Development of Water Resource Management in India: An Overview

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ABSTRACT

To all forms of life on earth, water is vital, as from the simplest of living organisms to the most complex of human systems. In India, the surface water and ground water resources play significant roles in agriculture, forestry, fisheries, livestock production and industrial activity. Lack of water for drinking, for use in agriculture, industry, and for several other essential needs is a limiting factor perhaps the most important factor hindering development in many regions of India. In order to appropriately address the present and future water and food security, the Government of India (GoI) through the Central Water Community (CWC) has been implementing various measures. The inefficient management of the resource has led to deterioration in water quality, posing new challenges for water management and conservation. The favourable utility of water resources has to be included with development based and efficient management. There is a need of formulating a water management strategy along with the extension of available resources and integrated development carefully.

Keywords: water, vital, inefficient management, GoI, CWC, efficient management.

INTRODUCTION

Water Management System in India

India has about 18 per cent of the world's population and only 4 per cent of the world's water resources, making it among the most water-stressed countries. It is severely water-stressed, thereby making water management a national priority. Since the country has a huge population, water conservation is the need of the hour. Water management is the control and utilisation of water available across various resources (Chaudhary, M., 2024). Evidence from research into India's water management techniques in the past suggests that they were in practice prior to colonisation. People relied on their collective wisdom to manage their water resources. The government outlawed certain ancient irrigation systems, taxed their usage, and spent a lot of money on water infrastructure, including tanks, wells, and tube wells for both home and agricultural use. The government launches awareness programs and educates farmers about efficient water use. Sustainable water future for India begins with a vision.

Water Resources

Water has a unique place in all of the planet's renewable resources. It is necessary for supporting all forms of life, food production and for general well-being. Water is also one of the most manageable of natural resources as it is capable of diversion, transport, storage and recycling. It is impossible to substitute for most of its uses, difficult to de-pollute, expensive to transport, and it is truly a unique gift to mankind from nature.

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All these properties impart to water its great utility for human beings. Basically, in India, there are two forms of water resources available viz. '*Ground Water Resources'* and '*Surface Water Resources'* that play a major role in agriculture, and hydropower generation:

Ground Water Resource:

Ground water is the water that seeps through rocks and soil and is stored below the ground. It is a replenishable resource. The rocks in which ground water is stored are called '*Aquifers'*. Aquifers are typically made up of gravel, sand, sandstone or limestone. Water moves through these rocks because they have large, connected spaces that make them permeable. The area where water fills the aquifer is called the *Saturated Zone*. The depth from the surface at which ground water is found is called the *Water Table*. The water table can be as shallow as a foot below the ground or it can be a few hundred meters deep. Heavy rains can cause the water table to rise and conversely, continuous extraction of ground water can cause the level to fall.

The main source of ground water is the recharge from monsoon precipitation. India has abundant ground water reserve which gets replenished every year mostly by monsoon precipitation. Ground water is an important source for irrigation as well as for domestic use, a source of drinking water in urban and rural India and industrial usage. With increasing population pressures, industrial-urban growth, the ground water is extracted from the lower and lower levels at a much faster rate than rainfall can even replenish.

As of April 2015, the water resource potential or annual water availability of the country in terms of natural flow in rivers is about 1,819 Billion Cubic Meter (BCM)/year. However, the usable water resources of the country have been estimated as 1,123 BCM/year. This is due to constraints of topography and uneven distribution of the resources in various river basins, which makes it difficult to extract the entire available 1,869 BCM/year. Out of the 1,123 BCM/year, the share of surface water and ground water is 690 BCM/year respectively. Setting aside 35 BCM for natural discharge, the net annual ground water availability for the entire country is 398 BCM. The annual potential natural groundwater recharge from rainfall in India is about 342.43 km; which is 8.56 per cent of the total annual rainfall of the country. The annual potential ground water recharge augmentation from the canal irrigation system is about 89.46 km. Thus, the total replenishable ground water resource of the country is assessed at 431.89 per cent. After allotting 15 per cent of this quantity for drinking and 6 km for industrial purposes, the remaining can be utilised for irrigation purposes. Thus, the available ground water resource for irrigation is 361 km, of which utilisable quantity (90 per cent) is 325 km.

