Role of Technological Science in Managing Water Related Issues

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Abstract

With consumption of water continuing to escalate as the world's population expands, the twenty-first century has been anointed the water century. The supply-demand imbalance caused by the uneven distribution of water resources has reached critical proportions, with fresh water in rivers, lakes, and other water bodies accounting for less than 0.01 percent of all water on the world. As a result, there will be a greater demand for dependable clean water sources that can fulfill demand while remaining environmentally benign. In this research article, the researcher(s) investigate the realities of technology's usage and effectiveness in maintaining available water resources in India in order to overcome this challenge and develop water infrastructure that is safe and provides consumers with trust in its purity. The application of advanced technology such as Water recycling as well as information and monitoring and control systems intends to execute complete water cycle management at a regional or municipal level, it is founded on the principles of peace, sustainability, and self-sufficiency by integrating water cycle traceability in such a manner that the water cycle is viewed as a movement of both water and ionized water.

Keywords: Water, Water Management, Technology, Artificial Intelligence.

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INTRODUCTION

"The earth, the land and the water are not an inheritance from our forefathers but on loan from our children. So, we have to handover to them at least as it was handed over to us." - Mahatama Gandhi

In 2012, the United Nations (UN) designated water and sanitation as fundamental human necessities. Currently, 786 million people lack access to safe drinking water. India has around 17% of the world's population but just 4% of its freshwater resources. Water resources are distributed unevenly across the country. India's burgeoning population is placing increasing pressures on its water resources, the quality of current water resources is diminishing due to pollution, and as a result of the added demands of feeding India's spiralling industrial and agricultural expansion, water consumption is fast growing while freshwater availability stays largely steady.

Freshwater is becoming more limited due to events such as floods, climate change, and pollution. Non-revenue water (NRW) losses are estimated to be 35% in 44 developed nations, according to a World Bank database. As a result of the leaks, more water must be pushed. For many governments and water sectors, sustainable management of water has become a serious concern. Researchers are developing self-learning systems known as Smart water systems (SWS) that may manage water more effectively using information technology.

In this context, it's worth noting that future water resource development is likely to be more difficult, as the best possibilities, particularly from topographical and geological perspectives, have already been exhausted. Future water resource development projects will also require extensive environmental and socio-economic assessments. It is a governance concern to provide basic water demands. Domestic water consumption accounts for just approximately 14% of total global water use. The average person consumes 2000–5000 litres of water every day. Producing food for an extra 40 crore people in India, which might be added in the next 40 years (the present population is 121 crores), would be a major issue that will necessitate significant technical and management improvements in the way we manage our natural resources.

CURRENT STATUS OF WATER SCARCITY

Scarcity of water has a variety of detrimental effects on the ecosystem, including ponds, lakes, rivers, wetlands, and other sources of freshwater. Furthermore, excessive water consumption can result in water scarcity, which is common in irrigated agriculture regions and can impact the ecosystem in a variety of ways. Increased salinity, eutrophication, and the erosion and loss of flood plains and wetlands are only a few of the consequences.

Flow management in the restoration of urban streams is often complicated by water scarcity. As a result of poor water resource management and climate change, India has been enduring a constant water shortage. India will suffer significant water restrictions by 2050, according to the OECD environmental outlook 2050. Due to rapid groundwater depletion and ineffective irrigation infrastructure, India's agriculture consumes 90% of the country's water.

India is the world's second-largest producer of agricultural products. In the year 2013, agriculture and allied businesses such as forestry and fisheries contributed for 13.7 percent of GDP (Gross Domestic Product) and employed half of the people. India is the 46th most dangerous country in the world, according to the Water Stress Index 2019, compiled by London-based risk analytics firm Verisk Maplecroft. It calculated the water consumption rates of families, industries, and farms, as well as the available resources in rivers, lakes, and streams, then plotted the index against predicted population growth patterns to determine which cities are most at risk of losing their water supplies.

According to the Aqueduct Water Risk Atlas released on August 06, 2019 by the World Resources Institute (WRI), Washington D.C. India is world’s 13th most water-stressed country out of 17 countries surveyed.

