NAME : ENGR FAIZA SANA

STUDENT ID : 14662

ASSIGNMENT : WATER DEMAND AND SUPPLY/DISTRIBUTION

Q#01: 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.

Hydrological Cycle:

Hydrological cycle is also known as the "water cycle"; it is the normal water recycling system on Earth. Due to solar radiation, water evaporates, generally from the sea, lakes, etc. Water also evaporates from plant leaves through the mechanism of *transpiration*. As the steam rises in the atmosphere, it is being cooled, condensed, and returned to the land and the sea as precipitation. Precipitation falls on the earth as surface water and shapes the surface, creating thus streams of water that result in lakes and rivers. A part of the water precipitating penetrates the ground and moves downward through the incisions, forming aquifers. Finally, a part of the surface and underground water leads to sea. During this trip, water is converted in all phases: gas, liquid, and solid. As mentioned above, water always changes states between liquid, vapore and ice, with these processes happening in the blink of an eye and over millions of years.

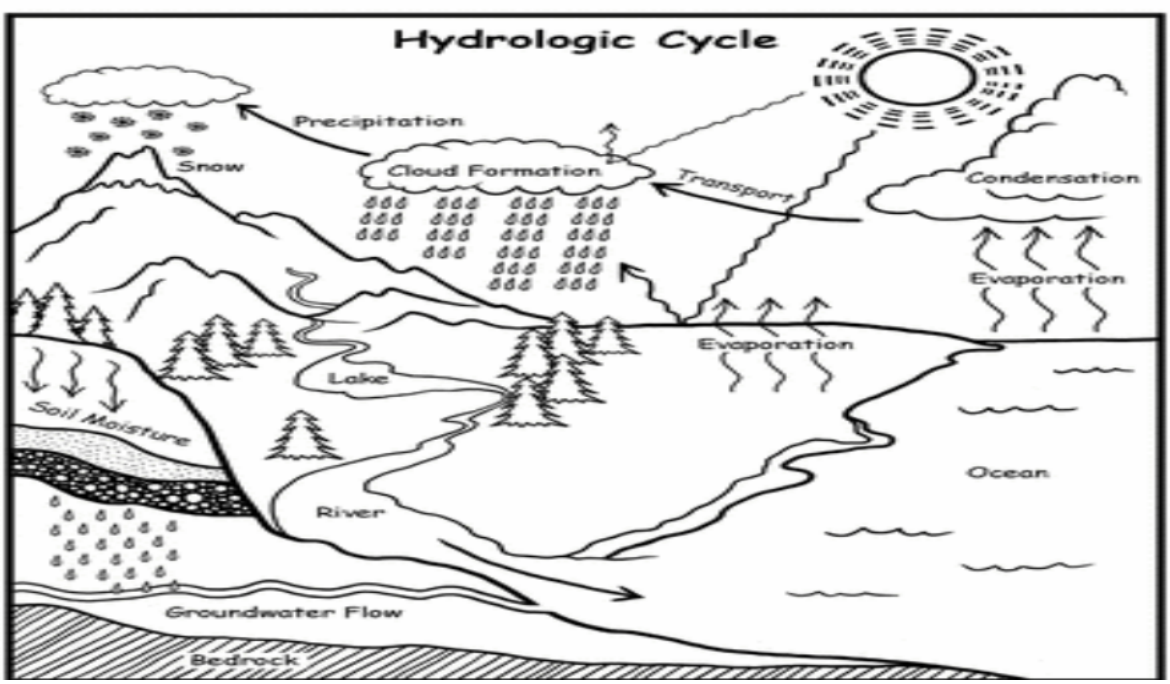


Figure The hydrological cycle

GENERAL DISCUSSION ABOUT HYDROLOGICAL CYCLE

The hydrological cycle is intimately linked with changes in the atmospheric temperature and radiation balance. Warming of the climate system in recent decades is unequivocal, as it is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising of the sea level globally. It is expected that the hydrological cycle will be affected from global warming due to the enhanced greenhouse effect and rate of evaporation from water surfaces and land surfaces will alter than normal. The hydrological cycle may be strengthened with more precipitation and more evaporation, but the extra precipitation will be unequally distributed around the globe. It is expected that some areas of the world may see significant reductions in precipitation or even more major variations in the timing of wet and dry seasons. Many aspects of the economy, environment, and society are dependent upon water resources, and changes in the hydrological resource base have the potential to severely impact upon environmental quality, economic development, and social well-being.

