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Effective management of water resources by using integrated approach

Surendra Pal Singh[1], Prashasti Ashok[2]*, Vijai Krishna[3], Tarun Gupta[4], Naol Wakgari Terfa[5], Marga Tashale Amanu[6]*, Dilip Santosh Chavan[7]
[1]Department of Surveying Engineering, Wollega University, Ethiopia,
[2]Department of Geology, Institute of Earth Sciences, B.U., Jhansi, India
[3]Department of Environmental Sciences, Rajiv Gandhi South Campus, Banaras Hindu University, India
[4,5]Department of Architecture, College of Engineering and Technology, Wollega University, Nekemte, Ethiopia
[6]College of Engineering & Technology, Wollega University, Nekemte, Ethiopia.
[7]Dept. of Commerce, SBES college of Arts and Commerce, Aurangabad, India.
Corresponding author Email ID: drprashastisaxena@gmail.com

ABSTRACT
Water is a fundamental requirement for life, not just for humans but also for plants and animals. Water is a fundamental element of all living things and the source of life itself. Water resources management is a comprehensive approach to managing water supply and water risks that aims to ensure enough quantity and quality to meet a variety of competing demands, such as those for drinking water, sanitation, food production, water transportation, energy production, navigation, recreation, and the maintenance of healthy ecosystems and the beauty of the natural world. This involves making plans, making projections, and figuring out the best, most ecologically friendly ways to manage resources while preserving fair, affordable access to water. The management of water resources has an impact on social, productive, economic, and infrastructure development. Water serves a fundamental purpose in preserving the integrity of the natural environment in addition to being a major factor in economic and social development. This essay has studied the theories of water resource specialists. From ancient to contemporary constructions, traditional practices of water resource management have been observed. We are also concerned with rules for the use of natural water resources and the sectors that are disproportionately impacted by water. The discipline of managing water resources will need to keep evolving to address both existing and foreseeable problems with water allocation.
Key words: Water, Natural Resource Management, Methods of WRM.

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INTRODUCTION

The Mauryan Empire (between 322-185 BCE) also saw the construction of the Pynes and Ahars (a combined irrigation and water management system), the reservoir (Sudarshan Lake) at Girnar, and several other constructions. The Mauryan Empire was "first and foremost a magnificent hydraulic civilization," according to McClellan III and Dorn (2015). The hydrological expertise developed by Indians more than three thousand years ago is shown by evidence from ancient water history. The Indus Valley civilisation was well recognised for its hydraulic engineering and is credited with creating the world's oldest flushing toilet facilities [8]. Almost 2000 years later, under the Roman Empire, similar amenities were only available in affluent areas. From the dawn of civilization until the development of GIS technology, WRM played a significant role. Water has always been and continues to be the foundation of society, and its planning and management are just as crucial to life as it is to humans. Planning, developing, allocating, and managing water resources across all water users in terms of both quantity as well as quality is known as water resources management (WRM). The information systems, infrastructure, incentives, and institutions that support and direct water management are all included. By ensuring there is enough water of sufficient quality for drinking sanitation and drinking water services, food security, power generation, inland water ways, and water-based recreational activities, as well as maintaining healthy water-dependent biodiversity and protecting the spiritual as well as aesthetic values of lakes, river systems, and estuaries, water resources management aims to maximize the benefits of water. In addition to managing water resources, one must also manage dangers associated with them, such as pollution, drought, and floods. It takes integrated management to take into consideration the

synergies and tradeoffs of the many different uses and values of water because of the complexity of the interactions between water and families, economies, and ecosystems. Building water control structures (dams, polders, drainage ditches, etc.) is a common part of water management operations since it increases water access and lowers the danger of water-related natural disasters like floods. Yet, these structures frequently alter water regimes, which has an impact on how water resources are distributed and allocated among various stakeholders [1].
Despite the fact that efforts to improve water resources aim to benefit society economically. The planet's life depends on water. 1.6 billion people live in locations with physical water shortage, complicating the reality that access to water is a basic human necessity. Nonetheless, 783 million people lack access to clean water in our increasingly wealthy globe, and 2.4 billion people will lack sufficient sanitation by the year 2050 if the current trend continue [2].