Surface Water Resources:

Surface water is the rain water flown and spread over the land as in streams, rivers, lakes and oceans. India is a water rich country with about 4 per cent of the world's water resources. Rainfall in India is dependent on the south-west and north-east monsoons, on shallow cyclonic depressions and disturbances and on local storms. Most of it takes place under the influence of south-west monsoon between June and September months except in Tamil Nadu, where it is under the influence of north-east monsoon during the October and November months. India is gifted with river systems with several tributaries that are perennial and some of them are seasonal. The rivers like *Gangas, Brahmaputra, Indus* and *Meghna* system is the largest river system in India with about 43 per cent of the catchment area of all the major river systems. The snow and ice melt of the *Himalayas* and the base flow contribute to the flows during the lean season. Other than rivers and canals, other inland water resources include numerous reservoirs, tanks and ponds, oxbow lakes, derelict water and brackish water that cover almost 7 MHA of area.

Do We have Safe Water?

Good water quality is important for a healthy life as well as for the ecosystem. To ensure sufficient healthy

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Good water quality is important for a healthy life as well as for the ecosystem. To ensure sufficient healthy water for the entire nation is quite a big challenge. Due to the rise in demand and developmental pressure in India, the feature of water is drastically changing. The majority of the surface water is polluted and not suitable for human use on the other hand; the ground water is depleted and less available. *World Health Organisation* (WHO) has stated that domestic effluents contribute a substantial proportion of water pollution and half of India's morbidity is water-related. To produce safe water for the people, waste management has not been as efficient as required to manage the increasing volume of waste generated daily.

WATER RESOURCE MANAGEMENT

Water resources are essential, for life, livelihood and ecology. They are vital for, food security, national security and energy security and are also crucial for economic development. Due to the rapid increase in the Indian population, the researchers and policy makers are required to frame long term projects for the development of water resources and their efficient management to be prepared to face the challenges of critical climatic conditions.

Development of Hydroelectric Power

India has more than 1,50,000 MW productive capacity of hydropower in spite of the fact, only 21per cent of hydropower producing capacity is possible and 10 per cent of the work is in progress. Right place, opportunity, rehabilitation, environment and forest-related problems and inter-state disputes are the reasons for the slow progress in establishing hydropower stations.

There is a need to develop eco-friendly and renewable power while giving attention through long waiting and geological wonders. An added speciality of this pattern of developing power reduces maintenance expenditure compared to other patterns. There is a pressing need for time to draw a master plan for the development of a small, medium and large hydro scheme for power generation.

Flood Management

Among all-natural disasters, floods are the most frequent to be faced in India. According to the information published by various government agencies, the tangible and intangible losses due to floods in India are increasing at an alarming rate. As reported by the *Central Water Commission* (CWC) under the *Ministry of Water Resources, Government of India*, the annual average area affected by floods is 7563 Mha. It is estimated in India that 46 Mha areas have become flood-affected area but out of this, 19 Mha area has been protected by constructing embankments and flood control reservoirs. In order to reduce the loss and damage caused by floods, flood and weather forecasting centres have been established in more than 200 places. Flood forecasting doesn't prevent floods but can check loss of life and to some extent the loss of property. Flood plain zoning refers to restricting various activities in flood plains, depending on the risk assessment. And during floods, relief operations are needed to rescue stranded people and provide them with shelter, food, water and medical help.

Estimation of Water Requirement in Future

Currently, in India, about 83 per cent of water is used for irrigation and the remaining percentage of extent is used for domestic, industrial and other purposes, as estimated by *National Commission for Integrated Water Resources Development* (NCIWRD). It also estimates that, due to the increasing capacity of surface and geo ground water in agriculture and other fields, there will be towering demand for about 1180 BCM water by the year 2050. Thus, it is expected that the increasing demand for water requirement from today's 83 percent will be 69 percent by 2050.

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Water Field Challenges

In India, there are many tribulations in the water field such as declining water availability extent as per the increasing population, the decline in water quality, lessening ground water level due to heavy increasing use of underground water, scarcity of water equipment and their lessening capacity in utilizing water are all the prominent challenges. Due to the reason of not having the right laws and strict implementation, excessive use of water geo ground water level has gone down. As a solution, there is a need for urgent research study and planning based on the correct statistics and data. So far, 30 states and union territories have made rainwater harvesting compulsory through laws, rules and regulations and including provisions in building bye-laws.

