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ANALYZING THE EXISTING SCENARIO OF MAJOR TRADITIONAL WATER HARVESTING SYSTEMS

Anurag Chauhan
Department of Humanities, Graphic Era Hill University, Dehradun, Uttarakhand, India 248002

ABSTRACT

This is due to rising demand for water to meet demands in households, farms, and factories as the world's population grows. Because of faulty and inefficient water distribution networks, the situation has been deteriorating. It has been shown that RWH is a viable long-term solution to the problem of water scarcity at ground level. During the last two decades, India has suffered through a severe water shortage. India's location and topography make it a prime candidate for RWH development. The purpose of this research is to analyze the change in Joda, India's groundwater levels over the previous decade in order to determine the effect of using RWH procedures as an artificial recharge option for assessing the town's groundwater table (2009-19). The technical viability was determined by comparing the amount of water collected during the rainy and dry seasons with the amount of water used per family per month. The water system's intake and discharge were also tested for 16 different chemical, physical, and microbial characteristics.

KEYWORDS Rainwater, Harvesting, Water Resources Management, Groundwater

INTRODUCTION

Water is essential to our survival and the foundation of our daily lives. We use water in almost every aspect of our daily lives. Use of water includes its use for drinking, washing, cooking, irrigation, industry, hydropower production, and many more purposes. Rainfall is the primary source of freshwater use. Lakes, streams, ponds, wetlands, rivers, and aquifers are all natural places where rainwater may be collected and stored (aquifers). Most people get their drinking water from aquifers that are deep below. In areas where surface water is not readily available, groundwater must be used as the only water supply. Although extracting groundwater by pumping may address a wide range of water issues, relying too much on this solution might eventually lead to its overuse and abuse. The overexploitation of groundwater supplies threatens human health and the economy. Future dangers include a lower-than-expected water table, a drop in water quality, a hike in water costs, sinking soil, and more. India is one of the world's leading groundwater extractors, according to the 2015 UNESCO The State of the World's Water Report. Nevertheless, 54% of India's groundwater wells have decreased during the previous seven years, and 21 large cities are projected to run out of groundwater by 2020. The lengthy and constant increase in precipitation rates is evidence that global warming is having an unfavorable influence on precipitation. The southwest and northeast monsoons contribute significantly to India's yearly precipitation totals. The Indian monsoon is a highly changeable system that depends on a number of meteorological and marine variables.

Due to the growing failures of government-sponsored contemporary piped water systems, a variety of alternative techniques of water collecting, storage, and management have been tried out, typically by para-statal groups, including local communities in certain regions. Traditional water collecting technologies have received a lot of attention and effort (TWHS). Surface and/or rainfall harvesting systems have been in use for ages, as their name indicates. These systems were lauded as "excellent" because they helped recharge groundwater, fulfilled local demand for the resource, were long-lasting, and were compatible with environmental and social norms unique to the area.

LITERATURE REVIEW

Ranga Naga Satyanarayana Murthy et.al (2022) Water shortage is becoming an increasingly pressing problem in the contemporary setting owing to a number of factors, including unrestrained exploitation, water contamination, and unequal distribution of the resource. Water management takes on utmost importance in a nation like India, where the population is rapidly expanding yet water supplies are limited. This research delves into the history of India's water management practices and evaluates whether or not they may still be useful now. The traditional methods of water management are recorded and studied here. The effectiveness of older water management systems may often be maintained or even improved upon in their integration with newer uses. The research suggests that India can lessen its water risk by incorporating traditional water management systems into modern practices.

