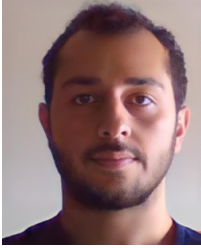


Usage of Water in Islamic Gardens and Sustainable Examples in the UNESCO World Heritage List



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Abstract: This study aims to explore the relationship between cultural landscapes, Islamic gardens, water-sensitive cultural heritages, and sustainability seeking to capture a multilayered understanding of sustainable land use-scape techniques that these cultures could develop over time through their creative and elaborative interaction with water. This study handles an eight-phased evaluation process involving collaboration between text mining technology, UNESCO documents, and literature reviews. Benefitting from the official documents and query engine of the UNESCO World List, 16 cultural landscapes from 5 countries are selected and then examined by Voyant Tools- text mining technology based on the data UNESCO declared about them. Water-based landscape components, techniques, approaches, and terms that are extracted for each of the sites are supported by scholarly readings to lead to a qualified comparison between the heritage sites and countries. Comparative studies followed by the identification of the unified landscape system formed by the collective data of the heritage sites. The terms related to water-based techniques and rural landscapes are more commonly used than those pertaining to architectural features. This trend can be seen in terms such as oasis, palm, agriculture, qanat, irrigation, river, and hydraulic. Although water has always had a spiritual dimension, considering the environmental challenges related to water, it is seen that technical issues related to accessing water and using it sustainably clearly come to the fore according to the evaluations of the historical spatial patterns and implementations. Focusing on the necessity to develop adaptive spatial studies, this study is an attempt to further water-sensitive landscape architecture studies for the benefit of sustainability.

Keywords: Water-sensitive Studies, Islamic Garden, Cultural Landscape, Text-mining, UNESCO, Sustainability

Suyun İslam Bahçelerinde Kullanımı ve Unesco Dünya Miras Listesindeki Sürdürülebilir Örnekler

Özet: Bu çalışma, kültürel peyzajlar, İslam bahçeleri, suya duyarlı kültürel miraslar ve sürdürülebilirlik arasındaki ilişkiyi keşfetmeyi amaçlamaktadır. Bu kapsamda, kültürlerin su ile yaratıcı ve ayrıntılı etkileşimleri yoluyla zaman içinde geliştirebilmiş oldukları sürdürülebilir arazi kullanımı - peyzaj tekniklerine yönelik çok katmanlı bir anlayış yakalayabilmek mümkün olabilecektir. Bu çalışma, metin madenciliği teknolojisi, UNESCO belgeleri ve literatür taramaları arasındaki işbirliğini içeren sekiz aşamalı bir değerlendirme sürecini ele almaktadır. UNESCO Dünya Listesindeki resmi belgelerden ve sorgulama motorundan yararlanılarak 5 ülkeden 16 kültürel peyzaj seçilmiş, UNESCO'nun onlar hakkında açıkladığı verilerden hareketle Voyant Tools-metin madenciliği teknolojisi ile incelenmişlerdir. Miras alanlarının her biri için çıkarılan su temelli peyzaj bileşenleri, teknikler, yaklaşımlar ve terimler, seçili alanlar ve ülkeler arasında nitelikli bir karşılaştırma yapılabilmesi için bilimsel okumalarla desteklenmiştir. Karşılaştırmalı çalışmaları takiben, miras alanlarından gelen verilerin toplanması ile oluşturulan birleşik peyzaj sisteminin tanımlanması gerçekleştirilmiştir. Bus sistemde, su temelli teknikler ve kırsal peyzajlarla ilgili terimler, mimari özelliklerle ilgili terimlerden daha yaygın olarak kullanılmaktadır. Bu eğilim; vaha, palmiye, tarım, kanat, sulama, nehir ve hidrolik gibi terimlerde görülebilmektedir. Suyun her zaman manevi bir boyutu olmasına rağmen, su ile ilgili çevresel zorluklar dikkate alındığında, tarihsel mekansal örüntüler ve uygulamalara ilişkin değerlendirmelerde suya erişim ve sürdürülebilir kullanım ile ilgili teknik konuların net bir şekilde ön plana çıktığı görülmüştür. Adaptif mekansal çalışmaların

geliştirilmesi gerekliliğine odaklanan bu çalışma, sürdürülebilirliğin yararına olacak şekilde suya duyarlı peyzaj mimarlığı çalışmalarını ilerletmeye yönelik bir girişimdir.

Anahtar kelimeler: *Suya Duyarlı Çalışmalar, İslam Bahçeleri, Kültürel Peyzaj, Metin Madenciliği, UNESCO, Sürdürülebilirlik*

1.INTRODUCTION

The 21st century will be a time of tumultuous environmental changes, which are likely to prove challenging and require innovative solutions. Water and climate appear to be the globally leading ones among these challenges. At this stage, the most crucial parameter determining our future is how much priority we give to water-sensitive works and whether spatial planning and design disciplines are in an effort to develop strategies for solving problems.

It is seen that international official platforms and treaties emphasize adaptive studies sensitive to land, heritage, water and climate. Beyond many credible others, three international treaties constitute a basis for the preparation of this research, which are the World Heritage Convention, the European Landscape Convention, and the 2030 Agenda for Sustainable Development.

Encouraging the identification, protection, and preservation of both the worldwide cultural and natural heritages, The United Nations Educational, Scientific and Cultural Organization (UNESCO) takes its roots from an international treaty titled the Convention concerning the Protection of the World Cultural and Natural Heritage declared in 1974. A follower of it, in 1992, the World Heritage Convention became the first international legal instrument for recognizing and protecting cultural landscapes [1].

Today, many cultural landscapes are at risk due to a variety of factors. In addition to the effects of disruptive human activities, increasing hybrid disaster risks and the impacts of climate change have become major threats to these areas around the world. This subject is sure capable of generating a vast amount of scholarly studies, but this study is focused on developing a multilayered understanding of sustainable land-use techniques that these cultural heritages could build throughout the centuries through their creative and elaborative interplay and equilibrium with the water.

Cultural landscapes are a visual representation of the range of human-nature interactions over time. They illustrate how different physical constraints and opportunities have affected our relationship with nature [2].

Within this study, it is decided to study Islamic gardens in regard to cultural landscapes as they have a high spiritual interplay with water and could have produced characteristic spatial fabrications under harsh environmental dynamics. This study pays a specific concern to not the figural patterns or replications but their experiences with nature and water in the context of sustainability.

Islam regards water as the source from which all life originates [3]. Water is an essential part of the Islamic faith and is used in daily religious ceremonies. It can be difficult to find water due to the desert climate in Saudi Arabia, where there are few plant species that can extract groundwater. Therefore, no area surrounding Hejaz has a history of garden design because there was never any vegetation present for this purpose. Thus, date trees and water were considered an oasis garden [4].

The surroundings of natural freshwater resources have always been ideal living and production areas for people; thus, such places have been used for centuries by people of different religions. Since Islamic cultural landscapes generally spread in arid or semi-arid regions, areas close to the natural water resources have a multi-layered and multi-cultural structure. These areas may exhibit patterns of cross-cultural transitions, adaptiveness, or accumulations. The reason to define these areas as Islamic gardens is that probably the best-read layer within this multi-layered landscape is the Islamic one.

