

Review of Water Crisis and Management Scope in India

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ABSTRACT

The Indian monsoon has shown sweeping changes over the last 20 years. The number of rainy days and the amount of rainfall has declined. Declining ground water levels and lack of adequate water resources to meet demands affects every state. The scarcity of water directly affects the food and energy crisis. The situation of water crisis has become even worse due to the gross neglect of the traditional water culture of India. Heavy water intensive crops such as paddy and sugarcane are cultivated in north-western parts of the country particularly in Punjab, Uttar Pradesh and Maharashtra. Owing to explosive population growth, the biggest impact is on groundwater in terms of its indiscriminate exploitation. Lack of awareness and poor infrastructure towards water conservation is the foremost driver behind the water wastage problem. The water bodies are vital for sustenance to Indian agriculture and have been playing important role in the overall management of water resources. Rainwater harvesting is considered an ideal solution to tackle water problems where there is inadequate groundwater supply or where surface resources are not sufficient. Designing and constructing a good rural rainwater storage system has become an urgent task for water resources revitalization. Ayurved Research Foundation (ARF) since its inception has been working on "Water Conservation" Technologies and strongly advocate their adoption to address water crises.

Key words : Rainfall, Water bodies, Agriculture, Jal shakti, Climate

Introduction

The Indian monsoon has shown sweeping changes over the last 20 years disrupting the hydrological system and decreasing water availability in the Himalayas. The number of rainy days and the amount of rainfall has declined. Consequently, the groundwater recharge has been reduced and water discharge in streams and springs has diminished by 35%, decreasing irrigation potential (15%), declining agricultural productivity (25%) and undermining food and livelihood security (Tiwari and Joshi, 2011). The country has a strange diversity of climatic regions, ranging from cold temperate and alpine in

the Himalayan north to the hot and humid tropical in the south, also cherishes a rich history of water harvesting systems, but on a large scale, reservoirs were constructed on a coordinated basis, the main objective of which was to create a wide range of water storage systems (Singh, 2021). In spite of all these bounties, the unfortunate aspect is that presently, India has become a house of a huge proportion of the world's water poor population (Sugam, 2018) and holds only 4% of the world's freshwater resources, but 18% of the global inhabitants.

Changes in rainfall pattern affect drinking water, river and surface runoff, soil moisture, groundwater

reserve, electricity generation, agriculture production and ultimately the economy of a country (Kuttippurath, 2021). The water bodies are vital for sustenance to Indian agriculture and have been playing important role in the overall management of water resources. They reflect the regional style of construction and typically were based on the provincial demand of water. Since last few decades, water bodies have been under continuous and unremitting stress, caused primarily by unplanned growth and rapid urbanization (Singh, 2021).

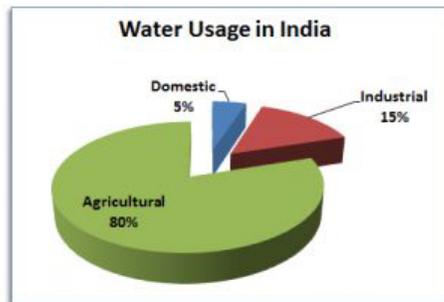


Fig.1

Presently in the country, agitating climate variability, rapid urbanization, and competitive demand of water for agriculture, industry, energy production, and municipal supply puts tremendous pressure on underground reservoirs (Singh, 2021) Agriculture accounts for 70% of water abstractions worldwide (Mateo-Sagasta, 2017). India has 18% of world's population, having 4% of world's fresh water out of which 80% is used in agriculture, 15% by industries and only 5% is used for domestic purpose (Fig.1) (Nayyar, 2019), hence making it increasingly tough to meet the water challenges of the near future.

Water crisis: factors to be considered

The monsoons play a key role in the growth of the country, as the amount of rainfall determines food production, electricity generation, and groundwater recharge and drinking water availability for most parts of India (Kuttippurath, 2021). Declining ground water levels and lack of adequate water resources to meet demands affects every state. Water crisis in rural areas is the prime reason; the people are obliged to migrate to the cities already fighting with population pressure. Apart from this, the urban areas are already under numerous anthropogenic pressures, ranging from industrial develop-

ment to desertification, pollution and loss of biodiversity (Singh, 2021). In this, we are not only monitoring the depletion of groundwater and pollution of surface water, but also vanishing water bodies — ponds, lakes, tanks, wetlands — due to encroachment. Water pollution is another cause of water stress, leading to collateral losses in healthcare (News, 2022). This fact itself necessitates an urgent action towards the conservation of the already scanty resources in rural areas, deprived of which the situation is bound to worsen day by day (Singh, 2021). The scarcity of water directly affects the food and energy requirements (Fig. 2) (Walker, 2020).

