Journal of Modern Science and Technology
Vol. 1. No. 1. May 2013 Issue. Pp.167-175

Roof Top Rain Water Harvesting System in Dhaka City

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Bangladesh has a warm humid tropical monsoon climate. Here rain falls almost each of the months of the year except the winter season. The aim of this paper is to high light the design of a sustainable water harvesting system for traditional sloping roof at rural and modern flat roof at urban area in Bangladesh. The methodology of the system is that the rainwater is harvested by collecting and storing rain water from a roof top into a large container. This container is cheap and easy to install. Rainwater that falls on a roof top it can be storage via a system of pipes. The first flush of rainwater after a dry season should be allowed to run to waste as it will be contaminated with dust, bird droppings etc. Roof should have sufficient incline to avoid standing water. The pipes are strong enough, and large enough to carry peak flows. Storage tanks should be covered to prevent mosquito breeding and to reduce evaporation losses, contamination and algal growth. However the amount of water collected is restricted by the weather. For urban area to get enough rain water every home would need to have its own collection system for the use of flushing and gardening purpose in Dhaka city. This means that initial installation charges are high but when this system is in place the water is free. The result shows that water harvesting system is an energy efficient technology and it leads to reduce water bill in urban Dhaka city. Rainwater harvesting systems require regular maintenance and cleaning to keep the system hygienic and in good working order.

1 Introduction

"Rain water harvesting" means collecting rainwater. Rooftop rain water harvesting is a system of collecting the rainwater that runs off from every roof. A popular and easy way to catch rain is by filtering the water through the gutters on roof. Once the water travels through the gutter, it is directed into a holding tank, and can then be used for any water needs people have. In most cases, it is used for non-potable applications but can become potable and it also used for drinking if proper filters are used. Rainwater is an easily obtained resource, and it is an excellent way to satisfy local people watering needs. People can save on well and fresh water, energy, irrigation water and municipality water by storing up this precious, free water that comes from the clouds above. Rain water harvesting stems representative can provide people with several options of how to start rainwater collection. Bangladesh has a warm humid tropical monsoon climate. Here rain falls almost each of the months of the year except the winter season. The aim of this paper is to high light the design of a sustainable water harvesting system for traditional sloping roof at rural area in traditional houses and modern flat roof at urban area in Bangladesh. Availability of long-term information on the variability of water resources in urban area is particularly important for sustainable resource management. Water based management and policy issues that also impact

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on economics and society of the country. *Bangladesh has a warm humid tropical monsoon climate. Here rain falls almost each of the months of the year except the dry winter season so* rain water harvesting is a sustainable technology in Bangladesh

