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A General Report on Water Management of Desert Ecosystems: Bikaner District

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

In the arid eco-systems, water constitutes the most important resource that limits plants growth and yield. There is broadly, three way demands on available fresh water for human uses are for agriculture, animal husbandry, fisheries etc. to provide food, to meet the civic needs of people in rural and urban areas, and water for industrial enterprises.
Water being a decisive component for quality of life and development activities, its supply, demand, quality and distribution for social and economic consumption patterns are important issues for developing a strategy of water management. Water is an essential commodity without which development of culture and economy is neither possible nor meaningful. Therefore, this paper "A General Report on Water Management of Desert Ecosystems: Bikaner District" is very significant in the present growing water crisis of the arid and semi-arid regions of India.

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1. INTRODUCTION

Water is one of the most important components of our planet and is essential to life on Earth. It is essential for all forms of life, food production, economic development, and the maintenance of general well-being. It is impossible to replace most of its uses, it is difficult to detoxify, it is expensive to transport, and it is truly a unique gift of nature to humankind. The value of water varies from user to user, depending on solvency, water use, access to alternative sources, and the diversity of social, cultural, and environmental values associated with resources. Water is also one of the most manageable natural resources as it can be diverted, transported, stored and recycled. All of these properties bring great benefits to humans for water. The country's surface and groundwater resources play important roles in agriculture, hydropower, livestock, industrial activities, forestry, fishing, shipping and recreational activities. Unfortunately, they are qualitatively and quantitatively degraded by human activity. Drinking water, which accounts for only 0.1% of all water available on the planet, is considered more threatening than climate change, with water shortages increasing daily. India and other semi-dry and dry countries will soon experience "water stress" conditions. Saving water and managing it better is just one practical solution to this huge problem, as there are no freshwater sources left to use. Precipitation is the main source of freshwater, but most rainwater flows back into the sea without proper use. Rapid urbanization exacerbated the problem of urban runoff, leading to regular floods and water table depletion in cities during the rainy season.

Selection of the Study Area: The study area is being part of the Thar Desert of Rajasthan, where harsh desert conditions prevail in such climatic conditions. Scarcity of water is common geographic phenomena of the desert environment; therefore the study of management of water resources of this arid ecosystem is very important.

Objective: The main contention of the from a geographical point of view, it aims to provide an overview of the ecological issues of water availability, water quality and water supply.

Data collection: In this study, both secondary and primary data are used in the General Report on Water Management of Desert Ecosystems: Bikaner District.

2. REVIEW OF LITERATURE

Mathur, S.K. and Shekhawat, M.S. [1] studied the impacts of canal irrigation on land-use and cropping pattern of I.G.N.P. command area. They suggested ecologically suitable land-use and cropping pattern along with strategies of optimum use of irrigation water for sustainable development of this desert region.

Johri, S.N. [2] observed in his study on this desert region that ground water is highly saline or saline-alkaline both. Due to continuous use of these waters the soluble salts are accumulated on the top surface of the soils. Therefore, the quality of irrigation water is of primary concern and the under ground water used as major source of irrigation water contains very high salt contents. The author emphasized on management on watershed basis depending on its land capability may be a viable option for sustained utilization of land and water resources available in this most thickly populated desert of the world.

Ali, A. and Singh, J.B. et al. [3] studied sustenance of water resources and urban ecology of Bikaner city. The authors examined the quality of water and its impact on human health. They suggested the strategies of rational management of water resources for the urban ecosystem.

Ali, A. and Swami, S.K. [4] studied impacts of canal irrigation on land-use and cropping pattern of Ganganagar tehsil. They observed that lack of water and land management strategies is responsible for land degradation problems of this irrigated arid tract. They emphasized on optimum use of available water resources along with ecologically sustainable land-use and rational cropping patterns.

Vaidyanathan, A. [5] in his book "India's Water Resources" explains that there is a clear gap between the policy formulations, implementations, and the governance and management of India's water economy. The volume in detail examines the agro-climatic context, irrigation and agricultural technology, legal-institutional arrangements, and the economic environment. The author lays

emphasis towards integrated watershed development in rain-fed regions, reducing waste and over-exploitation of water, resulting in a more efficient use of irrigation water.

Ali, A., Ranga, S.K., Swami, S.K. et al. [6] studied Sustainable Water Management of Churu District : Issues and Prospects. The study highlights the main aspects of water availability, spatial distribution patterns, consumptive patterns and the impacts of the quality of water on human health of the desert ecosystem.

Singhvi, S.L. and Ali, A. et al. [7] made an attempt to study "Land Degradation in the Rawatsar Command Area of Indira Gandhi Nahar Pariyojana (Stage-I) : An Environmental Impact Assessment" in which findings of the study indicates that the lack of land and water management strategies is the main cause of these environmental degradation problems of this irrigated arid ecosystem. The study suggests measures to protect, conserve and sustainable development of the region.

