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Reviving Stepwells: A Path towards Sustainable Water Harvesting in Bundi

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ABSTRACT: This study focuses on the deteriorating condition of stepwells in Bundi, Rajasthan, and proposes strategies to revive these traditional water harvesting structures. The availability of groundwater in the region has steadily decreased due to factors such as decreasing rainfall, excessive exploitation of groundwater, and changing consumer habits. The neglect of stepwells, once the primary source of water in Bundi, has led to their deterioration and potential destruction. The causes for their current state include unplanned urban expansion, the filling of natural water recharge channels, and a decline in average annual rainfall. To address these issues, various steps have been undertaken, including the identification of heritage sites and awareness campaigns for water conservation. Recommendations to revive stepwells include creating public awareness, unblocking water channels, improving water flow in lakes, implementing bans on tube well usage, reforesting the surrounding hills, and engaging NGOs, the archaeological department, and social organizations in the maintenance and revival efforts. By reviving traditional water harvesting methods, such as stepwells, the region can embrace sustainable development and secure its water resources for the future.

KEYWORDS: stepwells, water harvesting, sustainability

I. INTRODUCTION

Rajasthan, often referred to as the "Land of Kings," is a state in India known for its rich cultural heritage, magnificent palaces, and expansive arid deserts. Despite the challenging climatic conditions and limited water resources, the people of Rajasthan have developed ingenious and effective traditional methods of water harvesting that have sustained them for centuries. These age-old techniques not only cater to their water needs but also demonstrate their profound understanding of the environment and their ability to adapt to adverse circumstances.

Water scarcity is a pressing issue in Rajasthan, as the region receives an average annual rainfall of around 500mm, leading to arid conditions for most of the year. However, the resourceful water harvesting practices developed by the people of Rajasthan have enabled them to overcome these challenges.One prominent traditional method of water harvesting in Rajasthan is the construction of stepwells, locally known as baoris or bawadis. Stepwells are remarkable architectural structures that serve both functional and symbolic purposes throughout the state. These elaborate wells feature a series of steps that descend to the water level. They were ingeniously designed to collect rainwater during the monsoon season and store it for use during the arid months that follow. The stepwells in Rajasthan not only serve practical purposes but also showcase the architectural and engineering brilliance of the region.

Another widely practiced traditional method in Rajasthan involves the construction of small earthen dams or check dams across seasonal rivers or streams. These dams are constructed using locally available materials such as stone, mud, and clay. Strategically positioned, these check dams intercept rainwater runoff, allowing it to infiltrate the ground and recharge the aquifers. These check dams serve as vital water sources for irrigation, domestic use, and livestock watering. Moreover, they contribute to soil erosion control and help improve groundwater levels.

Rooftop rainwater harvesting is another traditional technique widely employed in Rajasthan. This method involves the collection of rainwater from rooftops, which is then channeled through a system of pipes and gutters into underground storage tanks. The stored rainwater is subsequently utilized for various purposes, including irrigation, drinking, and household use. Rooftop rainwater harvesting has proven to be highly effective in areas where surface water availability is limited.

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Additionally, traditional water harvesting techniques in Rajasthan encompass the creation of village ponds or "talabs" and the practice of "khadin" farming. Village ponds act as reservoirs, replenished by rainwater, and utilized for irrigation and livestock watering. Khadin farming involves the construction of small earthen embankments or bunds along the slopes of agricultural fields to capture rainwater and prevent soil erosion. The stored water gradually percolates into the soil, ensuring sustained agricultural productivity in arid regions.

The traditional methods of water harvesting in Rajasthan have withstood the test of time and continue to play a pivotal role in ensuring water security for the communities residing in this water-scarce region. These practices not only conserve water resources but also promote self-sufficiency and resilience among the people.