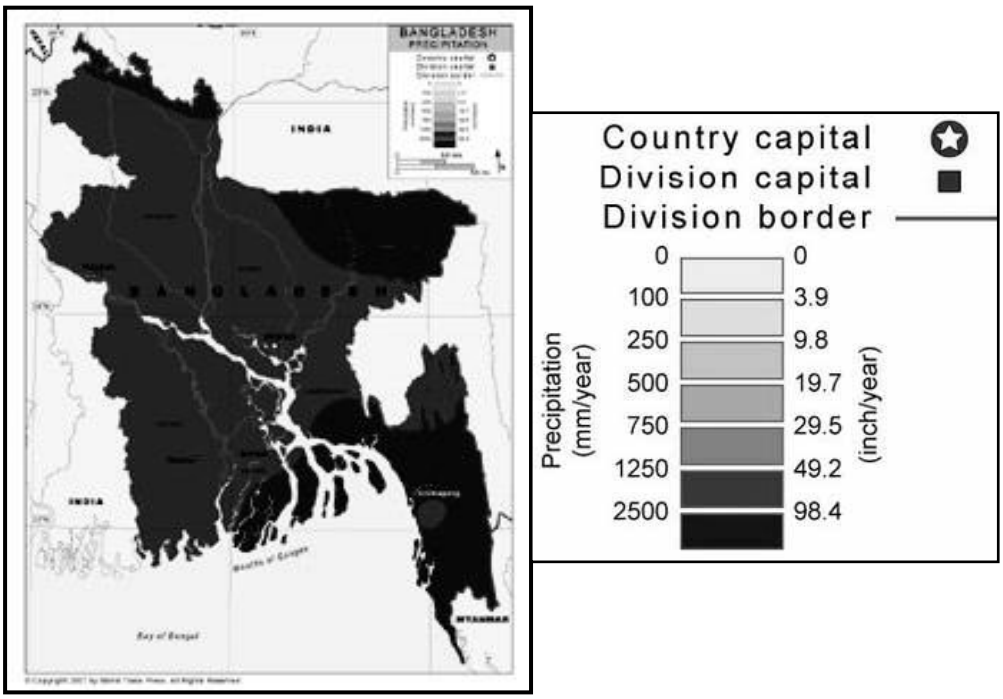

Figure 1: Average Rainfall or Precipitation in Bangladesh (Source Dhaka Weather Office)

2 Present Water Problem in Bangladesh

Now a day during dry season water is a big problem in Bangladesh. The effect of climate change, unorganized urban development on river bay and discharge of human and industrial waste and new chemicals from industries are key factors that contribute to deteriorating the quality of water and causing severe health hazards. Water quality is directly related to human health, economic activities, ecosystem and biodiversity (Mujibur Rahaman, 2010). Domestic sewage, industrial waste and agro-chemicals hugely pollute the surface water of the Buriganga, Balu and Sitalakkhaya rivers.

Figure 2: Waiting For Fresh Water Supply from Private Organization Truck in Bangladesh (Source: Rafiq Arif)

Figure 3: Human Chain for Demand of Fresh Water Crisis in Bangladesh (Source: Prothamalo News Paper)

The total ecosystem as well as biodiversity is being affected today and it is related to water quality. The people should formulate Clean Water Act following Rain water harvesting strategies of the developed countries to stop water contamination and ensure drinking water for all. Various water quality parameters in Bangladesh have deteriorated 16 to 20 times in recent times than those were in 1976. Industries are mainly polluting water. 60 percent of our contaminated water is created by industrial waste, 30 percent by Dhaka WASA and the rest percentage by Dhaka City Corporation (M Feroze Ahmed, 2010). 70 percent infant mortality is caused by lack of safe water supply, which could be prevented just by ensuring safe water supply (SMA Rashid 2010). Due to the increasing volume of the industrial waste generated all over the world, finding efficient and cost effective treatment methods to remove pollutants is increasingly being studied as a method to supplement limited fresh water resources in countries (A.Fakhrul razi,*et al*. 2010).most of these techniques are only suitable for pretreatment of industrial waste polluted water for in reuse. However, a more efficient technology should be em-

ployed when these water are to be reused (J. C. Campos;et al. 2000).further more, to produce high quality treated water for recycle and reuse, a series of different technologies should join together (A. Fakhru'l-Razi; *et.al.* 2009). Biological treatment of industrial waste polluted water is considered environmental friendly but a cost effective technology. To solve this fresh and safe water problem in Bangladesh through rain water harvesting system will be an effective strategy for environmental sustainability.

3 Importance of Sustainable Design for Rainwater Harvesting

Water is a potential resource for recovery, reuse and recycling (F. Hum,et al. 2005). Reuse of rainwater for irrigation, livestock or wildlife watering and habitat, and various industrial uses such as dust control, vehicle washing power plant make-up water, and fire control (J. Veil, *et. al.* 2004).

The climate of Bangladesh is characterized as semi-arid and may be one of the most important problems for agriculture encountered is insufficient water resources; since rainfall is remarkably lower than average. Therefore, there is a need to develop effective irrigation systems for the region in order to irrigate a larger area with same amount of water (B. Acar, 2010). Modern irrigation technologies have high water savings under well management especially semi-arid regions of the world. Some advantages of drip and sprinkler irrigation systems are; due to the high irrigation efficiency, size of the irrigated land with current water supply is higher comparison to surface irrigated areas and is possible to obtain high crop yield as well as more income with rain harvesting policy is better management in Bangladesh.

