

**XERISCAPING: A GREENING APPROACH  
FOR FACING WATER-SCARCITY IN ARID CITIES  
The case of Egypt**

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**Abstract**

There is no doubt that green spaces provide the urban environments with an important asset, however the water-scarcity issues that is facing many urban settlements, Egypt is one of these places that is not only suffering from the rareness of green spaces, but the water-scarcity issues as well, these issues have arose to the surface in the last several years forced the municipality's supply of these green spaces to decline dramatically. Xeriscaping is one of the methods that is used to challenge such scarcity, it is a method of gardening that doesn't sacrifice beauty to conserve water, Xeriscaping (zer-i-scaping) is a water conservation technique that first originated in 1981 by the Denver water department. It is a 7 step landscaping method which aims at using drought-tolerant plants among a series of other steps to protect the environment. Water scarcity is a spreading phenomenon that affects all sectors of the community and threatens the sustainability of the resources. The "Water consumption versus water scarcity" reality in Egypt emphasizes the importance of following procedures for water conservation, and this could be tackled through a water-wise practice such as "Xeriscaping". This paper summarizes the significance of Xeriscaping, its major characteristics; it aims at forming a framework which could be considered a counter measurement technique to mitigate the water scarcity phenomenon which is crippling the Egyptian economy.

**المخلص**

مما لا شك فيه أن الفراغات الخضراء تمثل رصيماً هاماً في البيئات العمرانية المختلفة، غير أن ندرة المياه تشكل التحدي الأكبر الذي يواجه توفير وتطوير الفراغات الخضراء بالبيئات العمرانية المختلفة. وتعتبر مصر أحد النماذج الهامة حيث أنها لا تعاني من مشاكل قلة المناطق الخضراء فقط ولكنها تعاني من مشاكل وتداعيات ندرة المياه أيضاً. ويتناول هذا البحث أحد الحلول المقترحة للتعامل مع قضيته ندرة المياه وتوفير المناطق الخضراء وذلك من خلال تبني مبادئ Xeriscaping والذي تتميز بالاستغلال الرشيد للموارد المائية مع الحفاظ على جماليات الحدائق بأنواع نباتاتها المختلفة ذات الألوان والملامس والروائح المختلفة. وقد نشأ لأول مرة في عام ١٩٨١ في مدينة دنفر بالولايات المتحدة. ويعتمد في الأساس على ٧ مفاهيم رئيسية تم ذكرها بالفصيل في البحث، مع التركيز على كيفية التطبيق والاستفادة في الواقع المصري المعاصر، ويقدم البحث طاقة نور لتوفير المناطق الخضراء بالمدينة في ظل تحديات ندرة المياه والجفاف.

## 1. INTRODUCTION

Water conservation is an important step toward protecting the pristine beauty of any country and the bio-diversity of natural environment. Living in an arid high desert, with its uncertain water supply, challenges the municipality to conserve water used outdoors around homes and businesses. Many researchers argue that savings in water consumption (during the summer) of 50-60% can be achieved through the use of Xeriscape, as xeriscaping protects one of our most important natural resources, which is "Water", Xeriscape can be defined as water-efficient landscaping appropriate to the natural environment (A Guide to Water-wise Landscaping Water Conservation Program).

Water scarcity affects all social and economic sectors and threatens the sustainability of the natural resources base. Water is one of the most important inputs for economic development. As the demand increases, so too does the importance of water. This is clearly the case in Egypt, where rainfall is rare and the governmentally enforced quota for withdrawal from the Nile River has not changed since 1959, and threatens of launching the Ethiopian Renaissance dame have escalated. Moreover, water shortages have become increasingly common across the nation and in our local area as drought conditions prevail, and water demand has multiplied as a result of population growth, agricultural expansion, as well as industrial development and a rise in the standard of living (Allam, 2007).

However, altering our everyday behavior can conserve these precious water resources. One area where this is particularly true is in the design and maintenance of our lawn and garden. With a little extra planning and consideration, xeriscaping can help conserve water supplies while providing an aesthetically pleasing landscape. Landscaping spends energy in a variety of ways; in the manufacture, use and fueling of landscaping equipment; in the production and distribution of our water supply and in physical effort, but Xeriscape saves energy. Xeriscape is a cost effective method of landscaping to conserve fossil fuel energy and water on a residential and community wide level (Burns & King, 1989).

Our landscapes may remain beautiful and productive if we use water efficiently and if we use landscape plants that require less water. A secondary benefit is that plants with low water requirements are frequently adapted to dry regions. Landscapes using these water-efficient planting methods are called Xeriscapes (Smith, 2000).

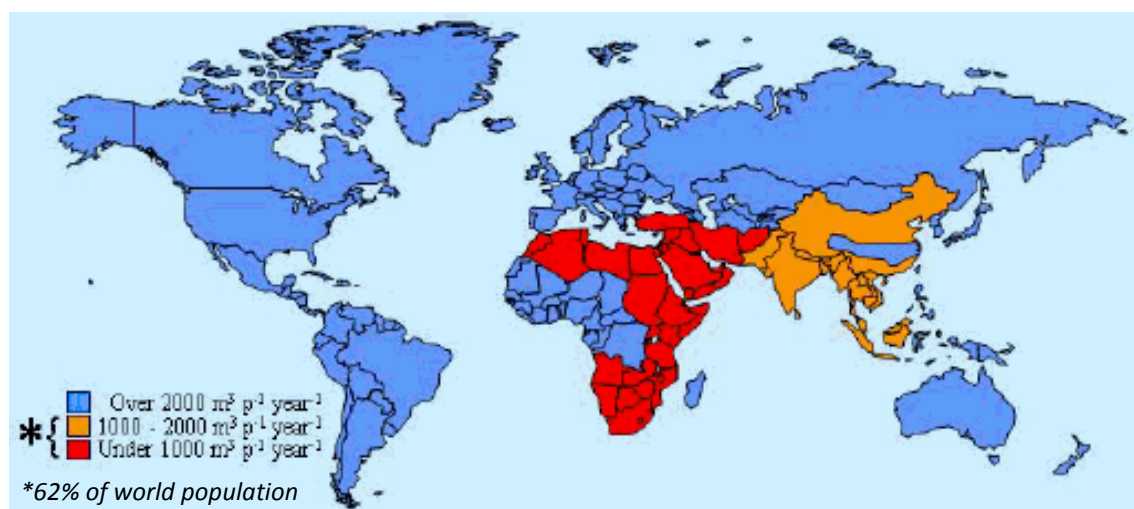
This research demonstrates the water scarcity generally and the case of Egypt specifically, and defines the Xeriscape origins and definition, beside distinguishing the differences between Xeriscape and zeroscape, beside identifying the concepts of Xeriscape and its zoning concepts, finally introducing the xeric-plants types and characteristics used in Xeriscape.

