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An Introduction to the Impact of Sustainable Landscape Parameters on the Archetype of the Design of Persian Garden: Royal Pasargadae Garden

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ABSTRACT

The architectural structure of the Persian garden was created along with the evolution of Iranian culture and civilization over centuries, and it has been known as one of the ancient cultural heritages. Pasargadae was a garden city created by Cyrus, the great, in 6BCE. Studies on historical documents and excavations of archeologists in the ancient site of Pasargadae and its royal garden show that Pasargadae Garden is one of the first documented examples of gardening in Iran, and recognized as an archetype of Persian garden. Moreover, studies show that sustainability is one of the most important factors, which contributed to the Persian garden design. This paper aims to synopsize the sustainable characteristics of Pasargadae Garden as the oldest recognized type of Persian garden, based on its architectural layout, identified by archeologists' excavations and historical documents. To achieve this purpose, the research employs the interpretive-historical method to recognize the parameters and constituent elements of Pasargadae Garden, existing in the subsequent Persian gardens, and data are gathered from the relevant documents. By the study and analysis of sustainable characteristics of royal garden of Pasargadae, some information will be obtained which have an effective role in gaining the design principles of the subsequent gardens. Results show that the architecture of archetype of Persian garden corresponds to the parameters of environmental sustainability.

***Keywords**: Persian Garden, Archetype, Pasargadae Garden, Sustainable Landscape*

1. INTRODUCTION

The Persian Garden is a garden with special and unique features that have included geographical, political and cultural areas of Iran throughout history. Persian garden is distinguished from other gardens in the world by its special features. Although the formulation of a rule for the definition of the Persian garden may not include some of the gardens that are considered as examples of the Persian garden (Mirfanderski, 2005), many of these definitions represent some characteristics of Persian gardens. So far, various criteria have been the basis for defining Persian gardens. Some of these definitions consider the Persian garden as the achievement of a human effort to create a pleasant environment with natural elements. Based on these definitions, it can be stated that the most important feature which distinguishes the Persian garden from other gardens in the world is its geometric shape (Mostafazadeh, 2008:3). According to the mentioned definitions, the Persian garden can be defined as a cultural-environmental phenomenon, where water, plants and architectural spaces are organized in an enclosed space with a specific geometry. One of the oldest Persian gardens registered by UNESCO is the Pasargadae Royal Garden in the vast area of Pasargadae. Pasargadae is located approximately 90km northwest of the city of Shiraz, in Fars province, Iran. It is within

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the Morghab plain, an area of 20*15 square kilometers with various geographical conditions like, mountain passes, riverbeds, agricultural land, dry land, etc. (Mozaffari, 2014: 4-5). Archaeological studies on this ancient area show that the Pasargadae land is a large complex including the royal garden, Tal Takht, the holy site, prison, tomb of Cyrus, etc., which are scattered in this plain (Bousharlat, 2017). Also, historical and archeological studies conducted by researchers have been able to find a lot of information about the structure and elements of the Pasargadae Royal Garden. However, there are still many unknowns in this regard. Many scholars have introduced the Pasargadae Garden as an archetype of Persian gardens based on its shape and physical structure. In addition to the physical structure, identifying the other many features of Pasargadae Garden and conducting comparative studies on these features and subsequent Persian gardens can be an appropriate method to better understand the Persian garden design. Since there are different factors affecting the Persian garden design, studying each of these factors requires a separate comprehensive study. For example, interest in green space could not be the only factor leading to gardening in these areas. The attractive combination of trees, shade and water in the often-arid landscapes in Iran is an important factor in creating a garden (Ghaem, 2017: 65). Therefore, the study of Persian gardens with a sustainability approach can be the response to many obstacles in landscape design today, and is effective in achieving the principles and parameters of sustainable landscape architecture.

Since the first step in studying the structure of the Persian garden and the influential paradigms in its creation is the accurate recognition of its historical origin, physical parameters and its constituent elements, in the present paper, considering the thousands of years old history of the Persian garden and its gradual evolution over the centuries, first the design methods in the Pasargadae royal garden are studied as an archetype of the Persian garden, and then these methods are analyzed by the principles of sustainable landscaping comparatively.