A prime objective of sustainable design is the conservation of quality water resources through water recycling and rainwater harvesting where practicable for a given locality. Water conservation is an important sustainable design goal because of the scarcity of good-quality water. Good-quality water has become a diminishing resource. Most humans could survive for several weeks without food, but not for more than a few days without water. In extremely hot climates just a few hours without drinking water causes death. There are those who contend that the water crisis threatens to dwarf the energy crisis in significance and severity. Of the global water supply, 97 per cent is in the form of saltwater. Only three percent is fresh. Only 1 percent is available for human consumption and use, agriculture and industry. The renewable freshwater on earth rainfall is only 0.008 per cent of all global water. Although about 4 trillion gallons of water (rainwater) falls globally daily in the form of precipitation, two-thirds thirds of this is lost in evaporation, transpiration and runoff. Urbanization, which leads to an increase in the impervious surfaces in our built environment, has long been recognized as a process that alters the water quality of urban and suburban aquatic systems. It increases sedimentation and thus the transport of nutrients into downstream (receiving) aquatic habitats. Site planning and layout planning in sustainable design must start by designing for surface-water management and natural drainage patterns. Humans currently use around half the total world supply provided by rainwater. At present, 1.1 billion people lack access to clean drinking water and more than 2.4 billion lack adequate sanitation. It has been estimated that by 2015, 3 billion people, or about 40 per cent of the estimated world population, will be living in water-stressed countries that will have

difficulty in meeting freshwater needs. Most of our planet's water is located in the oceans and is thus unsuitable in quality for residential, commercial or industrial use. The building industry uses 16 per cent of global freshwater annually. This percentage refers to the amount required to manufacture building materials and to construct and operate buildings. It does not reflect the impact of the building industry on water quality.

Water resources also go through cyclical transformations like everything else in nature. Water circulates regularly through rivers lakes, oceans and the atmosphere, making systemic detours through plants and animals. Plants grow and, through transpiration, they transfer water from the soil to vapor in the air. The rising water vapor condenses to form clouds, from which rain falls, enabling more trees to grow. Water vapor also condenses over the ocean. Algae in sea water produce dimethyl sulphide, which provides cloud - condensing nuclei, the particles around which water condenses to form clouds. The cloud vapor lowers the temperature, causing a differential in temperature and air movement. When the clouds condense over a landmass the result is rain (Kaniyan, 2006).

The Time That a Water Molecule Spends at Any One Point in the Cycle is as Follows:

Location	**Time**
Atmosphere	9 days
Rivers	2 weeks
Soil moisture	2 weeks to 1 year
Large lakes	10 years
Underground water at slight depth	10s to 1000s of years
Ocean mixed layer to a depth of 55 yards	120 years
Seas and oceans	3000 years
Underground water at depth	up to 10,000 years
Antarctic icecap	10,000 years

4 Rainwater Harvesting System in Bangladesh

The design of a sustainable water harvesting system for traditional sloping roof at rural and modern flat roof at urban area is start very recent in Bangladesh. The methodology of the system is that the rainwater is harvested by collecting and storing rain water from a roof top into a large container. This container is cheap and easy to install. Rainwater that falls on a flat roof top it can be storage via a system of pipes. The first flush of rainwater after a dry season should be allowed to run to waste as it will be contaminated with dust, bird droppings etc. Storage tank should be covered to prevent mosquito breeding and to reduce evaporation losses, contamination and algal growth. However the amount of water collected is restricted by the weather.