## 2. WATER SCARCITY & THE CASE OF EGYPT

### 2.1 What is water scarcity

When an individual does not have access to safe and affordable water to satisfy her/his needs for drinking, washing or livelihood, this is called person water insecure. When a large number of people in an area are water insecure for a significant period of time, then it is called area water scarce. (Rijsberman, 2004). It is surprisingly difficult to determine whether water is truly scarce in the physical sense at a global scale (a supply problem) or whether it is available but should be used better (a demand problem). Water is definitely physically scarce in densely populated arid areas, Central and West Asia, and North Africa, with projected availabilities of less than 1,000 cubic meters per capita per year, Figure (1).

**Figure (1)** Global water scarcity by the year 2030.



Source: Fischer and Heilig (1997) quoted in Frank Rijsberman (2004)

### 2.2 Water scarcity in Egypt

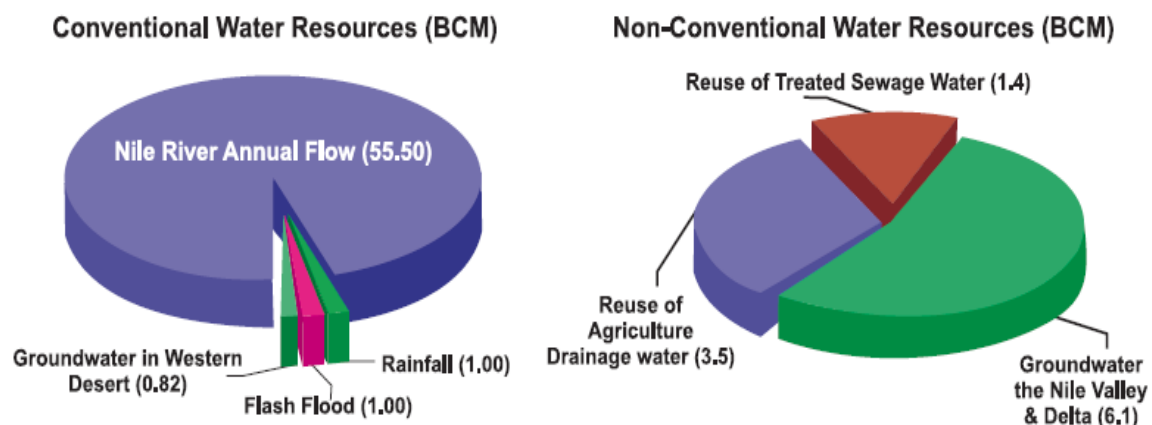
In Egypt, the acceleration of economic and demographic development, with rapid urbanization, growing industrialization and agricultural policy which emphasizes expanding production in order to feed the growing population, has stepped up the pressures on the country's water resources, triggering an increase in their demand accompanied by the deterioration of water quality. This situation is alarming as Egypt is an arid country that depends only on the River Nile (Abdin & Gaafar, 2004).

### 2.3 Water resources in Egypt

Water resources in Egypt are limited to the River Nile, rainfall and flash floods, deep groundwater in the deserts and Sinai, and potential desalination of sea and brackish water. Each resource has its usage limitation, whether these limitations are related to quantity, quality, space, time, or exploitation cost. Egypt receives about 98% of its fresh water resources from outside its national borders. This is considered to be the

main challenge for water policy and decision makers in the country as the Nile River provides the country with more than 95% of its various water requirements, Egypt water consumption is rising and continues to grow rapidly. The scope and extent of water conservation is decisively shaped by the shift to a demand-oriented water management strategy or a demand-managed water culture. Such a policy is imperative for Egypt and for other arid countries facing similar water constraints (Abdin & Gaafar, 2004).

**Figure (2)** Water Resources of Egypt.



Source: Abdin and Gaafar (2004)

## 2.4 Water Uses in Egypt:

Egypt is located in a dry climate zone where rainfall is scarce and the desert covers most of the land. Agriculture in Egypt, as in most developing countries, represents the main usage of water, followed, but with a large margin, by the residential, industrial and tourist uses, Table( 1). (Allam and Allam, 2007)

**Table (1)** Water Uses and Available Resources in Year 2000

Water Uses (BCM/year)		Water Resources (BCM/year)	
Sector	Amount	Resource	Amount
Municipalities	5.25	River Nile	55.50
Industry	3.50	Groundwater (Delta and Valley)	5.5
River Transport	0.25	Deep Groundwater	0.8
Fisheries	-	Drainage Water Reuse	
Hydropower	-	– Canals in the Delta region	4.5
Agriculture	63.00	– River Nile and Bahr Youssef	5.0
		– Illegal Uses	3.0
		Waste Water Reuse	0.2
		Rainfall and Flash Floods	0.5
		Evaporation Losses	3
Total	72.00	Total	72.00

Source: Allam and Allam (2007)

Agriculture consumes about 80% of Egypt's share of Nile water annually. Although the country lost part of its fertile land to urbanization, this has been balanced by expansion of agricultural areas. Expansion in agriculture is carried out horizontally and vertically through crop intensification by cultivating the land more than once a year. In 1990 cultivated lands were 7.0 Million Feddans (MF) with cropped area of about 12.5 MF, while in 2009 cultivated areas and cropped lands were 9.5 MF and 17.50 MF respectively. (Ministry of water resources and irrigation 2010).

Egypt has reached a state where the quantity of water available is imposing limits on its national economic development. As indication of scarcity in absolute terms, often the threshold value of 1000 m<sup>3</sup>/capita/year, is used. Egypt has passed that threshold already in nineties. As a threshold of absolute scarcity 500 m<sup>3</sup>/capita/year is used, this will be evident with population predictions for 2025 which will bring Egypt down to 500 m<sup>3</sup>/ca/yr.

In summary, the actual resources currently available for use in Egypt are 55.5 Billion Cubic Meter (BCM)/ year (yr), and 1.0 BCM/yr effective rainfall on the northern strip of the Delta, non-renewable groundwater for western desert and Sinai, while water requirements for different sectors are in the order of 75 BCM/yr. The gap between the needs and availability of water is about 20 BCM/yr. This gap is overcome by recycling (Ministry of water resources and irrigation 2010).

According to Attia (2004), there are several challenges facing water resources development in Egypt such as:

- A food security policy to feed the growing population
- The generation and development of employment for a wide sector of the population
- Water quality degradation
- The fragmentation of water management among different institutions
- Cost recovery of water resources services.

### **3. Xeriscape**

#### **3.1 Origin & definitions of Xeriscape**

Xeriscaping (zer-i-skaping) is a word originally coined by a special task force of the Denver Water Department, Associated Landscape Contractors of Colorado and Colorado State University in 1981 to describe landscaping with water conservation as a major objective referring to a set of seven principles that would define the concepts of water conservation oriented landscaping. The derivation of the word is from the Greek "xeros," meaning dry, and landscaping – thus, xeriscaping, the term is pronounced "zair-i-scape" and means "water conservation through creative landscaping.", (Wilson and Feucht, 2007).

"Xeriscape" does not refer to a specific look, or even a specific group of plants, but rather an approach to landscaping in arid or semiarid climates. Where water is

scarce and soil conditions challenging, landscapes do not have to be limited to a few prickly plants and a yard full of gravel – in fact, a well-planned, Xeriscape can be attractive, colorful and very rewarding.

