SPJ

WATER MANAGEMENT

Introduction

A scarce natural resource, water is fundamental to life, livelihood, food security and sustainable development. India has more than 18 % of the world's population, but has only 4% of world's renewable water resources and 2.4% of world's land area. There are further limits on utilizable quantities of water owing to uneven distribution over time and space. In addition, there are challenges of frequent floods and droughts in one or the other part of the country. With a growing population and rising needs of a fast developing nation as well as the given indications of the impact of climate change, availability of utilizable water will be under further strain in future with the possibility of deepening water conflicts among different user groups. Low consciousness about the scarcity of water and its life sustaining and economic value results in its mismanagement, wastage, and inefficient use, as also pollution and reduction of flows below minimum ecological needs. In addition, there are inequities in distribution and lack of a unified perspective in planning, management and use of water resources.

Importance of Water

Water as a resource is critical to our very survival. It is a remarkable substance that is essential for life. Its most important use is as drinking water. Besides this, it is also used for many other purposes – cleaning, washing and bathing and in factories. All these uses can make water dirty. Dirty water is not fit for drinking. We can fall ill if we drink dirty water. So, water needs to be purified before it is used.

Water is the most precious of natural resource and especially in the context of its relevance to human beings and modern countries – cannot be overstated. It is the utilization of water that necessitates the movement of water from the source to areas where human civilization resides – urban, semi-urban and rural. However, with fresh water constituting only a very small proportion of the enormous quantity of water available on earth (with world oceans themselves covering three-fourth of earth's surface), water conservation and water resources management issues come to the fore and have been acknowledged by world and unilateral development and natural resources organizations and bodies. What is effectively available for consumption and other uses is a small proportion of the quantity available in rivers, lakes and ground water. To be sure, the importance of water has been recognized and their more equitable distribution to all segments of the world population has been emphasized. Further, greater emphasis is being laid on its economic use and better management.

Uses of Water

Water is required for domestic, agricultural, hydro-power, thermal power, navigation, recreation, etc. Utilisation in all these diverse uses of water should be optimized and an

awareness of water as a scarce resource should be fostered. The Centre, the States and the local bodies (governance institutions) must ensure access to a minimum quantity of potable water for essential health and hygiene to all its citizens, available within easy reach of the household. Ecological needs of the river should be determined, through scientific study, recognizing that the natural river flows are characterized by low or no flows, small floods (freshets), large floods, etc., and should accommodate developmental needs. A portion of river flows should be kept aside to meet ecological needs ensuring that the low and high flow releases are proportional to the natural flow regime, including base flow contribution in the low flow season through regulated ground water use. Rivers and other water bodies should be considered for development for navigation as far as possible and all multipurpose projects over water bodies should keep navigation in mind right from the planning stage. In the water rich eastern and north eastern regions of India, the water use infrastructure is weak and needs to be strengthened in the interest of food security. Community should be sensitized and encouraged to adapt first to utilization of water as per local availability of waters, before providing water through long distance transfer. Community based water management should be institutionalized and strengthened.

Water Management

Water management is the activity of planning, developing, distributing and optimum use of water resources under defined water polices and regulations. It is a sub-set of water cycle management. It includes:
(1) management of water treatment of drinking water, industrial water, mine water, sewage or waste water; (2) management of water resources; (3) management of flood protection; (4) management of irrigation; (5) management of the water table and underground water. In an ideal world, water management planning has regard, to all the competing demands for water and seeks to allocate water on an equitable basis to satisfy all uses and demands. This is rarely possible in practice.
Successful management of any resources requires accurate knowledge of the resource available, the uses to which it may be put, the competing demands for the resource, measures to and processes to evaluate the significance and worth of competing demands and mechanisms to translate policy decisions into actions on the ground.
For water as a resource, this is particularly difficult since sources of water can cross many national boundaries and the uses of water include many that are difficult to assign financial value to and may also be difficult to manage in conventional terms. Examples include rare species or ecosystems or the very long term value of ancient ground water reserves.

