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Evolution of Water Resource Management in India: From Ancient to Contemporary Times

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***Abstract*-- Water serves as the foundation of our existence; our survival is dependent upon water. If we neglect this sector, future generations will encounter numerous challenges related to water. The act of conserving water is crucial for our existence. In India, a variety of techniques are employed to conserve water, which are both practical and responsive to the climatic conditions. From the era of the Indus Valley civilization to the present day, numerous practices have been observed across different regions of India. Effective management of water resources is imperative. At the same time, India is a nation where approximately half of the population resides in rural areas. As contemporary methods of water conservation prove inadequate to meet the needs of the populace, several traditional practices continue to be utilized to address water crises. In this paper, an attempt has been made to explore water resource management in India from a historical perspective, referencing methods of water management during ancient, medieval, and colonial periods, while also examining current practices and the distinctions that exist between them.**

***Keywords*-- ancient era, pre-colonial, colonial, and post-independence, water management, dams, Lothal, canal colonies, groundwater, Baolis and Khadins.**

I. INTRODUCTION

Water has consistently been a fundamental element for human survival throughout various civilizations over the centuries [1]. Rivers and lakes act as essential channels, transforming landscapes and supporting diverse ecosystems. Nevertheless, increasing pollution [2], excessive extraction, climate change, and other factors present significant challenges to the quality and quantity of surface water [3]. Groundwater, found in permeable rock formations known as aquifers, plays a crucial role in water supplies [4]. It is noticed that the number of regions depend heavily on groundwater for agricultural irrigation [5] and drinking water. Consequently, sustainable water management practices are vital to prevent the depletion and contamination of these underground reservoirs [6] The availability of freshwater resources is closely linked to climatic conditions.

Variations in precipitation, temperature, and extreme weather phenomena influence the distribution and volume of water [7]. As the global population expands, effective management of water resources becomes increasingly critical to satisfy the growing demands for food, energy, and sanitation [8].

Water conservation encompasses a range of policies, strategies, and techniques aimed at sustainably managing natural water sources, safeguarding the hydrosphere, and fulfilling both current and future water supply needs for humanity. Its effectiveness relies on various factors, including population size, pollution levels, climate change, and the efficiency of human usage. India is recognized for its extensive history of human involvement in water management, attributed to its unique climatic dichotomy of intense monsoons followed by extended periods of drought [9] Moreover, rainfall is limited to a few months each year, and it is often unpredictable, erratic, and uneven. Historically, Indian agriculture has been significantly reliant on various forms of irrigation. This reliance has prompted individuals and successive ruling powers, from pre-colonial to colonial and post-colonial eras, to make decisions across different regions and times, utilizing a diverse array of water control and distribution technologies.

The significance of water in ancient and medieval India is evident in numerous sources, particularly in epigraphical records [10].

This review paper seeks to elucidate how water management has been influenced by both cooperation and conflict throughout India's historical trajectory. Water is intertwined with cultural and spiritual significance, in addition to its economic value. This duality of the sacred and the profane complicates its management, as various stakeholders and parties with differing aspirations are involved. Water management in India has been influenced by socio-economic, political, and ecological factors, and water management policies among different social groups are hence different.

India's water management system of the ancient era, pre-colonial, colonial, and post-independence periods is discussed in this paper, leading up to the present circumstances.

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II. Objectives

1. This paper examines historical planning and water supply systems from ancient eras to contemporary times, with an aim for the future.
2. The paper also investigates the awareness and advancements in India concerning water management from ancient to modern times.
3. To analyze the evolution of water management.
4. Evaluate the effects of different approaches concerning water management.
5. To understand the interplay of social, economic, and political factors in water management

III. Water Management In Ancient India

Water management in ancient India was achieved through the construction of wells, dams, canals, and specialized irrigation systems [10] The Harappan civilization (3000-1500 BCE) is recognized for having one of the most advanced systems of its time. The Harappans demonstrated a keen awareness of seasonal rainfall, flooding, and drainage systems. It can be concluded that they possessed significant knowledge and understanding of water management and the conservation of natural resources. Harappan farmers regularly utilized Gabarbands and canals for managing water for the irrigation of agricultural lands during dry seasons.

Dholavira and Mohenjo-Daro, the two principal cities, serve as prime examples of water management within the Harappan civilization. In Dholavira, the artificial ponds exemplify effective water conservation practices. The inhabitants of Dholavira sourced water from two seasonal rivers named Mansar and Manhar. To manage the increased water levels in these rivers during the rainy season, the citizens constructed a dam to redirect this water into walls and ponds via canals, creating an artificial pond, which was essential for their survival and prosperity. A pond measuring 263 feet in length, 39 feet in width, and 24 feet in depth has been discovered in Dholavira. Additionally, a drinkable well with a diameter of 4–25 meters was also found. In Mohenjo-Daro, nearly 700 walls were uncovered, showcasing the extensive water management practices of the Harappan civilization.

