. After the colonization of India by the British in the 19th century, the Taj Mahal Garden underwent many changes, and the British changed the garden to their taste and in the manner of English gardens. As it was mentioned, the connection between the garden and the Yamuna River was cut (Singh, 2011); thus, today, the mausoleum can be seen at the end of the garden. The Yamuna River next to the Taj Mahal Palace as an important geographical phenomenon caused that instead of building the tomb pavilion in the middle of the garden, it was erected on the front of the garden, which was located next to the river (Sultanzadeh, 2000; Figure 2).

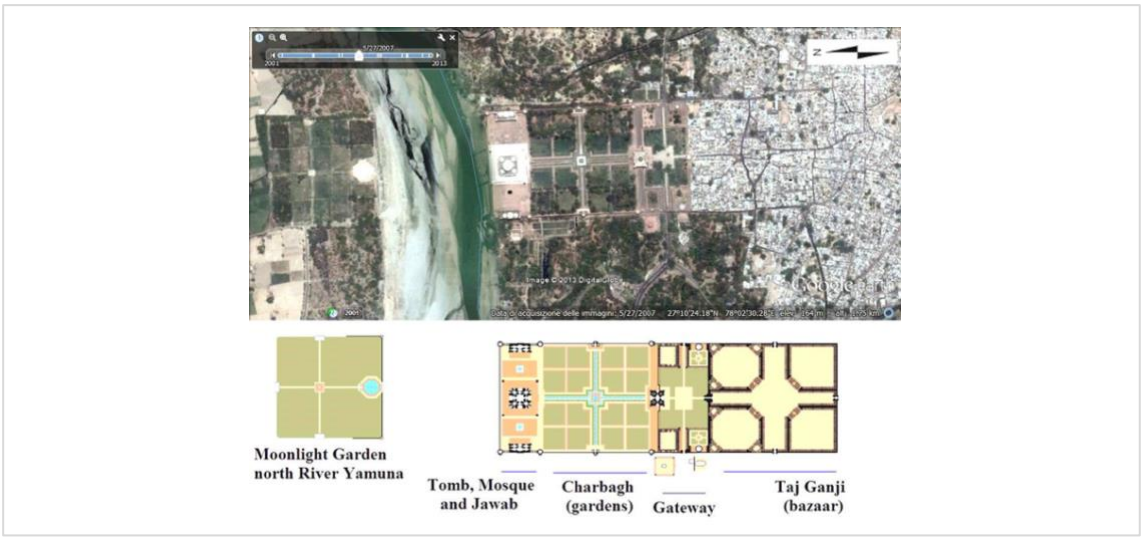

Figure 2: *The position of the Taj Mahal Garden concerning the river and Mehtab Bagh (above), the main spaces of the Taj Mahal (below) (Sparavigna, 2013).*

Landscape scholar Attilio Petruccioli has divided the Taj Mahal Garden into three areas: frontage and entrance, Charbagh, and tomb (Mazar). He thinks that the division of the garden into three parts was derived from the space regulation system in the Mughals' camps. Nevertheless, at the same time, he believes that because Iranian gardeners built the Taj Mahal, the features of the Persian garden dominate in its design (Etezadi, 2020). The entry to the Taj Mahal is as follows: Passing from the commercial arena (Chahar Su) to the connecting and transitional arena (frontage) and the ideal and paradise arena (garden), and the final and final arena (tomb) (Sultanzadeh, 2000).

In the 17th century, the Mughal obsession with symmetrical correspondence found new forms of expression under Shah Jahan, with a shift in emphasis. From the two-sided symmetrical designs of the huge Taj Mahal complex, the central design of the Hasht-Behesht (eight paradises), which was inspired by the Timurids, was changed to a radial design. In the Taj Mahal, the main building or mausoleum is located on a terrace overlooking the river (Golombek & Koch, 2017). The mausoleum is located on the platform. The design of the tomb is usually a dome-shaped central space in the middle of the building plan, through the center of which passes the four axes of symmetry. Two intersecting axes that pass through the center of the building and often four smaller porches are located along them (Sultanzadeh, 2000; Figure 3). The mausoleum with a symbolic view and considering the reduction of height and the importance of walls and trees is visible from a long distance (Ansari, 2011). Compared to the architectural spaces in Persian gardens, the mausoleum has more decorations. Decoration in the Indian taste space means the interest in the most precious and the most extravagant display of artefacts (Jamshidyan, 2014).

