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Water Resource Management

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A B S T R A C T

Human's whole existence depends on the availability of water. The management of water resources will need to keep evolving in order to meet the existing and foreseeable issues brought on by the allocation of water. The decision-making process will become considerably more difficult as a result of the increasing unpredictable nature of the impacts of global climate change and the long-term repercussions of management practises. Continuous climate change will probably result in situations that have never been seen before. Numerous alternative management options are being looked for as a result in order to minimise disturbances in the allocation of water resources.

In a perfect world, water resource management planning would take into consideration all of the competing demands for water and strive to allocate water equally in order to meet all of the uses and demands. In real practise, this is a rare option along with other types of resource management.

The sustainability of the allocation of water resources, both now and in the future, is one of the issues that we are most concerned about for the future of our water-based resources. The management of water resources assumes an increasingly critical role as the availability of this resource continues to decline. In order to ensure that water resources will be available for future generations, it is essential to strike a healthy equilibrium between the requirements of people and those of the natural world. Present paper discussed in detail about water resource management in India.

Keywords: Water Resource Management, Water Cycle Management

Introduction

The process of planning, producing, distributing, managing water resources so that they be used most effectively is referred to as water resource management. It is a component in the management of the water cycle.

India's water resources information includes statistics on precipitation, groundwater and surface water storage capabilities, hydropower potential. India gets 1,170 millimetres (46 inches) of precipitation annually, which is equal to around 4,000 cubic kilometres (960 cubic miles) of rain or 1,720 cubic metres (61,000 cu ft) of fresh water per person annually. India is home to around 4% of the world's water resources and accounts for approximately 18% of the world's total population. The creation of Indian Rivers Inter-link is one of the potential answers to the problems that the nation is having with its water supply. Rainfall of 750 millimetres (30 rains) or more falls year on about 80 percent of the land area. Nevertheless, neither the timing nor the location of this rain is consistent. The monsoon seasons in India run from June to September, during that time the northeastern and northern regions get much more precipitation than the western and southern regions. In addition to precipitation, the melting of snow atop the Himalayas towards the end of the winter season is another source of water for the rivers of the north. The flow of the rivers in the south, on the other hand, is more unpredictable throughout the year. This results in the Himalayan basin experiencing floods during certain months and a lack of available water during other months. In spite of the country's extensive river system, Both irrigation water resources for ecologically friendly agriculture and safe, clean drinking water are in short supply in India. This is partly because the country has only been able to use a tiny portion of its accessible and recoverable surface water resource. India used 761 cubic kilometres (183 cubic miles) of its available water in 2010. This portion was partially caused by the unsustainable groundwater use of the nation.

Indian rivers and groundwater wells provided 688 cubic kilometres (165 cu mi) of water for agriculture, 56 cubic kilometres (13 cu mi) for municipal and drinking water needs, 17 cubic kilometres (4.1 cu km) for industrial purposes. A significant portion of India is located in a tropical climate zone, which makes it an ideal location for agricultural pursuits all through the year because of the favourable warm and sunny conditions. This is only true, however, provided there is a permanent water supply to support the high rate of evapotranspiration from the cultivated area. Although the country has enough water resources to meet all of its needs, there are still gaps in the water supply due to the water resources' spatial and temporal dispersion. The rivers of India must be connected in order to fill these gaps. Once all rivers' moderate environmental and salt export water requirements have been taken into consideration, the total water resources that are being wasted into the sea come to around 1200 billion cubic metres. Food security in India is achievable if first the country is able to achieve water security, which in turn is conceivable if the country is able to achieve energy security so that it can supply the power necessary for the necessary water pumping as part of its rivers interlinking. In contrast to centralised mega water transfer projects, which would take a long time to provide results, the deployment of broad shade nets across cultivated fields would be a more cost-effective solution. This would make it effective to utilise the local water sources more wisely for agricultural production throughout the whole year. Less than two percent of the total water that plants use is required for metabolism, while the other ninety-eight percent is used for cooling requirements via transpiration. By deflecting the excessive and potentially damaging sunlight away from the harvested area, shade nets or polytunnels that are designed to be used in all kinds of weather might be constructed over agricultural fields to substantially reduce the possibility for water loss via evaporation.Here is a list of the top ten best management practises for water that the Environmental Protection Agency (EPA) has put into place at its various locations in order to cut down on water use:

- Meter/ Measure/ Manage
- Optimize Cooling Towers
- Replace Restroom Fixtures
- Eliminate Single-Pass Cooling
- Use Water-Smart Landscaping and Irrigation
- Reduce Steam Sterilizer Tempering Water Use
- Reuse Laboratory Culture Water
- Control Reverse Osmosis System Operation
- Recover Rainwater
- Recover Air Handler Condensate
- Meter/ Measure/ Manage

Potential savings might be found by identifying and monitoring the water use of a facility. Additionally, this guarantees that the machinery is properly maintained and operated, which helps prevent the waste of water that might result from leaks or mechanical equipment that is not operating properly.

Optimize Cooling Towers

Air conditioning is provided by cooling towers, which also use significant amounts of water due to their operation. Controlling the amount of water that is discharged via blowdown in ratio to the amount of water that is lost through evaporation is one way to improve the efficiency of cooling tower operations. The term "cycle of concentration" refers to the ratio between evaporation and blowdown. For the most water efficiency, cooling towers should be recommended at six cycles of concentration or greater. Using a tower to measure the volume of water pumped into and released from the cooling tower ensures that it is cooling effectively and may assist in identifying leaks or other sorts of defects.

- By decreasing the amount of water that was lost via blowdown in its cooling tower, the "Environmental Science Center at Fort Meade, Maryland", was able to save around $1,800 and 530,000 gallons of water

Replace Restroom Fixtures

In the 1990s, the United States Department of Energy was responsible for establishing federal water-efficiency standards. Before it, the majority of EPA buildings had sanitary fixtures that were not very effective. For instance, each flush of the toilet used 3.5 gallons of water (gpf). Since then, almost all of the EPA labs have installed water-saving fixtures, several of which have been awarded the WaterSense® designation by the EPA in recognition of their high level of efficiency and performance. Among them are:

- Modern toilets having flow rates of either 1.28 or 1.6 gallons per minute (gpf)
- Urinals that have the Water Sense label and flush with less than 0.5 gallons per flush (gpf)

- Showerheads with the Water Sense label and a flow rate of no more than 2.0 gallons per minute (gpm)

Most of the labs have also been outfitted with faucet aerators that have a “flow rate of 0.5 gallons per minute”, which is far lower than the 2.2 gpm federal norm.

Eliminate Single-Pass Cooling

When employing single-pass cooling, a continuous flow of water is sent through the system for cooling, after which it is drained. The EPA is working hard to phase out the use of single-pass cooling in its research facilities. Rather than that, the establishments have systems that use air-cooling or recirculating chilled water.

- A recirculated chilled water loop was installed in lieu of the single-pass cooling system that was previously used at the “National Vehicle and Fuel Emissions Laboratory in Ann Arbor, Michigan”. This resulted in an 80 percent reduction in water use, which resulted in the laboratory saving 24.8 million gallons of water and $235,000 yearly

Use Water-Smart Landscaping and Irrigation

It is possible to reduce the amount of supplemental irrigation that is required by planting native and drought-resistant plant species. An audit of the irrigation system’s water usage may cut water use for landscaping by ten to twenty percent. The EPA chooses audit experts who have obtained their certification via a Water Sense-accredited programme. It is possible to water plants just when they need it by using weather-based irrigation controllers that have the Water Sense label or soil moisture sensors.

Control Steam Sterilizer Water

To moderate the temperature of the steam condensate that is discharged from the steriliser into the laboratory drain, steam sterilisers make use of cooling water. Many of the older steriliser types include a mechanism that permits them to continuously remove tempering water even when it is not necessary. The Environmental Protection Agency (EPA) has either replaced older steam sterilisers with updated units that only use tempering water when required or refitted sterilisers with a tempering water control kit.

- In order to better regulate the temperature of the water used in its sterilisers, the “Western Ecology Division Laboratory in Corvallis, Oregon”, installed temperature control valves. This has resulted in an annual savings of between $6,000 and $9,000 and nearly 1.5 million gallons of water

Reuse Laboratory Culture Water

In order to do research on aquatic cultures, many EPA labs need access to water. In certain instances, the culture water for the specimen tanks in the laboratory is piped in from adjacent water sources, such as lakes or bays. After that, it is either treated or reintroduced to the body of water or it is discharged into the sewer.