According to the State of the World's Water 2017 report published by Water Aid, India, which boasts one of the world's fastest-growing economies and is home to 17% of the world's population, has the biggest proportion of rural people without access to safe drinking water. With 67 percent of the country's population living in rural areas and 7 percent without access to drinkable water, India's rural poor are particularly vulnerable to the consequences of extreme weather events and climate change. Domestic sewerage accounts for 75-80 percent of water pollution by volume, according to the report, it is derived on data from the Ministry of Urban Development (2013), the 2011 Census, and the Central Pollution Control Board. Untreated sewage running into bodies of water, particularly rivers, has virtually quadrupled in recent years. As a result, vector-borne illnesses such as cholera, dysentery, jaundice, and diarrhea are becoming more prevalent.

Water contamination has also been shown as a significant contributor to low nutritional status and developmental delays in children. India has 13 of the world's top 20 polluted cities, compared to only three in China. Air pollution affects mortality rate by 3.2 years for India's 660 million city dwellers, including Delhi. In China, the comparable drop is three years, which is somewhat smaller. The Ganga and the Yamuna rivers in India are among the top ten most polluted rivers on the planet, whereas China only has one. In a February evaluation, Vapi, Gujarat, and Sukinda, Odisha, were named among the top ten most ecologically devastated zones in the world, but China was absent from the list. Both nations had roughly comparable environmental concerns a decade ago, however China has cleaned up many of its contaminated waterways and implemented strict rules to combat rising urban air pollution.

According to a 2015 research by the Centre for Science and Environment, a Delhi-based Non - governmental organization, river pollution has degraded the country's overall environmental standards, which are now worse than they were three decades ago, waste accumulating in cities and more hazardous urban air. The Central Pollution Control Board found that roughly 66 percent of the lengths tested had excessive organic contamination in a 3 year research of river water quality in 290 rivers. This indicates that 8,400 kilometers of these rivers are severely contaminated and unable to support aquatic life. The polluting of our waterways is due to an increase in the discharge of untreated wastewater from cities into these rivers.

In India, water usage is increasing across all industries. Water consumption for agriculture, industry, and home usage is expected to rise in the next decades, according to various estimations and predictions. By 2020, India is expected to be classified as a water-stressed country. The industrial sector's water demand is increasing, and in 2025 and 2050, it will contribute for 8.5 and 10.1 percent, respectively, of total freshwater abstraction. In 2010, this is increased by 4% from the previous year's estimate of 6% of total freshwater abstraction by industry.

Both supply and demand-side sustainability techniques are required for effective water management. The water cycle is a mechanism that keeps precipitation, temperature, and evaporation, closely tied to the water delivery system (Iglesias, 2010). According to Iglesias (2010), a water crisis occurs as a result of significant water scarcity. Water security ensures the availability, usability, affordability, and distribution of sufficient safe drinking water and sanitation. Climate change is causing severe water resource imbalances on land and at sea. The purpose of this study is to discuss supply-demand efforts, examine policies and adaption measures, and make suggestions.

ROOT CAUSES OF WATER CRISIS

Enough good-quality water must be supplied to fulfill the needs of agriculture, industry, the residential sector, and other sectors for socio-economic progress and prosperity. Unfortunately, a difficult-to-manage scenario has resulted from insufficient preparation, lack of knowledge, and non-implementation of necessary actions. As a result, India is progressively developing an alarming picture of water shortage and environmental damage. Raw water supplies are being depleted as a result of intense rivalry for water among many industries. The quality of surface and groundwater is deteriorating due to widespread contamination.

In a nutshell, the underlying reasons of India's water dilemma are as follows:

1. Water availability is very variable, both in spatial and temporal, which frequently results in floods and droughts.
2. Extensive contamination of water sources, primarily from agricultural, industrial, and municipal sources.
3. An inconsistent and low-quality municipal water supply.
4. Laws that provide landowners unrestricted ownership of groundwater, along with the unregulated use of bore-wells, have permitted groundwater extraction at extremely high rates, frequently exceeding recharging.
5. Water conservation, consumption efficiency, water re-use, groundwater recharge, and eco-system sustainability are all overlooked.
6. Extremely low water pricing that do not deter waste.

