International Journal of Educational Research and Technology
P-ISSN 0976-4089; E-ISSN 2277-1557
IJERT: Volume 9 [4] December 2018: 35-41

Website: www.soeagra.com/ijert.html
ICDS : 5.8 [University of Barcelona, Barcelona]
Global Impact Factor: 0.765 Scientific Journal Impact Factor: 3.72
Journal Impact Factor (JIF) : 1.54, NAAS Rating: 2.96

REVIEW ARTICLE

OPEN ACCESS

Water Issues Including Pollution & Management Strategies In India

Manish Joshi[1], Neelam Joshi[2], Gajanand Sharma[3], Raaz K Maheshwari*[4]
1. Department of Sociology, SBRM Govt PG College, Nagaur, Rajasthjan
2. Department of Sociology, University of Rajasthan, Jaipur, Rajasthjan
3. Department of Public Administration, SBRM Govt PG College, Nagaur, Rajasthjan
4 .Department of Chemistry, SBRM Govt PG College, Nagaur, Rajasthan
Email: rkmgreenchem.jaipur@gmail.com

ARTICLE HISTORY
Received:
13.09.2018
Revised
17.10.2018
Accepted
19.11.2018

ABSTRACT
Water touches every aspect of life, and in India uncertainty over access to and the availability of this basic resource may be reaching crisis levels. As India continues to undergo dramatic shifts caused by a growing economy and population, competing demands for this limited resource coming from households, industry, and agriculture have wide-ranging implications for the country's future. It's the right thing to do. Global water consumption has raised almost 10 fold since 1900, and many parts of the world are now reaching the limits of their supply. UNESCO has predicted that by 2010 water shortage will be serious worldwide crisis. The unscientific and inefficient use of this vital resource is contributing to its increasing scarcity, reflected in steep decline of water levels and under certain situations in sharp deterioration in quality of water. This leads to misgiving in certain sections that groundwater availability scenario in the country has reached a critical stage and there is no scope for future development of groundwater. Groundwater management is the key for the sustainability of this vital resource, controlled by hydro geological features, not much scientific stress is given to understand the dynamics of its flow in space and time. Demand driven exploitation without required regulatory measures and understanding of area specific problems, leads to crisis not only to for the present but also may result in damage to ground water system with adverse effect on future water supplies. To cope up with the global water scarcity, UN's Assembly in 1992 declared March 22 as World Water Day to create awareness of the dilemma amongst individuals and communities. It's true that if each of us uses water judiciously and augment the water resources by becoming custodian rather than the absolute owner, the water resources can well be protected for the future mankind. The traditional as well as strategies of water management and conservation must be implemented wholeheartedly. Country's water crisis has been caused by a combination of factors, including population growth, dwindling groundwater supplies from over-extraction by farmers, and insufficient investment in treatment facilities at the federal, state, and local levels. This manuscript is an attempt to help in evolving a scientific policy for groundwater management, which can assure long-term sustainability of this fast depleting resource.
Keywords: Aquifers; Rainfall; Effluent; Irrigation; Hydrodyanamics; EPA; Contamination

CITATION OF THIS ARTICLE	Manish Joshi, Neelam Joshi, Gajanand Sharma, Raaz K Maheshwari·Water Issues Including Pollution & Management Strategies In India. Inter. J. Edu. Res. Technol. 9 [4] 2018; 35-41. **DOI**: 10.15515/ijert.0976 4089.9.4.35-41

INTRODUCTION
The importance of water as a vital recourse to the life system and an essential component of societal development cannot be overemphasized. Recognizing the importance of water resource development,

many ancient civilizations emphasized on various mechanisms of water supply be developing and marinating several ingenious strategies of string rain and flood waters. The maintenance of water quality and the means of regenerating the natural resource were crucial factors for sustainability, especially in desert zones. With recurring droughts year after year especially in Rajasthan, AP, Gujarat, MP and Odisha, environmentalists are emphasizing the need to revive and revert back the water harvesting systems which existed in earlier times. In Rajasthan, tankas, talabs and baodis traditionally performed the jobs of collecting and storing runoff water. In the event of scarce rainfall, water from nearby talabs, nadis or village ponds was used to fill up the tankas. Rooftop harvesting was a common feature in villages and towns across the Thar Desert. Over the years rising population, growing industrialization, and expanding agriculture practices have pushed the demand for water. Efforts have been made to collect water by building dams, reservoirs and digging wells. The idea of ground water recharging by water harvesting techniques is gaining importance in many cities too. Town planners and civic authority in many cities in India are introducing by laws making rainwater harvesting compulsory in all structures. Realizing the importance of recharging groundwater, the CGWB is taking steps to encourage it through rainwater harvesting in the capital and elsewhere.

