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Global Access to Clean Water: The Role of Rain Water Harvesting

Tahmina Afrose*, Anthony Leela, Kevin Fernandez and Swe Swe Latt

Department of Community Medicine, AIMST University, Malaysia

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***Corresponding author:** Tahmina Afrose, Department of Community Medicine, Faculty of Medicine, AIMST University, Kedah, Malaysia, Email: drafrosekeya@gmail.com

Abstract

Water is the most precious natural resource that plays an important role in human life and economics. Everybody on earth requires access to clean, safe water on every day. The United Nations considers universal access to clean water a basic human right, and an essential step towards improving living standards worldwide. This resource is essential for hydration, food production as well as for the sanitation. The quantity of drinking water suffering occurs due to alarming depletion of ground water either by natural or man-made cause. Rainwater harvesting system is gaining speed over time. Areas with high rainfall can take advantages from this system which can significantly reduce the reliance on water storage dams and also will be able to distribute water to dry lands with ease. A combination of several key issues such as economic growth, political and social stability, political will, effective sectoral reform, management of demand, effective project implementation, environmental sustainability, effective information management and transfer, skills and human resources, mutual trust and dialogue within the region, and regional cooperation are required to avoid widespread water stress problems.

Keywords: Safe water; Water stress; Surface water; Ground water; Runoff; Rainwater harvesting system

Introduction

Clean water is that water which is suitable for consume, free from pathogenic agents and harmful chemical substance and not associate with potential danger of human health. After major catastrophes destruction of the infrastructures of the water and/or sanitation system is one of the major causes of life-threatening epidemics of waterborne diseases. According to UN MDG report in 2015, about 91 per cent of the global population is using an improved drinking water source and among 2.6 billion people who have gained access to improved drinking water since 1990, 1.9 billion gained access to piped drinking water on premises. About 58 percent people now getting this higher level of service [1]. However still a huge amount of people are not having access to an improved water source and are using unprotected sources of water such as springs, canals, lakes or rivers etc [2]. The objectives of this review study was to appreciate the socio cultural and socio economic factors affecting water resources, to describe the relationship between safe water and health, to describe the importance of rainwater harvesting system and explain the challenges of rural and peri urban water supply. In most of the developing countries continuity of water supply is a severe problem where they receive water on an intermittent basis. It is our responsibility to maintain the sustainable practices for efficient use of water resources and at the same time to protect the environmental ecosystems. Effective application of scientific knowledge is required to give priority in decision and policy making as well as implementation of the strategies.

Background: Literature Reviews

The Financial aspect

According to World Bank report in urban areas in developed countries the full cost of supplying water is about US$1-2 per cubic meter. Throughout the world major portion of these costs being financed through direct or indirect subsidies from the governments. Besides subsides the investments are also financed through internally generated revenues and through debt [3].

Surface water: Surface water is usually naturally replenished by precipitation and is vitally important to everyday life. The example is oceans, seas, lakes, rivers, reservoirs or wetlands. Surface water collects on the surface of the earth and is maintained by rainfall or other precipitation, and lost through the ground, evaporation, or used by plants and animals (Figure 1).

Groundwater: Groundwater is an important part of the water cycle which is located in the cracks and spaces in soil, sand and rock that moves slowly through geologic formations of soil, sand and rocks called aquifers. Groundwater supplies drinking water for majority of the rural population and has a significant role on irrigation to grow crops. It is also important for many industrial processes. Groundwater can be polluted from overuse of fertilizers and pesticides, by landfills, septic tanks and if groundwater becomes polluted, it will be then very dangerous for health. One common example for ground water is wells [5].