Often it is thought that a Xeriscape means the use of all native or low water use plants, resulting in limited plant selection. However, Xeriscapes can incorporate hundreds of plant choices including trees, shrubs, evergreens, perennials and grasses (Detweiler et al., 2005).

The goal of Xeriscape is to create a visually attractive landscape that uses plants selected for their water efficiency. Properly maintained, a Xeriscape can easily use less than one-half the water of a traditional landscape. Xeriscape Garden concept is initially popular in the dry, thirsty lands of the western United States.

A Xeriscape may be designed to minimize labor or to require frequent care. It serves the many people appreciating beautiful landscapes, but has limited time to spend tending a garden. By using plants that are well adapted, mulches that suppress weeds and conserve water, and drip irrigation to make the most use of water, these landscapes can have color and fragrance with only monthly or seasonal gardening chores.

**Figure (3)** Xeriscape symbol



Smith (2000) argues that one of the merits of Xeriscape is that gardeners who like to spend time in the garden can design a Xeriscape to be as labor intensive as a highly maintained traditional garden, but use much less water, he states that "There is a Xeriscape for every gardener".

Among the most comprehensive definitions of Xeriscape are, Smith & Larson's (2003) which states:

*"A Xeriscape is a landscape which uses plants that have low water requirements, making them able to withstand extended periods of drought. Xeric landscapes are a conscious attempt to develop plantings which are compatible with the environment."*

While the South Florida Water Management District (2011) definition stresses on the quality landscaping, and the proper usage of plants, as they state:

*"Xeriscape is quality landscaping that conserves water and protects the environment. The term Xeriscaping means water-conserving, drought tolerant landscaping, or simply the use of*

*the right plant in the right place—with proper maintenance and water-wise watering.”*

Wilson and Feucht (2007) draw some important tips to take in consideration when designing for water conservation with Xeriscape, their tips included:

- Proper planning is the first step in landscaping to reduce water use.
- Steep slopes with south and west exposures – which are more exposed to the direct sun rays - require more frequent water to maintain the same plant cover as east or north slopes.
- Terracing slopes reduces runoff.
- Soil preparation is a key to water conservation.
- Proper irrigation practices and system design can lead to 30 to 80 percent water savings.
- *Xeriscape* is *NOT* just rocks and gravel.
- *Xeriscape* is *NOT* necessarily lawn-less landscaping.
- *Xeriscape* is *NOT* a boring mono-culture of spiny plants; On the contrary, well planned Xeriscapes are splendid examples of the beauty and diversity.
- Although there are vast arrays of wonderful plants indigenous to all regions, non-invasive introduced plants, that are well adapted to the local regional climate, are wonderful additions to landscaping that uses water economically.

### **3.2 Xeriscape vs. Zero-scape**

Many people confuse “xeriscaping” with “zero-scaping”. While both of these landscapes use less water than the traditional turf-dominated approach, they are totally different in appearance and appeal. Xeriscaping is lush and beautiful, while Zeroscaping tends to be arid and less interesting. Xeriscaping uses a wide variety of water efficient plants to create an oasis-like feeling, while Zero-scaping uses lots of rocks and usually a juniper or yucca. Xeriscaping makes an area colorful and inviting, while the colour spectrum used in zeroscaping is much shorter with less colors.

To summarize the differences, we can say what Xeriscaping is NOT:

- It is not “zero-scaping” which uses only rocks, cacti and yucca plants
- It is not rigid or formal; every Xeriscape can be different depending on individual needs and resources
- It does not require the use of only low-water-use plant species; parts of the property can still include water-demanding species.

## **4. Seven Basic steps and principles**

Applying Xeriscape principles to landscape, allows not only water saving, but enjoying the beauty and diversity of native and other water-wise (drought-tolerant) plants as well. The principles serve as a basic introduction to successful Xeriscaping. The researchers agreed that Xeriscaping follows seven simple principles that save water while creating a colorful landscape, the seven principles are compiled from several literature sources and demonstrated below (Smith and Larson, 2004; Wilson

and Feucht, 2007; The University of Georgia College of Agricultural and Environmental sciences, 2007; The University of Arizona, 2009).

### **Principle 1: Start with Careful Planning and Design**

A good landscape and garden begins with a good design. Water conservation in the garden can be maximized if it is considered in the initial planning phase. Designing the landscape with areas of differing water demands is called “hydrozoning”. In some regions, harvesting run off water from roofs and paving during rain seasons and storms can be used to reduce the need for supplemental irrigation. Therefore, grading should be in consideration and designed from the beginning. In the South Florida Water Management District Quick Facts on Xeriscape: How to Save Water Through Water-smart Landscaping, published in 2011 some useful tips were introduced such as:

- Devise a plan to create distinct watering zones by grouping together plants with similar water needs.
- Plan zones to transition from least to most drought-tolerant. Place the least drought-tolerant zone closest to a water source or near a water feature.
- Use and/or modify existing slopes to divert runoff water to the least drought-tolerant plants in your Xeriscape.
- Incorporate a water feature into the highest water use zone, such as a recirculating waterfall or pond that provides a moisture environment where water-loving plants can thrive without additional irrigation, it is preferred for these areas to be shaded in order to reduce water loss from evaporation.
- Locate the most drought-tolerant plants in areas with southern or western exposures, as these tend to be the hottest and driest spots.
- Minimize the use of rocks, plastic, and sand in high heat areas, as these materials will simply raise temperatures and often cause runoff problems.

### **Principle 2: Use and Place Plants Appropriately**

It is important to put in consideration that most plants have a place in Xeriscape, especially adapted varieties. Numerous attractive trees, shrubs, garden flowers, ground covers and turfs are available to complement Xeriscape designs. The golden rule is to give preference to drought-resistant plants and group plants with similar water needs together (The University of Arizona, 2009).

Different areas receive different amounts of light, wind and moisture. To minimize water waste, group together plants with similar light and water requirements, and place them in an area that matches these requirements. Smith (2000) argues that Xeric plants depend on the formation of extensive root systems to effectively gather water for proper growth, thus choosing more drought-tolerant plants and breaking landscape up into water use zones help in orchestrating and managing plantings in site, however it's important to put the following recommendations in mind:

- Native plants are better adapted to the area's climate and require less water.



- Although prairie plants are not common as such in our Egyptian landscapes, but many dry prairie plants are adapted to arid conditions and work well in “hot” zones.
- Group water-hungry plants such as roses together in a high water use zone where they can benefit from available water.

### **Principle 3: Use Lawn Areas Economically, if Needed**

Turf provides a play surface especially for children. It is an important element in cooling the local environment, reducing erosion, and preventing glare from the sun. Beside, turf is easy to maintain, although it requires more frequent care than many other landscape plants. But the question is, can we use it in Xeriscape designs?

