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Assessment of Water Scarcity in Western Rajasthan

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Abstract

The importance of water is known to everyone and cannot imagine existence of life in the form of flora and fauna without water. The World is experiencing high climatic variability and has its impact on all ecosystems, regions and sectors, but the nature and extent of vulnerability to climate change differs with adaptive capacity of individual, society and region. The climate variability has direct impact on the water resources of the region. The present paper emphasizes of the future planning of utilization of water resources particularly in Rajasthan.

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Introduction

In India, water supply is predominantly dependent on either monsoon or ground water and as a result it is one of the major issues as still millions of people in the country do not have access to safe drinking water. Rajasthan is worst affected in terms of water supply as natural condition along with man-made calamites have had a significant impact on the water resources in Rajasthan.

Western Rajasthan is one of the most frequently affected drought-prone areas in India. The long-term average of annual rainfall in western Rajasthan is 330 mm, and approximately 85% of the rain is received mainly during the rainy season i.e. June to September. Hence, due to scanty rainfall and no perennial water source this area shows desertic semi-arid conditions. Moreover, technology development in drilling and pumping methods have resulted in massive exploitation of ground water mainly for irrigation, industry and domestic purposes which have further worsen the conditions in the area. The poor water holding capacity of soils, absence of perennial rivers and forests, poor groundwater quality, high withdrawal from limited groundwater reserve, a paradigm shift in land use and neglect of the traditional coping mechanism that were basic to survival in an arid ecosystem is resulting in a severe water scarcity problem in the districts of western Rajasthan.

Objective of the Study

1. To find out present status of water resources in Western Rajasthan
2. To propose plans for future planning of utilization of water resources.

Hypothesis

1. Optimum use of water resource can change the situation of water scarcity
2. Water Scarcity has directly affected the Society

Study Area

The study areaincludes the districts of western Rajasthan. It extends between24°02'N to 27°02'NLatitude and 69°48'E to 74°21'E Longitude. It covers a geographical area 1645.09 sq.km where the highest elevation is about 453 meters above mean sea level.

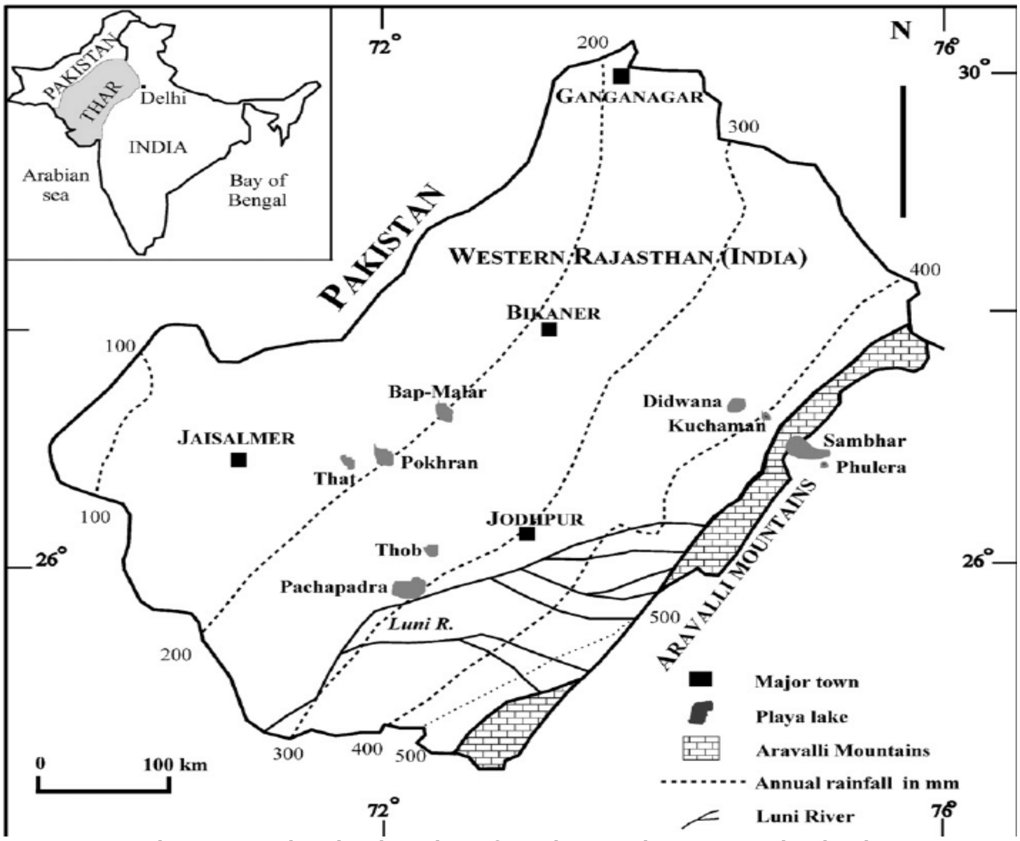

Fig. 1: Map showing location of Study Area (Western Rajasthan)

