SUBJECT: WATER DEMOND AND SUPPLY CODE 652

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HYDROLOGICAL CYCLE:

Water cycle**,** also called hydrologic cycle**,** cycle that involves the continuous circulation of water in the Earth-atmosphere system.

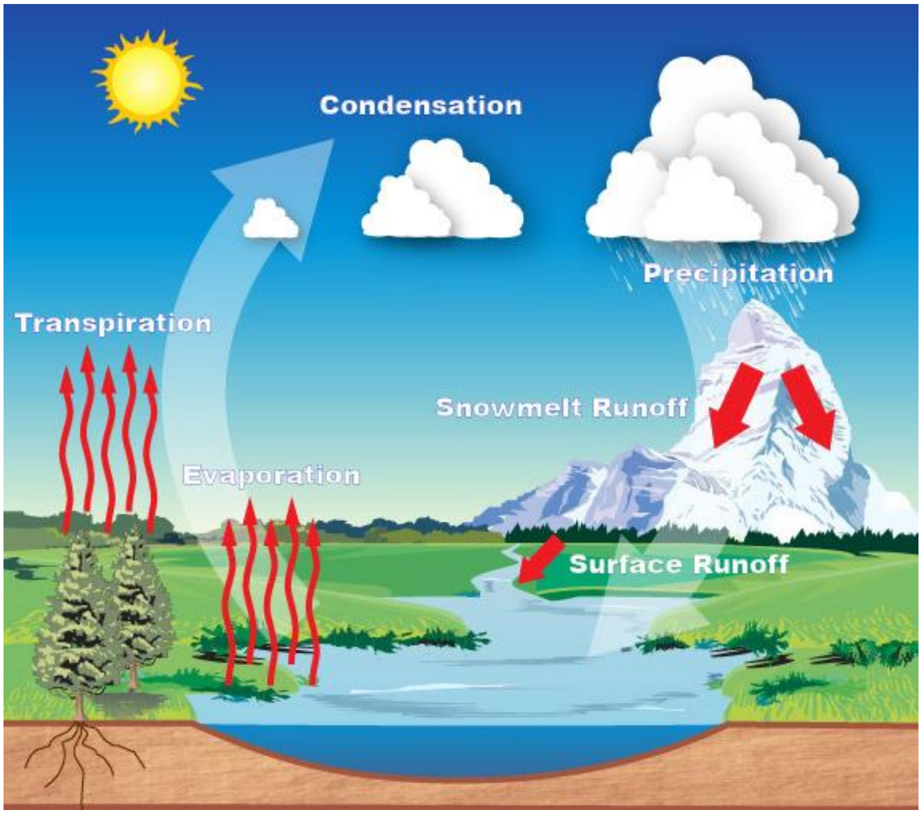


Figure 1: A view of Hydrologic Cycle,

Process/Components of Hydrologic Cycle:

The most important components of hydrological cycle are

- Evaporation
- Transpiration
- Condensation
- Precipitation
- Runoff

Evaporation:

One of the major processes in the cycle is the transfer of water from the surface of the Earth to the atmosphere. By evaporation, water in the liquid state is transferred to the gaseous, or vapors, state.

TRANSPIRATION:

Transpiration is the evaporation of water through minute pores or stomata in the leaves of plants.

- The transition process from the vapors state to the liquid state is called

CONDENSATION:

Condensation may take place as soon as the air contains more water vapors than it can receive from a free water surface through evaporation at the prevailing temperature. This condition occurs as the consequence of either cooling or the mixing of air masses of different temperatures.

PRECIPITATION:

Precipitation is the result when the tiny condensation particles grow too large, through collision and coalescence, for the rising air to support, and thus fall to the earth. Precipitation can be in the form of rain, hail, snow or sleet.

RUNOFF:

Runoff occurs when there is excessive precipitation and the ground is saturated (cannot absorb any more water). Rivers and lakes are results of runoff. There is some evaporation from runoff into the atmosphere but for the most part water in rivers and lakes returns to the oceans.