USE OF TECHNOLOGY IN VARIOUS ISSUES

According to the National Water Policy (2012), the water allocation priorities include water for drinking, agriculture, hydropower, the ecosystem, agro-businesses and non-agricultural sectors, and navigation.

In order to use water sustainably in India, a well-planned long-term strategy is essential, given the existing state of freshwater consumption and the difficulties that are projected to occur in the future.

River Water Pollution

The pH value, hazardous content, dissolved oxygen, and other parameters of river water must all be determined. Floating sensors might be utilised to keep an eye on the aquatic body and its many properties, including temperature, salinity, freshness, pollution, and so on. These devices can sound an early alert in the case of flooding, water pollution, rising hazardous levels, and so on. Skinner et al. employed hundreds of temperature sensors put in water bodies with regard to depth in major water bodies such as rivers, lakes, and other bodies of water to monitor temperature changes. At varying depths, a considerable temperature difference of 0.58 C has been recorded.

To evaluate the salinity of the San Joaquin River, the University of California at Berkeley developed a Generation 3 drifter floating sensor. This sensor network includes a pressure sensor, a salinity sensor, and a GPS receiver. The sensors communicate data to the central station concerning the pace and direction of water flow, which analyses the data and generates the appropriate information. Sensor technology has been demonstrated to be effective in conserving aquatic environments by monitoring harmful levels.

Water imaging is being used to centrally monitor water pollution in vast bodies of water as part of the Contamination Identification and Level Monitoring Electronic Display Systems (CILM-EDS) project. The central display detects and reports any pollutants in the suspension. Despite the fact that the prototype is still being tested, it has shown potential in identifying toxins in the water. Similar devices are advised for monitoring the pH level, water temperature and dissolution value of small water bodies such as lakes and ponds, and the results can be now tracked using mobile phones.

Sensor technology has simplified and accelerated the research of aquatic environments. Storey et al. gave a study of current online water quality monitoring technologies in the United States and the United Kingdom, which are used to keep an eye on bodies of water like rivers and lakes. Maintenance, expensive gadgets, sensor life (battery) in water, data dependability, and physical damage avoidance might all be problematic. The use of such sensor technologies in the field must be encouraged in the near future.

AGRICULTURE WATER MANAGEMENT

The water utilized in crop production (both rainfed and irrigated), animal production, and inland fisheries all fall under the category of agricultural water management. The solution to global food security and poverty reduction is better agricultural water management in these productive zones. To fulfill the world's food demands by 2050, current food output must be doubled; this growth must come from rain-fed agriculture as well as expanding and improving existing irrigated agriculture.

Agriculture has traditionally been the foundation of India's economy. As a result, under the 5-year plans, the irrigation sector was given top emphasis. To boost agricultural potential and hence agricultural productivity, massive projects like as the Damodar Valley, Nagarjunasagar, Bhakra Nangal, Hirakud, Rajasthan Canal Project, and others were implemented. Crop output is predicted to rise by 70% by 2050 in order to keep up with demands of a burgeoning population. This suggests a rise in water consumption as a result of the greater crop production. For optimum crop development, the timing and availability of water and nutrients must be perfect. Water usage may be minimised by using smart irrigation. Figure 1 illustrates some of the technologies for smart farming and its uses.