Main causes of India's water crisis &India's twelfth five-year plan (2012–17) recommendations to tackle proficiently

India's water crisis is rooted in three causes. The first is insufficient water per person as a result of population growth. The total amount of usable water has been estimated to be between 700 to 1,200 BCM (billion cubic meters). With a population of 1.2 billion according to the 2011 census, India has only 1,000 cubic meters of water per person, even using the higher estimate. A country is considered water-stressed if it has less than 1,700 cubic meters per person per year. For comparison, India had between 3,000 and 4,000 cubic meters per person in 1951, whereas the United States has nearly 8,000 cubic meters per person today. The second cause is poor water quality resulting from insufficient and delayed investment in urban water-treatment facilities. Water in most rivers in India is largely not fit for drinking, and in many stretches not even fit for bathing. Despite the GAP (Ganga Action Plan), which was launched in 1984 to clean up the Ganges River in 25 years, much of the river remains polluted with a high coliform count at many places. The facilities created are also not properly maintained because adequate fees are not charged for the service. Moreover, industrial effluent standards are not enforced because the state pollution control boards have inadequate technical and human resources. The third problem is dwindling groundwater supplies due to over-extraction by farmers. This is because groundwater is an open-access resource and anyone can pump water from under his or her own land. Given how highly fragmented land ownership is in India, with millions of farmers and an average farm size of <2 hectares, the tragedy of the commons is inevitable. India extracted 251 BCM of groundwater in 2010, whereas the US extracted only 112 BCM. Further, India's rate of extraction has been steadily growing from a base of 90 BCM in 1980, while this rate in the US has remained at more or less the same level since 1980 (Rani, B, Singh U, Maheshwari RK. 2013).

Of the many critical areas, the main concerns are the pressing need to increase irrigation and the difficulty of creating water-storage facilities. Of the 140 mh (million hectare) of net cultivated area in India, only around 60 mh are irrigated. In order for Indian agriculture to grow at its targeted rate of 4% per year, it needs to increase the area irrigated, introduce new high-yield technology, or expand cultivable land. There is no scope to expand the cultivated area, which has remained around 140 mh for the last two decades. Since rain is concentrated in a few months and unevenly distributed across the country, it is imperative for India to develop the capacity to store and transport water. Although water can be stored either above or below ground, there are limits to how much can be stored through groundwater recharge and water harvesting. The first step is to increase local storage and recharge through watershed development. However, in the long run, dams are inevitable. Even with full groundwater recharge, water harvesting, and recycling, there will still be a need to store water in reservoirs; otherwise, this water will drain into the sea during monsoon floods. The storage capacity in India was 258 cubic meters / person in 1997, compared with 2,043 cubic meters / person in the United States in 2002. Even on a per hectare of cultivable land basis, storage capacities were 1,474 and 3,287 cubic meters in India and the United States, respectively.

Many national and international environmentalists oppose dam construction. Storage dams, in particular, are controversial because they often submerge forests and reduce biodiversity by disturbing habitats. With India's high population density, dams would also displace many people, often poor tribal communities. Even when these people are resettled and compensated properly, which frequently is not the case, their lifestyles, social support system, and culture are disrupted. Despite these objections, there remains a critical need for storage dams because climate change will increase the availability of water while greatly altering its distribution. India's future economic growth is also a concern. If the country cannot expand irrigation or increase agricultural productivity by other means, economic growth will be restricted. Given its size and humiliating experience of "ship to mouth" grain imports from the United States in the 1960s, India is likely to limit its dependence on imports. As stated earlier, agriculture needs to grow by at least 4% per year if India is to sustain its targeted economic growth rate (above 8%). With 8% growth, demand for agricultural products will increase. Limited land and restrictions on imports will limit the supply of agricultural products unless the expansion of irrigation makes it possible to double-crop more land or technical progress increases per-hectare output.

