Water Resources: Use and Over-Utilization of Surface and Ground Water

Dr. Krishnappa Venkatesharaju,
Assistant Professor, Department of Environmental Science And Engineering, Presidency University, Bangalore, India
Email Id- venkateshraju.k@presidencyuniversity.in

ABSTRACT:
Water resources are essential for maintaining life and a variety of human endeavours. The use and overuse of surface and groundwater are discussed in general, with an emphasis on their importance, difficulties, and possible remedies. It addresses the numerous industries that rely on water supplies as well as the unsustainable behaviours that fuel their excessive consumption. In order to guarantee the availability and fair distribution of water resources for both current and future generations, the chapter emphasises the significance of sustainable water management practises, integrated methods, and international collaboration.

KEYWORDS:

Irrigation, Lakes, Resources, Supply, Water.

I. INTRODUCTION

According to some, water is a valuable resource. Irrigation is a significant usage of water in our nation. Water is also needed in huge quantities for home and industrial use. There is no need to explain the significance of water. It is as follows. The development of human civilisation has shown the close relationship between water availability and civilization. Water shortages brought on by climate changes have caused the demise of several cities and civilizations. Every year, water-borne diseases claim the lives of millions of people throughout the globe, mainly in impoverished nations. Knowledge of the sources, composition, reactions, and movement of water provides the foundation for comprehending the many elements of aquatic environment chemistry. Of the remaining 97% of the earth's water supply, which is unsuitable for human use, 3% is in the ocean, 2% is frozen in the polar ice caps, and just 1% is accessible as fresh water in rivers, lakes, streams, reservoirs, and ground water [1]. Water is not always readily accessible, unlike land, which is always used in its current state. Our nation is a monsoon region. The majority of rainfall only occurs from July to October, a short time span of 3–4 months. As a result, a significant portion of the nation lacks surface water supplies for a significant portion of the year [2].

Surface Flow

1. River

14 significant river systems experience surface flow. Brahmani, Bhrahmaputra, Cauvery, Ganga, Godavari, Indus, Krishna, Mahanadi, Mahi, Narmada, Periyar, Sabarmati, Subarnarekha, and Tapti are some of them. Between them, the following situation exists: They comprise 85% of the surface flow, share 83% of the drainage basin, and are home to 80% of the nation's population. In addition, there are 55 minor rivers and 44 medium rivers. These rivers, which include Godavri, are swift-moving, monsoon-fed, and they rise in the coastal mountains of the big rivers Brahamputra, Ganga, and Indus. They encircle more than half the nation. Only four are perennial: Brahamputra, Ganga, Mahanada, and Brahmani. Their annual minimum discharge is 0.47 Mm3 per km3.

2. Ponds and lakes

Lakes: Inland depressions with standing water are known as lakes. They may range in size from little ponds with fewer than a dozen acres to vast oceans with thousands of square kilometers. They might be anywhere from a few feet and over 5,000 feet deep. There are three to five distinct horizontal strata in a lake, and they are as follows:

i. The littoral zone is formed by shallow water close to the coast. It has a zone of higher, warm, and flowing water that is rich in oxygen. Vegetation with roots is present in the littoral zone.

ii. Sublittoral zone comprising rooted plants and chilly, stagnant water with low oxygen levels, or hypolimnion.
iii. The limnetic zone is the area of open water that is not near a coastline.
iv. The profundal zone is the deep-water region that is below the limnetic zone and beyond the depth at which light may effectively penetrate.
v. Because the abyssal zone is located 2,000 meters below the surface, it can only be found in deep lakes.

Pond: Small bodies of water that are so shallow that rooted plants may cover the majority of the bottom are referred to as ponds. Because filling, however gradual, is inevitable, most ponds and lakes have outlet streams, and both are more or less transient features on the landscape.

II. DISCUSSION

Stratification of Ponds

They have a larger littoral zone than a limnetic zone or profundal zone. The limnetic profundal zones are not present in tiny ponds. The sun heats the warm upper layer, or epilimnion, which is then homogenized by the wind and other currents. The deep cold layer, or hypolimnion, on the other hand, is neither heated by the sun nor moved by wind. Simply thermal principles underlie the maintenance of the layers, which result from the lighter density of warmer water compared to colder water. There is no water interaction between the epilimnion and hypolimnion when a thermocline forms [3], [4].