HYDROLOGIC CYCLE's DISRUPTION:

The reality behind disturbance of Hydrologic Cycle is based on following evidence;

1. The Earth's water cycle involves evaporation and precipitation of moisture at the Earth's surface. Changes in the atmosphere's water vapors content provide strong evidence that the water cycle is already responding to a warming climate.

2. Further evidence comes from changes in the distribution of ocean salinity, which, due to a lack of long-term observations of rain and evaporation over the global oceans, has become an important proxy rain gauge.

3. The water cycle is expected to intensify in a warmer climate, because warmer air can be moister: the atmosphere can hold about 7% more water vapour for each degree Celsius of warming. Observations since the 1970s show increases in surface and lower atmospheric water vapour at a rate consistent with observed warming. Moreover, evaporation and precipitation are projected to intensify in a warmer climate.

4. Recorded changes in ocean salinity in the last 50 years support that projection. Seawater contains both salt and fresh water, and its salinity is a function of the weight of dissolved salts it contains. Because the total amount of salt—which comes from the weathering of rocks—does not change over human time scales, seawater's salinity can only be altered—over days or centuries—by the addition or removal of fresh water.

ANSWER.(2)

GROUNDWATER SUSTAINABILITY:

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

Ground water is one of the Nation's most important natural resources. It provides about 40 percent of the Nation's public water supply. In addition, more than 40 million people, including most of the rural population, supply their own drinking water from domestic wells. As a result, ground water is an important source of drinking water too.

Groundwater is a highly useful and often abundant resource. However, over-use, over-abstraction or overdraft, can cause major problems to human users and to the environment.

Groundwater depletion is primarily caused by sustained groundwater pumping.
Excessive pumping can overdraw the groundwater "bank account"

- Drying up of wells.
- Reduction of water in streams and lakes.
- Deterioration of water quality.

- Increased pumping costs.
- Land subsidence.

Perhaps the most important attribute of the concept of ground-water sustainability is that it fosters a long-term perspective to management of ground-water resources.

Several factors reinforce the need for a long-term perspective. These are;

1. Ground water is not a nonrenewable resource, such as a mineral or petroleum deposit, nor is it completely renewable in the same manner and timeframe as solar energy. Recharge of ground water from precipitation continually replenishes the groundwater resource but may do so at much smaller rates than the rates of ground-water withdrawals.

2. Ground-water development may take place over many years; thus, the effects of both current and future development must be considered in any water-management strategy.

3. The effects of ground-water pumping tend to manifest themselves slowly over time. For example, the full effects of pumping on surface water resources may not be evident for many years after pumping begins.

4. Losses from ground-water storage must be placed in the context of the period over which sustainability needs to be achieved. Ground-water withdrawals and replenishment by recharge usually are variable both seasonally and from year to year. Viewing the ground-water system through time, a long-term approach to sustainability may involve frequent temporary withdrawals from ground-water storage that are balanced by intervening additions to ground-water storage.

The sustainability of ground-water resources is a function of many factors, including decreases in ground-water storage, reductions in stream flow and lake levels, loss of wetland, land subsidence, saltwater intrusion, and changes in ground-water quality. Each ground-water system and development situation is unique and requires an analysis adjusted to the nature of the water issues faced, including the social, economic, and legal constraints that must be taken into account.