There is emphasis throughout the country on watershed development. This involves leveling land and tapping rainwater in small ponds created by building small dams in the streams (called check dams). This water increases soil moisture, recharges groundwater, and permits a second crop to be planted. India's eleventh five-year plan (2007–12) covered some 15 mh with watershed development, and many NGO-led efforts have shown the program's success. For example, Anna Hazare has transformed the village of Ralegan Siddhi in Maharashtra into a model sustainable village through water harvesting and cooperation. Another example is Rajendra Singh, whose NGO Tarun Bharat Sangh has transformed the Alwar District of Rajasthan through community-based efforts in water harvesting and water management. Singh is known as the "waterman of India" and was awarded the Ramon Magsaysay Award in 2001. Similarly, with the support of the government, NGOs, community groups, and other civil society organizations, the state of Gujarat has built over 100,000 check dams. Some economists have attributed Gujarat's 8%-plus growth rate of agricultural GDP to these efforts.

The problem of urban water supply is due to poor and leaky distribution networks leading to large amounts of "unaccounted water." Even though New Delhi's per-capita availability of water is greater than that of Paris, the city does not provide reliable water. Inadequate pricing is one problem. Some cities have used private firms to help streamline distribution in order to provide reliable water and reduce waste. The city of Dharwad in Karnataka, for example, now has a constant water supply with the help of private consultants. India's twelfth five-year plan (2012–17) has focused attention on all of these issues discussed. The plan puts great emphasis on aquifer mapping, watershed development, involvement of NGOs, and efficiency in developing irrigation capacity. Because water is a state subject in the federal constitution, state governments are expected to play a large role in these efforts. At the same time, many active NGOs are now able to enforce compliance with environmental obligations through the right to information act, active and competitive media, and growing awareness on water issues. The following recommendations address the most important issues in India's water crisis (Romani, 2007).

1st, the central and state governments should empower local groups with knowledge, understanding, and real-time information on the status of groundwater so as to manage extraction in a cooperative way. Since groundwater is an open resource, farmers extract as much as they can. But when everyone does this, it leads to extraction above a sustainable level. This problem can only be managed by a cooperative agreement among the users of the aquifer, who should know how much can be extracted without depleting the resource. The state can monitor and provide this information. **2nd,** India needs to promote watershed development. The example of the state of Guajarat as well as the efforts of Rajendra Singh and Anna Hazare have shown that this approach is effective and profitable.

Moreover, it can be undertaken at the local level all over the country and can be accomplished in a relatively short time. **3rd,** India must educate people about the need for dams to store water. The environmentalists and other groups who oppose dams should be engaged in a dialogue to work out alternatives and build a consensus. **4th,** the government should strengthen SPCBs (State Pollution Control Boards) to enforce effluent standards. The technical and human resources currently available to the boards are inadequate to effectively monitor activities, enforce regulations, and convict violators. In addition, adequate sewage treatment facilities must be constructed. Many cities treat only a part, and some no more than half, of the effluent. Cities need to charge a proper price for water so that local sewage work operators have the income and resources to sufficiently maintain treatment plants. If necessary, India should work with private firms to modernize urban water-distribution systems. Should India adopt these recommendations at all levels—federal, state, and local—it will be a great step toward addressing the most critical issues causing the country's water crisis?. India has made improvements over the past decades to both the availability and quality of municipal drinking water systems, its large population has stressed planned water resources and rural areas are left out. In addition, rapid growth in India's urban areas has stretched government solutions, which have been compromised by over-privatization. Regardless of improvements to drinking water, many other water sources are contaminated with both bio and chemical pollutants, and over21% of the country's diseases are water-related. Furthermore, only 33% of the country has access to traditional sanitation. One concern is that India may lack overall long-term availability of replenish able water resources. While India's aquifers are currently associated with replenishing sources, the country is also a major grain producer with a great need for water to support the commodity. As with all countries with large agricultural output, excess water consumption for food production depletes the overall water table. Many rural communities in India who are situated on the outskirts of urban sprawl also have little choice but to drill wells to access groundwater sources. However, any water system adds to the overall depletion of water. There is no easy answer for India which must tap into water sources for food and human sustenance, but India's overall water availability is running dry. India's water crisis is often attributed to lack of government planning, increased corporate privatization, industrial and human waste and government corruption. In addition, water scarcity in India is expected to worsen as the overall population is expected to increase to 1.6 billion by year 2050. To that end, global water scarcity is expected to become a leading cause of national political conflict in the future, and the prognosis for India is no different. On a positive note, some areas of India are fortunate to have a relatively wet climate, even in the most arid regions. However, with no rain catchment programs in place, most of the water is displaced or dried up instead of used. Figure (1) depicts about utilizable water, demand and available water in India [Source: WBRWII]

