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Water Provenance and Management

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Abstract: Water in any form is, "The elixir of life of all living organisms". This is the most critical natural resource of earth and it is the natural gift of nature. It is available in almost all parts of the World and at some places it is available in abundance and at some places it is a scarce commodity. Water conservation leads to better water management. There has been conflict between different nations, different provinces, different communities and even different families for this precious resource. Many people opine that the next World War will be for water only. We are receiving enough water every year and its availability is reducing day by day but the lips of consumption are increasing years after year. Thus, it is the responsibility of each and every Government as well as each citizen to take care of this important resource.The ever-growing population, primary and secondary sector activities of human being is polluting water resourcescontinuously. The fact is that, the water of the river which I was drinking while going to my school during the sixties and early seventies is not suitable for taking bath or even for the purpose of agriculture at present. Water scarcity is both a natural and a human-made phenomenon. There is enough freshwater on the planet for seven billion people but it is distributed unevenly and too much of it is wasted, polluted and unsustainably managed. Major cities like Sau Paulo, San Diego, Las Vegas, Istanbul, San Antonio, Beijing, New Delhi, Chennai, Mexico City, Cairo, Tokyo and Cape Town are already on the brink of water scarcity. Around 1.2 billion people, or almost one-fifth of the world's population, live in areas of water scarcity, and 500 million people are approaching this alarming situation. Another 1.6 billion people, or almost one quarter of the world's population, face economic water shortage. Many countries lack the necessary infrastructure to manage the water resource and also to tap water from rivers and aquifers. Urban Local Bodies (ULB) of many developing and under developed countries are not managing their sewerage system and polluting the ever-resourceful ground water and surface water mostly rivers. In order to manage water resources, the strategy should be to have more water infrastructure like construction of dams, barrages and reservoirs across all rainfed rivers.Further, it is therefore very high time to train each and every citizen right from their childhood, the value of water and how to conserve for a sustainable environment. Water resource management planning is of utmost importance and it seeks to allocate water on an equitable basis to satisfy all uses and demands.

Keywords: Water resources, water management, meteoric water, aquifer, unconformity, groundwater pollution, groundwater management, waste management, grey water, black water, surface water, microfiltration, panipanchayat, rainwater harvesting.

Introduction

Water is the one the major creation of God, which the mother earth cannot conceal by any means.We,with various means suck out its innermost secrets of Earth and brings them to our very lips. No matter, how much rich one will be but he /she can't live without water. It is said that a human can go for more than three weeks without food (Mahatma Gandhi survived 21 days of complete starvation) but one can survive around 100 hours without water. Water is essential for human health, food security, *energy* supplies, sustaining cities and ecosystems. Today, the world's water systems are facing a growing crisis, threatened by overuse, pollution and climate change. Communities all over the world are experiencing extreme conditions like floods, droughts and short supply of water for day to day activities both in rural and urban areas as there are poor management of flood control and water supply at many places.

Paradox of nature is that Earth is covered with around 71% of water and an adult human body is also made up of almost 70% (some says 75%) of water. According to H.H. Mitchell, Journal of Biological Chemistry, the brain and heart are composed of 73% water, and the lungs are about 83% water, the skin contains 64% water, muscles and kidneys are 79%, and even the bones have also around 31% water in some form or other. Water acts as a lubricant for our joints, regulates our body temperature through sweating and respiration, and helps to flush waste.Life-forms use water to carry nutrients around the body and to take away waste. Water also helps break down food and keep organisms cool, among other very important jobs. In that respect all living organisms be animal or plants need water for its survival. It is said that, the most powerful country (USA) uses around 4% of its energy for treatment, transportation and pumping of one product i.e. water.

Water molecule is made up of two hydrogen atoms bonded to an oxygen atom. "The way they're bonded together makes water this wonderful universal solvent," meaning that almost majority of substances can dissolve in water, Glazer told Live Science. Pure water is tasteless, odourless and colourless. Water can occur in three states: solid (ice), liquid (water) or gas (vapor).

