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WATER CONSERVATION - IMPORTANCE OF TRADITIONAL AND MODERN TECHNIQUES IN INDIA

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Abstract

Water conservation is a process that involves policies, rules and regulations and techniques to sustainably manage natural water resources, protect watersheds and meet the present and future demand for water supply for humans. India has a rich heritage of traditional water conservation practices, in the past various states of India adopted traditional water storage methods such as Khadin, Kund, Johad - (Rajasthan), Eri - (Tamil Nadu), Katta- (Karnataka), Bawdi (Gujarat), Tanks (South India), Tal, Bandhara - (Maharashtra), Kuhls - (Himachal Pradesh), Bundhis - Uttar Pradesh and Madhya Pradesh, Surangams - (Kerala).

This includes rainwater storage methods like 'Tanka' and 'Aahar', which effectively store monsoon rains and recharge groundwater in various regions; However, with increasing water scarcity, modern techniques such as drip irrigation, sprinklers, smart irrigation systems and efficient water management practices are being adopted to optimize water use in agriculture and domestic sectors, which highlights the need to combine traditional knowledge with advanced technology for sustainable water conservation in the country. Also, smart water metering, green building design, drought-resistant agriculture, educational campaigns and water conservation apps are becoming important in 21st-century water conservation techniques.

Introduction

The water crisis in the world is continuously increasing. In this first decade of the 21st century, 50 percent of the world's population is directly or indirectly facing water crisis. Not only humans are responsible for the creation of the water crisis, but nature also increases it in various ways. For example, the distribution of rainfall in the world and in India is not uniform. Therefore, some regions have abundant water availability while some regions are prone to drought, so it is necessary to adopt traditional and modern techniques of water conservation in those places.

What is water conservation?

1. Water conservation is the prudent management and preservation of water resources to ensure their sustainable use for present and future generations.
2. Water is a limited resource, therefore, reducing unnecessary use of water and using it efficiently is water conservation.

The art of water conservation in India has a long history, which is deeply rooted in its cultural and geographical landscape. Various traditional methods such as 'Katta' (check dam), 'Baoli' (step wells) and 'Kund' (tanks) are used, especially during the monsoon season, to collect and store rainwater. These techniques, often used in specific regions, reflect a deep understanding of the local water cycle and are highly efficient in managing water scarcity.

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Even today, these systems are beneficial, valuable, and cost-effective options for rejuvenating depleted groundwater reserves. Drawing on centuries of experience, Indians continued to build structures to capture and store monsoon rainwater for the upcoming dry season. These traditional techniques, although less popular today, are still in use and efficient in some places. This could be a more sustainable approach to solving the water scarcity crisis across India. Ultimately, water conservation should be a key component of any policy to end India's perennial swings between drought and flood.

However, with the growing population and changing weather patterns, along with traditional methods, modern water conservation techniques such as rainwater harvesting, greywater recycling, drip irrigation, xeriscaping and efficient plumbing fixtures, and green building design are being implemented in the water conservation techniques of the modern era and the 21st century, to address the growing water crisis in India.

Area of Study

The present research article attempts to study the historical, traditional, and modern methods of water conservation across India.

India is located north of the equator between latitudes 8°4' N and 37°6' N and longitudes 68°7' E and 97°25' E. It is the seventh largest country in the world, with a total area of 3,287,263 square kilometers, comprising 28 states and 8 union territories. India is 3,214 km long from north to south and 2,933 km long from east to west. It has a land border of 15,200 km and a coastline of 7,516.6 km.

Study Methodology

The present research article has used a regional study method, analytical study method, observational study method, survey study method and integrated study method for the research study to collect data on traditional and modern water conservation techniques in India.

Studies on traditional and modern water conservation techniques in India generally involve a methodology that includes a literature review to identify the major traditional methods in different regions, a field survey to assess the current implementation and effectiveness of both traditional and modern techniques, and data analysis to compare their water conservation capacity considering factors like geographical conditions, socio-economic aspects and technological advancements, but it is concluded that an integrated approach using traditional knowledge and advanced water management techniques is important for sustainable water conservation in India.

- **Major Water Conservation Techniques in India**

Almost every region in India has its unique method of water conservation and storage which has been prevalent since time immemorial. A look back at history reveals the ecologically sound engineering marvels of water conservation that have existed in India for nearly 1,500 years, with modern approaches focusing on rainwater harvesting, greywater recycling, drip irrigation, smart irrigation systems, and advanced water treatment technologies, along with traditional water conservation techniques in India, aimed at increasing water use efficiency and reducing wastage.

