Sustainable Landscaping for Paradise: Persian Garden

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Introduction

This paper introduces the ecological design techniques used to ameliorate harsh environmental conditions in traditional Persian gardens. Hot and dry weather of the Plateau of Iran, scarcity of water and sand storms has shaped large scale decisions (location, water systems) as well as small scale considerations (choice of plants, incorporation of architectural elements and water channels). The gardens in return, impact environmental conditions in large scale (towns and villages) and small scale (walkways and buildings).

This paper discusses passive strategies used in Persian gardens to create comfort conditions with regards to temperature, humidity, and light. This includes introducing resource management strategies and self sustained systems. Design guidelines that can be implemented in contemporary landscape and architecture projects in other arid areas are discussed.

Background/Literature Review

A review of the literature revealed that studies on Persian gardens usually involve aesthetics and artistic formalism. Very little literature is available on ecological techniques and sustainability concepts used in Persian gardens. This study uses the literature available combined with authors' personal observations in numerous long-established Persian gardens as the main resource of information.

Weather and Geography: Plateau of Iran is 900 to 1,500 meter above the sea level and contains several mountain ranges. The mountains, with the highest pick at 5610 meters, shield the central plain from rain-bearing winds to limit annual rainfall to 30 cm. The level of rainfall determines dominance of steppe or desert conditions and the cultivation potential.

A Brief History of Persian Garden: Early gardens were located in the Mesopotamian river deltas of the Euphrates and Tigris, the Northern foothills of Zagros, and the Nile valley in Egypt (Hobhouse, 2004). The origin of Persian gardens dates back to 4000 BC; as discovered potteries displayed the typical Chahar-Bagh (cross-plan gardens). The remains of Cyrus the Great's garden, 500 BC, still exists.

Between 521 and 485 BC, Persian rulers expanded the summer capital of Ecbatana (now located in the west of modern Iran). Walled terraced gardens displaying rows of trees ringed the city. According to Xenophone's Cyropaedia, pairidaeza (walled-

around, a walled garden) consisted of large parks hosting animals to be chased. The name Pardis, referring to garden in Persian, and Paradise, referring to heaven and Garden of Eden in English, are derived from Achaemenid's Pairdaeza.

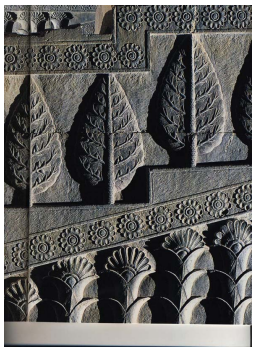


Figure 1. Stone Carvings of Persepolis

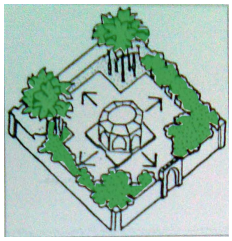
The quadripartite plan, present in Persian architecture and Landscape design, represents four cardinals, directions, elements and seasons. Persian's appreciation of nature is reflected on carvings of Persepolis, through flower and tree patterns. Persepolis was built to observe Persian New Year, the first day of spring and rebirth of the nature.

Islamic garden was born at the time Islam occupies civilized countries in 7th Century (Clarck, 2004). Muslims adopted royal gardens and hunting parks of Persia and expanded them to other Islamic countries. The concept of Persian garden then travelled to Syria, Egypt and Western premises of Islamic empire (Brooks, 1987).

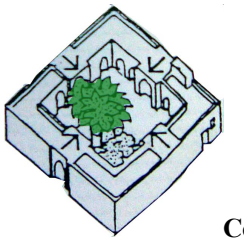
Types of the Gardens: Traditional gardens on Iran plateau can be found in three main groups: regional gardens, leisure gardens and courtyard gardens. Regional gardens, usually clustered with farm lands, are owned and operated for economical outcomes with prolific trees and plants. The green cluster could also contribute to protect the residential areas and farm lands from sand storms and unpleasant winds of the desert.

Leisure gardens, always separated from outdoor environment by high walls, belonged to higher levels of society for pleasure and political meetings. Architectural elements and structures are present in these gardens and work as an integrated part of the garden.

Courtyard houses are typical residential units for all levels of society in Middle East. Each house has its own private garden with fountains and trees. The courtyard houses have balconies to the garden and rarely have windows to the street (Clarck, 2004). This type of design is more concerned with volume rather than mass. In contrast with Western architecture which the identity of a building is defined by its external appearance, the Middle Eastern style is known by the space created within (Brooks, 1987).