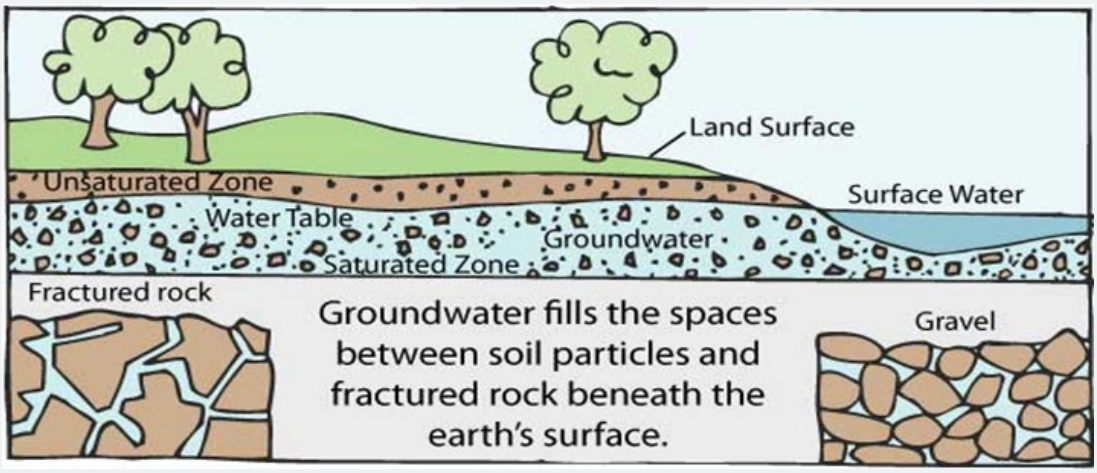

Figure 1: Surface water and Ground water [4].

Water Cycle (Hydrologic cycle)

The water cycle regulates the temperature of the surroundings by changing weather and creates rain. This phenomenon goes through the following steps [6-8]:

Step 1: Evaporation

It is the process of conversion of surface water into vapors after absorbing heat energy from the sun. Usually oceans, seas, lakes and the river waters are the main source of evaporation. Water moves from hydrosphere to atmosphere through its evaporation process.

Step 2: Condensation

It is the process occurs at high altitudes where the water vapors converts into very tiny particles like ice or water droplets which come close together and form clouds and fogs in the sky.

Step 3: Sublimation

In this slow process ice directly converts into water vapors without converting into liquid water in low temperature or in high pressure. The main sources of water from sublimation are the ice sheets of the North Pole and the South Pole and the ice caps on the mountains [9] (Figure 2).

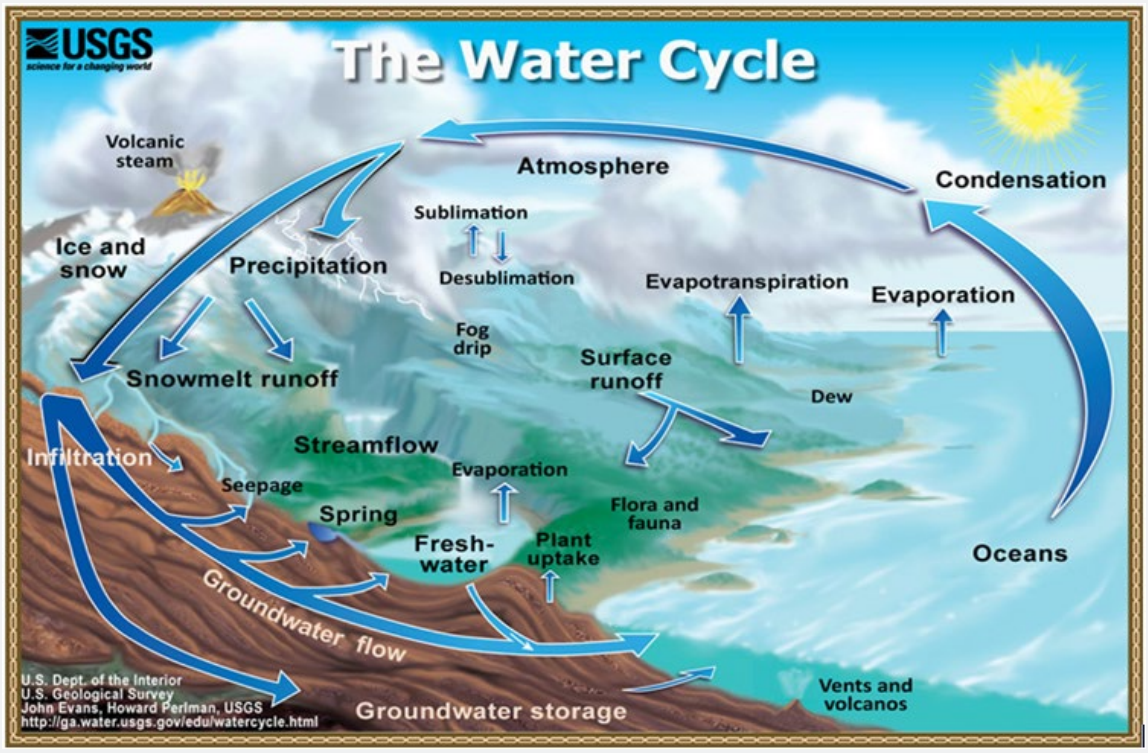

Figure 2: Water cycle [9].