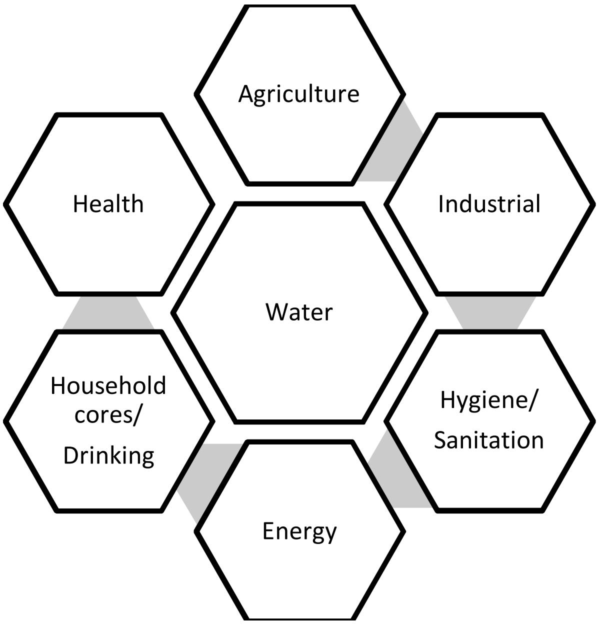

Figure 1Water and it's utilization sectors in broad spectrum.

Despite the fact that certain areas have inherently poor access to clean water, these areas are home to the population groups whose daily lives and urgent food requirements are most dependent on these resources. [3] Water is essential for farming and other livelihood activities in addition to being a fundamental human right in and of itself.

OBJECTIVES OF WATER RESOURCES MANAGEMENT

Sustainable water usage is the aim of water resources management. Water quality, quantity of water, drought management (operating reservoirs and diverting water), geothermal and renewables network d), watershed management (regulating drainage water, protecting forests, and conserving land), and facility maintenance are the items that must be considered necessary for the proper monitoring, evaluating, and controlling works in order to achieve effective water resources management.

WATER SCARCITY

We tend to take water for granted despite its seeming abundance. We frequently misuse and abuse it. This has caused a shortage of water. Water shortage results from an increase in water demand brought on by the fast population growth. India has the second-highest yearly rainfall in the world, yet it drains 400 million hectares of land each year. Just 100 million hectares of this are preserved in the earth. The remainder is discharged into the oceans and seas as runoff. Low groundwater supplies as a result of overgrazing and deforestation, which cause soil erosion and render the soil incapable of allowing water penetration. One of the key causes of shortage is inadequate storage facilities. Groundwater overuse in locations with limited water supplies frequently causes the infiltration of salty sea water in coastal zones. the discharge of numerous contaminants into our water bodies, which makes the water less potable. hybrid wheat, cotton, sugarcane, tobacco, and paddy types are being grown. These crops use more water. Water contained in huge reservoirs is lost due to evaporation, as well as through seepage in extensive canal networks. Water shortage was caused by the siltation of bodies of water as a result of the destruction of the plant cover in the catchment areas and hills. Water is a rare resource in many areas of our nation. In communities, women must travel several kilometres each day, often making many journeys, to gather a few pots of water. People must endure significant hardships even in urban areas only to gather a few water containers. Water shortage will rise, not diminish, as our population continues to grow. It's time we made judicious use of our resources.

CHALLENGES OF WATER RESOURCE MANAGEMENT

WRM's main obstacle is dealing with people. Lakes and rivers that contain freshwater are contaminated by human activities. Future conflicts over access to fresh water are possible if sustainable water management is not achieved. Without water, life on earth would not be possible since water is a necessary component of life. Much of the globe is currently experiencing severe water shortages caused by drought, which is thought to be a result of climate change. Several rivers are becoming contaminated, dry up, and besieged. The question of whether future generations will have access to enough freshwater for survival is more important than ever. We used freshwater as humans for drinking, hygiene, watering cattle, and irrigation, to name just a few uses. The decisions that humanity makes will determine how they participate in WRM. To actively engage in identifying long-term approaches to managing water resources, people must make trade-offs in their way of life and finances.