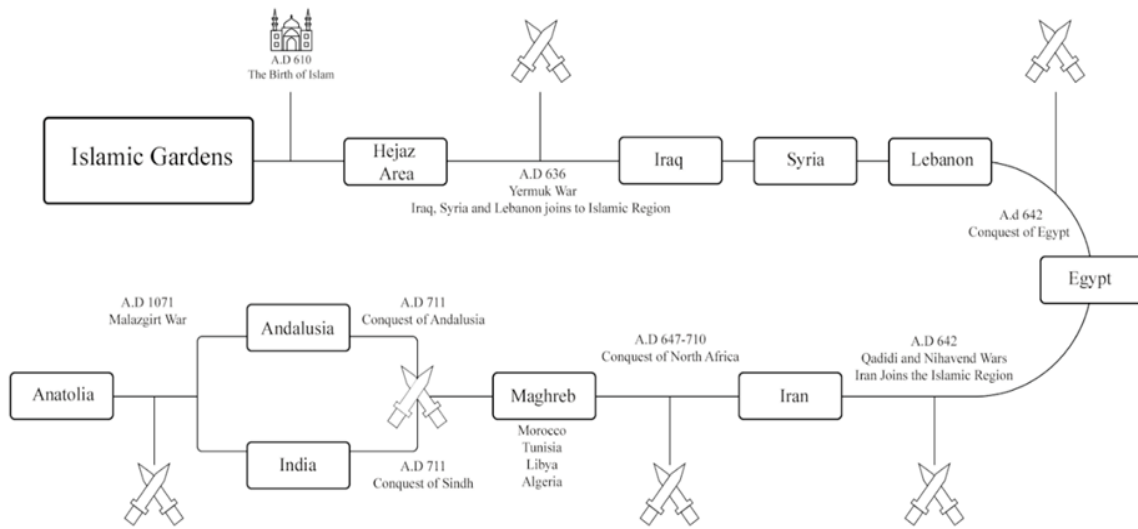


Figure 1. The Spread of the Religion of Islam

Figure 1 illustrates the Islamic civilization spread over a large geographical area where it has witnessed and interacted with different cultures. Gardens reflect both the differences and connectivity with the cultures and geographies. According to [5], “Islamic gardens can be divided into Maghrib, Turkish, Middle Eastern, Iranian, Central Asian and Indian groups”.

Where natural water sources do not exist, people have developed innovative techniques with sedulous efforts to improve their water provisions. Moreover, they have succeeded in creating living spaces for themselves out of almost none. One of the motivations for developing this research is to discover and understand these techniques, which may stand at the interface of landscape planning and landscape engineering. To start a scrutinisation process, this study focuses on the projects that are known and titled with their cultural identities but survived for centuries due to their respectful design towards natural data.

Landscape architecture is a field that is well-suited for conducting multiscale studies, which makes the profession competent to participate in multi-disciplinary research projects [6].

In such a period when there is a need to find solution strategies for climate and water-based problems, landscape architecture, as a discipline that has the training to carry out multi-disciplinary and multi-scale studies, should fulfill its responsibilities in the name of sustainability.

This study aims to gain a multilayered understanding of the interplay between the discipline of landscape architecture and historical Islamic gardens- cultural landscapes toward their water-sensitive settings.

2. Materials and Method

The method of this study has taken shape from the interplay between the keywords of the cultural landscape, Islamic garden, water-dominant cultural heritage, and sustainability seeking. Due to its credible presence toward heritage-based issues, this study has taken UNESCO’s knowledge for the development of the method.



Figure 2. Regions with UNESCO Heritage sites where the first Islamic civilizations are shown

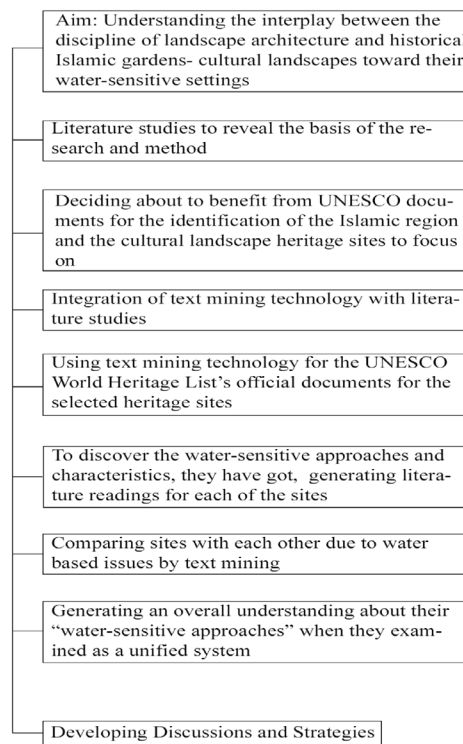


Figure 3. Regarding the aims declared in the preceding section, this study benefits from a 8-phased process available.

Via the map in Figure 2, it is available to see the fabrications of Islamic civilizations protected by UNESCO. Islamic impact covers many countries with a total number of 235 heritage sites. Regarding the 25 countries holding these heritages, cultural, climatic, and topographical variations take place; thus, altogether, they represent a dashing lushness [7].

Although Islam has a worldwide extension, this study defined and focused on a specific boundary, a region representing the chronological expansion of the Islamic garden culture.

This internationally leading association forwards a query engine for discovering heritage sites with their attributes. Benefitting from this occasion, this study conducted a query for the keywords of Islam, Water, and Garden. Overlaying the received results of the queries and the boundary selected within this research, protected areas within the boundaries of 5 countries as 16 heritage sites were gathered. This study did not

solely rely on the results of the queries but also conducted a text control within the official pages of the related heritage sites for proofing their nominal contact with the water-dominant heritage character.

These 16 different heritages [7] are selected by UNESCO due to their attributes corresponding to 6 different criteria among the overall 10 criteria. According to [8], these criteria are as follows:

- I- to represent a masterpiece of human creative genius;
- II- to exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design;
- III- to bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared;
- IV- to be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history;
- V- to be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change;
- VI- to be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria).

Following the detection of the heritages to study on, literature studies revealing their relation with water were conducted to generate a multilayered understanding for each of the areas. Another question of this study is also the official visibility of the water-dominance within their character via their pages within the UNESCO website. Therefore, Voyant Tools as an open source text mining software was operated. Using a computational algorithm, the Voyant tools platform is capable of extracting linguistic and statistical information from texts of all sizes, types, and languages. All extractions are available in visual formats [9].

This text-mining tool was beneficial for comparing the heritage sites with each other due to water-based characteristics and how they represent a unified stance about this specific subject. Although this study focuses on a particular topic that is getting increasingly important within this decade, these heritage sites are valuable due to several aspects and criteria. Thus, this study also tried to understand the proportion of water-sensitive characteristics of these cultural landscapes within their characteristic richnesses and scholarly studies. Following these phases, standing as the last phase, revealing discussions and strategies did finalize the research.

3. RESULTS AND DISCUSSION

This section examines the heritage sites within the borders of 5 countries in the context of their interaction with water, while its final part conducts both a comparison between the cases and the final discussion holding the Voyant tools extractions.

Saudi Arabia

The variety of plants grown in Saudi Arabia, including the Hejaz Region, where Islam was born, is limited. Saudi Arabia is experiencing an acute water shortage due to its limited and non-renewable groundwater resources, as well as the country's arid climate [10]. However, when searching with the keywords "Islam, garden and water", one region appears: "Al Ahsa" region.