- The “Mid-Continent Ecology Division Laboratory in Duluth, Minnesota”, uses 35 to 40 gallons of Lake Superior water every minute for its laboratory research

Control Reverse Osmosis System Operation

The production of creating reverse osmosis-produced deionized (DI) purified water involves a usage of processes and may use up to 10% of the water used in a laboratory (RO). Water savings are guaranteed by carefully controlling the production rates of purified water to satisfy laboratory demand and by properly sizing the systems to satisfy that demand.

- By reducing the amount of time the DI/RO system is in operation from 24 hours/day to 12 hours/day, the “Environmental Science Center at Fort Meade, Maryland”, saves roughly 1.5 million gallons of water per year in addition to more than $5,000 in savings on its yearly water bills

Recover Rainwater

Rainwater that falls on the roof is collected by recovery systems, which then channel it into a storage tank. There are several uses for this water, including the filling of cooling towers, the flushing of toilets, the irrigation of the surrounding area.

- At the Region 7 Science and Technology Center in Kansas City, Kansas, a rooftop rainwater recovery system was erected. This system might save the lab 300,000 gallons each year

Recover Air Handler Condensate

The cooling coils in air units are responsible for the production of condensate water. This water is being collected by a number of EPA labs so that it may be used in cooling tower make-up systems.

- The “Region 4 Science and Ecosystem Support Division Laboratory in Athens, Georgia”, routes 400,000 gallons of condensate from three rooftop air handlers to the building cooling tower

Urban Water Management

As a result of the traditional approach of urban water management’s inability to differentiate between the various kinds of water and identify appropriate uses for each, high-quality water is diverted for urban water requirements. Even basin-level management typically ignores cross-scale interdependencies in freshwater, wastewater, flood control, storm water. As a result, it is necessary to identify and then put into action various ways for the rehabilitation of urban ecosystems. In order to do this, we will need to develop novel institutional processes and strike a balance between independence and collaboration. Urban water planning, development, management require innovative solutions since water is only one part of a complex system that involves “energy, food, employment, transit, job creation”.

Benefits of Water Recourse Management

We have just in the last half a century or so come to understand the motions that take place in all of the Earth’s layers, including the mantle, the core, the plates near the surface, as well as the atmosphere and ocean. The Earth System is fragile, the consequences of carrying on as normal might tip it out of the environment that has supported life on our planet throughout its history due to the velocity and acceleration of those consequences. This new geological period is being referred to by some as the Anthropocene. Water is becoming an increasingly important concern in this new period. This is true not just for the systems that include freshwater but also for the seas, their depths, the life that may be found there. The interdependence between societal or human objectives and the amount, quality, environment of our natural resources should not come as a surprise. The sort of development that is both viable and steady is determined by this dependency. The development in recent years in the production and supply of products and services has resulted in more opportunities for employment, higher income levels, generally better living conditions. This has meant in increased pollution of natural ecosystems and increased exploitation of natural resources. There is no doubt that this has a detrimental effect on water and other important components of the Earth System. Many river basins throughout the world have either been deemed “closed” or are near to being deemed “closed.” Their flows no longer reach the ocean as a result. In closed basins, which provide fewer opportunities for development, 1.4 billion people are expected to live. A rise in both the frequency and the severity of flood-related damages may be attributed to the development of potentially flood-prone regions close to rivers and beaches. Nearly two billion people, 85% of whom were victims of floods and droughts, were affected by natural disasters during the last decade of the past century, according to the World Health Organization (WHO) 2007 There is no escaping the undeniable fact that there will be an increase in the need for, demand for, competition for vulnerable and perishable water. We may expect increasing levels of water supply uncertainty, a rise in the frequency of severe weather events, faster water return flows to the atmosphere in the future. Future water allocations and patterns of water use will deviate from past trends due to changes in the hydrologic cycle brought on by changes in land use and climate, as well as the closed character of many basins.