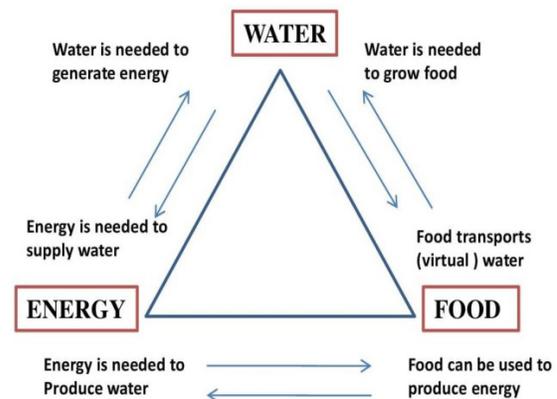


Fig. 2. The Water-Energy-Food Link

The root cause behind tough scenario of water crisis is vital to be explored first in order to deal with it. Overlooking non-judicious distribution system, promoting dire habits and misusing the water resources are the core realities behind the current water crisis. The situation of water crisis has become even worse due to the gross neglect of the traditional water culture of India (Singh, 2021). Following are some of the major problems being faced:

Over extraction of groundwater for farming

Farming, it is known that over the years, many changes in its cropping pattern and the approaches of irrigation occurred over the years. With the decreasing availability of water in reservoirs like canal, ponds and rivers along with the development of advanced techniques, there has been a vast change in the method of irrigation. Heavy water intensive crops such as paddy and sugarcane are cultivated in north-western parts of the country particularly in Punjab, Uttar Pradesh and Maharashtra. The Punjab is entirely dependent on ground water for rice cultivation. Punjab uses two to three times more water

in comparison to Bihar and West Bengal to produce one Kg of rice. Farmers in Maharashtra state cultivate sugarcane on a large scale and use ground water for its irrigation. At the same time, where Bihar extends quite favorable environment for sugarcane cultivation, ironically, only 4% of the total sugarcane production of the country is produced.

Despite being numerous demerits of flood irrigation like water wastage, nutrient leaching, and weed growth, majority of farmers still prefer it over other water saving methods. Tube Wells and canals are the most common modes of irrigation. Due to the spatial-temporal variation of rainfall, the scarcity of water makes irrigation necessary for some crops (Singh, 2021). Along with this livestock sector is growing and intensifying than crop production, the associated waste including manure has serious implications for water quality (Mateo-Sagasta, 2017).

Population growth and Water demand

When the population reaches an explosive state in, it starts growing disproportionately with the resources, and so is the case with ground water. Owing to this explosive growth, the biggest impact is on groundwater in terms of its indiscriminate exploitation. But it is quite unfortunate that even if laws are in force, they themselves have become the victims of ignorance and resulting in deterioration of water resources. The total domestic and public need for water includes the water requirement of animals, for irrigation, domestic and public use, industry, power generation, inland shipping and ecological purposes. Recycling of water is not practiced and there is considerable scope. They estimated that recyclable water is between 103 and 177 km³/year for low and high population projections (Bhattacharyya, 2015). The growing imbalance between demand and supply, indiscriminate and excessive use of ground water requires urgent attention.



Fig. 3. Drinking and household water availability (Saberin, 2018)

Rapid urbanization

Today, even a small piece of land in urban areas has a high economic value. Hence, these urban water bodies are no more acknowledged for their ecosystem services but as real estate (Bhattacharyya, 2015).

With the expansion of cities, there has been an unprecedented increase in buildings, roads and other construction works. Most parts of the metropolitan cities are either residential areas or commercial spaces. It is hence very hard to find open, fallow land in the cities. Almost the entire ground surface is covered with asphalt roads and that too at the cost of massive deforestation. There is an inextricable relationship between forest and rain, due to which the water storage areas do not irrigate the underground aquifers and create conditions like drought in summer and flood in monsoon. These conditions make it almost impossible for the rainwater to percolate into the soil and recharge the groundwater tables. Furthermore, most of the metropolitan cities mainly depend on groundwater reserves as their primary source of water (Singh, 2021).

