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Water Efficient Landscapes Understanding Surface and Groundwater for Smart Cities Landscaping

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Abstract

Understanding simple techniques in Water Efficient Landscapes to enhance Surface water utilization and Groundwater Replenishment in Smart cities as a part of Landscape development and management. The paper discusses main features of water saving through efficient landscapes. A city equipped with basic infrastructure to give decent quality of life, a clean and sustainable environment through application of smart solution with a wise management of natural resources, through participatory action and engagement. The term sustainable development goes beyond the boundaries of science and business development and trade to include human development, values and differences in culture.

Keywords*: Percolation, Precipitation, Run-off, Evapo-Transpiration, Infiltration, Groundwater Recharge*

INTRODUCTION

OUR WATER RESOURCE

Water is one of the most abundant resources on Earth, covering three-fourth of the planet's surface. 97% of Earth's water is saltwater in the oceans and of the 3% fresh water, most is located up in polar ice sheets. Only a minute percentage of the Earth's water is in groundwater, lakes and rivers "Fig.1". This water supplies most of the humanity. Most of India and its cities depend on surface water and rainfall. Thus water is a precious resource, which we cannot continue to use as an unlimited resource.

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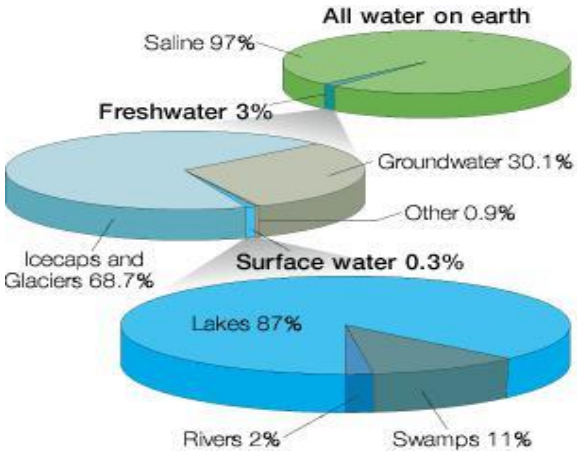


Figure: 1Distribution of water on the planet earth (Image Source: www.pacificwater.org)

As India moves towards developing numerous Smart cities, we can take an optimistic approach for Conservation of groundwater in Landscape Designs. With better plant knowledge and emphasis on water efficiency through various design elements, landscapes can be developed. Preparing for a water deficiency now is a sensible choice rather than to face the consequences later. With regard to our current cities, combined with sharply increasing demand water resources are becoming more precious in urban areas.

Short-sighted and unwise use of water resources in the past has resulted in an all-time high water dependency. Thus Smart cities with Water-Efficiency in landscape designs are certainly a stride further in sustainability and appropriate utilization of the limited natural resource –"WATER"

WATER AND LANDSCAPES: The water cycle

The entire water cycle on the planet is a closed system. Water changes its form and location, but no water which has existed on the earth has ever disappeared. In its simplest form the water cycle consists of evaporation, transpiration collectively known as evapo-transpiration and precipitation. "Figure: 2".

Man has very often interfered or has modified this natural water cycle by using the groundwater from aquifers for irrigation in rural areas and to meet the colossal water requirements in the urban areas.

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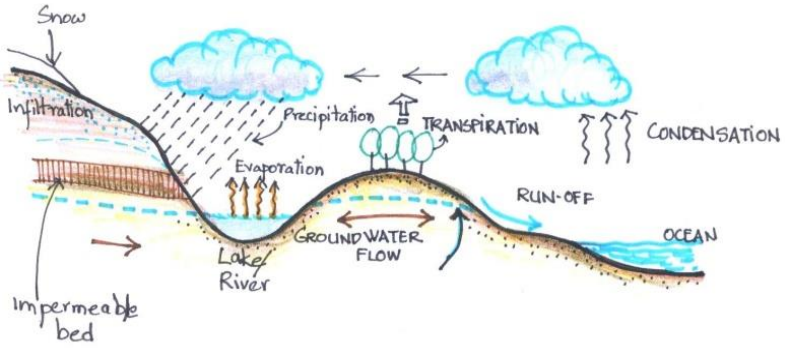


Figure: 2 Hydrological Cycles

(Image Source: www.pacificwater.org).