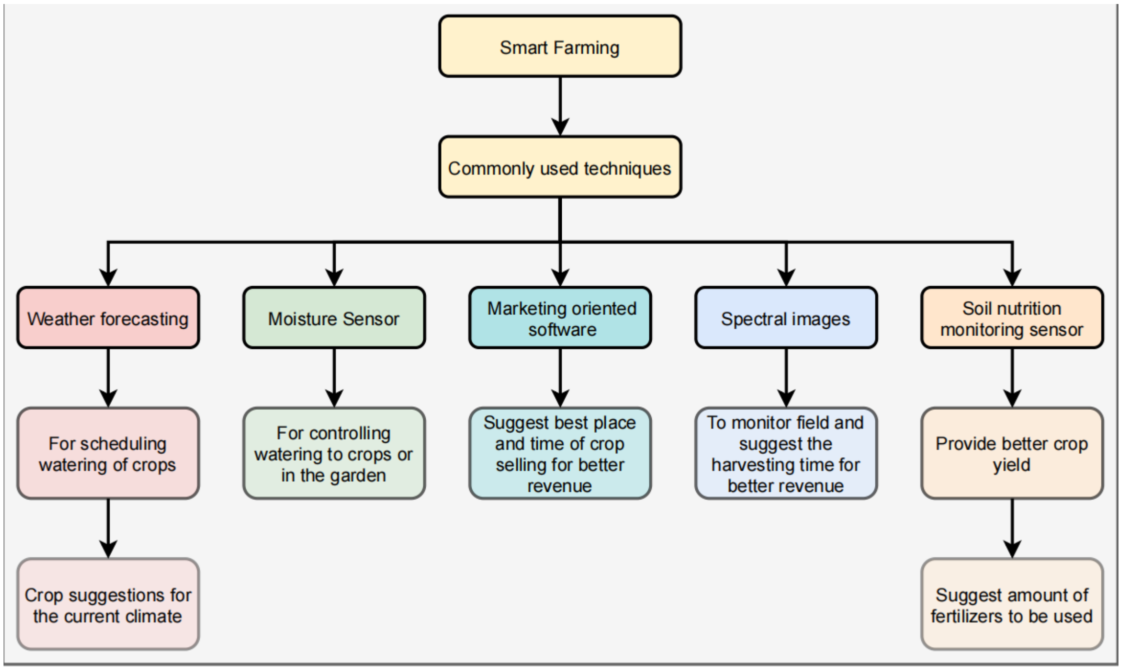

Figure 1. The implementation of Smart Agricultural Technology

Real-time data aids in preventing lateral damage to the playing field. IBM Inc. has developed a smart sensor for smart farming in order to minimize water use and increase profitability.

These programs examine weather and soil characteristics like as moisture and humidity content before recommending crops that can be grown in a certain place and, as well as when they should be harvested. They give information on when and where such crops should be sold to maximise profits. It is possible to enhance production by 8.5 percent while reducing fuel and water usage by using this smart farming technology.

Dacom is a Dutch company that makes smart agricultural equipmentthat gathers information on soil moisture, humidity, and temperature using weather stations, GPS, and moisture sensors and other parameters. On a daily basis, the farmer can keep track of how much water his crops need. Only giving the quantity of water required by the crops saves 20 percent of the water used throughout the field. The sensor network uses a significant amount of energy.

In developing nations like India and Bangladesh, providing energy to rural areas is a difficult endeavor in and of itself. As a result, deploying a sensor network in such an environment is incredibly difficult. Consequently, energy-free sensor technology is required.

Despite the availability of several smart agricultural options, these technologies have received very limited adoption. The biggest source of frustration is inaccuracy in forecasted weather information. Some farmers have also been observed to be hesitant to share their field data due to the lack of legislation forbidding such sharing. Because of the lack of data, smart farming software has a tougher time producing reliable findings. Researchers can conduct field surveys to determine why farmers are sluggish to adopt such valuable technology. Smart agricultural software that is standardized might be considered near-future work. The lack of wireless, internet coverage, and electricity in rural locations, as well as the expensive cost of these devices, makes field deployment in underdeveloped nations more difficult. As a result, to maximise man power and profit, we must create a variety of innovative engineering approaches in the agricultural industry.

GROUNDWATER RECHARGE

In rural areas of India, groundwater has risen to prominence as a critical civic water supply and poverty-reduction tool. It is the most popular source of water in India owing to its near-universal availability, dependability, and small capital cost.

Groundwater has played a crucial role in India's socio-economic development and has contributed greatly to the country's economic prosperity. The fact that groundwater resources provide more than 85% of India's rural water needs, 50% of its urban water demands, and more than 50% of its agricultural needs indicates its value as a valued natural resource in the Indian setting. Because of the country's growing reliance on groundwater as a stable source of water, it has been developed on a huge scale and frequently indiscriminately in various sections of the country, with little consideration for aquifer recharge capacity or other environmental concerns.