INSTITUTIONAL FRAMEWORK

Within Central Government, the *Ministry of Water Resources* (MoWR), *River Development and Ganga Rejuvenation* (RD & GR) is responsible for the conservation and management of water in the country. The *Ministry of Rural Development* (MoRD) also implements certain programmes related to ground water management for the prevention and control of pollution, including water pollution, and ground water contamination. In addition, there are four major central institutions that are responsible and addresses issues related to ground water, the main roles of these institutions are summarized as follows:

A. Central Water Commission:

Initiating and coordinating schemes for the conservation and utilisation of water resources in the country in collaboration with state governments and monitoring water quality.

B. Central Ground Water Board:

Developing and disseminating technology related to sustainable use of ground water, monitoring and implementing policies for the sustainable management of ground water resources; estimating ground water resources.

C. Central Ground Water Authority:

Constituted under Section 3(3) of the Environment (Protection) Act, 1986, to regulate and control development and management of ground water resources; can resort to penal action and issues necessary regulatory directives.

D. Central Pollution Control Board:

Implementation of the Water (Prevention and Control of Pollution) Act, 1974, which seeks to restore water quality.

The district collector in every state is the point of contact for the *Central Ground Water Board* (CGWB). The collector has the power to implement the suggestion or corrective measures provided by the CGWB.

National Environmental Monitoring Committee for River Valley Projects (NEMCRVP) was constituted to monitor the implementation of environmental safeguards of irrigation, multipurpose and flood control projects. The committee is entrusted with the work to review the mechanism established by the state governments and project authorities to monitor the implementation of environmental safeguards and to

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suggest additional compensatory measures in respect of water resource projects.

NATIONAL WATER PROGRAMMES

The following five objectives have been recognised for *National Water Programmes*:

1. It is to estimate the impact of the integrated information of housings and climates variation on water resources.
2. Encouraging people and governmental actions in water conservation and extension.
3. It is to concentrate attention on heavy water use and vulnerable areas.
4. It is to increase the water utilisation capacity to 20 per cent.
5. It belongs to encouraging the integrating water resource management from the level of catchment areas. *Ministry of Water Resource Department* has undertaken the cost-based information development system of water resources through the cooperation of the *National Remote Sensing Centre* (NRSC). Except for subtle and graded (Secret) information. This is helpful to all stakeholders to prepare better projects with improved measures.

In order to give more attention to the encouragement to the speed of water resource development, the Government of India launched the '*Pradhan Mantri Krishi Sinchayee Yojana'* (PMKSY) in 2015 with the motto of *'Har Khet Ko Pani' (Water to every field)* ensuring access to some means of protective irrigation to all agricultural farms in the country, to produce *'per drop more crop'*, thus bringing much desired rural prosperity. *Accelerated Irrigation Benefits Programmes* (AIBP), *Repair, Renovation and Restoration* (RRR) of Water bodies and *Command Area Development and Water Management* (CADWM) have been subsumed in PMKSY.

Flood Management and Border Areas Programme (**FMBAP**) with an outlay of Rs. 3342.00 Crore and for period 2017-2020 with merged components from the existing *Flood Management Programme* (FMP) and *River Management Activities & Works related to Border Areas* (RMBA) schemes during the 12^{th} five-year plan has been approved by the Union Cabinet on 07^{th} March 2019 and aims at completion of the on-going projects already approved under FMP.

Central Water Commission has implemented the plan scheme **Development of Water Resources Information System (DWRIS)** with an objective to operate a standardized national water information system in the country with provision for data collection, data processing and storage and online data dissemination. The scheme has the following four major components:

1. Hydrological Observations Monitoring System
2. Irrigation Census
3. Strengthening of Monitoring Unit in CWC
4. Data Bank and Information System

As of April 2020, *Central Water Commission* is operating a network of 1569 *Hydrological Observation* (HO) stations in different river basins of the country to collect water level, discharge, water quality and silt. This includes 716 new stations opened during the 12^{th} five-year plan. In addition to this, meteorological parameters including snow observations are also recorded at some key stations. This will help in addressing the data requirement of the country more precisely and in a better scientific manner.