In conclusion, the traditional methods of water harvesting in Rajasthan have been developed and refined by the resourceful people of the region. Stepwells, check dams, rooftop rainwater harvesting, village ponds, and khadin farming are among the techniques that have sustained communities in the face of limited water resources. These practices provide immediate solutions to water scarcity while also contributing to environmental conservation and promoting sustainable development. Preserving and reviving these traditional methods is crucial for ensuring water security and addressing the challenges posed by Rajasthan's arid climate.

II. REVIEW OF LITERATURE

Here are a few notable researchers and scholars who have conducted research on traditional methods of water conservation. Environmentalist, and water conservationist, Anupam Mishra dedicated his life to studying and documenting traditional water management practices in India. He extensively researched ancient water harvesting techniques and wrote several books, including "Aaj Bhi Khare Hain Talaab" (Even Today, Ponds Are Relevant), highlighting the importance of traditional water conservation methods. Rajendra Singh, also known as the "Waterman of India," Rajendra Singh is an eminent water conservationist who has extensively studied and implemented traditional water management practices, particularly in the arid state of Rajasthan. His efforts in reviving traditional rainwater harvesting techniques and building community-based water conservation structures have garnered international recognition.

Dr.Labhsetwar is a scientist and researcher at the National Environmental Engineering Research Institute (NEERI) in India. He has conducted extensive research on traditional water harvesting systems, such as stepwells, and their effectiveness in water conservation. His work focuses on understanding the engineering aspects of traditional structures and finding ways to integrate them with modern water management practices. Dr. Sharad Kumar Jain is a renowned hydrologist and professor at the Indian Institute of Technology (IIT), Roorkee. His research primarily revolves around water resources management, including the study of traditional water harvesting techniques. Dr. Jain has conducted numerous studies on the effectiveness and sustainability of traditional water conservation methods in different regions of India.

Dr. Veena Joshi is an environmental scientist and researcher known for her work in the field of water management and conservation. She has extensively studied traditional water harvesting systems, such as rooftop rainwater harvesting and village ponds, and their potential for sustainable water resource development. Dr. Joshi's research focuses on the social, economic, and environmental aspects of traditional water management practices. Jetwal, Yadav and Jain have carried out their research on Stepwells of Bundi.

These researchers have made significant contributions to the understanding and promotion of traditional methods of water conservation. Their work has shed light on the importance of these age-old practices and their relevance in addressing contemporary water challenges. By studying and implementing these traditional techniques, their research has provided valuable insights into sustainable water management and the preservation of traditional knowledge for future generations.

III. OBJECTIVES

Some key objectives of this research include:

1. Documentation and Preservation: Research on traditional methods of water conservation seeks to document and preserve the knowledge, techniques, and cultural significance associated with these practices. By

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conducting comprehensive studies, researchers aim to safeguard traditional wisdom from being lost or forgotten over time.

2. Understanding Effectiveness and Adaptability: One objective is to evaluate the effectiveness of traditional water conservation methods in different geographic regions, climates, and socio-cultural contexts. Researchers aim to assess the adaptability of these techniques to modern-day challenges such as water scarcity, climate change, and population growth.

3. Enhancing Sustainability: Research aims to identify and promote sustainable water management practices embedded in traditional methods. This involves examining the ecological, social, and economic sustainability of these practices, assessing their long-term impact on water resources, and identifying ways to enhance their efficiency and resilience.

IV. STUDY AREA

The 25° 27' North latitude and 75° 39' East longitude pass through the city of Bundi. It is situated in a valley along a narrow gorge of the Aravalli Hills about 210 km. South of Jaipur, 36 km. East of Kota on the National Highway No.52.The climate of the area is moderate. Average annual temperatures are about 20°C. January is the coldest month with average temperatures of 24.5°C. May is the hottest month when temperature may go upto 46°C. Average annual rainfall is 628 mm of which 90% is during the Monsoon season. Phyllites, shales, slates and quartzites are the common rocks of the area. An alluvial mantle is superimposed on the older rocks in the river valleys. The rest of the area has thin alluvial soils. Natural vegetation comprises of Tropical Deciduous forests which are generally open. Hill slopes are fairly covered with Dhokra(Anogeissus Latifolia), Dhau(Anogeissus Pendula), Khair (Acacia Catechu)and Khejra(ProsposisSpicigera). Bundi forests abound in variety of wildlife and provide natural habitat to various animals, birds, and fishes. Agriculture is the main stay of the area with 67%of working population engaged in agriculture and allied activities. Bundi is the transport nodal centre of the district. It has a Broad-Gauge railway station and a State Roadways Bus Terminus. The Television Relay Centre of' Bundi has the tallest T.V. tower in the State. Being the district headquarter.