In India, groundwater recharge is mostly fueled by rainfall, with other sources of water, such as canal recharge, irrigated fields, and surface water bodies, augment it. The higher unconfined aquifers, which are also active recharge zones that keep the groundwater supply replenishable, account for the majority of groundwater removal. The Central Ground Water Board, in collaboration with the respective State Government agencies, assessed the country's active recharge zone's replenishable groundwater resource. The block/mandal/taluka/watershed was used as the unit for the evaluation, and following the guidelines of the Ground Water Estimation Committee (GEC) from 1997. In this zone, the yearly replenishable groundwater resource is estimated to be 432 billion cubic metres, of which 399 cm is available for development for various uses after reserving 34 cm for natural discharge during the non-monsoon season to maintain flows in springs, rivers, and streams, according to the most recent assessment (Central Ground Water Board, 2006).

Groundwater resource management in India is a difficult task since it involves human civilization and the physical environment. Because of the very unequal distribution of groundwater availability and use, there is no way to establish a single management approach for the entire country. On the other hand, each circumstance needs a solution that considers the geomorphic setting, climatic, hydrologic, and hydrogeologic settings, groundwater availability, water use patterns for various sectors, and the region's socio-economic setup.

Any scientific groundwater management strategy comprises a combination of supply-side approaches targeted at boosting groundwater extraction based on the availability of resources and demand-side policies aimed at regulating, preserving, and conserving them.

The following sections go through the many possibilities that fall into these categories in depth.

A. Supply Side Measures

These initiatives, as previously said, are aimed at boosting groundwater supply while taking into account environmental, and socio-economic issues. They're also known as “structural measures”, and they entail scientific advancement and the augmentation of groundwater resources. This category includes the development of additional groundwater resources by appropriate techniques, as well as the augmentation of groundwater resources through artificial recharge and rainfall collection. It is vital to have a thorough grap on effective and efficient supply management of the hydrologic and hydrogeologic elements that impact aquifer yields and groundwater level behaviour during abstraction stress. Surface and groundwater interactions, as well as variations in flow and recharge rates, are all significant factors to consider.

B. Demand Side Measures

To maintain long-term sustainability, proper groundwater resource management demands a focus on prudent resource consumption in addition to the scientific development of current resources. Groundwater ownership, need-based resource allocation pricing, stakeholder participation in various phases of project design, implementation, monitoring, and the proper application of regulatory controls where appropriate are all important components for demand-side groundwater management.

Considering the increasing need to improve agricultural output, these regions' under-utilization of groundwater resources is attributable to a number of reasons, including fragmented land holdings, low socioeconomic level, limited infrastructure, and a lack of knowledge of modern technologies. In this situation, it's vital to look at a number of options for making the most of these resources.

Proper groundwater resource management necessitates a focus on responsible resource usage in addition to the scientific development of present resources to ensure long-term sustainability. In demand-side groundwater management, groundwater ownership, need-based resource distribution, and pricing, stakeholder engagement in various aspects of project design, execution, and monitoring, as well as the successful implementation of regulatory measures when appropriate, are all important concerns.

RAINWATER HARVESTING

Long-term total annual precipitation in the nation is 1160 mm (Lal 2001), which is the highest in the world for a country of comparable size. India receives an average yearly precipitation of roughly 4000 km^3 in terms of volume. The monsoons of the South West and North East, as well as shallow cyclonic depressions and turbulence, and isolated storms all influence rainfall. Rainfall in India varies dramatically in both temporal and spatial. Between June and September, the majority of it (about 3000 km^3) is subjected to the South-West monsoon, which brings 100 hours of wet days. Approximately 21% of the country receives less than 750 mm of rain, whereas the remaining 15% experiences more than 1500 mm.

In many parts of the world, artificial recharge and rainwater harvesting are now universally acknowledged as a cost-effective approach to enhance groundwater resources, and to prevent or reverse groundwater level. There are artificial recharge processes that are suited to a certain place. Artificial recharge initiatives must consider the requirement, the area's suitability for subsurface storage capacity, and the availability of surplus monsoon run-off.