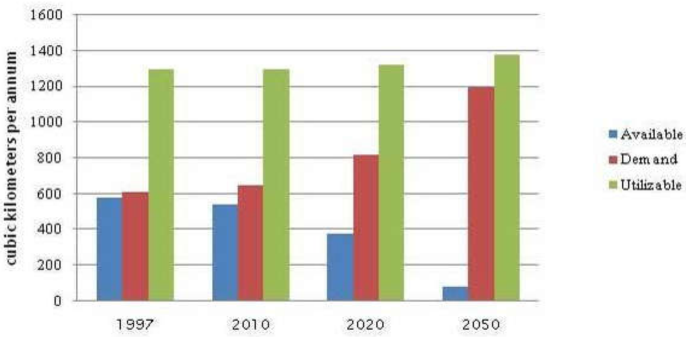

Figure 1: Utilizable water, demand & available water in India [Source: WBRWI]

In these areas, rain harvesting could be one solution for water collection. Collected water can be immediately used for agriculture, and with improved filtration practices to reduce water-borne pathogens, also quickly available for human consumption. Whatever the means, India needs solutions now. Children in 100 million homes in the country lack water and one out of every two children are malnourished. Environmental justice needs to be restored to India so that families can raise their children with dignity, and providing water to communities is one such way to best ensure that chance (Kudesia, V.P., 2003).

STEPS İN THE DİRECTİON OF FİNDİNG MNAGEMENT SOLUTİONS TO İSSUE OF WATER

The most important step in the direction of finding solutions to issues of water and environmental conservation is to change people's attitude and habits – this includes each of us, conserve water because it's the right thing to do. Groundwater management deals with a complex interaction between human society and physical environment and presents an extremely difficult problem of policy design. Aquifers are exploited by human designs and over-exploitation cannot be always defined in technical terms, but as a failure to design and implement adequate institutional arrangements to manage people who exploit the groundwater resources. 'Common pool' resources such as groundwater have been typically utilized in an 'open access' framework, within which, resources ownership is according to a rule of capture. When no one owns the resources, users have no incentive to conserve for the future, and itself interest of individual users leads them to overexploitation.

The various management options available for ameliorating or solving problems related to groundwater quantity and quality can be broadly grouped under two major categories. The fist category relates to supply side management and is referred as "structural measures" which involve scientific development and augmentation of groundwater resources. For an effective supply side management, it is essential to have full knowledge of hydro geological controls which govern the yield and behavior of groundwater levels under abstraction stress, the interaction of surface and groundwater in respect of river base flow and changes in flow and recharge rates due to their exploitation. The effects of groundwater development can be short term and reversible or long term and quasi-reversible which require a strong monitoring mechanism for scientific management. The other category encompasses demand side management which is user targeted and are referred as "non-structural measures". In demand side management the socio-economic dimension plays an important role involving managing the users of water and land. Actions are required for proper resource allocation and prevention of the likely adverse effects of uncontrolled development of groundwater resources. Mere regulatory interventions like water rights and permits and economic tools of water pricing, etc. cannot be successful unless the different user groups are fully involved to get their cooperation and participation. Figure (1) depicts three women reach their water source, a low water level lake in India. For effective management of groundwater resources there is a need to create awareness amongst the different water user groups and without area specific plans for sustainable development. In a nut shell the first category of management options targets policies for 'managing the water' and the second category calls for 'coordinating the people' (Maheshwari *et al* 2013).