There is a wrong believe that lawn areas and turf grasses are excluded from the Xeriscape list of useable areas, Turf grasses have a place in the landscape, even the Xeriscape, however the usage of lawn areas and turf grasses need to be wisely and to locate turf where it is most beneficial. It is important to choose a manageable size and shape for such areas. The following recommendations need to be in mind:

- Select turf types and varieties for low maintenance and reduced water needs, when renovating an existing lawn or installing new turf.
- Separate turf from other planted types such as; trees, shrubs, ground covers and flowering plants so it may be irrigated separately.
- Direction of foot traffic needs to be taken into consideration.
- Turf areas should lead easily through your landscape.
- Considering reducing the size of lawn all the time, instead of using a lawn to cover large areas, lawn size and type ought to fit family’s needs, beside using drought-tolerant grasses such as Bermuda grass and Buffalo grass, instead of water-thirsty other types of grasses.

### **Principle 4: Irrigate Efficiently**

At the heart of xeriscaping is a focus on efficient irrigation practices and grouping plants together with the same water requirements (hydrozoning) –as previously mentioned (Detweiler et al., 2005). A water-wise landscape is not a waterless one. Efficient irrigation is a very important component in this type of landscaping, at least during the first few years while the plants’ root systems are developing. Following establishment, irrigation may still be necessary depending on the landscape design and plants’ needs. The landscape designer is free to choose the most proper irrigation system—whether automatic, manual, or hoses as it is an integral part of landscape planning and design.

It is crucial to use the proper irrigating system, as for efficient water use, turf areas are always irrigated separately from other plantings. At this point in time and with the recent research and science development, turf areas can only be watered properly with sprinklers. Trees, shrubs, garden flowers and ground covers, however, can be watered efficiently with low volume drip, spray or bubbler-type emitters.

Regular adjustment of your irrigation system will save you water and money (Cornell Cooperative Extension Nassau County).

The following practices allow irrigating landscape without wasting water:

- Typically, established landscape plants and turf grass require one inch of water per week, thus watering frequency should be based on soil moisture, and plant/turf conditions. Water-wise landscaping is designed to avoid additional irrigation.
- Be a weather watcher. Putting in mind that the Egyptian weather is characterized by being a dry one, however, never irrigate if the area has received one inch of rain in the past week.
- Regarding the hot/dry zone plants, avoid watering them, unless they are under extreme drought conditions.
- Water deeply and infrequently to develop deep roots.
- With the considerably hot weather of Egypt, especially during the day, never water during the day to reduce water lost to evaporation.
- Use low-flow, hose end irrigation. Choose drip or trickle emitters where irrigation is needed.
- Always check irrigation systems for leaks and malfunctions.

#### **Principle 5: Use Soil Amendments, if Needed**

Plants should either fit the soil or soil should be amended to fit the plants. Most plants will benefit from the use of compost, which will help the soil retain water. Some desert plants prefer gravel soils instead of well-amended soils. Soil improvement allows for better absorption of water and improved water-hold capacity of the soil, moreover, soils that have an acceptable percentage (3-5%) of organic matter also provide additional nutrients to plants. It is important to improve the soil prior to planting and the installation of any irrigation system. Proper soil preparation is the foundation of Xeriscape. Healthy soils require less water and chemical amendments. The following soil preparation practices will help to achieve and keep a healthy soil:

- Test soil prior to planting, because the soil type and texture will dictate the varieties of chosen plants and the amendments needed to be added to it.
- Turn the soil before planting to reduce compaction, as loosening the soil allows for better root development and penetrability of water and air.
- In the high water use zones, add organic matter such as manure and compost which helps retaining soil moisture.
- In the oasis and moderate-water-use zones, adding compost increases the soil's water-holding capacity. While in the low-water-use zone, soil preparation may only consist of turning the soil to loosen it and reduce its compaction.

#### **Principle 6: Use Mulch**

When mulches are properly selected and applied, they keep soil temperatures moderated, minimize loss of soil moisture due to evaporation, reduce weed growth

and slow erosion, where a two to four-inch layer of top-dressing, like gravel or woodchips will be enough. Moreover, certain organic mulches can provide landscape interest, where organic mulches are typically wood chips and nuggets, nut shells, shredded bark, seed hulls, pine needles and chopped leaves. On the other hand, it is popular to use inorganic mulches that include rock and various gravel products. Within the Egyptian context, using mulches is not frequent as such; therefore it will be more proper to use the light colored gravel, rocks and non-toxic soy-based ink newspapers to avoid gaining sun heat which rises temperatures and causes water lost. Appropriate thickness of any of organic or inorganic mulches is applied directly on the soil, and using plastic sheets is avoided in planting areas. The following are some useful tips for the proper using of mulches:

- Organic mulch is renewed on a yearly basis.
- Organic mulch draws nitrogen from the soil, thus mixing a nitrogen-rich fertilizer in with organic mulch helps plantings to balance their essential nutrients.
- As most modern newsprint is non-toxic soy-based ink, newspapers can be used as mulch, however, it is important firstly, not to use more than two layers to avoid forming a water and nutrient flow barrier, secondly, to cover the newspaper with a thin layer of organic mulch for aesthetics and to hold it in place.

#### **Principle 7: Maintain the Landscape Properly**

The pivotal merit of Xeriscape is the minimal maintenance required. However, any garden will require some maintenance; such as: pruning, removing trash that has blown into the landscape, occasional weeding and pest management, checking that the irrigation system is functioning properly, and adjusting automatic irrigation systems as the seasons change.

Though a water-wise landscape can be designed to be practically maintenance free, it cannot be completely neglected. The following practices keep landscape plants and turf from being stressed:

- Healthy plants always require less water.
- Weeding routinely.
- Mowing turf as needed, but raise your mower blades to a height of 2-3 inches.
- Checking for pest and disease infestations and control accordingly.
- Fertilizing based on soil testing.

#### **5. Xeriscape zoning concepts**

Xeriscape relies on zonal planting concept in order to achieve the wise usage of water across the entire site, with this concept, the high water requiring plants are planted closest to the main building and sitting areas, often given the term “oasis zone” (zone #1). The moderate, or regular watering zone (zone #2), usually contain plant materials that, after establishment, would require only occasional watering

during extended droughty periods. The “no water zone” (zone #3) could have some native or adapted plant species that are drought resistant, and have adapted to the usual precipitation patterns of the particular region, these plants would usually need water for the first year (usually through a drip irrigation system) to become established, then allowed to go entirely on their own, with the least maintenance requirements. With the three zones clearly defined, it is obvious that three entirely different classes of plant materials will be needed, which takes careful thought in planning and planting to avoid a hodgepodge design (Smith and Larson, 2003).

Every landscape should start with a site plan outlining the areas that get the most sun or wind, which way the ground slopes, and the intended use of the space. Good Xeriscape planning makes use of overlapping “hydro-zones” with differing water requirements. Xeriscapes take advantage of different microclimatic conditions. Microclimates are affected by moisture, sun, shade, air movement and heat; for example, reflected light from south and west-facing structures creates high temperatures that increase the loss of water from nearby plantings, thus deciduous shade trees are strategically planted in these exposures to reduce temperatures in summer, yet allow sunlight in winter, similarly, water-loving plants can be grown in a microclimate where irrigation and other water runoff is captured in drainage swales, on north facing slopes or in areas surrounding the gutter basin.