Rainwater harvesting and artificial recharge systems implemented by a variety of organisations around the country, including Central Ground Water Board, with promising outcomes in terms of enhanced groundwater recharge, decreased surplus runoff, and slowed groundwater level decline. Other project benefits include enhanced groundwater quality, higher irrigation potential, the rebirth of springs, soil conservation through increased soil moisture, and increased sustainability of present abstraction systems. Tidal regulators built to impound waters upstream and increase natural recharge are helpful in reducing saline incursion in coastal regions. Rooftop rainwater harvesting is ideally suited to the space constraints of urban habitations, whether for immediate consumption, storage, or recharging aquifers. The effort must be transformed from an institutional endeavour to a mass movement. Instilling a sense of responsibility among stakeholders through community-based rainwater collection and artificial recharge projects would improve system maintenance efficiency.

WASTEWATER TREATMENT

A basic human requirement is safe drinking water. Unfortunately, in the developing world, more than one out of every six individuals lacks dependable access to this valuable resource. Aeration, chemical coagulation, flocculation, sedimentation, filtration, and disinfection are all used to treat water in India, however, the quality of the raw water varies substantially. In terms of disposal, the backwash water and sludge generated by water treatment facilities are an issue. To decrease rejections from water treatment facilities, optimizing chemical dosage and filter runs is critical. The Water Treatment Plant (WTP) is a critical component of the infrastructure that guarantees that the community has clean drinking water. For water quality assurance, real-time monitoring is critical. Online water quality monitoring has become possible because of technological advancements. It also optimizes device use by providing real-time alerts when any quick changes are detected, such as water leaks and pollutants. This intelligent technology offers a solution for worker management that is both efficient and cost-effective, which is necessary for pipeline maintenance to be completed faster.

The leading industry has supplied many smart water technologies for improved control of water treatment facilities. Schneider proposed a method for sustaining water infrastructure by employing sensor technologies to check water quality. It also cut water losses by identifying leaks in pipelines.

This conserves energy that would otherwise be required to pump and filter extra water that would otherwise be wasted, reducing carbon emissions and electric expenses by 20% and 15%, respectively. It helps with labour management by using cameras in the WTP to give real-time field monitoring, resulting in a 25% improvement in worker productivity. On water and sewer infrastructure issues, IBM and the DC Water and Sewer Authority (DC WASA) work together. By providing a real-time mapping application, the system handles valve maintenance, pipeline maintenance, and public fire risks.

The system determines which parts of the WDS require maintenance. Water prices have decreased as a result of automated meters installed in WDS. This simplifies and speeds up pipeline management while also reducing the number of workers required. The SIWA sewer was developed by Siemens and is used to manage wastewater flow by uniformly spreading the load across the sewage treatment facility. Water quality monitoring and leak detection are also included in WDS. A combined sewer overflow causes pollution in nearby rivers (CSO). Schneider designed an ingenious mechanism for monitoring trash and runoff. Rainfall, floods, and other natural disasters can all have a significant impact on the drainage system. It minimizes the impact of rainwater on sewage infrastructure while also saving money.

The functioning of all water waste treatment sectors necessitates a high level of power consumption, resulting in a higher carbon footprint. Electricity usage may be lowered by 15% when network modeling is used. To minimize power use and carbon emissions, energy harvesting equipment must be used. Reducing carbon emissions will aid in environmental improvement. The OR waste treatment facility in Gresham, Oregon, creates more or equivalent energy than plants. 2015 saw the installation of solar panels and biogas generators. Biogas generates 92 percent of the electricity, and the rest is provided by solar panels, which saves the US $500,000 in power expenditures. By spreading load equitably among sewage treatment plants, SWS for WTP checks water quality, detects leaks, and mitigates pollution. It also boosts job productivity by enabling for real-time employee monitoring. Because WTP utilizes a huge amount of energy, it's critical to urge people to adopt renewable energy. The study of SWS data had a secondary purpose. China is using wastewater analysis to try to figure out how much drugs are used in society. They are developing a system that will evaluate drug content and monitor probable drug users based on the location of the trash and the users who live nearby.

As a result, it is necessary to investigate the status of performance of water treatment plants, and to establish the most viable method for assuring enough clean water production with the least potential rejections, as well as its management.

In light of this, the Central Pollution Control Board (CPCB) investigated water treatment plants around the country for raw water quality, treatment technology, operating procedures, chemical usage, and rejects handling.