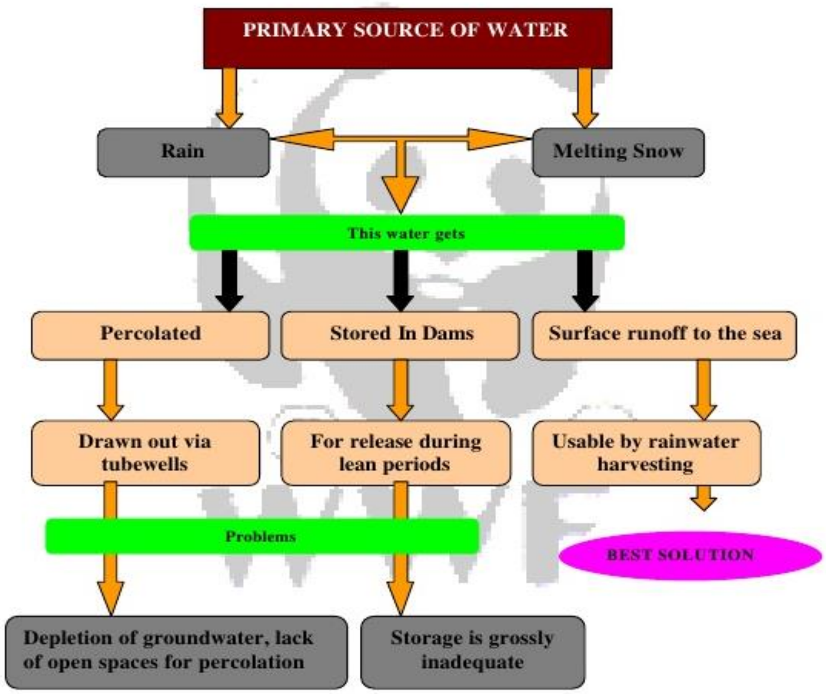
RAINWATER HARVESTING:

Rainwater harvesting is a type of harvest in which the rain drops are collected and stored for the future use, rather than allowing them to run off. Rainwater can be collected from rivers or roofs and redirected to a deep pit (well, shaft, or borehole), aquifer, a reservoir with percolation, or collected from dew or fog with nets or other tools. The harvested water can also be used as drinking water, longer-term storage, and for other purposes such as groundwater recharge.

RAINWATER HARVESTING & GROUND WATER SUSTAINABILITY:

- Over the years rising populations, growing industrialization, and expanding agriculture have pushed up the demand for water. Efforts have been made to collect water by building dams and reservoirs and digging wells; some countries have also tried to recycle and desalinate (remove salts) water. Water conservation has become the need of the day. The idea of ground water recharging by harvesting rainwater is gaining importance in many cities.

- Rainwater harvesting is the accumulation and storage of rainwater for reuse on-site than allowing it to run off. Rainwater can be collected from rivers or roofs. The harvested water can also be used as drinking water, longer-term storage, and for other purposes such as groundwater recharge. It is essential to stop the decline in groundwater levels, arrest sea-water ingress, it prevent sea-water from moving landward, and conserve surface water run-off during the rainy season. Rainwater harvesting is considered a very reliable way to conserve water.



- Traditionally, rainwater harvesting has been practiced in areas where water exists in plenty, and has provided drinking water, domestic water, water for livestock, water for small irrigation and a way to increase ground water levels.

- In the forests, water seeps gently into the ground as vegetation breaks the fall. Not only does this recharging arrest groundwater depletion, it also raises the declining water table and can help augment water supply.

- The artificial recharging are becoming very important issues. It is essential to stop the decline in groundwater levels, arrest sea-water ingress, prevent sea-water from moving landward, and conserve surface water run-off during the rainy season.

ANSWER (3)

QUALITY PARAMETERS FOR WATER DISTRIBUTION SYSTEM:

The quality parameters that engineer must be consisted in designing water supply system for community:

Selection Criteria of Water Sources

While selecting a water source for development, the engineer must consider three primary factors:

1. Water quantity
2. Water reliability
3. Water quality

WATER QUANTITY:

The source must be capable of supplying enough water for the rural community. If not, another resource or perhaps several sources will be required. Water Source Selection The process of choosing the most suitable source of water for development into a public water supply largely depends on the local conditions.