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Step 4: Precipitation

In this stage due to change of the temperature or wind the condensed water vapors named as clouds pour down as precipitation. The air cannot hold the bigger water droplets anymore and then fall down as rain. At very low temperature such as below 0 degrees, the water droplets fall as snow. Water also precipices in the form of hail, sleet and drizzle.

Step 5: Transpiration

In the transpiration stage some of water is absorbed by the soil. Usually the roots of the plants absorb the water which is essential for the photosynthesis process. The additional water is moved out of leaves as water vapor.

Step 6: Runoff

It is the process where water runs over the surface of earth. During the runoff process water displace the top soil and takes the minerals along with the stream, ultimately ends up into rivers, lakes and the oceans.

Step 7: Infiltration

After precipitations some water moves deep into the soil. This process is called infiltration which helps to increase the ground water level.

Water Resources and the Driving Forces

All over the world both natural and human activities are creating pressures on the water resources. According to UN report on 2017 some key driving forces affecting water resources includes [10]:

Population growth

According to UN by 2050 there will be an additional 3.5 billion people, mostly the growth in developing countries which lead to increase in water demand and stress unless there are corresponding increases in recycling of this vital resource [11].

Rapid urbanization: It is significantly related to cost of investment in water infrastructure.

Population migration: Movement of large numbers of people from the countryside to towns and cities is related to demands for greater food security and higher living standards.

Increased competition: All over the world the competition between different uses of water resources are significantly increasing.

Pollution: It is directly related to population growth, industrialization and agricultural sources.

Climate change: Climate change could have significant impacts on water resources. High temperatures usually associated with increased evaporation and also in high precipitation that will further complicate the sustainable development of the water resources [12].

Urban and Rural Water Supply: The Threats

Now a day's most of the countries are facing some environmental, economic and social challenges, which are intensified by the process of urbanization such as:

Disruption of the natural water cycle

Due to rapid urbanization the demand of ground water is increasing but on the other hand the water runoff and groundwater recharge are reducing [13].

Pollution of water sources: According to UNESCO urban settlements are the major source of pollution of water resources [14]. In most of the low and middle income countries more than 90% of sewage is discarded directly into the surface water such as rivers, lakes, and coastal waters without treatment of any kind and leakage on site sanitation facilities together with the absence of sewerage pipes that dispose the wastewater are a very common features that facilitates large volumes of local wastewater soaking into the soil, and eventually seeping into aquifers and polluting groundwater [15, 16].

Depletion of groundwater sources: Most of the world's megacities depend on shallow groundwater. This is directly related to ground water depletion.

Waste of resources: Sometimes potable water is using for non potable purposes in many rural areas [17].

High water demand: Due to growing urbanization together with the population growth the water demand is gradually increasing day by day [18].

Cost-intensive infrastructure: The water supply system is very cost intensive in terms of construction, operation and maintenance. Most of the developing countries insufficient maintenance and over exploitation of raw water resources lead to a loss of valuable resources [19].

Rain Water Harvesting (RWH)

It is a technique in which rain water is collected and storage into natural reservoirs or tanks or infiltration of surface water into subsurface aquifers before it is lost as surface runoff. The rain water is commonly collected by rooftop harvesting method. This water can be used for landscape irrigation and other purposes [20].

The Basic Components

The basic components of RWH system include [21]:

Catchment surface: The amount of the water harvested depends on the hard, smooth surface, the size and the slope of the catchment area.

Gutters and downspouts: It is the distribution systems that carry water from the catchment area to a holding container such as a barrel, cistern or planted area.

Leaf screens: It is used for removal of the debris.

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Roof washers: The function of this device is to divert the "first flush" of rain to an outside area of the storage system before it enters the storage tank to avoid the accumulation of bird droppings, debris and other pollution.