Methodology

Water Scarcity assessment in the study area has been carried out with the help of various secondary data which includes libraries of various universities, necessary information is inferred from the Jal board Rajasthan, Jal Vikas Nigam Ltd. Geological survey of survey of India. The Ground water department, Government of Rajasthan calculated the magnitude of ground water exploitation into various strata's which was very useful for the study.

Review of Literature

1. Ashok Kumar Yadav et. al. (2010) determined the water quality index of 20 water sample of tube well, open well and hand pump in to Todaraisingh tehsil of Tonk Rajasthan. It was reported that drinking water of study area is severely polluted with hardness causing salt.
2. Umesh Saxena et. al. (2014) evaluated the ground water quality with special reference to fluoride and nitrate contamination in Bassi Tehsil of Jaipur. The study conducted that drinking water of Bassi Tehsil was not potable and there is instant need to take ameliorative steps in study area to prevent the population from adverse health effects.
3. Sharma et al. have reported that the nitrate concentrations decrease as depth of well and depth below water table increase. These relationships indicate that the shallow ground water is more susceptible to contamination than deeper water because of the shorter pathway for nitrate transport and less subsurface clay to retard the downward transport.
4. P.L. Meena et. al. (2016) has worked on the ground water quality and its suitability for drinking and domestic uses by using water quality index and statistical analysis in river basin area in Jahazpur Tehsil of Bhilwara, Rajasthan by collecting 40 water samples from dug well, tube well, hand pump and Tap.
5. The impact of seasonal trends on groundwater quality were analysed by Yadav et al. They reported that the most of groundwater samples were unsuitable for irrigation in post monsoon compare to that pre monsoon.
6. Assessment of heavy metals in correlation with physico-chemical properties of drinking water of the Northern Rajasthan, India has reported by Mittal et al. they concluded that drinking water contaminated with heavy metals is prone to radiological and chemical threats for inhabitation.
7. Rachel&Vengosh has worked on effect of geogenic and anthropogenic processes along with concerns over water availability, endemic water quality issues which are critical and affect the usability of available water and potential human health risks.

Water Scarcity in Rajasthan

Rajasthan being water scarce State in the country cannot afford to pollute its precious water resources. It has only two river basins out of 15 defined basins as perennial and majority of the rivers are not flowing at present due to low influx of water or changing watersheds. It makes really difficult for people to have access to safe water for meeting their household demands. The factors which are mainly responsible for water crisis in Western Rajasthan are:

1. Drought Prone Area
2. Scanty and Inconsistent rainfall
3. Minimal sources of surface water.

In Rajasthan, surface water is available in sizeable amount and hence groundwater is the major source of water being utilized in the western part of Rajasthan.

Fig. 2: Condition of Well in Study Area

Rainfall and Groundwater

Rainfall is the most vital factor in determining quality and distribution of surface and sub-surface water sources. Often the impact of rainfall variability is clearly evident on surface water sources within a short time, but its impact on sub-surface sources is complex and long-lasting. A careful understanding of the terrain and recharge conditions and long-term studies on variations in rainfall patterns and water exploitation are needed in order to interpret changes in groundwater storage.

The average annual rainfall of the study area is around 236 mm and because of the increased use of groundwater from all the potential regions of study area, recharge to the aquifer during normal rainfall periods is inadequate, especially because of the sporadic rainfall distribution patterns and the terrain characteristics, with a major portion of the precipitation being lost as runoff or through evaporation. It is therefore important to identify the potential aquifers so that the limited surplus rainwater received in the region is conserved efficiently for use during the drought years and to meet the increasing demands of rising population.

Present Water Quality in Rajasthan

The CGWB, RGWD and PHED monitor the groundwater quality in the State. As per the findings of these agencies, the water quality is highly polluted. Currently, Rajasthan has the lowest per capita availability of water with 807 m^3 per person water available to each person of the state, this set to further decreased to 457m^3 by 2045. Western part of Rajasthan is mostly affected in water scarcity.

The major water quality issues of Rajasthan are related to salinity as reflected by electric conductivity values in water quality data, fluoride and nitrate. According to PHED, the Fluoride is around 51% and salinity is at 42%. These pollutants are both anthropogenic and geogenic.