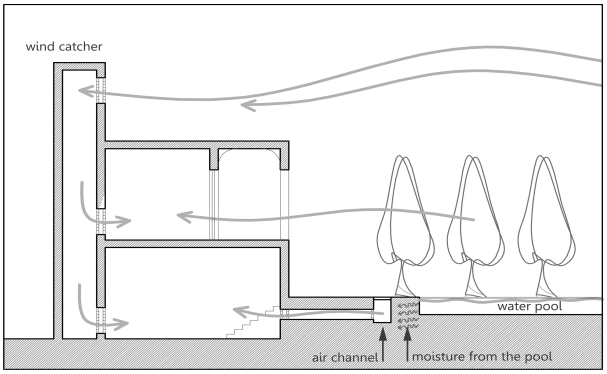
Leisure Garden



Courtyard

Figure 2. Leisure Garden and Residential Courtyard Garden

The courtyard gardens and leisure gardens greatly contribute to regulate environmental conditions for occupants and visitors.



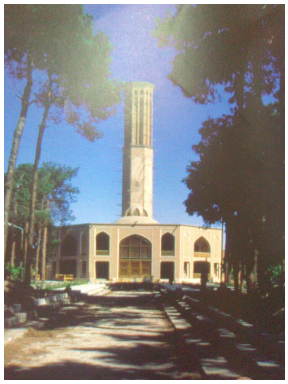


Figure 3. Gardens Regulating Environmental Conditions

Case Studies

Fin Garden, Kashan: Water feeds into this garden from a cistern kept full with a mountain qanat. The walled garden has existed since 1504, used for royal meetings. It has been witnessing many political meetings and stories, as well as design and construction modifications until 1852.

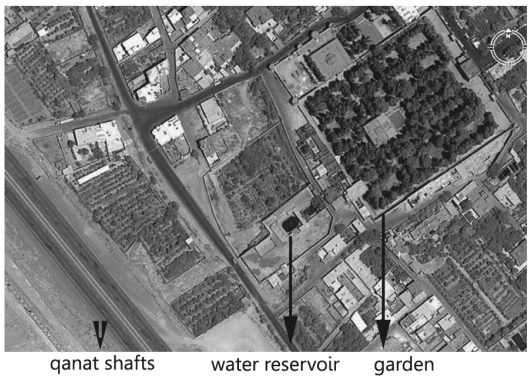


Figure 4. Fin Garden Location and Arial View

Dolat-Abad Garden, Yazd: Five qanats provide water from Mehriz 35 kilometres south of Yazd in foothills of a mountain. A quarter of the supply is being used by the garden and the rest is distributed in the city. The garden includes a winter house facing south and a shaded summer house. Badgirs (wind tower or wind catcher) capture cool breezes and carries them to the ground floor. The pool in the basement further cools the air. In 1888 Edward G. Brown discovered that this garden was a public garden where after wandering in the bazaar, he could rest and converse in the shade (Hobhouse, 2004).

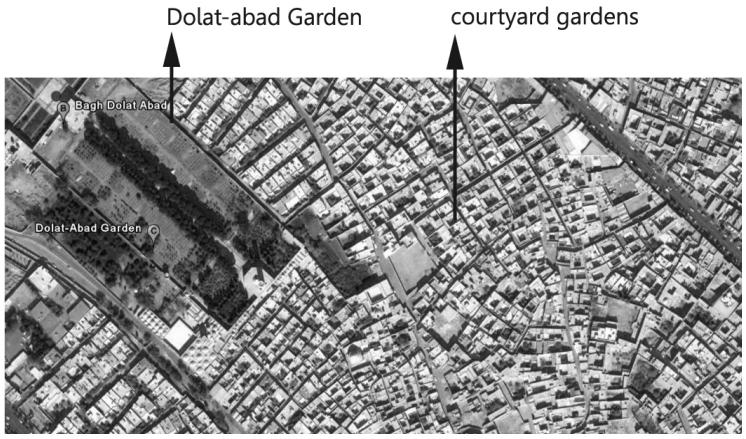


Figure 5. Yazd Gardens

Shazdeh Garden, Mahan: This garden is built in early 1880s, with desert to the east and distant mountains to the north and south. Water from the mountains to the south is stored in a vast cistern outside the walls to feed pools, cascades and fountains. The garden is broken into levelled terraces that shapes small water falls. Tall trees shade on both water stream and flower beds and orchards of pear and pomegranate.

