DEPARTMENT OF CIVIL ENGINEERING

Mid Assignment / Quiz (Spring 2020)

Subject: Water Demand Supply and Distribution

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Q1: What is "Hydrological Cycle"? Now a days there is general discussion that Hydrological Cycle has been disturbed. Is this a myth or reality? Briefly explain.

Ans: Hydrological Cycle:

The sequence of conditions through which water passes from vapor in the atmosphere through precipitation upon land or water surfaces and ultimately back into the atmosphere as a result of evaporation and transpiration.

The hydrological cycle is involved in the total earth system. The total system can be classified into three important zones: Atmosphere, Hydrosphere and Lithosphere. Atmosphere forms the gaseous envelope that is above the hydrosphere. Hydrosphere forms the body of water that is covering the surface of the earth. The environment that is below the hydrosphere till the solid rock forms the lithosphere.

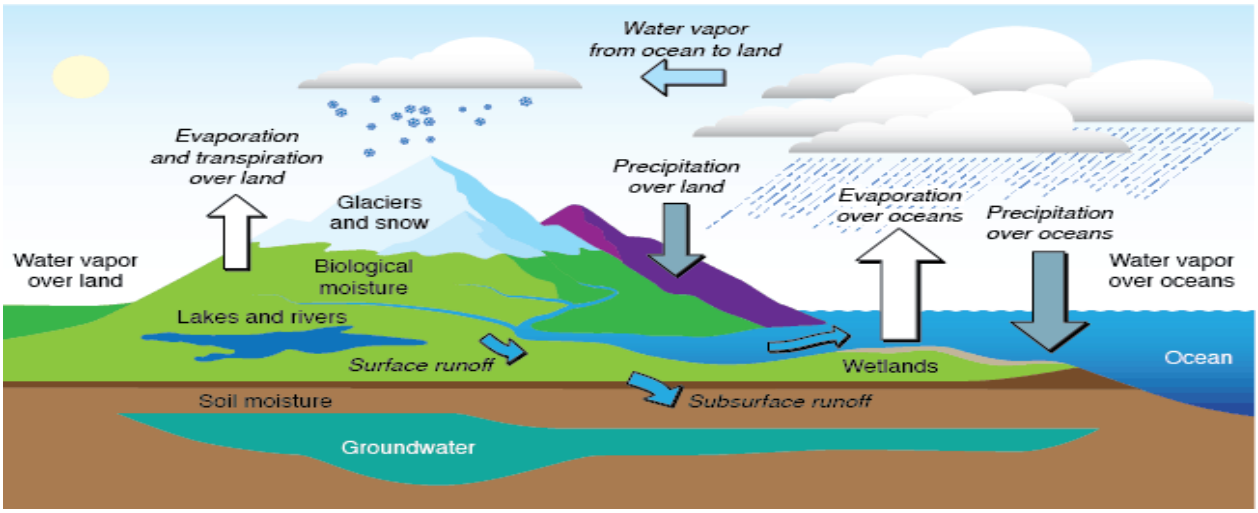
Purpose of the hydrological cycle

The hydrological cycle is important because it is how water reaches plants, animals and us! Besides providing people, animal and plants with water, it also moves things like nutrients, pathogens and sediment in and out of aquatic ecosystems.

Basic components of Hydrological Cycle

The major components or elements of the hydrological cycle;

1. Precipitation
2. Evaporation
3. Transpiration
4. Evapotranspiration
5. Surface Runoff
6. Condensation
7. Infiltration
8. Groundwater base flow
9. Sublimation
10. Interception



Hydrological Cycle has been disturbed. Is this a myth or reality?

It is a reality, because hydrological cycle effected by human activities, such as water resource exploitation, urbanization, and deforestation. Below we will consider three of these factors: human consumption, effects of global climate, land use changes, deforestation, and greenhouse effect.

1. Human consumption

During times of low rainfall and stream flow, farmers have relied on ground water sources when available resulting, in many cases, in "ground water mining" where withdrawals from underground aquifers exceeds replenishment. Ground water over pumping and aquifer depletion is now occurring in May the world's important crop-producing areas. This over pumping can also cause salt intrusion into fresh water aquifers and other Stalinization problems. Other potential environmental problems include water pollution from sewage treatment, industrial wastes, mining wastes, or other surface drainage such as, non-point source pollution (mercury from streets, oil and grease, nitrates and pesticides from agricultural operations), special pollutants including detergents, toxic chemicals, trace metals, and insecticides; and acidic water from acid rain and dry acid depositor.

