Biannual Open Access Journal
Peer-Reviewed/Refereed International Journal
JOURNAL OF GLOBAL RESOURCES
Published by: ISDESR, Jaipur, India
www.isdesr.org
ISSN: 2395-3160 (Print)
ISSN: 2455-2445 (Online)
January 2023, Volume 09 (01)
DOI Prefix: 10.46587/JGR

11

CLIMATE CHANGE IMPACT ON GROUNDWATER RESOURCES IN DISTRICT JHUNJHUNU, RAJASTHAN, INDIA

Jyoti Chouhan
Assistant Professor, Dept. of Geography,
Vedanta P.G Girls' College, Reengus (Sikar), Rajasthan, India.'
Email: jyoti.chouhan218@gmail.com

How to cite this paper:
Chouhan, Jyoti (2023) Climate Change Impact on Groundwater Resources in District Jhunjhunu, Rajasthan, India, Journal of Global Resources, Vol. 09 (01)

DOI:
10.46587/JGR.2023.v09i01.011

Received: 11 Sep. 2022
Reviewed: 30 Oct. 2022
Final Accepted: 09 Dec. 2022

Abstract: *Climate change will affect our lives through its impact on our health, water resources, food, natural environment and economy. One of the primary effects of climate change is the disruption of the water cycle. Since so much of everyday life and planning is determined by hydrological systems, it is important to understand the impact that climate change is having on drinking water supplies, sanitation, food and energy production. This paper is about the impact of climate change on the Ground water resources, mainly it has focused on the water resources of Jhunjhunu (Rajasthan) area. The main source of water is ground water in this area. Ground water is an important source of water supply throughout the world and it is the main source of drinking water in the most of the rural areas. The quality of ground water is continuously changing as a result of climatic change and human activities. The main essence of this study is to explore the overall aspects of water resources and its impact on the people that are using the resources. This study finds the problems faced by the people on water resources, sources of water resources, pattern of rainfall and how the people will deal with those consequences. This study predicts the intensity of rainfall will increase due to climate change. Issues that need to be addressed with respect to climate change/variability in sustainable water resources planning and management are discussed. We find that a comprehensive and detailed understanding, clear assessment of the impact of climate change on water resources are required to reach a definitive conclusion and explanation of the trends to understand a better policy actions.*

Key words: Climate Change effects, Ground Water Resources, Management.

Introduction

Climate change directly and indirectly impact on multiple sectors including water resources, agriculture, regional, human system, food security & health etc. Climate change consequences related to water resources are increase in temperature, precipitation patterns. Ground water recharge may also be affected with reduction in the availability of ground water for drinking water in same regions. Climate change generally impacts on renewable ground water recharge. Resources that are fed by diffuse ground water recharge (recharge associated with rain fall across the landscape) and localised ground water recharge (recharge associated with water losses from rivers and flood plains) both of which are largely depend on annual rainfall and its seasonal distribution. Water is invaluable gift of nature and the existence of only living beings rests on it. With the change of time, excessive exploitation of this natural resource and lack of rainfall are leading to water crisis in the state.

Rajasthan is the largest state in India. Due to low availability and scarcity of surface water in the state, about 90 percent of drinking water schemes and 60 percent irrigation works are based on ground water. Our ancestors understood the importance of water in the state and were doing the strong water management from the very beginning. Since the last 40-50 years, when the state government took the responsibility of managing drinking water and started getting this water at a very low price without any labour, we forget its importance and also stopped the rainwater harvesting that our ancestors were doing for years. Along with this, due to indiscriminate drainage of ground water and fall in ground water recharge from rainwater, the ground water level of the state started falling rapidly. The ground water situation of the last years of the state indicates how we are moving towards a serious ground water crisis. While 86 percent of the areas used to be in the safe category in the year 1984, currently only 13 percent of the areas fall under the safe category. Currently 198 out of 237 blocks are in the Dark category.