Harshita Kaur et.al (2022) For a sustainable water management system in both urban and rural contexts in India, it is necessary to reverse the decrease of traditional water bodies. While traditional methods of water conservation have been largely rendered ineffective by rapid urbanization, they are nevertheless capable of easing the strain that this phenomenon has placed on the environment. Many rulers throughout the course of several centuries-built water storage facilities at Deeg, which earned it the nickname "city of water palaces," to alleviate water scarcity during the summer in semi-arid regions of India. This study was conducted to present evidence in favor of resurrecting the old Gopal Sagar and Roop Sagar at the Deeg palace. The purpose of this research is to evaluate the water quality of such bodies of water in order to estimate the direct influence they have on their surrounds. Several analytical approaches have been used to appreciate the long-term durability of these measurements, including talks with technical personnel, naturalistic surveys and in-depth discussions with locals. Possible conservation strategies for the location under consideration are explored, and the hydrological system of the associated water body is studied. This in-depth research has increased our knowledge of the water bodies' spatio-temporal behavior, which may help authorities and policymakers everywhere in India construct and improve traditional water bodies like these in the future. It is crucial to monitor, regulate, prevent, and most importantly educate the public and grassroots institutions to ensure the survival of these essential water sources in cities with water shortages.

More, H. B (2020) For centuries, indigenous communities have been able to meet their water needs with only traditional water harvesting methods. Harvesting water involves creating a source of flowing water, then capturing and storing that water for later use. In India, rainwater is collected using a variety of methods. While the forts of India were constructed in a wide variety of climates, each developed its own system for collecting rainwater to provide the fort's domestic requirements. We need to acquire and understand the old wisdom and use it in contemporary society to eliminate the current water shortage, since our temples were constructed with big tanks or water bodies on the grounds centuries ago. The water harvesting system is a dependable and low-cost alternative to replenishing India's dwindling water supply. Civil engineers nowadays are obligated to analyze this building using cutting-edge research methods. To meet the need for irrigation and domestic use, these systems need to be revitalized.

R. S. Krishna et.al (2020) The average yearly demand for water across all sectors has grown. This is because of rising populations and the consequent need for more water to meet human consumption in all its forms (drinking, bathing, farming, and industry). Because of faulty and inefficient water distribution networks, the situation has been deteriorating. Harvesting rainwater (RWH) has been shown to be a sustainable solution to groundwater depletion. For the better part of two decades, India has had a dire water scarcity. India has a greater opportunity for RWH owing to its location and topography. The purpose of this research is to analyze the change in Joda, India's groundwater levels over the previous decade in order to determine the effect of using RWH procedures as an artificial recharge option for assessing the town's groundwater table (2009-19). The research demonstrated an uptick in the area's subterranean water level and confirmed the vitality of RWH systems in dry areas.

Mohd. Saleem et.al (2018) Water scarcity is a problem all throughout the globe, but it particularly affects emerging nations. This is true for both industrial and commercial uses, as well as for drinking. The present scarcity of groundwater in India calls for a comprehensive evaluation of the existing resources and the development of a long-term strategy for managing groundwater. Groundwater recharging by rainwater harvesting (RWH) is considered a viable option. As a result, there has been a rise in watershed development initiatives, of which RWH has been a central pillar. To guarantee that these development activities have a good net impact on groundwater both locally and throughout a watershed, it is essential to understand the net effect of these initiatives. Improving system performance and water supply stability requires careful consideration in the design and assessment of a RWH system. Literature on RWH design, aquifer modeling, and GIS/remote sensing applications for artificial recharge are the subject of this study.

RAINWATER HARVESTING

Recharging groundwater, reducing flood damage and runoff during the rainy season, and supplying customers with drinkable water during drought are just a few of the many benefits of rainwater harvesting. This method may make use of familiar techniques, tools, and materials. A person may collect water from his roof and manage it on his own throughout the rainy season. Homeowners have the option of either storing rainwater for later use or making direct use of it. Water may be collected from the rooftops of a row of buildings and stored for later use. By channeling this water into deep wells, groundwater levels may be replenished.