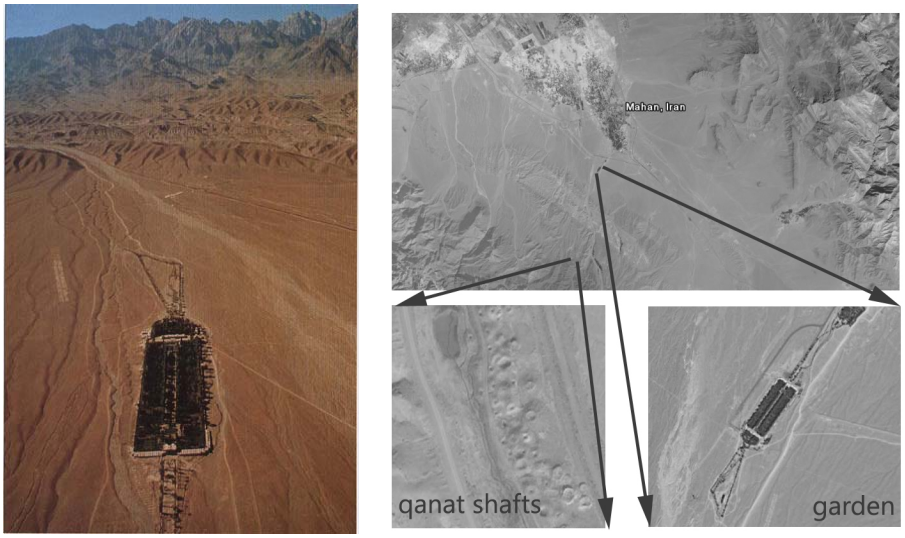


Figure 6. Shazde Garden

Design Guidelines

Case studies shed light on two aspects of sustainable landscaping: making the best use of the available resources without doing any harm to the environment; and incorporating gardens to control environmental conditions in large (town) and small (house) scale and hence helping other sectors achieve sustainability.

Water Resources and Distribution: Water as the most important element of life in gardens, is the major factors in finding the suitable locations to create a garden in arid areas. On Iran plateau the major source of water is the underground water table that will be brought to the garden using underground canals. In contrast with open irrigation water canals, the underground passages protect water from evaporation in the summer heat. The underground water system known as Qanat or Kariz, is a historical strategy to obtain water to be used for residential and agricultural purposes.
To build a qanat a well, around 50 meters deep, was dug at the foothill to reach subterranean water. Once reaching water, an underground tunnel with a mild tilt toward gravity was excavated to direct underground water to place needed. Access shafts were dug at intervals roughly around 20 m, to provide air for workers and remove the spoil in the tunnel. Once qanat was completed, it needed constant monitoring on a seasonal basis to make sure water canal and all shafts are open.

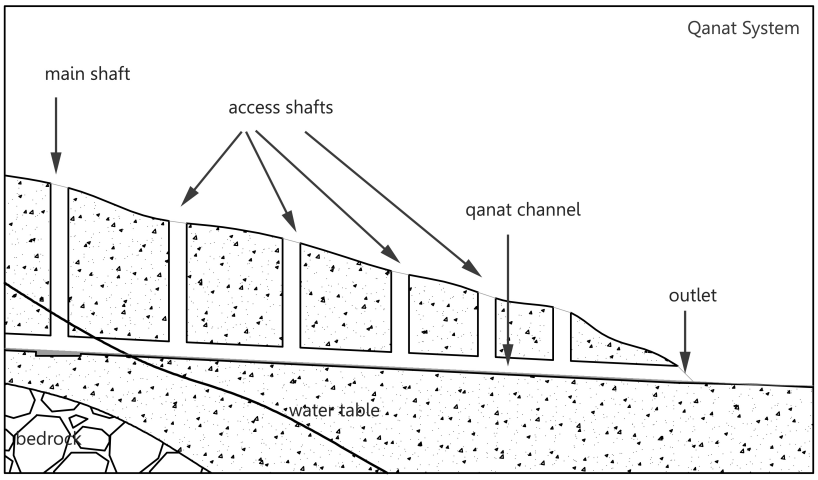


Figure 7. Qanat System

The water emerging a qanat could enter various reservoirs or canals. Distribution policy between various lands or neighbourhoods was based on the partnership of the local community. By taking turns in irrigating farms or filling house pools the effective pressure and speed of the water in canals was ensured. In most cases an open pool would reserve the water for distribution. From there, through open canals, the water was directed to farming lands and gardens, and then would pass through

the residential areas. In larger towns a number of Ab-anbar (Water-reservoirs) was utilized to distribute water among different neighbourhoods.