Study Area

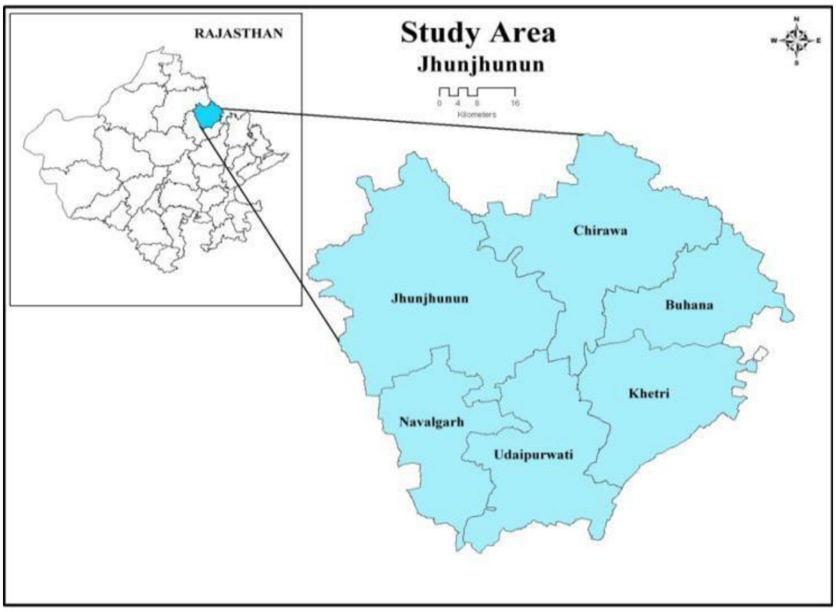
The study area is located in the North -western part of India and Jhunjhunu district is located in the state of Rajasthan which comes under western part of India. Jhunjhunu has a latitude of 28°7'48"N and a longitude of 75°23'60"E or 28.13 and 75.4 respectively. Jhunjhunu district comprises of 5928 sq. km. geographical area, having 535 sq. km (9 percent) is hilly area considered not suitable for water recharge and balance 5393 sq. km is mappable area inclusive of 120 sq. km is saline area. The administrative set up of the district bus given below. The district falls within Shekhawati region. Jhunjhunu district is located in North-Eastern Rajasthan with Churu to its the North-West, Hissar and Mahendragarh (Hariyana) on its North-East and by Sikar to it's in the South, South East and West.

Objective & Methodology

This study finds the problems faced by the people on water resources, sources of water resources, pattern of rainfall. This study predicts the intensity of rainfall will increase due to climate change based on 36-year climate data of Jhunjhunu. Data Collection was done from the Secondary data through to two main sources of ground water data were used for the purpose of this work–

- 1.Data from the central ground water Board (CGWB)
- 2.Data from Rajasthan Ground water Department (READ)

Figure 01: Study Area Map



Source: www.researchgate.net

Jhunjhunu District Climate and Rainfall

The climate of the district can be classified as semi- arid. This location is classified as BSh by Koppen and Geiger. It is characterized by very hot summers and very cold winters with poor rainfall during south- west monsoon period. In May and June, the maximum temperature may sometimes go up to 48 C. The Winters are quite pleasant in Jhunjhunu with minimum temperature is 0 C. The normal annual rainfall is 479.44 millimetre, about 12.7 of the annual rainfall is in sandy area and 7 percent of the water in rocky area goes in to the land, which collected about 244 million cubic meters of ground water but 556 million cubic meters of ground water area being exploited. Drinking water scheme and irrigation works in the district are based on ground water. About 92 percent of the maximum water is spend in agriculture, 7 percent in drinking water and rest in industries and other activities. The annual rainfall of the district based on 36-year data (1971-2006), Following Table shows the average climate data Jhunjhunu, both the long-term and short-term.