Lothal is also renowned for its water management techniques. The water management system in Lothal is referred to as the "terrakkal culture." They implemented canals for irrigation and established water purification plants for drinking water.

In Lothal, one can observe a modern interpretation of water management, including practices such as water conservation, water harvesting, and groundwater sustainability.

The Mauryan Empire (approximately 322-185 BCE) is recognized as the first civilization to construct dams. They possessed knowledge of measuring water balance, rainfall, a water pricing system, and various water management techniques. During the Mauryan period, there existed a dedicated department responsible for the supervision, construction, and maintenance of a sophisticated irrigation system that included wells, canals, lakes, and tanks. According to the Arthashastra, penalties were established for obstructing or diverting a watercourse, causing flooding in fields, constructing a well or dam on another person's land, neglecting waterworks, or failing to assist in the construction of an irrigation tank. Water pricing was also a significant aspect of water management during the Mauryan era. Kautilya's classification method for rainfall in relation to the annual average quantity is commendable, as the methodology outlined in the Arthashastra aligns with contemporary practices.

Examples of the regionally diverse and rich history of water conservation in the area include the Baolis and Khadins of Rajasthan, the Ahar Pynes of Bihar, the Zing in Ladakh, the Zabo of Nagaland, the Kuhls in Himachal, and the Panam Keni in Wayanad. The Ahar-Pyne system serves as an exemplary model of rainwater harvesting from the Mauryan period. An archaeological survey conducted by the Archaeological Survey of India between 1951 and 1955 uncovered a canal measuring 45 feet in width, 10 feet in depth, and 450 feet in length, which is believed to date back to the Mauryan era. Chandragupta Maurya, a ruler of the Mauryan Empire, constructed the Sudarsana Dam in Girnar, Gujarat. Numerous dams and canals were built during the Mauryan Empire for drinking water and irrigation purposes.

During the period of the Atharvaveda, people were also acquainted with concepts such as water evaporation, condensation, river flow, and rainfall storage. The movement of water and the concept of infiltration were integral to Vedic society in ancient India.

The Brihatsanhita (circa 550 AD) discusses the development of groundwater and the enhancement of water quality. The Rigveda mentions the construction of artificial canals, referred to as 'Kulya.'

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We can quote the regionally diverse and rich history of water conservation systems as Baolis and Khadins of Rajasthan. It was the Ahar Pynes in Bihar. It also includes the Zing in Ladakh, the Zabo of Nagaland, the Kuhls in Himachal. The water conservation system is known as Panam Keni in Wayanad. The Ahar-Pyne system serves as an exemplary model of rainwater harvesting from the Mauryan period. An archaeological survey conducted by the Archaeological Survey of India between 1951 and 1955 uncovered a canal measuring 45 feet in width, 10 feet in depth, and 450 feet in length, which is believed to date back to the Mauryan era. Chandragupta Maurya, a ruler of the Mauryan Empire, contributed to the management of water by constructing the Sudarsana Dam in Girnar, Gujarat. A lot of dams and canals were built during the Mauryan Empire, which was used for drinking water and irrigation purposes. At the time of the Atharvaveda, individuals possessed an understanding of water evaporation, condensation, river flow, and the storage of rainfall. It is also point out to be hare that the movement of water and the concept of infiltration were also integral to Vedic society in ancient India. The Brihatsanhita (circa 550 AD) discusses the development of groundwater and the enhancement of water quality. The Rigveda refers to the creation of man-made canals, known as 'Kulya.'

The most unassuming yet arguably the most significant water structure was the village pond or reservoir. Its importance stemmed not only from its capacity to replenish groundwater but also from its connection to numerous neighbouring ponds—sometimes forming networks that spanned hundreds of kilometers, as seen in Karnataka and Tamil Nadu.

These networks allowed water-abundant regions to support those who were less fortunate, and they were managed by village committees, which vanished when the colonial government took control, taking with them most of the reservoirs and channels they oversaw. Although government initiatives aimed at revitalizing these systems have yielded mixed results, many individuals and organizations have engaged in these efforts, often facing challenges from land speculators or sheer indifference.