2. Effect of changing global climate

The hydrologic system is potentially very sensitive to changes in climate. Changes in precipitation affect the magnitude and timing of runoff and the frequency and intensity of floods and droughts. Changes in temperature results in changes in evaporation, soil moisture, and infiltration.

3. Land use changes of the Earth

Changes in land cover patterns can directly impact energy and mass fluxes. For example, when large areas of forests are cleared, reduce transpiration results in reduced cloud formation, less rainfall, and increased drying. Changes in land cover can alter the reflectance of the earth's surface and induce local warming or cooling; generally as reflectivity increase surface temperature declines. Desertification can occur when overgrazing of savanna vegetation alters surface reflectivity and surface water budgets, and thus changes the regional circulation and precipitation

patterns. Overgrazing can also increase the amount of suspended dust that, in turn, causes radioactive cooling and a decline in precipitation.

4. Deforestation

Rain forests store vast quantities of water, and when those trees are cut down, the water they store is lost. As trees and plants are responsible for extracting groundwater from the soil and returning it the atmosphere, deforestation results in the water not being able to be released back into the atmosphere, affecting the balance of the water cycle. This results in lush rainforest turning into barren deserts, leading to dry climates, which affects livings conditions.

5. Greenhouse effect

Climate change intensifies this cycle because as air temperatures increase, more water evaporates into the air. Warmer air can hold more water vapor, which can lead to more intense rainstorms, causing major problems like extreme flooding in coastal communities around the world.

The climate changes touches very corner of our planet's ecosystem and the water cycle is no exception. Because the processes involved are highly dependent on temperature, changes in one have consequences on the other. Specifically, as global temperatures have steadily increased at their fastest rates in millions of years, it's directly affected things like water vapor concentrations, clouds, precipitation patterns, and stream flow patterns, which are all related to the water cycle.

Q2: Briefly describe "Ground water sustainability"? How can "Rainwater Harvesting" be linked to ground water sustainability?

Ans: Groundwater sustainability:

It is the development and use of groundwater resources to meet current and future beneficial uses without causing unacceptable environment or socioeconomic consequences.

Groundwater is the water found under ground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through geological formation of soils, sand and rocks called aquifers. It is one of the Nation's most important natural resources. It plays a major role in ensuring livelihood security across the world, especially in economies that depend on agriculture. Ground water contains mineral ions which slowly dissolve from soil particles, sediments, and rocks named as dissolved solids. Continuous discharge of industrial effluent, domestic sewage use of fertilizers and pesticides, waste dump and over exploitation of the resources have badly impact on ground water sustainability. Through over utilization of ground water is the key factors for ground water depletion but there are other factors which have negative impact on ground water sustainability. The most important impact of groundwater depletion is loss of base flow; other impacts being server crisis of safe drinking water and irrigated water. Lastly it is to be mentioned that protection of the water resource from depletion is not possible unless the users agree to cooperate and manage the resource themselves in a sustainable manner. Moreover the state also needs to play a key role of facilitating and fostering community action for sustainable management.

Ground water can be sustainable?

There are also some strategies to promote sustainable ground water supply. Conjunctive use of surface water and ground water, desalination, recycling and wastewater reuse, water harvesting, increasing recharge to the ground water system are also a effective measure to promote **sustainable ground water** supply.