Physical and Chemical Characteristics of Ponds and Lakes

In order to experience a clear seasonal periodicity in depth, heat distribution, and oxygen content, lakes have a propensity to become thermally stratified throughout the summer and winter. Additionally, depending on the turbidity, light only penetrates to a particular depth.

Variety of Lakes

There are several categories of lakes based on physical characteristics, production, etc. Hutchnson (1957) divided lakes as dimitic, meromictic, and polemicist lakes based on temperature. While monomictic lakes only show one overturn year, dimictic lakes show two overturns annually. Cold monomictic and monomictic lakes are a possibility.

Monomictic cold

i. It is distinguished by a circulation that only occurs in the summer.
ii. It circulates during the winter as well.
iii. Polomictic lakes have circulation all year round.

The world's lakes have been divided into clear water lakes and brown water lakes based on how acidic humans are the brown water includes a lot of humus. Clear water takes may be separated into the following two categories. Its water is deficient in nutritious plant matter and exhibits roughly equal oxygen distribution in the summer and winter. Little organic material may be found in the mud bottom, the eutrophic kind. It is nutrient-rich. Eutrophic lakes have a significant fall in oxygen concentration below the thermocline in the summer, and its mud bottom is made of ordinary muck.

Flowing Water or Lotic Ecosystems

Rivers, streams, and other areas associated to moving water are referred to as lotic ecosystems. They range in magnitude from the Ganga, Yamuna, Hindon, Kali Nadi, Sutlez, and Gomti, among others, to the trickle of a little spring. Similar distinctions may be made based on flow. The rivers' movement is so smooth as to be nearly imperceptible on one side, while on the other, there are wild torrents and waterfalls. As a river flows from an alpine stream to a major river, it undergoes significant variation throughout its whole course. Principal Features of the Lotic Environment Lakes and ponds and moving water vary in the following ways:

i. The current is a limiting and regulating force.
ii. Land water interchange is excellent since flowing water systems are smaller and deeper than lakes.
iii. Except when there is pollution, oxygen is generally always plentiful.
iv. Extreme temperature swings are more common than in standing water.
v. The characteristics of flowing water ecosystems that stand out the most are those that are connected to their motion, such as the rate of flow and the stream's velocity. The amount of water that passes a certain

observation point over a given period of time is referred to as the rate of flow. This quantity is expressed in units like m3, ft3, or acre-feet/sec.

Water Moving Quickly

The area of a stream where the flow is both brisk and turbulent is known as rapidly moving water. As a result, the current carries away anything that is not connected or heavy. This applies to both organisms and sedimentary components. Rock or gravel often makes up the substrate. The water progressively smooths and rounds the particles [5].

Water that Flows Slowly

Compared to quick streams, a slowly moving water environment is a totally different kind of system. Both the flow speed and the likelihood of laminar flow are slower. As a consequence, the stream's erosive strength is significantly diminished, which causes tiny silt particles and decomposing organic material to be deposited on the bottom. Additionally, the temperature of the slower streams is greater. Planktonic creatures, particularly protozoans, are hence abundant in this ecosystem. The bottom muds of certain running streams are richer in organic matter than in mineral shards. The fundamental limiting element in sluggish water streams is oxygen content. The abundance of animal life and a flowing stream of debris [6]. Additionally, since there is less turbulence, less oxygen is dissolved into the surface water. As a result, a stream that is going slowly is likely to have a significantly lower concentration of dissolved oxygen than a stream that is moving quickly.

Estuaries

All rivers and streams ultimately empty their water into the sea. Estuaries are where this freshwater merges with the seawater. Estuaries, which are transitional areas between the sea and rivers, are thus the locations of special biological features. They are semi-enclosed coastal bodies of water with a free access to the open where freshwater from a river has been used to measurably dilute saltwater. Not all rivers, nevertheless, have access to estuaries. Some rivers only empty into the ocean their drainage. Estuaries are not all the same. Rather, the geology of the area in which they are found influences how they vary in size, form, and water flow. The sediments carried by the stream are dumped into the calm water as the river approaches the approaching sea. These build up to create deltas in the upper mouth region, shortening the estuary [7], [8].