DRINKING WATER AVAILABILITY/WATER DISTRIBUTION

In India, there is a lot of variety in terms of water availability, both spatially and chronologically. The Brahmaputra-Barak basin has 13,393 m^3/year of available water per capita, while the Sabarmati basin has only 300 m^3/capita/year. Water-stressed countries have groundwater resources of more than 1,700 m^3/capita/year, whereas water-scarce countries have fewer than 1,000 m^3/year, according to international standards.

Forty-Five billion cubic metres of water are squandered each year, costing roughly US$ 14 billion, according to a survey by the World Bank. Poor connections, pipe leaks, incorrect metering, unauthorised connections, and other factors contribute to the loss of water. The top-down and bottom-up methodologies can be used to determine Non-Revenue Water (NRW) for any district metering area (DMA). The disadvantages of these strategies are data dependability, data unavailability, and high prices.

Leakage Detection

The most prevalent source of NRW losses is leakages, which are highly dependent on water use as well as pressure and result in increasing pollution. Acoustic sensors are an old and popular method of detecting leaks in WDS. Electromagnetic sensors, ground-penetrating radar, and infrared thermography are some of the other emerging leak detecting technologies. These devices have a restricted surveying range for leakage detection. Researchers are developing SWT that can automatically recognise and pinpoint burst events, thanks to recent developments in science and technology. Pressure signal analysis in real time, live monitoring, and other smart tactics for identifying leaks and occurrences of pipeline network bursts are described in this section.

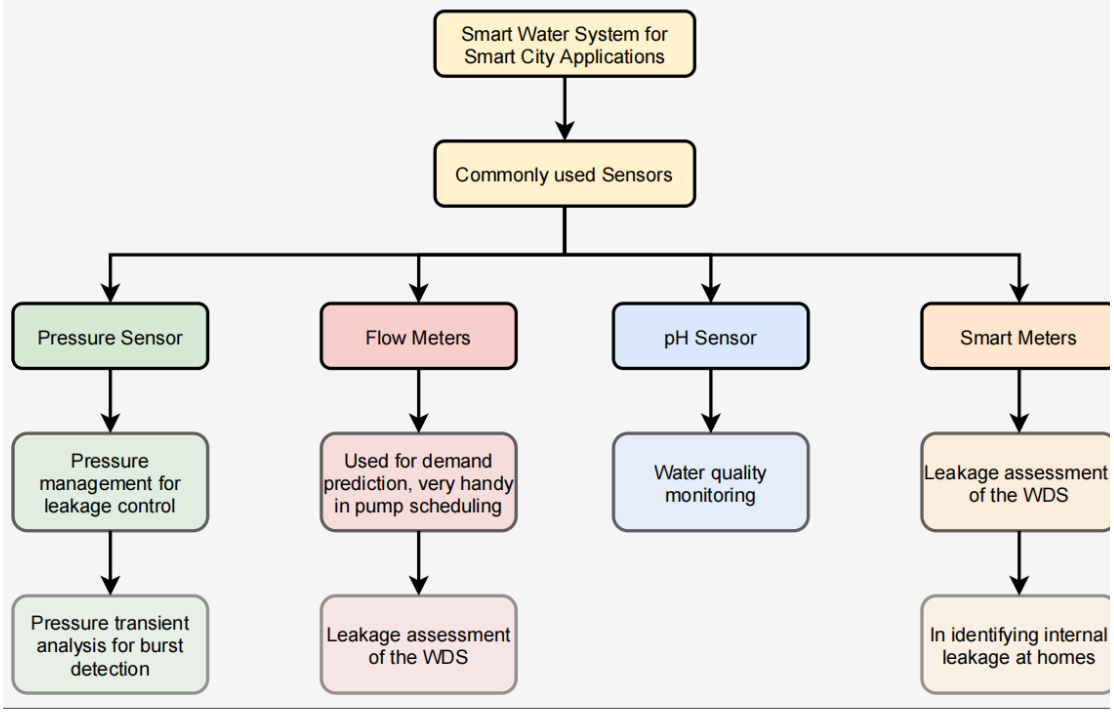

Figure 2. Application of Senors in Smart Cities

Water infrastructure is monitored in real time thanks to sensor technologies. When the data collected by these sensors is combined with effective data processing tools, resulting in improved management, and reaction in the event of infrastructure breakdown may be achieved. The Neptune Project Research Consortium in the United Kingdom has implemented a system to improve the functioning of the water distribution system, called Decision Support System (DSS). To find leaks and schedule pumps, data from flow and pressure sensors was analysed, and also to explore the system's stable and dynamic features while under PRV management. The Bottom-up technique is used to investigate leakage in the Lisbon water supply system. For data collection, flow metres and pressure transducers are put at predetermined locations. Acoustic sensors are used to pinpoint the location of leaks. Researchers have recently focused on Inverse Transient Analysis (ITA) and frequency analysis of pressure signals received from the sensors for leak detection in the pipeline system.