"Rainwater harvesting" linked to ground water sustainability

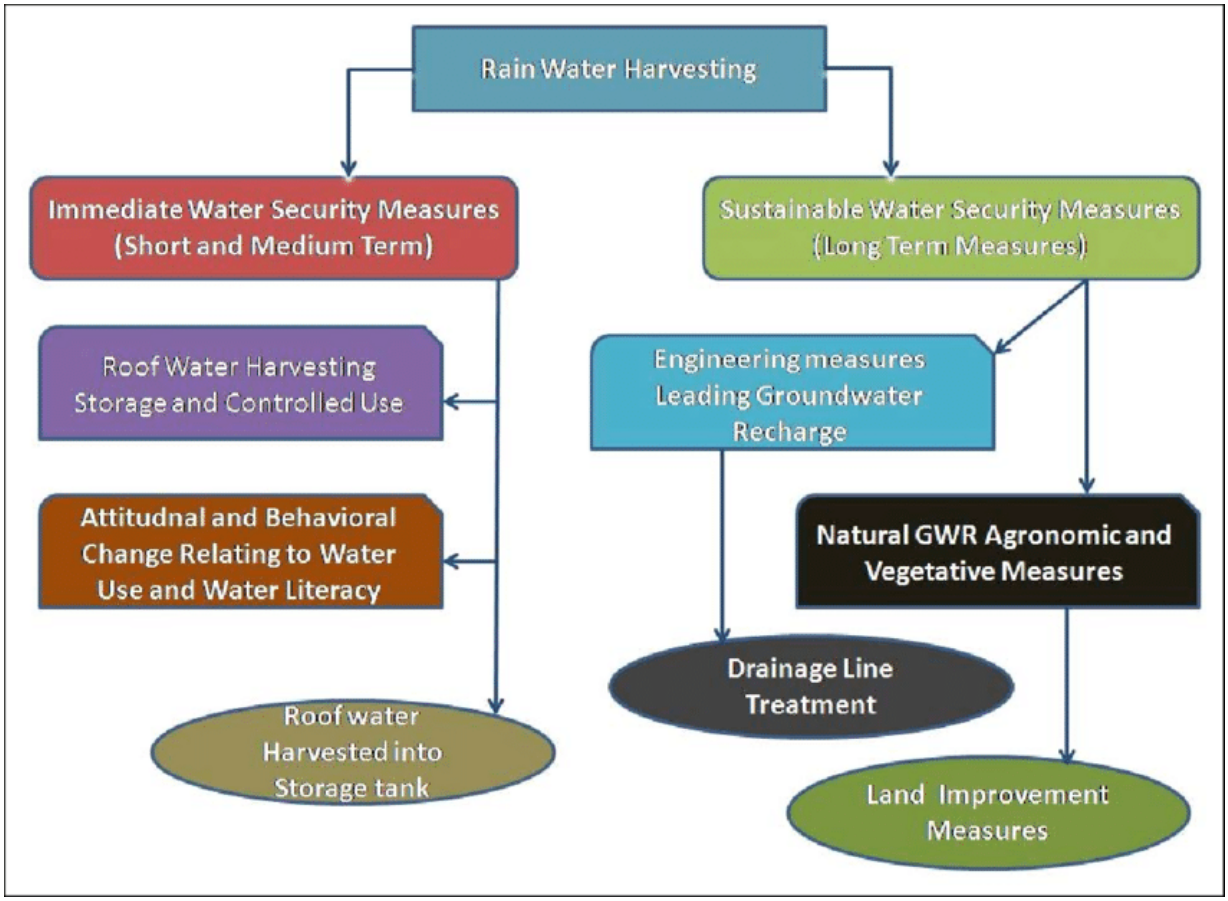
Sustainable use of water could maintain a balance between its demand and supply.

Rainwater Harvesting (RWH):

It is the most traditional and sustainable method, which could be easily, used for potable and non-potable purposes both in residential and commercial building.

Water is considered an everlasting free source that can be acquired naturally. Demand for processed supply water is growing higher due to an increasing population. Sustainable use of water could maintain a balance between its demand and supply. Rainwater harvesting (RWH) is the most traditional and sustainable method, which could be easily, used for potable and non-potable purposes both in residential and commercial building. This could reduce the pressure on processed supply water which enhances the green living. This paper ensures the sustainability of this system through assessing several water quality parameters of collected rainwater with respect to allowable limits. A number of parameters were included in the analysis: pH, fecal coli form, total coli form, total dissolved solids, turbidity, NH3-N, lead, BOD5, and so forth. The study reveals that the overall quality of water is quit satisfactory as per

Bangladesh standards. RWH system offers sufficient amount of water and energy savings through lower consumption. Moreover, considering the cost for installation and maintenance expenses, the system is effective and economical.



Q3: What "Quality parameters" should be considered in designing water supply system for community?

Ans: Water Quality Parameter:

Water quality testing is an important part of environmental monitoring and when water quality is poor, it affects not only aquatic life but the surrounding ecosystem as well. A wide range of water quality parameters are monitored within the lower lakes with key parameters reported herein being pH, alkalinity, salinity, turbidity, nutrients, chlorophyll, and metals.