One of the keys to creating a successful Xeriscape is planning for different areas of landscape use. By putting plants into specific zones based upon the needed functions to serve and the water needs of the selected plants which results in the creation of a water-efficient landscape that are both beautiful and functional.

The following are guidelines for the creation of three Xeriscape microclimates which are characteristic of Xeriscape designs having 3 different zones of very low, low and moderate zones, each zone is based upon the amount of water applied, the guidelines are compiled from (Conserve Water with Xeriscape Landscaping, (n.d.); Feucht, 1999; Smith and Larson, 2003; Wong, 2008; The University of Georgia College of Agricultural and Environmental sciences, 2007; South Florida Water Management District, 2011). Figure (4) demonstrates some zonal planting concepts using these 3 zones, putting in mind that all the examples incorporate the seven Xeriscape fundamentals reviewed earlier.

#### **Very low water zone:**

This is the lowest water zone in a Xeriscape, providing the greatest savings relative to traditional landscapes. These beds or plantings are generally located the furthest distance from the residence or proximity to available water. Irrigation is needed only during the establishment of new plantings. Once established, the plants in this zone require no supplemental water. Plants in the very low water zone must be selected carefully for minimal water use.

Far away from the most active areas of the landscape, this zone features the most drought tolerant vegetation that usually hosts native plants and other varieties that only rarely require supplemental watering.

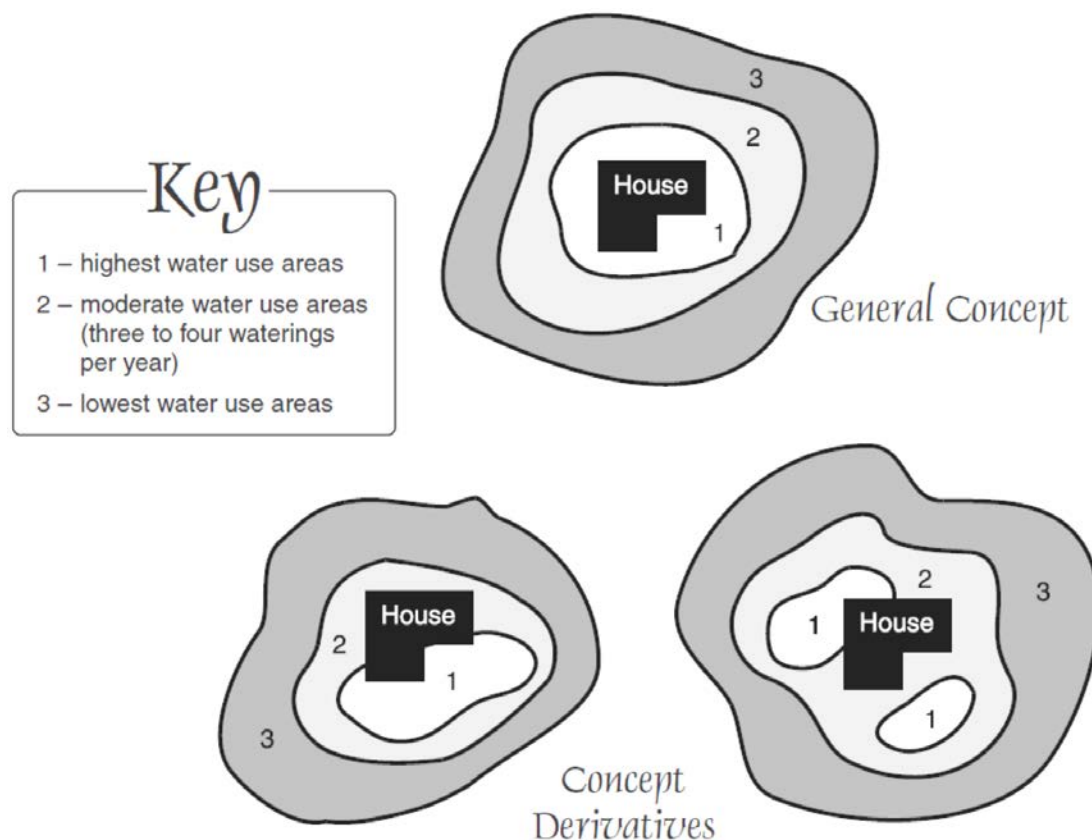
**Low water zone:**

This is a transitional Zone that extends beyond the Oasis and includes those plants with moderate water needs like ground covers, shrubs, and some trees. The zone is used to blend lush areas with the more arid parts of the landscape. During very dry periods, supplemental irrigation may be necessary.

**Moderate water zone:**

This is called the "Oasis Zone", it describes the area closest to the house. This is the place for higher water use plants that will provide shade and a cooling effect for outdoor living areas such as the patio or the entry. Even though this zone uses the most water, it still demands less than traditional landscapes. This zone is kept small to limit water need. "Outdoor living room" where the most time is spent outdoors should be in or near the oasis zone, as it is the lushest zone. The oasis zone usually includes the lawn area (if any) –which is typically the highest water-use area.

**Figure (4)** Xeriscape zonal planting concepts



Source: (Smith and Larson , 2003)

## 6. Xeric plants used in Xeriscape: Types and Characteristics

Although plants differ from a region and climatic zone to another, still there are lessons to be learned, as the xeric plants characteristics are almost similar, names and types may differ from one context to another but the concepts behind using each and every xeric plant successfully need thorough understanding.

Xeriscape landscaping uses plants that requires or tolerate dry (xeric) conditions and is a water-wise and smart practice that emphasizes minimal use of fertilizers and pesticides; it offers an opportunity to select plants that are more compatible with local conditions and able to thrive when other landscape plants cannot. (Feucht,1999). Xeriscaping can incorporate a wide variety of native and arid-adapted plants in exciting combinations. Xeric plants offer a wide range of foliage density, color and texture, as well as plant forms, with which to work.

Smith and Larson (2003), argues that xeric landscaping should not be undertaken without proper planning, plant selection, and placement; they add that xeric landscaping will require a change in styles as well as plant materials. Going “native” in plant selections is often thought to be synonymous with “drought resistant.” Native plant establishment is often one of opportunity or timing; when the seeds make contact with the soil, whether adequate moisture is available or not.

**Figure (5)** Xeric plants are no different than other landscapes.



The western slopes of Al-Azhar park, all plants are drought-tolerant

Source: <https://sites.google.com/site/tourisminmasr/tourism-in-cairo>



Adrere Amellal Siwan ecolodge, and the use of indigenous plants

Source: <http://luxatic.com/15-bizzare-hotels-you-should-visit-before-you-die/>

Feucht (1999), Welsh & Welch (n.d.), Smith and Larson (2003), Wilson and Feucht (2007) states some recommendations for establishing xeric plants, among these are:

- When selecting woody plants, consider aesthetics, functions, soils, drainage, exposure to heat and wind and irrigation method.
- Plant trees and shrubs in areas separate from irrigated lawns, unless the lawn also is a low-water type.
- Water xeric trees and shrubs just as much as other plants until established, usually two years. Once established, gradually reduce watering frequency.