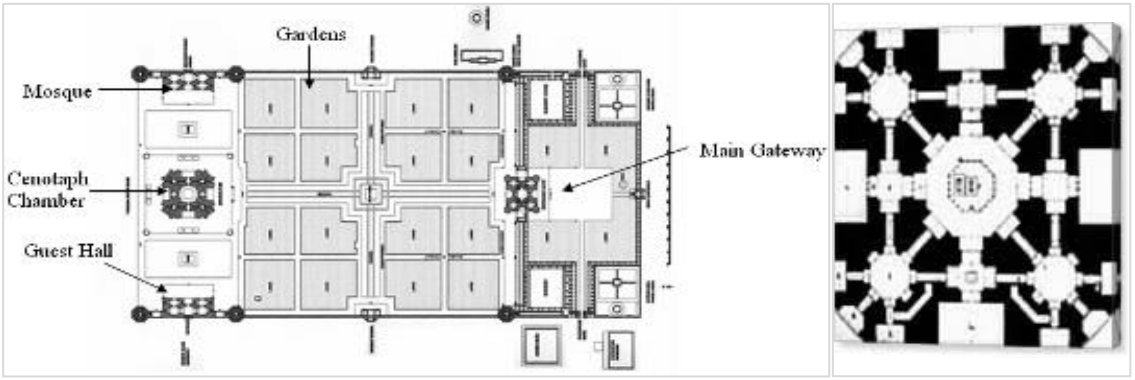

Figure 3: *Left: The plan of the Taj Mahal Garden and its spatial areas, Right: the plan of the tomb (FSTC, 2004).*

After the colonization of India by the British in the 19th century, the Taj Mahal Garden underwent many changes, and the British changed the garden to their taste and in the manner of English gardens. For instance, the connection between the garden and the Yamuna River was cut off (Singh, 2011). Early account of the garden describes a profusion of vegetation, including roses, daffodils, and fruit trees, but the plantings were altered during the reconstruction by Lord Curzon, the British victory of India, and lawns became the main feature (Janick et al., 2010).

Social Sustainability in Architecture Design

Initially, sustainable societies were associated with environmental issues, but their concept has grown over time to include other dimensions of sustainable development. Nowadays, sustainable societies are related to a variable range of issues, such as social and environmental relations (Kosanovic et al, 2018). In many existing definitions of social sustainability, the physical environment is considered as a factor for social coexistence, social integration, and improving the well-being and quality of life of different groups. Such communities are well balanced and connected, that can meet the needs of a wide range of those who live or work there (Mehan & Soflaei, 2017). In addition, the social sustainability definition relates the term social to human society, the interaction of the individual and the group, or the welfare of human beings as members of society (Baffoe & Mutisya, 2015). According to scholars, Bostrom (2012) believes social sustainability is all about human welfare, including quality of life, social justice, social cohesion, cultural diversity, etc. Altman considers security, spatial dynamics, social interactions, solitude, personal space, and territory as the principles and characteristics of social sustainability (Ghafourian et al., 2017). Among other aspects of social sustainability in urban life, factors such as security, social communication, voluntary activities, and participation have been identified as effective factors in the social aspect and improving the level of people's interactions. Moreover, Culture is often considered part of social sustainability, which covers aspects such as equality, participation, awareness, and maintenance of social patterns (Soini & Birkeland, 2014).

From some scholars' perspective, social sustainability is commonly defined by four key criteria: social justice, solidarity, participation, and security (Rahimi & Shahamat, 2024).

According to other studies, the most important parameters of social sustainability are social interaction, social equity, and participation (Ozel, 2023). In general, other features of sustainable communities are claimed to include a sense of place in a healthy and safe environment. Social interaction and a stable community of residents who feel attached to where they live. Social sustainability also relates to the participation in collective groups and collective aspects of social life (Mohammad Alizadeh & Esbah Tunkay, 2019). It is clear that social sustainability defies a single definition. What one society considers crucial to its welfare might differ from another, even in the same region. This means that any attempt to assess social sustainability at any level has to put particular emphasis on the prevailing contextual conditions and preferences of the people. It is only when this is done that one can confidently relate the results to the realities on the ground (Baffoe & Mutisya, 2015).

Social Sustainability in Landscape Design

A vibrant and dynamic city can be defined by various characteristics, with the most important being people's participation in city affairs, holding meetings, and creating opportunities for interaction among citizens (Fathololumi & Mohseni, 2023). Landscapes are one of the most effective parts of the cities for humanity, for spending leisure time and passing daily activities (Mohammad Alizadeh & Esbah Tunkay, 2019). Thus, it is important to pay attention to parameters of sustainability in landscape design. A sustainable landscape not only reduces negative environmental effects but also has benefits for the site and its users. In addition to that, the sustainable perspective also pays attention to social and economic concerns (Bean & Yang, 2009). In other words, the most important features of a sustainable landscape can be categorized into three main parts: social sustainability, affecting from nature, and using renewable energy sources (Shakoor et al., 2018). Moreover, a sustainable landscape is not based on a deterministic state or condition. It represents a dynamic state of the system with multiple trajectories and outcomes and embodies multi-functionality. In this regard, the social dimension of sustainability usually refers to the acceptance of the landscape changes in a specific context, particularly touristic areas or other areas where the landscape is rapidly changing (Palang et al., 2017).