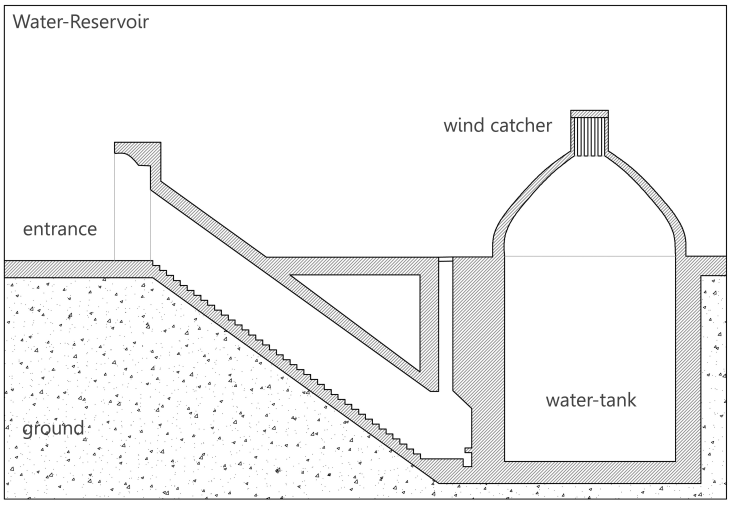


Figure 8. Water Reservoir

Water Circulation in the Gardens: In Persian gardens, water canals and pools define the main garden paths and gathering points. Gardens either have a mild slope or are constructed in multiple terraces, and help the water stream to circulate the garden. Fountains work passively by the force of gravity and water pressure (Daneshdost, 1990).

Water contributes to regulating the temperature and humidity of the air through creation of micro-climates in addition to feeding plants. The speed of the running water and depth of the canals is determined in a way that water evaporation under the hot summer sun is minimized. Applying green shading on the surface of running water and incorporating alkaline and other mineral elements in the soil are some of the other methods used to help reduce evaporation rates. Meanwhile, with applying appropriate stone texture and coverage in the canals the water penetration rates is regulated to avoid water wastage (Daneshdost, 1990).

Figure 8. Water Circulation in Fin (left) and Shazde (right) Gardens

Planting: The agriculture knowledge of the local community is based on water preservation. Applying the right kind of plants and their suitable arrangement can contribute to this aim. Local plants in arid areas benefit from their physiological properties to resist heat, aridity and harsh sunlight. Roots of the plants and trees help to preserve the moist in the soil. Plants shading on soil and running water makes a dramatic reduction in water evaporation (Arianpour, 1986).
Plants and trees in Persian gardens provide various functions including producing crops and bearing fruits, creating beautiful scenery and protecting inner spaces in case of view and access. In addition, trees in the Persian garden play a crucial role in ameliorating environmental conditions by shading the surfaces beneath and water streams (Eghtedari & Yavari, 2004). The difference in temperature between shaded and sunny areas leads to generation of breezes that helps to distribute water vapour through out the garden and keep the garden cooler. Tall trees also contribute to protect the garden and buildings from undesirable winds and sand storms from desert. Selecting and arranging the suitable kind of plants can result in creating eco-corridors that not only will help to control daylight but also can work effectively as breeze corridor to run it in main axes.

Natural fertilizers were used in farms and gardens that included bird manure. In the towns and country sides around Isfahan, structures were built containing hollow niches for birds, known as pigeon tower. Ibn Battute first mentioned these buildings in 14th century, built by brick and coated with lime (Hobhouse, 2004). These structures still exist and some are being utilized.

Wind Protection: Pleasant and unpleasant winds as well sand storms impact formation and planning of Persian gardens. In some regions these gardens were colonized in one side or as a ring belt around the town prone to sand storm and undesired winds. Various species of plants and trees were applied, which could afford resisting sand storm and undesired winds. In smaller scale, as already mentioned in planting section, taller trees would protect the garden from unpleasant winds, and provide shade for architectural structures, pathways and more sensitive plants. Water can also be used as an important factor to moderate winds and absorb dust in collaboration with green elements in Persian gardens (Naima, 2006).

Daylight Control: Harsh sunlight and dry and hot weather condition are regarded as climate characteristic of arid area in the plateau of Iran. Persian gardens' direction and shape are always formed considering the sun. The paths, location and positioning of architectural elements, and layout of the garden in general is formed considering sunshine so that best shading results could be achieved.
Furthermore, plant and architectural shading is utilized to control sunlight including: trees, green walls, masonry walls, pavilion, and porches. The integration of adjacent shaded and not shaded spaces results in different temperature and convection effect that creates a desirable breeze in the garden.

Discussion and Conclusion

Sustainability and eco-design have been inseparable parts of architectural and landscape design for several centuries, until the excitement of oil discoveries and electricity invention distracted designers and society. Today, through design guidelines empowered with new technologies, sustainable design is valued once again. Accomplishing research on traditional ecological design techniques can largely contribute to today's modern architecture and landscape design.

Persian gardens as the green oasis-like habitat benefit from of ecological design techniques to create a well-suited interaction with their context and to ameliorate harsh environmental conditions. These techniques, considering today's technology are affordable and easy to implement.

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