- Frequent shallow watering promotes shallow roots and defeats the purpose of xeriscaping.
- Wildflowers, visually pleasing and water efficient landscape plants can be used within gardens or even to replace an entire lawn. There are too many species to list but they are easily obtained and very attractive.
- Use xeric plants for the same functions as more traditional types. Pines and upright junipers, for example, make excellent screen plantings under low irrigation. Xeric plants also are excellent for mass plantings on steep banks, particularly on hot south and west exposures.
- Succulent Species-Cacti, aloe and others require very little water yet come in a wide variety of colors and shapes, an advantage that can be utilized in site.
- Rock Gardens-Burying boulders of different sizes, colors and textures in sand can be very attractive. Focus on contrasts between rocks and include clusters of succulent plants and walkways within the garden, but always remember to avoid putting the dark colored types of them in south and west hot areas in order not to increase the temperatures.

## **7. An example for Xeriscape layouts development:**

To begin a xeriscape plan, the first step is to indicate the public, private and service areas of the landscape plan on the site analysis sheet (figure 6 left), secondly to indicate the conceptual diagram of water-use zones based on the site analysis and the space requirements for each activity (Figure 6 right).

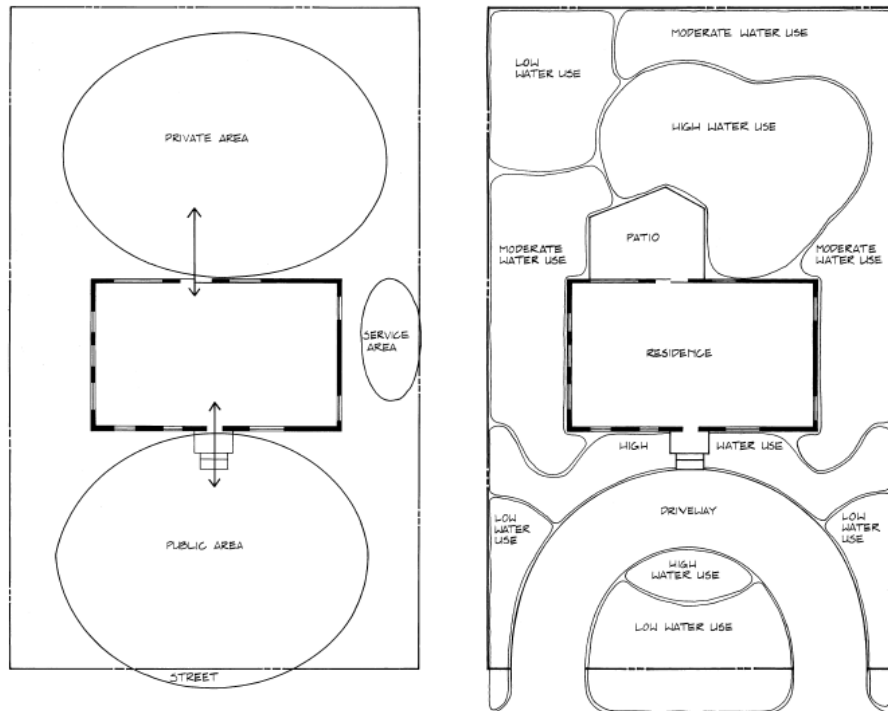
The *public* area is the highly visible area that most visitors see, such as the entry to the home. In a traditional landscape, this area typically receives the most care, including the most water. Therefore, the careful design of this area is important for water conservation. With Xeriscape concepts this area can be designed to require minimal water and maintenance without sacrificing quality or appearance.

The *private* area of the landscape, usually the backyard, is where most outdoor activity occurs. It is generally the family gathering area, or the outdoor living space. It may also include a vegetable garden or fruit orchard. The landscape in this area needs to be functional, attractive and durable, but it also should be designed to require less water than the public area of the landscape.

The *service* area is the working or utility area of the landscape, an area usually screened from view. In terms of routine maintenance, this area would be designed to require the least care and water of the three areas, (Xeriscape: A guide to developing a water-wise landscape, 2007).

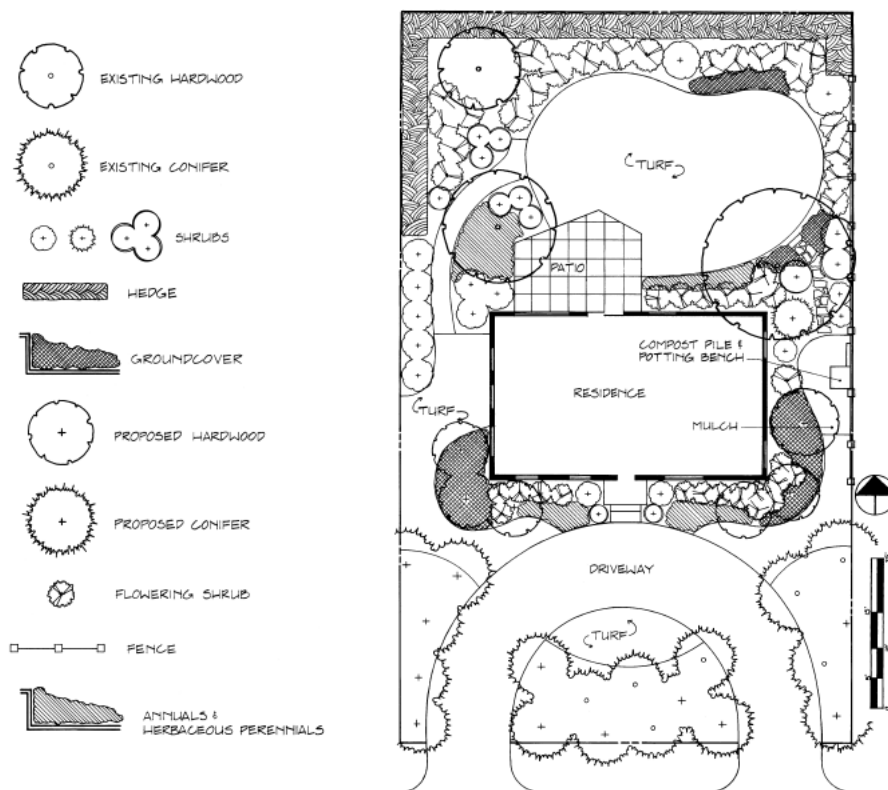
The final layout in figure (7), shows how the character of the final product is very similar to that of traditional landscape, however the added value in the Xeriscape layout is the wise usage of water, and the thorough understanding of the water requirements for every and each plant in the design.

**Figure (6)** The basic use area of typical residential lot (Left),  
Conceptual diagram of water-use zones (Right)



Source: Xeriscape: A guide to developing a water-wise landscape, 2007.

**Figure (7)** Master plan for incorporating Xeriscape principles. Note how the character of this landscape is very similar to that of traditional landscape.



Source: Xeriscape: A guide to developing a water-wise landscape, 2007.



## 8. Xeriscape and the Egyptian context

There is no doubt that the main privilege of adopting xeriscape within the contemporary Egyptian context is the minimal amounts of water it needs, while in the same time persevering almost the same aesthetical qualities of traditional landscapes, Table (2) demonstrates a selected drought-tolerant and water-wise plants list that successfully grow in Egypt, the table introduces the Arabic common name to identify the plants easily, the table shows a huge variety of plants and species that can serve the xeriscape concepts and ideas efficiently.