Importance of Water

We celebrate 22nd March of the year as the "World Water Day". The need of observing the World Water Day is to focus on the importance of water and to remind everyone the need and conservation of water. The United Nations General Assembly designated 22 March 1993 as the first World Water Day, and this year it was the 25th

World Water Day. The main theme for World Water Day 2018 is "Nature for Water" considering the fact that entire World will face the Water Scarcity in the ensuing century and years forward.World Water Day, on 22 March every year, is about focusing attention on the importance of water.

It is difficult to think of the world without water. Without water it would make the human race impossible to survive. The same can be said for all the animals and plants. Major causality on account of scarcity of water is that entire greenery will soon diminish as all the vegetation will die and turn into barren land. The occurrence of different seasons that we experience will soon cease. It may so happen the green belts like rain forest and savannahs will look like deserts and human being will vehemently searching for oasis. The earth will be caught in one big endless summer. We therefore need to realise the reasons on the importance of water, which may be for any of the following:

- Water for Good Health
- Water for Good Mental Health
- Clean Water for Best Health
- Water for blood circulation
- Water helps by creating saliva
- It regulates body temperature
- Water aids cognitive functions
- Water protects the tissues, spinal cord, and joints
- It helps excrete the waste in our bodies through perspiration, urination, and defecation
- Water maximizes our physical performance
- It helps to boost our energy levels
- Water prevents overall dehydration

There are two varieties of water, which are polluting the ever-resourceful groundwater. First one is flowing rivers including their tributaries and distributaries besides lakes and ponds, which are directly or indirectly polluting the ground water. Second and most critical varietyof wateris **"Grey Water"** and **"Black Water"**, which are generated from households of each and every housedaily and are polluting the ground water in most dangerous way.

Greywater is the domestic wastewater produced, excluding sewage from the households. Many Urban Local Bodies, Housing Complexes, Hospitals, Hotels, individual House Holds etc. are now waking up to the benefits of greywater re-use, and the term "Wastewater" being used by many is a misnomer. It is better to rename this to an appropriate termas "Used Water".With proper treatment grey water can be put to day today use. These uses include water for laundry, toilet flushing and also irrigation of plants, washing of vehicles, construction purposes besides industrial uses. Treated greywater can be used to irrigate both food and non-food producing plants. The nutrients in the greywater (such as phosphorus and nitrogen) provide an excellent food source for these plants that can replace many chemical fertilizers. Reusing this treated water does not diminish our quality of life, however it can provide benefits on many levels. Further it will reduce the pressure onthe fresh and meteoric water, which is becoming scarce day by day. Saving on fresh water use can significantly reduce household water bills, but also has a broader community benefit in reducing demands on public water supply.There are many ways developedin recent years to treat the greywater so that it can be reused. The various methods used must be safe from a health point of view and not harmful to the environment.

Blackwater is the wastewater released from bathrooms and toilets that contains faecal matter and urine. Water from kitchens and after washing dishes are also considered by many as blackwater due to the contamination by different kinds of pathogens and oils /fats (Your Home, Australian Government).It is also referred to as Sewage or Brown Water and carrybacteria that creatediseases, both of which could be harmful to human and other living creatures. Biological or chemical treatment and disinfection are required for treating this blackwater. Many developed countries of the world have developed several accredited treatment systems for treatment of both greywater and blackwater for outdoor use. Countries like Sweden, Australia and other nations have efficient methods of treatment and reuse system, which involves the following steps.

- Settlements of solids from waste water
- Effluent is aerated to assist bacterial breakdown of organic matter
- Disinfection by chlorine pellets
- Microfiltration of blackwater

Availability and Sources of Water

Earth is considered to have four-layer, viz; Crust, Mantle, Outer Core and Inner Core.Many geologists believe that the Earth is cooler in the crust and as one goes deeper, it is heavier, denser and hotter. Because of this, the crust is composed of the lightest materials (rock- basalts and granites) and the core consists of heavy metals (nickel and iron). The crust is the layer that we live on, and it is the most widely studied and understood. The Earth's Crust is like the skin of an apple and is thinner in comparison to the other three layers(Fig.2). The crust is only about 3-5 miles (8 kilometres) thick under the oceans(oceanic crust) and about 25 miles (32 kilometres) thick under the continents (continental crust). It is therefore the crust of the earth only has water in different forms besides different kind of soils it has. The scarcity of water as being discussed by different group of people is an abstract concept to many and a stark reality for others.