Storage tanks: It is usually aboveground or underground that can be made from galvanized steel, wood, concrete, clay, plastic, fiberglass, polyethylene, masonry etc. To prevent algae growth the storage tanks are usually opaque, preferably placed away from direct sunlight, close to the area of use and supply line and placed on an elevated area to take advantage of gravity flow.

Delivery systems: Either gravity fed or pumped to the supply areas.

Purification/treatment system: Required for portable systems to make the water safe for human consumption [22] (Figure 3).

Figure 3: The basic components of RWH system [22].

Rainwater Harvesting System: Benefits

People all over the world are harvesting rainwater, but most of them do not know its practical applications. Areas with heavy rainfall can take this advantage by harvesting rain water. This technique can reduce our dependence on traditional water sources and take benefit of a renewable natural resource. USA, Malaysia, India, Australia and some other countries are a big example for utilizing rainwater harvesting system.

Rainwater Harvesting System provides certain advantages to the community [23,24]:

Simple technology

It allows us to better utilize an energy resource as well as helps in reducing wastage. This system is relatively simple to install and operate. Little time and energy are required for the maintenance.

Cost effectiveness: The overall cost of the installation and operation is much lesser than that of water purifying or pumping systems. RWH system leads to a large reduction in the utilities bill. On an industrial scale, harvesting rainwater can provide the needed amounts of water without having to deplete the nearby water sources.

Lessens the burden of soil erosion: Rain Water Harvesting system also helps in reducing soil erosion by allowing the land to thrive once again.

Suitable for Irrigation: It allows little requirement for building new infrastructure. As rainwater is free from many chemicals it is excellent source of water for landscape irrigation and watering gardens.

Lessens the impact on the environment: By using a natural resource this system helps reducing flooding, storm water runoff, and soil erosion, contamination of surface water with pesticides, fertilizers and also reducing use of fuel based machines. It promotes both water and energy conservation.

Reduces Demand on Ground Water: With the growing urbanization and the population growth the demand of water is also increasing day by day. To fulfill their requirements they are primarily depends on the ground water. As a result some areas are facing significant depletion of ground water.

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Drawbacks of Rainwater Harvesting

There are some drawbacks of this system such as [24]:

Unpredictable Rainfall

Rainfall is hard to predict. In areas where there is limited rainfall it is not wise to depend on rainwater alone for all water needs. Rainwater harvesting system is suitable in areas with plenty of rainfall.

Initial High Cost: Initially this system requires higher cost which can be recovered in few years.

Require Proper Maintenance: If Rainwater harvesting systems are not properly maintained they can become as breeding grounds for many animals [25] (Figure 4).

Figure 4: Rainwater Harvesting [25].

Methods

The duration of this review study was six months. The relevant articles which were published in between year 2004 to year 2017 have been considered for the literature review. Data's were extracted independently.

Results

Around twenty nine relevant published articles have been assessed for the literature review. The study showed that population growth, increased food production, urbanization and the increased need for agricultural irrigation are the leading causes for water stress worldwide. The rain water harvesting system is a simple technology, it is cost effective, is suitable for irrigation, it reduces the burden of soil erosion and reduces the demand on ground water. Nevertheless the drawbacks of this system are initial high cost and the unpredictable rainfall. But in areas with high rainfall this practice is very much beneficial which can reduce the consumption of groundwater.

Discussion

Water is our most valuable natural resource and one of the fundamental human rights. Every year a lot of people are suffering from water borne diseases especially in the developing countries which can be easily preventable. Universal access to clean water is an essential step towards better standards of living. Water is essential not for only hydration and the food production but equally important for the sanitation. Because of the close connections between the climate and water cycle, the climate change has direct impacts on water resources. In recent decades many of the world's major aquifers are becoming depleted due to sharp rise in fresh water demand. The supply of ground water is gradually decreasing. As a consequence majority of the global population are facing severe water scarcity every year at a certain period of time.

Rainwater harvesting system is the collection and storage of rainwater for the reuse. It can be used for domestic purposes, for irrigation, gardening, as a drinking water and as well as for the ground water recharging. One of the advantages of the rain water harvesting system is that it can be stored for long term. Some developed countries are using this source as a supplement to the main source. Countries with high rainfall can use rainwater harvesting as a cheap and reliable source of clean water. With increased urbanization and water scarcity we should take some efforts for proper utilizations of this valuable resource and need to give more focus on the future needs and demands also. Deforestation and the urbanization are the leading causes for less recharge that hampers the hydrologic cycle. Therefore traditional rain water harvesting system may be an alternative option and in coming future rain may be the only source of clean water. So effective utilization of this natural resource may be an obvious solution to this issue.