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There is a need to conserve clean water resources in all countries at regional and global levels, and water conservation should be done by adopting appropriate methods in different geographical locations and conditions. Over time, the pattern of water use has also changed in the context of increasing demand and diversification of economic activities, which, although it is not possible to restore it to its original form, can be preserved in the changing environment of time. The following methods will be effective for this-

1. Ahar Pinas

Ahar Pinas are a traditional floodwater storage system in South Bihar. Ahars are reservoirs. Ahars are catchment basins built on three sides, the 'fourth' side being the natural slope of the land. These are built at the end of diversion canals like Pinas. Ahars are artificial canals built to use river water in agricultural areas. Pinas are artificial channels to collect water from rivers for irrigation during the dry months. Rice cultivation in this relatively low rainfall area mainly depends on Ahar Pinas.

2. Bandhara/ Phad

A major traditional water conservation system in India is the "phad" system, a community-managed irrigation system found mainly in the Tapi River basin in north-western Maharashtra, where check dams are built across rivers to distribute water to agricultural fields through canals, ensuring efficient water use through a network of channels and outlets; Phad irrigation systems probably came into existence around 300–400 years ago. The system operates on three rivers of the Tapi Valley - Panjra, Mosam and Aram - in Dhule and Nashik districts.

3. Bamboo Drip Irrigation

Bamboo drip irrigation system is used by tribal farmers in Northeast India to irrigate seasonal crops. Bamboo drip irrigation system is an innovative system of efficient water management. It has been used in Northeast India for over two centuries. This ancient method has been used by tribal farmers in the Khasi and Jaintia hills of Meghalaya for 200 years to drip irrigate their black pepper plantations.

4. Baoli

The ancient method of storing water in Baoli has played an important role in Indian culture for thousands of years. Baoli is an ancient type of water harvesting system that has been used for centuries. This method uses a network of interconnected wells or pits to collect rainwater from rooftops and other nearby surfaces, allowing it to slowly percolate into the ground where it is stored as groundwater for future use. Baolis are commonly found in India, Pakistan and Bangladesh but are also found in other parts of South Asia and the Middle East.

5. Bawdi / Bawari

Bawdi means a well with steps. Bawdi is called Vav, Vavari or Vav in Gujarati. Bawdi is called Bawari in Rajasthani. In Hindi-speaking regions, Bawdi is also known as Baudi, Bawari, Baori, Baoli. The characteristics of Bawdi are that the Bawdi is many stories deep. Bawdi is adorned with artistic beauty. Bawdi is a traditional way of collecting water.

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Bawdi is used for water conservation, entry, religious ceremonies, and rituals. Bawdi are unique stepwells that are part of the ancient water storage networks in the cities of Rajasthan.

6. Eri

Eri is a traditional Indian water harvesting system. Tamil Nadu's system is one of India's oldest water management systems. It uses earthen dams to collect and store rainwater. An Eri functions as a collection, distribution, storage, and reuse system. About one-third of Tamil Nadu's irrigated area is supplied by eri (tanks).

7. Jackwells

Jackwells are a traditional water conservation technique that helps in storing water in rocky terrain. Jackwells are traditional water storage pits used by the Shompen tribe of the Great Nicobar Islands. The Shompen tribe of the Great Nicobar Islands live in a region with rocky terrain that they make full use of to collect rainwater and create water reserves in low-lying areas.

8. Jhalara

Jhalaras are generally rectangular-shaped steps with steps on three or four sides. These steps collect water from the underground seepage from a reservoir or pond on a slope. Jhalaras were built to ensure easy and regular water supply for religious rituals, royal ceremonies and community use. They are mostly found in Rajasthan and Gujarat. There are eight Jhalaras in the city of Jodhpur, the oldest of which is the Mahamandir Jhalara which dates back to 1660 AD.

9. Johad

A Johad is a small pond or pond found in the northern part of India. It collects rainwater and uses it for many purposes. Johad is a traditional technique of water conservation. Johads are found in Rajasthan, Haryana, Punjab and western Uttar Pradesh. Johads are used for drinking, washing, bathing, sanitation, etc. Some Johads have ghats made of bricks or stone construction and cement. One of the oldest systems used for groundwater conservation and recharge, johads are small earthen dams that collect and store rainwater.

10. Khadin

Khadin is a traditional method of water conservation. It is a long dam built on a sloping agricultural field. Rainwater is collected from the khadin and percolated into the ground. This increases the groundwater level and helps to overcome the problem of drought. Khadin is a traditional method of rainwater harvesting in Rajasthan. Khadin is found in the Jaisalmer district of Rajasthan. This system was first designed by the Paliwal Brahmins of Jaisalmer in western Rajasthan in the 15th century.