Fig.1. Standard waste treatment plant

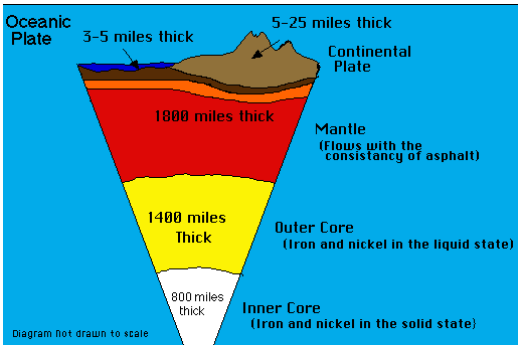

Fig.2.Internal structure of earth

The present state of affairs of water scarcity is the result of myriad environmental, political, economic, and social forces. The water that is available to our lips has been around us since Gondwana Period in one form or another while other school of thought is that it has been around us since Dinosaurs roamed on Earth, which will be some millions of years ago. Freshwater of our planet has remained fairly constant over the time on account of continuous recycling of water through the atmosphere and that are coming back into our cups, though there is constant growth of population. However, there is always crave for clean, copious supply of water for drinking, cooking, bathing, and sustaining life intensifies. The issue is not restricted to man and animal but between nations and continents. Oceans hold about 96.5 percent of all Earth's water. What we consider as fresh water is only very small fraction of all water available on our planet. Although almost over 70% of the world is covered by water barely around 2.50% of it is considered as freshand the balance quantity of water is in oceans, seas or are brackish.

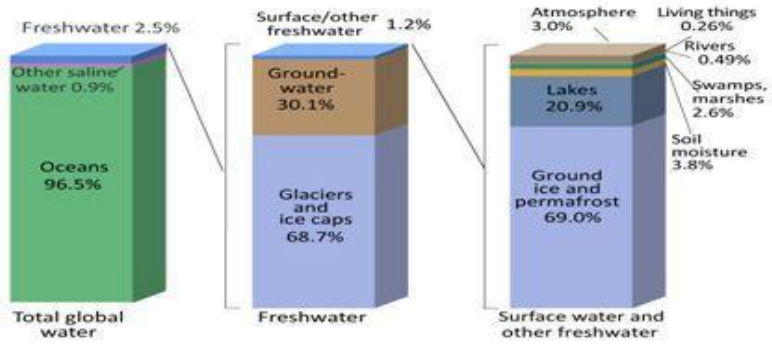

Fig.3.World Water Resources. Courtesy: Igor Shiklomanov

Looking to this statistic and figures it is said that around 1.2 % percent of available freshwater is easily accessible, with much of it trapped in glaciers and snowfields. Thus, only 0.007% of the planet's water is available to fuel and feed its 7.8 billion people. Due to awareness of Government and Citizens of many nations, besides geographic condition, climatic conditions, engineering, regulation, and competition for resources, some regions of the World are relatively flush with freshwater, while many countries face drought and debilitating pollution. In much of the developing world, clean water is either hard to come or thecommunity is putting a lot of resources to have the fresh potable water. A pictorial presentation of Earth's water as follows:

Of the 2.50% fresh water as stated above groundwater, glaciers and ice caps contains maximum (68.70%). Groundwater is 30.10% and surface &other water contains only 1.20%. Water available for human consumption is the surface and other water. In many countries people receive ice melted water that flow through their snow fedrivers. Due to pollution by man-made actions(anthropogenic), poor water treatment, defective sewage management and archaic water management, almost all the water as stated above by the time it reaches for human consumption are contaminated to a greater extent. This causes almost all kinds of water borne diseases and also pollutes the nearby areas.