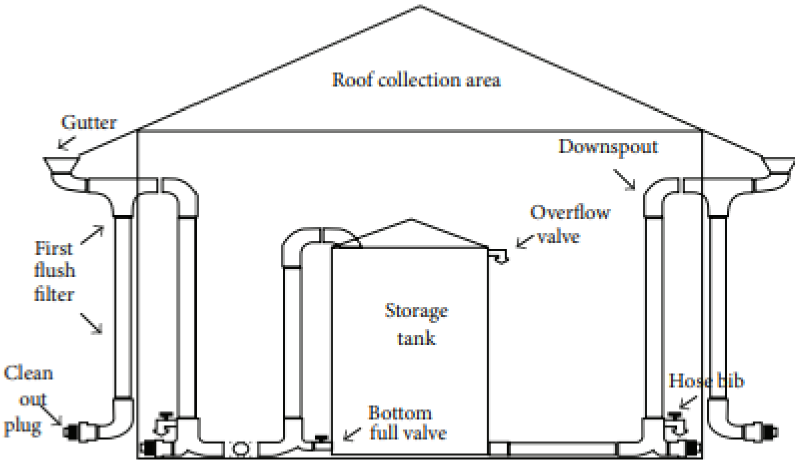

Figure 1: Schematic of a rainwater harvesting system

Reservoirs to dilute recovered water for nonpotable usage; ponds to gently replace groundwater. A rainwater collection system is seen in simplified form in Figure 1.

TRADITIONAL RAINWATER HARVESTING METHODS AT VISITED SITES

Nahargarh Fort: Over 6 kilometers of land surround the Nahargarh fortification, serving as a water catchment region. Little canals link a series of six controlled catchment areas, and water channels and drainage channels are strategically located both within and outside the castle. The little canal carries rainfall from the upstream of the hills.

Jaigarh Fort: Around 4 kilometers away from the fort is the rainwater catchment area of Jaigarh. The fortress's interior and outside are both outfitted with drainage canals, smaller canals, and their respective arterial networks. Channels like this collect rainwater and direct it into smaller canals or stucco channels that go to the fortress's central water tank. The rain drained up the mountainside via these narrow channels.

Jal Mahal: Mansagar Lake, or just Mansagar Lake, is a man-made lake. Location: on the banks of the Darbhawati. As nobody was swimming there anymore and the palace had been deserted, the sewage from the Walled City of Jaipur was dumped into the lake.

Galta kund: the Aravalli Hills, where pilgrims go from all around the state to take a holy dip. The Kund rely on groundwater seepage from the mountain for their water supply. Galtaji is home to seven kunds.

NEED FOR RAINWATER HARVESTING

The residents of Joda Township have relied on both underground water and the municipal water supply for their water needs. Joda's groundwater level data over the last decade reveals an increasing need for aquifer recharge. Between 2010-2015, as seen in Fig. 2, subsurface water levels have been decreasing. The lack of adequate water management systems, unregulated mining, and excessive groundwater use have all contributed considerably to the problem. In order to keep up with the ever-increasing demand for water, local businesses and government have adapted and installed new water management systems. However, the decline in groundwater levels has a negative impact on groundwater quality and drives up pumping expenses. Wells may dry up, land may sink, and water levels in rivers and lakes may drop as a result. Exploration for mines disrupts the hydrological cycle. Since the dynamics of groundwater are altered by changes in excavation size, estimating groundwater levels in mining sites is difficult. The existence and influence of freshly erected RWH structure in the research region is shown by a rising water level from 2017 to 2019, with the highest level ever recorded in 2019.