V. ANALYSIS

The availability of groundwater in Rajasthan is steadily declining, posing significant challenges to the sustenance of life. This decline can be attributed to several factors, including a decrease in average annual rainfall, excessive exploitation of groundwater, and overuse of water in various aspects of daily life. The changing consumer habits, increasing water demands for agriculture and industries, and the rise of nuclear families have all contributed to the worsening water availability situation. Furthermore, the process of modernization has exacerbated the crisis, as activities such as the use of washing machines, flushed toilets, automobile washing, and home gardening require substantial amounts of water compared to earlier times when water usage was lower.

Even the Hadauti region of Rajasthan, which experiences relatively high rainfall, has not been spared from water shortages. The city of Bundi, located in this region, faces similar challenges. Bundi's geological structure is distinctive, situated at the confluence of the Aravallis and the Vindhyans mountain ranges. The Aravallis are composed of marble schists, while the Vindhyans consist of ferruligineous limestone. The underground layers in Bundi comprise a combination of porous and non-porous, rocky strata, which hinders the recharge of groundwater.

Since its inception, Bundi has relied on stepwells as a primary source of water due to its steep sloping terrain, plateau ground, black clayey soil, and hard underground strata. The construction of these stepwells was primarily undertaken by the royal family or wealthy individuals known as "seths." These stepwells facilitated water recharge through two mechanisms. Firstly, rainwater collected directly in the stepwells as surface runoff, and secondly, the walled city featured a 40 feet wide and 30 feet deep trench surrounding its perimeter. This trench had a 10 feet high safety wall to prevent waste from being discarded inside. The water contained within the trench recharged the stepwells of Bundi.

Until 1956, the stepwells served as the sole source of water for the city. With 33 stepwells and 9 tanks, they fulfilled the water requirements of a population of 25,000. However, in 1959, the waterworks department introduced a tap connection scheme, diverting water from the stepwells at a cost of seven lakh rupees. This marked the beginning of

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neglect towards the stepwells. Following independence, rapid urbanization, the breakdown of the joint family system, and excessive reliance on the waterworks department led to the abandonment of the stepwells, pushing them to the brink of destruction.

Until 1975, the stepwells in Bundi were able to pump out 2000 gallons of water per hour. However, as the population rapidly increased, tubewells began to emerge as an alternative water source. Unfortunately, due to the filling of the trench by the previous district administration, these tubewells quickly dried up. As a result, the city had to rely on the Mangli River for its water supply. Initially, Bundi enjoyed 24-hour water supply, but by 1982, this was reduced to only 4 hours per day. The situation further deteriorated, and from 1998 onwards, the city's water supply was limited to just one hour per day. In 2004, water supply was available only every three days. Currently, the city of Bundi experiences a water supply of only 30 to 40 minutes per day.

Unfortunately, many of the once vital stepwells in Bundi have fallen into disrepair and have become dumping grounds for waste. Out of the original 21 remaining stepwells, 12 have been filled with garbage. Among the remaining 17, only 6 still provide potable water, while the other 4 have completely dried up.

Causes for the bad condition of stepwells:

The town witnessed uncontrolled growth due to the increasing population, resulting in the unplanned expansion of the urban area. Consequently, the natural pathways through which water could recharge the stepwells became obstructed.The construction of roads using cement concrete also played a role in impeding or minimizing the seepage of groundwater. The impermeable nature of the roads hindered the natural flow of water into the underground aquifers.

