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Water Conservation Strategies in Emory University (Atlanta) and its Implementation in India

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Abstract: It is an extremely ironical fact that although 70% of Earth is covered with water, yet many countries across the globe are witnessing a water crisis. There are finite sources of safe drinking water that is fundamental to human well being. Consequently water conservation and management forms the root of all sustainable development initiatives and is critical for the survival of human life on the planet, healthful ecosystem and the socio economic development. United Nations Department of Economic and Social Affairs has identified a trend that will see two-thirds of the world's population living in water-stressed countries by 2025. However in India, sustainable practices still remain under covers besides alarming ground water table levels, inadequate climatic conditions, farmers' plight, natural disasters, loss of bio-diversity and disturbed hydrological cycles. Community initiatives are negligible as far as the Grey Water Management is concerned. The paper intends to deal with the study of innovative water management initiatives by the Emory University, Atlanta. Taking lessons from the Georgia drought, the Emory University has developed a comprehensive storm water management plan addressing the problems of storm water management and overall water conservation at Emory's campus. The paper takes account of the retrofitting fixtures as well as the behavioral amendments under taken to conserve water. Many field experts in earlier years after having studied the best sustainability practices of the developed nations have tried to implement the same in Indian setting. But the probability of the success of such implementations is not very high. India, being a country of rich cultural heritage, faces ideological conflicts with the western strategies. Finally the paper defines basic societal challenges and issues in the acceptance of sustainability measures in India and a brief overview of how these issues can be resolved with and without government intervention.

Key words: Water, Socio Economic Development, Grey Water, Storm Water Management, Retrofitting Fixtures, Conservation, Sustainability, Potable Water, Green Building

1. Introduction

Earth is generally regarded as the “Blue Planet” of the universe. This is because of the abundant availability of water on the surface of this planet. After the air that we breathe in, water is the most crucial natural resource essential for the survival and earth is the only planet known so far that is blessed with the ample reserves of both these resources. As it is generally known, around 71% of the earth is covered with water and from this amount only 3.5% is available as the fresh water[1]. As stated by the World Wildlife Fund, There are more than 326 million trillion gallons of water on Earth. With such an immense figure, one might feel that the reserves are enough for the survival of species for at least a few million years, but the actual truth is represented in the picture below.