Surface Water Position in the Country

India has abundant surface water resources at its disposal. The nation's total water resources are estimated to be 1880 km3 per year. Thus, it could be able to capture 690 km3 of water for useful purposes. Additionally, the country's ground water resources are estimated to be at 452 km3.

Storages

India has built a significant number of storage facilities and diversions to take use of its enormous warehousing capacity.

- **i.** Too far, the projects that have been completed have built up around 163 km3 of live storage.
- **ii.** The ongoing project will provide an additional 7 km3 of live storage.
- **iii.** 131 km3 from projects that are being thought about.
- **iv.** There are also other tiny tanks with a combined storage capacity of roughly 30 km3.

The country's total hydropower capacity has been estimated to be 84,000 mW at a 60% load factor. At this time, completed and ongoing schemes will use around 15,600 mW, or 20% of the potential assessed. At the conclusion of the Sixth Plan, hydropower installed capacity was 14, 450 mW. constituting around 34% of the installed capacity overall. Estimates made in this respect (1985) suggested that water usage may be in the magnitude of 530 km3 is from surface Water and 180 km3 from Ground Water, in the lack of information on actual water use by different sectors. Out of this, 470 km3 will be used for irrigation, and the remaining 70 km3 will be used for various purposes, including as domestic (16.7 km3), industrial (10 km3), and thermal plant (2.7 km3) needs. According to a recent estimate, household needs in 1991 were about 26 km3. The following table details the development of water resources according to basin for 12 major river basins, Runoff from agricultural fields continues to pollute surface water supplies with pesticides, fertilizers, soil particles, industrial waste chemicals, and sewage from urban and rural regions. Even in areas with abundant rainfall, like Chakrapani and Konkan, during the dry months, there is a water shortage. Every year, certain areas of our nation experience hunger and flood difficulties brought on by the uneven distribution of rainfall. The mass balance of yearly precipitation reveals that 30% of it enters streamflow and 70% is lost to direct evaporation and plant transpiration. This streamflow's estimated human consumption breakdown is as follows: 18% for irrigation, 2% for personal use, 4% for industrial usage, and 12% for electrical utilities. The two biggest users of water are electric generating plants and agricultural irrigation.

Growth Water

There are plenty of ground water resources only in the northern and coastal plains. Its supply is insufficient in certain areas. There are around 210 million m3 of groundwater. This amount comprises recharge from seepage, evaporation, and infiltration. Even now, not all villages and cities in our nation have access to clean drinking water. Minerals from the soil layers that the ground water travels through are dissolved in the water. The majority of the microorganism that were initially present in the surface water are mostly removed from the water through seepage through the earth. Despite sometimes having an abnormally high salt level, it is typically better as a supply of household water. Vast colonies of bacteria and algae are fed by the vast amounts of organic debris and mineral nutrients found in surface water. The country's total replenishable groundwater resources are now assessed to be around 45.23 million hectare metres per year. Of this, 6.93 million hectares are used for industrial, drinking water, and other purposes, leaving 38.34 million hectares as usable space. Resources of Ground Water for Irrigation.

Overutilization of Water

Our water budget reveals that the overall water resources are in the range of 167-million-hectare metres, assuming that the average annual rainfall for the whole nation and its entire territory are taken into account. In actuality, we can only use 66-million-acre metres of water for irrigation. We aim to utilise it completely only by the year 2010 A.D. due to several budgetary and technical limitations. Only 9.7 million ha metres of water had been utilised for irrigation by 1951. It reached 18.4 million ha metres in 1973. It has been noted that the agriculture industry uses the most water. In 2000 A.D., 73% of the water utilised for irrigation, which was only around 40% two decades earlier, was being utilised. The usage of irrigation is quite ineffective. As a result, 25–30% efficiency and watering technique must be dramatically altered. It is clear from the statistics on water consumption shown in the table below that irrigation, including livestock and electricity use, uses 79.6% and 13.7% of water, respectively. Domestic (3.5%) and industrial (3.3%) applications follow.