Generally human interference and modification are both expensive and energy consuming. The aquifers are being depleted because of excessive pumping for use in agriculture, industries and residential purposes. The largest consumers of water include Agriculture, Industries, and Landscape etc.

Man-made Landscapes and its Water Consumption

Landscape water consumption can include watering the lawns, shrubs ground covers etc. It also includes washing of pavements or footpaths, use of water to fill the water features like fountains and water bodies. Landscape designs can be highly sensitive and can help to conserve water in a number ways.

The amount of urban water use depends on climate, level and efficiency of public supply services, patterns and habits of water use by the population, technological changes and socioeconomic instruments. Urban water use is not evenly distributed over time as households and services tend to demand more water in hot and dry periods. There are also seasonal variations in population, for example due to tourism, that influence the amount of water used at a particular time. The deficiency in supply of water available on ground leads to depletion of groundwater aquifers.

WATER AND OUR CITIES

With the rise in population, drastic change in the climatic conditions and lack of awareness among people, the water consumption has exponentially increased in the urban areas as well as the rural areas.

Sources of water

In the urban scenario, the major source of the water supply would be by the local authorities. This water can be sourced from ground water aquifers, rivers, lakes

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etc. Ground water utilization in terms of bore wells, tube wells is also seen. Another set of source includes the wells and tanks utilizing the ground water. Rainwater is a major contributor for the groundwater aquifers. Thus rainwater utilization is considered the best method of conserving water.

Reasons for inefficient use of water

Landscaping is always preferred by all. The reasons for the wastage of water in landscapes can be either the use of water Inefficient systems or the use of overdesigned systems. Either the equipment used may be faulty which results in inappropriate use of water or the systems are designed for higher values of usage which may be a burden on the water requirement of the landscaped spaces.

The areas which come under landscape can be the Softscape which includes the lawns, ground covers, herbs, bulbous plants, climbers, shrubs and trees etc. The other category is the Hardscape which can include the water features like fountains and stagnant water bodies, lily ponds etc.

WATER-EFFICIENT LANDSCAPES

Water-efficient landscapes include those which require very limited watering and maintenance. These landscapes are dependent on various conditions some of which include the rainfall, soil conditions, wind movement in the region etc. They utilize the ground water available or require very less watering.

Such landscapes also have very little surface run-off as they utilize the water to the maximum before allowing excess water as run-off.

Native plants become a very integral part of the water-efficient landscaping. Any landscape that is developed and maintained with a low requirement of supplying additional water to the soil, other than that supplied to it by rainfall can efficiently use water.

A. Design and Development

To design a new landscape or to modify an existing landscape, planning plays a critical part of the process. The first step in planning a water-efficient landscape is the process of site analysis [1]. Through very basic and simple techniques the water on the surface and below the surface of earth can be utilized and conserved.

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Site analysis and existing site features: Existing trees, shrubs, and bare ground or area covered by ground covers should be considered in the design. The sun and wind exposure, topography, and drainage shall aid in designing. Relationships among all these site features are vital. Planning considerations: For example, Existing shade trees should be left untouched wherever possible, because landscapes having shaded areas are cooler and need less water than bright areas which are exposed to sunlight.

Areas that require grading, paving or any other type of construction should be planned at the design stage. This shall effectively reduce the utilization of groundwater aquifers as a source of water. “Fig.3”

Use the rainfall and run-off on site: Areas that receive more water, such as precipitation runoff from the roof or depressions on the natural land that collect water, should also be noted. This shall help in gradually replenishing the groundwater aquifers through constant infiltration and percolation of water.