The following are some advantages and ideas demonstrating the vital role which Xeriscaping can play in enhancing the Egyptian built environment:

- It can be used in landscaping archaeological sites and the surrounding areas.
- It can be used in protected areas landscaping, especially when using indigenous plant species.
- Xeriscape can be used in eco-tourism sites efficiently specially in desert locations, putting in mind that more than 90% of the Egyptian territories are desert, and Adrere Amellal is one of the successful examples, Figure (8).
- The four-season advantage of xeriscape, which secures adequate sites all over the year for all users.
- The richness of the plants pallet, with succulents, cactus, shrubs, trees, ground covers..etc, which helps in creating wonderful urban landscapes, table (2).
- Xeriscape not only needs minimal maintenance (mowing – pruning ...etc), but even the needed maintenance is considerably cheap, which is evidenced in the plant choices for the development of the western slopes of the Al-Azhar park, which are characterized by their very steep slopes which results in a tremendous difficulty in maintenance and being exposed to direct sun light, which was faced by choosing drought-tolerant plants, Figure (9) shows the division of this area into 7 different zones, and the three sections demonstrated shows the different types of plants used, such as shrubs , trees and ground covers.
- Minimal need for fertilizers, either organic or inorganic.
- Xeriscape allows and encourages the economically beneficial plants, as far as their existence is well studied and fits within the main design concept.
- Xeriscapes could be used very efficiently in roof gardens and vertical landscapes, which are a very powerful tool to enhance the green space supply in Egypt according to Kafafy (2009).

To summarize the benefits of xeriscaping, and above all the previously mentioned advantages comes the fact that xeriscape provides a more sustainable built environments as it does not only create venues for greening the arid, congested, over-populated Egyptian built environment, while preserving the water resources, with its minimal water consumption and defeating the threats and challenging of water scarcity in Egypt.

**Table (2)** A selected water-efficient plant list for common species used in Egypt

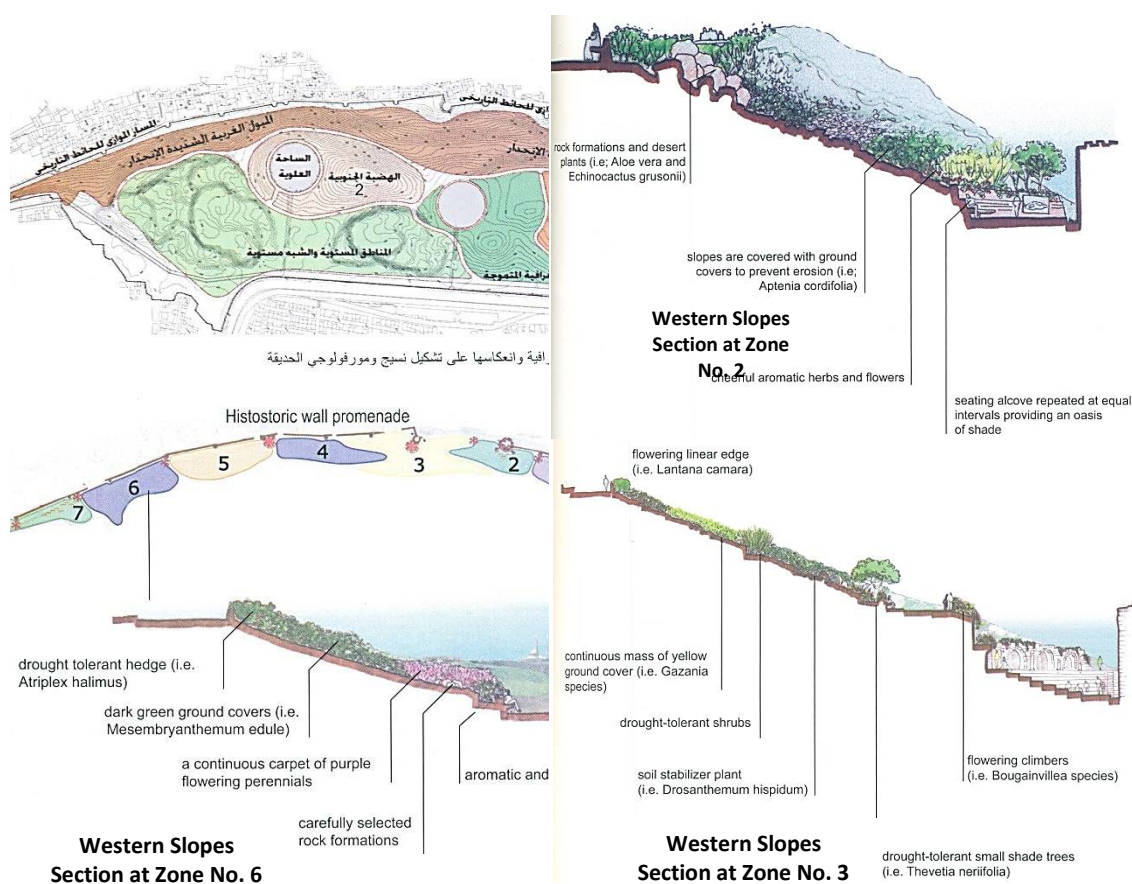
TREES			SHRUBS		
SIENTIFIC NAME	COMMON NAME	ARABIC	SIENTIFIC NAME	COMMON NAME	ARABIC
Cassia Tomentosa	Wooly Senna	كاسيا تومينوزا	Atriplex Lentiformis	Salt Bush	اتربلكس
Casuarina Equisetifolia	Beefwood	كازوارينا	Callistemon Lanceolatus	Lemon Bottlbrush	فراشة الزجاج
Chorsia Speciosa	Floss Silk Tree	كوريزيا	Carissa Grandflora	Natal Plum	كاريسا
Cupressus Semperviens	Italian Cypress	السرو	Cestrum Parqui	Lady of Night	ملكة الليل
Dalbergia Sissoo	Sisso	السرسوع	Chilopsis Linearis	Desert Willow	شيلوبيس
Eucalptus Rostrata	Eucalptus	كافور	Datura Candida	Flora plena	داتورا
Koelruterla Bipnnata Heuryi	Chinese Flame tree	كروتولاريا	Dodonaea Viscosa	Hopseed Bush	دودونيا
Melia Azedarach	China Berry	زنزلخت	Duranta Repens	GOLDEN Dewdrop	دورانتا
Olea Europea	Olive	الزيتون	Lantana Camara	Bush Lanatana	لانتانا كمارا
Parkinsonia Aculeata	Jerusalem Thorn	باركنسونيا	Lavender Officinalis	Lavender	لافندر
Pinus Halepensis	Aleppo Pine	صنوبر حلبى	Nerium Oleander	Common Oleander	دقة
Pongamia globra	pongam	بنجاميا	Ocimum Basilicum	Sweet Basil	الريحان
Acacia Arabian	Arabian Acacia	السنط	Poinciana Gilliesii	Bird of Paradise Bush	سيز البينيا
Acacia Farnisiana	Sweet Acacia	الفتنة	Rosmarinus Officinalis	Rosemary	حصالبان
Albiazia Lebeck	Mothers Tongue	البلخ	Tecoma Capensis	Cape Honeysuckle	توكوما حمرا
Araucaria Excelsa	Chrisitmas Tree	عيد الميلاد	Yucca Whipplei	Candel Yucca	يوكا
Azadirchta Indica	Neem Tree	النيم	Phyllanthus Atroporporious	Felantus	فيلانتس
Balanites Aegyptiaca	Balanites Aegyptiaca	نخيل السكر	GROUND-COVER		
Punica Granatum Nana	Pomegranate	رمان الزهور	Pennistum Setaceum	Fountains Grass	بنسيتيم (ديل القط)
Schins Molle	Pepper Tree	فلفل رفيع	Al Ternanthera Amoena	Alanterha	النيترا
Schins Terebinthifolius	Brazilian Pepper Tree	فلفل عريض	Asparagus Sprengeri	Asparagus Fern	اسبرجس خشن
Tamarix Aphyllia	Athel Tree	عيل	Carpobratus Acinaciformis	Ice Plant	حى علم (مبرد)
Taxodium Distichum	Balio Cyress	ناكسوديم	Catharanthus Roseus	Peri Winkle	وينكا
Terminalia Catappa	Indian Almond	ترميتاليا	Gazania UniFlora	Trailing Yellow Gazania	جازانيا متسلق
Palm Trees			Lampranthus Aurantiacus	Orange Ice Plant	حى العلم
Hyphane Thebaica	Hyphane	نخيل الدوم	Lampranthus Spectabilis	Trailing Ice Plant	حى العلم
Cycas Revluta	Sago Palm	نخيل ذيل الجمل	Lantana Montividensis	Trailing Lantana	لانتانا زرقاء
Dracaena	Dracaena	دراسينا	Portulaca Grandiflora	Rose Moss/Sun Plant	رجلة الزهور
SUCCULENTS			Senecio Cineria	Dusty Miller	زيناريا
Agave Americana	Century Plant	اجاف امريكاني	Tegets Patuula Marigold	French Marigold	قطيفة
Agava Marginata	Varegated Century	اجاف امريكاني	Verbena Hybride	Garden Verbena	فريبنيا
Aloe Vera	Medicinal Aloe	الصبار البلدى	Verbena Tenera	Pink Verbena	فريبنيا
Yucca Aloifolia	Spanishbayonet	ابرة ادم	Wedelia Triloba	Wedelia	ويديليا
Yucca Elephantipes	Giant Yucca	يوكا	Pelargonium Peltatum	Ivy Geranium	جارونيا لير
Echinocactus	Barrel Cactus	عمة القاضى	Artemisia Absinthum	Warm Wood	شبح بلدى
Espositoa Lanata	Old Man Cactus	اولدمان	ANNUALS		
Sansevieria Hahnii	Tiger's	جلد النمر / اخضر	Oenothera Speciosa Chiblsii	Mexican Evening Primrose	اونثيرا
Sansevieria Trifasciata	Mother-in-law tongue	جلد النمر / اصفر	Petunia Hybrida	Petunia	بيتونيا
CLIMBERS			Tropaeolum Majus	Nasturtium	ابو خنجر
Euphorbia Tirucalli	Euphorbia	ايغوريبيا ام اللين	Chenopodium Murale	Goose Foot	زرنينخ
Bignonia Unguis Cati	Cat's Clumb	خربوش القط	Amaranthus Graecizans	Amaranth	عرف الديك
Bougainvillea Glabra	Bougainvillea	جهنمية بلدى	Phyllanthus Rolundifolius	Phyllanthus	فيلانتس حولى
Bougainvillea Mrs Butte	Bougainvillea	جهنمية مس بيوت			
Bougainvillea Spectabilis	Bougainvillea	جهنمية دم الغزال			