Wavelet and Cumulative Sum (CUSUM) analysis of transient pressure data received from the sensor network allows for automatic identification of burst events in the pipeline. A tiny pipeline test bed is being used to test the technology. The use of wavelet analysis alone to detect burst occurrences is shown to be insufficient.

The Transient Damping Method (TDM) and Impulse Response Analysis (IRA) are two further leakage detection approaches that are confined to basic pipeline layouts. These approaches' field deployment and verification have yet to be shown. Water that has been lost caused by physical and economic losses in the past, might serve a large number of individuals who are deprived of water. This might help to alleviate global water scarcity. The expense of pipeline maintenance is reduced when burst incidents are localized. To discover tiny leakages and commercial losses in the network, further tools must be created. Future efforts might include locating the exact site of the blast.

Smart Water Grid

Smart Water Technology (SWT) deployment is an expensive endeavor. The government can enlist the help of the private sector to construct smart city infrastructure. The service quality will increase as a result. In Singapore, the government has teamed up with a commercial company called Water-Wise to cut water losses by half. To create a smart water grid network, sensors for pressure, flow of water, pH level, and Oxidation-Reduction Potential (ORP) were placed.

Water Distribution System with Smart Metering

From the standpoint of the water customer, smart water metering can provide early warning of unexpected occurrences such as leakage, excessive water use, and so on. The study of gathered data aids in the formulation of intervention programmes, pricing methods, and the determination of water use reduction objectives.

During the winter of 2010 and the summer of 2012, smart metres were put in 337 households in Melbourne city to determine how much water each person uses on a daily basis. The city's water consumption rate during the summer was 149 litres per capita per day, whereas during the winter, it was 117 litres per capita per day. During the summer, more water is used for irrigation, evaporative cooling, and toilets, which raises water demand. Smart metres will increase service quality, data dependability, and data gathering operations labour. However, if a smart metre fails, it will create uncertainty about water loss in WDS, necessitating a suitable replacement. Data security, interfering with other electronic equipment, power consumption, high cost, and poor precision at low flow, and uncertainty about water loss as a result of broken metres are among issues that smart metres face.

CONCLUSION & SUGGESTIONS

People, governments, many communities, and other elements make up the real world. There are several social dimensions to smart technology in the city. For example, building appropriate sanitation toilets would be a more significant and priority assignment for water corporations in emerging towns than constructing a smart sensor network in the water system. As a result, while implementing such technologies into practise in the real world, local constraints may operate as a roadblock.

Smart water technology adoption is impeded not only by technical and scientific challenges, but also by economical constraints such as a lack of finances. Even if funds are readily available, competent technical assistance (depending on geographical location) is sometimes lacking. It is up to the local administration to decide whether or not to employ such technology for the city's advantage. As a consequence of their lack of understanding of local governance, citizens may be unable to profit from such technologies.

Another concern that prevents people from implementing smart water technologies, such as sensors used on farms or at home for personal awareness, is data security. Consumers may be worried about how their personal data is handled in the cloud. A third party might exploit the information. Governments must establish regulations to prohibit firms from exploiting personal data or launching cyber-attacks. As a result, water demand in an agrarian country like India is managed in the face of rising population pressures, industrial expansion, and agricultural requirements, all while contending with water shortages and climate change. Aside from water shortages, the poor quality of available freshwater exacerbates the problem. Water treatment systems and processes that are effective would help manage and augment water demand. To properly handle India's water management issues, a long-term plan that incorporates both present and future generations must be enacted. The government should focus on areas where water is being misused. Participatory water management should be used to achieve long-term water reuse and recycling.

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