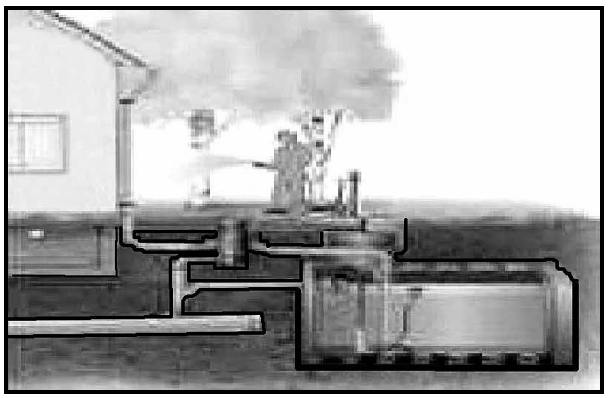

Figure 4: Rainwater Harvesting System at Rural Area in Bangladesh (Source Author)

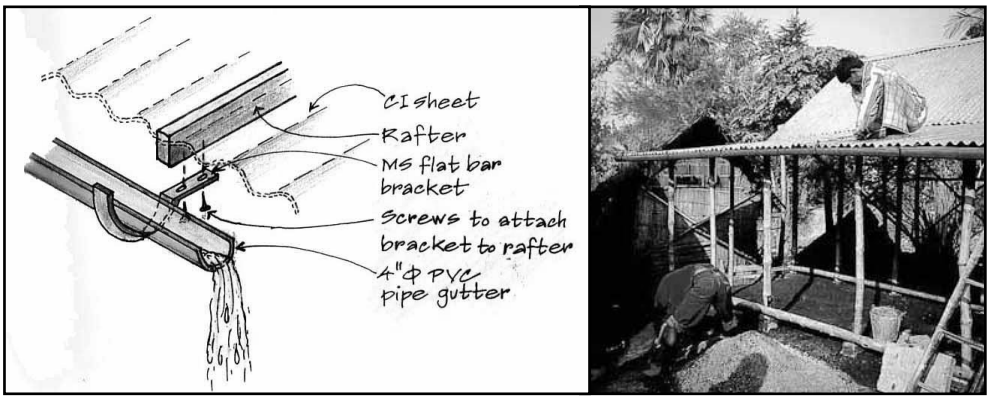

Figure 5: Rain Gutter Detail and Using in Bangladesh Traditional House (ADPC)

At the rural area in Bangladesh rain water harvesting system is experimentally started by different private organization. Forty number of house are still under experiment. Harvesting strategy by rainwater gutters collects rain falling down from roof eaves. Arsenic-free rainwater can be collected for household use by keeping a container where the water drains down. It also prevents rainwater splashing on walls. 4 inch diameter PVC (polyvinyl chloride, i.e. plastic) pipe can be cut into half lengthwise using a saw. M S (mild steel) flat bar brackets can be screwed to rafters or wall plate to hold gutter. If brackets prove too difficult or expensive to make, GI (galvanized iron) wire or nylon rope can also be used for attaching gutter.