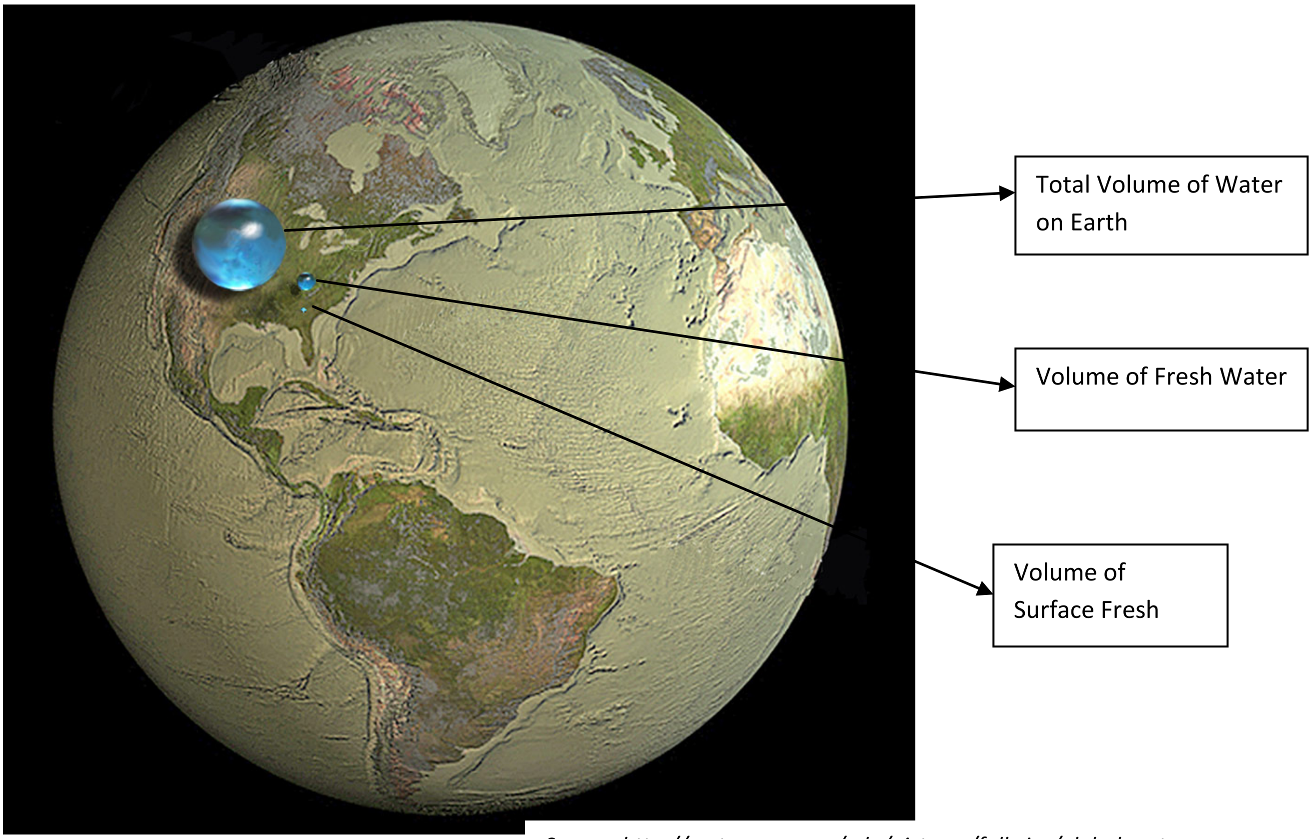


Figure 1: Representation of Water on Earth

Source: http://water.usgs.gov/edu/pictures/full-size/global-water-volume-fresh-large.jpg

The picture above shows the relative amounts of water on earth in comparison to the size of the planet. The largest sphere represents the total water of the earth as it is present in oceans, rivers, lakes, springs and even inside the metabolic structures of flora and fauna. The second sphere is the fresh water which is required for the survival. It is present as groundwater, swamp water, lakes and rivers. The smallest sphere which actually appears as a tiny dot is the fresh water in all the rivers and lakes of the planet. This bubble is vital

[1] Information on Earth's water by Kimberly Mullen, CPG

because most of the water people and life of earth need every day comes from these surface-water sources.

Water comprises approximately 66 percent of the weight of an adult human. The amount of water by weight in animals varies from as high as 97 percent in the jellyfish to as little as 48 percent in the pea weevil. Thus from a purely physical viewpoint, all life is dependent upon water. In addition to its indispensability for biological survival, water is of crucial importance to business and industry. Water is used in many manufacturing processes and in construction, either as an aid in production of, or as an ingredient in, the final product. While it is conceivable that substances other than water could be used for some processes, the cost and the technology of the processes would be unfavorably affected by such a change because of water's relatively low cost and its unique characteristics. **(Authenbach, 1968)**

2. World Water Scarcity

Water is a renewable resource. it is very soothing to see it from this viewpoint that water replenishes itself by natural means, yet conservationists fear severe droughts in many parts of the world due to the limitless exploitation of resource. Japanese scientists say the Earth could be dry and barren within a billion years because the oceans are draining into the planet's interior. Researchers from the Tokyo Institute of Technology have calculated that about 1.12 billion tonnes of water leaks into the Earth each year. Although a lot of water also moves in the other direction, not enough comes to the surface to balance what is lost. **(Maruyama, 1999)**

The world water council argues that ome 1.1 billion people worldwide lack access to water, and a total of 2.7 billion find water scarce for at least one month of the year. Many of the water systems that keep ecosystems thriving and feed a growing human population have become stressed. Rivers, lakes and aquifers are drying up or becoming too polluted to use. More than half the world’s wetlands have disappeared. At the current consumption rate, this situation will only get worse. By 2025, two-thirds of the world’s population may face water shortages.

The scarcity of water can be either the lack of sufficient supply of water (quantitative) or the lack of adequately clean water for daily purposes (qualitative). It involves three basic phenomenon: water stress, water deficit and water crisis. Water Stress is the difficulty of obtaining sources of fresh water for use during a period of time and may result in further depletion and deterioration of available water resources. Water deficit is the lack of clean water in the sources due to climate change, overuse, altered weather patterns due to droughts and floods.

