



SUSTAINABLE WATER RESOURCE MANAGEMENT IN INDIA

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Abstract

Water is a precious and indispensable resource that is essential to human survival. Water is essential for healthy ecosystems, socioeconomic development, and environmentally sustainable growth. It is crucial for improving population health, education, and production as well as for lowering the burden of illness on the planet. Global water demand is anticipated to increase by 20% by 2050. The population increase, urbanization, manufacturing, thermal electricity production, and home consumption account for the majority of the increase in water demand. India is already experiencing severe water shortages, and by the year 2050, the world's population is projected to have increased to 1.6 billion people. India is ranked 133rd out of 180 countries in the world for the amount of water available per person per year. For sustainability and human well-being, water can be a serious obstacle. Therefore, protecting the valuable resource is crucial. The problem of a water shortage can be greatly reduced by taking steps like using efficient water sources and recycled water again. As a result, the study aims to describe the importance of water, the current condition, demand and supply, and water scarcity. The current study concentrates on the generation and management of wastewater as well. Finally, give recommendations for how the government, local authorities, agricultural, industrial, and household users may play a significant role in ensuring that water resources are wisely utilized and protected against waste.

Keywords: Water, Sustainability, Availability of water, population growth, Urbanization, Conservation, Recycling.



INTRODUCTION

Water plays a crucial and vital role in all facets of life-food safety, development, health and sanitation, and politics. At a primary level, everybody needs access to clean water in sufficient amounts for drinking, cooking, and personal hygiene, as well as sanitation facilities that do not endanger health or integrity. Water shortage takes a tremendous toll on health and well-being and comes at immense financial expense, with significant loss of economic activity in many countries. Water is a crucial element of the three sustainability supports-economic, social and environmental. From this point of view, it is understood that water must fulfil the needs of not only of the present population but also of future generations. Sustainable development is, therefore, the cornerstone and fundamental to the quantity and efficiency of water supplies, as well as national security, economic health and social well-being. Sustainability implies the ability to preserve, protect and nourish life. Development means developing or establishing a condition which is more advanced. Thus, water sustainability means a population's ability to retain access to sufficient quantities of water to preserve human health and ecosystem health. Human use and freshwater supply contamination have reached a level where water quality security is in jeopardy. The resulting loss of water scarcity and water quality restricts agricultural development, decreases the functioning of the environment and hinders economic growth. A new report has suggested that drinking water would not exist in the country by 2040. Pollution of fresh water supplies from factories and industries with untreated water has further worsened the situation. To meet the present and future demand for water and food grain requirements, the Government of India has identified the following thrust / focus areas of water management:

- a) Increasing performance in water utilization
- b) Establishment of the command area and participatory management of the irrigation.
- c) Flood and erosion control.
- d) The defense against coastal erosion.
- e) Protection and conservation of the dams.
- f) Regeneration and rehabilitation of natural bodies of water.
- g) Effective monitoring and groundwater management.
- h) Recharging ground water



OBJECTIVES OF THE STUDY:

1. Per capita availability of water (cubic meters) in India.
2. Status of Sectoral Consumption of water.
3. Status of Wastewater Generation and its treatment.
4. Challenges in Wastewater Recycling in India.
5. Rainwater Harvesting as a viable Alternative Source.

RESEARCH METHODOLOGY

The current study is explanatory in nature. It is based on secondary data and information collected from the concerned sources as per the need of the research. The related books, articles and journal papers and published documents of various ministries/departments and organizations and websites are used in this study mentioned in the bibliography and Citations.

REVIEW OF LITERATURE

Sustainable water management (SWM) is a key component of sustainable development and is responsible for issues similar to sustainability. For all water users, Mays defines SWM as meeting current water demand without impairing future supply. More explicitly, SWM should make a contribution to the goals of society and preserve the integrity of ecology, environment, and hydrology. The definition proposed for groundwater resources by Alley mentions the protection of the components of the triple bottom line of sustainability: environment, economy, and society. Elnaboulsi stated that sustainable production of public wastewater utilities could be accomplished by encouraging full-cost pricing and taking into account the external costs of wastewater services. Zanni analyzed and contrasted the environmental impacts due to the use of sources of water supply (such as rainwater harvesting and recycling of greywater), which provide alternatives to tradition. Integrated control of water is necessary for environmental sustainability, economic sustainability and the growth of the nation and the enhancement of human life. (2014- 15 MoWR Annual Report).