Right choice of soil mixtures: Good, well drained and water retentive soil is one of the best ways to preserve landscape plants during times of water shortages. Compacted soil wastes water, causing it to runoff and not be used by plants. Soil that is too loose causes water to be wasted because it is not retained for use of the plants. This also helps in greater percentage of run-off transformed into aquifer recharge through percolation.



Fig.3: Regrade the land and allow water to percolate

(Image Source: www.pacificwater.org).

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Simple Landscape design elements

a) Paving details: Paving mostly is impervious to falling water. Therefore when rainfall and runoff falls on asphalt or concrete it flows across the paving and into a storm water outlet where it is carried to a treatment plant or disposed off into a water body.

b) Curb details: Various curbing configurations funnel or channel the water to drain inlets or curb inlets which enables the water to move into storm water systems and off. But it is always advisable to design or install curbs to allow water excess water into a planting area while a saw-tooth or dragon tooth curb may vent rainfall runoff into vegetated areas.

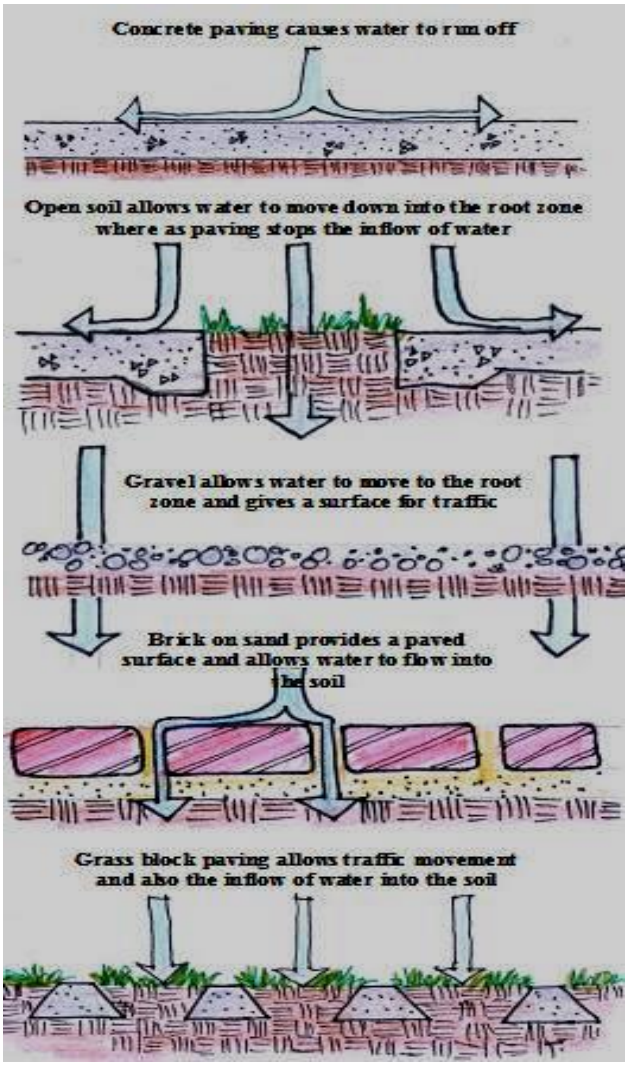


Fig.4: Variations in paving for water conservation

(Image Source: www.pacificwater.org).