In addition to flexibility, heritage is an important part of the group identity and collective identity that are deeply associated with the landscape, which is viewed as a vital source of inspiration and well-being for all. Thus, preservation of identity and cultural heritage can be considered as one of the factors of social sustainability. One of the issues of social sustainability is the provision of social justice in the sense that it is possible for citizens to be productive and use different levels of urban facilities and opportunities in a balanced manner (Mosharzadeh Mehrabi et al., 2009). Landscape can be a context for social communities, and therefore it is a critical notion for social sustainability. Feeling safe in the environment, using the place for social life, spending time, and the existence of a social community are indicators of sustainability. Social sustainability has two main dimensions that are equitable access and the sustainability of the community (Mohammad Alizadeh & Esbah Tunkay, 2019).

Finally, some scholars recognize the parameters such as, qualitative factors in landscape design include social factors and sociability, flexibility, readability and participation and choice, attention to the quality of space, creating a sense of place and belonging, social security, environmental desirability and harmony with the surroundings environment as the social sustainable factors (Nasr & Emadi, 2021).

Table 2 briefly defines the views of scholars about the concept of social sustainability and its role in architecture and landscape design.

Table 2: *The Parameters of Social Sustainability in Architecture and Landscape Design from Scholars' points of view.*

No	Scholars, Year	Perspectives and attitudes about social sustainability
1	Bostrom, 2012	Social justice, social cohesion &cultural diversity
2	Soini & Birkeland, 2014	Social communication, social security, voluntary activities &participation
3	Baffoe & Mutisya, 2015	Social interaction & social wellbeing
4	Ghafourian et al., 2017	Social interaction, solidarity &spatial dynamics
5	Mehan & Soflaei, 2017	Social interaction & wellbeing
6	Palang et al., 2017	Flexibility & cultural heritage, and identity preservation
7	Mohammad Alizadeh & Esbah Tunkay, 2019	Social interaction, sense of place, social justice & desirable place
8	Nasr & Emadi, 2021	Sense of place, security. Environmental desirability, readability, harmony with nature, flexibility & participation
9	Ozel, 2023	Social interaction, Social equity (Justice) & participation
10	Rahimi & Shahamat, 2024	Social justice, solidarity, security & participation

In summarizing the contents of social sustainability according to scholars' views (Table 2), the most common criteria and strategies of social sustainable design can be summarized as follows (Table 3):

Table 3: *Features and Principles of Social Sustainability in Architecture& Landscape Design.*

No	Parameters & Principles of Social Sustainability	Strategies in Social Sustainable Design
1	Social Justice	Providing well-being and physical comfort - creating spaces for all genders and age groups
2	Social Interaction	Creating public and flexible spaces for social interactions
3	People Participation	Creating public spaces for the use of all citizens (green spaces, pedestrian walkways, etc.)
4	Creating a sense of Cheerfulness, Comfort, and Place	Creating human physical and mental comfort, proximity to nature, providing daylight, beautifying, and creating visual proportions in the building
5	The Interaction between Architecture and Nature	Creating harmony between architecture and nature - using plants and green spaces in building design
6	Social Security	Protection of privacy - provision of lighting
7	Preservation of Identity and Cultural Heritage	Using the traditional and historical patterns of Iranian architecture in building design
8	Readability	Using clear and specific orders and proportions
9	Localism	Using local materials and local methods in the building construction
10	Coordination with the Site	Coordination of functional aspects with the building's form - coordination of the building with the site and its neighbors

Discussion

Explaining the Principles and Features of Social Sustainability in the Taj Mahal Design

Due to the importance of social factors in the sustainable landscape, while explaining them, these factors are discussed and investigated in the Taj Mahal Garden. Therefore, social sustainability and its strategies in architecture and landscape design were described and explained (Table 3). After that, the strategies of socially sustainable design in the main elements of the Taj Mahal Garden (natural and built elements) are analyzed and explained. Finally, the compatibility of Taj Mahal design features with the strategies of social sustainability is evaluated (Table 5):

1. *Social Justice and Social Interaction*

- Natural Elements: In addition to garden's veranda with the green spaces, on the southern side of the garden area, which is the boundary between frontage square and the garden area, a number of verandas have been built side by side (Sultanzadeh, 2000) that can be used for all people as spaces for social interactions (Figure 4). The Taj Mahal Garden is a multi-purpose space that, in addition to being a place of passage, can also be a space for people gathering and entertainment.