Sectoral divisions in water resource management have occurred, particularly between irrigation authorities and organizations concerned in water supply and sanitation. Little attention has been paid to industrial uses, which are managed (when governed at all) by a patchwork of licenses from municipal or irrigation systems and various degrees of water quality management. Aquatic ecosystems and other forms of environmental fluxes often fall under the purview of a different group of environmental authorities. Yet as human populations have grown and industry and consumption habits have changed, water withdrawals have risen sharply, putting various uses in conflict with one another. [5] When the productive potential of water is maximised and its destructive potential is controlled, water security is attained. In contrast to the ideas of food security or energy security, the problem of ensuring sustainable resource availability also includes reducing the risks that water brings in areas that aren't well managed. The ability to offer dependable water utilities, manage and mitigate water-related hazards, and assure sustainable water resource use are all examples of water security. In order to think more generally about societies' expectations, decisions, and accomplishments with regard to water management, the concept of "water security" provides a dynamic framework that extends beyond specific goals like water shortage, pollution, or access to water and sanitation. It is a dynamic policy objective that shifts in line with changes in societal values, economic prosperity, risk exposure, and risk tolerance. It has to deal with fairness problems [6-7].

METHODS

So, effective water management is the need of time. It entails managing water supplies for future generations. It entails the process of organizing, creating, allocating, and managing the best possible use of water resources. Water management preservation may be accomplished through a variety of techniques, some of which are described here. A general overview of WRM and its integrated system is provided in Figure 2.

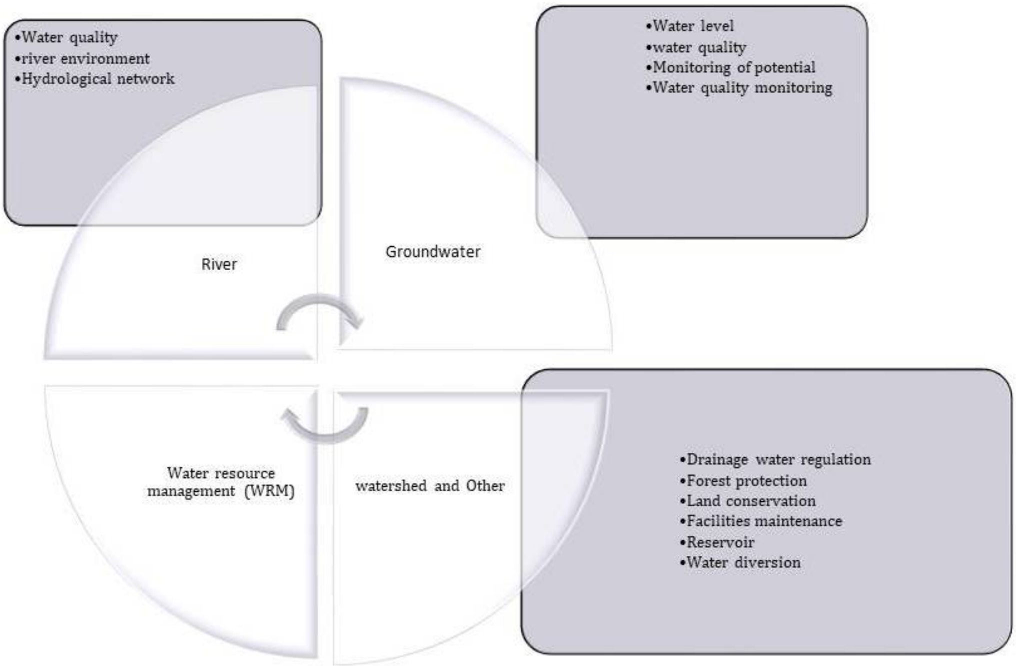

Figure 2: Framework of water resource Management (WRM)

DRIP IRRIGATION

By letting water gently flow to plant roots from above the surface of the soil or from buried below the surface, drip irrigation is a sort of micro-irrigation system that has the ability to conserve water and nutrients.