Conclusion

Clean, drinkable water is a vulnerable natural resource. Water stress is happening as a result of population growth, increased food production and development programs and the increased need for agricultural irrigation. Unregulated new local industrial practices are one of the major causes of water pollution in many developing countries. Agricultural pollution is a major factor in changing the water quality [26]. Now days the practice of rain water harvesting system has been growing rapidly. In areas with high rainfall this practice can be used to recharge ground water. Many people around the world are using rainwater harvesting system which is helping them to reduce the consumption of groundwater. Even in several rural areas it is a primary source of drinking water [26-28]. Water stress is a highly complex phenomenon which is related to social, political, economic and natural factors. Effective plan are required for mitigate against the effects of water stress [29].

References

1. (2015) The Millennium Development Goals Report 2015. Time for Global Action for People and Planet, United Nations New York, USA.
2. WHO/UNICEF joint monitoring report 2010.
3. (2006) Water, electricity and the poor: who benefits from utility subsidies? The World Bank , Washington, USA.

How to cite this article: Tahmina Afrose, Anthony Leela, Kevin Fernandez and Swe Swe Latt. Global Access to Clean Water: The Role of Rain Water Harvesting. Ann Rev Resear. 2018; 2(2): 555585.

4. What is groundwater?
5. (2006) Earth's water distribution. United States Geological Survey.
6. (2006) Dr. Art's Guide to Planet Earth. The Water Cycle.
7. Estimated flows of water in the global water cycle.
8. (2006) Arctic Climatology and Meteorology. Evaporation
9. Rainwater Harvesting Information.
10. (2017) U N World Water Development Report, Wastewater: The Untapped Resource. UNESCO World Water Assessment Programme.
11. (2005) World population to reach 9.1 billion in 2050, UN projects.
12. UNESCO UN World Water Development Report 2 (2006) Changing Natural Systems & WMO with Global Hydrology and Water Resources, pp. 121-122.
13. Corcoran E, Nellemann C, Baker E, Robert B, David Osborn, et al. (2010) Sick water? The central role of wastewater management in sustainable development - A rapid response assessment. United Nations Environment Programme (UNEP), UN-HABITAT, Nairobi, Kenai, Alaska, USA.
14. Zektser IS, Everett LG (2004) Groundwater resources of the world: and their use. Paris UNESCO, pp. 346.
15. Luethi C, Mcconville J, Norstroem A, Panesar P, Ingle R, et al. (2009) Rethinking Sustainable Sanitation for the Urban Environment.
16. Groenwall J, Mulenga M, Granahan MG (2010) Groundwater, Self-Supply and Poor Urban Dwellers a Review with Case Studies of Bangalore and Lusaka. London Iied, UK.
17. Howe CA, Variavamoorthy K, Steen PN (2011) Sustainable Water Management in the City of the Future. Findings from the SWITCH Project 2006-2011 Delft UNESCO-IHE.
18. Chocat B (2002) Sustainable Management Of Water In Cities. Valencia, Universidad International Menendez Pelayo.
19. UNESCO (2004) Water, Sanitation and Sustainable Development. The Challenge of Cities in Developing Countries. Paris, UNESCO, Veolia Water and Solidarity Program.
20. Rainwater harvesting.
21. Rainwater Harvesting Guide. California, USA.
22. Rainwater Harvesting System.
23. Jenni Wiltz (2017) Importance of Rain Water.
24. https://www.conserve-energyfuture.com/advantages_disadvantages_rainwater_harvesting.php
25. Rainwater harvest systems for new housing estates?
26. Keating M (1993) Combating Desertification and drought. Agenda for change UN Centre for Our Common Future Geneva, Switzerland.
27. Winpenny JT (1997) Managing Water Scarcity for Water Security. A discussion paper prepared for the First FAO E-mail Conference on Managing Water Scarcity.
28. Ohlsson L (1995) Water and Security in Southern Africa. Publications on Water Resources.
29. Appelgren BG Keynote paper-Management of Water Scarcity: National Water Policy Reform In Relation To Regional Development Cooperation. FAO, Rome.

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