ALARMING STATISTICS

- Per capita water supply in the country has decreased from 6,042 cubic meters in 1947 to about 1,545 cubic meters in 2011. 76 million people are denied access to clean potable water.
- In 2015, 329,000 children under the age of five died from diarrhoea.
- 70 % of the freshwater present in soil and surface water is contaminated.
- Due to the lack of storage facilities, 65 % of rainwater ends at sea.
- 90% of the sewage water pumped into rivers and lakes is untreated and contributes to further groundwater pollution.
- By 2050, the rising population of India and the contracting of water supply would hit alarming proportions.

PER CAPITA AVAILABILITY OF WATER (CUBIC METRES)

India has 2.45% of the world's ground, containing 16 % of the world's population, but just 4% of the world's freshwater reserves. The nation has recorded an average annual precipitation of 4000 billion cubic meters. The precipitation is not uniformly distributed; the precipitation ranges from less than 100 mm in Rajasthan to over 2500 mm in Assam. The country's per capita water supply is declining steadily due to population growth. The Central Water Commission (CWC) estimates annually that the country has an average annual per capita water supply, declined from 5,177 cubic meters in 1951 to 1,545 cubic meters in 2011, below the 1,700 cubic meters 'stress level. Declining PCWA has put India on the brink of water scarce category nine of our 20 river basins with a population of 200 million now face a "water-scarce" situation. According to the Ministry of Water Resources the water supply per capita is expected to decline by approximately 36% and 60% respectively in 2025 and 2050. India is now shifting from stressful water to scarce water. If this pattern continues, India in future will face a huge water deficit, especially in the irrigation sector.

SECTORAL DEMAND OF WATER

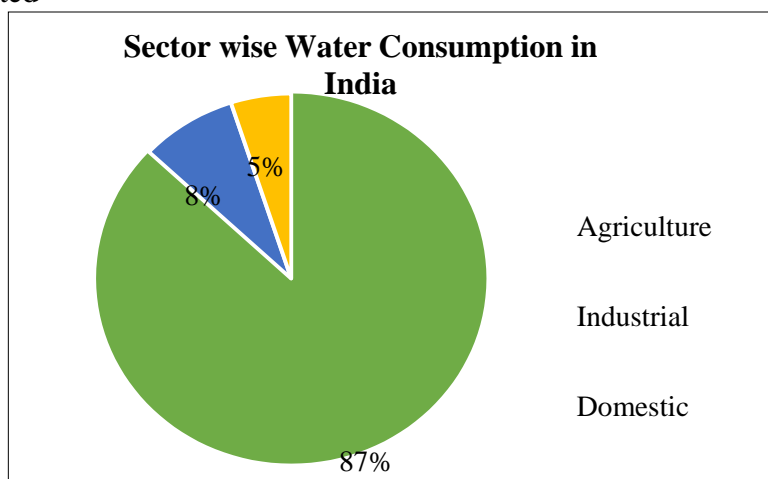
The growing population and rapid urbanization have a major effect on India's demand for water. The changing food pattern, lifestyle and land use also play a significant role in water requirements. India receives plenty of water as rainfall during monsoon, but due to lack



of storage only a small percentage of that water is actually added to the reserve. In a country like India, where the spatial distribution of available water with the population is substantially uneven, the situation becomes alarming; unsurprisingly less water is available where more people live. The water demands in all sectors are rising due to rapid economic and demographic change. According to National Commission on Integrated Water Resources Development (NCIWRD) estimates, by 2025 the irrigation sector alone will require an additional 71 bcm and 250 bcm of water by 2050 compared to 2010 demands (Press Information Bureau 2013). The average domestic water demand has grown from 85 litres per capita (lpcd) per day in 2000 to 125 lpcd and 170 lpcd by 2025 and 2050, respectively. Total industrial water demand could also rise by 2025 and 2050 to 92bcm and 161 bcm (Ministry of Statistics and Implementation Program 2011), respectively. Other industries are very likely to have increased water demand. Though groundwater satisfies a considerable amount of water requirement, a long-term water recharge study in both pre-monsoon and post-monsoon seasons shows a reduction in the water resources due to minimal recharge.