Water Resources

Water is an essential resource for all life on the planet. Of the water resources on Earth only three per cent of it is not salty and two-thirds of the freshwater is locked up in ice caps and glaciers. Of the remaining one per cent, a fifth is in remote, inaccessible areas and much seasonal rainfall in monsoonal deluges and floods cannot easily be used. At present only about 0.08 per cent of the entire world's fresh water is exploited by mankind in ever increasing demand for sanitation, drinking, manufacturing, industrial application, leisure and agriculture. Much effort in

water management is directed at optimizing the use of water and in minimizing the environmental impact of water use on the natural environment.

Present Scenario

The present scenario of water resources and their management in India has given rise to several concerns, important amongst them are;

(i) Large parts of India have already become water stressed. Rapid growth in demand for water due to population growth, urbanization and changing lifestyle pose serious challenges to water security.

(ii) Issues related to water governance have not been addressed adequately. Mismanagement of water resources has led to a critical situation in many parts of the country.

(iii) There is wide temporal and spatial variation in availability of water, which may increase substantially due to a combination of climate change, causing deepening of water crisis and incidences of water related disasters, i.e., floods, increased erosion and increased frequency of droughts, etc.

(iv) Climate change may also increase the sea levels. This may lead to salinity intrusion in ground water aquifers / surface waters and increased coastal inundation in coastal regions, adversely impacting habitations, agriculture and industry in such regions.

(v) Access to safe water for drinking and other domestic needs still continues to be a problem in many areas. Skewed availability of water between different regions and different people in the same region and also the intermittent and unreliable water supply system has the potential of causing social unrest.

(vi) Groundwater, though part of hydrological cycle and a community resource, is still perceived as an individual property and is exploited inequitably and without any consideration to its sustainability leading to its over-exploitation in several areas.

(vii) Water resources projects, though multi-disciplinary with multiple stakeholders, are being planned and implemented in a fragmented manner without giving due consideration to optimum utilization, environment sustainability and holistic benefit to the people.

(viii) Inter-regional, inter-State, intra-State, as also inter-sectoral disputes in sharing of water, strain relationships and hamper the optimal utilization of water through scientific planning on basin/sub-basin basis.

(ix) Grossly inadequate maintenance of existing irrigation infrastructure has resulted in wastage and under-utilization of available resources. There is a widening gap between irrigation potential created and utilized.

(x) Natural water bodies and drainage channels are being encroached upon, and diverted for other purposes. Groundwater recharge zones are often blocked.

(xi) Growing pollution of water sources, especially through industrial effluents, is affecting the availability of safe water besides causing environmental and health hazards. In many parts of the country, large stretches of rivers are both heavily polluted and devoid of flows to support aquatic ecology, cultural needs and aesthetics.

(xii) Access to water for sanitation and hygiene is an even more serious problem. Inadequate sanitation and lack of sewage treatment are polluting the water sources.

(xiii) Low consciousness about the overall scarcity and economic value of water results in its wastage and inefficient use.

(xiv) The lack of adequate trained personnel for scientific planning, utilizing modern techniques and analytical capabilities incorporating information technology constrains good water management.
(xv) A holistic and inter-disciplinary approach at water related problems is missing.
(xvi) The public agencies in charge of taking water related decisions tend to take these on their own without consultation with stakeholders, often resulting in poor and unreliable service characterized by inequities of various kinds.
(xvii) Characteristics of catchment areas of streams, rivers and recharge zones of aquifers are changing as a consequence of land use and land cover changes, affecting water resource availability and quality.

Future of Water Resources

One of the biggest concerns for our water-based resources in the future is the sustainability of the current and even future water resource allocation. As water becomes scarcer, the importance of how it is managed grows vastly. Finding a balance between what is needed by humans and what is needed in the environment is an important step in the sustainability of water resources. Attempts to create sustainable freshwater systems have been seen on a national level in countries such as Australia and South Africa, and such commitment to the environment could set a model for the rest of the world.

The field of water resources management will have to continue to adapt to the current and future issues facing the allocation of water. With the growing uncertainties of global climate change and the long term impacts of management actions, the decision-making will be even more difficult. It is likely that ongoing climate change will lead to situations that have not been encountered. As a result new management strategies will have to be implemented in order to avoid setbacks in the allocation of water resources.