Water from **Glaciers and Ice Caps** are evaporated to a great extent and some flow to the rivers through its tributaries. This water is fresh and not contaminated in the true sense by the time it touches the streams. City dwellers, industries and even people living by the banks of these streams, tributaries and rivers pollute these valuable resources of nature on the way and again we spend our resources to de-contaminate it for human consumption. With little awareness by these people and group, there is a high level of scope to minimise the pollution and thus savings of tax payer's money.Further, there will be a better environment around these streams, tributaries, rivers and distributaries as also savingof lives of Flora and Fauna. The situation of these streams, tributaries, rivers and distributaries are very bad in most of the South Asian and African countries but similar

places attract many international tourists in European, American and Oceania Countries. Following picture shows how Zayandeh river of Iran near Isfahan has been maintained till last decade (Fig .4)

Fig.4.Zayandeh River in Isfahan, Iran (Photo taken by the Author during March 2007)

Meteoric Water

Meteoric water occurs near the earth's surface and is caused by the infiltration of rainwater. This will be the water derived from precipitation (snow and rain). This also includes water from lakes, rivers, and melted ice, which all originate from precipitation indirectly. While the bulk of rainwater or meltwater from snow and ice reaches the sea through surface flow, a considerable portion of meteoric water gradually infiltrates into the ground. Thus, meteoric water is the water that has fallen as rain and has filled up the porous and permeable shallow rocks, or percolate through them along bedding planes, fractures, and permeable layers.Major sources of water of India arerain water, which is otherwise termed as Meteoric Water. While countries like Colombia, Sao Tome & Principe, Papua New Guinea and Solomon Islands receive more than 3000 millimetres (mm) of annual rainfall, India receives an Annual Rainfall of over 1050 mm. India ranks 85 out of 186 major countries ahead of developed countries like Germany, France, Denmark, Belgium. Netherland, United States of America, Belgium etc. India's rainfall from 2000 to 2018 as per Indian Meteorological Department, Ministry of Earth Sciences, (Tab.1) :

YEAR	SW – MONSOONRAINFALL (mm)		ANNUALRAINFALL (mm)	
	RAINFALL	%DEPARTURE	RAINFALL	%DEPARTURE
2000	798.1	-10%	1035.4	-13%
2001	818.8	-8%	1100.7	-7%
2002	700.5	-21%	935.9	-21%
2003	902.9	2%	1187.3	0%
2004	807.1	-9%	1106.5	-7%
2005	874.3	-1%	1208.3	2%
2006	889.3	0%	1161.6	-2%
2007	943.0	6%	1179.3	-1%
2008	877.8	-1%	1118.0	-6%
2009	698.3	-21%	953.7	-20%
2010	911.1	3%	1215.5	2%
2011	901.3	2%	1116.3	-6%
2012	823.9	-7%	1054.7	-11%
2013	937.4	6%	1242.6	5%
2014	781.7	-12%	1044.7	-12%
2015	765.8	-14%	1085.0	-9%
2016	864.4	-3%	1083.2	-9%
2017	845.9	-5%	1127.1	-5%
2018	804.1	-9%	1020.8	-14%

Tab.1. South West (SW) Monsoon andAnnual Rainfall of Indiafrom 2000-2018

Duringthisperiod of 19 years, only 4 years annual rainfall is normal or above normal in India and rest of the years annual rain fall is below thenormal. The deficiency during these 19 years is as high as 21%, which is considered as very high.**On account of climatic imbalance coupled with high level of pollution and denudation of greenery, there will be shortage of rainfall in many areas of India as well as the World. It is therefore, we should be alert in managing the water resources as efficiently as we can otherwise our next generation will curse us.**