The issue of water scarcity is a very crucial challenge for the world leaders. It is evident from the fact that the United Nations Committee on Econimic, Social and Cultural Rights established a foundation of five core attributes to water security. They declared that the human right to water entitles everyone to sufficient, safe, acceptable, physically accessible, and affordable water for personal and domestic use. At the millenium summit in the year 2000, eight Millenium Development Goals were drafted and one of these goals sets a target for reducing the proportion of the population without sustainable access to safe drinking water by half by the year 2015.

Water is the driving force of all nature, Leonardo da Vinci claimed. Unfortunately for our planet, supplies are now running dry – at an alarming rate. The world's population continues to soar but that rise in numbers has not been matched by an accompanying increase in supplies of fresh water. In the Middle East, swaths of countryside have been reduced to desert because of overuse of water. Iran is one of the most severely affected. Heavy overconsumption, coupled with poor rainfall, have ravaged its water resources and devastated its agricultural output. Similarly, the United Arab Emirates is now investing in desalination plants and waste water treatment units because it lacks fresh water. **(McKie, 2015)**

3. Water Crisis – A threat to Peace

In January 2014, scientists have reffered to the NASA images and inferred that from California to the Middle East, many parts of the world are drying up. These images showed the artics and tropics, the already wet portions of the planet getting wetter whereas the arid and semi-arid regions of the middle latitudes getting drier. The Middle East, North Africa and South Asia are projected to experience water shortages in the coming few decades due to bad management and overuse. Peter Gleik, President of the Pacific Institute found in his study a fourfold increase in the confronttions related to water. Several other countries like Egypt, Jordan, Syria and UAE are either struggling to safeguard their natural reserves of water or are fighting the influx of refugees and huge burdens due to investment in desalination projects. The crown prince of Abu Dhabi declared at a conference that for them, water is now more important than oil. However, water, on its own, was unlikely to bring down governments. But the report warned that shortages could threaten food production and energy supply and put additional stress on governments struggling with poverty and social tensions. **(Goldenberg, 2014)**

The global experts and the US intelligence agency have already warned the international leaders of a resource shock world. It has predicted two nightmare scenarios: a global scarcity of vital resources and the onset of extreme climate change — are already beginning to converge and in the coming decades are likely to produce a tidal wave of unrest, rebellion, competition, and conflict. The annual supply of drinking water from the natural precipitation generally remains constant (40,000 cubic kilometers). But most of this precipitation lands in Greenland, Antractica, Siberia and Inner Amazonia where there are very less people living. On the other hand, the region between the two tropics where most of the population of the world lives and the demand grows constantly, water supplies are relatively sparse. The result, even when the supply remains constant, is an environment of increasing scarcity. Normally when we consider climate change, we think of melting glaciers, rising sea levels, extinction of bio diversity, expanding deserts and intensifying disasters. But a growing number of experts are coming to realize that the most potent effects of climate change will be experienced by humans directly through the impairment or wholesale destruction of habitats upon which we rely for food production, industrial activities, or simply to live. Essentially, climate change will wreak its havoc on us by constraining our access to the basics of life: vital resources that include food, water, land, and energy. This will be devastating to human life, even as it significantly increases the danger of resource conflicts of all sorts erupting. **(Klarke, 2013)**

3.1. Water in crisis - India

According to the World Bank, India has taken noteworthy steps to reduce poverty but the number of people who live in poverty is still extremely disproportionate to the number of people who are middle-income, with a combined rate of over 52% of both rural and urban poor. According to 2001 census figures, 77.9 per cent of India's population had access to safe drinking water. At 90.0 per cent, urban population was better placed than 73.2 per cent of rural population. However, these figures might be deceptive and the actual picture emerges only when we glance at the individual cities.

A survey conducted by Tata Institute of Social Science (TISS) showed 50 lakh households in Mumbai, Delhi, Kolkata, Hyderabad, Kanpur and Madurai are water. World Health Organisation (WHO) specifies that minimum water requirement should be 100-200 litres per day. That is way above the average urban figure, 90 litres. Also, it is important to bite that nearly 40 per cent of water demand in urban India is met by ground water. So ground water tables in most cities are falling at alarming rate of 2-3 metres per year according to the TISS study. Another significant factor is water leakage. Delhi loses at least 30 per cent of its water due to leakages in its 83.0 km long pipeline network. Mumbai loses about 20 per cent of its water due to leakage.