Managing Water Resources

The primary objective of water management is to save the main resources of water supply. For this knowledge of all the resources is required. Management relates that water should be clean and it must be potable so that it should be easily available to the people who need it. Water management is a wide topic; it not only relates with clean supply of water but also with sewerage management and wetland restoration, recycling of water, optimum utilization and conservation of water. In 1977 collaboration was formed for wastewater and sewage treatment know-how with Ames Crosta Babcock (ACB) of UK, well-known leaders in the field for decades.

One area of water management deals with handling the water present in the nature. This includes monitoring the amount of water in the environment, seasonal and annual changes in water levels. Flood prevention and purifying the water to make it germ-free are also the part of water management.

As water is necessary for all fields – whether it is an industry, agriculture, and house-hold purpose – its demand is increasing many fold to fulfill the various need of human beings at the peak. So, proper distribution among all fields is also vital task. Monitoring water use in these areas also allows governments to be proactive about industrial and agricultural pollution. Water scarcity may not be an immediate issue in all areas of the world, and many communities accept that there are growing pressures on water supplies and thinking ahead about water security is advisable.

How to Overcome the Problem

Water harvesting: While water harvesting has become the need of the hour, there aren't many who know about it. It is advisable that we talk to someone who understands water harvesting for getting advice.

From the tank, filtered water is used either for non-drinking purposes or sent deep down into the ground through a PVC pipe to recharge groundwater. The cost for the entire operation can be as low as Rs. 10,000 to Rs. 12,000 per household. The expenditure can be lower if the project is taken up by local residents' welfare associations, which can identify existing dried-up or unused wells or even bored lines to send the water down. The system requires maintenance once or twice a year, at very little cost. It has to be remembered that rainwater harvesting means that we have got to get involved and build a relationship with water.

Water is getting scarce and we need to conserve it. This no doubt is true but another pressing reason why we should know about the water we consume. Most of us living in big cities get water from far away. Delhi, for instance, sources its water also from the Uttarakhand hills of Tehri. At intermittent stages of its long travel to our city, the water is pumped ahead. This means burning of energy. Once it reaches the city, it goes into water treatment plants and then pumped into the city network of pipes until it reaches our home. And this means more burning of energy. Each of us consumes this water and, therefore, adds to the total energy consumption. If we get water from nearby sources, we can save on energy.

Since these sources are drying up and are inadequate for everyone's consumption, the thing to do is to recycle water and to harvest it. That way we not only save on a scarce resource but also reduce the state's burden on emissions. Water harvesting is all very good but we are required to know how to do it.

A basic rainwater harvesting system consists of a catchment area, a harvesting tank and a channel to take the water deep into the ground. So, first you need an area that directly receives rainfall, say, the terrace or a paved courtyard. This is the catchment area. Water that collects here has to be directed into the harvesting tank-in other words, pipes or channels leading to it.

It is a good idea to put a coarse mesh at the mouth of the outlet to prevent debris from flowing with the water. Also, the water collection from the first shower is often discarded, as it is usually

the dirtiest. The bottom of the harvesting tank is a filter bed. It is usually made of three layers of one foot each—boulders gravel and sand. Charcoal is also used as a layer of filter. These days architects, plumbers and masons are fairly well clued into these techniques and designs.

Underground water:

When it rains, some of the water seeps into the ground. This water passes through the soil and the porous rock below it. It collects over rock that does not allow it to seep through any further. This water is called underground water. We draw underground water with the help of wells and tube wells. The level of underground water in a place is called water table.

Water management

Water management means dealing with water in the best possible way. This can be done by local authorities (municipal water management) or it can be done by individuals at home (when we manage how we use our own water supplies).

Good water management will involve organizing water so that everyone has enough, and controlling water supplies and water treatment centers (and other equipment and logistics relating to water) so that they work in the best possible way. It thus often involves some knowledge of the chemical properties of water.

The importance of water management

Water management affects many aspects of our lives. Water is so common that we often do not think about where it comes from or where it is managed. But, bad water management can really hit us hard. Below are some key ways in which water management is important.