GROUNDWATER RECHARGE

The improvement of natural groundwater supplies by the use of man-made modes of transportation, such as infiltration basins, tunnels, reservoirs, or injection wells, is known as groundwater recharge. Groundwater recharge techniques known as aquifer storage and recovery (ASR) are used to increase groundwater supplies while also storing the water for future use. Rain and snowfall, as well as surface water, naturally replenish groundwater (rivers and lakes). Human actions like pavement, construction, or logging may inadvertently hinder recharge. As the volume-rate of water that is drawn from an aquifer over the long term should be less than or equal to the volume-rate that is recharged, groundwater recharge is a crucial process for sustainable groundwater management [8].

ARTIFICIAL GROUNDWATER RECHARGE

As a result of our extraction exceeding the pace at which aquifers naturally replace themselves, or recharge, groundwater levels are decreasing nationwide. Artificial groundwater recharge is one strategy for managing eroding water levels. The method of boosting water entering an aquifer through human-controlled ways is known as artificial recharge. In India, where excessive groundwater use by farmers has caused subterranean supplies to become depleted, artificial groundwater recharge is becoming more and more crucial.

RAINWATER HARVESTING

The practise of collecting rainwater and storing it as opposed to letting it flow off is known as rainwater harvesting (RWH). Rainfall is gathered from a roof-like surface and sent to a tank, cistern, deep pit (well, shaft, or borehole), aquifer, or reservoir by percolation. With the use of nets or other instruments, dew and fog may also be gathered. In contrast to stormwater harvesting, rainwater harvesting collects runoff from roofs rather than from roads, sewers, streams, or any other land surface. It may be used for irrigation, home usage with correct handling, watering gardens and cattle, and domestic heating. A groundwater recharge or longer-term storage project may be undertaken using the gathered water. To prevent groundwater depletion, Tamil Nadu was the first state to mandate rainwater collection for every structure. The programme was introduced in 2001 and is now being used in all of Tamil Nadu's rural districts. Those who live in the Thar Desert have historically harvested rainwater in Rajasthan. In Rajasthan, some antiquated water collecting devices have recently been reactivated. Rainwater harvesting is currently required in Pune for the registration of any new housing society.