In 1982, the district administration made the decision to fill up the trench surrounding the walled section of the town in order to create a market. Unfortunately, this action resulted in the loss of the unique recharge mechanism that the stepwells relied upon.The decline in the average annual rainfall also contributed to the diminishing water levels within the stepwells. Over time, Bundi experienced a decrease in precipitation, with the average rainfall decreasing from 764mm in 1955 to 588 mm in 2019.

Moreover, the once lush hills surrounding the princely town of Bundi were once covered with dense vegetation. However, these hills have now transformed into barren and rocky landscapes. This transformation has led to a decline in annual rainfall and an increase in surface runoff, further exacerbating the water scarcity issue.

Steps undertaken to save Stepwells:

The renowned 'Raniji ki baori' in Bundi holds the prestigious status of being a world heritage site, while the 'Bhavldibaori' has been entrusted to INTAC (International Council on Monuments and Sites) for its preservation and enhancement. These initiatives aim to ensure the continued maintenance and restoration of these significant stepwells.In a remarkable display of collective action, a massive rally took place on January 13, 2006, with the objective of raising awareness among the public regarding the importance of water conservation and the protection of the stepwells. This event served as a catalyst for instilling a sense of responsibility and inspiring individuals to actively contribute to safeguarding these historical water structures.

The implementation of the Amrit Jalam scheme by Rajasthan Patrika, a leading newspaper in the region, garnered a positive response from the local community. As part of this initiative, the revival of the Chudaklion Ki Bavadi resulted in the restoration of clean and potable drinking water, a testament to the effectiveness of the scheme in revitalizing these crucial water sources. To this day, the revived Bavadi stands as a symbol of hope and serves as a reliable source of quality drinking water for the community.

These endeavors, including the preservation of world heritage sites, the organizing of awareness-raising events, and the implementation of effective schemes, reflect the collective determination to protect and revitalize traditional methods of water conservation. By valuing and investing in these invaluable resources, we can ensure a sustainable future for both the communities and the rich cultural heritage of Rajasthan.

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Suggestions to revive these stepwells

1. A key objective is to raise public awareness regarding the importance of conserving and replenishing step wells. This entails educating communities about the significance of these historical water structures and the need to actively participate in their preservation.

2. An essential step is to unblock the channels that lead to the step wells, allowing for natural recharging and seepage to occur unhindered. By removing obstructions, we can facilitate the replenishment of groundwater resources and ensure the long-term sustainability of these traditional water sources.

3. Enhancing the water flow in the Navlakha Sagar lake can significantly contribute to the recharging cycle of step wells. By improving the water supply to the lake, we can enhance the replenishment of underground aquifers, ensuring a continuous source of water for the step wells.

4. Implementing a mandatory ban on personal and commercial usage of water through tube wells is crucial. This measure aims to regulate and reduce excessive water consumption, protecting precious groundwater resources and directing them towards sustainable practices such as step wells.

5. The reforestation of the hills in Bundi holds great importance in controlling surface runoff and preserving water availability. By restoring the green cover on these hills, we can mitigate the loss of rainfall, minimize soil erosion, and facilitate the recharge of groundwater sources.

6. Collaboration among various stakeholders is vital for the maintenance and revival of step wells. NGOs, archaeological departments, wealthy individuals, and social organizations should step forward to adopt and support these cultural treasures. Through collective efforts, we can ensure the preservation and revitalization of step wells, safeguarding our heritage and promoting sustainable water management.

In conclusion, step wells were a remarkable testament to sustainability in their time. To realize the vision of sustainable development, it is imperative that we revive and uphold the traditional methods of water harvesting embodied by step wells. By raising awareness, restoring natural water channels, improving water flow, implementing regulations, reforesting hills, and fostering collaboration, we can ensure the continued availability of water resources and the preservation of our cultural heritage for future generations.

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