- Built Elements: The public area around the frontage was developed to the size of a town called Mumtazabad at the time of the construction of the tomb. Four caravanserais are organized on the four fronts of Charsu Bazar arena, and four residential and service spaces are located on four sides of the frontage square (Figure 4). The creation of such spaces allowed the possibility of social interactions between citizens and pilgrims alike.

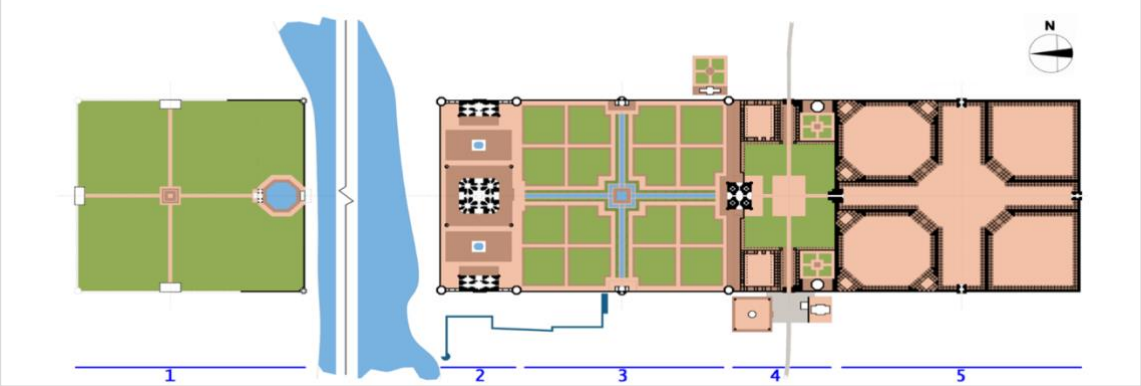

Figure 4: *Positioning the four arenas of the Taj Mahal on one axis, rhythm, symmetry, and hierarchy are the design principles of the Taj Mahal (McGinnly, 2011).*

Figure 5: *Original image of the Taj Mahal with denser trees and Iranian cedars, On the way to the street (Danielle, 2015).*

2. *People's Participation*

- Natural Elements: The footpaths in the main axes of the garden for visitors, along with the possibility of sitting on the garden grass, are also another factor for citizens' participation. According to Francois Bernier, as he saw the Taj Mahal, he describes the pathways being 4-6 feet above the planting beds, giving a sensation of walking above the shrubs and trees (Singh, 2011).
- Built Elements: Because in most important and large pilgrimage and tourism centers and complexes, there is a space or a commercial complex to present some goods that are considered and used by the pilgrims and tourists (Sultanzadeh, 2000) the public spaces such bazars, caravanserai, etc. can be the suitable spaces for people participation.

3. *Creating a Sense of Cheerfulness, Comfort, and Social Security*

- Natural Elements: The Taj Mahal Garden, with its plants and water, like natural environments, is effective on people's peace and comfort. The natural environment can bring mental comfort and reduce people's stress. Man's natural need to connect with nature and enjoy it is the motivation to connect him with nature (Nili et al., 2014). Green plants create shade and scenery and provide a pleasant feeling and perception in humans (Nili et al., 2014). Since the correct combination of lines of paths and trees promotes a sense of safety (Mohammad Alizadeh & Esbah Tunkay, 2019), the existence of these orders in the Taj Mahal can promote a sense of comfort and happiness.

- Built Elements: Creating physical comfort by gradually transitioning from public to private space and using visual proportions (rhythm, symmetry, balance, and hierarchy) in landscape design and architectural spaces are effective in the psychological security of people (Figure 4). The variety, interest, and contrast that are produced by the use of different materials with different colors make sense of security and place attachment for users that are important factors in social sustainability (Mohammad Alizadeh & Esbah Tunkay, 2019) that can be seen in Taj Mahal.

4. *The Interaction between Architecture and Nature*

- Natural Elements: According to some scholars, looking at the natural elements such as trees in the Indian garden, such Taj Mahal was often decorative. After entering India, this principle, although not completely lost, has become much weaker. The trees can emphasize the main axis and at the intersection of the axes (Jamshidyan, 2014). However, old pictures of the Taj Mahal Garden prove the opposite and show the Taj Mahal as a garden with lots of trees (Figure 5). What is certain is that after the occupation and colonization of India by the British government, there were many changes in the way of planting. This is probably the lack of trees is the result of these interventions. For instance, regardless of the climate of India, they planted the grass, which requires a lot of care and watering and does not create any shade (Singh, 2011).
- Built Elements: In the Taj Mahal mausoleum, like other tomb-gardens of the Mughal, the use of special local materials such as white marble and red stone and creating combinations of them, causes the building to contrast more with nature. It also turns the mausoleum into a focal point of view in the garden landscape with complete mastery over nature (Akbarian, 2014; Figure 5).