The location may alter if the land area is considered as a whole. The area irrigated almost quadrupled to 67.5 million hectares by 1984–1985. A further 13 million hectares were to be placed under irrigation after five years, or by 1990, bringing the total to 80 million ha. This might be evaluated in comparison to the 133 million hectares overall potential by the year 2010 A.D. It should be noted that this is the gross sown area, not the net sown area. More over 3% of the net planted area, the former, is now covered by irrigation. The World Health Organisation (WHO) estimates that nations with a water shortage are located far away. Nordic Water Supply, a Norwegian corporation, has been shipping enormous floating bags of fresh water, or clean drinking water, across the seas. These bags that float is meant to be lengthy. 35,000 tonnes of water are included in each. The supertanker-sized floating water bags, which can hold 100,000 tonnes of water and are 300 metres long, are created in a polyester facility. In this manner, the Nordic corporation does business.

Water Supply

Water is in short supply in our nation. Fewer than 2000 of the more than 3000 communities in our country have a formal water supply. Water supply coverage must be expanded to include both urban and rural areas. Current water supply conditions include the following Low daily per capita supply, Inefficient distribution, High leakage, and poorly managed system. In towns, this is the position. Water supply improvements in rural areas have been quite sluggish. The six lakh villages concerned are where 76% of our people resides. Previously, people had access to clean drinking water through tube wells or piped water delivery systems. There are ongoing efforts, and it is anticipated that supplies would eventually reach more than one lakh communities. During the Water Supply and Sanitation Decade (WSSD) (1981–90), the situation has somewhat improved. Other safety precautions must be followed in order to address the water issue. We must utilise as little water as possible. Waste water is the amount of water that is returned after usage. According to statistics on water consumption in our nation, by the year 2000 A.D., out of the 1900 Mm3 of water that was accessible, more than half or 1092 Mm3 had been utilised for four primary consumptive uses irrigation, power production, home use, and industrial use. It is believed that in order to maintain sustainability, at least half of the entire amount of water should be utilised each year. By the year 2000 AD, the nation had already beyond the 50% level, which is not in our ecological interest.

Measurement to Check Over-Utilization of Water Resources

The responsibility of developing policies and programmes for the country's water resource development and regulation falls to the Ministry of Water Resources in our nation. It has authority over the following:

- **i.** Strategic planning.
- **ii.** Coordination.
- **iii.** Policy directives.
- **iv.** Project technical analysis and tech-economic evaluation.
- **v.** Central support for particular initiatives.
- **vi.** Facilitating outside aid and helping to settle interstate water conflicts.
- **vii.** Formulating policy, planning, and providing direction for small irrigation.
- **viii.** developing command areas.
- **ix.** Exploitation of groundwater resources.

Its scope of authority is obviously fairly broad. The National Water Policy was established by the National Water Resources Council in September 1987. The council emphasised the fact that Water is a valuable natural resource, a need for all living things, and a priceless national treasure. As a result, it should never again be wasted or consumed in excess. It argued that national considerations should direct the planning and development of water resources. The field of water resources development and management has faced several problems and obstacles since 1987. It was deemed essential to revise the National Water Policy as a result. At its fifth meeting, held on 1 April 2002 in New Delhi, the National Water Resources Council followed the same procedure and endorsed the (Revised) National Water Policy. Each state is required to develop its own State Water Policy, backed by an operational action plan in a time-bound manner, and the period so specified is a period of two years. All states, aside from the federal government, are required to take immediate action in order to achieve the desired objectives of the policy.

III. CONCLUSION

Surface and groundwater resources are essential for maintaining ecosystems, industry, agriculture, and home requirements. However, the excessive and unsustainable use of these resources has created serious problems and effects. In response to the rising demand for water brought on by population increase, urbanization, and economic development, groundwater aquifers have been depleted and rivers and lakes have dried up. Groundwater overuse may cause land to sink, restrict stream flow, and let saltwater seep into freshwater aquifers. Additionally, the problems with the quality of the water are made worse by the contamination of surface and groundwater sources. Sustainable water management techniques are essential to addressing these issues. It is essential to use integrated strategies that take the demands of many stakeholders and sectors into account. This entails implementing effective water conservation practises in families, encouraging water-saving technology in industry, implementing efficient irrigation practises in agriculture, and spending money on wastewater treatment and reuse. The preservation of ecosystems that provide natural water storage and filtering functions as well as watershed management techniques are crucial.

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