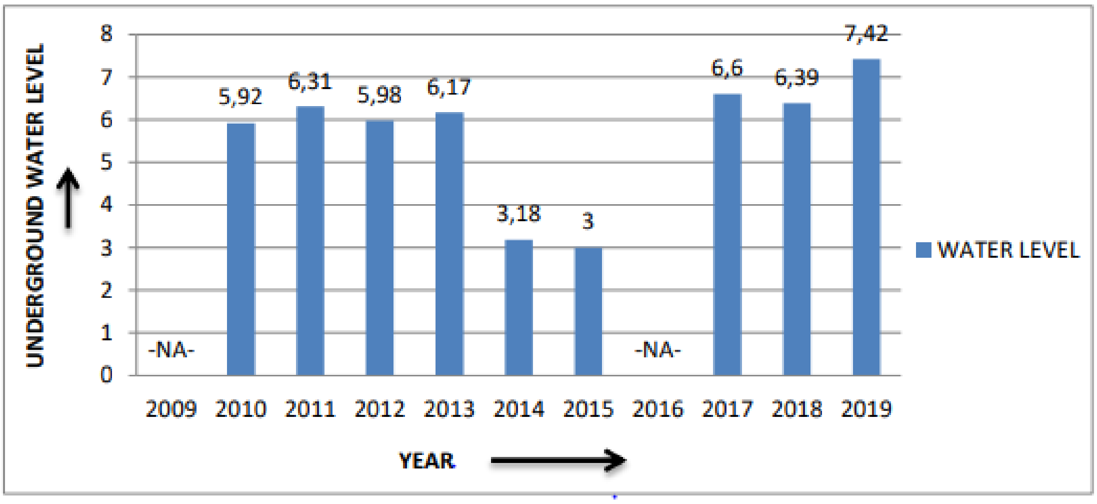

Figure 2. Ground water level of Joda for the past decade (2019-2009).

RWH SYSTEM

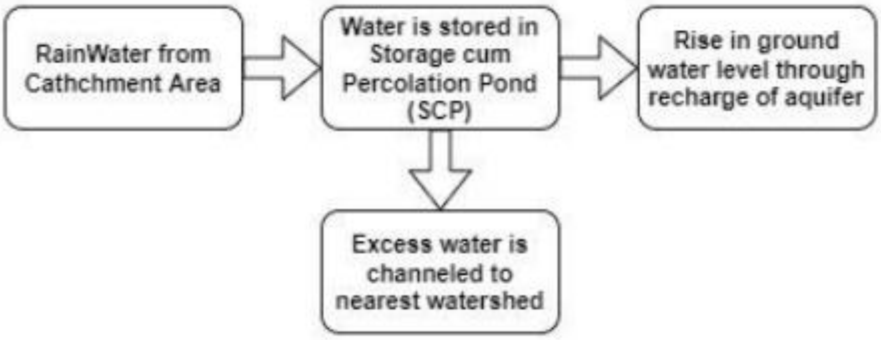

Figure 3. Block diagram of the RWH system

M/s KRG Rainwater Foundation of Chennai did a thorough feasibility assessment after which, TATA Steel established the first-ever scientific system in the region. TATA Aquatica - Rain Water Harvesting Park, where a new rainwater collecting system has been erected to meet the growing demand for water, is available to the public 24 hours a day, seven days a week. Its coordinates are 22 degrees 1 minutes 18 seconds north and 85 degrees 25 minutes 53 seconds east. The technology was unveiled at the tail end of 2018 as part of TATA's Rain Water Harvesting Project Phase-II. The analysis used a multidisciplinary approach, taking into account geomorphologic, hydro-geological, traditional water divining studies, and other methods to identify prospective revitalization areas. The park is a whopping 3.5 acres in size, and its rainwater collection area is around 2500m by 1000m (2.5 Lakh sq.m). The park is home to a huge Storage cum Percolation Pond (SCP) measuring in at 29000 KL. The park has a lined RWH pond that is about 8567 square meters in size, as well as various other amenities including a yoga center (65 square meters), workout area (50 square meters), playground equipment, a jogging path, and lush grass. The average depth of the pond is 3.5 meters. Eighty-seven thousand kilos per year (KL) of water are added to the aquifer from the pond. To the pond are tethered five of Nos imploders. At all times, the pond has a discharge capacity of 50-70 KL per hour, and the time it takes to restore its water supply is just 10-15 hours. A large diameter recuperation well with well-planned weep holes is built near the northeastern corner of SCP, where the groundwater flow line converges. The recharge well is 6 meters in diameter and 8 meters deep.

Reasonable diversion procedures have coordinated the flow of runoff water from several channels to the SCP. The SCP's built-up water supply would be recycled through the recuperation system. We have completed construction of the percolation pond and the accompanying gorgeous park, and we have located recharge zones on the southern side of the SCP. The SCP has a huge catchment area that extends all the way to Banspani Lake in the southwest. Joda East Iron Mine's western wall and the open region on its southern side are both sources of water that eventually make their way to the SCP, as shown by the geomorphological analysis and the examination of seepage design.