5. *Preservation of Identity and Sense of Place*

- Natural Elements: The sense of identification will happen when there are different kinds of forms and elements in the landscape. Belonging to a place will also occur when people can spend their time in a way that they enjoy. These are some of the factors that make a landscape socially sustainable (Mohammad Alizadeh & Esbah Tunkay, 2019). The existence of the pathways with the trees, the yards, and pools inside the garden causes the users to feel a sense of place attachment and belonging to it.
- Built Elements: The monuments that have a high visual weight will cause a sense of place attachment for people and are identifiable (Mohammad Alizadeh & Esbah Tunkay, 2019). In the Taj Mahal, the axes lead to the tomb. In addition, the placement of the tomb on the main axis with its visual weight creates a sense of place for its visitors. Apart from the geometric form and spatial patterns, the design of the Taj Mahal, like other Persian tomb gardens in the Timurid period, is inspired by Iranian decorations and symbols, such as Chaharbagh (four garden), which is a sacred number in Persian culture. Using the symbols and signs of the Persian garden is proof of preserving the identity in the Taj Mahal design.

6. *Readability*

- Natural and Built Elements: The design principles used in the Taj Mahal include the orders such as hierarchy, centrality, symmetry, and rhythm in all its natural and built elements (Figure 4). In this garden, symmetries can be seen not only in the exterior but in the drainage system as well. For example, we can see the drainage system in the Taj Mahal. In some of the stones, drainage holes have a striking hexagonal pattern (Patil, 2023). The use of geometrical order, straight and perpendicular paths, and placing the tomb in the focal point of the garden's perspective are all effective in the clarity and readability of the garden.

7. *Localism*

- Natural Elements: Historical evidences show that the Taj Mahal Garden had four hundred plants before the removal of the plants by English Lord Curzon in the early 20th century. These trees included cypress trees, symbolizing death, and fruit trees, symbolizing life. The favorite fruit trees of the Mughals were

mangoes, lemons, and pomegranates. Moreover, jasmine and hibiscus bushes perfumed the air with a sweet smell (Sandra Wagner-Wright, 2015). These findings identify that indigenous and symbolic plants were used in the way of planting in the Taj Mahal.

- Built Elements: Despite the Taj Mahal's impression of Iranian architecture and art, builders used Indian indigenous materials in the mausoleum. In the mausoleum, the exterior is white marble with a sparing use of inlay work in colored stones. The supply of marble for the Taj Mahal was made from the quarries at Makrana and ensured by Raja Jai Singh under imperial orders (Kumar et al., 2018). The other local materials that used in the Taj Mahal, brick masonry and natural red rock, are located at a depth of 85m below the ground level and can be mentioned (Patil, 2023).

8. *Coordination with the Site/Harmony with Surroundings*

- Natural Elements: In the Taj Mahal, there is no wide axis of water with its fast and noisy movements. The sound of water is less heard, and instead, the narrow water paths in which the water is moving slowly are seen (Jamshidyan, 2014). The reason for this difference is in the climatic conditions of Agra. Agra is situated in or near the subtropical dry forest biome. The average annual temperature is 26 degrees Celsius (Climate Top, 2025). Divisions and differentiation with the environment in Indian gardens were done by removing trees, unlike Persian gardens, which were done by planting trees. Due to the continental and monsoonal conditions of Agra and the lack of water there, agriculture is dependent on monsoons, and Irrigation in the gardens of Agra was provided by wells (Massoudi, 2009). Therefore, planting and watering the garden were under the climatic conditions of the region.
- Built Elements: As mentioned before, in the architecture of the main building of the Taj Mahal (mausoleum), the domination of nature can be seen. This disharmony with nature and the garden is observed not only in the form and scale but also in the color of the building (Figure 5).

In Table 4, the parameters of social sustainability in the natural and built elements of the Taj Mahal Garden are briefly described.

Table 4: *Description of social sustainability Parameters in the Elements of the Taj Mahal Garden.*