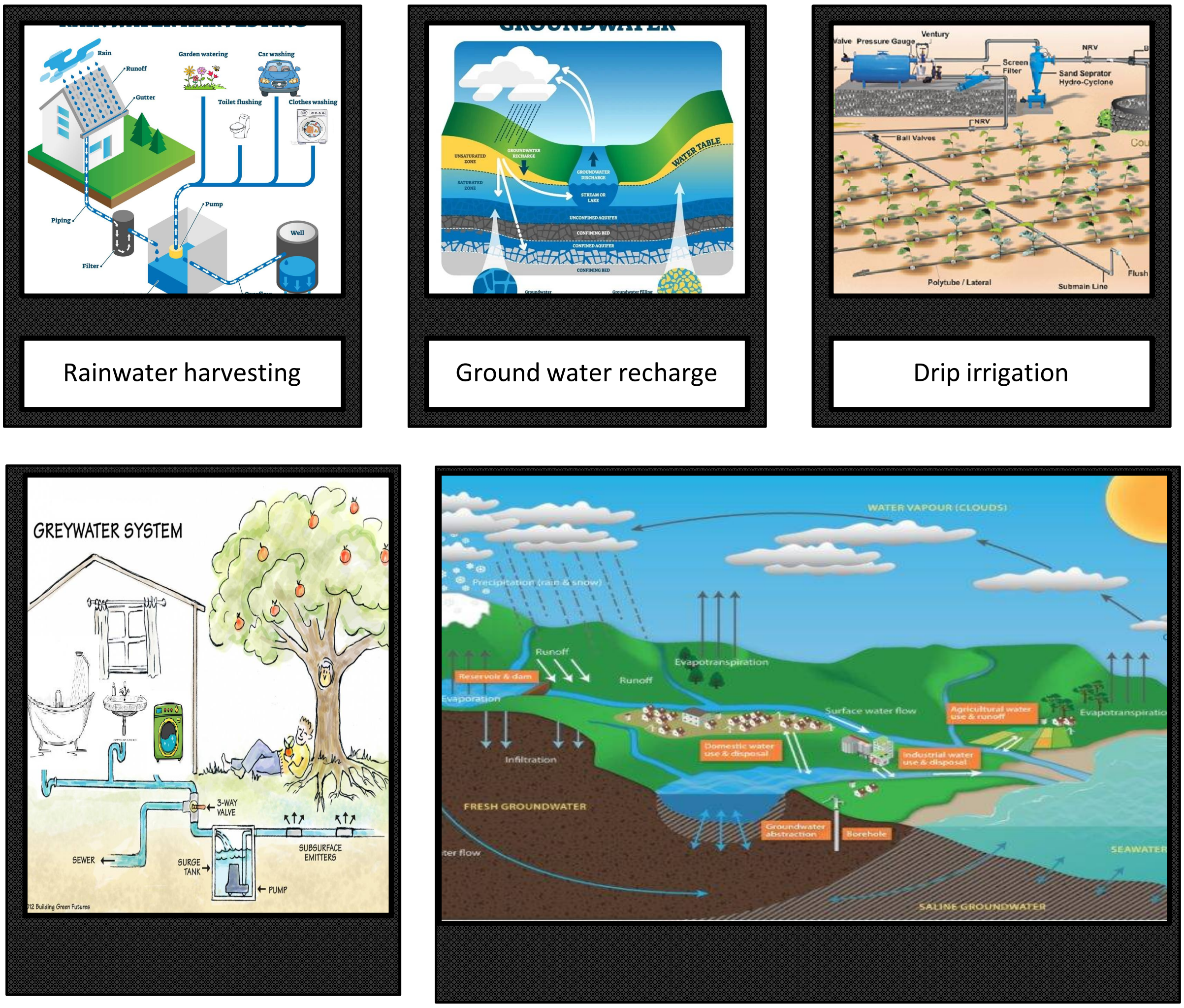

Figure 3: Methods of WRM, part 1

GREYWATER

The water that is softly used in your bathroom sinks, showers, tubs, and washing machines is known as greywater. No, neither water from washing diapers nor water from the toilet has come into touch with excrement. Traces of debris, food, grease, hair, and certain home cleaners may be present in greywater. Greywater is a harmless and even useful source of irrigation water for a yard, despite the fact that it may appear "filthy." Before being released to an irrigation or treatment system, the greywater is temporarily stored in the tank.