IV. Water Management In The Medieval Period

During the medieval period, people frequently encountered both drought and flood, leading them to create ponds for rainwater harvesting and to utilize excess water from rivers during heavy rainfall and flooding. This stored water was later used during times of drought. In this era, agriculture expanded significantly alongside the development of new water resources. The Tughlaq dynasty was the pioneer in establishing canal irrigation. it is mentioned in the book "Tarikh-i-FirozShahi," written by Barani, Ghiasuddin. Subsequently, Firoz Tughlaq built numerous canals, including the Rajabwahi and UlugKhani canals for the Hisar region. Mughal Empero Shah Jahan, in his tenure 1628-1653 CE, also constructed many canals called as the Nahar-i-bihist. The Mughals developed a complex system for water conservation, including the construction of canals in various locations, where water flowed from tunnels into open tanks. Baolis were also constructed to conserve water in arid or semi-arid regions, with the Chand Baoli in Jaipur, Rajasthan, being a prominent example. Numerous baolis were built to address the recurring issues of drought and famine, such as the Red Fort Baoli, Hazrat Nizamuddin Baoli, Agrasen ki Baoli, Delhi Raja kiBaoli, and Gandhakki Baoli. Later, kings from the Chola dynasty also constructed large-scale tanks; for instance, the Cholagangam was built by Rajendra Chola (1014-1044 CE) in his capital, Gangaikonda Cholapuram. A Portuguese traveler, Domingo Paes, also noted a large tank in Vijayanagar constructed by Krishnadeva Raya. Fryer described the Dhenkli, which was utilized when the water level was close to the surface[11]. In the Deccan region, small canals originating from rivers served towns and villages, benefiting agricultural practices and likely managed according to the Phad system[12]. An individual was appointed to supervise the canal as a superintendent (Mir-i-ad) in Multan.

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V. Water Management In The British Period

The British ruler introduced government control over the surface water of the country. The British engaged in deforestation of extensive areas to obtain coal and timber, as well as to enhance agricultural output, resulting in a lack of water and a decline in underground water levels. Colonial legislation established a division of responsibilities between the central and state governments concerning water management. In British India, they took the initiative to renovate, improve, and expansions of existing waterworks to make the water management more effective. It may be cited as Upper Ganga Canal, Upper Bari Doab Canal, Betwa Canal, Nira Left Bank Canal, Gokak Canal, and Rushkulya Canal as important irrigation projects initiated during the British rule. To achieve rapid economic benefits from water development, the colonial government attempted large-scale irrigation projects in the Deccan region, which ultimately proved unsuccessful. This initial failure prompted the British Raj to consider rehabilitating the traditional irrigation tank system. However, efforts to revive this traditional system were largely unsuccessful due to a lack of understanding of the intricate social structures involved in its management. One notable effort was the revival of the Kudimaramat system (the term Kudimaramat is a combination of the Tamil word 'kuti,' meaning 'inhabitant' or 'subject,' and the Arabic word 'maramat,' meaning 'repairs' [13]. The traditional irrigation method followed by constructing embankments along flood-prone rivers which was served as both irrigation and flood protection purposes in Bengal during British rule. Peasants in need of water for irrigation would breach the embankments to divert water, a practice referred to as 'overflow irrigation' by [14]. In the drier regions of the Upper Ganges, colonial engineers initiated the extensive construction of a new canal network, which later became the primary mode of development [15]. The British Raj primarily focused on what is called 'productive' irrigation initiatives involving canals that had the potential to generate yearly revenues adequate to meet the interest on their capital expenditures. [15].

One of the most notable instances of the colonial irrigation policy is represented by the Punjab 'canal colonies,' as these areas were referred to, which were cultivated through a network of interconnected irrigation canals. In the 1880s, colonial engineers initiated the construction of a series of these canals in Western Punjab, transforming approximately 14 million acres of previously arid land into agricultural colonies and settlements [16].

In order to improve water development for irrigation purposes, the colonial administration recognized the upper river valleys of South India and the Deccan as suitable locations for large and medium canal projects, while smaller surface systems, such as tanks and mechanized groundwater development, were designed for upland areas. [17]. The last two decades before India's independence was characterized by economic downturns, the impending conclusion of the colonial empire, and the impact of World War II and jointly led to a slowdown of irrigation development in colonial India. It was during the colonial period that India emerged as a leader in the application of modern engineering science in the design of extensive and diverse irrigation infrastructures. The modern era of large dam construction can be traced back to nineteenth-century India [18] and it was only during the colonial period that India began to experience its identity as a hydraulic society, albeit with significant centralized bureaucratic oversight on water development and management. The partition that accompanied India's independence ushered in new approaches to water management and strategies for irrigation.

