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CHAPTER 9

Traditional Water Conservation Techniques in Indo-Gangetic Plains of India

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Abstract

Water, an indispensable natural resource, is crucial for the survival of living beings. However, both surface and groundwater supplies are diminishing at a concerning pace due to the incessant demand driven by various developmental activities, such as agriculture and industry. The crisis of water scarcity is becoming a growing problem affecting numerous regions around the world, including India. This challenge of water shortage could be tackled through conservation efforts and strategic planning. There are numerous methods for managing water, including rainwater harvesting, traditional water conservation practices etc. From the era of the Indus Valley civilization to the present, many techniques have been observed across different regions of India. Traditional methods for water preservation and cooling buildings were prominent in ancient times. Forts were constructed near water bodies for safeguarding against adversaries. Some distinctive water conservation methods are still in use in India and prove to be

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effective. In fact, these practices often surpass contemporary water-saving methodologies. The chapter covers need for water preservation methods and a brief outline on the prevalent conventional techniques in Indo-Gangetic plains.

Keywords: Water preservation, traditional methods, storage, Indo-Gangetic Plains

Introduction

Water, a vital natural resource, is an essential requirement for the survival of the living creatures. Water covers over 71% of the Earth's surface, with the seas containing approximately 96.5 percent of all water on the planet. While freshwater accounts for only 2.5% of Earth's water, it meets the majority of life's requirements (Shiklomanov, 1993). Nonetheless, surface and groundwater resources are depleting at an alarming rate as a result of the constant demand for them brought on by different developmental activities including agriculture, industry etc. Water shortages are an escalating issue impacting numerous locations globally, including India (Moglia, Cook, & Tapsuwan, 2018). More than 40% of the global population currently experiences water scarcity, a figure anticipated to increase in the forthcoming years (Msweli, et al., 2025).

India, a country in South Eastern Asia, has a varying agro-ecology, climate and physiography. This variation in the climatic conditions affects the rainfall and water resources throughout the country (Pani, Ghatak, & Mishra, 2021). India is the second most populous country in the world, and its rapidly expanding middle class is driving up the need for safe, clean water. A World Bank figures illustrate the dire situation the nation is in such as lack of access to better sanitation and safe drinking water. Severe contamination of the Indian rivers along with the dependence on seasonal rains that are frequently scarce in certain years, while bountiful in others, only contributes to the human burden. Unpredictable weather patterns tend to be one of the many causes for agricultural failures and farmer suicides (Msweli, et al., 2025). Thus, effective management is crucial to preserving the water environment and supplying the future's growing water demand (Ramappa, Reddy, & Patil, 2014).

It is important to highlight that there exists a significant temporal and geographical variance within the country in terms of availability of water. For example, the Ganga-Meghna-Brahmaputra basin spans 33% of India's geographical area and contributes to 60% of the country's water resources, whereas the catchment of rivers flowing west is 3% which accounts for 11% of the nation ’s water resources (Islam, Islam, & Hassan, 2017). The lush Indo-Gangetic Plain, often referred to as the Northern Plain or North Indian River Plain, covers 700,000 km^2 (270,000 sq mi) in the northern and northeastern regions of the Indian subcontinent. Although the Indo-Gangetic Plains are well-known for their flat terrain, rich soil, sufficient drinkable surface ground water, and suitable climate, in recent years they have been facing huge water shortages due to the increasing demands of the expanding urban population and extensive agriculture use (Raju, et al., 2024; Singh & Sontakke, 2002). According to the data collected from 2002 to 2008, the Gangetic Alluvial Plains groundwater loss rate was 54 ± 9 km^3/yr. By 2025, the resulting groundwater supply in alluvial aquifers is predicted to be reduced by as much as 25 to 50% (Raju, et al., 2024).

The issue of water scarcity may be resolved through water conservation and careful planning. There are several approaches to water management, including rainwater harvesting, drip irrigation, forest restoration, waste water treatment facilities and water conservation (Kumar, 2019). India has excellent examples of traditional water preserving methods, such as sand bores, katas, johads, bamboo drip irrigation systems etc. Prominent urban practices that were formerly employed include water wheel technology, rainwater syringe, cycle operated water pumps, and roof type rainwater gathering (Verma, 2022). These conventional methods were more than simply a technique for harvesting water; they were an integral part of the people's culture and were deeply ingrained in the socio-cultural reforms. The main benefits of traditional techniques are that they are simple, inexpensive, reproducible, sustainable, highly adaptive and efficient (Joji & Jacob, 2023).