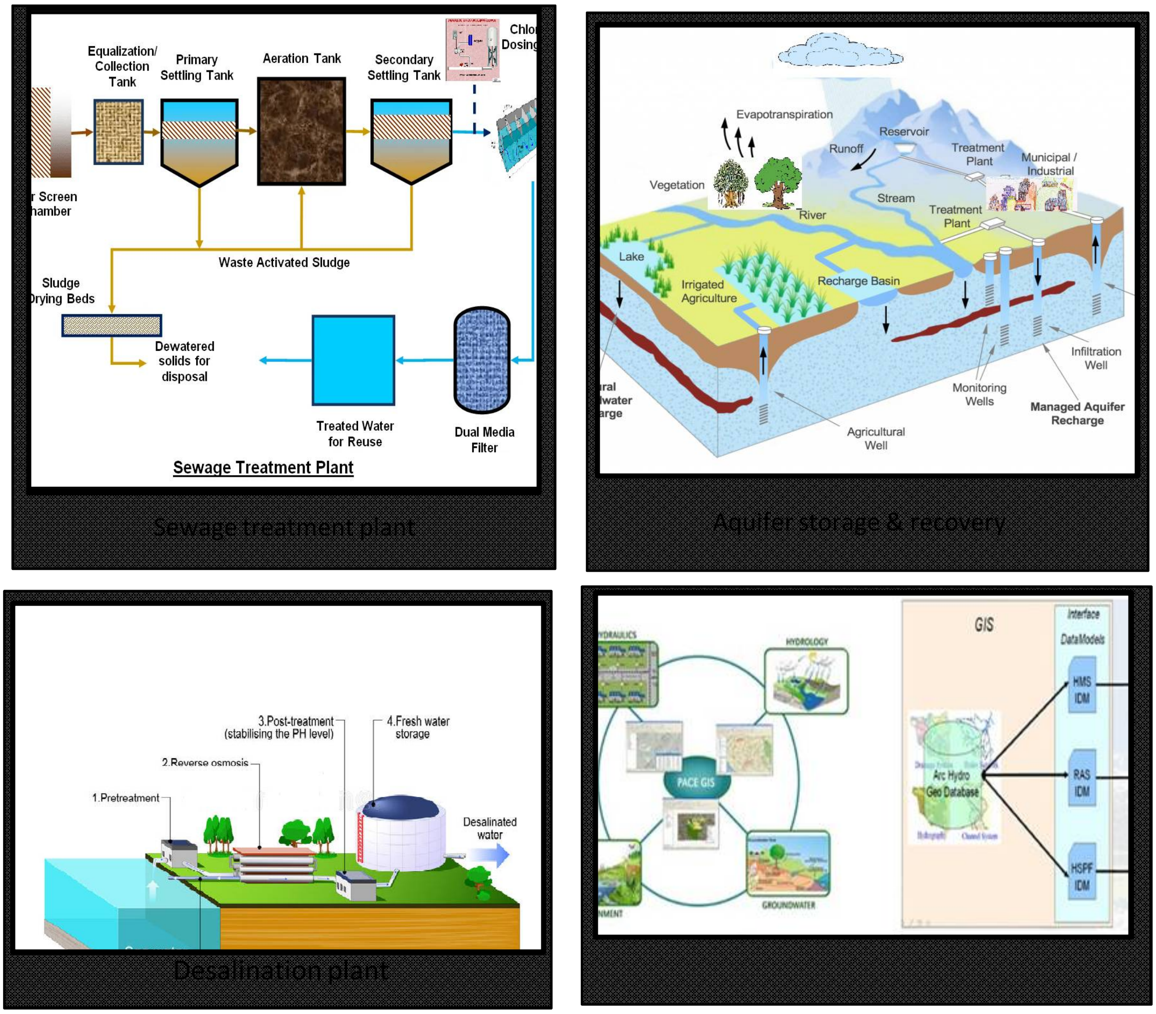

Figure 4 Methods of WRM, part 2

SEWAGE WATER TREATMENT

The method of sewage treatment involves eliminating impurities from municipal wastewater, which mostly consists of sewage from homes and some industrial effluent. Contaminants are eliminated through physical, chemical, and biological processes to create wastewater (or treated effluent) that is safe to discharge into the environment. Sewage sludge is a semi-solid waste or slurry that is produced as a by-product of sewage treatment. Before being appropriate for disposal or application to land, the sludge must undergo further treatment.

AQUIFER STORAGE AND RECOVERY

The process of directly injecting surface water sources, such as potable water, reclaimed water (rainwater), or river water into an aquifer for eventual recovery and usage is known as aquifer storage and recovery (ASR). The injection and extraction are frequently carried out using a well. Rainwater ASR may be able to help keep rainfall contained in regions where it cannot or cannot permeate the soil quickly enough (i.e., urban areas). In these areas, precipitation is redirected to rivers. Municipal, commercial, and agricultural uses all include ASR.