Rainwater Harvesting and Treatment System

Monthly Precipitation. Annual precipitation in the province of Condorcanqui is predicted to be anywhere from 1,200 to 1,800 mm. November had the highest precipitation total at 396.2 mm, similar to Tunants, while June saw the highest total at 429 mm, corresponding to Yahuahua, in the research region (Figure 4). August had the least precipitation (24 mm) in the Yahuhua region and the least precipitation (5.76 mm) in the Tunants region. As a result, water catchment systems in both communities could rely on reliable precipitation.

Figure 5 shows the range of annual rainfall at the sites, which ranged from a high of 2,032.1 mm to a low of 987.64 mm. Rainfall in the Nieva area is reported to average between 1,376.4 and 2,227.8 mm annually by the Peruvian National Service of Meteorological and Hydrology (SENAMHI). Considering the separation from the station and the existing infrastructure, the readings from the rain gauges showed a general trend toward the values provided by SENAMHI. Regions Anticipated to Capture Rainfall Roof area measurements have been extrapolated to get an estimate of the sheds' catchment areas and hence the total quantity of water that can be collected from them.

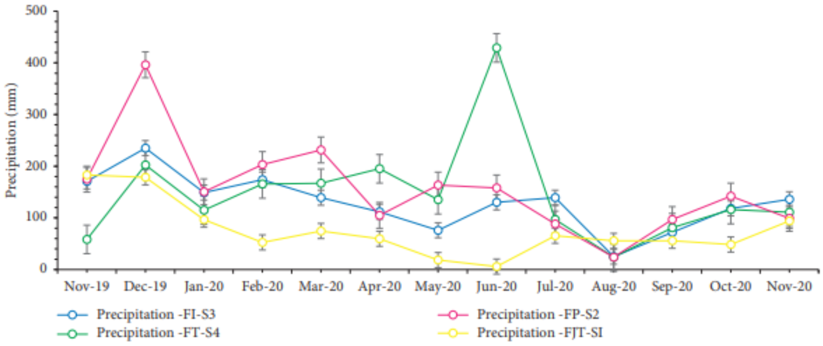

Figure 4: Rainfall evolution

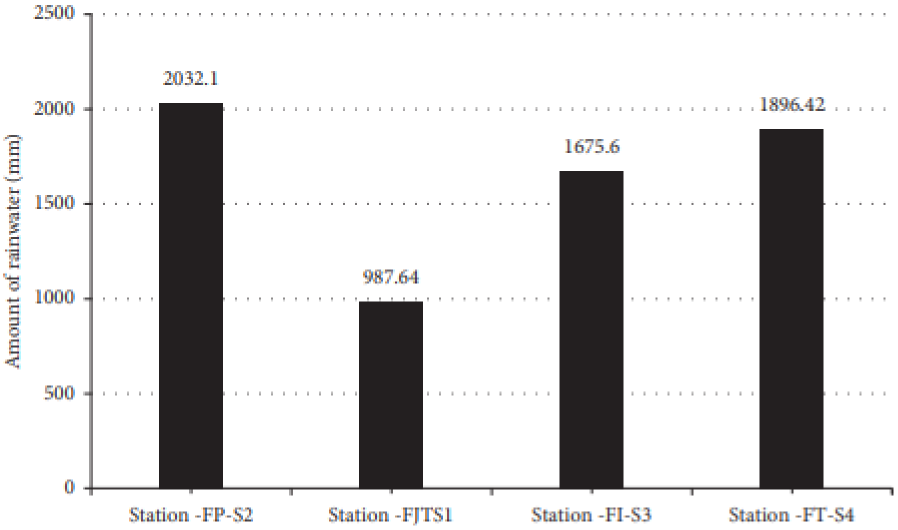

Figure 5: Total annual rainfall reported from rain gauges.

CONCLUSION

RWH systems are very important in rural India, maybe much more so than is currently believed. Thus, it is strongly recommended that comparable systems be implemented in other water-poor habitat/arid places throughout India. Technical and economic validation shows that rainwater gathering for home use and human consumption in indigenous villages in Amazonas (Northwest Peru) is possible. Six people in a household may have their daily water needs met by collecting rainwater at the rate of 32.5 liters per person. In indigenous societies, rainwater collection devices may provide as a low-cost and easily accessible alternative water source. Nevertheless, following treatment, it may only be used if proper water management systems are in place.

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