SECTORAL CONSUMPTION OF WATER

Over the years, water usage is rising rapidly, and availability of fresh water remains more or less constant. Approximately 87% of the water is spent on agriculture, followed by the industrial sector which uses about 8%. The domestic industry constitutes roughly 5% of overall water use. This share is projected





to rise to 11% by 2050. By 2050 the per capita intake will double. Currently more than 85% of household water and 60% of farm water use is dependent on groundwater. India uses more freshwater than China and the USA combined. The industrial sector uses just 8% of water and is worst affected by the water crisis, as they are given the last preference by the National Water Policy. The demand for industrial water has doubled over the past decade and is expected to rise by about 3 folds by 2050. Water plays an important role in electricity production as well (from 42 BCM in 2000 to 151 BCM in 2050). According to the Central Public Health and Environmental Engineering Organization, (CPHEEO) under the normal conditions, water intake in India is around 135 liters / day / per capita. The per capita demand for big cities is typically higher than in small towns. Climate conditions, industrial activity, fluctuations in demand, human activities and their economic status are responsible for this growth.

WASTE WATER GENERATION AND ITS TREATMENT

With diminishing sources of fresh water and growing industrial, agricultural, and domestic demand, treatment of wastewater and its use is absolutely necessary. In order to bridge the gap between supply and demand for water in India, priority should be given to using treated wastewater in the urban, municipal and industrial climate. In India there are presently 1093 sewage treatment plants, however, India has the facility to handle the present sewage generation of just 26869 million litres per day (MLD), but only about 30 % of the sewage is treated. There is a major difference between producing wastewater and treating it. Because of technical deficiencies in the sewer pipes and large cities treatment plants, only 30-40 % are treated and small cities / towns handle only 8 % of the wastewater. Delhi uses 4.346 million litres of water per day, 87 % of which returns as waste. Delhi, however, has the facility only to handle 61 % of the total wastewater it generates. Every day the untreated wastewater is recycled into water bodies. Pollution levels are rising in water bodies because of the influx of untreated waste and effluents.



Table-1 Number of Sewage Treatment Plants in the Country

Sr. No.	STP Status	2014		2020	
		No. of STPs	Capacity (Mid)	No. of STPs	Capacity (Mid)
1.	Operational	522	18883	1093	26869
2.	Actual Utilization	-	-	1093	20235
3.	Compliance	-	-	578	12197
4.	Non-Operational	79	1237	102	1406
5.	Under Construction	145	2528	274	3566
Total (Sr.No.1+4+5)		746	22648	1469	31841
6.		70	628	162	4827

Source: CPCB Annual Report 2020-21 Updated on 2nd Aug., 2022

CHALLENGES IN WASTE WATER RECYCLING IN INDIA

In India there was a very low understanding of over-exploitation of water resources. Wastewater recycling systems are neither adequately funded nor planned in India's urban spaces resulting in restricted recycling options for people. Water used for sanitation is rarely treated in urban areas of India. Recycling infrastructure for wastewater in India's urban spaces is neither properly funded nor planned, resulting in restricted recycling options for residents. Just 30% of the wastewater in India is treated. The apathy about wastewater treatment in India is evident from the nature of its sewage systems. Much of India's urban drainage systems lead directly to rivers or reservoirs. High-income nations handle about 70 % of the wastewater they produce, a figure that falls to 38 % for countries of upper middle income. Just 8% of industrial and municipal wastewater undergoes some form of treatment in low-income nations. The biggest problem facing India is the expense of installing wastewater treatment plants and reorganizing sewerage systems. As calculated by the Centre for Science and Environment, the cost of building a wastewater plant is Rs 1crore for per million litres of water. Urban and rural India can't afford to develop such plants without generous government and private sector funding. Public authorities usually do not want to take up wastewater treatment because there is no clear economic return on any of the current technologies. Land unavailability also acts



as a common barrier to wastewater plant construction in India, especially in urban areas where land is a highly expensive commodity. Many wastewater treatment plants are still out of date and require the latest technologies and capacity expansion. Other problems such as continuous power supply, professional labour force, adaptation to environmental standards are consistent features in the establishment of wastewater treatment plants.