1. Domestic use

a. Drinking water: humans need to drink around 8 glasses of water a day in order to get sufficient hydration. So clean drinking water is a necessity for us. Without water, we can only survive for a few days at most. But, if we have water and no food, we can survive for several weeks. This shows just how crucial it is that we have daily access to clean water that is suitable for drinking. If we have pets, they will need daily access to water too.

b. Washing and cleaning: we also use water to keep ourselves, our clothes and our homes clean and hygienic. A clean water supply is important for this too. From washing our hands before a meal to deep cleaning a hospital floor, we need clean water for almost all aspects of good hygiene.

c. Leisure and fun: swimming, boating and many other leisure activities involve water. Swimming pools and other facilities need to be well maintained so that they remain safe and enjoyable places to be. Swimming pool water needs to be managed by treating it with chlorine

and regularly testing its levels of bacteria and other substances, for instance, to ensure that it is safe for people to swim in.

2. Agriculture: Agriculture is the largest user of the world's freshwater resources, consuming 70 per cent. As the world's population rises and consumes more food (currently exceeding 6 per cent, it is expected to reach 9 per cent by 2050), industries and urban developments expand, and the emerging bioftiel crops trade also demands a share of freshwater resources, water scarcity is becoming an important issue. Water is used throughout the world to grow crops such as grains and fruits. A good water supply is needed to prevent hunger and famine.

3. Biodiversity: managing water well ensures that we do not deplete or contaminate rivers, lakes and other important water sources which are habitats for a wide range of birds, mammals, fish, reptiles and amphibians as well as water dwelling plants.

Methods of water management

There are several water management methods available in the world, and these are being honed all the time as scientists and engineers find new ways to look after our water supplies. Below are 5 key water management strategies that are widely used today.

1. Waste water systems – recycling and treating: sewage systems help to dispose of waste water in a clean and safe way. They also very often involve recycling water and treating it so that it is safe to be piped back into people's homes and used for drinking, washing and so on. These systems are absolutely essential for ensuring that our waste water does not cause us to fall ill.

2. Irrigation systems: good quality irrigation systems can be deployed to nourish crops in drought hit areas. These systems can be managed so that water is not wasted – and they can use recycled water or rain water to avoid unnecessarily depleting water supplies.

3. Water Conservation

An integrated approach is the need of the hour. Top priority is fresh water conservation by stopping seepage and increasing storage through watershed development and rainwater harvesting. By recycling industrial effluents and domestic sewage, we can significantly reduce use of fresh water, and it should be made mandatory for all new projects. Good water management is so urgent, critical and gigantic a task; it needs collaborative efforts between public, private and voluntary sectors and particularly community participation.

Conservation of water through recycle of industrial effluent and domestic sewage will reduce use of fresh water by 50 per cent. Small industries which now contribute most of the pollution in our country should be helped with incentives and encouraged to treat their effluents before discharge into common effluent treatment plants which could treat the water and return it for reuse.

The water treatment industry must focus on how to make more fresh water available, by promoting concepts of rainwater harvesting and watershed development and at the same time, take more initiatives in developing cost-effective technologies for conservation of water through its recycling. In other words, a total water management approach is needed and techniques must also increasingly utilize less or no chemicals and less energy.

Both big companies and private individuals can conserve many gallons of water every day, simply by not running taps or using water-guzzling appliances unnecessarily. Water can also be conserved by generally consuming less. Not many people realize how much water goes in to the production of a car or an item of clothing, for example. Cutting down on the amount of things that we buy can really reduce the amount of water that is needed to support our lifestyle.

4. Caring for the natural water supplies: natural water sources such as lakes, rivers and seas are so important. Both fresh water ecosystems and marine ecosystems are home to a wide variety of different organisms and without the support of these ecosystems, these organisms would most likely become extinct. Good water management thus also involves ensuring that we do not pollute natural water sources.

5. Effective implementation of plans – ensuring that everyone has enough water: there is no denying that easy access to fresh, clean, safe water is a right that all humans should enjoy. However, in many parts of the world, people have to walk many miles in order to access clean water. So, good water management systems are only truly praiseworthy if they are implemented throughout the world so that everyone can benefit from them. Good water management means not just a convenient and safe water supply for some people – but water for everyone to use.