India's water crisis is basically rooted in three main causes. The first is inadequate water per person as a result of population growth. With a population of 1.2 billion according to the 2011 census, India has only 1,000 cubic meters of water per person. A country is considered water-stressed if it has less than 1,700 cubic meters per person per year. The second cause is poor water quality resulting from unsatisfactory and delayed investment in urban water-treatment facilities. Water in most rivers in India is mainly not fit for drinking, and in many stretches not even fit for bathing. Despite the Ganga Action Plan, which was launched in 1984 to clean up the Ganges River in 25 years, much of the river remains polluted with a high coliform count at many places. Furthermore, industrial effluent standards are not enforced because the state pollution control boards have scarce technical and human resources. The third problem is diminishing groundwater supplies due to over-extraction by farmers. This is because groundwater is an open-access resource and anyone can pump water from under his or her land. Further, India's rate of extraction has been steadily growing from a base of 90 bcm in 1980, while this rate in the United States has remained at more or less the same level since 1980.

4. Best Practices

The tragedy of India's water scarcity is that the crisis could have been largely avoided with better water management practices. There has been a discrete lack of awareness to water legislation, water conservation, efficiency in water use, water recycling, and infrastructure. Historically water has been viewed as an infinite resource that did not required to be managed as a scarce commodity or provided as a basic human right. These attitudes are changing in India; there is a increasing desire for decentralized management developing, which would allow local municipalities to manage water as best desirable for their particular region.

4.1 The Columbia Water Center/Punjab Agricultural University Partnership:

To address the problem of groundwater sustainability in Punjab, the Columbia Water Center has partnered with Punjab Agricultural University (PAU) to promote the use of technology and science in farming.

The CWC-PAU initiative in Punjab aims to trim down the water demands of agriculture by engaging farmers, agricultural corporations, insurance providers, and regional agencies in a field project to adapt better crop choices, irrigation practices, and insurance options. Over 500 farmers across 50 villages in Punjab have as a result implemented water-saving techniques in five of the twenty districts–Amritsar, Jalandhar, Ludhiana, Moga and Sangrur. The farmers continue to grow rice but utilize targeted techniques to endorse water efficiency throughout the process. Technologies includes laser leveling of fields before sowing and the use of tensiometer technology for effective irrigation scheduling.
(Perveen, 2010)

Moreover, in lieu of the main objective to solve the water crisis issue, the CWC/PAU organized various workshops and meetings to initiate discussions with the farmers on water issues. The initiative intends to reduce the impact of climate uncertainty through changing water use patterns, diminishing resource depletion and reducing energy use, all while maintaining yields and income. By shifting the spotlight from water development to water management, the project aims to reduce pressure on rapidly vanishing groundwater reserves in the region by combining research and best practices in both economics and ecology. Further policy and project interventions include the late transplantation of rice, direct seeding of grains, and the promotion of diversification towards more remunerative and less water-intensive crops such as basmati, sweet corn and baby corn—crops that have the potential to become increasingly profitable to farmers while consuming significantly less water than rice.

4.2 Akole Taluka

The practice originated from research collaboration between the non-governmental organization BAIF Development Research Foundation (Pune, Maharashtra, India) and University of Windsor Earth Sciences (Windsor, Ontario, Canada), who worked in partnership with the tribal and rural people of Akole Taluka. The beneficiaries are the people of the villages Ambevangan, Manhere and Titvi and outlying areas.

Masonry check dams, gabion structures, and gabion structures with impervious, ferrocement barriers were constructed across the valleys of ephemeral streams at different locations to impound water in reservoirs on the up-slope side. Gabion structures were held together by galvanized iron chainlink. Shallow bedrock provided the foundation. An underground stone dam also was constructed to localize the occurrence of ground water, which is accessed through a dug well.