Ground Water and Its Management

Groundwater is almost 30.10% of total fresh water available. The top of the surface where groundwater occurs is called the water table. Sediments including rocks and soils of the crust have porosity, faults, joints, fractures, etc. that have capacity to hold water besides the normal groundwater. This water will normally look clear and clean because the ground naturally filters out some solid waste and other particulate matter. Undergroundof Earth stores

large quantity of water and it exists everywhere though the degree of ground water enrichment differs from place to place. At some places the water table is so deep that it will be difficult to retrieve but at some places it is so shallow that only few feet of drilling are required to pump out the groundwater. Groundwater is generally enriched every year and the enrichment depends upon the rain fall and nearby water bodies including flowing rivers. Groundwater enrichment causes water to filtrate down until it reaches impermeable zones where it is diverted laterally. Gravity plays an important role and it generates the flow of springs, rivers, and wells. If the permeability of rocks and sediments are connected, gravity allows the water to move slowly through the porosity of these materials.

Meinzer defines permeability as follows: "The permeability of a rock is measured by the rate at which it will transmit water through a given cross section under a given difference of pressure per unit of distance." In a sequence of sedimentary rock with varying permeability, it commonly can be shown that horizontal permeability or permeability that is parallel to the bedding of rocks such as sandstone and conglomerate is greater than permeability at right angles to bedding. This is because some beds in the sequence have such low permeability that vertical infiltration is slow whereas lateral permeability in units below confining beds isfast and good.State-Wise Ground Water Resources of India (2017) in billion cubic meters (BCM), Tab.2 (below)

Ground Water (GW) Recharge (Re.)											
		Monsoon Season		Non-Monsson Season							
Sl. No.	States / Union Territories	Re. from rainfall	Re. from other sources	Re. from rainfall	Re. from other sources	Total Annual GW Re.	Total Natural Discharge	Annual Extractable GW Resource	GW Allocation Domestic Use PA as on 2025	Net GW Availability for future use	Stage of GW Extraction (%)
1	Andhra Pradesh	9.96	5.62	1.21	4.42	21.22	1.07	20.15	1.48	12.31	44.15
2	Arunachal Pradesh	1.89	0.18	0.95	0.01	3.02	0.36	2.67	0.03	2.64	0.28
3	Assam	20.22	0.43	7.28	0.74	28.67	4.42	24.26	0.79	21.43	11.25
4	Bihar	19.83	3.95	3.14	4.5	31.41	2.43	28.99	1.83	15.78	45.76
5	Chhattisgarh	7.82	1.36	0.76	1.64	11.57	1	10.57	0.79	5.76	44.43
6	Delhi	0.13	0.06	0.03	0.11	0.32	0.02	0.3	0.29	0.02	119.61
7	Goa	0.19	0.03	0.01	0.05	0.27	0.11	0.16	0.04	0.07	33.5
8	Gujarat	15.95	3.4	0	3.02	22.37	1.12	21.25	0.9	7.98	63.89
9	Haryana	3.56	2.55	1.03	3	10.15	1.01	9.13	0.72	0.87	136.91
10	Himachal Pradesh	0.34	0.02	0.11	0.04	0.51	0.05	0.46	0.34	0.16	86.37
11	Jammu & Kashmir	1	0.5	0.88	0.51	2.89	0.29	2.6	0.5	1.84	29.47
12	Jharkhand	5.25	0.13	0.41	0.42	6.21	0.52	5.69	0.56	4.13	27.73
13	Karnataka	6.59	4.36	2.67	3.22	16.84	2.05	14.79	1.14	5.41	69.87
14	Kerala	3.91	0.04	0.68	1.13	5.77	0.56	5.21	1.57	2.41	51.27
15	Madhya Pradesh	27.1	1.51	0.82	6.99	36.42	1.95	34.47	1.72	15.84	54.76
16	Maharashta	20.59	2.29	0.53	8.23	31.64	1.74	29.9	2.28	12.91	54.62
17	Manipur	0.23	0.01	0.17	0.02	0.43	0.04	0.39	0.04	0.34	1.44
18	Meghalaya	1.37	0.01	0.43	0.02	1.83	0.19	1.64	0.02	1.59	2.28
19	Mizoram	0.16	0	0.05	0	0.21	0.02	0.19	0.01	0.18	3.82
20	Nagaland	1.65	0.03	0.52	0	2.2	0.22	1.98	0.02	1.96	0.99