Sustainable Water Management

A necessary step in reducing adverse impact on fresh water as well as on marine environment, is to use water more efficiently. A fundamental strategy in sustainable water management is to integrate water management goals into physical, social and economic planning. It includes agriculture management, overall land use planning, forest resources utilization, protection of coastal zones and marine environments from land based activities. It can assist planners in achieving more efficient water use.

1. Water Conservation Strategy:

Conjunctive use of surface and groundwater should be encouraged to shorten the water use and to alleviate the degradation of water and soil resources. Various technologies for groundwater recharge such as use of dug-wells, ponds, water harvesting structures in drains and rivers should be studied for feasibility.

2. Rainwater Harvesting:

Rainwater harvesting is defined as a method to induce, collect, store and conserve local surface run-off for agriculture in arid and semi-arid regions. Basically, for run-off inducement, vegetation management, surface treatment and chemical treatment are involved. Vegetation management is more effective in areas having an annual rainfall of more than 280 mm.

Arid zones are beset with water shortage caused by low annual rainfall. The problem is often overcome by the introduction of irrigation, provided surface or ground water is available. An efficient drainage system is necessary to maintain a favourable salt balance for crop growth. Broadly, miro catchment water harvesting and run-off farming water harvesting are the main run-off collection methods. The aim of micro catchment water harvesting strategy is to store sufficient runoff water during the rainy season so as to meet the water requirements of crop growing. Other method is to collect the rain water in small digs and then recycling it.

Appropriate water conservation strategies, such as rainwater conservation by terracing slopes and different means of water storage, including underground storage will differ according to the characteristics of the region and are particularly important in arid areas.

3. Irrigation Management:

Other potential measures include improvements in irrigation management, such as lining canals and using high- efficiency irrigation systems to prevent land degradation through salinization and water-logging. Using treated waste-water for irrigation increases the fresh water available for other uses, including the maintenance of healthy aquatic ecosystems. Decreased use of fertilizers in agriculture can reduce the need for expensive treatment of water from nearby water bodies to make it suitable for human use.

4. Watershed Management:

One of the simplest strategies to improve both water supply management and water quality is the protection of watersheds through maintenance of naturally vegetated buffer strips along streams, river channels and around lakes.

There is a difference between watershed and a river basin. According to one group of thought, the area that drains water into a river is described as watershed and the boundary line between adjacent watersheds is called the divide. The other group defines the area drained by a river as catchment area or river basin. Kenneth Brooks has distinguished on the basis of scale. The line between adjacent areas is called the watershed. The river basin is larger than a watershed and covers the total area that drains through the river and its tributary system.

Watershed management must be considered as a process of participatory planning, implementing, monitoring and evaluating a course of action involving natural, human and other resources. A holistic soil conservation and watershed management approach should consider those physical, socio-economic and institutional linkages that exist between upstream and downstream of a river basin or watershed.

5. Wetland Preservation:

It is an important element of watershed protection. The resulting gains in water quality and natural water storage can reduce the need for, and therefore, the costs of water-treatment and storage downstream.

6. Mapping Aquifers:

Almost 22% of the ground water in the country either dried or in the critical category. An aquifer is an underground water resource that helps to store and release water. Our dependence on groundwater is 65%. It is not infinite. It is invisible, so we do not know how much water is being used. Therefore mapping of aquifers will help in managing aquifer recharge and sustainable ground water use.

7. Establishment of Effluent Treatment Plant (ETP):

Installing an effluent treatment plant is the first step to control industrial pollution. The effluents are treated according to various standards such as river standards, inland water-bodies and sewer standards, depending on where the treated water has to be drained.

8. Community Participation:

Community involvement in the construction, operation, maintenance and funding of water systems should Strengthen village institutions. On the other hand, women's organisations must organise awareness programmes which will enable the women to realise the scarcity of water and consequently take steps to conserve it.