Figure 4. Al Ahsa region, Date gardens and water canals [11]

Figure 4, illustrates a part of the Al-Ahsa region. Most recently, in 2018, as the biggest oasis in the world with 2.5 million date palms, the Al-Ahsa oasis was inscribed as a cultural landscape heritage. Traditional farming systems, such as wells, canals and springs, have been in use at this oasis since the Neolithic era. These systems are still used today to manage crops for traditional farming practices. Al Ahsa is home to a rich cultural heritage, including historical and archaeological structures dating back to the early Islamic era. In addition, it features fortresses and mosques from that period [12].

There is a cultural landscape idea with an agricultural organization based on the distribution of spring water through a network of open-air channels for the continuity of the oasis tradition. The oasis is a notable example of traditional human settlement located in an arid environment, illustrating the close relationship between landscape, natural resources, and humanity’s struggle to establish dominion over the land. Thus, it is included in the UNESCO Heritage List due to Criteria III, IV, and V. [13].

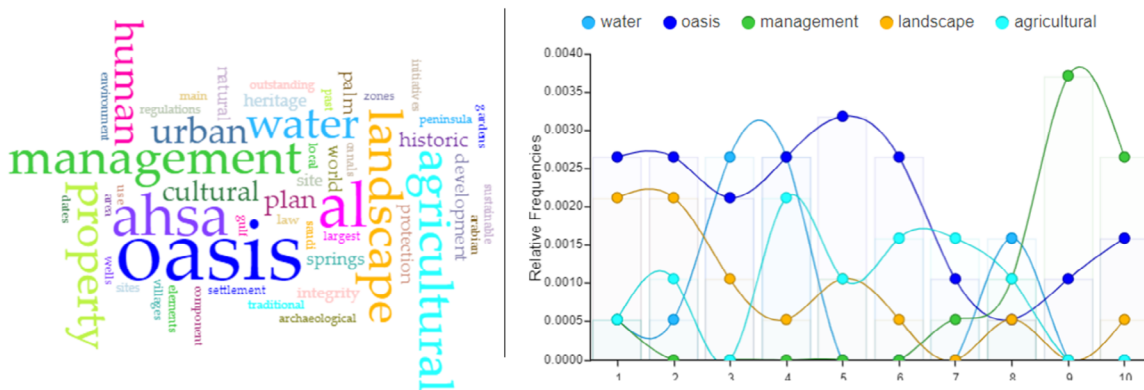


Figure 5. and Table 1. Comparing Usage of the Words With Wordcloud and Graph for Saudi Arabia Which was in the UNESCO Heritage List

In Table 1, we see the most commonly used words and the comparisons of the texts written for the Al-Ahsa region on the UNESCO website via the “Voyant tool”. Regarding the relative frequency levels of the related terms, “water”, and “oasis” together with the “landscape and agricultural” terms, appear significant even in such a desert and harsh geography. Apart from these, the words “property and management” are apparent due to the official role of UNESCO. When we examine the figure above for the other keywords, palm, springs, dates, wells, gardens, and sustainable are visible.

Iran

Garden design dates back to pre-Islamic Iran. We see that the roads and canals are perpendicular to each other and surrounded by high walls in the gardens we encountered during the Persian and Sassanid periods [14]. The most substantial elements of these gardens are flowers and water. To use the water in the garden, pools or channels are made. The pools are placed on the main axis of the gardens and courtyards [15]. Char-bagh is the most important model of the Persian garden and is an “archetype” [16]. Always divided into four sectors, where water plays a vital role for both irrigation and ornamentation, the Persian garden symbolizes Paradise and the four Zoroastrian elements of sky, earth, water, and plants [17; 18]. We see four of Iran’s works related to garden and water use in the UNESCO Heritage List.



Figure 6. Isfahan, Naqş-ı Cihan Square [19]

Naqş-ı Cihan Square, one of the largest examples of Chahar Bagh seen in Figure 6, has great dimensions of 520 m in length and 160 m in width [20]. It was built by the Great Shah Abbas at the beginning of the 17th century. Monumental buildings are connected by a series of two-story arches; the Royal Mosque, Sheikh Lütfullah Mosque, the Qaysariyyeh Portico and the 15th century Timur Palace [21]. With its diagonal features, sharp walkways and green spaces, the square has a dominant pool element at the intersection of the Chahar Bagh. It is included in the UNESCO Heritage List due to Criteria I, V, and VI.



Figure 7. Persian Qanat System [22]

Further than 5.000 years ago, Persians devised a sustainable groundwater system, named Qanat. This ancient water management system was used to provide a reliable amount of water to human settlements and for irrigation in arid and semi-arid climates. Currently, there are scholarly studies indicating that the Qanat system is an Asian masterpiece for climate change adaptation [23].

Iran's arid regions; thanks to the water filling the alluvial spaces at the beginning of the valleys, the law of gravity is calculated and transmitted through underground tunnels. In Figure 7, we see the Persian Water Qanat, which includes eleven qanats representing this system, rest areas for water tanks and water mills. These water qanats continue on an axis. There is also a pool with a fountain in front of the main entrance door [24].

Another invention in Iranian civilizations using water qanat, water channels and gravity-based waterway systems is the Shushtar Historical Hydraulic Water System. The Historical Hydraulic System dates back to Darius the Great in the 5th century BC. It is used to convey water to the city of Shushtar through a series of tunnels that supply water to the mills. It creates a magnificent cliff from which the water flows downstream. It then enters the plain in the south of the city, where it provides orchards and farming on an area of 40.000 hectares [25, 26]. It is included in the UNESCO Heritage List due to Criteria III and IV.

Unesco heritage site Takht-e Soleyman captures its name from a robust travertine spring lake with a great volume of water. There is a travertine platform on the site where it is available to see the remains of a castle, a gorgeous palace related to the Sassanid era, and a Zoroastrian fire temple constructed during the Sassanid period named Azargoshnasb. With a lake at the center of it, this volcanic geosite, with its tangible cultural and intangible facts, still attracts the respect of both the Christians and Muslims [28].



Figure 8. Takht-e Soleyman, Iran [27]

With its worship history, this heritage site is specific, with its power coming from a multicultural landscape integrated with a unique natural water body and geographical environment. Thus, it is one of the heritage sites well-known as one of the representative sites of geomorphology [29]. With a date of inscription 2003, this heritage site is accepted as significant based on Criteria I, II, III, IV, and VI. [30].



Figure 9. Persian Gardens, Iran [31]

It exemplifies the diversity of Persian garden designs that have adapted and evolved to different climatic conditions while preserving principles that have their roots in the times of Cyrus the Great in the 6th century BC. It is an important example that water has an important role for both irrigation and ornamentation [17, 18]. The Persian Garden, which we see in Figure 9, is an outstanding example of a kind of garden design that is achieved by using natural and human elements and integrating the important achievements of Persian culture with a physical and symbolic-artistic expression in harmony with nature. This garden has become the prototype for the geometrically designed garden layout spread around the world [18]. It is included in the UNESCO Heritage List due to Criteria I, II, III, IV and VI.