Table 01: Climate data of Jhunjhunu District

Month	Long Term average (1970-2000)					Short term average (2008-13)		
	Min. Temp (°c)	Max. Temp (°c)	Avg. RH (%)	Wind Speed (kmph)	Rain (mm)	Min. Temp (°c)	Max. Temp (°c)	Rain (mm)
Jan	5.0	22.0	60.6	4.1	9.2	1.9	27.7	5.1
Feb	8.0	24.8	52.9	4.8	10.1	4.3	33.9	9.1
Mar	13.6	31.1	44.9	5.2	7.3	10.6	40.2	6.7
Apr	19.5	37.2	34.4	5.8	5.4	15.8	44.9	12.9
May	24.5	40.8	35.6	6.9	22.2	22.0	46.6	26.0
Jun	27.1	40.3	65.2	7.7	47.2	19.5	46.4	60.5
Jul	26.2	36.2	68.0	6.9	155	24.2	44.0	120.2
Aug	25.2	34.8	73.2	5.6	147.7	24.4	38.3	169.0
Sep	23.0	35.5	64.1	5.3	67.3	21.4	39.4	117.7
Oct	17.6	34.9	48.5	4.0	10.9	15.3	38.8	3.1
Nov	11.3	29.9	48.8	3.4	3.7	9.7	34.4	8.5
Dec	6.2	24.5	56.8	3.5	6.6	3.7	29.8	6.6
	17.3	**31.7**	**54.4**	**5.3**	**492.6**	**1.9**	**46.6**	**545.4**

Source: Central Ground Water Board

GROUND WATER SCENARIO

Hydrogeology

Quaternary alluvium is the principal water bearing formation in Jhunjhunu District. Besides, hard rocks of Delhi Super Group including post Delhi Intrusive form ancillary aquifers in Jhunjhunu. Alluvium (composed of sand, silt, clay, kankar and gravel) forms the principal and potential aquifer in the area. Area and thickness of sediments varies widely from 15 to 140 m whereas saturated thickness varies from 30 to 70 meter. Ground water occurs under unconfined to semi-confined conditions in the primary porosity i.e., pore spaces. Aquifer system is present to a depth of 100 m in general. The depth to water level varies from 7.53 to 75 m below ground level(fig:3). In Jhunujhunu town, groundwater occurs under alluvial conditions and thickness of alluvium ranges from 80 to 100 m. Groundwater table is very deep in the town, and ranges between 70 to 80m..According to Central Ground Water Board (CGWB) Report of Jhunjhunu District (2008), ground water is alkaline in nature. The electrical conductivity ranges between 450 and 3000 ms/cm. Fluoride and Nitrate concentration is more than permissible limit (1.5 mg/l and 45 mg/l respectively) in some of parts of Jhunjhunu and in some other parts of the district.

Ground Water Resources of Jhunjhunu district

Jhunjhunu district is covered under mainly Shekhawati basin and North western part falls under the outside the basin i.e., having inland drainage. The area is drained mainly by Kantali river. The area in the South Eastern part is drained by Singhana river and a small area in South western corner of district is drained by Budhi Nala, the South and east of hill ranges in Khetari area is drained by Dohana river. All the river nalas are ephemeral in nature and flows in response to heavy precipitation during monsoon. Being a desert terrain particularly in North eastern and North western part of district has inland drainage. Another physical impact that is often associated with excavation is the effect on drainage and the local water table if groundwater and surface water collect in the voids. In Jhunjhunu groundwater is much deeper than the proposed trenching depth, and rains are scarce and limited to very short duration during monsoon. However, to ensure that water will not pond in pits and voids near project location, the construction contractor will be required to conduct excavation works in non-monsoon season to the maximum extent possible. The dynamic groundwater resources as per ground water estimation 31.03.2013 is furnished below in table 2.

Table 02: Ground Water Resources, Jhunjhunu District

Block	Ground Water Availability (MCM)	Irrigation Draft (MCM)	Domestic /Industrial Draft (DCM)	Gross Draft (MCM)	Stage (percent)
Alsisar	26.7296	17.7706	9.1498	26.9204	100.71
Buhana	26.6425	40.3020	9.9937	50.2957	188.78
Chirawa	5.6765	5.2762	3.1069	8.3831	147.68
Jhunjhunu	32.3191	45.5782	13.1006	58.6788	181.56
Khetri	5.0267	9.1164	1.0592	10.1756	202.43
Nawalgarh	17.8170	44.3556	10.4390	54.7949	307.54
Surajgarh	22.8437	53.4720	11.4982	64.9702	284.41
Udaipurwati	29.8514	56.5182	15.5900	72.1082	241.56
Total	250.7626	462.6845	104.0513	566.7358	226.00

Source: Central Ground Water Board

IMPACT OF NATURAL CALAMITY ON GROUND WATER RESOURCE

Influence on Ground Water recharge due to change in precipitation and evapotranspiration:

Climate change affects surface water resources directly through changes in the major long-term climate variables such as air temperature, precipitation, and evapotranspiration The greater variability in rainfall could mean more frequent and prolonged periods of high or low groundwater levels. The direct effect of climate change on groundwater resources depends upon the change in the volume and distribution of groundwater recharge. Therefore, quantifying the impact of climate change on groundwater resources requires not only reliable forecasting of changes in the major climatic variables, but also accurate estimation of groundwater recharge. Rainfall pattern is changing and trend show that decrease in rainfall and increase in temperature in the district. Surface water availability is limited and there is no proper estimation available in Jhunjhunu District. the district is covers under Shekhawati river basin and 60 percent area falls in outside basin the drainage system is limited so surface water according has become difficult. However, there is ample scope for rainwater harnessing. Scanty and irregular rainfall conditions have resulted in poor recharge to ground water climate projections indicate further decrease in rainfall in the future which will further limit the recharge of ground water resources.

Effect on ground water availability in alluvial aquifers due to increase and decrease in flood events:

The main source of groundwater is Floods Rainwater and meltwater which infiltrates downward through the pore spaces of surficial materials and collects in large quantity in aquifers of varying sizes and locations. Floods are an important source of groundwater recharge in most of the world's dry lands. Appropriate management practices, flooding can benefit the ecology of arid and semi-arid regions. Recharge is the portion of infiltration that reaches the water table after passing through the soil profile. The area is drained mainly by Kantli River. The area in the south eastern part is drained by Singhana river and a small area in south western corner of district is drained by Budhinala. The south and east of hill ranges in Khetri area is drained by Dohana River. All the rivers/nalas are ephemeral in nature and flows in response to heavy precipitation during monsoon. Being a desertic terrain particularly in north eastern and north western part of district has inland drainage. but due to Rainfall pattern is changing and trend show that decrease in rainfall and increase in temperature in the district. The volume of water in the Kantali river has decreased since 1982. Groundwater levels have been reduced by about 30-40 feet in the last 35 years. The drainage system is limited so surface water according has become difficult.

Reduced groundwater levels due to drought:

The total ground water area is 744.96 sq. km. There is mainly a single aquifer (ground water area). The total sandy area is 744.98 sq. km. Average annual rainfall is 405 mm. The groundwater level ranges from 41 m to 62 m. There is only Kantali river in the area which is the rainy river. Groundwater reserves are recharged only by rainwater. The fall in ground water level is 0.83 meters per year. As a result of the fall in groundwater recharge from rainwater, the ground water level of the state started falling rapidly. The ground water situation of the last years of the state indicates how we are moving towards a serious ground water crisis. The average groundwater level in Jhunjhunu district was 36 meters in 1995, which has fallen to 48 meters in the year 2010. This has increased the electricity expenditure. Tube wells and wells have dried up, and are drying up. This has led to drinking water crisis along with irrigation in the village. There is a drastic reduction in ground water level. decrease in the discharge of wells, borewells etc. and drying up of them, high expenses on electricity, etc. are causing crisis.

Ground Water Development and Management Strategy

1. 1 As the district has 200.05 percent stage of ground water development (all the blocks except Alsisar rest in over-exploited category having 107.41 percent to 314.78 percent stage of ground water development), thereby leaving little scope of further ground water development for irrigation except for drinking purpose which may be taken up only in very restricted and planned way to avoid becoming further over-exploited.
2. 2 Ground water should be used judiciously taking in to account of modern agriculture water management techniques by cultivating crops requiring less watering and use of sprinkler system and drip irrigation should be encouraged.
3. 3 A modern agriculture management must be taken into account for effective water management techniques involving economic distribution of water maintaining minimum pumping hours and also be selecting most suitable cost-effective crop pattern i.e., for getting maximum agriculture production through minimum withdrawal. Adopting proper soil and water management even the ground water with somewhat dissolved solids (TDS) may also be suitable for irrigation for salt tolerant crops in the area having high salinity.
4. 4.Desalination and fluorosis plants may be installed in the areas /villages facing ground water salinity and fluoride hazards.
5. 5.Area is underlined by unsaturated moderate thickness of alluvial which provides sufficient scope of artificially augmentation of the ground water body as alluvial formation has very good storage and transmission capacity in the district. In the district, there is rainfall of about 2878.64 mcm considering the area and average annual rainfall. Out of this, 235.1238 mcm is annual natural recharge as per the ground water. The above data indicate the availability of surplus water which can be used for artificial recharge through the various techniques feasible in alluvial and hard rock terrain.