11. Kuhls

Kuhls are a traditional irrigation system in Himachal Pradesh - which uses canals to divert water from glaciers to villages in the hilly regions. The word "kul" comes from the local dialect and means "diversion channel". Kuhl systems had developed over centuries in Himachal Pradesh. Local communities were responsible for constructing and maintaining kul systems. Surface canals to divert water from natural flowing streams (khuds). A typical community kuhl serves six to 30 farmers, irrigating an area of about 20 hectares.

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12. Kund

"Kund" is a traditional rainwater harvesting method in India, the history of storing water in kund dates back thousands of years as it was a part of ancient Indian culture. It is mainly found in western Rajasthan and parts of Gujarat. Particularly prevalent in the Thar Desert of Rajasthan, in the sandy regions, villagers have developed a system of rainwater harvesting known as kund or kundi (local name for a covered underground tank) as a solution to the problem of drinking water.

13. Nadi

"Nadi" is a traditional water conservation system in India, found mainly in Rajasthan, most often near Jodhpur, Rajasthan.Nadi, found near Jodhpur in Rajasthan, are village ponds that store rainwater collected from the adjacent natural catchment area. The location of a nadi greatly affects its storage capacity and hence the location of the nadi is chosen with careful consideration of its catchment and flow characteristics.

14. Panam Keni

The Keni or sacred wells and tunnels reveal the ancient knowledge and wisdom of the tribals of Wayanad in water conservation and sustainable use of perennial water resources. This valuable indigenous knowledge is being neglected, and it is necessary to preserve it and pass it on to future generations. The indigenous Kuruma tribe in Wayanad stores water in a unique type of well called Panam Keni. The "Panam Keni" is a special type of well used in the Mullu Kuruma settlements.

15. Pat System

The Pat system is a traditional rainwater harvesting system in Maharashtra, India. It uses dams to divert rainwater from streams into irrigation channels in the form of streams. The Pat system was developed in the village of Bhitada in the Jhabua district of Madhya Pradesh. Stones, teak leaves, and mud are piled up across a stream to form a pat dam. The dam diverts water from the stream into channels that carry it to the fields.

16. Ramtek Model

Ramtek Model is a traditional water storage system in Ramtek, Maharashtra, India. It is a network of tanks and canals that collect and store rainwater from the foothills of the hills to the plains. The Ramtek Model is named after the water storage structures in the city of Ramtek, Maharashtra. This system, which consists of a complex network of groundwater and surface water reservoirs, was built and maintained primarily by the Malgujars (landowners) of the region.

17. Talabs / Bandhis

Talabs are reservoirs that store water for domestic use and drinking. They can be natural, such as the Pokhariyan Lake at Tikamgarh in the Bundelkhand region, or man-made, such as the Udaipur Lake. A reservoir with an area of less than five bighas (1.5 hectares or 3.25 acres) is called a talai, a medium-sized lake is called a bandhi and a larger lake is called a sagar or samand. Pokhariyans serve both irrigation and drinking purposes. After a few days of monsoon, when the water in these reservoirs dries up, rice is cultivated in the ponds.

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18. Tanka

Tanka is a traditional method of storing rainwater indigenous to the Thar Desert of Rajasthan. In which rainwater is collected. It is also called a lake. A tanka is a cylindrical paved underground pit (underground tank). Into which rainwater flows from a roof, courtyard or artificially created catchment. Once filled, the water stored in the tanka can last the entire dry season and is sufficient for a family of 5-6 members. An important element of water security in these arid regions, a tanka can save families from the daily hassle of fetching water from distant sources. The tanka is used for drinking water.

19. Zabo

Zabo (meaning 'to stop flowing water') system Located in the rain shadow of Phek district in Nagaland, the residents of Kikruma village have developed their own water management system that can capture rainwater flowing from the hills. This innovative water conservation method and integrated farming system is called Zabo. It involves forestry, horticulture, agriculture, fisheries and animal husbandry. The word Zabo is derived from the Chokri dialect of Nagaland, zabö, which means 'flowing water'.

20. Zing

Zing is a traditional method of water storage in the Trans-Himalayan region. These systems are intended to store rainwater. Zing is a system of collecting water from melting glaciers. Zing, commonly used in the Jammu and Kashmir region and Ladakh, are small tanks that collect meltwater from glaciers and can be used in other seasons.

- **Modern techniques of water conservation**

Water conservation has become a serious issue due to increasing demand, water scarcity, and climate change. Modern methods, technologies, innovations, and sustainable practices of water conservation to ensure the efficient use of this precious resource are as follows.