Effect on Hydrological cycle from Global Warming

During colder climatic periods, more ice caps and glaciers form, and enough of the global water supply accumulates as ice to lessen the amounts in other parts of the water cycle. The reverse is true during warm periods. During the last ice age, glaciers covered almost one-third of Earth's land mass with the result being that the oceans were about 122 m (400 ft) lower than today. During the last global "warm spell," about 125,000 years ago, the seas were about 5.5 m (18 ft) higher than they are now. About three million years ago the oceans could have been up to 50 m (165 ft) higher. A number of human activities can impact on the water cycle: damming rivers for hydroelectricity, using water for farming, deforestation and the burning of fossil fuels

Effect on Hydrological cycle from Change in Climate

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.

Fundamental thermodynamics and climate models suggest that dry regions will become drier and wet regions will become wetter in response to warming. Efforts to detect this long-term response in sparse surface observations of rainfall and evaporation remain ambiguous. We show that ocean salinity patterns express an identifiable fingerprint of an intensifying water cycle. Our 50-year observed global surface salinity changes, combined with changes from global climate models, present robust evidence of an intensified global water cycle at a rate of 8 ± 5% per degree of surface warming. This rate is double the response projected by current-generation climate models and suggests that a substantial (16 to 24%) intensification of the global water cycle will occur in a future 2° to 3° warmer world.

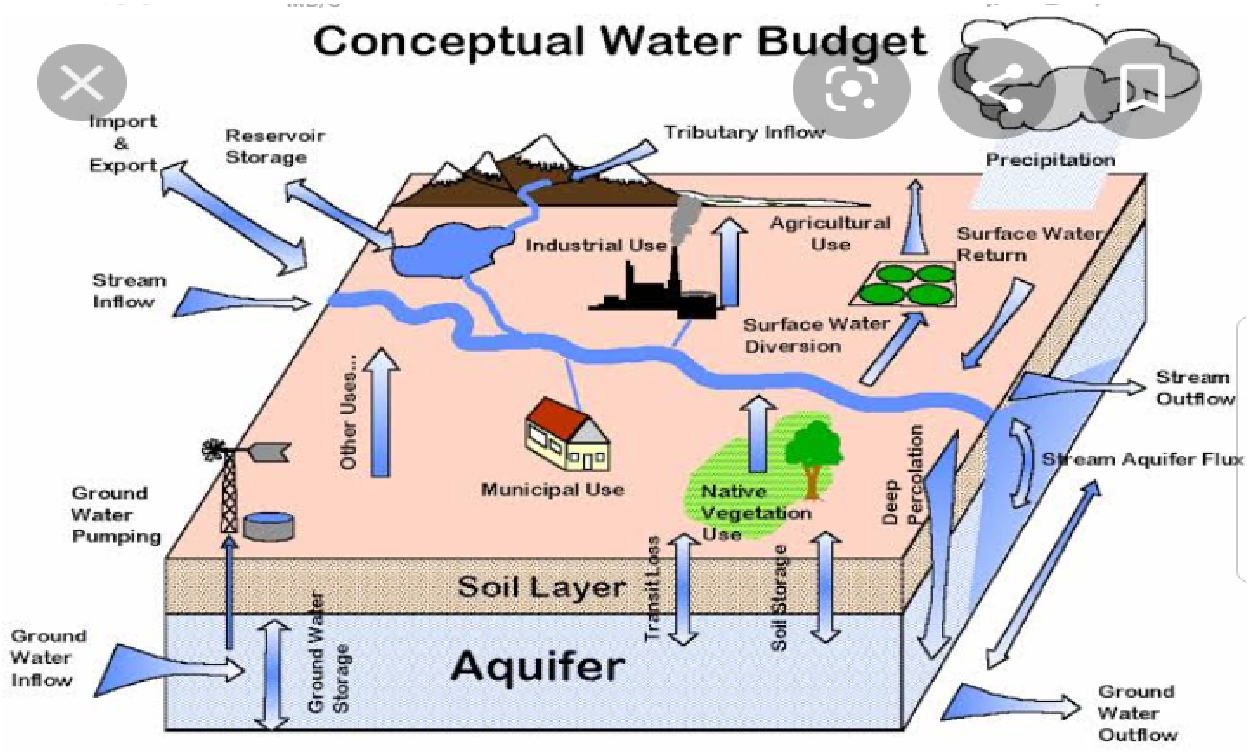
It is not a **myth it's a reality** that the hydrological cycle has been disturbed due to increase in temperature and increase frequency of intense precipitation as briefly discussed above.

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

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

Groundwater is a critical component of the nation's water resources. Globally, groundwater resources dwarf surface water supplies. But because groundwater is hidden, the resource is often forgotten or misunderstood. Groundwater is, in fact, vital to public health, the environment, and the economy.