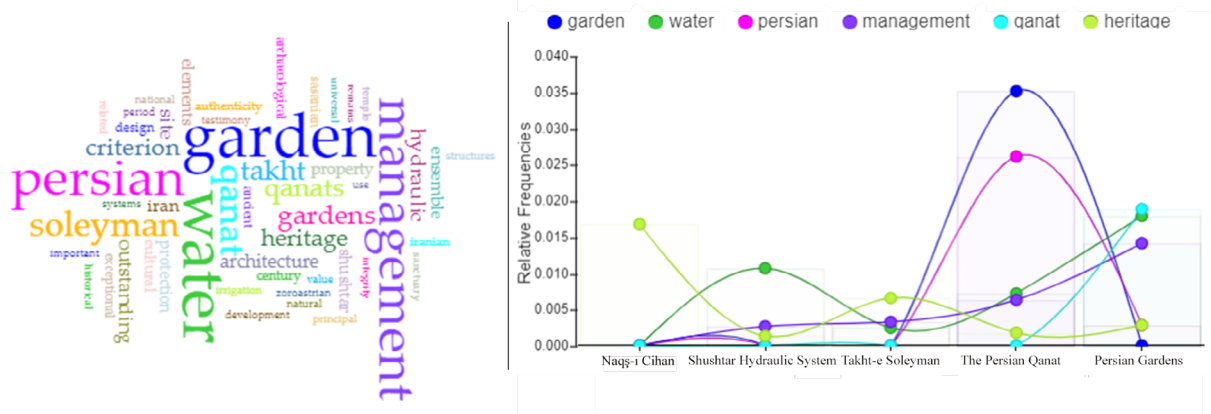


Figure 10. and Table 2. Comparing Usage of the Words With Wordcloud and Graph for Iran Which was in the UNESCO Heritage List

Persian Garden has been associated with the idea of Earthly Heaven, constituting a sharp contrast to its desert setting. We see the word cloud “hydraulic, qanat, water and gardens” in Table 2, which was made for Iran and also made with the “Voyant tool”. In the Iranian region, some parts of which are deserts, the Persians gave great importance to water and used the “hydraulic system”, one of the first examples, for water transmission. The emergence of the word garden is also important. In fact, “Char Bagh”, which is one of the main plan schemes of Islamic gardens, is a planning scheme learned from the Persians but did not take place at the table beyond expectations. The table refers to the six keywords identify them as garden, water, Persian, management, qanat, and heritage. In between the system of the Persian Garden Heritage Sites, the qanat is essential together with the term water. Shushtar Hydraulic System appears to be the second heritage site handling the term of water. Within this word cloud, attention should be given to plural forms of two keywords: qanat and qanats, garden and gardens. The term irrigation also takes place in the system, although not firmly.

Turkey

Turkish gardens are designed in such a way that nature and adamite are used together skillfully without establishing a strict architect and landscape relationship. They considered the garden as a whole, a core area to be designed regarding both the qualitative and quantitative parameters [15, 32]. As the Ottoman Empire’s capital for centuries, Istanbul also has an important place in other countries. The philosophy of landscape understanding throughout the centuries in the capital has the potential to do a lot of other scholarly work. Its multi-layered grift and rich system have been not powered solely by the water issue. Therefore, this study focuses on Diyarbakır Fortress and Hevsel Gardens Cultural Landscape, which were announced by the results of the inquiry of the UNESCO interactive map described in the materials and methods section of this study. Witnesseth, the strength of this heritage site comes from the physical and conceptual character of the interaction between water and landscape morphology.

Even though the Ottoman gardens have the same purpose as the gardens created in other Islamic countries, to make the rivers described in the Qur'an resemble the image of paradise filled with blooming trees, Ottoman gardens are neither like Isfahan nor large areas like Agra. The vessels are not as ornate as in Spain [32].



Figure 11. Diyarbakir Walls ve Hevsel Gardens, Turkey [33]

Diyarbakir City Walls are among the oldest and strongest walls in the world. They stand behind China's Great Wall, Istanbul Walls, and Antakya Walls when it comes to length, but they possess a unique place within Turkish history with their spectacular reliefs on the walls and bastions as well as inscriptions and gates. As such, Diyarbakir City Walls, beyond being a plain wall surrounding the city, are a cultural heritage, an open-air museum that bears the most beautiful traces of many civilizations that have lived on these lands since its foundation [34]

Hevsel Gardens, situated in a region where garden culture is highly esteemed, have been considered as civic gardens continuously since ancient times. With their existence as a garden for 8 thousand years in a region bearing the traces of more than 30 civilizations, this set of gardens has a unique cultural and historical place besides the agricultural value. The vital cooperation generated by the Diyarbakir Castle and Hevsel Gardens and the pattern of cultural landscape constituted by the Hevsel Gardens are the most influential factors in the uninterrupted life of the city for thousands of years, thus the inscription to the UNESCO heritage list [35].

Diyarbakir and its surroundings have been an important center since the Hellenistic period. The property includes the impressive Diyarbakir City Walls with a length of 5800 meters with many towers, gates, buttresses and 63 inscriptions from different historical periods (Alper, Karadoğan, & Soyukaya, 2015: 379). The site also includes the Hevsel Gardens, the Anzele spring, and the Ten-Eyed Bridge, a green link between the city and the Tigris that provides food and water to the city [36].

Hevsel Gardens, with an area of 300-350 hectares, is located within the boundaries of Diyarbakir city in southeastern Turkey. It is irrigated by using hydraulic systems from the Tigris River. Poplar tree production takes up a 100-150 hectares area of land close to the riverbank, while the rest of the farmland nearby is dedicated to growing vegetables and orchards[37]. It is included in the UNESCO Heritage List due to Criteria IV.

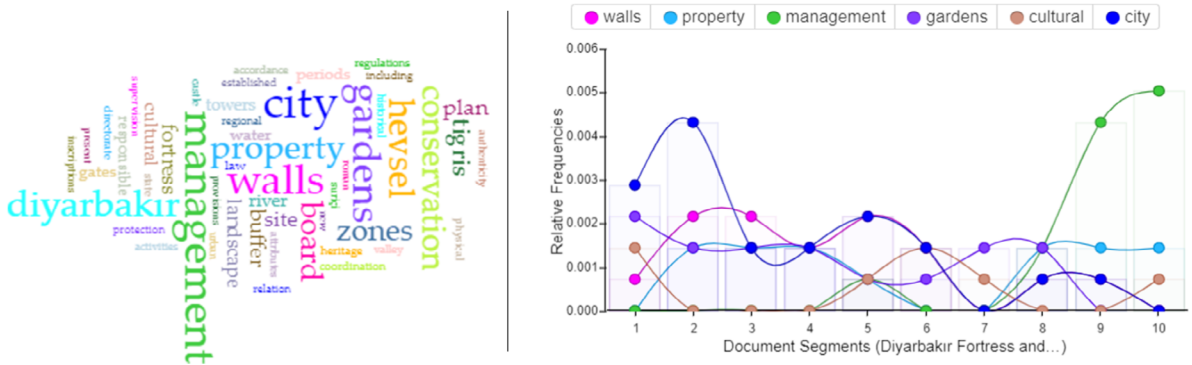


Figure 12. and Table 3. Comparing Usage of the Words With Wordcloud and Graph for Turkey Which was in the UNESCO Heritage List

This heritage site involves two major components, which are a fortress and a garden. The fortress is not shaped by a modest wall system but rather a complicated and multilayered one. Thus, while the keyword of “walls” takes the first place, “water” can enter the word cloud but merge into the background. Instead of the water, the terms of river, Tigris, and valley take place in the word cloud referring to the flowing water impact on the surrounding gardens of the fortress.

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South Spain and Northern Africa

The areas where the Maghreb gardens have spreaded most are Marok, Morocco and Andalusia. These gardens are small in size and arranged on the basis of “Chahar Bagh” protected by walls, terraces and gazebos [5].