Climate unpredictability

The critical levels of climate change are alarming. The changes in weather over the years have been very apparently noticed in the form of dryer summers and recurrent droughts. Then comes dripping winters too that causes flooding. The dryer and hotter summers simply mean a greater amount of water evaporating back into the atmosphere leading to lesser availability of ground water for abstraction when it is urgently required, particularly in times of drought. Unpredictable and sudden heavy rainfalls cause flooding that lakes, rivers and reservoirs cannot cope with and thus affecting all forms of human activities directly including structural and environmental damage (Singh, 2021). According to the Inter Governmental (IPCC) Panel on Climate Change, the rainfall intensity, duration and frequency are going to increase in the future. Also, incidence of cyclonic circulations and cloud bursts that cause flash floods are increasing due to Climate change. These all scenarios indicate the need to understand potential impacts of climate unpredictability.

Water reservoirs, recharges and recycling of water resources

Wastage of water does not only mean using it more than what we require when it is scarce, rather it en-

compasses failing to conserve it when it is in abundant. Groundwater utilization is very high in the states of Punjab, Haryana, Rajasthan, and Tamil Nadu. If the present trend continues, the demands for water would need the supplies. Lack of awareness and poor infrastructure towards water conservation is the foremost driver behind the water wastage problem. It's pretty regrettable that despite realizing the horrific situation of water crisis in the future, we are using the available ground water indiscriminately. The crisis seems even more daunting when the numbers related to the wastage of water are shockingly high. Inside the 1.3 billion tons of food wasted every year worldwide involves 45 trillion gallons of water. Continuous declines in groundwater levels could permanently stop the outflows into the rivers, adversely affecting the in stream flows and the ecosystems (Kumar, 2000).

Drinking water quality and health concern

Farms discharge large quantities of agrochemicals, organic matter, drug residues, sediments and saline drainage into water bodies. The resultant water pollution poses demonstrated risks to aquatic ecosystems, human health and productive activities. The falling groundwater levels are not the only red flag that we see today. Rather, the issue of quality of drinking water is also a major concern. Cases related to water borne diseases like typhoid, cholera and jaundice are increasing in recent years. Application of the heavy doses of chemicals to ensure a good yield and these chemicals get washed away and canals and rivers get contaminated by lethal chemicals. These reservoirs are not only used by humans as a source of drinking water but also by the animals and livestock of that area, as a result we end up consuming not just unhealthy water, but also unhealthy food, milk, eggs and meat, all grown using the very same toxic water and this has led to an adverse impact on agriculture as well as on human health (Singh, 2021).

Water resources management – the possible solution

The practice of water harvesting and management in India is incredibly old. Rainwater harvesting is considered an ideal solution to tackle water problems where there is inadequate groundwater supply or where surface resources are not sufficient (Rustogi, 2017). The effective reservoir design of rural rainwater resources can not only alleviate floods,

but also serve as water supply for rainy seasons. It can also reduce excessive consumption of groundwater resources in rural areas, preventing the destruction of environmental ecology. Designing and constructing a good rural rainwater storage system has become an urgent task for rural revitalization (Deng, 2019). The first Indian state to make rainwater harvesting compulsory for buildings to reduce groundwater depletion was Tamil Nadu in 2001, which has reaped enormous benefits for the state. It is responsible for lessening the load on primary water sources, adding fresh and potable water availability for the masses (Shrinivasan, 2021). The solution to rapid groundwater depletion and changing rainfall patterns can be in the form of digging open wells and recharging these shallow unconfined aquifers. These recharge wells replenish groundwater by catching rainwater from rooftops and stormwater drains (Khambete, 2019). Traditional systems are a characteristic hybrid of the ecology and culture of the region in which they develop. They have not only stood the test of time, but also met the local needs keeping in sync with the environment. Unlike modern systems that exploit the environment, these ancient systems emphasize on ecological conservation. It can be said that traditional systems were more effective then and still are in terms of water supply and return on capital (Singh, 2021).

It is extremely important for us to meet the rising demand for water expansion, civilizing the health of water bodies as they are required to manage microclimate, biodiversity and nutrient cycling.

The initiative of the Jal Shakti Abhiyan, a time-bound, water conservation movement under the ministry of water resources of government of India is a convivial step focusing on rainwater conservation, rejuvenation of water bodies, reuse of wastewater after proper treatment, and serious afforestation. Besides, Wetlands Authority is being established in many states for notifying and conserving natural water bodies.