VI. Scenario Of Water Management In India After Independence

The primary objective of the Government of India following independence was to expedite development and tackle the regional investment disparities, as the nation was confronted with a significant shortage of food grains and a rapidly growing population. The sluggish advancement of irrigation during the final decades of colonial rule had further exacerbated the existing food scarcity issues. In contrast to the run-of-the-river irrigation systems utilized during colonial India, the extensive irrigation projects were intended for multiple purposes and depended on reservoirs.

In the early years after independence, there was a sense of pride in initiating extensive new projects, with large dams being regarded as 'modern temples of modern India,' reflecting the vision of Pundit Jawaharlal Nehru, the first Prime Minister of Independent India. Driven by a commitment to swift social advancement, these expansive multi-purpose irrigation initiatives were celebrated as a source of national pride in the initial post-independence period. Over 90 percent of public funding for agriculture was directed towards large-scale projects in the first four decades following independence [19].

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However, these 'temples of modern India' were flawed in three significant ways: a) Firstly, the construction of large projects in various locations resulted in considerable delays in project completion due to budgetary limitations [20]. b) Secondly, these initiatives did not adequately consider the complex topographical and environmental conditions that rendered canal construction and expansion unfeasible in regions such as the eastern floodplains and the Deccan [21]. c) Ultimately, the colonial laws that conferred significant authority upon the government and the Irrigation Department (ID) remained in effect across all facets of surface water development and management, thereby effectively denying water users their rights.

The Government of India initiated the Command Area Development Programme (CADP) in the years 1974-75, intending to enhance water management in command areas. However, this initiative failed to address the crucial aspect of system design and management practices [17]. The water management strategies in Independent India can be categorized into two main areas: small-scale community-based management and the groundwater revolution, both of which will be elaborated upon in the subsequent sections.

In the early 1990s, India recognized Participatory Irrigation Management (PIM) through Irrigation Management Transfer (IMT) to farmers as the most effective approach for optimizing irrigation water use, ensuring equitable distribution, and promoting sustainable irrigation [20]. Moreover, concerning community involvement in irrigation management, the Government of India introduced the National Water Policy (NWP) in 1987, which highlighted the importance of farmer participation in managing irrigation systems in water distribution and the collection of water charges [22]. The National Water Policy (NWP) of 2002 further stresses a participatory approach to water management, advocating for collaboration among various governmental agencies and stakeholders, including the involvement of women in the management of water resource schemes.

The period following independence has seen a considerable increase in irrigated regions due to extensive surface systems overseen by the government. Conversely, small community-managed water surface systems have experienced a decline, attributed to insufficient public investment and government efforts to enhance its legal and administrative control over these systems.

To mitigate the over-exploitation of groundwater resources, the Government of India formulated a Model Bill in 1970, intended for adoption by State Governments to regulate groundwater usage.

While the responsibility for water management lies primarily with the State Government, as stipulated by the constitutional provisions of India, it is categorized as a State subject .

The water crisis in India presents a multifaceted challenge, influenced by various factors such as rapid urbanization, industrialization, unsustainable agricultural practices, and the escalating demand for water. Additionally, climate change and alterations in rainfall patterns are impacting water sources, making effective water management a pressing concern in today's world. Sustainable water management is a viable solution to the water crisis, as the scarcity of clean drinking water adversely affects community health, particularly in rural regions, with significant repercussions for human well-being.

Uncontrolled urbanization, along with concrete and other infrastructure developments, hinders the natural absorption of rainwater into the ground. As per the 2016-17 groundwater yearbook published by the Indian government, Delhi utilizes 390 million cubic meters of groundwater each year, representing a 25% increase over the natural replenishment rate of 310 million cubic meters.

VII. Conclusion

The management of water resources in India has proven to be a multifaceted and controversial matter, influenced by a range of socio-economic, political, and ecological elements. Elements such as caste and class disparities, the diversity among farmers, the rural-urban divide, and significantly varying ecological conditions have all played a role in shaping water management practices.

This paper investigates the awareness and advancements in India concerning water management. By referencing ancient literature and evidence from the Harappan civilization to the colonial era, it is evident that ancient India, particularly during the Harappan civilization, exhibited effective irrigation and water conservation practices. They constructed canals and ponds for water storage to support agriculture. Throughout the Mauryan Empire, there was a rigorous enforcement of water regulations, accompanied by penalties for any infractions.

In the medieval period, water was regarded as a vital resource. The projects implemented during that time are appreciated today for their effectiveness in addressing water scarcity. It is clear that there was an understanding of water management, suggesting that we can learn from ancient practices and revitalize them.

Conventional water management methods, including Kulyas in Himachal Pradesh, Kuhals in Jammu & Kashmir, Kattas in Karnataka, Surgams in Kerala, and Ahar-pyns in Uttar Pradesh, Madhya Pradesh, and Bihar, are still in use today.