Throughout history, Muslims have built many masterpieces in Andalusia, inspired by the East. The understanding of the garden, inspired by the East, has survived to the present day. In the 10th century, they arranged magnificent gardens and courtyards around Cordoba and the capital city of Seville. Despite the expulsion of Muslims from Spain in the 15th century, these gardens have survived to the present day without any deterioration or destruction [15].

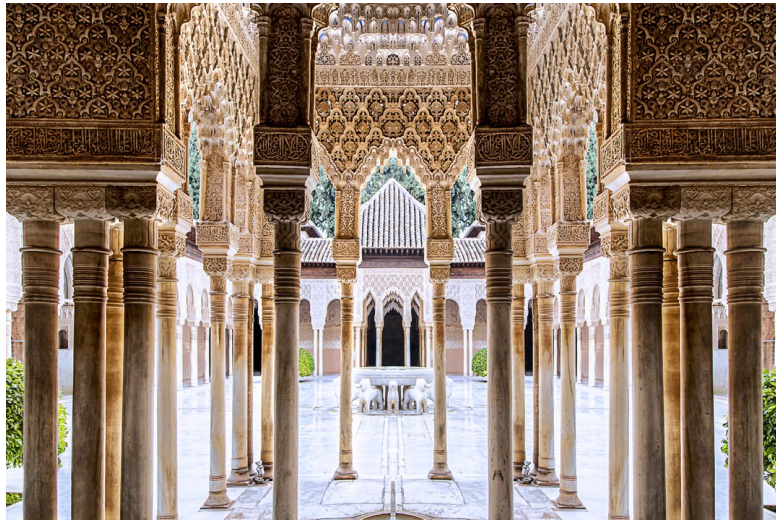


Figure 13. Alhambra Palace [38]

The first heritage site related to South Spain is titled “Alhambra, Generalife and Albayzín, Granada” by the UNESCO World Heritage List.

Settled on two adjacent hills, The Alhambra and Albaycín form the medieval parts of Granada. Within this setting, Albaycín represents the historical residential area of Granada. The Generalife gardens located to the east of the Alhambra fortress and residence are a magnificent sight, dating back to the time when this part of Spain was ruled by emirs from these rural areas in the 13th and 14th centuries [39].

The Alhambra, a palace and Generalife gardens located in Granada, Spain, incorporates the Moorish gardening traditional style that features beautiful water displays and terraced garden plots used for both production and leisure activities. This particular area, the Generalife, is one of the oldest surviving Moorish gardens. The exhibit showcases both the Renaissance period and more contemporary gardening techniques as a result of growing concern for preserving botanical design traditions. The Alhambra and Generalife are both home to a vast collection of Islamic artistry, including all known techniques employed by the Hispano-Muslim world [39, 40].

The Alhambra palace is often praised for its stunning views of the fertile Granada plain and snowy Sierra Nevadas, which makes it a good example of Nasrid artistry with its architecture and decorative aspects [39, 41]. Inside this castle, there is a vast amount of courtyards and, on this occasion, many gardens. These gardens host pools of varying types. It is one of the courtyards we see in Figure 13. The most important of the courtyards is the Lion Courtyard, which occupies an inner location on the property. It reaches a central fountain involving a pool with twelve lions, well-coming water from all four sides of the courtyard flowing through four channels [4]. This system is reminiscent of the four rivers mentioned in the Qur’an - all of which flowed from Paradise. Although there are no Islamic motifs present, this scene depicting paradise is an important concept to understand when viewing this courtyard. Somewhere in the Alhambra it is written: “The central fountain is like the soul of a believer immersed in the remembrance of Allah” [42].

There are more courtyards in Alhambra, and those names are the Court of the Myrtles and the Court of Cuatro Dorado. The abundance of pools in this castle is due to the fact that there are no such mountains in Arabia; thus, the snow which melts there contributes to their creation. The construction of aqueducts and water storage tanks helped the inhabitants of the castle access a reliable source of fresh water during periods when snowmelt from Sierra Nevada Mountain [43]. This site is included in the UNESCO Heritage List due to Criteria I, III and IV.



Figure 14. Cordoba, Spain [44]

Cordoba's most significant period of development began following the Moorish conquest in the 8th century. During this time, 300 mosques were constructed as well as numerous palaces and public buildings that rivaled those in Constantinople, Damascus, and Baghdad [45].

In 1523, the largest mosque in Cordoba was converted into a Catholic church by completely demolishing its prayer areas. But, the citrus and date palm trees in its garden have been carefully preserved, as they are a part of the historical heritage of the area. In Figure 14, we see the trees, water channels and the triangular roof of the building. They lived by the accumulation of water pouring from this roof in cisterns and watering from there. It is highly probable that the vegetation of the former mosque was carved into the soil in connection with small surface channels, and the trees were in the form of a grid [46]. It is included in the UNESCO Heritage List due to Criteria I, II, III and IV.



Figure 15. Seville, Alcazar Palace, Spain [47]

The third heritage site from Spain is titled "Cathedral, Alcázar, and Archivo de Indias in Seville." The Alcazar Gardens were built in the 10th century as an Islamic palace, and feature a Chahar Bagh system. [48].

The garden's central water supply system originates from Sevilla's Real Alcazar, an aqueduct built in 1172. It will show us the discovery of a significant water distribution box at the end of the aqueduct [49].

The gardens underwent a series of renovations between the 11th and 14th centuries, preserving their original plan-design scheme. We see one of these gardens in Figure 15. They perfectly represent the “Golden Age” of Spanish culture, which is a perfect synthesis of Islamic influences, centuries of religious power, royal rule, and the trading prowess accrued through Spain’s colonial possessions in the New World [48]. It is included in the UNESCO Heritage List due to Criteria I, II, III and IV.



Figure 16. The Palmeral of Elche, Spain [50]

The Palmeral of Elche, in Figure 16, is a landscape consisting of groves of date palms that was formally laid out in the tenth century A.D. at the time the Muslim city Elche was erected. The complex irrigation systems were put into place at that time to ensure prosperity. The Palmeral is an oasis that exemplifies Arab agricultural practices on the European continent. Dating back to at least the Iberian era, settlers in Elche have been cultivating date palms there. This knowledge has likely been passed down for centuries. When we regard the irrigation system, it preserves the organization of the orthogonal plot, defined by the intersection of rows of palm trees, by adapting to the layout of the canals [51].

The plants used for agricultural purposes were typically grown inside a square orchard consisting of palm trees as the marginal ones. The plants of interest for agriculture were cultivated inside a square orchard where the palm tree constitutes the marginal plant. However, from the palm trees, many materials, products, and byproducts were obtained, and usage of them was a sustainable practice over nine decades [52].

This is also one of the unique samples of Arab farming practices in Europe. Muslim engineers mastered the use of hydraulic techniques to build water distribution dams (rafas). These structures consisted of fixed or movable flow dividers (tallamares), allowing diverted water to be transported through a vast network of irrigation canals. Elche’s successful management of its scarce water resources is a textbook example of the sustainable use of the environment and the evolutionary adaptation of cultural landscapes in response to historical changes [51, 53]. It is included in the UNESCO Heritage List due to Criteria II and V.



Figure 17. Medina of Marrakech, Morocco [54]

The Medina of Marrakesh is particularly well-conserved due to its original, protected conception; its construction materials and decoration that remain in constant use; as well as the natural environment featuring Gardens of Aguedal (Agdal), Ménara, and Palmeraie. All these initial components contribute to making the Medina an Outstanding Universal Value. Marrakesh is home to an impressive number of masterpieces of architecture and artworks, each of which would merit recognition as an Outstanding Universal Value on its own. Figure 14 illustrates the Kutubiyya Mosque, as one of the most important symbols of the urban landscape and the symbol of the city [55].