Water for the Environment

The built and natural surroundings in which we live have the potential to either enhance or worsen the quality of our lives. Nature provides us with a wide variety of benefits, such as “food and fuel; enhanced air and water quality; moderated water flow and temperature regimes; improved soil formation and fertility; production of oxygen; storage of carbon and nutrients; recycling; and enhancement of our cultural, recreational, spiritual lives”. The regimes of water and sediment that occur naturally within ecosystems have a natural role in defining the health and sustainability of such ecosystems. Additional crucial financial and social advantages may be reaped when physical environments are thoughtfully conceived of and meticulously maintained. The withdrawal of water to satisfy the demands of urban areas, to increase the amount of food grown, less water is available for the environment and for preserving the health of the ecosystem as a result of all efforts to increase the quantity of energy generated. Finding a lasting balance among all of these shifting and unreliable demands is our problem, we must do it before we can even begin to identify them.

The quality of the water that comes in is just as crucial as the total water. Changes to the water quality may bring about unnoticed changes in the ecosystem. Multiple contaminants may often interact in a synergistic manner to generate affects that are either magnified or significantly different from the cumulative effects of pollutants when each pollutant is studied individually. Continuous introduction of pollutants might eventually cause an ecosystem’s resistance to be overwhelmed, which can result in significant and probably irreparable damage. One of the most vulnerable sources of freshwater is groundwater systems; once contaminated, it is difficult and costly to restore them to their original state.

Both flooding and drought have the potential to have a significant influence on the ecosystems of wetland and forest environments. Ecosystems are subject to natural cycles of droughts and floods, to which they must adapt and from which they are also impacted. Natural ecosystems may be recharged by floods and the sediments that they bring with them, which in turn provides additional water and makes the soil more fruitful for plant growth (including food crops). Some activities may have an adverse effect on the water quantity and quality regimes in ecosystems, which would then change ecosystems, include urbanisation and other land use changes, as well as inefficient farming practises and industrialisation. Other examples of these activities are: Just 35 years ago, only half of the commercially accessible freshwater was being utilised to serve human demands, but now that number is likely closer to two-thirds. Although many of these ecosystems have already been devastated as a result of excessive water withdrawals, we do not know how much water must be left in them in order for them to be maintained. However, there are signs that we are approaching the limits of how much water we can take from many other species while still preserving their health, which will also preserve ours. We are fortunate that research into the function that water plays in ecosystems is helping us become better able to value water and comprehend the large-scale, long-term processes that occur in ecosystems as well as the water flows that are necessary for these processes.

The preservation of ecosystem values that are often ignored requires order amongst scientists, engineers, managers, policy makers, stakeholders. One of the most fundamental difficulties confronting ecosystems today is the capacity to identify the spatial and temporal dimensions required to comprehend and manage ecosystems in a manner that assures their resilience and sustainability. More focused efforts are being made to better explain the connections between flow regime, its alteration, ecosystem dynamics; yet, determining the "bounds" on ecosystem sustainability continues to be a research objective. Nearly every hydrologic approach that is presented before to the year 2050 will have been modified to some degree in order to take into consideration the greater uncertainty and nonstationarity that have emerged as the primary concerns facing our profession. Regardless of the technological advancements that have been made by the year 2050, Planning and management of water resources will continue to take place in a social or political environment, that is, in an environment where people have control. Research is required in order to have an informed conversation about whether it is essential to pay for something to continue to exist even if there is no need for it and no expectation that anybody would ever use it or see it. If this is to happen, there must be a substantial place in how the average person views and values the natural environment, as well as in how we think about the place of national wealth and the cultural significance that people attach to their access to water resources.

Water is a natural resource that many countries' religious and cultural values are deeply entwined with. It is the subject of the photographs and paintings that we take. It is for this reason that we build fountains. The ways in which people in various civilizations perceive, value, administer water are profoundly influenced by cultural norms and traditions. Both the fight against global poverty and the improvement of global health include cultural dimensions; culture may have both good and bad effects on an individual's well-being, in particular on the health of women. It is necessary to do research to better understand the cultural factors that influence water management practises and how they impact behaviour in different communities. In this specific context, the contribution of social scientists is very important. If we want our methods for managing water resources to be sustainable over the long run, we need to take culture into consideration in every facet of our management. Engaging in conversation across cultural lines ought to be a pillar of the awareness-raising process. Cultural variety is a wellspring for the development of environmentally sustainable practises. Indigenous knowledge holders, also known as local stakeholders, scientists need to work together to identify answers to water-related issues wherever possible.