21	Odisha	10.53	2.34	1.5	2.37	16.74	1.17	15.57	1.3	8.85	42.18
22	Punjab	5.54	11.83	1.31	5.25	23.93	2.35	21.58	1.41	1.09	165.77
23	Rajasthan	9.74	0.78	0.24	2.44	13.21	1.22	11.99	2.67	0.88	139.88
24	Sikkim	5.2	0	0.43	0	5.63	4.11	1.52	0.01	1.51	0.06
25	Tamil Nadu	6.67	9.41	1.89	2.26	20.22	2.02	18.2	1.85	5.66	80.94
26	Telangana	7.56	1.42	1.88	2.76	13.62	1.25	12.37	1.39	4.26	65.45
27	Tripura	0.8	0.06	0.4	0.26	1.53	0.29	1.24	0.11	1.11	7.88
28	Uttar Pradesh	37.73	11.67	1.59	18.93	69.92	4.6	65.32	5.96	20.36	70.18
29	Uttarakhand	1.15	0.93	0.09	0.87	3.04	0.15	2.89	0.22	1.25	56.83
30	West Bengal**	18.71	1.51	5.26	3.85	29.33	2.77	26.56	1.53	14.19	44.6
33	Andaman & Nicobar	0.35	0	0.02	0	0.37	0.04	0.33	0.01	0.32	2.74
34	Chandigarh	0.02	0.01	0	0.01	0.04	0	0.04	0.03	0	89
35	Dadra & Nagar	0.06	0	0	0.01	0.07	0	0.07	0.01	0.04	31.34
37	Daman & Diu	0.02	0	0	0	0.02	0	0.02	0	0	61.4
38	Lakshdweep	0.01	0	0	0	0.01	0.01	0.004	0	0	65.99
39	Puducherry	0.09	0.07	0.02	0.05	0.23	0.02	0.2	0.04	0.05	74.33

Tab.2 State-Wise Ground Water Resources of India (2017) in billion cubic meters (BCM)Ground Water (GW), Recharge (Re.), Annual (PA)

From the above table it indicates that states and union territories like Delhi, Haryana, Punjab and Rajasthan extract groundwater more than 100% whatever being recharged. This situation will not be sustainable in the long run. InRajasthan, a xerophytic condition exists and receives less rainfall than requirement, Delhi, Haryana and Punjab have better soil condition and have good number of perennial rivers. In these areas there are enough scope to recharge groundwater by tapping both meteoritic water as well as river water. These areas are with high population density and to take care of future water requirement they have to think of possible ways to recharge and manage their ground water.As discussed above, groundwater is being polluted by various ways by human beings and on account of poor water management. If groundwater contamination is identified on a site and contaminations are found above regulatory limits, remedial activities or feasibility studies must be done how to curtail it. Common remedial methods are mentioned below:

- Groundwater pumping and treatment
- Onsite treatment
- Offsite removal through excavation
- Soil vapor extraction springing
- Passive recovery of non-aqueous phase liquid
- Enhanced bio-remedification
- Onsite encapsulations
- In-situ onsite treatment
- Separating waste at home

Groundwater situation also depends upon the sub-soil quality and unconformities besides Aquifer condition.**Unconformities** are stratigraphic features of Earth and are of particular importance in Hydrogeology. There are six types of Unconformities, viz; Disconformity. (an unconformity between parallel layers of sedimentary rocks which is a period of erosion or non-deposition), Nonconformity, Angular Unconformity, Para Conformity, Buttress Unconformity and Blended Unconformity. The gravels together with the weathered zone beneath the *unconformity can* make a prolific *aquifer*.