Water is that the most essential material indispensable to any or all living things. Without water, there's no life, and therefore the solution to the matter of desertified water has become a worldwide problem [8,9]. The source of water within the desert consists of artificial external water, groundwater, sand adsorbed water, precipitation and air water. Artificial foreign water and groundwater must be limited to the foremost limited amount; the aim is to confirm the benign cycle of ecological restoration and also the economic problems of water application. So far, the research during this field is restricted and mainly focused on mechanical micro-irrigation. However, there's still a large range of research space during this field, especially the introduction of recent material technology may be a ought to have attention In recent years, people have tried to revive desert ecology without watering, As a result, bionic condensation materials, sand surface biological crust materials, water absorbent resin materials have emerged [10-16]. The looks of those materials provides a replacement direction for ecological restoration in desertification areas.

A General Account of Bikaner District: The study area of Bikaner district has dry climatic conditions with large variations of temperature, unpredictable and scanty rainfall. Groundwater, the main source of drinking and other uses, is typically about 80-120 meters above the surface of the earth. Outflows from wells range from 18,200 liters per hour (4000 gallons per hour) to 91,000 liters per hour (20,000 gallons per hour).

The Bikaner district has four major hydrological units: Villara limestone, Nagaul sandstone, Tertiary sandstone, and Quaternary alluvium. There are approximately 227.0832 mm of groundwater resources in the study area, and 214.9282 mm of water is currently in use. The available amount of groundwater for irrigation in the study area is about 17.1003 mm, and the groundwater development rate is about 94.65%. The alluvium covers most of the area (northwest), but the salty groundwater and thick continuum portray small areas in the northeast and southwest of Lunkalansar and Korayat Block as groundwater potential increase. In these formations, the depth to the water table ranges from 100 to 140 m, and these layers occupy about 14% of the potential area. The general depth to the water table increases from southwest to northeast. Contour lines on the water table indicate that the general direction of groundwater flow is from southeast to northwest. According to groundwater surveys, the hydraulic gradient generally varies between 1 and 1.

1-2.5m / km. The quality of groundwater is suitable for irrigation and drinking. The slope is steep in the south (4.5-5.0 m / km). In the Bikaner block and Korayato block, the quality of groundwater is salt water. According to a ground water survey, a Tertiary sandstone layer occupies the southwestern part of the Bikaner block and covers a vast area. These formations also extend to the perimeter of adjacent blocks. The depth of these formations to the water table ranges from 140m in the west to 200m in the east of the district. These hydrogeological layers cover about 56% of the potential area. The groundwater capacity of these formations is 110 to 200 m3 / day.

The third most important geological aquifer is the Nagaul sandstone, which belongs to the Marwar Supergroup rocks. The thickness of the litho unit varies from 140m to 250m. The geographical south of Korayat and Nocatecil is covered by these hydrogeological layers.

Groundwater depths in these formations vary over time and range from 38.10 to 116.38 m. The quality of the groundwater in these formations is suitable for home and non-home use. The depth to the water table ranges from 160m to 260m. The depth to the water table increases from north

to south. The Nagaul sandstone layer occupies about 28% of the potential area. The southern part of Nokha Tehsil is covered with a Bilara limestone layer with a depth of more than 260 m to the water table. The thickness of the hydrogeological layer varies between 115 and 225 m. These litho units cover a small area of the southern perimeter of the Noka block, covering almost 2% of the potential area. Groundwater depth ranges from 48.42m to 78.20m, and groundwater capacity varies between 70 and 120m^3/ day. Groundwater quality of these hydrogeological layers suitable for consumption purposes. Qualitatively, the alluvial formations of Bikaner and Kolayat contain non-drinkable salt water. The depth of these formations to the water table ranges from 23.87m to 47.59m for Bikaner Tesir and 11.12m to 63.48m for Korayato Tesir Blocks. As of, there are about 771 inhabited villages in the Bikaner district. About 56.81% (438) of villages depend on groundwater resources. The remaining 43.19% (333) of the villages (Pugal, Kajuwara, Chatalgar) receive canal water services. The villages of Nokha and Sridungargarh Tehsils are completely dependent on groundwater resources. The villages of Bikaner, Kolayat and Lunkalansar are sourced from both surface and groundwater resources.

Bikaner district, covering a total geographical area of 30381.75 square kilometers In km, about 55.22 percent (16779.24 km²) of area contains saltwater groundwater, and the rest of the district (44.78 percent) has drinking water used for both domestic and non-household purposes. Overfishing of groundwater for agricultural purposes. It leads to the rapid depletion of limited groundwater resources. The continuous decline in groundwater levels is a concern for hydrogeologists and environmentalists. Given these circumstances, there is an urgent need to develop a solid master plan for the conservation, conservation and sustainable management of the scarce water resources of this desert region.