Parameters & Principles of Social Sustainability	Social Sustainability in Natural Elements	Social Sustainability in Built Elements
Social Justice	Green spaces of the garden for visitors' entertainment	public spaces such as bazar and caravanserai in the frontage of the garden and mosque, and a rest house inside it for the citizens
Social Interaction	Green spaces of the garden for visitors' interaction	The public spaces in front of the garden are a place for social interactions.
People Participation	The possibility of using the green space of the garden during leisure time	Spaces and paths inside and around the garden for social activities of citizens and tourists (commercial, recreational, etc.)
Creating a sense of Cheerfulness, Comfort, and Place	Trees along the paths, pools, and flowers	Physical comfort is achieved by gradually transitioning from public to private space, visual, and a variety of colors in architectural spaces.
Social Security	-	Establishing security by enclosing and creating a hierarchy in reaching the tomb
The Interaction between Architecture and Nature	Before changing the garden, there were many shading and indigenous trees	Despite the abundance of local trees, architecture prevails over nature, and there is a lack of connection between them
Preservation of Identity and sense of place	Preserving the sense of place by green pathways, yards, and pools Using sacred numerical symbols in garden design (Chahrbagh).	Preservation of identity and sense of place by influencing the geometric form and using sacred numerical symbols in the buildings' architecture.
Readability	Geometric patterns, symmetrical ordering, planting, and water display	Geometric order (rhythm, symmetry, and hierarchy) and placement of the building at the focal point of the garden
Localism	planting indigenous vegetation	The use of local materials in the tomb architecture, such as marble and red stone
Coordination with the Site	Irrigation system, water display, and planting by Agra's climate	Despite the fact that the building is not compatible with the garden, the architecture of the garden (planting and irrigation) is in accordance with the climate of Agra.

After analyzing the socially sustainable principles and parameters in the design principles in the elements of the Taj Mahal Garden, in Table 5, the compliance of the Taj Mahal design features with social sustainability criteria is assessed. Black squares indicate compliance and white squares indicate non-compliance with social sustainability parameters.

Table 5: *Assessing Compliance with Social Sustainability Parameters in Taj Mahal Design.*

No	Parameters & Principles of Social Sustainability	Compliance with Social Sustainability in Natural Elements	Compliance with Social Sustainability in Built Elements
1	Social Justice	■	■
2	Social Interaction	■	■
3	People Participation	■	■
4	Creating a sense of Cheerfulness, Comfort, and Place	■	■
5	Social Security	■	■
6	The Interaction between Architecture and Nature	□	□
7	Preservation of Identity and sense of place	■	■
8	Readability	■	■
9	Localism	■	■
10	Coordination with the Site	■	□

Conclusion

This research was conducted to explain the social sustainability criteria in the Taj Mahal as an example of the Persian historical tomb garden. Since social sustainability is one of the main dimensions of sustainable development, recognizing and using its parameters in architecture and landscape design can be an effective step in achieving the objectives of sustainable development. In this regard, the principles and criteria of social sustainability were analyzed and assessed with the characteristics of the Taj Mahal Tomb Garden (Tables 4 & 5). As Table 5 indicates, except for the cases of relation and interaction between the mausoleum and nature, and its coordination with the garden, the design of the Taj Mahal Garden complies with social sustainability parameters in all cases. Therefore, in response to the main research question, the parameters of social sustainability such as social security, social interaction and justice, people participation, preservation of identity, belonging to the place, localism, sense of pleasure, readability and compliance with the climate can be considered effective factors in the design of the Taj Mahal. Furthermore, based on the research and written and imagery documents that were described, it can be acknowledged that the Taj Mahal is a type of Persian garden in India.

The findings demonstrate that the Taj Mahal tomb garden, as an example of Persian gardens located in India, was not only a place of pilgrimage, but also a space with social sustainability characteristics in harmony with its context and its environment. In general, the parameters of social sustainability have been among the principles of interest in the design of Persian tomb gardens, which can be considered as models for designing a desirable space in landscape architecture and used in urban landscape plans. The findings of this paper can be a basis for future studies, including:

- Studying other aspects of sustainable development in the Taj Mahal design (environmental, cultural sustainability, etc.).
- Feasibility study of expanding social sustainability parameters, such as social interactions, increasing the sense of place in the Taj Mahal as a tourism cultural heritage.

- A comparative study of the Taj Mahal with other Persian tomb gardens with the same approach for better understanding the parameters of social sustainability in the design of gardens and cultural landscapes.
- Investigating the feasibility of generalization of social sustainability features of the Taj Mahal in the design of contemporary green spaces.

References

Akbarian, M. (2014). *Domination over nature in Tomb-Gardens of India*. Journal of Art and Civilization of the Orient, 2(3), p. 8-13.

Ansari, M. (2011). *Persian garden, the common language of landscape architecture in India and Iran*. Manzar, 3(13), p. 6-7. [In Persian].

Asher, C. B. (2009). *Brief and contestation in India: The case of the Taj Mahal. ASIAN Network Exchange*. A Journal for Asian Studies in the Liberal Arts, 17 (1), p. 8-26. https://10.16995/ane.212

Baffoe, G., & Mutisya, E. (2015). *Social sustainability: A review of indicators and empirical*. Environmental Management and Sustainable Development Application, 4 (2), p. 242-263.