Some Traditional Water Conservation Methods in the Indo-Gangetic Plains

1. Historical Overview

Throughout history, numerous locales have created approaches that are specific to their climate, such as stepwells in dry Gujarat or tanks in Tamil Nadu and zingers in the Himalayas. These systems were not only utilitarian, but also closely related to cultural, religious, and social behaviors. India's earliest known water conservation systems date back to the Indus Valley Civilization around 3000 BCE. Archeological excavations have uncovered water drainage systems, a network of brick-lined wells, public baths (such as the Great Bath of Mohenjo-Daro), large water reservoir at Dholavira and small bunds at Lothal and Inamgaon.

Although archaeological evidence of conservation establishments from Vedic period is limited, literature references indicate an early grasp of the hydrological cycle, including rainfall, evaporation, and groundwater recharge. The Arthashastra, written by Chanakya, describes state-controlled irrigation infrastructure including dams, bunds and canals, indicating the understanding among folks about water as a resource to be managed. Small scale constructs such as tanks and ponds for preserving rainwater were predominated at this time. In desert areas such as Rajasthan and Gujarat, stepwells had become well-known. One such buildings which served as water reservoirs in the 11th century was Rani ki Vav in Patan. The Chola empire built a vast irrigation system in Tamil Nadu that included eris and canals. An example of ancient architecture for water conservation is the Grand Anicut, which the Cholas constructed on the Kaveri River (Venkatraman, 1985; Agarwal, 1997; Singh & Upadhyay, 2025).

2. Types Of Traditional Water Conservation Methods

2.1. Ahar-Pynes

The Ahar-pyne water supply system, a traditional method indigenous to the Indian plains of South Bihar, is based on a profound comprehension of the distinct agroclimatic features of the area. Bihar's Ahar-Pyne irrigation system may have been in existence during the Jataka period. It is predominantly found in the alluvial plain, uplands, sloping surfaces as well as in regions with a mixture of quaternary alluvial deposits along with granite gneiss. The Ahar, popularly known as Surajkund, in Nalanda District, is a rectangular embankment used for water harvesting, with three sides creating a catchment basin while the fourth

following the natural incline of the ground. The primary components of the system are the embanked catchment basin and canals. Ahar beds are used to grow Rabi (winter) crops after surplus water from the Kharif (summer) cropping is drained. Unlike the conventional tanks, ahars donot have excavated beds but feature an elevated embankment. Moreover, any surplus water can be discharged into aa minor brook. An ahar could irrigate more than 400 hectares of land. The two main sources of water for ahars are rainfed ahars and through man – made channels called pynes, which redirect water from rivers to agricultural areas. Pynes are engineered canals built to use river water in agricultural lands. From the river, pynes flow across fields before arriving at an ahar. The majority of pynes are no longer than 20 km and run within 10 km of a river. The AharPyne system served as a flood control technique by controlling heavy floodwater in alongside irrigating agricultural lands. Ahars and pynes transport water during the rainy season (July-September). This innovative technique allows for paddy production in South Bihar, which was previously unsuited for the crop (Dhiman & Gupta, Rainwater Harvesting and Artificial Recharge., 2011; Singh S. , 2012; Joji & Jacob, 2023).

2.2. Bengal's Inundation Channels

Inundation pathways primarily occur within the floodplains of Bengal. Historically, Bengal had a remarkable network of flood channels with distinct features. According to a British irrigation specialist, Sir William Willcocks, the inundation canals were quite popular in the region until around two centuries ago. The overflow irrigation technique, which was extremely prevalent in Bengal, utilized the monsoon rains and the copious amounts of water from the Ganges and Damodar floods. As stated by Willcocks, the key characteristics of the irrigation framework were:

- Shallow and wide structured canals
- These canals carried crest waters from river floods, abundant in fine clay and devoid of coarse sand.
- The canals extended extensively and continuously, parallelly aligning with one another and spaced appropriately for irrigation needs.
- Irrigation was carried out through canal bank cuts, which were sealed off once the floods subsided.