More than 70% of Population in Rajasthan is affected by the same. The State Government is partly responsible as they have time again have been unable to manage the water scarcity in the western part of Rajasthan, even after sanctioning huge budget. The lack of proper infrastructure in the terms of dams, lakes and barrages has also adversely affected this crisis.

From average fluoride concentration point of view the values were found highest in Jalore and Ajmer districts at 2.5 mg/l followed by Nagaur, Pali, Jodhpur, Sirohi, the values exceeding 2 mg/l. In the remaining districts the average values are below 2 mg/l. The lowest average value was recorded as below 0.5 mg/l. There are nine districts having average values less than 1 mg/l. There are 15 districts having fluoride values exceeding 1.5 mg/l. The analysis of PHED data indicated that majority of water sources are affected by fluoride except Ganganagar and Hanumangarh districts which can be attributed to annual average rainfall in the area. The annual average rainfall has strong influence on groundwater quality as higher rainfall results in higher recharge, which in turn has dilution effect on groundwater.Fluoride in water can be a blessing or a hazard depending on the concentration levels. Bureau of Indian Standards (BIS-1991) and Indian Council of Medical Research (ICMR) prescribe a fluoride concentration of 1.0 mg/1 as the desirable limit, and 1.5 mg/1 as the maximum permissible limit in drinking water, if there is no alternate source. The study area falls in the climatic zone where average summer temperature is greater than 27.5°C and the average drinking water consumption is higher than 4 litres per day. For these population groups, drinking water containing less than 0.6 mg F/1 is fit for consumption. Assimilation of fluorine by the human body from potable water at the level of 1 mg/1 enhances bone development and prevents dental carries. It is found to cause fluorosis when it exceeds a limit of 1.2 mg/1. It is a deadly disease with no cure so far.

As per the CGWB/RGWD data the nitrate problem is severe in 1/3rd of the State where the values exceed the maximum permissible limits prescribed by BIS for drinking water. There are 5 districts exceeding the average nitrate concentration of 3 meq/l. The highest average nitrate concentration was observed as 4.7 meq/l in Churu district. The lowest average value was 0.5 meq/l in Banswara district. There are 3 districts having average nitrate concentration values below the desirable drinking water limit of 0.73 meq/l (45 mg/l) and 17 districts having average nitrate concentration values within the maximum permissible drinking water limit of 1.61 meq/l (100 mg/l). The PHED data analysis indicated that nitrate is a water quality problem in most districts and mainly in western part of the State. Some of the districts like Ajmer and Barmer are worst affected. Both these districts are having nitrate levels higher than desirable limit of drinking water prescribed by BIS in groundwater. Such values may be due to either higher use of nitrogenous based fertilizers or due to inadequate sanitation or dispose of the domestic wastes, which may have polluted the groundwater.

The salt contents in ground water depend upon the source and on the aquifer through which it moves. Factors which apparently influence relative ground water salinity are as follows-

1. Imbalance between annual evaporation, precipitation and runoff
2. Rate of weathering
3. Transportation of salts into the region by stream, wind and rain.
4. Permeability and hydraulic gradient of the aquifer and confining bed.
5. The rate of ground water circulation and rate of salt accumulation in the aquifer body from infiltrating water.
6. Inherent saline ground water.

Trend of Water Level in the Study Area (Year 1984-2019)

On the basis of study of water level data of the study area from the year 1984-2019, it may be concluded that the water level in the study area reveal depleting trends. The average water level in the study area during pre-monsoon 1984 was 10.87 m (According to G.W.D. Ajmer) while during pre-monsoon 2019 it was19.11 m below groundwater level. The total depletion was 8.27 m over a period of 37 year which amount to about a depletion of approximately 0.23 m per year.

This depletion can be attributed to mainly two factors; first due to randomly rainfall distribution over the entire area and secondly due to over exploitation of ground water withdrawal for agricultural and industrial purposes. Significant decline is observed in the long-term pre and post monsoon water table in the study area. The condition of ground water development in the study area is overexploited and alarming. As a result, the overexploitation has resulted in the problem of fluoride and salinity which has increased in past few years. The drinking water is available in very small amount for consumption from both the surface and ground water. Comprehensive management and conjunctive use of both surface and ground water, incorporating both quality and quantity aspects of water are largely lacking.

Ground Water Resources Management

Depletion of ground water level in the study area is at alarming scale. Latest technological developments in drilling, pumping methods in different types of construction of wells coupled with its increased demand for domestic, irrigation and industrial purposes have resulted in large-scale exploitation of ground water resource availability would become more critical. The situation, therefore, needs adoption of adequate measures for management of ground water resources besides encouraging rainwater harvesting.