Explanation:

Since the industrial revolution in the late eighteenth century, the world has discovered new sources of pollution nearly every day. So, air and water can potentially become polluted everywhere. Little is known about changes in pollution rates. The increase in water related diseases provides a real assessment of the degree of pollution in the environment. According to its quality, water can be classified into four types. Those four water quality types are discussed through an extensive review of their important common attributes including physical, chemical, and biological parameters. Water quality can be classified into four types: Potable water, palatable water, contaminated water, and infected water.

- The water supply organization must ensure water quality while supplying water to the community the main parameter of water quality are sediment transport and deposition algae, phytoplankton and chlorophyll dissolved organic matter conductivity.
- Salinity and total dissolved solid pH of water, turbidity total suspended solids and water clarity water temperature and solar radiation.
- We use water in many ways under use for process fish, making ice is supposed to meet drinking water standard safe. WHO has issued guide lines for drinking water quality these guide lines consist of the three volumes.

    1. Volume-1: Deal with guideline values
    2. Volume-2: Deal with each contaminate
    3. Volume-3: Supply of water to small rural

Community keeping the quality parameter under consideration. There many quality parameter almost 60 or more than 60 parameter have been elaborated. Qualities and quantitative measurement are needed from time to time to consist monitor the quality of water from the various sources of supply.

Water Quality and Testing

Water from ground or surface sources are not always potable for drinking and need some level of water treatment prior to supply for water supply system. Following are some of the quality issues that are normally seen in various types of water sources

Water Source	Type of quality issues
Surface water	
Lakes and ponds	Development of algae on top, development of Micro organisms, high turbidity in bottom layers. May be affected by organic and chemical pollutants by disposal of wastewater.
River, irrigation canals	Organic debris, mineral salts May be affected by organic and chemical pollutants by disposal of wastewater.
Ground Water	
Well, tube wells, hand pump etc	Salinity, fluoride, alkalinity, hardness Chemical contaminations due to disposal of domestic waste/industrial chemical near by

- While supplying water to the community water sampling and analysis should be done b 150-certified laboratories to check the quality of water two type of test i-e physical and chemical test are require.

1. **Physical Test**

   Physical test consist of color, turbidity, total solid, dissolved solid, suspended solid.

2. **Chemical Test**

   This test consist of pH hardness, presence of selected group of chemical parameter, highly trace chemical and B.O.D are

3. **Bacteriological**

   For the detection of harmful organize so, it is necessary to conduct water quality test by taking harmful parameter under consideration while supplying water to the community.

Sampling Frequency:

Water from all the sources like wells/tube well/hand pump or collection point like stand post or HH level/intermediate storage tank should be tested at regular intervals. Normally, one sample for every 5000 population should be tested in each month. Additional tests should be conducted during monsoon and epidemics as per need. Where there are issues of biological contaminations, samples should be taken every week from the specified water source.

Following chart enlists the minimum sampling frequency from distribution system as per NESPAK guidelines:

Minimum Sampling Frequency and number from Distribution System		
Population	Maximum intervals between successive sampling	Minimum number of samples to be taken from entire distribution system
Upto 20,000	One month	1 sample per 5,000 population per month
20,000-50,000	Two weeks	
50,000-100,000	Four days	
>100,000	One day	1 sample per 10,000 of population per month

Sampling for physical and chemical test:

- Samples should be collected in inert materials like glass or polythene.
- Sample bottle must be cleaned prior to taking samples as directed by laboratories.
- About 2.5 liters is required for testing from each sample.
- Prior to filling, the sample bottle must be rinsed 2-3 times with water to be collected.
- Sample should reach the testing place within 72 hours of collection.
- Certain parameters like pH, temperature chlorine etc. may change during transport and it is advisable if they are tested on spot by specific kits.
- Samples collected from wells should be taken only after the well has been pumped for sufficient times so that the sample will represent ground water

Sampling for bacteriological test

- Sterilized bottle, as directed by laboratory should be used for sample collection.
- While collecting sample, hand should not touch the bottle neck or stopper. Bottle should be held from the base, filled without rinsing and stopper be closed immediately. Bottle should have some air space left and should not be filled completely. Finally, brown paper should be wrapped for avoiding further contamination of water.
- Size of sample should be at least 250 ml (1/4th of liter).
- The sample should preferably be analyzed within one hour after collection. The test of the sample should be done maximum within 24 hours.