2. Literature Review

Among the studies conducted on Pasargadae, the first excavations in Pasargadae and the royal garden were carried out by Ernst Herzfeld in1938. After Herzfeld, Archaeological Department of Iran under the supervision of Ali Sami excavated an extensive area of Pasargadae (Azizi and Salimi, 2012). The other important archaeological findings are the results of ten years of studies and excavations at the historical site of Pasargadae by David Stronach (1968-1968). In the first excavations of Pasargadae and the Morghab plain, he described the arrangement of the elements of royal garden of Cyrus in Pasargadae. Although most of his findings remained as hypotheses, they are important resources for recognizing the spatial structure and architectural elements of Cyrus' garden in Pasargadae. By conducting archaeological studies on the remains of pavilions and water canals, he found the existence of a royal garden in this area and the exact characteristics of the elements of the garden, such as palaces and pavilions, and concluded that the origin of the Persian garden dated back to the Achaemenid period. In 1999, an archeological team, under the supervision of Rémy Boucharlat, started the field work on Pasargadae. This project was undertaken by "Iranian Cultural Heritage Organization" and a team from "Maison d'Oreint" (university Lyon 2) and CNRS. The team employed innovative approaches such as geophysical survey and kite aerial photographs, and tried to survey the "empty areas" between monuments and beyond them (Boucharalat, 2017:279). The main aims of this expedition were determining the limits of the occupied area in Pasargadae plain, enriching the data on the currently recognized site, and recognizing beyond the archaeological Achaemenid site (Boucharalat and Benecht, 2002). These studies did not finish, and the "Iranian-French" mission in 2015 started to continue the Boucharalat's fieldwork in order to reveal Pasargadae landscaping. The renewed Iranian-French project, managed by Mohammadkhani and Gondet, was implemented by Iranian Cultural Heritage. It was an interdisciplinary team that continued mapping Pasargadae by means of geophysical methods to better understand the chronology of some of the previously revealed settled sectors of the Pasargadae site (Gondet et al, 2018). Except for archaeologists, among architectural scholars, Mehrabani Golzar conducted studies on Pasargadae architectural layout from three different perspectives. First, he tried to prove the existence of an order between the structural elements of Pasargadae through archeological

findings. Next, by referring to historical texts about Pasargadae, he proved the existence of a garden and geometrical designs, and finally, he analyzed the structural elements and their relations to each other from the viewpoint of landscaping (Mehrabani Golzar, 2012). Continuing his research based on archaeological documents, patterns and traditions of Persian garden, he concluded that unlike Herzfeld, who considered Pasargadae to be a vast camp, Pasargadae was the closest model of Iranian garden cities, and there was a link between Persian gardens and the physical elements of Pasargadae (Mehrabani Golzar, 2016).

According to what was previously mentioned, most of the studies on the land of Pasargadae and its royal garden in the last two centuries were conducted by archaeologists who had been able to discover many unknowns of this ancient site and provide a model of the first Persian gardens. In recent years, the architectural scholars have studied on some of the features and spatial arrangement of this ancient site, based on archaeological findings and historical texts. Among these studies, one research only that was written by Ali Mozaffari was about the social, historical and philosophical factors affecting the Pasargadae site's conception (Mozzafari, 2014), and so far, no study has been conducted on the effective factors in the creation of Pasargadae Garden. One of these important factors is environmental sustainability. Despite lack of enough information and a lot of puzzles to recognize this ancient site, this research concentrates on sustainable characteristics of Pasargadae Garden to propose an appropriate design model for sustainable landscaping in arid climates. Furthermore, the present paper attempts to recognize design principles of Pasargadae Garden based on the findings of other scholars to be able to identify the parameters of sustainability in the design of this ancient site.

3. Research Methods

The methodology employed in this research is the descriptive-analytical method and data were collected by the interpretive-historical method. The main question of this research is: How do the environmental parameters affect the design principles of the archetype of the Persian garden? Since the criteria of sustainability have been constant over the centuries, in this paper, based on the latest findings of landscape sustainability, the design principles of the first Persian garden, which have been continued throughout the history, are studied to achieve more scientific results. In this study, the characteristics of Pasargadae Garden and its constituent elements were first described based on the interpretive-historical method, and then the principles of sustainability in landscape design were explained. Finally, the parameters of sustainability in Pasargadae Garden were evaluated according to design strategies in sustainable landscaping. The research procedure was as follow:

1. Describing the historical background of Persian garden
2. Introducing and describing the archetype of the Persian garden
3. Explaining the principles of environmental sustainability in landscape design
4. Recognizing the design pattern and elements of the archetype of the Persian garden (Pasargadae Garden)
5. Assessing the sustainable landscaping in Pasargadae Garden