Agdal Gardens were built around 1130-1269. Water is sourced from the Atlas Mountain range, as one of Marrakech’s primary water sources. The Agdal today is a large and extensive enclosure comprising 340 hectares of land. It is surrounded by a wall that stretches for 9 kilometers. The land on which the estate stands has been cultivated primarily with olive, citrus, and pomegranate trees; these are species that have been present at Agdal from its inception. The enclosed area within this boundary contains another space that is bounded by a 1.5 kilometer perimeter wall and constituting a palatial center, known as Dār al-Hanā’ (palace of happiness). Both of these enclosures contain a diligent setting for historical recreational facilities, reservoir, hydraulic structures, and industrial installations [46, 56]. The Medina of Marrakesh is included in the UNESCO Heritage List due to Criteria I, II, IV and V.

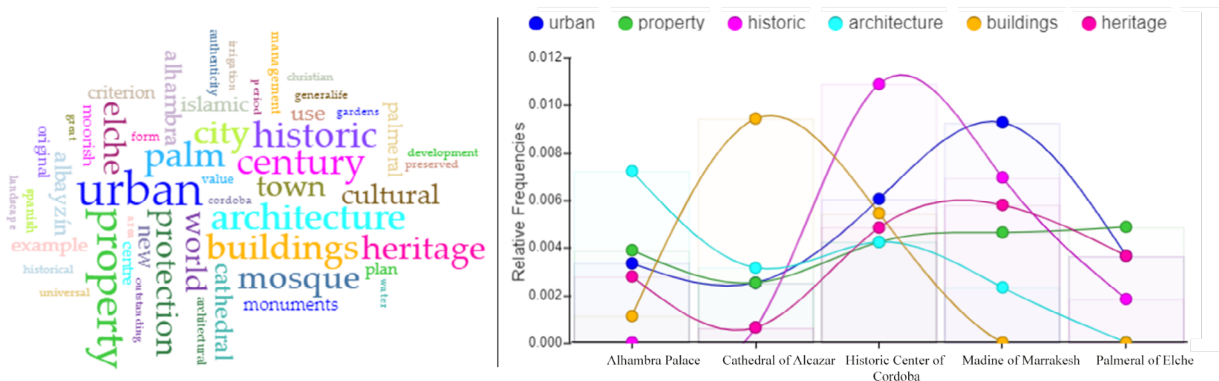


Figure 18. and Table 4., Comparing Usage of the Words With Wordcloud and Graph for South Spain and Northern Africa Which was in the UNESCO Heritage List

In the table here, we see the comparison graph of the heritage sites; both involve hard and soft scape components generating unique patterns illustrating the harmony between green and built-up spaces in Andalusia and North Africa. Not all but some of the historical terms captured through the examination of South Spain and Northern Africa heritage sites are aqueduct, water mill, oasis, traditional irrigation system, terraced garden, water distribution dam, reservoir, and hydraulic structures. Although these sites represent some unique samples for the sustainable use of the environment by considering water circumstances, due to the dominance of the city-based components and characteristics, the first six terms can not reveal the related details. The table above identifies them as urban, property, historic, architecture, buildings, and heritage. When we search for the existing inside the word cloud backwardly, they are palm, palmeral, water, and gardens.

India

During the 13th century, after the Mongolian invasion of Iran led to their domination of India, they also established Kabul as their capital. Later in that century, Babur Khan moved the country's capital from its traditional location to Agra. As a result, Iranian architecture and garden design experienced a significant change due to this shift in geography. [57]. Indian gardening art typically falls into two categories. The initial one is the terrace garden. This was a Central Asian-originated concept, wherein the garden was laid out on a slope, blending with the landscape of the region. Design benefitted from the ascending terraces to place main buildings. The second type of garden is the traditional char bagh garden [58].



Figure 19. Taj Mahal, India [59]

In Figure 19 we see the Taj Mahal, an impressive white marble mausoleum located in Agra. It is the jewel of Muslim art in India and one of the world's universally appreciated masterpieces [60]. The building should be viewed as a "figure in the landscape," with an intention to create a sense of spatial unity throughout. "Landscape" is inferred to be not only the neo-colonial version of Mughal gardens that dominates the foreground of Taj's ubiquitous imagery but also includes a much larger cultural landscape, including the river Yamuna and its floodplain, rural hamlets and farm fields, and the streets and open spaces in Agra city [61].

In the Taj Mahal and other tombs, the person who built the tomb actually had a deep understanding of the concept of burial, viewing it as an act of entering into heaven. It represents a structure in the symmetrical "Chahar Bagh" system. The water is drawn from the river in successive rehants [62]. The storage tank used for watering the garden is located outside of the complex. It first receives a full load of water, and then it is delivered to where the gardens need it most. In addition, this tank also exists in hydraulic welding - but it's not its main source of supply [46]. It is included in the UNESCO Heritage List due to Criteria I.



Figure 20, Humayun's Tomb, India [63]

In Figure 20 we see Humayun's Tomb, Delhi. This tomb represents a particular cultural significance due to its location within a cross-axial garden as it stands as the first example of a tomb set within a cross-axial garden in India. This character brings about naming the tomb as garden-tomb. The massive scale and symmetrical design of the Mughal royal mausoleum building style makes it one of the most iconic examples in that style [64; 65]. The tomb located in the middle of the Chahar Bagh plan was designed within the "hesht bihisht" (perfectly planned) plan of Islam. The Chahar Bagh plan is a series of four interconnected quarters. Each quarter is divided into nine units, each with wide walkways and water channels that open up land pools at the intersections [46]. It is included in the UNESCO Heritage List due to Criteria II and IV.



Figure 21. Fatehpur Sikri, India [66]

In Figure 21 we see Fatehpur Sikri. It takes place in Agra District in the State of Uttar Pradesh in northern India. It was built on the sloping levels of the ridges of the Vindhyan hill, on the southeast of an artificial lake. As the first planned city of the Mughals, it is known as the "city of victory". The city is shaped like a rectangle, with evenly spaced streets and lanes that are cut at right angles. It also features an efficient drainage system and a well-managed water supply [67]. It is included in the UNESCO Heritage List due to Criteria II, III and IV.

One of the unique features of Mughal architecture pertinent to natural ventilation is Panchmahal, located in Fatehpur Sikri. The five-story pavilion has an asymmetrical form with decreasing size from the bottom to the top and is covered by a dome-shaped canopy [68].



Figure 22. Red Fort Complex, India [69]

The Red Fort Complex was originally constructed as the palace fort of the city Shahjahanabad, Shah Jahan built this in the 17th century. The structure is made of red sandstone, which gives its name to it [70]. The private apartments of the fort consist of a series of pavilions attached by a continuous water channel known as the Nahr-i-Behisht (Stream of Paradise) [71]. The complex had a spacious lawn and various artificial features, such as canals and fountains, which were located on the eastern side of the city. Additionally, there was a large green space separating it from other areas of the city [72].

As illustrated in Figure 22, the Red Fort Complex is a classic example of the Chahar Bagh style, a raised pool in white marble at the intersection of axial walkways. The water flows from the terrace down to another pool in the form of a lotus, poured into the water basin over a tile in the panel, and finally, from there, it flows to the rest of the garden [46]. This heritage site is included in the UNESCO Heritage List according to the Criteria II, III and VI.