Bean, C., & Yang, Ch. (2009). *Standards in sustainable landscape architecture*. UTSoA Seminar in Sustainable Architecture, The University of Texas at Austin, p. 1-14.

Begley, W. E. (2014). *The myth of the Taj Mahal and a new theory of symbolic meaning*. The Art Bulletin, 61(1), p. 7-37. https://doi.org/10.1080/00043079.1979.10787632

Bostrom, M. (2012). *A missing pillar? Challenges in theorizing and practicing social sustainability: introduction to the special issue*. Sustainability: Science, Practice and Policy, 8 (1), p. 3-14.

Climate Top. (2025). Agra Climate and Temperature. Available at: https://www.climate.top/india/agra/, Accessed 15 January 2025. [Online].

Daneshdust, Y. (2002). *The Tomb-Garden*. Waqf, Eternal Legacy. 35- 36, p. 59-64. [In Persian].

Daniell, T. (2015). *Taj Mahal Agra - Thomas Daniell - Vintage orientalist paintings of India - Framed Prints*. Available at: https://www.tallengestore.com/products/taj-mahal-agra-thomas-daniell-vintage-orientalist-paintings-of-india-framed-prints, Accessed 15 January 2025. [Online].

Etezadi, L. (2020). *Landscaping in Islamic world, Mughal Gardens of India-third part*. Tehran: Shahid Beheshti. [In Persian].

Fathololumi, P., & Mohseni, A. (2023). *Principles for designing age-friendly environments to enhance social sustainability and prevent Alzheimer's among the elderly*. Journal of Design Thinking, 4 (1), p.105-116. https://doi.org/10.22059/JDT.2024.372123.1115

FSTC. (2004). *Taj Mahal: Architecture of love*. Available at: https://muslimheritage.com/taj-mahal-the-architecture-of-love//, Accessed 15 January 2025. [Online].

FUSD. (2021). *Fontana Unified School District - Taj Mahal*. Available at: https://www.fusd.net/cms/lib/CA50000190/Centricity/Domain/2807/209%20Taj%20Mahal.pdf, Accessed 15 January 2025. [Online].

Ghafourian. M., Afshin Mehr, V., & Norouzi Zadeh, Z. (2017). *Recognition of components of social sustainability and their impact on increasing social interactions in housing (case study: bazar neighborhood, Tehran)*. Hoviat Shahr. 11(2), p. 31-44. [In Persian].

Golombek, L., & Koch, E. (2017). *The Mughals, Uzbeks, and the Timurid Legacy*. In: F. Barry Floods, and G. Necipoğlu, (eds.), A Companion to Islamic Art and Architecture. John Wiley & Sons, Inc., p. 811-845. https://doi.org/10.1002/9781119069218.ch32

Jamshidinazar, F., Ajili, M., Kazemzadeh Ryef, M. A, & Mirderikvandi, S. (2021). *Comparative and analytical comparison of Iran's Afshari architecture with the architecture of the Great Mughals of India, case example: Khurshid Kalat Palace and Taj Mahal, Agra*. 3th International Conference on Jurisprudence, Law and Religious Research, Tibilis, Georgia. [In Persian].

Jamshidyan, M. (2014). *Aesthetic of Iranian Gardens in India*. Journal of Art and Civilization of the Orient, 2(3), p.14-23.

Janick, J., Kamenetsky, R., & Puttaswamy, S. (2010). *Horticulture of the Taj Mahal: Gardens of the imagination*. ASHS (American Society of Horticultural Science). Annual Conference, Palm Desert, California, 50(3), p. 30-34.

Kasravi, R. (2015). *Organic and classic view in India's Islamic Tombs Building*. Journal of Art and Civilization of the Orient, 2(6), p. 22-29.

Kosanovic, S., Glazar, T., Stamenkovic, M., Folic, B., & Fikfak, A. (2018). *About Socio-cultural Sustainability and Resilience*. Sustainability and Resilience: Socio-spatial Perspective. TU Delft Open Publisher.

Kumar, R., Singh, A. K., Shetti, B. V., & Sankhala, P. (2018). *Unit-6 describing a monument: The Taj Mahal*. In: Block-2Guides and Escorts. India: IGNOU.

Mcginnly. (2011). *Taj Mahal Site Plan*. Available at: https://commons.wikimedia.org/wiki/File:Taj_site_plan.png, Accessed 15 January 2025. [Online].

Massoudi, A. (2009). *Acquaintance with Iranian Gardens; Baghe- E-Shazdeh*. Tehran: Faza Publication. [In Persian].

Mehan, A., & Soflaei, F. (2017). *Social sustainability in Urban Context: Concept, definitions and principles*. The 10th EAAE-ARCC International Conference. https://doi.org/10.1201/9781315226255-47

Mohammad Alizadeh, E., & Esbah Tunkay, H. (2019). *Social sustainability in landscape design elements (case study: Istanbul Technical University Maslak Campus)*. International Journal of Landscape Architecture Research, 3 (1), p. 39-55.