In order to appropriately address the present and future water and food security Government of India has been implementing various measures. As per the CWC's Annual Report 2019-20, the following thrust/priority areas, for further water resources development, have been identified:

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1. Improving the overall water use efficiency in irrigation and drinking water supply system.
2. Adoption of the piped distribution system in place of the open canal system to reduce the conveyance water loss.
3. Command area development by implementing more micro-irrigation systems and participatory irrigation management.
4. Flood management and erosion control using new tools and techniques.
5. Protection from coastal erosion by the creation of proper coastal data collection and management network.
6. Dam safety, dam rehabilitation and performance improvement.
7. Repair, Renovation and Restoration of existing water bodies use for irrigation, drinking water supply, cultural activities, etc.
8. Construction of more minor irrigation structures to achieve the goal of appropriate regulation and improvement in the management of ground water.
9. Increasing the ground water availability by various Ground water recharge techniques.
10. Inter-basin transfer of river water by inter-linking of rivers.
11. Improving the rural drinking water supply system and sanitation.

Central Water Commission has been thriving for sustainable development of water resources of the country, by directly and indirectly contributing to achieving the objectives of these thrust/priority areas.

PARTICIPATION IN MANAGEMENT (PIM)

The participation of stakeholders in water resources is very important. The stakeholders should participate in the activities of increasing water extent, maintaining the quality of fresh water, and water quality management. The policy of virtual water transfer has been adopted for food trade, water management and agriculture. The capacity building and awareness programmes may be organized for the users and public for encouraging their effective participation in water management practices and developing ethical concepts for making efficient use of water resources. Capacity building is also needed for the water resources managers and developers for updating the knowledge and technology in the areas of water resources management.

The concept of community participation in resource management that started in the 1990s has made a revelation that technology alone cannot solve the problem-related water resource management without the involvement of community locals, since then the concept of community participation in water resource management has spread worldwide. In India, participatory water resource management has started from the southern states like Karnataka and Tamil Nadu, where farmers and water user groups were involved in water management. The outcome of this experiment was very successful which could lead to solving the water problem, empowering the farmers as well as maintaining the sustainability of the project.

Similarly, the participatory approach in drinking water management started after the initiation of the *Jal Nirmal and Swar Jal Dhara* project in different states of India. Apart from the institutional involvement of water users in water-related projects, the local people have been participating in water management for their domestic needs like drinking, cooking and for cattle as well as for irrigation. There are number of studies that have highlighted success stories of the community effort for water resource management in different parts of India and other countries of Asia as well.

DISCUSSION

Water resources (surface water and groundwater) are renewed through the continuous cycle of evaporation, precipitation and runoff. The water cycle is driven by global and climatic forces that introduce variability in

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precipitation and evaporation, which in turn define runoff patterns and water availability over space and time. As a result, discrepancies in water supply and demand are becoming increasingly aggravated. On the basis of the water balance approach, it is possible to make a quantitative evaluation of water resources in the basins and their change under the influence of people's activities (McCabe, G.J. & Markstrom, S.L., 2007).

Keeping the availability of water extent in view, essentially, there is a need of implementing the favourable method of water utility urgently. The favourable utility of water resources has to be included with development based and efficient management. There is a need of formulating a water management strategy along with the extension of available resources and integrated development carefully. All classes of society have to join hands to face the problems of water zones; basically, it should include central government, state government, panchayat raj institutions, urban local institutions, industries, civic institutions and any stakeholders. Through adjoining together, the aims of the required demand of water in all sectors such as clean water, for domestic use, development based irrigational use, basic water facilities for various industrial uses and water for other than utilisation activities can be attained.

The profitability of development programmes and efficient management of the people is possible only through mutual understanding and cooperation of the states. According to the constitution, water supply, irrigation and canals, under-drainage, water collection comes to the scope of state governments. It is to be guarantying the provision of extensive cooperation between the state governments. One of the prominent roles of the central government is in resolving the inter-state litigations and controversies through the possible better and total agreeable ways.

CONCLUSION

India is not a water-scarcity country, but due to severe neglect and a lack of monitoring of water resource development projects, several regions in the country experience water stress from time to time. Further neglect in this sector will lead to a future water deficit. The challenge is manageable, provided we have favourable policies and mechanisms to persuade our people to change their lifestyles. It is, therefore, necessary to prevent this crisis by making the best use of the available technologies and resources to conserve the existing water resources, convert them into usable form, and make efficient use of them for agriculture, industrial production, and human consumption. Imposing regulatory measures to prevent the misuse of water and introducing rewards and punishments to encourage judicious use of water will be helpful to conserve water.

The final urge is that awareness and orientation to all the people to change their lifestyle to conserve water can help India tide over the water crisis in the future. The government should encourage and generate awareness amongst the people regarding the long-term benefits of community participation in water resource conservation and management.

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Conflict of Interest:

I (The author) declare that there is no conflict of interest.

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