Demand Management and Water Use Efficiency

A system to evolve benchmarks for water uses for different purposes, i.e., water footprints, and water auditing should be developed to promote and incentivize efficient use of water. The 'project' and the 'basin' water use efficiencies need to be improved through continuous water balance and water accounting studies. An institutional arrangement for promotion, regulation and evolving mechanisms for efficient use of water at basin/sub-basin level will be established for this purpose at the national level.

The project appraisal and environment impact assessment for water uses, particularly for industrial projects, should, inter-alia, include the analysis of the water footprints for the use.

Recycle and reuse of water, including return flows, should be the general norm.

Project financing should be structured to incentivize efficient & economic use of water and facilitate early completion of ongoing projects.

Water saving in irrigation use is of paramount importance. Methods like aligning cropping pattern with natural resource endowments, micro irrigation (drip, sprinkler, etc.), automated irrigation operation, evaporation-transpiration reduction, etc., should be encouraged and incentivized. Recycling of canal seepage water through conjunctive ground water use may also be considered.

Use of very small local level irrigation through small bunds, field ponds, agricultural and engineering methods and practices for watershed development, etc, need to be encouraged. However, their externalities, both positive and negative, like reduction of sediments and reduction of water availability, downstream, may be kept in view.

There should be concurrent mechanism involving users for monitoring if the water use pattern is causing problems like unacceptable depletion or building up of ground waters, salinity, alkalinity or similar quality problems, etc., with a view to planning appropriate interventions.

Water Pricing

Pricing of water should ensure its efficient use and reward conservation. Equitable access to water for all and its fair pricing, for drinking and other uses such as sanitation, agricultural and industrial, should be arrived at through independent statutory Water Regulatory Authority, set up by each State, after wide ranging consultation with all stakeholders. In order to meet equity, efficiency and economic principles, the water charges should preferably / as a rule be determined on volumetric basis. Such charges should be reviewed periodically.

Recycle and reuse of water, after treatment to specified standards, should also be incentivized through a properly planned tariff system. The principle of differential pricing may be retained for the pre-emptive uses of water for drinking and sanitation; and high priority allocation for ensuring food security and supporting livelihood for the poor. Available water, after meeting the above needs, should increasingly be subjected to allocation and pricing on economic principles so that water is not wasted in unnecessary uses and could be utilized more gainfully.

Water Users Associations (WUAs) should be given statutory powers to collect and retain a portion of water charges, manage the volumetric quantum of water allotted to them and maintain the distribution system in their jurisdiction. WUAs should be given the freedom to fix rates subject to floor rates determined by WRAs. The over-drawal of groundwater should be minimized by regulating the use of electricity for its extraction. Separate electric feeders for pumping ground water for agricultural use should be considered.

Conclusion

Public policies on water resources need to be governed by certain basic principles, so that there is some commonality in approaches in dealing with planning, development and management of water resources. Good water management should be an absolute priority for every generation, and for every government throughout the world. More should be done to ensure that absolutely everyone in the world has daily access to safe, clean water that they can use for drinking, washing and growing crops.

These spatial and temporal variations in water resources availability pose great challenges for storing and regulating the use of the water resources in the country. There is a wide gap between the potential created and the utilization, i.e., more than 10 M ha at any point of time.

At present, the need of the hour is not only the development of water resources, but also their efficient management in a sustainable manner. The approach of integrated water management to meet the demand of water for agricultural use, drinking and industrial needs, can be highlighted by giving thrust on following points for the need to use the resource judiciously.

1. Conservation of River Corridors, Water Bodies and Infrastructure
2. Interlinking of rivers.
3. Inter basin transfer
4. Rain water harvesting and groundwater recharge
5. Recycling and Reuse of Municipal, Industrial and Mine waste water
6. Improving Water Use Efficiency through better technology
7. Reducing seepage losses and de-silting of tanks
8. Arrest over exploitation of ground water and rationalized water rates
9. Avoid all forms of pollution
10. Revise Warabandi system
11. Deficiencies Allowed by Management
12. Participatory irrigation management
13. Management of Flood & Drought
14. Managing Aquifer Recharge and Sustainable groundwater use
15. Database & Information System
16. Research & Training Needs