An **Aquifer** is a body of rock and/or sediment that holds groundwater. Groundwater Geologists generally come across four types of aquifers, i.e., Unconfined Aquifer, Perched Aquifer, Confined Aquifer, and Leaky Aquifer or Semi-Confined Aquifer.

Occurence of Ground Water

Over 50% of the United States population depends on groundwater for drinking water and it is also one of their most important sources of water for irrigation. Around 80 % of India's 1.35 billion residents depend on

groundwater for both drinking and irrigation. Unfortunately, groundwater is susceptible to pollution. Natural as well as human-induced chemicals can be found in groundwater. Since groundwater flows through the ground, it is quite but natural that different metals such as iron and manganese are dissolved and may later be found in high concentrations in the water. Major risk besides this natural process is **Industrial discharges, urban activities, inorganic agriculture, over pumping of groundwater and disposal of waste affect groundwater quality**. More harmful is leakages from septic tanks and waste-disposal sites introduce bacteria to the groundwaterand added by pesticides and fertilizers used by farmers. If river water and other surface water is polluted, there will be contamination of groundwater.

Generally surface water is used more by Urban Local Bodies (ULB) for drinking purposes in urban areas and by Government organisationsto supply for agriculture purposes.Groundwater is a major source of water, which not only helps tofeedwater torivers andlakesat many places but also provides water to thepeople in places where visible water is scarce. Therefore,it is always necessary to keep the groundwater recharged when there is abundant availability of meteoric water and surface water. There are possible ways to recharge groundwater in an artificial way is shown.

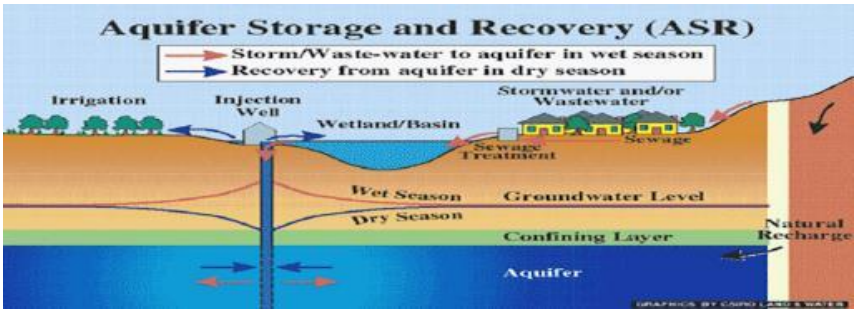

Fig.5 Depletion and Artificial Recharge

River (Surface) Water and Its Management

Rivers and rivulets are like arteries, veins and nervous system of our biosphere. It supplies water and indirectly food and oxygen through plants for survival of human beings. They are considered to be the lifeline of people in rural areas as it helps them in agriculture short run navigation including transportation. Rivers of the world are generally rainfed excepting some rivers, which are ice fed. Almost 90 per cent of India's river flows to the Bay of Bengal and rest are in to the Arabian Sea. Major rivers of India are Indus, Ganges, Brahmaputra, Godavari, Yamuna, Narmada, Tapi, Mahanadi, Krishna, Sutlej, Chenab, Ravi, Beas, Jhelum, Ghaghara, Chambal, Koshi and others. While Indus, Ganges, Brahmaputra and its tributaries are ice fed, others are rain fed. This river not only is major sources of water supply to the major cities of India but also helps in irrigation and hydro power generation. On account ofintense weathering and other activities in the catchment /upstream areas of rivers, the water of these rivers is beingpolluted over the years besides their basins are also being heavily silted thus reducing their water retaining capacity. Therefore, many areas in the downstream areas of these rivers suffer from floods during rainy season and draught during summer season.