1.2 There is a need to develop a clear and elaborate definition of lake and other water bodies that must consider all aspects including the climatic and ecological changes over the time. Identification of water bodies like lakes, ponds, johads etc, and their proper record should be notified as the municipal assets- their area, particular location etc (Advisory on Conservation and restoration of water bodies in Urban areas, 2013).

- 1.3 More focus on Green infrastructure encompasses a variety of water management practices, such as vegetated rooftops, roadside plantings, absorbent gardens, and other measures that capture, filter, and reduce storm water as it cuts down on the amount of flooding and reduces the polluted runoff that reaches sewers, streams, rivers, lakes, and oceans. It captures the rain where it falls, mimics natural hydrological processes and uses natural elements such as soil and plants to turn rainfall into a resource instead of a waste. It also increases the quality and quantity of local water supplies and provides other environmental, economic, and health benefits—often in nature-starved urban areas.
- 1.4 Different advanced irrigation and water saving techniques like sprinkler, drip irrigation, microirrigation, watershed management approach, water harvesting and recycling etc. are used to conserve water and thereby increase water use efficiency (IndiaAgroNet.com, 2016).
- 1.5 Any outfall of domestic /industrial sewage into the water body should be prevented and only treated effluent, as per effluent standard of the State Pollution Control Board, may be allowed to dispose into the water bodies (Advisory on Conservation and restoration of water bodies in Urban areas, 2013).
- 1.6 Heavy water intensive crops are irrationally grown in the water scarce state; the state governments should promote the cultivation of less water consuming crops like pulses, jowar-millet and oilseeds. Rice and sugarcane cultivation should be allowed only in those areas where water is available in plenty (Singh, 2021).
- 1.7 The misuse of water bodies by local communities for their cultural or religious festivals such the immersion of idols should be banned (Laloo, 2017). Separate tank may be built for religious/cultural festivities that require immersion into water body (Twadboard, T.N).
- 1.8 Ayurvet Research Foundation, Sonipat, Haryana, for the last 15 years is working on 5F programme for the sustainability of environment and integration of agriculture and livestock for the benefit of farmers and society at large.
- a) Hydroponics Technology developed by ARF to raise paddy nursery within 8 days and it mechanized transplantation in the field helps in saving of approx 1.5 lakh liter of water/ acre.
 - b) Hydrogel technology used by Organization has helped farmers in saving one to two irrigation/ season in the fields of cereal crops.
 - c) Organisation promotes organic farming in its area of operation where vermicompost is added to soil which helps in retention of moisture and water conservation.
 - d) Organization promotes zero tillage technique among farmers which require direct sowing of seed without preparing the field for next crop and saving of huge volume of water/hectare.
 - e) Multilayer farming practice being promoted among farmers by Organization to grow multiple crops in every acre of land helps in optimal utilization of land and saving of water used in multiple irrigations.

Conclusion

The monsoons play a key role in the growth of the country, as the amount of rainfall determines food production, electricity generation, and groundwater recharge and drinking water availability for most parts of India. Changes in rainfall pattern affect drinking water, river and surface runoff, soil moisture, groundwater reserve, electricity generation, agriculture production and ultimately the economy of a country. Declining ground water levels and lack of adequate water resources to meet demands affects every state. The water bodies are vital for sustenance to Indian agriculture and have been playing important role in the overall management of water resources. Since last few decades, water bodies have been under continuous and unrelenting stress, caused primarily by unplanned growth and rapid urbanization. Different advanced irrigation and water saving techniques like sprinkler, drip irrigation, microirrigation, watershed management approach, water harvesting and recycling etc. are to be used to conserve water and thereby increase water use efficiency. More focus on Green infrastructure encompasses a variety of water management practices, as it cuts down on the amount of flooding and reduces the polluted runoff that reaches sewers, streams, rivers, lakes, and oceans. Vermicompost being produced from biogas spent helps in retention of moisture in the soil and timely release of nutrients to plants, hydroponics technology helps in water conservation during paddy seedling production in 8 days and mechanized transplantation at farmers

field, application of hydrogel technology helps in retention of moisture and less number of irrigations in cereal crops. The initiative of the Jal Shakti Abhiyan, a time-bound, water conservation movement under the ministry of water resources of government of India is a convivial step focusing on rain-water conservation, rejuvenation of water bodies, reuse of wastewater after proper treatment, and serious afforestation.

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