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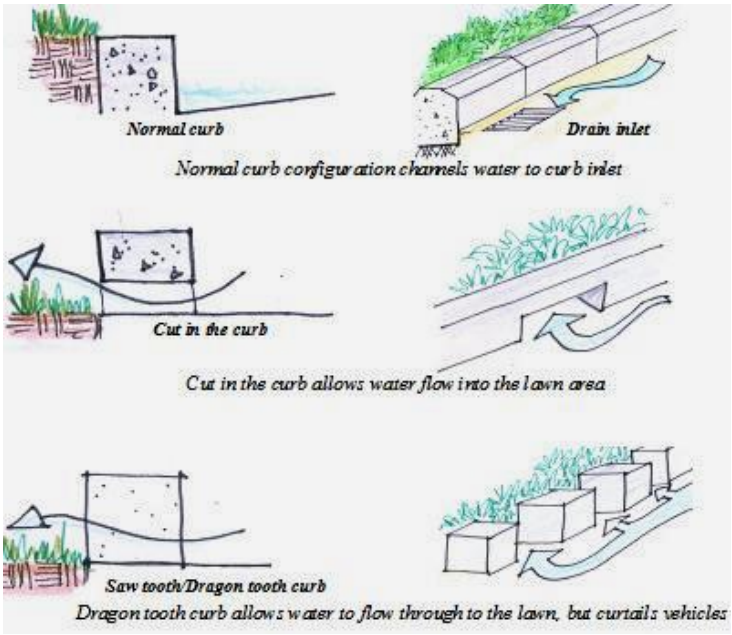


Fig.5: Variations in curbing for Water conservation (Image Source: www.pacificwater.org).

Thus the paving can be so designed to admit water into the soil rather than encouraging it to runoff, thereby allowing more water to stay on site and need not be replaced by external watering. There are a number of ways in which paving can admit water into soil. Paving mostly is impervious to falling water. Therefore when rainfall and runoff falls on asphalt or concrete it flows across the paving and into a storm water outlet where it is carried to a treatment plant or disposed-off into a water body. The water can be slowed, channeled or directed so that it does not cause erosion or damage to the plants or to the soil. A rolled curb may allow water to flow through the curb and on to a planted area.

Advantages of Water-efficient landscapes

Proper landscaping techniques not only create prominent gardens, but also benefit the environment and save water. Water efficient landscaping also has other economic and environmental benefits like:

- Conservation of natural resources and preservation of habitat for plants and wildlife.

- Decreased energy use (and air pollution associated with its generation) because less pumping and treatment of water is required.

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- Lower water bills from reduced water use.

- Reduced home or office heating and cooling costs through the careful placement of trees.

- Reduced runoff of storm water and irrigation water that carries top soils, fertilizers and pesticides into lakes, rivers, and streams.

- Extended life for water resources infrastructure (e.g., Reservoirs, Treatment Plants, Groundwater Aquifers)

- Reduced landscaping labour and maintenance costs.

CONCLUSIONS

By following certain basics principles of Water efficient landscapes we can develop smart cities and be ecologically sustainable.

The basic principles of water-efficiency in landscape design firstly involve proper planning in design and Development. Secondly the use of wind barriers make a huge difference in the evapo-transiprational losses thereby leading to less depletion of groundwater resources by plants for their survival even in the harshest climates.

Thirdly the existing soil can be improved to allow greater percolation of rainfall or run-off water which aides in the replenishment of groundwater aquifers.

This can be further reinforced by efficient irrigation systems like sprinklers and drip irrigation which provide water which is just sufficient for the plants to grow rather than using traditional techniques of flood irrigation. The irrigation systems also need to be designed based on the climate and the appropriate grouping of plants and their water requirements [2].

Sometimes our ancient traditional methods do have crucial learning's for all of us. For example the system of mulching which is coined as a new term in India in fact was used from the ancient times. The use of leaf litter as a mulch is an excellent example to conserve water and its losses.

Many organic and inorganic types of mulch can be widely used in the landscaped areas. "Fig.6". They also allow moisture to be retained for a longer time thus allowing slow utilization of

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groundwater by plants. The idea behind mulching is inspired from the natural process of leaf shedding in the forest and decomposition of the same to act as manure.

We can thus realize that our responsibilities as a designer mainly lies in being sensitive to what we have in nature and to judiciously use them. Simple techniques can lead to a smarter city and can be extremely effective on the longer run.

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