Ground water storage of depleted aquifers can be improved by adopting various suitable artificial recharge methods. Poundage of water in "Nadis" or farm ponds can be used for inducement of recharge of ground water. In comparison to ponds, percolation tanks conserve water to greater extent. The construction of sub surface barriers reduces the rate of the depletion of ground water. Recharge by injection well is the only method for artificial recharge of confined aquifers or deep- seated aquifers with poorly overburden. It is also effective in highly fractured hard rocks. The ground water is the main source to meet domestic, irrigation and other requirements. So, here it is important to evaluate ground water utilization to quantify the existing and prospective development.

Ground water recharge is very limited in the study area depending upon rainfall, run off and evapotranspiration. Ground water withdrawal exceeds the recharge in potential area resulting into regular water table depletion. This necessitates the intelligent use of ground water in irrigation, water supply and industries. Application of remote sensing and geographic information system (GIS) techniques for ground water management studies should also be taken up for good results. Imposition of suitable ground water legislation, with consensus among people from different social, political and administration platforms can check over exploitation of precious ground water resources. A new thought is emerging nowadays that if third world war is fought it will be for WATER. Therefore, we all the inhabitants of this planet must wake up and be aware of judicious water use.

Ground Water Related Issues & Problems

The important problems related to ground water emerged in this study area as follows:

1. Decline in Water level of the study area: Growth of Tube Wells are most important cause of ground water level depletion
2. Ground Water Quality: The major problem associated with ground water quality is of fluoride, nitrate, TDS, chloride and salinity of the study area.

These two problems are quite serious because the study area is over-exported. Following measures can be adopted to sort out the problems:

1. To enhance the recharge of the aquifer by the construction of certain civilengineering structures like Anicuts, Check dams on nalas i.e. rainy streams of thestudy area.
2. The water is extracted mainly for irrigation purpose and farmers usually appliesfaulty irrigational practices mainly the flooding of water in the farms, whichrequires a lot of water to irrigate their farms. The farmers may be banned orrestricted to use such practices and may be encouraged to adopt some newirrigational practices, such as sprinkling, drip irrigation in which lesser water isrequired to irrigate.
3. The people of the areamay be advised or rather forced to create rainwater Tankas in each and everyhouse so that they may collect rainwater in to those Tankas by using 'RainwaterHarvesting Techniques'.
4. The people of the area shall be motivated for plantation and a forestation toimprove the climatic balance to enhance the rainfall in their area and to augmentthe rate of infiltration through plants roots in the area.

5. The cost-effectiveness of various technologies, under varying conditions, fordesalination of saline and brackish ground water should be explored. Pilot projectsshould be undertaken to evaluate these technologies under field conditions.
6. Revival of traditional ground water storage system i.e. Baori, open wells, Tankaetc for rainwater conservation for use in day to day life will reduce ground waterdraft.
7. The delegated organizations, should undertake community awareness programsrelated exclusively to ground water conservation and water-related issues, withparticular emphasis upon improved water management and the reduction ofground water extraction in over-exploited and critical study areas.
8. Ground water should be regularly monitored for quality. A phased programmeshould be undertaken for improvements in water quality.
9. Exploitation of ground water resources should be so regulated as not to exceed therecharging possibilities, as also to ensure social equity. Ground water rechargeprojects should be developed and implemented for improving both the quality andavailability of ground water resource.
10. Mass awareness program and water management training program shouldbe must compressor and will be beneficial to check the decline in the water leveland justified use. A perspective plan for standardized training should be anintegral part of water resources development. The training should extend toall the categories of personnel involved in these activities as also the farmers.

Conclusion

The study area is climatically semiarid region and has a mineralized native groundwater due to different physio-chemical phenomenon like low precipitation, high rate of evaporation, variable rates of recharge and discharge, soil salinity, Base Exchange phenomenon and longer stays time of water in aquifer etc. Subsurface lithologies also contribute a lot to the salinity of groundwater.The ground water is the main source to meet domestic, irrigation and otherrequirements. So, here it is important to evaluate ground water utilization to quantifythe existing and prospective development. Imposition of suitable ground water legislation, with consensus among people fromdifferent social, political and administration platforms can check over exploitation ofprecious ground water resources. A new thought is emerging nowadays that if thirdworld war is fought it will be for WATER. Therefore, we all the inhabitants of thisplanet must wake up and be aware of judicious water use.

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