DESALINATION

Mineral components are removed from salt water during the desalination process. Desalination more generally refers to the process of removing salts and minerals from a target substance, such as soil, which is problematic for agriculture. Desalination is the process used to create water that is appropriate for agriculture or human use. Brine is a residue of the desalination process.
Need for Planning and Management

The following reasons make planning and management of water resource systems crucial: (1) While port expansion necessitates deeper rivers, restricting the river for shipping operations would raise the flood level (2) Riverbank erosion and riverbed degradation upstream of the reservoirs may enhance the flooding risks (3) The extent to which droughts, floods, and excessive pollution have negative effects. This can result in a number of problems, including a lack of water due to increasing urbanisation, higher water demands, increased stream flow needs, etc. At times of shortage, steps should be done to lower demand. b. An excess of water caused by more frequent floods and increasing water needs brought on by growing economic development along river floodplains. c. Water contamination brought on by domestic and industrial wastes. (4) Poor water quality owing to discharges of pesticides, fertilisers, wastewater effluents, etc., degradation of aquatic and riparian systems as a result of river training and reclamation of floodplains for urban and industrial development. (5) The reservoir's build-up of sediment as a result of the water's low quality. Considering all of these variables, the main objective of planning and management policies is the identification and assessment of alternative measures that may improve the quantitative and qualitative system performance.

MANAGEMENT OF WATER RESOURCES

There are few methods for the restoration of management of water resources. Afforestation should be done to reforest rocky, bare slopes on a war footing. Trees are more drought-resistant than crops. They control dust, refill streams, offer livestock and people shade, and supply animals with feed. They provide several benefits to man. It is reckless and short-sighted to clear the land of trees without compensating afforestation in an effort to meet urgent demands. Soil moisture may be preserved by using agronomic techniques like off-season tillage (before pre-monsoon precipitation). Despite the soil's restricted moisture content, other techniques including early seeding, modest fertiliser usage, weeding, insect and disease management, and prompt harvesting boost the yield. The construction of tiny reservoirs and percolation tanks must be properly carried out and maintained. The soil's ability to hold moisture is improved by contour ploughing and the planting of grasses and trees, which also reduce run-off water. Water runoff is reduced by terrace farming on sloping terrain. Crop rotation (growing various crops in succession based on the soil and climate, for example, cereals followed by legumes) and "green manuring," which involves adding new, green leaves to the soil, both help to keep the soil wet. For closely spaced crops like millet, lentils, groundnuts, etc., spray irrigation conserves 30 to 40% of the surface water. Organic waste can be used as a mulch to retain soil moisture. Row crops like vegetables, cotton, and sugarcane that are spaced tightly apart are best suited for drip watering. This technique is around 25 to 30 percent effective in retaining soil moisture. Drilling one to three holes in a mud pot and partially burying it in the ground adjacent to the plant is the simplest and least expensive method of drip irrigation. Collecting rainwater and storing it in tiny ponds assures water availability throughout summer. The water in the pot drops gently, ensuring that the soil is continually wet and the plant gets a consistent supply of water. It is possible to dig deep trenches next to bunds to catch soil and water runoff. Only when correctly used are all these techniques beneficial.

Regular summertime desilting of canals, tanks, etc. is necessary. Tree protection around tanks, a long-ago habit, should be encouraged once again. Groves were built around towns and along major rivers, and sacred rivers were declared.

PARTICIPATORY WATER MANAGEMENT

One of the main issues the nation now has is a lack of water. Poor resource management is a major contributor to this issue. We overuse our rivers, lakes, groundwater, and other water supplies while at the same time allowing enormous volumes to wash off unutilized into the ocean. In order to solve the issue of water shortage in the nation, the need of participatory water management needs to be underlined. Government, public society, and local communities must all collaborate to create solutions that will maintain, protect, and improve the water resources that are now accessible.