**Figure (8)** Adrere Amellal eco-lodge in Siwa.



Source: <http://turismblog.ro/regaseste-te-intr-o-oaza-de-liniste.html> (Right)

**Figure (9)** Using drought-tolerant shrubs, trees and ground cover in the steep considerably drought western slopes of Al-Azhar park .



Source: ElMasry, 2013, pp. 77 (Left),86 (Top Right),194 (Bottom Left)

It could be claimed that the future of urban greening in Egypt and similar regions is in water-wise practices to face the threatening water scarcity issue, and simply, xeriscaping provides a water-wise high quality urban landscape that faces these challenges, thus it is not an exaggeration when saying that, Xeriscaping needs to be adopted in all projects concepts, and to be perceived as a national security issue,

that provides adequate urban landscapes for a more sustainable healthier built environments in Egypt.

## **9. CONCLUSION**

The water scarcity phenomenon has a negative effect on all aspects of the community in Egypt whether it is affecting the economy or generally affecting the resident's quality of life, water scarcity in Egypt is mostly the result of limited water resources faced by an increasing demand of the multiplying population.

Xeriscaping as a water conservation method is an easily applicable technique which is basically no more than a 7 step plan based on suitable planning and design, depending on drought tolerant native plantation without compromising the beauty of the landscape, it possess the following advantages:

- Xeriscaping saves water. Using native and other drought-tolerant plants can significantly reduce water use, Typically xeriscaping uses 25-75% less water than traditional landscape designs. More water available for other domestic and community uses and the environment.
- Xeriscaping saves time. It can reduce the time spent in watering, fertilizing and mowing, less time and work needed for maintenance effort.
- Xeriscaping saves money; as reducing water use lowers water bill. Xeriscaping can also reduce maintenance costs—and increase the beauty and value of property, putting in mind that Xeric maintenance is minimal.
- Xeriscape plants in appropriate planting design and soil grading and mulching, takes full advantage of rainfall retention and excess irrigation water.
- Xeriscape plants will tend to survive and thrive, when water restrictions are implemented, by municipality or water costs, while more ornamental plants may be unable to adapt, and this assumption is very real in the Egyptian context.

It is crucial to consider converting to water-wise methods of landscaping such as Xeriscape in order to face the water scarcity within the Egyptian context, which needs the introduction of the xeriscape concepts in landscape courses, and the encouragement of the municipal authorities for this trend, beside the advertising and spreading the advantages between the practitioners, users and the different clients.

Xeriscaping doesn't have to be an "all or nothing" proposition, as it is easy to convert existing landscape plans, to low-water-use plants one zone or area at a time, in order to create more water-wise plans.

Spreading the awareness among citizens is pivotal in the way of facing water scarcity issues, it needs the people's perception and acceptance of a different type of landscape to be enhanced, as a new xeriscaped space is better than no space, enormous challenges are influencing the green space supply in Egypt, and adopting xeriscaping can contribute in addressing these challenges.

Xeriscape is simply our way and first step to provide water-smart landscape designs for spaces in the critical time of drought and water scarcity that we are living in nowadays; it provides smart sustainable solution for green areas supply and maintenance with minimal water consumption

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