4. Historical Background of Persian Garden

Archaeological studies show that the history of horticulture in Iran dates back to centuries BC. In studying and recognizing the roots of Persian garden design, the most sources recognize the Pasargadae Garden, built by Cyrus in 546 BC, as the archetype of the Persian garden. It was a model that could be adapted as a prototype (Masoudi, 2009: 36-7). In studying the roots of Persian garden, some scholars have considered the history of Persian garden beyond the garden of Cyrus in Pasargadae and believe that the background of the plan that Cyrus laid in the garden of Pasargadae was created many years before him, so that the origins of Persian garden are attributed to gardening in the Mesopotamian civilization, which included the civilizations of the Sumerian, Babylonian and Assyrian kingdoms. Maria Eva Subtelny attributes the history of gardening in the Middle East to the reign of Assyria, who for the first time thought of creating royal gardens for the purpose of royal propaganda (Subtelny, 2002).

Heidi Walcher also considers the origins of gardening in ancient Persia to be inspired by the ancient gardens of Egypt and Mesopotamia in the 8th century BC and writes, "Persian Islamic gardens have developed in a dialectic cycle of pre-Islamic Persian Garden traditions and Qur'anic notion of Paradise from contemporary

pre-Islamic and Persian traditions. The form of pre-Islamic Persian gardens have roots in the antecedent garden structures of Mesopotamian and Egyptian gardens probably absorbed major structural, functional, and aesthetic patterns from Assyrian Gardens of the 8th century B.C" (Walcher, 2012: 344-5). Walcher has not provided any evidence to support her claim. However, considering the similarities between the physical structure in the gardens of Iran and Egypt, similar climatic conditions as well as cultural relationship between the two civilizations during the Achaemenid period, it is possible that Egyptian gardens have had a small effect on the creation of Persian gardens. In addition, due to the functional differences in the gardens of Iran and Egypt, the Persian type was used as a residential and entertainment space, and the Egyptian type was used as a pilgrimage garden or temple. There is a hypothesis that the similarity between the Persian and Egyptian gardens is limited to their shape, which requires separate research (Figure 1).

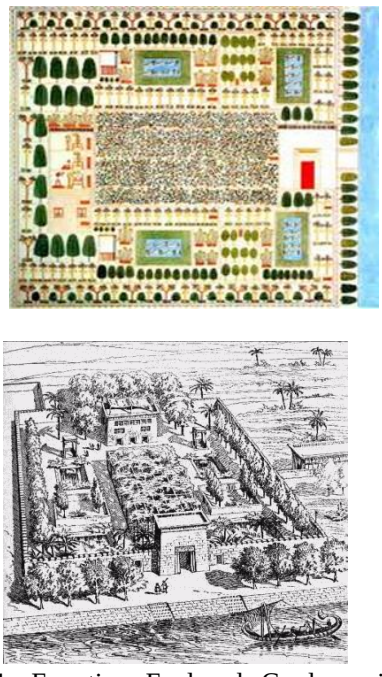


Figure 1. Egyptian Enclosed Garden with the Central Axis and Geometric Planting (Leszczyinski, 1997: 98)

Although David Stronach considered the Garden of Pasargadae as an adaptation from the gardens of the previous reigns in the Assyrian and Babylonian periods that sought to convey the message of political power through the architecture of the royal gardens (Stronach, 1990: 171), he found differences between the Garden of Pasargadae and the royal Mesopotamian gardens. He expressed his doubts about the discovery and continuation of ancient Mesopotamian gardens in royal Achaemenid gardens. He mentioned, "The royal gardens of Assyria and Babylon have always been a complementary and separate part of the palace, but we see that the palaces of Cyrus with long and elaborated porches were used as parts of the garden. In other words, the garden itself has become a royal residence" (Stronach ,1994: 59), and he wrote again, "Once It was thought that the Achaemenid gardens continued exactly the method of garden design in Mesopotamia, but recent findings show that this is only a hypothesis and a small part of it is the story" (ibid: 63). According to the mentioned theories, most of the documented sources about the history of Persian garden before the establishment of Pasargadae Garden do not include enough evidences to prove their hypothesis. Historical documents and archaeological evidence indicate that Pasargadae Garden is the archetype of the Persian garden, which will be explained more in the next section.