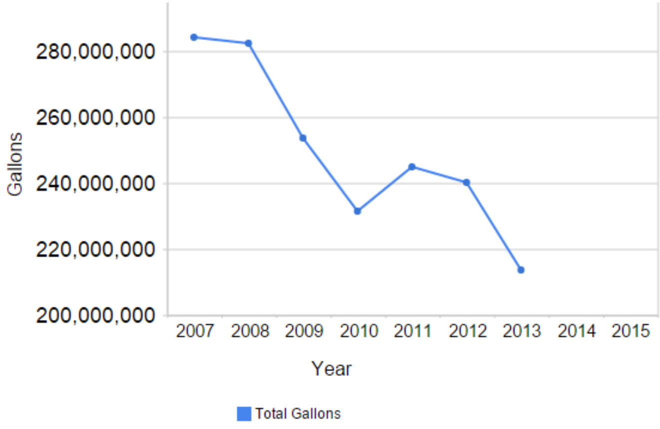
Barriers, including some gabions and masonry gully plugs, were constructed at right angles to the slope to reduce runoff velocity and to trap eroded soil. Hedges also were planted at right angles to the slope on selected hillsides. Local vegetation was augmented through additional planting in areas of wasteland. These strategies of revegetation also had the effect of reducing soil erosion. Roof water harvesting was introduced into the villages as a partial response to the priority placed by the people on a domestic water supply. The houses in the villages are of stone and mud and have tiled roofs, which form effective catchments. Gutters of galvanized iron were added and connected to ferrocement storage tanks by means of PVC pipe. Infiltration (recharge) pits, in the vicinity of dug wells, had the effect of improving water yields. Existing bore wells were given an extensive workover in order to improve their yields.

5. Case Study- EMORY University

Emory University is one of the top ranked internationally recognized universities located amidst the historical Druid Hills suburbs of Atlanta, Georgia (USA). Emory identifies sustainability as a top campus priority, with a vision to help restore the global ecosystem, foster healthy living and reduce the university's environmental impact. This university is ranked in the top 25 institutions with an overall commitment to sustainability. Emory University strives to meet the need of present generations without compromising the needs of future generations. In 2004, Emory University adopted sustainability as a guiding principle and inscribed it into the 2005-2015 Strategic Plan. Since that time, the university has become known for innovations in green building, curriculum development, sustainable food and procurement, and energy and water conservation. **(Emory University, 2015)**

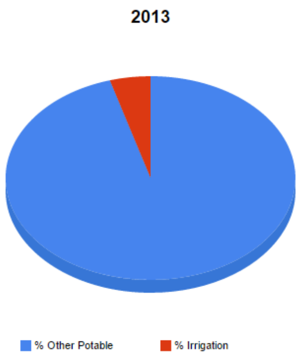
5.1 Water Consumption at Emory University

This graph represents water used directly by Emory University and Emory Healthcare for irrigation, cooling, drinking, food preparation and other direct uses. The decrease in our water consumption is directly tied to the water conservation efforts in our buildings and a decrease in potable water used for landscape irrigation due to the recent Georgia drought.



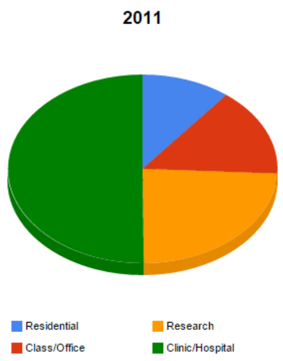
Source: http://sustainability.emory.edu/html/dashboard/water-use-by-year.html

The pie-chart shows a comparative analysis of percentage of potable water used for irrigation v/s potable water used for other facilities in buildings in 2013. From the data sets available in the database of Emory University, between 2007 and 2013, only 4.9% of the total potable water consumed has been used for irrigation purposes. Emory has worked hard to harvest rainwater or use plantings with low watering demand in order to keep the campus green.



Source: http://sustainability.emory.edu/html/dashboard/water-irrigation-v-potable.html

The next figure below represents the water consumption of Emory University based on the type of water usage for 2011. Healthcare is Emory's largest water user due to the need to constantly occupy facilities and 24-hour a day operations.