The inundation canals allowed floodwater to infiltrate the fields, bringing with it rich silt and fish that could swim through the canals into the lakes and tanks to eat mosquito larvae. This reduced the prevalence of malaria in this area. This regulated system of water preservation besides preventing malaria, also improved the soil, and guaranteed a water supply for each cultivating land (Joji & Jacob, 2023; Hazarika, A Comprehensive Review of Traditional and Modern Soil and Water Conservation Practices, 2023).

2.3. Baolis

Baolis, also known as step wells, baoris or vavs, are subterranean structures associated with water. Baolis are exclusively found in India, mostly in Gujarat, Rajasthan, and Delhi. These can be located in the floodplain of the Yamuna, the alluvial plain and the Delhi Ridge. These exquisite structures have played a

crucial role in water conservation especially in drought-prone areas. Baolis are characterized by a pond in front, a round well at the base and staircases that slope downward across multiple levels from the surface. In addition to the storied halls and rooms, baolis usually consisted of two separate sections: a rectangular tank in front and a circular well that extended deep below to the water table. The frontal reservoir was primarily utilized for bathing, washing and irrigating crops, while the well held potable water and was occasionally emptied using a pulley system. These stepwells functioned as venues for social meetings and religious events. Travelers, pilgrims and nomads utilized the baolis with connected chambers as a refreshing haven during the summers. By the early 1800s, it is believed that a multitude of step-wells, showcasing diverse styles and contours, thrived across India. Famous baolis in India are: Gandak-ki-baoli, Rani Ki Vav in Gujarat, Agrasen Ki Baoli in Delhi, and Chand Baori in Rajasthan (Dey, 2019; Davies, 1989; Amirthalingam, 2015; Joji & Jacob, 2023).

2.4. Dighis

Dighis and Shahjahani canals are the outstanding examples of historical water preservation system in the states of Punjab and Delhi. A dighi was a circular or square shaped water storage structure measuring approximately 0.38m by 0.38m, equipped with stairways for accessibility. Each dighi has its own set of sluice gates. Bathing and washing clothes were prohibited in the dighis. Water was taken exclusively for personal use. Typically, residents would summon a kahar or a mashki to obtain water from the dighis. Most households featured smaller dighis or private wells on their premises. Wells served as the main water source when the canal waters did not reach the town and the dighis ran dry. Some significant dighis were: Pahar-wala Kuan adjacent to Gali-pahar-wali, Indara Kuan and Chah Rahat at Chhipiwara. In 1843, Shahjahanabad had 607 wells, with 52 containing sweet water (Joji & Jacob, 2023; Hazarika, A Comprehensive Review of Traditional and Modern Soil and Water Conservation Practices, 2023; Agarwal A. , 1997).

Conclusion

The technological innovations and human actions have led to environmental consequences within communities. It is therefore crucial for us to safeguard our rights to preserve water resources and the environment as a whole. Various nations are crafting policies for managing water resources, yet these initiatives are intricately linked to the age-old traditional wisdom that emphasizes the significance of a simple lifestyle. It is imperative for national, regional, and local authorities to honor, rehabilitate, and conserve water resources for the advancement of our society. Although Although conventional water preservation offers many benefits, it also has significant drawbacks. Some traditional methods of rain water harvesting are expensive. The expense of setting up a rainwater collection system varies significantly based on the scale of the system and the strategies employed, in addition to the high costs associated with construction methods and materials. Rainfall is difficult to anticipate, and subject to where we reside, we may receive very little or none at all. Therefore, depending exclusively on rainfall to meet the water requirements is not advised.

We ought to revisit and grasp the age-old wisdom and utilize it in our contemporary society to alleviate the current water scarcity issues. It is essential to explore both conventional and contemporary

techniques for conserving water and formulate strategies for optimal success. Merging these water systems can lead to economically viable solutions, enabling all segments of society to engage or contribute. We assert that to enhance the quality of life, the preservation of water is crucial, and in India, a combination of both age-old and contemporary methods should be employed to develop innovative conservation strategies. The progress made over time is vital for grasping how to address the errors and shortcomings of previous attempts.

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