5. Introduction and Description of The Archetype of The Persian Garden

The historical-evolutionary method is one of the study methods in the history of architecture. In this method, a building is analyzed as a primary species through the historical and archeological documents. Furthermore, the building is considered as a living being and the goal is to recognize the evolutionary chain of the building (Memarian, 2007: 236). Also, this method requires identifying the archetype in architecture. Archetype is a trait that has been formed in the human imagination in ancient times, has been transformed into a genetic code over time and has been passed down to subsequent generations (ibid: 194). By studying on Persian gardens and comparing them with early pre-Islamic gardens, it could be found out that the Persian garden has evolved over the centuries. Archaeological documents indicate that pre-Islamic Persian Garden was an archetype of Safavid gardens (Hooshangy, 2000: 4-5), which is known as one of the most important eras in the history of Persian gardening (Figures 2 and 3).

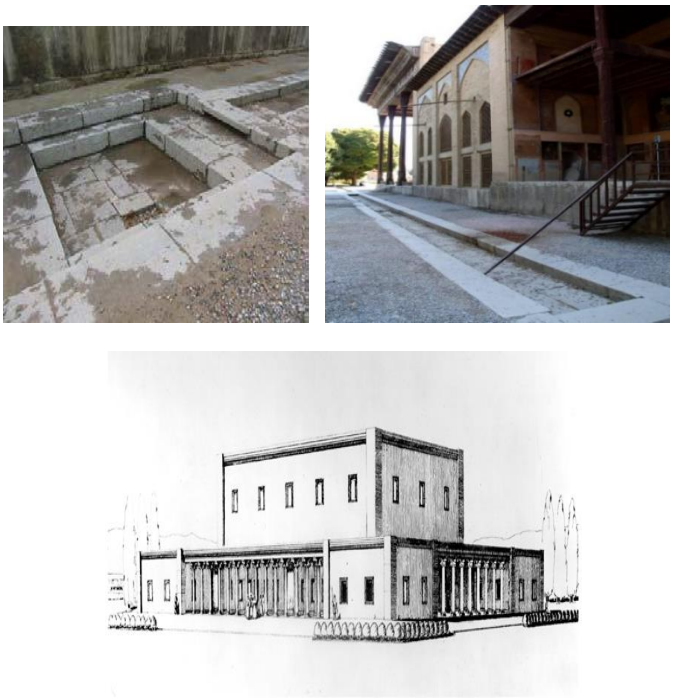


Figure 2. Safavid Gardens Inspired by Achaemenid Garden; Left: Ponds and Canals around Safavid Pavilion; Centre: Safavid Garden's Pavilion with Columned Porch (Naeema, 2004); Right: Achaemenid Pavilion with Columned Porch (Stronach & Gopnik, 2009)

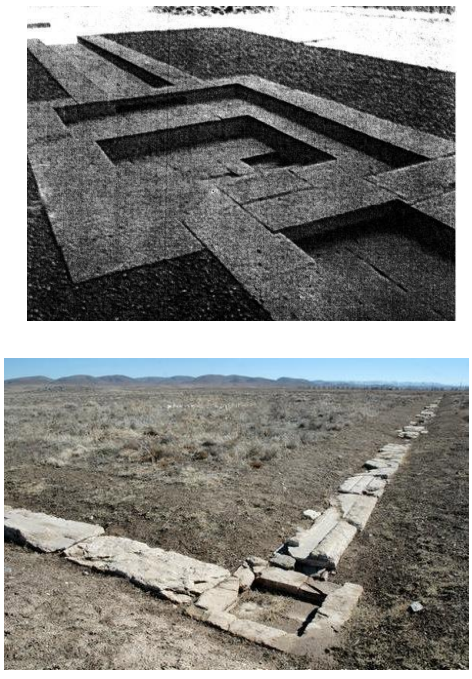


Figure 3. Connecting Water Channels to the Pond; Left: Safavid Garden; Right: Pasargadae Garden (Masoudi, 2009: 196)

The first Persian garden known as the Archetype of the Persian Garden is the Garden of Cyrus in Pasargadae. The oldest written document that indicates the geometric structure of this garden is related to the observations of the Greek General Lisandre. Nevertheless, there are researchers who have the other view. For instance, Tom Turner has considered the origin of Persian gardens unclear (Turner, 2005: 86), or Donald Wilber has attributed the construction of the archetype of Persian garden to the Sassanid era (2-6A. D), and without providing any documents, he has only referred to the ancient pottery bowl (Wilber, 2006: 1919). However, the study of historical texts such as the Xenophon's writing and archeological findings of David Stronach in the Pasargadae Garden indicates that the garden of Pasargadae is one of the most documented examples of the Persian garden and it is known as the archetype of later gardens. Elizabeth Moynihan believes that what was built by Cyrus in Pasargadae is a very simple design that has been the basis for designing Persian gardens to date (Moynihan, 1980: 15). Also, David Stronach considered the Pasargadae Garden as the archetype of the Persian gardens and believed that all Persian gardens were the heirs of Pasargadae Garden. For examples, Khosrow palaces in the Sassanid period, Balkavara palace in Syria, Timurid gardens in Herat, Safavid gardens in Isfahan, all have been adapted from Pasargadae Garden, which is one of the most important Achaemenid inventions in the field of monumental garden design for the first time in the 6th century BC (Stronach, 1994: 59).