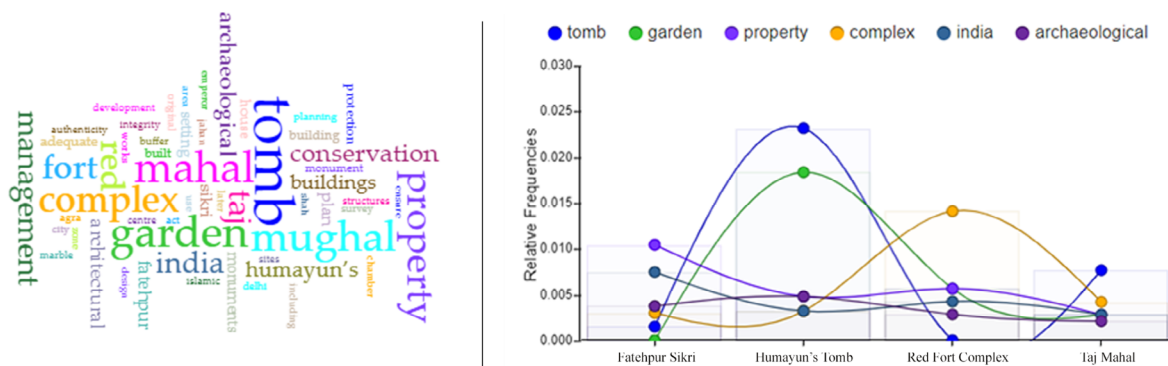


Figure 23. and Table 5, Comparing Usage of the Words With Wordcloud and Graph for India which was in the UNESCO Heritage List

There are four heritage sites in India, and water's existence within their systems is eye-catching. Via "Voyant tools", it is possible to see in Figure 23 that the most frequently used words are detected as "garden, tomb, property, complex, India, and archaeological". As a result of the dominance of architectural features mentioned, water-related can not even take place backwardly within the Indian cases.

4. FINAL REMARKS, COMPARISONS AND DISCUSSIONS

This part of the study aims to conduct a brief comparison between the case studies examined so far to develop a multilayered understanding of their water-dominant design approaches. Thus, this section of the study begins with the brief comparison illustrated by Table 6. It describes the heritage sites according to their geographic position, climate, continuity, water use pattern, garden, and Islamic content. At this stage, it should be noted that as these areas are historical places, they are the transition and adaptation examples of the overlapped format of the different cultures, religions, land-use, and water-use types. Thus, the characters declared by the table refer to the most obvious ones for each of the sites but not all the varieties they handle. In such a geography, a heritage site carries the tangible and intangible layers of both the current and past cultures. Thus a heritage site can hold not only the attributes of Islamic landscapes but also others. Each of these heritage sites operates micro and macro landscapes constituting a pattern. Thus, an area representing Char Bagh Plan will for sure hold an integrated system with other water systems. Similarly, it should be regarded that advanced and combined water technologies are vital for arid and semi-arid geographies.

Table 6. Basic characteristics of the heritage sites

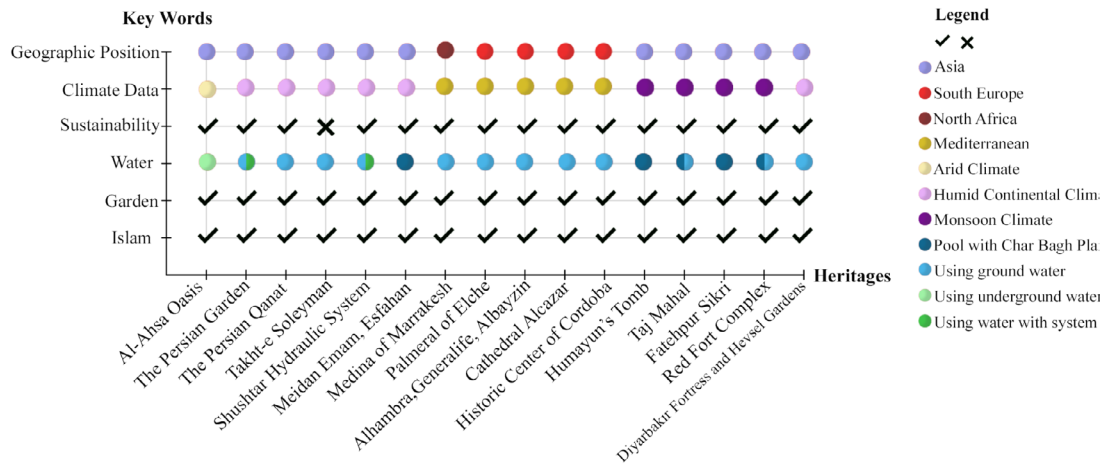


Table 7. Inscription Criteria for the selected 16 Heritage Sites of UNESCO

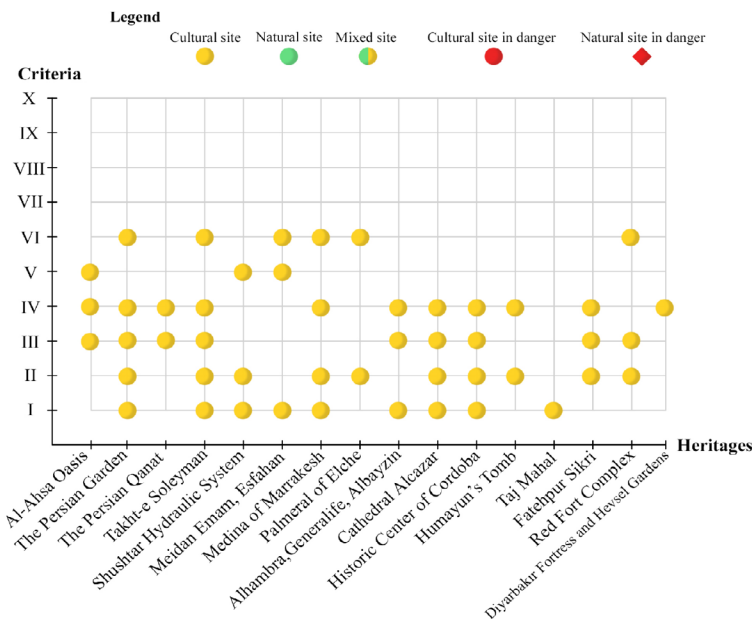
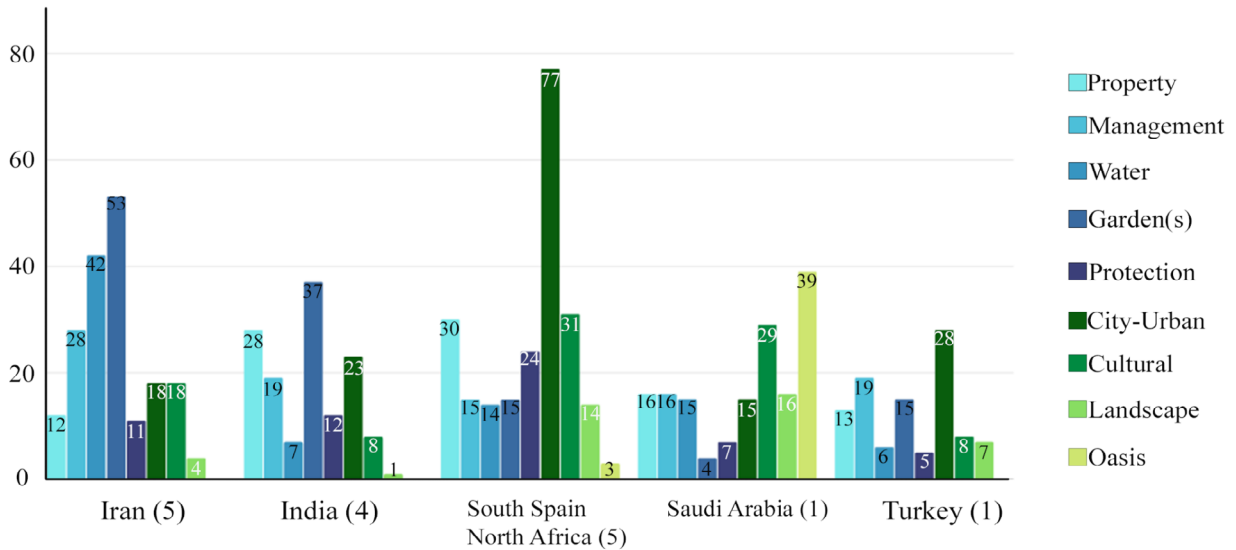