Many rivers of Europe and North Africa are major sources navigation, transportation and ideal sites of tourism. Hydro power is one of the cheapest sources of energy besides being a renewable source of energy. If managed properly rivers can help in water management, irrigation, logistics, flood control, power generation and tourism. River water is one of the major sources to create a good environment. It is high time to remove the silt and sand by dredging from many river beds, thus increasing their basin capacity. Major benefits of rivers are:

- **For water:** It carries water and nutrients to areas all around the world.
- **Habitat:** Rivers provide excellent habitat and food for many of the organisms. Major ancient civilizations like Mesopotamia, Egypt, Indus Valley, Yellow River Civilizations etc are built on the bank of rivers.
- **Transport:** Rivers provide travel routes for exploration, commerce and recreation.
- **Farming:** River valleys and plains near river provide fertile soils for farming and agriculture.
- **Energy:** Rivers in the higher and undulated terrain are excellent sources of Hydro Power. Besides, there is possibility to build dams across the rivers in plains also so as to have Run-of-the-River Power Plants in smaller capacities. River deltas are the places where most of the coal deposits of the world are found.
- **Fishing:** many people living near riverside depends upon river to catch fish for their food as well as to earn living by selling fish.

Surface Water Management

Various simple and implementable ways can be used to limit the pollution of our water resources. These actions can be taken individually or collectively and must be done repeatedly to reduce the impacts on the water systems. Some of the possible ways that every individual can do to reduce water pollution are as follows:

1. Keep out oils, fat, or grease from the sink.
2. Abstain from flushing contaminated liquids, pills, drugs, or medications down the drain.
3. Desist from using the toilet as a bin.
4. Ensure minimal use of bleach or detergents.
5. Reduce the use of chemical herbicides, pesticides, fertilizers and try practicing organic farming.
6. Proper sewage treatment and management.
7. Dispose trash, motor oil, batteries or antifreeze at specially assigned collection points.
8. Avoid direct dumping of waste into thew water systems.
9. Try to conserve water as much as possible.
10. Insist on using environmentally safe products.
11. Practice and preach tree planting
12. Re-use automobile oil as much as possible and keep your vehicle well maintained.
13. Support green-oriented companies.
14. Use super energy saving washing machines and wash when you have a full load.
15. De-clog your drains naturally.
16. Always opt for recyclable and reusable options.
17. Skip the use of plastics.
18. Keep your boat well maintained if you have one or in charge of any.
19. Pick up plastic waste.
20. Contact the local water protection and conservation authority whenever you notice any pollution activities.
21. Install water-efficient household appliances.
22. Take action by actively participating in water pollution prevention.
23. Look for rain water harvesting in your building, colony and organization.
24. If possible, train people and farmers to create **"Pani Panchayats".**

Conclusion

Rapid urbanization, industrialization and large-scale pumping out of groundwater without a long-term planning is responsible for depletion of water table and pollution of this valuable natural resource. Government is taking different steps for water management, awareness and water conservation activities, but those are very slow and not enough to meet the challenges. Water management and environment management are both sides of same coin as one depends upon another. Better water management means a healthier environment. Agriculture consumes maximum water and also many people are dependent upon agriculture. Planned agriculture coupled with modern and systematic irrigation system can have a significant impact on the environment and yield agriculture output. There can be appropriate water management system so as to restrict depletion of water sources, containing of water pollution, managing soil infertility /soil erosion and maintaining anatural ecosystem. As per World Bank, most countries of World are placing unprecedented pressure on water resources. The global population is growing fast, and estimates show that with current water consumption pattern, the world will face a 40% shortfall between forecast demand and available supply of water by 2030. Furthermore, chronic water scarcity, hydrological uncertainty, and extreme weather events (floods and droughts) are perceived as some of the biggest threats to global prosperity and stability. In order to have better environment and proper water system for our next generation, it is high time to look into institutional strengthening on management of water, natural and man-made water infrastructure development, market oriented water pricing, incentives for "Rainwater Harvesting" and making it compulsory for all Educational Intuitions, Commercial Organizations and Housing Complexes, strengthening of developed "Pani Panchayat" as guided by V B Salunke, education to younger generations on water management from school levels, allocation, regulation and conservation water resources, investments in innovative technologies for water management, recycling storm water and wastewater and developing non-conventional water sources.

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