It is not entirely unjust to suggest that environmental conservation was somewhat overlooked during the colonial period, where minimal attention was given to the preservation of natural resources. Nevertheless, steps were taken towards improving water management and promoting sustainable water development. A significant number of canals and dams were constructed during British rule, many of which remain operational today.

Traditional water systems may offer benefits over modern methods, such as longer durability, reduced energy requirements, and greater reliability. For instance, qanats operate without the need for power, as they transport water through gravity without requiring pumps. India's traditional approach to water management offers solutions to the contemporary water challenges and crises faced by the nation. With its geographical diversity, India has historically had various systems of water management tailored to the specific climates of its regions. It is essential to rejuvenate these ancient water conservation methods in today's context, applying a modern perspective.

REFERENCES

[1] Yevjevich, V. (1992). Water and civilization. Water International, 17(45), 163-171.

[2] Chadetrik, R., & Kumar, B. U. (2015). Assessment of water quality parameters using multivariate chemometric analysis for Markanda river, India. International Research Journal of Environment Sciences, 4(12), 42-48.

[3] Akhtar, N., SyakirIshak, M. I., Bhawani, S. A., & Umar, K. (2021). Various natural and anthropogenic factors responsible for water quality degradation: A review. Water, 13(19), 2660.

[4] Younger, P. L. (2009). Groundwater in the environment: an introduction. John Wiley & Sons.

[5] Garrido, A., Martínez-Santos, P., & Llamas, M. R. (2006). Groundwater irrigation and its implications for water policy in semiarid countries: the Spanish experience. Hydrogeology Journal, 14, 340-349.

[6] Bouwer, H. (2002). Integrated water management for the 21st century: problems and solutions. Journal of Irrigation and Drainage Engineering, 128(4), 193-202.

[7] Trenberth, K. E. (2011). Changes in precipitation with climate change. Climate Research, 47(1-2), 123-138.

[8] Cosgrove, W. J., & Loucks, D. P. (2015). Water management: Current and future challenges and research directions. Water Resources Research, 51(6), 4823-4839.

[9] Naz, Farhat; Subramanian, Saravanan V. (2010) : Water management across space and time in India, ZEF Working Paper Series, No. 61, University of Bonn, Center for Development Research (ZEF), Bonn

[10] Kulkarni, R. P. (1999). Irrigation in Ancient and Medieval India (As Revealed From Inscriptions).Mumbaj: Directorate of Archaeology and Museums.

[11] Habib, Irfan. 1970. 'Presidential Address (Medieval India)' in Indian History Congress: Proceedings of the Thirty–First Session, Varanasi 1969. Patna: Indian History Association

[12] Pandit,S.(2010). Water Management System At Kanheri.Journal of the Asiatic Society of Mumbai., 27-45

[13] Mosse, David. 1997. 'The Symbolic Making of Common Property Resources: History, Ecology

[14] Willcocks, W. 1984. Ancient System of Irrigation in Bengal. Delhi: B.R. Publishing Corporation.

[15] Stone, Ian. 1984. Canal Irrigation in British India: Perspectives on Technological Change in a Peasant Economy. Cambridge: Cambridge University Press

[16] Gilmartin, David. 1995. 'Models of the Hydraulic Environment: Colonial Irrigation, State Power and Community in the Indus Basin' in David Arnold and Ramachandra Guha (eds) Nature, Culture, Imperialism: Essays on the Environmental History of South Asia. New Delhi: Oxford University Press, 210-236

[17] Bottrall, Anthony. 1992. 'Fits and Misfits over Time and Space: Technologies and Institutions of Water Development for South Asian Agriculture' in Contemporary South Asia 1 (2): 227-247.

[18] Postel, Sandra. 1999. Pillar of Sand: Can The Irrigation Miracle Last? New York: W.W. Norton and Company.

[19] Kishore, Avinash. 2002. Social Impact of Canal Irrigation: A Review of 30 Years of Research. Paper Presented at First Annual Partners' Meet of the IWMI-TATA Water Policy Research Program, Anand, Gujarat.

[20] Swain, Mamata and Deepak Kumar Das. 2008. 'Participatory Irrigation Management in India: Implementations and Gap' in Journal of Developments in Sustainable Agriculture (3): 28-39.

[21] Hanson, A.H. 1966. The Process of Planning—A Study of India's Five Year Plans 1950-1964. Oxford: Oxford University Press.

[22] Randhawa, V.S and P.B.S. Sharma. (eds). 1997. National Water Policy 1987. New Delhi: National Academy of Agricultural Sciences.