Figure 2: Three women reach their water source, a low water level lake in India [USAID]

The major challenge for effective management of groundwater is the scientific development of available resources. The lack of proper understanding of the local groundwater regime behavior and demand driven development without addressing to management needs aggravates the situation. The need for scientific planning in development of groundwater under different hydrological situations in the country is discussed below to provide the necessary insight effective management of this vital and scarce resource. Development of groundwater in areas with low stage groundwater development is below 40%. Special attention is drawn to the eastern and northern parts of the country, mainly in the states of Assam, Bihar, Orissa, UP and West Bengal, where small and marginal farmers are not able to afford the cost of sinking and energization of wells due to their poor socio-economic status. Water marketing is prevalent in these areas, where effluent farmers having substantial land holdings, monopolize on groundwater extraction for selling to poor farmers. There is a great scope of groundwater development in these areas, which often faces floods during rainy seasons. The concept of virtual water is also very much relevant to such areas of low stages of groundwater development. In areas like Gujarat, where in addition to the requirement of water for dairy development, fodder for the cattle is also grown which leads to over-exploitation of groundwater. If the fodder requirement is met from agriculture production in the eastern states a large quantity of water can be saved in the form of virtual water, hidden in the grains, which can be transported to water scarcity areas. Stage of groundwater is very high in the states of Haryana, Punjab, and Rajasthan and majority of the dark and over-exploited blocks fall the states (IWWA, 2007).

The studies of CGWB in alluvial parts of Haryana and UP have revealed the existence of a huge reserve of groundwater in the deeper aquifers, which has not been fully utilized. The thickness of the alluvium in the area exceeds 500m and only a small fraction of this is under active circulation due to prevailing shallow groundwater development. Under utilization of groundwater from the deeper aquifers has resulted in near stagnant conditions at depth and provided the necessary time factor for the deterioration in quality of groundwater. It was observed that calcium carbonate type with depth, indicating a base exchange between the cat ions of groundwater and the subsurface clays. In the groundwater discharge areas the potentiometric head of water in the deeper aquifers have been recorded to be higher than that on the shallow aquifers. Slowly but surely, the interior quality water leaks upwards as well as laterally to deteriorate the quality of water in shallow aquifers of downstream areas. It is observed that in the southern part of the states of Punjab, Haryana and UP, fresh water aquifers of limited thickness overlies the brackish to saline water in deeper aquifers. It is evident that the deeper aquifers in alluvial areas are not only fully developed in upper reaches and the unutilized ground water in confined aquifers ultimately is lost to the saline aquifers adjacent to the basin boundary. Even though multiple aquifer systems occur in large areas in upper reaches of the river systems, groundwater development is from only shallow phreatic aquifer, which is reflected in the increasing decline in groundwater level. In these areas the deeper aquifer are not developed which is not only under utilization of resources but also the quality of water deteriorates with time. A large fresh water resource of confined aquifers is ultimately lost to the saline belts. There is a great scope of groundwater development of deeper aquifers in alluvial areas of Punjab, Haryana and Western UP where the confined aquifers have good quality water (Maheshwari RK, Rani B. 2007).

The Thar desert of Rajasthan, covering 60% of land area on western side of the state, presents a paradoxical situation of surplus and deficit water areas during short period of monsoon. The IGNP

(Indira Gandhi NaharPariyojna) is utilizing water from Ravi, Beas and Setluj rivers for irrigation in Western Thar Desert. During monsoon enormous quantity of outflow from Harike Barrage cannot be fully utilized and flow out to Pakistan. The monsoon river flood waters of Ghaggar river, is also retained in 19 natural depressions causing water logging in the adjoining low lying areas like Baropal, where water level has risen from 50mbgl to less than 5mbgl in last one decade. In contrast to this situation of surplus water availability in northern part of the Thar Desert, the adjoining districts of Jalore, Sikar, Jhunjhunu, and Nagaur are facing alarming decline in groundwater levels and even drinking water is scarce. There is a great scope of transferring the surplus water available for a short period during monsoon to adjacent areas for artificial recharge of fast drying up aquifers. The existing lift irrigation systems (Nohar-Sahwa and Gajner lift systems) can be extended to cover adjoining districts of Jhunjhunu, Sikar, Churu, Nagaur and adjoining areas to provide source water for artificial recharge. The augmentation of groundwater resources during the monsoon, through appropriate artificial recharge structures, will go a long way in meeting the water crisis in these water starved areas. Groundwater resources management requires strategies not only for a scientific development of available resources, but also a focus on need based allocation and pricing of resources, involvement of all problems and needs and effective implementation of implementation of regulatory measures after making them aware of available management options. Capacity building of people to undertake necessary changes, if required, and fostering a sense of identity for achievement of goals is the key to success (IWWA, 2007 and Jain *et al* 2003).