There are about 749 villages in the Bikaner district, about 62.08 percent (465) have drinking water resources, and the remaining 37.92 percent (284) have salt water. The spatial distribution pattern of groundwater resources is that there is salt water in the north and west (Kolayat, Kajuwara, Chatalgar, Pugal, Lunkalansar), and more than half of the other half is in the south and east (Bikaner, part of Lunkalansal, Dangargal, Noka).)It is in. Tehsil) has drinking water. Groundwater availability in the Bikaner area ranges from 11.12 to 13515 meters. Geologically, Kolayat and Lunkaransar Tehsils are safe groundwater areas, with drinking water at depths of approximately 37.85m to 135.15m and 20.53m to 66.15m, respectively. Look at the consumption patterns of water resources and the stages of groundwater development. Bikaner and Nocatecil are overstressed groundwater areas (105.78 and 131.78%), and the groundwater resources of Dungarh Gartesil (96.33%) are in jeopardy. The main causes of groundwater resource depletion are increased water demand due to increased demographic pressure and insufficient replenishment of groundwater resources due to low and unpredictable monsoon rainfall. With regard to the drinkability of groundwater resources, block rates range from 24.13 percent (Korayato) to 97.68 percent (Nokha block).

In the southeastern part of the district where the Nokha and Sridungargarh blocks are located, the proportion of drinking water is over 90%. On the other hand, the western part of the district (Kolayat, Bikaner, Lunkalansar) has a very low proportion of drinking water, with saltwater groundwater proportions ranging from 65.61 percent of the Bikaner block to 75.87 percent of the Kolayat block. The Bikaner district has approximately 227,0832 MCM groundwater resources. Groundwater availability in various blocks in the study area varies from 11.82 percent (Korayato) to 27.86 percent (Noka) blocks. Therefore, Nokha block has a maximum of available groundwater resources (63.2686 MCM). The water resource consumption pattern in District is that the Nokha (131.78), Bikaner (105.78), and Sridunggargarh (96.33) blocks are overfished because the groundwater development rate exceeds the availability of groundwater resources. is showing.

The current state of groundwater resources shows that the blocks of Bikaner and Noka were important in 2001, and the remaining three blocks were hydrogeologically safe. In 2004, these two blocks (Nokha and Bikaner) were overfished, and the Dungarhgarh block also reached an important stage in groundwater development. The Kolayat and Lunkaransar blocks were safe during the groundwater development phase. Just as important as the is the issue of water volume. Water quality has a direct and serious impact on human and animal health. Population growth, urbanization and industrialization trends are gradually threatening

the quality of surface and groundwater resources.

In terms of water quality, groundwater in Kolayat and Lunkalansar has higher salinity than Tehsil in Noka and Bikaner. Therefore, TDS chemical analysis shows that the quality of groundwater in the study area is not suitable for consumption purposes. The study emphasizes that the entire district has high concentrations of abiotic components such as chlorides and nitrates in groundwater, and levels of pollutants are higher than the maximum recommended levels of WHO standards. Spatial fluoride distribution in the study area indicates that low to moderate saline is usually free of fluoride contamination.

3. CONCLUSION

The study area is completely dependent on free groundwater. Assessing biocontamination in water makes more sense because most water-borne diseases such as cholera, diarrhea, dysentery, typhoid fever, and hepatitis spread to contaminated water bodies. Therefore, the field of study needs a solid strategy to solve human health problems.

With population growth and steady industrial growth, the need for groundwater has increased. Groundwater is the only source of drinking water for residents, industry and agriculture in the study area.

The study area of Bikaner was in safe groundwater until 1998. However, as the number of public and outdoor wells has increased over the last decade, the use of groundwater has increased, making the area a very important stage. In 2021, groundwater resources were in a critical stage, but resources are the main cause of the transition to the overfishing stage of groundwater development due to three years of unplanned excessive water consumption (131.78%). With the development of groundwater for irrigation and the introduction of commercial and water-loving plants, Tehsil of Noka and Bikaner has been placed in a very important zone and Dangargal has reached an important level (2015). Other Tehsil, such as Korayato and Lunkalansar, have salt water that is not suitable for cultivation. The remaining three Tehsil, Chatargarh, Khajuwala and Pugal, have a canal irrigation system and brackish water. Therefore, it is important to save rainwater to mitigate the water crisis.

Under these circumstances, it is important to save rainwater in order to mitigate the adverse effects of drought, stabilize agricultural production and develop local water resources. The use of water in society depends on time and space. There are two ways for society to use water resources. The first is traditional and the second is modern. Traditional water usage methods are being developed to maximize the use of available water.

In the arid regions of Rajasthan, people create unique underground structures of various shapes and sizes and collect rainwater for drinking. These structures called Tanka, Kund, and Kundi are made. Tanka is the main source of drinking water in these areas, so people are enthusiastic about keeping and caring for tanka. Just before the monsoon begins, the Nagaga River basin is cleaned to remove all pollutants, and human activity and cattle grazing in the area are banned. The stored rainwater is used all year round. These simple traditional catchment structures are useful even in years with below average rainfall. The survey area in the Bikaner area has a higher rate of population growth in 2011 (56.96%) than Rajasthan (28.33%) and the country (21.34%). This growth rate has been high since 1971 with the introduction of the Indira Gandhi Canal. The number of livestock has also increased 2.5 times over the last 40 years. Similarly, daily water requirements have increased from 310.8 liters. Per day until 1330.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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