RAINWATER HARVESTING AS A VIABLE ALTERNATIVE SOURCE

Today, centralized water management schemes have a significant effect on our lives and people around the world are searching for new resources to increase the available water resources. One of these processes, rainwater harvesting, is the collection and preservation of rainwater. The Rainwater Harvesting System consists of components like pipes or drains, filtration and reservoirs for storage of the collected water. Water harvesting may provide a supplementary supply depending on local environmental conditions. Rainwater harvesting is cost-effective and can release the capital required in times of disasters of surprising magnitudes with support technologies. There are also cost savings related to the collection of rainwater using simple processes and thus infrastructure, including the pumps and energy inputs required. This also decreases emissions of greenhouse gases associated with water sources. Today, many countries around the world recognize rainwater harvesting as a viable source of decentralized water and practice rainwater harvesting as a strategy for sustainable development. Rainwater management can have a positive impact on both ecosystem services and human well-being, generating potentials in desired and positive development directions. However, rainwater harvesting can be successful with local intervention, with habitats and human livelihoods. Rainwater harvesting technology will lead to both mitigation and adaptation to climate change. Many studies have reported how the irrigation of rainwater conserves groundwater. The decentralized existence of the irrigation of rainwater has minimized dependency on public (or private) water supply systems. This is useful both in rural areas, where dispersed households make water supply service expensive and, due to local biophysical circumstances, often almost impossible. India maintains a Central Groundwater Board, which in both rural and urban areas supervise artificial groundwater



recharge. Implementing policies for the absorption and application of rainwater harvesting is a first step towards increasing availability of water. For instance, moving from a centralized to a decentralized water system is not an impossible challenge, but one that involves sustained rationalization, preparation, implementation and adjustment efforts.

KEY OBLIGATIONS FOR VARIOUS STAKEHOLDERS IN THE WATER SECTOR

It is critical that the various stakeholders take the requisite measures to improve the current situation of water scarcity in India. The regularity, economic viability and reliability of water supply and wastewater treatment facilities urgently need to be improved. The Central Government should increase funding under schemes such as JNNURM for the development of water supplies, sewerage networks and treatment plants to reform the National Water Policy and encourage the use of treated wastewater and reduce the use of waste water, promote grants for technical assistance to improve the capacity of urban local authorities to create public-private partnerships. Extend technical assistance for groundwater recycling and recharge programmes. The State Governments must specify the roles and obligations of each entity within the sector establish administrative bodies to oversee the management of water supplies and the pricing of bulk water The State Governments should assist ULBs in developing a powerful water supply and wastewater treatment project to attract private investment ,increase information sharing among regional development planners on state-of-the-art water resources The State Governments should introduce reforms by local authorities to promote operational control and improve without raising environmental concerns, build dams. The Municipalities can initiate daily water tariff Adjustments to ensure efficient usage of water supplies They can create plans to extend the wastewater collection networks and construct more wastewater treatment plants. They can cut non-revenue water by repairing leaks, track the quantity and consistency of the water supply and they should build capacity for planning within local authorities by the number of planners, environmental engineers. Agricultural users may invest in water quality to boost technologies such as drip irrigation. Industrial users may use automated shut-off valves for machines which are not in operation for certain commercial purposes, drinking water may be supplemented by non-drinking or



reclaimed water. They can undertake construction and maintenance of wastewater treatment systems and wastewater treatment plants in the industrial region and substitute existing facilities with more water-efficient facilities They can also reduce the use of artificial fertilizers to combat water contamination. Finally, the households must clean vegetables in a water bowl rather than under running water Switch taps when teeth are brushed, add water-saving shower heads and take a shorter time to shower Do use full loads in a washer and dishwasher Water garden only if it is essential Clean your car less often and use a water bowl to clean your vehicle Mount toilets with water.

CONCLUSION

Water is the most important aspect of any planet that sustains life. Without food one can live without electricity for weeks, but cannot survive without water for over 60 hours. Our country has minimal and inadequate renewable water supplies. Lack of care in this business in the next 1-2 decades it will head to water shortage. Hence, this situation must be avoided by making the full use of the current technologies for maintaining and transforming existing water supplies into usable forms and for making productive use of them in farming, processing and human use Implement regulatory measures to avoid water misuse to promote Fair use of Implement regulatory measures to avoid water being misused and promote it water usage sensitively can be effective in water conservation. Finally, awareness and understanding should improve for all water consumers. Their water conservation lifestyle will help the country win the water crisis in the future.

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