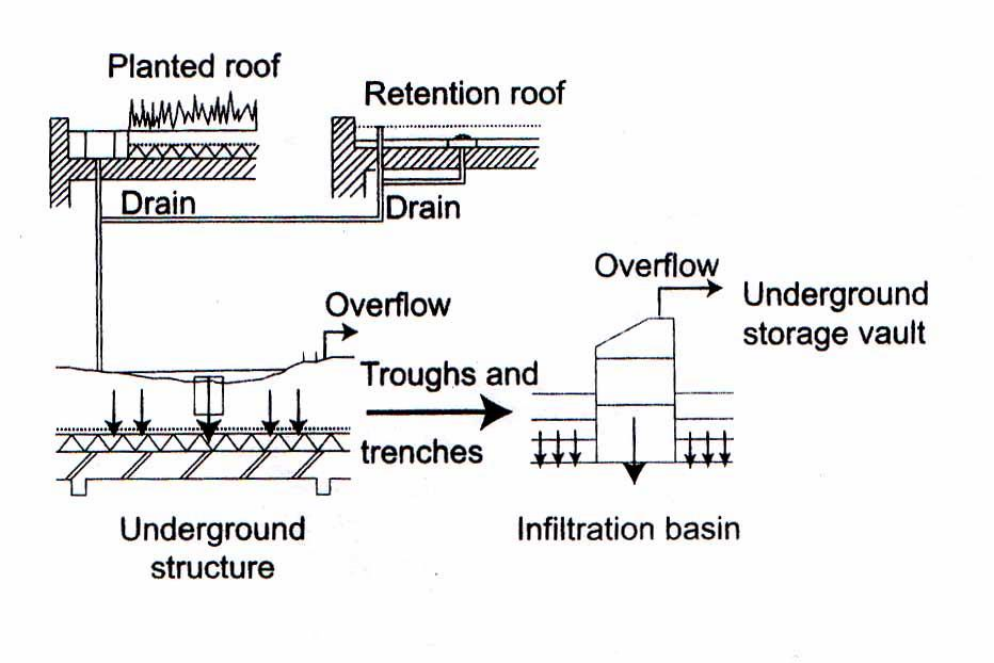

Figure 6: Rainwater Harvesting System for Flat Roof in Modern Building (Source: Author)

For urban area to get enough rain water every home would need to have its own collection system for the use of flushing and gardening purpose in Dhaka city. This means that initial installation charges are high but when this system is in place the water is free. Roof should have sufficient incline to avoid standing water. The pipes are strong enough, and large enough to carry peak flows. Several number of three inch pipes are uses to collect rain water in tank. The result shows that water harvesting system is an energy efficient technology and it leads to reduce water bill in urban Dhaka city. Rainwater harvesting systems require regular maintenance and cleaning to keep the system hygienic and in good working order.

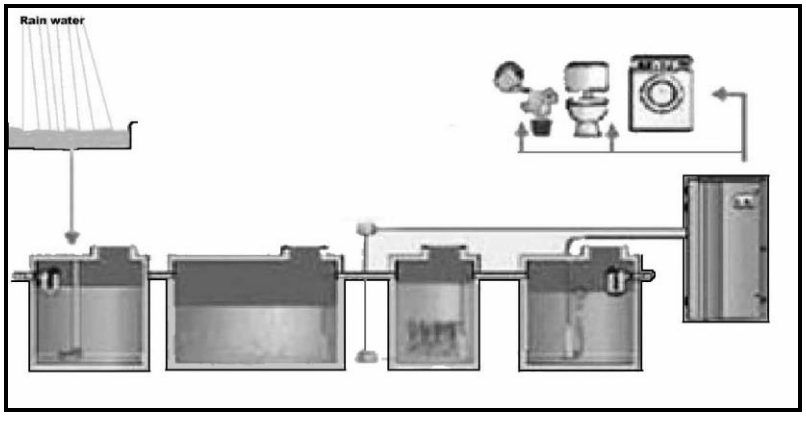

Figure 7: Rainwater Collection, Filter and Domestic Use (Source: Author)

The rain water harvesting systems have proved to be absolutely are used and recommended by people. Used mainly for residential use. It is equally at home in flats, commercial and industrial use. The cost of the installation system depends on a number of factors to do with the plumbing and layout of a residential home. It is now viable to harvest rainwater for whole household.

This includes rainwater harvesting, storing and pumping rainwater for bathing, showering, toilet flushing, laundry and gardening. Rainwater harvesting together can save up to 70% of water bill.

5 Conclusion

Typically, a system of gutters from the roof collects runoff and channels it into a cistern. Ecologically conscious buildings employ these methods of collecting rainwater to reduce the need for fresh water. Catchments areas are often designed to look like ponds or marshes. The rainwater collected by these methods is used for landscape maintenance. often comparable in cost to drilling a well, rainwater-collection systems can be employed within a group of buildings or an entire community, In some municipalities, rainwater may be used as a back-up supply connected to the area's regular water system. Designing for conservation of water can influence the shape and extent of the horizontal surfaces of the building roof as potential water collectors. The result shows that water harvesting system is an energy efficient technology and it leads to reduce water bill in urban Dhaka city. Rainwater harvesting systems require regular maintenance and cleaning to keep the system hygienic and in good working order. The implementation strategy of rainwater harvesting policy will be a good solution for environmental sustainability.

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