The innovation of Pasargadae Garden was related to the relationship between the built form and landscape as structures becoming pavilions within gardens (Mozaffari, 2014:5). Also, innovative factors, such as symmetrical pavilions and stone aqueducts that first appeared in Pasargadae Garden, continued in subsequent Persian gardens especially in all gardens of the post-Islamic periods in Iran and India (Stronach, 1994: 62-3). Earlier, in the Assyrian and Babylonian royal gardens, the gardens were always separate or complementary parts of the palaces, but the palaces of Cyrus with their long porches and surrounding open spaces were used as a complement to a general plan. In other words, the garden became a royal residence (ibid). The existence of a regular geometry in the royal garden, on a large scale, has turned it into a model that was considered later in the Sassanid

and post-Islamic periods (Mehrabani Golzar, 2012: 10). Some traditions of Persian garden design in later periods, such as geometry, organization based on the main axis, view, network divisions, the presence of water, pavilion and the porches, have all been among the features and principles in the design of Pasargadae Garden (Mehrabani Golzar, 2016: 70). In addition, the location of the royal garden, the tomb of Cyrus and Tal Takht in one direction indicates the existence of an axial geometry similar to the Persian gardens that have been expanding on a large scale. This pattern was recreated in landscape design in the following centuries (ibid: 70-2).

6. Explaining the Principles of Environmental Sustainability in Landscape Design

performance that is visually desirable and environment-friendly (ibid). According to the "American Society of Landscape Architects (ASLA)" description, sustainable landscapes are responsive to the environment, re-generative, and can actively contribute to the development of healthy communities. Sustainable landscapes sequester carbon, clean the air and water, increase energy efficiency, restore habitats, and create values through significant economic, social and, environmental benefits (Asla, 2017).

In general, sustainable landscape design is a strategy that responds to environmental issues. Principles of sustainability in landscape design include adapting to climatic conditions, preventing carbon emissions, preventing global climate change and pollutions resulted from the use of toxic pesticides, as well as the use of renewable energy sources and native plants. Since the elements of landscapes often include water, plants and built materials, the principles and criteria of environmental sustainability in landscape design are analyzed in these three elements as follow:

6.1 Water and Irrigation

Irrigation methods should prevent the reduction of water by evaporation. In sustainable landscape architecture, the goal is to use water properly and prevent its loss. Designing slopes and surfaces to reduce flooding and adequate drainage are other appropriate methods of water efficiency (Klett and Cummins, 2014).

6.2 Vegetation and Planting

Sustainable planting is a method of selecting or planting plants in horticulture that conforms to

Sustainable landscape is a part of sustainable architecture that focuses on the planning and design of the building's external environment and includes various activities in response to the environment. These activities are conducted at every stage of landscaping, including the design, construction, execution, and management of residential and commercial landscapes (Loehrlein, 2009). The sustainable landscape creates an attractive environment that balances with the local climate and requires using minimal resources such as fertilizers, pesticides and water. It reduces water consumption and prevents air, water and soil pollutions. Also, in this design method, the selection of suitable plant species and their appropriate planting are considered. Sustainable landscape design can be considered as an appropriate design with efficient

sustainable principles. This method includes planting vegetation while considering such issues as planting native plant species, not using chemical fertilizers and pesticides, not doing heavy irrigation and using methods to eliminate or reduce water consumption while irrigating at the site.

"We are now facing climate change; it is an urgent need to develop adaptive strategies. Creative use of a green infrastructure is a promising opportunity," said John Benson, Professor of Landscape Architecture Management and Planning. To meet these needs, regional spatial strategies are considered at all scales in the planning process (Benson and Roe, 2007:190). Other effective plants in creating a sustainable landscape are fruitful trees that are considered as urban landscape network in some societies today. The presence of fruitful plants, the connection of a network of fruitful landscapes to the urban fabric and their coordinated design with the ecosystem in these landscapes have led to the formation of new sustainable landscapes in today's cities (Sheibani and Chamanara, 2012: 19-21). In addition, the selection of healthy and long-lived plant species and planting the appropriate trees in suitable places to conserve energy and prevent air pollution have a significant impact on creating a sustainable landscape.

