

Lesson - 17

Hydrological Cycle and Distribution of Water Bodies

Hydrological cycle

It is also called water cycle. This includes movement of water and its transformation into gas, liquid and solid state. The major process of this transformation is condensation, which causes rainfall. It includes accumulation and movement of water on and below the earth's surface, evaporation and transfer of humidity. Thus, the water cycle includes the cyclic form of water on hydrosphere atmosphere and lithosphere. We have already studied about condensation and evaporation in the previous chapters.

The water from oceans, lakes, rivers and plants reaches the atmosphere through evaporation and evapotranspiration and with changing weather conditions it takes the form of clouds through the process of condensation and it reaches back to the water bodies on lithosphere and hydrosphere in the form of rainfall.

The cyclic stages of water that occur in different forms of water are called Hydrological Cycle. The circulation of water in the hydrological cycle also happens freely in different spheres. In this the transfer of humidity from one place to the other, the circulation of water through ocean currents in hydrosphere and the water from rivers and glaciers moves towards the oceans. In the same way the water reaches in the ground through evaporation from the soil and evapotranspiration from plants. Every year 1% of the total water available, is circulated in hydrological cycle. The major portion of hydrological cycle consist of pure water. The rest of its proportion is permanently frozen in the form of glacier. The rivers play an

important part in hydrological cycle as they flow from land towards the sea and oceans. Therefore the water is retained longer in oceans, snow peaks and rocks of the earth, whereas the water is stored for a shorter period of time in rivers and atmosphere.

The process of Hydrological cycle

The transformation of water into water vapour, and its relaining in the atmosphere, is a very important process, as the changes of weather conditions depends on it. There are several agents that affect the mobility of water in the water cycle that is operating on the earth. The water of oceans enters atmosphere in the form of vapour created by energy received from the seen. The winds blowing from oceans towards land create movement in vapour and help in trasfer of vapour from one place to the other. Due to this, water vapour condenses and causes rainfall on the earth surface. Thus the water received from the rainfall flows in rivers and finally reaches the oceans. In this way some amount of rain water is reduced, as it is utilised in evapotranspiration by vegetation, and some of its portion is evaporated from rivers,lakes, ponds and the water reaches back to the atmosphere.

Major stages of Hydrological cycle

There are three major stages of hydrological cycle-

(i) Evaporation and Evapotranspiration

Through these processes the water from the surface reaches the atmosphere.

(ii) Rainfall

Through this, the water from the atmosphere

reaches the earth's surface.

(iii) Circulation of Wind

The mechanism of winds and weather are included in this, as they transfer and redistribute water from one place to the other.

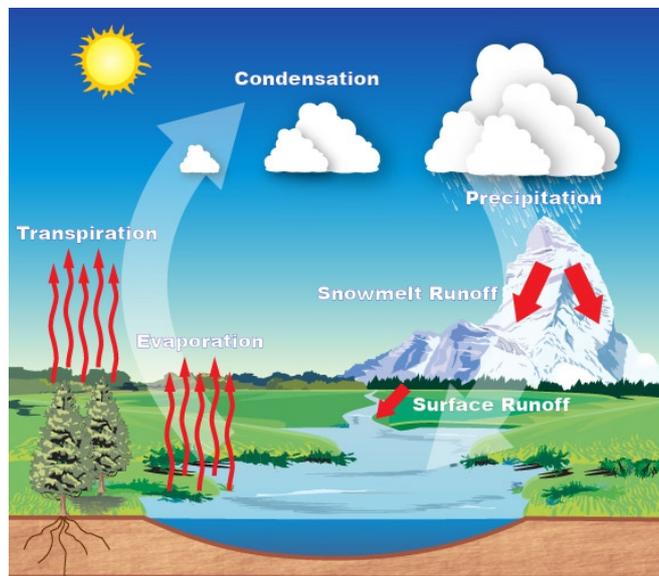


Fig.17.1 : Hydrological Cycle

Importance of hydrological cycle in nature

The transformation of water into water vapour and its retention in the atmosphere is an important process. Therefore hydrological cycle is very important for all types of activities of organism because without the circulation of water the water balance will be disturbed and life will not be possible. The hydrological cycle is the basis of life for human beings, vegetation, climate and for the entire organism of the world.

Waterbodies

The total area of the earth is 50.995 million sq km, out of which 36.10 million sq km area is covered by hydrosphere and 14.889 million sq km is of lithosphere. The ratio of lithosphere and hydrosphere was first presented by Dr. Long in 1942 which was 1: 2.81 i.e 26% of land and 74% of water, where as Wegner proposed 28.3% of land and 71.7% of water, of the entire earth.