Groundwater sustainability is the development and use of groundwater to meet both current and future beneficial purposes without causing unacceptable consequences. It is important that we understand the factors that contribute to local, regional, or statewide groundwater shortages, the strategies that can be implemented to promote a sustainable groundwater supply, and what resources or tools are needed to implement these strategies successfully. It is time to take action to develop public understanding of the ground water sustainability. A figure attached show groundwater budgeting.

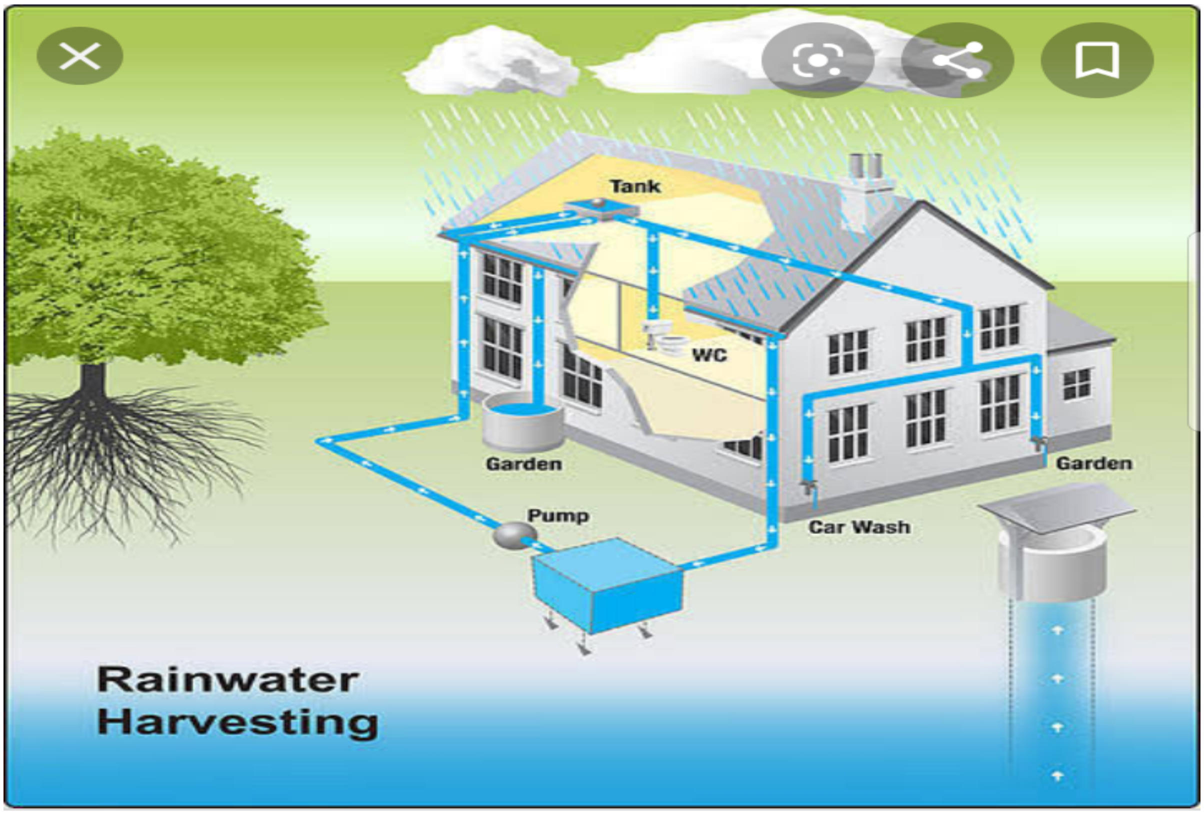


Following are the ways to sustain ground water;

- Recharge or return of water to aquifers.
- Prevention of salt water intrusion into an aquifer.
- Methods that promote the wise use of groundwater supplies
- Need to determine strategies and legislation that promote groundwater sustainability
- Need for cooperative efforts to fill data gaps and undertake priority research
- Need for increased collaborative educational efforts

Link of Rainwater Harvesting to Groundwater Sustainability

Rainwater harvesting (RWH) is a technique to conserve water and later use it in irrigation and other purposes. Now-a-days water harvesting system such as Rooftop, Rainwater storage tank, Recharge well and Check dam, etc. has been installed because it increase the declining water table, avoids flooding, improves the quality of groundwater through the dilution of fluoride and prevents soil erosion etc.so that's why Rainwater harvesting is linked with groundwater sustainability, a sample is shown in figure that how rain water is harvested



Q#03: What "Quality Parameters" should be considered in designing water supply system for a community?