6.3 Built Environment and Materials

The best way to achieve efficiency of resources and materials in design is to consider the site as a functional system with inputs and outputs from internal resources and cycles (Benson and Roe, 2007: 197). In general, sustainable

landscaping includes indigenous and renewable materials, which means that they can grow and re-create themselves with low energy consumption and avoid using the materials and products that are harmful to the environment. Table 1 summarizes the principles and criteria of landscape sustainability in irrigation methods, planting and using the built materials.

Table1. Principles and Parameters of Sustainable Landscape

Water and Irrigation	Vegetation and Planting	Built Environment and Materials
Reducing water evaporation	Planting native plants with low water consumption	Using renewable materials
Optimizing the use of water and avoiding waste of water	Planting fruitful trees	Using durable materials with low energy consumption
Appropriate drainage	Not using pesticides and chemical fertilizers	
Preserving the flood	Planting deciduous trees for shading in summer days and using sunlight in winter days	Using local materials
Aligning the irrigation system with planting systems	Planting evergreen trees to protect the space from cold and unpleasant dusty winds	Using non-poisoned materials
	Planting the plants with low water consumption to control the flood	

Moreover, as mentioned, compliance to climatic objectives in landscape design has been one of the principles and features of environmental sustainability in landscape architecture. Pasargadae is located in Fars province, in a semi-arid region. But, how was the climate of this land thousands of years ago? Although there is no definite answer for this, by referring to the old resources, the presence of shade trees and shade porches in the pavilions which were considered as strategies in climate design in hot and arid areas can be recognized. Stronach has written that the porches were a place to watch and enjoy the spring rain because the inhabitants knew that it would not rain for months, which indicates the dryness of the weather in that area (Stronach, 1994: 61). Also, studies have shown the garden orientation was from northwest to southeast, which made the garden to have the most shade during the day (Ghaem, 2001: 72).

Based on the above, the design strategies in arid climates are as follows:

6. 3.1 Shading

In the gardens, trees and built elements such as walls and porticos can play an effective role in reducing the intensity of solar radiation on building surfaces and creating shade (Rouhani 1986:95).

6.3.2 Wind Control

Plants can control wind by obstruction, guidance, deflection, and filtration. This is achieved through the form, texture and height of the plant itself or by its placement. Plants are used in conjunction with landforms and architectural structures guide the flow of air over the landscape (Leszczyinski, 1997: 100).

6.3.3 Modification of Sunlight

Plants absorb heat, provide shade, and create insulation. They absorb the sun's heat during the day and release it at night; they reduce the daytime temperature and increase the evening temperature. Each plant has its own texture, which determines the density of its shadow. With dense or open foliage, each plant form, whether deciduous or evergreen, has its benefit as a modifier (ibid).

6.3.4 Natural Ventilation and Increase in the Humidity

In arid climates, air movements in the outside, during the midday hours, can increase discomfort as the air is very hot. Under these conditions it is necessary to reduce ventilation and exclude external air movement unless the incoming air is cooled before entering (Nielsen, 2002: 122). Hot air can be cooled by passing over or through vegetation and water before entering the building. Moreover, plants like water play a key role in increasing humidity, especially in hot and arid regions. Plants release large amounts of water into the air through evaporation and transpiration (Rouhani, 1986: 161).

7. Results and Discussions

After describing the Persian garden archetype and discussing the sustainable strategies in landscape design, the strategies of irrigation and planting and architecture systems of Pasargadae Garden are defined and analyzed.

7.1 Recognizing the Design Pattern and Elements of the Archetype of the Persian Garden (Pasargadae)

By studying the constituent elements and design principles of Pasargadae Garden, information is obtained that is effective in recognizing the later

Persian gardens. The main elements of Pasargadae Garden are as follow:

7.1.1. Water Elements and Irrigation Systems of Pasargadae Garden

In Pasargadae Garden, irrigation was done by streams with rocky bed. Water basins filled by the Polvar River irrigated the plain (Mehrabani Golzar, 2016: 70). The water streams through permanent channels flowed from the northeastern slope of Tal Takht to the water passages and then to the southwest and to other parts of the garden in accordance with natural slope of land. In this garden, the limestone water canals were in the form of well-cut and connected blocks, and in each corner with intervals of 13-14 meters in this path, square ponds were located. Each square pond, with an area of more than 90 sq. cm and a depth of more than 50 cm, was used to store water. If necessary, the water flowed from the ponds to earthen canals through small valves or siphons (Stronach, 1994: 59). This irrigation system was due to the low rainfall in the region, which had led to a special type of morphology regarding the shape of farms that was mainly geometric (Masoudi, 2009: 38).