According to many researches conducted, with the help of latest technology at the polar regions, the scientists have determined the proportion of land and water to be 1:2.43 that is 29.2

% of land and 70.8% of water . These researchers also highlighted that 43% of the entire hydrosphere is extended in northern hemisphere and 57% of it extends in southern hemisphere.

In order to clear the distribution of land and water, if we divide the entire earth into two imaginary hemispheres, the situation will be like this-

1. To depict the lithosphere, if an imaginary hemisphere is drawn, considering the mouth of river Loire, on the coast of the France as centre and the distance from this Centre to Singapore as radius, then 47.3% of this hemisphere will be land and 52.7% of this will be under water.
2. To depict the Hydrosphere, if an imaginary hemisphere is drawn from the south eastern part of New Zealand, considering as centre and the radius is taken from the north eastern coast of Sumatra to this centre, then the water will extend on 90% part of this hemisphere and land will extend upto 9.5%.

In this way, after studying the distribution pattern of land and sea, two major characteristics are highlighted:-

1. Land and Water areas are situated opposite to each other, for example African land mass opposite to Pacific Ocean, American Landmass opposite to Indian Ocean and Antarctic Landmass opposite to Arctic Ocean.
2. The shape of the continents and oceans are almost triangular. The base of the oceans is in Southern hemisphere and its head in the north whereas the base of the continents is in north and the head towards south.

**Table 17.1
The Area and Volume of water bodies**

| S. No. | Waterbody | %age of area | %age of volume |
|--------|---------------------------------|--------------|----------------|
| 1. | Oceans | 88.91 | 96.46 |
| 2. | Enclosed Seas | 0.63 | 0.03 |
| 3. | Fringing Bays | 2.29 | 0.52 |
| 4. | Inland continental Seas & Lakes | 8.17 | 2.99 |

The water bodies of the world apart from

extensive oceans (Pacific, Atlantic and Indian) also include enclosed seas like Mediterranean sea, Red Sea, fringing bays like Gulf of Mannar, Gulf of Baffin, inland continental seas and lakes like Caspian Sea, Dead Sea etc. The area and their volume is given in the table 17.1.

As the study of air masses is important in climatology in the same way the study of water bodies is also important in hydrology. The water bodies, in the central and lower latitude, extend extensively in a horizontal direction than vertical. The density of water increases with the increase in depth and in Polar Regions the water bodies extend in a horizontal direction than vertical.

On the basis of density, the difference in the nature of various water bodies can be well explained. According to Haylend Hassen, it is not necessary to have the same density in water of same temperature and salinity. In other words, the water bodies of varying temperature and salinity may have the same density.

The knowledge about the nature and the demarcations of water bodies, can be easily done by observing their temperature and salinity. As there are layers in the atmosphere in the same way there are layers in the oceans too. In the mid latitudes, near the equator, the surface of the oceans has a layer having lesser temperature, salinity and density, in which high velocity ocean currents flow. There is comparatively a denser layer below this. The bottom of the ocean consists of a layer of highest density.

The structure of water bodies are affected by the following factors:-

1. Latitudinal distance
2. The availability of fresh water from rain or Glacier
3. Direction of permanent winds
4. Divergence of water
5. Ocean currents
6. Oceanic cyclones

Distribution of Water Bodies

Most of the scientists have presented the classification of water bodies on the basis of temperature and salinity. It is important in a water body to possess the similarities of temperature and salinity extensively. The water bodies having same temperature and salinity are found in many seas

but many variations are found in Pacific and Atlantic Ocean. Equatorial water is not found in Atlantic Ocean. In the western parts of North and South America, the Equatorial Pacific water bodies are more. In the same way the central water bodies of Pacific ocean and North Atlantic Ocean are very different.

The world distribution of water bodies that progress in oceans, are as follows:-

1. Antarctic water body

This water body is found near Indian Ocean and south of Atlantic Ocean.

Near the continental margins due to high melting point the salinity is higher. The salinity of this place is 34.62 and the temperature is -1.9°C and the density is 27.89. After reaching the freezing point density of the water increases and it descends towards the bottom because the nearby water is comparatively warmer, which has the salinity of 34.68, temperature 0.5°C and the density is 27.84. This is a specific type of waterbody which expands in the bottom and through mixing, forms a specific type of water body.