1. Rainwater Harvesting

Rainwater harvesting is the collection and reuse of rainwater. Rainwater harvesting involves collecting rainwater from roofs, surfaces, or specially designed catchment areas. This saves water. The collected rainwater is used for irrigation, toilets, flushing and washing cars, gardens, livestock, irrigation, and domestic use. In rainwater harvesting, rainwater is stored for reuse instead of being allowed to run off.

2. Greywater Recycling

Greywater recycling is a modern method of water recycling. Greywater is wastewater from activities such as bathing, laundry, and dishwashing, which can be reused for non-potable purposes. Modern systems treat and filter greywater to make it safe for irrigation and flushing toilets. This method not only saves water but also reduces the load on wastewater treatment plants.

3. Smart Irrigation Systems

Advanced irrigation systems equipped with sensors to monitor soil moisture and adjust watering schedules accordingly, optimize water use, weather data integration, and

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automation are revolutionizing agriculture and landscaping. These systems deliver the right amount of water to plants based on their specific needs, while minimizing water use by reducing waste and over-watering.

4. Drip Irrigation

Drip irrigation is a method of delivering water drop by drop to the roots of crops. Drip irrigation was invented by Israeli expert Simcha Blass. In this method, water is delivered through a network of polythene tubes. Drip irrigation is an efficient method of using water. This method reduces evaporation and does not waste water. Drip irrigation is a good method for arid and drought-prone areas.

5. Low-Flow Fixtures

Low-flow fixtures are plumbing fixtures that use less water than traditional fixtures, which can help conserve freshwater resources, save water and money, and reduce stress on water supplies. Low-flow - The use of high-pressure technology in faucets, showerheads, and toilets, along with advanced design, saves water. Low-flow fixtures are often easier to install than traditional fixtures.

6. Leak Detection Technology

Many technologies are used to detect leaks. These include imaging, drones, acoustic leak detectors, vacuum technology, network monitoring, software, etc. Modern technology makes it possible to detect leaks in plumbing systems early. Smart water meters and leak sensors can send alerts to homeowners or businesses when unusual water usage patterns are detected, helping to prevent water waste.

7. Sprinkler Irrigation

Sprinkler irrigation is a method in which water is carried through pipes to sprinkler nozzles and then sprayed into the air. It falls on the ground in the form of small water droplets. Drizzle irrigation is a method of delivering water like rain. Drizzle irrigation is suitable for uniform irrigation of small and large areas. It saves water and increases productivity.

8. Xeriscaping

Xeriscaping is a technique that selects drought-resistant plants and emphasizes local features such as slope, soil type, and native plant range. Xeriscaping can be an alternative to a variety of traditional gardening practices. Xeriscaping involves planting plants that are native and more drought-resistant.

9. Wastewater Treatment and Reuse

Wastewater treatment is the process of removing contaminants from wastewater and reusing it. Treating and disposing of wastewater improves the health of citizens and protects the environment. The wastewater flows through a grit chamber, where cinders, sand and small stones settle to the bottom. The wastewater is treated and disposed of. The wastewater is recycled and greywater is produced from it. Greywater is used for flushing toilets, in washing machines, for gardens. The treated wastewater is used to recharge surface water and groundwater.

10. Water Conservation Apps

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There are many apps available to save water. With these apps, you can track your water usage and get tips to save water. Some of the apps available for water conservation are: water-app Drop Counter, Water Time App, Net Water, Jal Shakti Abhiyan. Technology has also enabled the development of apps and platforms that help individuals and businesses find ways to reduce their water consumption. Education and awareness campaigns play a key role in promoting water conservation practices.

11. Educational information and Water Conservation Schemes

Teaching through interactive workshops and demonstrations, organizing storytelling sessions revolving around water conservation themes, organizing water conservation competitions and campaigns, involving parents, and local communities in water conservation activities, etc. are effective ways to engage children and put the concept of water conservation into practice. Apart from this, children need to be aware of various government schemes for water conservation such as 1. Jal Shakti Abhiyan 2. Atal Bhujal Yojana 3. National Water Mission 4. World Wildlife Fund (WWF) water conservation campaigns 5. United Nations (UN) water conservation initiatives etc.

Conclusion

1. Traditional and modern water conservation systems are important in addressing water scarcity, water crises, atmospheric changes, and climate change.
2. Traditional water conservation systems are easy to construct and operate, cost-effective, community-based, environmentally safe, and long-lasting.
3. Modern water conservation systems use technology to maximize resource utilization and increase water management efficiency.
4. Along with traditional and modern water conservation methods, it is necessary to adopt some water conservation methods of the changing times, such as water reuse and redistribution, water pollution control, population control, use of improved irrigation methods, increase in forest area, change in agricultural practices, reuse of wastewater, regeneration of traditional water sources, flood management and industrial water management, etc.

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