In order to achieve prosperity, it is necessary to address the constraints imposed by water management. Two thirds of the world's population might be affected by a water crisis over the next few decades. Many countries still have a tendency to solve their water shortage problems by increasing their water supply. This may be accomplished in a variety of methods, such as increasing surface and groundwater storage and allocation via the development of additional infrastructure, desalinating salty or brackish water, recycling wastewater, or replenishing aquifers. Reusing wastewater or refilling aquifers are further choices. This tendency has taken precedence over efforts to reduce water demand, such as by preventing losses in transportation and distribution systems, increasing appropriate tariff systems intended to encourage lower water demand levels, changing water use technologies,, generally speaking, reducing the efficiency of water use in domestic, industrial, irrigation systems; or, to put it another way, aiming to increase overall water productivity.

It may also be possible to reduce the quantity of water that is achieved by adjusting other, equally important factors that are not directly related to water. This can be achieved in a variety of ways, including controlling population growth, improving the efficiency with which goods requiring large amounts of water are used in their manufacturing processes and supply chains, particularly food products, encouraging responsible land use planning, or limiting the detrimental effects of climate change on water resources by taking the necessary precautions to adapt to and mitigate its effects.

Both the current water managers and their successors in the future will need to be knowledgeable about a variety of relevant disciplines and be able to communicate effectively with a wide range of professionals, stakeholders, users. In order to have a dialogue with the professionals and interested parties in the regions where better water management is needed, these managers and their stakeholders should possess the sufficient technical, economic, social, financial abilities. This dialogue need to take place in regions where better water management is required. They should be able to interact in conversation with political politicians and provide them with information on the scientific basis for any effect forecasts. They need to have an understanding of the short-term political commitments that policy makers make, they must be able to back the balancing of political action with long-term, sustainable water resource policy. The capacity of analysis and simulation tools to accurately reflect the actual world will change, revolutionising this area of engineering practise. The sole constraint may be the rate of improvement in scientific knowledge rather than the rate of rise in engineering skill, since this change will allow for fine-grained depiction of the actual world. This will result in a revolution in engineering practise in this area. As a result, not only in terms of pace and size, but also in terms of type, we will see changes in practise. The human skill sets that are necessary for successful management and work in an environment that is always shifting will continue to develop. The capacity to use one's intellect and propositional reasoning will not change, despite changes in syntax, sources, organisational models. Systems analysis will be one of the most important tools in the not too distant future. People are said to be living prosperously when they are doing well in both their personal and professional lives. People are content and in good health. The resource of our society should be to provide the circumstances under which it is possible to grow prosperity while still adhering to the ecological standards and conserving the natural resources that are available in our limited world. Understanding the complexity of the system of forces and impacts that have an impact on human well-being via water security, as well as the risks and potential advantages of different policy and management options for society, is necessary for determining the optimal way to carry this out so that one can make the most informed choice possible. It is possible to identify resilient adaptive policies that function across a variety of sectors and sizes if one makes use of a variety of models for the analysis of the repercussions of numerous possible future scenarios. These model-based studies might thus help us avoid the current conundrum of introducing new policies only to discover that they make the issue worse rather than finding a solution to it since there are aspects in the system that have been overlooked.

Conclusion

Civil engineers are responsible for contributing to society in a way that is knowledgeable, collaborative, ethical. They are entrusted by society with the responsibility of making the world more sustainable as:

- "Master planners, designers, builders, operators of the built environment, which serves as the economic and social engine of society
- Guardians of the natural environment and the resources it contains
- Innovators and integrators of new ideas and technological developments in the academic, commercial, public sectors
- Managers of the risks and uncertainties produced by natural occurrences, accidents, other hazards
- Leaders in conversations and choices that shape public environmental and infrastructure policy

Finding a way to reconcile our desires for everyone on this planet to live happily with the constraints imposed by the availability of a renewable but limited water resource is the fundamental dilemma that we are all up against. It's not insurmountable. Let our optimism be a torch to illuminate the next step!

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