2. North Atlantic Coastal Water Body

This water body is found between Oakland and Southern Greenland. The warm and saline water flow of North Atlantic gets cool down as it merges with East Greenland current and its density increases. Its divergence occurs at the depth of more than 1,000m. At that time its density is 27.88, salinity is 34.90 and temperature between 2.8°C to 3.3°C .

3. Antarctic Central Water body

It originates due to inclination of the

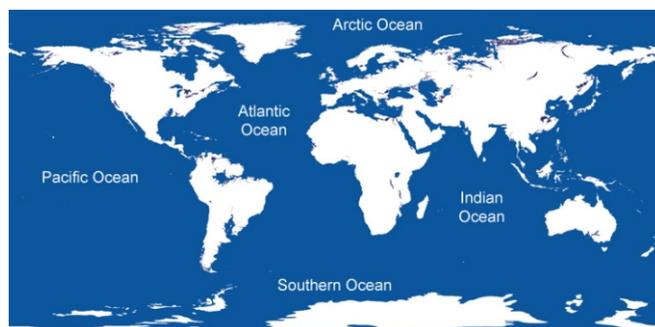


Fig.17.2 : Oceans of the world

Antarctic region. It originates all around Antarctica continent. The main cause of its origin is not known properly but it is definite that its salinity is 33.8, temperature 2.2°C and density is 27.0 which remains same at all the places. It is also affected by westerlies high velocity wind belt.

4. North Pacific Central Water body

It rises near the north east of North Pacific Ocean, near 40° north latitude. This water is deficient in oxygen levels. As it proceeds towards southern and western direction other types of water bodies also merges along with it. This is the reason why the properties of this water body after the convergence, are not always the same as it should be.

5. Central Water body

These water bodies are located centrally between 35° to 42° North and South latitudes. The amount of temperature and salinity is comparatively lower on the surface of these water bodies and keep decreasing towards higher latitudes but the density increases. These water bodies are not very deep. Its maximum depth of 900m is found in Saragossa Sea. These water bodies located in Pacific Indian and Atlantic Ocean do not have uniform relationship between temperature and salinity. The temperature of these water bodies is from -0.82°C to -1.2°C and the amount of salinity varies from 34.89 to 34.92%.

6. Equatorial Water body

This water body is located between Pacific and Indian Ocean along the equator. Due to the peculiar shape of Atlantic Ocean, equatorial water bodies are not found in them. The temperature of water is warmer. The thickness of this water body varies between 100 to 200 m. With the change of season, the temperature and salinity of this water body also changes.

Important points

1. The total area of hydrosphere is 36, 106 million square kilometre and the total area of lithosphere is 14,889 million square km which is 70.8% and 29.2% of the entire earth surface.
2. 43% of the entire hydrosphere is located in Northern hemisphere and 57% in Southern

hemisphere.

3. The distribution of land and water can be well defined in the form of two hemispheres.
4. Hydrological cycle is directly or indirectly related to the sun. Due to this fresh water is always available on the earth. Evaporation and condensation plays an important role in this.

Exercise

Multiple choice questions

1. The average amount of water present in the atmosphere is-
 (A) 1 inch (B) 2 inch
 (C) 3 inch (D) 4 inch
2. The cyclic stages which completes in different forms of water is called-
 (A) Evaporation
 (B) Condensation
 (C) Hydrological cycle
 (D) Rainfall
3. The difference in the nature of the water bodies can be expressed through-
 (A) Salinity
 (B) Density
 (C) Temperature
 (D) Depth
4. What is the total percentage of freshwater available in water?
 (A) 1.6 (B) 2.6
 (C) 3.6 (D) 4.6
5. The central water bodies are located between-
 (A) 25° to 35°
 (B) 35° to 45°
 (C) 35° to 42°
 (D) 32° to 45°

Very short type questions

6. What are the different parts of water bodies?
7. Which is the main process of hydrological cycle?
8. What percent of air water is circulated every year in hydrological cycle?
9. What are the major stages of hydrological cycle?
10. At which place, the maximum depth of the

water body is found?

Short type questions

11. What is hydrological cycle?
12. What are the major stages of hydrological cycle?
13. What are the factors that affect the structure of hydrological cycle?
14. What are the factors that affect the structure of waterbodies?
15. What are Central water bodies?

Essay type questions

16. What is hydrological cycle and water bodies, explain the importance of hydrological cycle in nature.
17. What are water bodies and explain its distribution pattern.
18. Differentiate between equatorial and Central water bodies.

Answer Key

- 1.(A). 2.(C). 3.(B). 4.(B). 5.(C)