Conclusion

Rainfall pattern is changing and trend show that decrease in rainfall and increase in temperature in the district. Surface water availability is limited and there is no proper estimation available in Jhunjhunu District. The stage of ground water development of the district is 200.05 percent which reflects excessive withdrawal of ground water in comparison of recharge, resulting in depletion of ground water levels and reduction in yields of wells. In view of this, three blocks viz. Buhana, Chirawa and Surajgarh in Jhunjhunu district have already been notified by Central Ground Water Authority, New Delhi for regulation and control of ground water development. Now regulation on ground water use in the area should be implemented effectively.

Suggestion

“Work will have to be done on the notion of *'Save as much as you can - you will get more'*.”

At the household / personal level:

1. Reuse of domestic discharged water in garden and do not waste water from domestic taps.
2. Use small size utensils and appropriate amount of water for cooking. While cooking cover the vessel so that water loss can be saved from evaporation.
3. To stop cutting of trees and plants for cooking, so that average annual rainfall can increase, as well as soil conservation will also happen.

4. Make arrangements for rainwater harvesting in homes, so that the pressure of tapping ground water for domestic work can be reduced.
5. To recharge ground water from rainwater in every house, a recharge structure should be created so that groundwater reserves can be increased.

Agricultural sector level:

1. Adopting sprinkler and drizzle irrigation system to save 40 to 60 percent of water.
2. About 30 to 40 percent of water can be saved by growing crops with low water usage.
3. Use appropriate fertilizers and pesticides in appropriate quantities so that pure water can be saved from pollution.
4. Recharge by dug well/percolation pit in agriculture farm. In hard rock terrain nala bunding, anicuts, dug wells, percolation tanks etc. are feasible structures which may be used to recharge the ground water body. Technical guidance is provided to various organizations as and when approached

At the industrial level:

1. To make recycling required for reuse of 80 percent of the water used by all industries.
2. Artificial ground water recharge should be mandatory in all industries.
3. 3.Roof top/paved area rain water harvesting for recharge to ground water in urban and industrial area.

At community level:

1. Make the water filled around tube wells / hand pumps etc. by making recharge structures, artificially recharge ground water and do not let this filled / collected water go waste.
2. After calculating the annual groundwater recharge due to rainfall, decide for yourself how much groundwater is to be removed.
3. Use of unused wells, tube wells, hand pumps etc. for groundwater artificial recharge.
4. Renovation of village ponds, stepwells etc. in which rainwater can be collected and used. This work can also be done under MNREGA scheme.
5. Implementing effective methods of minimizing evaporation rate of surface water such as ponds.
6. Mass awareness programmes should be arranged at local level to make common mass aware of importance of ground water resources, its better practices of use in domestic, irrigation and industrial fronts, present status of ground water scenario, its conservation etc.
7. Training programmes should be arranged at local level to teach the common mass of various techniques of artificial augmentation to ground water resources.

References

1. Central Ground Water Board Ministry of Water Resources, Government of India, Report on National Aquifer Mapping Programme (July,2017), District Jhunjhunu, Rajasthan.
2. Central Ground Water Board (2008) Ministry of Water Resources, Government of India, Ground Water Brochure-Nov 2008, District Jhunjhunu, Rajasthan.
3. Article (Published: 14 July 2017), Flood Effect on Groundwater Recharge on a Typical Silt Loam Soil, China.
4. Rajasthan Urban Sector Development Program, Government of Rajasthan for the Asian Development Bank, Water Supply and Sewerage in Jhunjhunu.
5. Panchayat Samiti, bhujalsthiti, Jila Jhunjhunu, Rajasthan
6. Professor H. S Sharma and Dr. M. L Sharma, Geography of Rajasthan (2005), Panchshil Publication., Jaipur Rajasthan
7. United States Environmental Protection Agency,
8. https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-water resources_.html
9. Central Ground Water Board (2010). Ground Water Scenario of India 2009-10. Ministry of Water Resources, Government of India.