Mosharzadeh Mehrabi, Z., Sabri, S., & Sabri, S. (2009). *A comparative study of office park and sustainable urban development approaches*. Hoviateshahr. 3(5), p. 111-122. [In Persian].

Mukherjee, M., Ganguly, S., Mukherjee, S., & Roy, M. (2024). *Analyzing the environmental impact on tourism in Agra: Air pollution case study*. African Journal of Biological Sciences, 6(10), p. 5222-5239. https://doi.org/10.33472/AFJBS.6.10.2024.5222-5238

Nasr, T., & Emadi, M. (2021). *Investigating the role of socio-cultural sustainability indicators in urban public spaces' development (Case study: Kholdebarin Park and Eram Garden Street, Shiraz).* Journal of Urban Environmental of Policy, 1(4), p. 57-76. [In Persian].

Nili, R., Nili, R., & Aminzadeh, B. (2014). *The healing potential of garden landscape at Qajar Era's*. Armanshahr: Journal of Architecture, Urban Design and Urban Planning, 6(11), p.167-180.

Ozel, B. (2023). *A framework for impacts of bio-architecture on social sustainability: Existing situation and possibilities*. Thesis for Master Program in Architecture. Graduate School, Izmir University of Economies.

Palang, K., Soini, K., Printsmaan, A. & Birkeland, I. (2017). *Landscape and cultural sustainability*. Norwegian Journal of Geography.71 (3), p. 127-131. https://doi.org/10.1080/00291951.2017.1343381

Patil, P. K. (2023). *Mathematical beauty in the Taj Mahal*. International Journal of Engineering Technology and Management Sciences, 6(7), p. 276-284. https://doi.org/10.46647/ijetms.v07i06.040

Porter, Y. (2016). *Funerary landscape in Pre-Mughal Delhi Sultanate (1206-1555)*. Manzar, 7(33), p. 22-31.

Rahimi, R., & Shahamat, H. (2024). *Enhancing social sustainability in public spaces: An evolution of garden halls in Ilam, Iran*. International Journal of Sustainable Building Technology and Urban Development, 15 (4), p. 484-497. https://doi.org/10.22712/susb.20240034

Sai Kishore, S., & Chandramouli, K. (2021). *Taj Mahal Construction*. International Journal for Modern Trends in Science and Technology, 7(7), p. 256-257. https://doi.org/10.46501/IJMTST0707043

Sandra Wagner-Wright. (2015). *Taj Mahal Gardens & Lord Curzon*. Available at: https://www.sandrawagnerwright.com/taj-mahal-gardens-lord-curzon/, Accessed 25 May 2025.

Shakoor, A., Abodolahzade Fard, A., & Moahammadi, Z. (2018). *The role of urban rural perspective on sustainable development (Case study: Shiraz Soltanabad River)*. Research and Urban Planning, 8 (31), p. 321-340. [In Persian].

Singh, P. (2011). *Changing imagery of the gardens of Taj Mahal (lessons from the narrative of a historic garden)*. In P. Vandal, (eds.), Historiography of Architecture of Pakistan and the Region. Lahore: Thaap Publication, p. 101-115.

Soini, K., & Birkeland, I. (2014). *Exploring the scientific discourse on cultural sustainability*. Geoforum, 51, p. 213-223. https://doi.org/10.1016/j.geoforum.2013.12.001

Soltani, M. (2014). *Comparative study of Iranian garden concepts in Iran and India*. Journal of Art and Civilization of the Orient, 2(3), p. 5-7.

Sparavigna, A. C. (2013). *The gardens of Taj Mahal and the sun*. International Journal of Sciences. 2(11), p. 104-108. https://doi.org/10.18483/ijSci.346

Sultanzadeh, H. (2000). *Design continuity of the Persian garden in Taj Mahal Mausoleum of an Iranian origin lady*. Tehran: Cultural Research Bureau. [In Persian].

UNESCO World Heritage Convention (2009). *Taj Mahal*. Available at: https://whc.unesco.org/en/list/252/, Accessed 15 January 2025. [Online].

Vij, S. (2019). *Deteriorating Taj Mahal-Impact of climate change and pollution*. Neuro Quant ology, 17(2), p. 209-215. https://doi.org/10.48047/nq.2019.17.02.2002

Wescoat, J. L. (1997). *Mughal garden and geographic sciences, then and now*. In A. Petruccioli, (eds.), Gardens in the Time of Great Muslim Empires; Theory and Design. Leiden, New York: E. J. Brill, p. 187-202.