Ground water as a source generally for rural communities is the best option is exploring ground water resources. For rural water supplies simple prospecting methods will usually be adequate, whereas larger supplies, more extensive geo-hydrological investigations using special methods and techniques are likely to be needed. Dug wells can be appropriate for reaching ground water at medium depth. Tube wells are generally most suitable for drawing water from deeper water-bearing ground strata. Dug wells often are within the local construction capabilities, whereas the drilling of tube wells will require more sophisticated equipment and considerable expertise. In some cases, drilling may be the only option available.

Surface water as a source If ground water is not available, or where the costs of digging a well or drilling a tube well would too high, it will be necessary to consider surface water from sources. Such as rivers, streams or lakes. Surface water will almost always require some treatment to render it safe for human consumption and use. The costs and difficulties associated with the treatment of water, particular the day to day problems of operation and maintenance of water treatment plants need to be carefully considered.

Rain water as a source where the rainfall pattern permits rainwater harvesting, and storage during dry periods can be provided. Thus Rainwater harvesting may serve well for household and small-scale rural community supplies. However this source should be considered where rainfall is heavy in storms of considerable intensity, with intervals during which there is practically no or very little rainfall

Water Reliability:

The reliability of a water supply is one of the most important factors that the engineer considers when selecting a water source. A reliable water source is one that will supply the required amount of water for as long as needed. To determine the reliability of the water source, the engineer studies data, such as hydrological data, to determine the variations that maybe expected at the water source. Geological data should be studied since geological formations can limit the quantity and flow of water available. Also, legal advice may be necessary when selecting a water source since the laws regulating and controlling water rights may vary considerably from state to state and country to country. The stability and reliability of Water distribution systems (WDSs) is one of the important factors in ensuring public safety and the continuous operation of urban functions. Such functions include water supply, infrastructure construction and industrial development, etc. It is also the key field for infrastructure construction. The WDS is a large scale network system with complex topological structure. Its functions are designed to convey volumes of water to customers under adequate pressure. Nowadays, along with the increased population and population density, WDS is developing into wide-range supply which carries fluid under high or less pressure. A WDS can be represented as a spatially networks of multiple interconnected components. Pipes can be represented as links. Junctions, reservoirs and consumers can be represented as a collection of nodes. With the link-node representation of physical components in WDS, complex network analysis can be applied to evaluate the system reliability.

Water Quality:

The third primary factor the engineer must consider when selecting a water source is the quality of the water. Water supplies are generally exposed to pollution of some kind. Therefore, to ensure that water is potable, it must be tested to determine the existence of any impurities that could cause diseases, odor, foul taste, or bad color. In case of any impurities, the water will require treatment. In water treatment, the water is subjected to various filtration and sedimentation processes, and in nearly all cases is disinfected using chlorine or other disinfecting chemicals .Developing a water source includes all work that increases the quantity and improves the quality of the water or makes it more readily available for treatment and distribution. In developing a source, the engineer may use the construction of dams, diversion structures, digging or drilling of wells, and other improvements to increase the quantity and quality of the water. An examination of water quality is has basically a determination of the organisms, and the mineral and organic compounds contained in the water. The basic requirements for drinking water are that it should be:

- Free from disease causing (Pathogenic) organisms
- Fairly clear (low turbidity, little color)
- Containing no compounds that cause an offensive taste or smell
- Containing no compounds that have an adverse effect acute or in the long term, on human health.
- Neither of causing corrosion on encrustation of the neither water supply system, nor straining clothes others washed in it the results of the studies and research on drinking water quality are laid down in practical guidelines which usually take the form of a table giving number of selected water quality parameters, the highest desirable level and the maximum permissible level. Such values should not be taken as absolute standards but as indicative only. The most important parameter of drinking water quality is the bacteriological quality, i.e. the content of bacteria and viruses. It is not practicable to test the water for all organisms that it might possibly contain. Therefore water is examined for a specific type of bacteria which originates in large numbers from human and animal excreta and whose presence in water is indicative of faucal contamination.