Source: http://sustainability.emory.edu/html/dashboard/water-use-by-type.html

5.2 Water Conservation Steps

1) Emory University reuses sewage water to heat and cool its campus. Recycling of water for this purpose is done through a system called WaterHub. Emory's WaterHub looks like a fancy greenhouse with a solar panel installation on the side. According to Mathew Early, vice-president of campus services, "It takes wastewater, cleans it, and then we're reusing it in our steam plant and chiller plants". It goes through several bioreactors and ultraviolet disinfection before it's

transferred to underground storage tanks that hold 50,000 gallons of water. There are lots of green plants inside and outside the greenhouse. They're part of an elaborate water purification system that recycles up to 400,000 gallons per day – that's about 40 percent of all of the water that Emory uses. **(Shamma, 2015)**

Source: http://mediad.publicbroadcasting.net/p/wabe/files/201504/EmoryWaterhub2_042015.jpg

2) Emory University has engaged Siemens Industry, to retrofit campus buildings in order to improve their energy efficiency and decrease water consumption. They advised to replace the existing plumbing fixtures with new and water conserving models. (Gray, 2010)
3) As per the achievements claimed on the university website, Emory manage to save 2.8 million gallons of water per year with the help of its closed loop laser system installed in the math and science centre.
4) The Whitehead Biomedical Research Building and Emory-Children's Center conserve water and energy at the same time by using large heat wheels to wring the humidity out of the atmosphere, resulting in almost 4 million gallons per year of water being captured and used in Emory's chilled-water system.
5) Emory's Evans and Few residence halls, designed to LEED standards, pump collected rainwater using solar power to flush toilets. Emory's Longstreet and Means first-year residence halls collect grey water and rain water for toilet flushing.
6) Low-flow shower heads, dual-flush toilets, and low-flow urinals are installed at various locations on campus.
7) Rainwater cisterns holding over 350,000 gallons of collected rainwater can be used to water campus trees and gardens.

5.3 Vision 2025

Emory University has drafted a vision document as a statutory framework to guide the sustainability initiatives of the university towards community involvements. They have decided 2025 as the target for the completion of the tasks mentioned in the draft report taking 2015 as the base line. The university intends to integrate sustainability into the life of the campus through academic programmes and degrees to assure universal sustainability literacy and leadership throughout a student's life. With a pledge to conserve water, Emory University plans to Eliminate drinking water use for heating, cooling, toilet-flushing, and other non potable uses, with a goal to reduce campus water use by 50%.

6. Conclusion – Yet Several Miles to be Covered

From the case study discussed above, it is very evident that it is possible to conserve huge volumes of water with a tint of sensitivity and awareness in our day to day livings. The solutions taken up by the administration of Emory university are an excellent example of designing a sustainable building that decreases the load on the narural resources consumed by the building itself and its occupants. However, these fixtures have been induced with high-end technological advancements that are quite difficult to be implemented in the residential areas. But the installation of low flow plumbing fixtures can help save huge amounts of water annually. Also the major universities of India and large development projects that are carried out should adopt technologies such as WaterHub and Closed Loop Laser System as a part of operation and maintenance of the building.

Without refering to the actual statistical data, it can be easily inferred that the comparison of Emory University in Atlanta with Inidan scenario is not suitable and justifiable. This is because of the huge difference in the population densities, settlement typology and literacy rates. Hence, by adopting same techniques as Emory did in its campus, we cannot expect any Indian settlement to produce same results. The old buildings are reluctant to intervene with the structure of their building in order to incorporate such new retroffitting structures for sustaianbility. Moreover, even the majority of new constructions that are coming up do not tend to show much interest towards resource conservation strategies. This is because of unawareness in terms of cost-benefit analysis.

Relenting upon just the mistakes of the past and challenges of the future are not the enlightening sources of the path of sustainability. It involves actions in the present. On the side of the government authorities, they can check for the effective and stringent implementations of the water conservation standards mentioned in the National Building Code 2005. Also there can be Water Conservation Building Code on the grounds of ECBC that can be published as a reccomended framework for the water conservation by buildings. The developers, real estate giants and authorities should largely promote the green building rating systems such as LEED and GRIHA. This is enable the buildings to save not only water but to decrease the overall footprint of the building. But it is not the duty of only authorities, individuals have a pivotal rople to play in protecting the resources.

Hence we should subject them to judicial use and plan our strategies after proper environmental and social impact assessment.

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