7.1.2 Planting and Vegetation System of Pasargadae Garden

The planting system of the garden was in accordance with the irrigation system of the garden, and it became a model in the design of future gardens. This garden included a variety of fruitful and shady native plants such as cypress, cherry and pomegranate, and the ground was covered with herbs and fragrant flowers such as clover, yellow rose, jasmine, iris, and tulip (Khansari et al., 2004: 38).

7.1.3 Architectural System in Pasargadae Garden

In the studies and excavations carried out by Stronach, the hypothesis that Pasargadae Garden is enclosed is probable. There is a distance of one kilometer to the northeast between the tomb of Cyrus and the palace grounds, which was covered by a garden in the Achaemenid period, probably separated by short walls of stone and clay (Stronach, 1978). The garden included two palaces and two main pavilions, which were extroverted buildings and opened to the garden from all sides with wide porches (Figure 4). The porches of these palaces and pavilions were semi-open and provided shaded spaces that were supported by tall columns overlooking the garden view. The porches were located at the direction of the internal and external gardens. Stronach believes that palaces and pavilions with wide porches were a long-standing tradition of Iranians using the garden (i bid).

According to mentioned studies, it can be concluded that Pasargadae, as the ancient Persian garden, had the following characteristics:

-Having a geometric order in accordance with irrigation and planting systems.

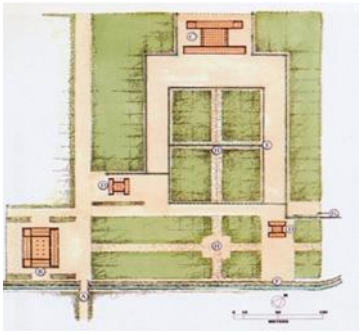
-Using the geometric order with a focus on axes in garden design (Figure 4).

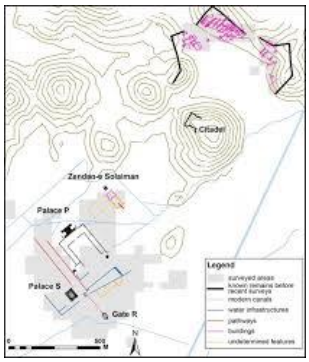
-Planting the fruitful and native plants.

-Using the streams and water channels for irrigation, water storage and decoration, which also increase the humidity and passive cooling inside the garden.

-Creating extroverted palaces and pavilions with porches as semi-open spaces that made it possible to view the garden (Figure 4).

-Being considered as an enclosed garden.





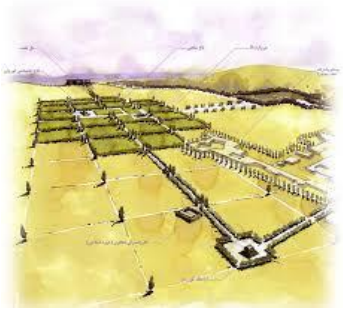


Figure 4. Left: Pasargadae Garden Depicted by Stronach (Khansari et al, 2004: 40); Centre: Aerial Photo of Pasargadae (Boucharlat, 2017); Right: Garden City of Pasargadae Depicted by Mehrabani Golzar (Mehrabani Golzar, 2016:72)

7.2 The Assessment of Sustainable Landscaping in Pasargadae Garden

By analyzing sustainable landscaping features and explaining the elements of the design of Pasargadae Garden, the criteria based on environmental sustainability as the important parameters in landscape designing were investigated. Accordingly, as climate plays a key role in the creation of sustainable landscape, Table 2 shows the climatic design strategies of the elements of Pasargadae Garden, including solar preservation, decreased heat, natural ventilation, increased humidity, dusty winds control in natural systems (irrigation and planting), and built elements (pavilion).

Table 3 indicates the compliance of natural and built systems of the garden with sustainable design objectives. Based on the mentioned explanations about landscape sustainability and the features of Pasargadae royal garden, landscape sustainability principles are explained in Table 3. Also, the correspondence of these parameters with the design features of Pasargadae royal garden is discussed, and the percentage of their compliance with the mentioned standards is shown, using the black and white squares and cross. Black squares indicate full compliance; white squares indicate non-compliance with landscape sustainability parameters, while the cross shows indeterminate features that require separate research (Table3).