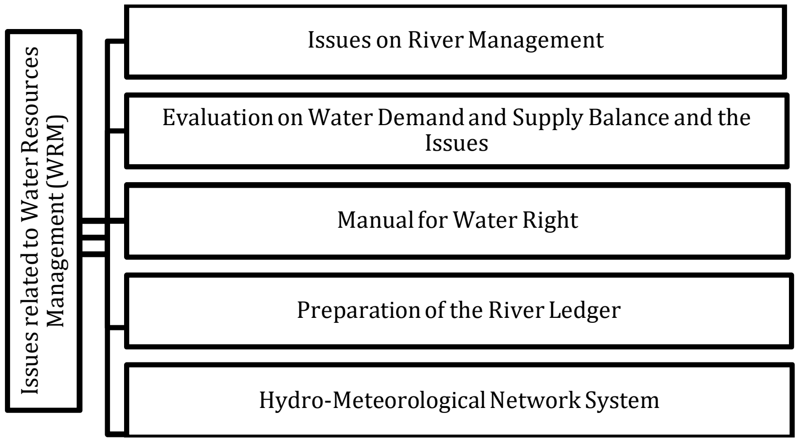

Figure 1: Issues related to water resources management (WRM)

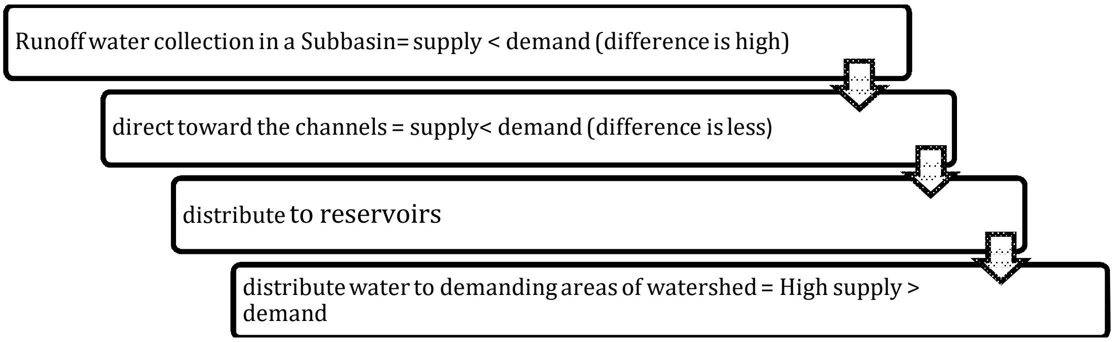

Figure 2: Flow Chart of the water resources management model.

There are instances from states like Tamil Nadu and Maharashtra where participatory management of water has assisted in transforming dry, parched farmlands into fields that produce a variety of crops throughout the year.

INTERNATIONAL DEVELOPMENT ON WRM

The Global Water Development Report was created and published every three years from 2003 to 2012, using a thorough methodology. The WWDR became an annual thematic report in 2014, focusing on several critical water concerns each year. Leading governments and NGOs from across the world are focusing on integrated water resource management (IWRM) and sustainable water resource management (SWRM) to safeguard both mankind and water in the future.

CONCLUSION

Methods for managing water should be used strategically while keeping in mind the necessity of carrying out the task. Where practical, planning groups must consider the demands of all water users. Efficiency in water management may be applied at all levels and across all industries, including those of river basins, communities, big water users (utilities, industry), agriculture, and households. Demand management may be quite efficient at lowering total water use in scenarios and levels of management when there are several separate tiny uses and water appliances (such as home water use). A significant amount of water can be saved at the industrial level by modifying the way water is utilized (for instance, lowering pressure) or by reusing water several times for different purposes that call for water of progressively poorer quality. To achieve water security through WRM, it will likely be necessary to combine supply management with demand management in many emerging countries where water availability is limited or erratic. Instead of utilizing river basins as the hydrological unit, the majority of water planning and development in the nation has been done according to administrative borders. As most river basins are shared by numerous states, this has resulted in water conflicts as each state's water consumption has increased dramatically to accommodate growing household, industrial, and agricultural demands. These problems have gotten worse due to the lack of river basin management plans and operational river basin agencies.

Priority should be given to developing the guidelines and manuals for river works and water rights. The priority is to improve the current hydro-meteorological network systems, hence early deployment is preferred. Concerned enterprises must manage their groundwater data networks thoroughly in order to manage measured data effectively. It is advised to set up the river ledger, which is a database for rivers that contains the fundamental facts and figures needed to manage water resources.

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