Table 8. Dispersion of the mostly used terms according to the countries



When we regard the stance of the garden term within the table above, it is interesting to see the sharp frequency level differences among countries. This is undoubtedly related to both the conceptual value of gardens inside these countries and the inner dynamics of the heritage sites. Besides the significantly different ones, property and management terms represent a balanced distribution and thus receive a high score in the end. This table helps to identify the differences between the countries' natural and cultural landscape parameters. The city-urban term is efficient for revealing the interaction between the built-up spaces and heritage sites. Within the expressions of Diyarbakir Fortress and Hevsel Gardens, the city-urban word takes place 28 times. When we look at the Iran and South Spain - North Africa regions, both have five samples each, and the value is 18 in Iran while it is 77 in Spain. Another apparent term is the oasis, as among all other concepts and techniques associated with water use, oasis is the only one that could enter the word cloud bunch. It is seen that solely in Saudi Arabia and Spain-North Africa, the oasis becomes a landscape component.

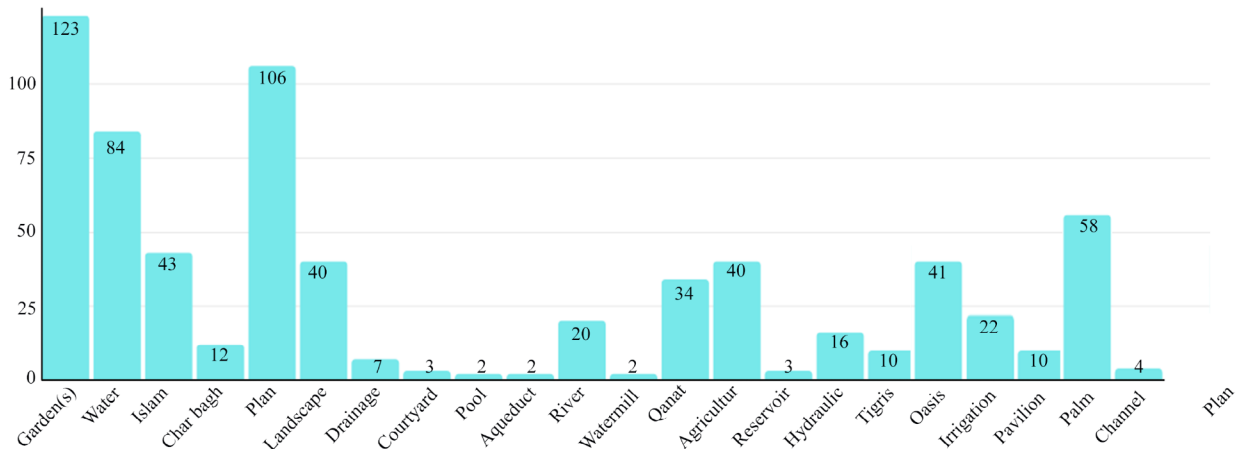
“Each landscape generates a unique signature on the Earth” [73]. This study relies on the diversity in landscape thus such differences mentioned above seem to have great potentials to discuss.

“Cultural landscapes are at the interface between nature and culture, tangible and intangible heritage, biological and cultural diversity—they represent a closely woven net of relationships, the essence of culture and people’s identity” [1]. In order to gain an overall understanding of such a woven net, the occupancy of water-sensitive landscape practices, concepts, and techniques forwards a potential for evaluation and discussion.

When we examine table 9, it is understood that some concepts and techniques turned out to be significantly lower than expected. The first of these are the terms of Charbagh and courtyard. The existence of the term Pavilion is critical at this stage as the word pavilion is frequently used in cases with char bagh and larger water surfaces. Aqueduct is a word that is expected to be at least more in number due to the fact that they are prevalent in ancient Roman geographies and around the Mediterranean. Water scarcity and geographical characteristics may have a considerable impact on their recessiveness. It was already expected from the concepts of oasis and qanat to be remarkable, and it is possible to say that the palm was considered together with oasis and agriculture to a certain extent. The existence of words like irrigation, hydraulic, and drainage are precious as they refer to the technical dimension of the study area. In arid and semi-arid

environments that have got harsh environmental circumstances, the generation of landscape patterns like an oasis, pam, and agriculture represents the support of water engineering techniques. Referring to the existence of flowing waters, river and Tigris terms are remarkable. As everything starts with the aim to access surface or groundwater resources and in their existence even far distant places or in scarcity, the struggle to access them without harming the entity motivates people to develop innovative techniques blended with their culture. From a certain point of view, the critical situation is not the number of techniques used but rather the fact that they are performed in the right place with the right formula, which is easy to understand as they survived through the centuries more or less in a sustainable way.

Table 9. Comparing Usage of the Words in UNESCO Heritage List for 16 Examples



Cultural landscapes are often reflective of specific sustainable land-use techniques, taking into consideration the characteristics of the natural environment. This illustration can help to protect a spiritual connection between people and nature, as well as maintain or enhance landscape qualities such as biological diversity. The protection of traditional cultural landscapes is also beneficial for modern practices in sustainable land management and helps to protect human welfare [2].

This research did not handle the case studies involving the interplay between the Islamic garden and cultural landscape but the cases with a specific concern about the water presence and usage as declared by the UNESCO World Heritage List. In this context, terms that are not related to the spiritual dimension but technology have become prominent. Therefore the received results are the ones appropriate to the scope of this study and capable of generating a platform to open discussion. For the development of studies carried out within this paper’s scope, increasing the number of heritage sites and parameters may support statistical studies for further studies.

4. CONCLUSION

This study searches for new ways to develop sustainability and thus focuses on the cultural landscapes that are well known due to the water-sensitive approaches and techniques they involve. Since it has an official stance focused on management and conservation, heritage world lists from the UNESCO database have been examined. The text-mining technique was used in the research process to bring together qualitative and quantitative data, along with the information available from UNESCO. Supporting them with scholarly documents, quantitative evaluations were made for each heritage site and country. Although water also has had a spiritual dimension, considering the environmental challenges related to water, it is seen that technical issues related to accessing water and using it sustainably clearly come to the fore according to

the evaluations on the historical spatial patterns and implementations. Focusing on the necessity to develop adaptive spatial studies, this study is an attempt to further water-sensitive landscape studies for the benefit of sustainable development.

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