As the analyzed data in Table 3 shows, in Pasargadae Garden, the compliance percentage of the systems of irrigation, planting, materials to sustainable parameters are 66.6%, 77.5%, and 100% respectively, while this value for the garden design is 81.3%.

Table2. Climatic Design Strategies in Pasargadae Garden

Climatic Objectives	Natural Elements		Built Elements
	Planting	**Water and Irrigation**	**Palaces and Pavilions**
Solar Preservation and Decreasing the Heat	Planting massive vegetation to absorb solar radiation and decrease temperature	Cooling the garden through directing airflow over the various water resources (pool, pond, canal)	Controlling shading and sunlight through creating the porches
			Using local and renewable materials
Natural Ventilation and Increasing the Humidity	Increasing humidity by increasing vegetation coverage	Increasing the humidity through directing airflow over the various water resources (pool, pond, canal)	Preserving the garden humidity by surrounding walls
			Creating cross ventilation inside the pavilions by placing the porches on their opposite sides
	Planting shrubs to preserve humidity and avoid wasting water	Using passive cooling techniques such as positioning the pools in front of the buildings	Creating passive cooling by positioning water elements near the buildings
Dusty Winds Control	Planting evergreen trees to control dusty winds	Controlling dusty winds by positioning different water elements near the buildings (e.g., pools, ponds, etc.)	Using the foyer such as porches to prevent dusty winds from entering

Table 3. Assessing the Compliance of Natural and Built Elements in Pasargadae Garden with Sustainable Design Objectives

	Sustainable Landscape Parameters		Comments
Irrigatio	Reducing water evaporation	■	Using straight and perpendicular water canals and placing the water streams under the trees' shades can reduce water evaporation

	Optimizing the use of water and avoiding waste of water	■	Avoiding waste of water by irrigating through the canals and storing the water in the ponds and pools
	Appropriate drainage and controlling the floods	×	There is no evidence
	Aligning the irrigation system with the planting system	×	The drawn plans don't show the irrigation and planting systems clearly.
	Natural ventilation and increasing humidity	■	According to the comments in Table 2
	Controlling the unpleasant dusty winds	■	According to the comments in Table 2
	Percentage of Compliance: 66.6%		
Planting	Planting native plants with low water use	■	-
	Planting fruitful trees	■	Planting fruitful trees such as sour cherry and pomegranate
	Not using the pesticides and chemical fertilizers	□	-
	Planting deciduous and evergreen trees for shading	■	Planting cypress trees on the main axes
	Planting evergreen trees to protect the garden from dusty and unpleasant winds	■	Planting evergreen trees (cypress) in different sides of the garden
	Planting the plants with low water use to control the flood	■	Planting shrubs and short plants such as grass
	Protecting the garden against solar radiation	■	According to the comments in Table 2
	Creating natural ventilation and increasing humidity inside the garden	■	According to the comments in Table 2
	Percentage of Compliance: 77.5%		
Materials	Using local, renewable and non-poisoned materials	■	Using materials such as stone, adobe
	Using low-energy durable materials	■	-
	Absorbing the heat of solar radiation	■	According to the comments in Table 2
	Creating natural ventilation and increasing humidity inside the building	■	According to the comments in Table 2
	Controlling dusty and unpleasant winds	■	According to the comments in Table 2
	Percentage of Compliance: 100%		
	Percentage of compliance of Pasargadae Garden with the parameters of landscape sustainability: 81.3%		

8. Conclusion

The garden of Pasargadae as an archetype of the Persian garden is a turning point in the history of gardening in Iran; in other words, what Cyrus built in Pasargadae is the prototype of many historical gardens in Iran that have evolved over millennia. Based on the findings of the principles of sustainability in landscape design and the climatic goals and strategies in landscape architecture described in this paper, the principles of landscape sustainability in vegetation, water elements and pavilions in Pasargadae Garden were explained, and the percentage of compliance of each element with the criteria of landscape sustainability was assessed. The results of the studies on Pasargadae Garden can respond to the question presented in this article: How the environmental parameters have affected the design principles of the archetype of the Persian garden? It seems that the parameters of landscape sustainability in the design of Pasargadae Garden have been transferred to the later Persian gardens, which requires more studies in the future. Also, because recognizing the parameters of landscape sustainability is very important in designing green spaces in today's cities, reinterpreting these principles in Persian gardens design, including the archetype of Persian gardens, can be a strategy in designing sustainable patterns in urban landscape and generalizing the design of the green spaces of today's cities.

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