ANS: Water that is absolutely pure is not found in nature. Water vapor in the air condenses about particles as it fall, absorb, dust and dissolves oxygen, carbon dioxide and other gases. At the ground surface it takes up silt and other inorganic matter. A few bacteria will enter the water from air and picked up more as it runs off in stream or rivers. Also carry small amounts of decompose organic matter, nitrates, nitrites, carbonates, bicarbonates, chlorides, ammonia and carbon dioxide etc: into solution form.

Hence all the above impurities retain by water needs to be removed or bring into the range of approved water quality standards/parameters. These impurities in water are mainly categorized as Physical, Chemical and Biological contamination.

Quality Parameters: The proportion of samples or supplies that comply with guideline values for drinking-water quality and minimum criteria for treatment and source protection.

A wide range of water quality parameters are monitored within the Lower Lakes with key parameters reported herein being PH, alkalinity, salinity, turbidity, nutrients (total nitrogen and total phosphorus), chlorophyll *a* and metals (aluminium and iron). A brief description of these parameters and typical historical (pre-drought) levels are provided below:

1. PH is an indicator of acidity or alkalinity. PH is a logarithmic scale and an

   Increase or decrease of one PH unit is a 10 fold change. Neutral water has a PH of 7, acidic solutions have values between 0-6 and alkaline solutions have values between 8-14. Prior to the current drought, the PH in the region was typically between 7 and 9.

2. Alkalinity is a measure of the buffering capacity of water, or the capacity of the water to neutralize acids and resist PH change. Alkalinity within water bodies is consumed as acid is released from acid sulfate soils. Adding limestone contributes alkalinity to waters, helping to neutralize any acid released from the sediments. Historically, alkalinity levels within this region have been between 80 and 250 mg/L as $CaCO_3$.

3. Salinity is a measure of the amount of dissolved salts in the water. Saline water conducts electricity more readily than freshwater, so electrical conductivity (EC) is routinely used to measure salinity. As salinity increases, it may become toxic to native freshwater organisms. Prior to drought conditions, salinity was on average less than 700 (EC) μS/cm in Lake Alexandrina (at Milang) and less than 1600 (EC) μS/cm in Lake Albert (at Meningie). Seawater has a salinity of approximately 55,000 (EC) μS/cm.

4. Turbidity is a measure of the cloudiness or haziness in water caused by suspended solids (eg sediment, algae). Turbidity is expressed in Nephelometric Turbidity Units (NTU) and is measured using a relationship of light reflected from a given sample. Turbidity is very variable in the Lower Lakes and influenced primarily by wind events. Prior to drought conditions, turbidity was on average about 60 NTU in Lake Alexandrina (at Milang), 8 NTU in the tributaries (at Goolwa), and 89 in Lake Albert (at Meningie).

5. Nutrients–Total nitrogen (TN) and total phosphorus (TP) are the total amount of nitrogen and phosphorus present in the water body. Nitrogen can be present in different forms (e.g. organic nitrogen in plant material, ammonia, nitrate and

nitrite). Phosphorus can also be present in different forms (eg organic phosphorus, phosphate). High concentrations of phosphorus and nitrogen can result in excessive growth of aquatic plants such as cyanobacteria, phytoplankton, macrophytes and filamentous algae. Prior to drought conditions, TN was on average about 1.2 mg/L in Lake Alexandrina (at Milang), 1.5 in the tributaries (at Goolwa) and 1.6 mg/L in Lake Albert (at Meningie) with TP on average about 0.15 mg/L in Lake Alexandrina (at Milang) and in Lake Albert (at Meningie).

6. Chlorophyll *a* is the main photosynthetic pigment in green algae. The concentration of chlorophyll gives an indication of the volume of aquatic plants present in the water column. Levels in excess of 15 µg/L are considered very high ('hyper-eutrophic') and nuisance algae and plant growth can occur. Prior to drought conditions, chlorophyll was on average about 24 µg/L in Lake Alexandrina (at Milang) and 35 µg/L in Lake Albert (at Meningie).

7. Metal concentrations in the Lower Lakes allow us to determine what processes are proceeding within sediments. During concentration events (ie evaporation and low inputs) the concentration of metals are expected to increase, alternatively during flooding events the volume of metals will be diluted and expected to reduce. In addition to this, where acid sulfate soils are present, as the sediments acidify and the pH is reduced, metals that have been previously unavailable and bound up within sediment are liberated. This increase in metal concentration can be used as an indicator of acid sulfate soil impacts.

8. Removal of Bacteria and other pathogenic organism causing water borne diseases through treatment of bacteriological contamination methods such as filtration, chlorination and removal through rays from ultra violet lamps (UV Lamps and UV Filters).