CONCLUSİON

It is clear that water issues are common knowledge in India and a better solution is eagerly awaited.Groundwater management is a much debated issue but there are very few examples of effective actions on ground. With an unclear status on the ownership of groundwater both at individual and at government level, an effective regulation of groundwater development is lacking. In the absence of a well defined policy on allocation of ground water for different user groups and its pricing, a lopsided development results on its over-exploitation. The unscientific development in localized pockets often infringes upon the water availability in adjoining areas and may result in dwindling yields of wells or their getting dry. With little scientific understanding of groundwater occurrence, fanners often resort to construction of deep tube wells in areas where no aquifer exist at depth. The groundwater in confined aquifers at deeper levels is not only under-utilized but also with passage of time it gets deteriorated in its quality. Groundwater resources in the country have to be looked into with a holistic approach and planning for its development has to be done on a scientific basis. For example, the water consuming industries, which do not have any surface water source, should be essentially based in areas with high potential of groundwater availability, irrespective of their geographic location in a state treated as unfavorable due to various other considerations. In areas with shortage of groundwater there is an added need to scientifically manage the available resources. Rainwater harvesting and artificial recharge to groundwater is an important management tool. There are a number of options available for effective management of groundwater resources but what we lack is the proper understanding of problems and their likely solutions. The actual implementation of these management options requires a strong infra-structural support both are central and state level. A strong data base, supported by field oriented R & D studies, is the basic need. A clear policy has to be formulated on the role of central and state agencies in creating scientific data base. Both at central and state levels the subject of groundwater is covered under different departments dealing with drinking water, agriculture, irrigation, pollution and environment, with very little control on their programmes and activities. An effective management of groundwater resources requires an integrated approach in both planning and implementation of schemes. Central Government Agencies should coordinate and bring out policies on scientific considerations for effective management of groundwater resources and provide the necessary guidelines for successful implementation. There is a greater responsibility for central agencies to carry out system analysis essential for management. The R & D studies, support by mathematical models, defining the behavior of groundwater systems under different stress, can provide a scientific base for states to crystallize these findings on ground. There is urgent need in each state to enhance the scientific capabilities of their organizations to address in right earnest the various issues of groundwater management. Without an effective institutional mechanism the targets for sustainable management of groundwater cannot be achieved. States have to first understand the emerging challenges and work out solutions which can help in providing water to people in the best way at least cost and on a sustainable basis. Groundwater being a community resource requires an active public participation. With increasing scarcity of groundwater the time has come when government and public should work hand in hand for an integrated management targeted towards providing water to all on a sustainable basis.

REFERENCES

1. Rani, B, Singh U, Maheshwari RK. (2013) Environmental Conservation & management of Water for Future Perspectives, *Environmental Management* Edited by Khanna DSR, Chopra AK, Singh V, Bhutiani R &Matta G. Daya Publishing House, New Delhi, pp. 133-159.
2. Romani, S. (2007). "Groundwater Management – Emerging Challenges", *Water Digest,* 1-2, pp. 11-28.
3. Kudesia, V.P., (2003). "*Water Pollution—Toxicity of Metals*", Pragati Prakashan, Meerut (India).
4. Maheshwari RK, Singh U, Gaur M, Sharma M, Shazli T, Rani B. (2013). Quintessence of climate change on water resources, *International Journal of Geographical Sciences* 4 (1):17-26.
5. Maheshwari RK, Rani B. (2007). Readers Shelf, Safe water: Best gift to the future's mankind (Towards conserving the elixir of life 3 (11*): 11-18.*
6. Rain water harvesting 38the Annual convention IWWA, Jaipur, India, pp. 228-235. 39th IWWA Annual Convention, Emerging opportunities in management of water supply & sanitation projects, 1-3February 2007 held at IWWA, Mumbai Centre
7. Jain SK, Sharma A, Kumar R, Kumar CP. (2003). The global & India freshwater crisis: A perspective, NHI, Roorkee, UK, India

