Role of Groundwater Community Participation and Regulatory Measures for Sustainable Groundwater Reservoir of Rajasthan, India

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Abstract*- Groundwater is a major source of water, but over a few years, the water level is highly likely to go down due to overexploitation and a lack of artificial recharge. Through regulation and governance, the groundwater community's participation is now required as a viable mitigation strategy for balancing the supply and demand of the groundwater reservoir. The State of Rajasthan is the largest state in the country, covering an area of 3.42 lakh square kilometres, which is more than 10% of the total geographical area of the country. Based on secondary data and primary data sets gathered during field research, it is noted that the water level below the ground surface drops very far, about more than 50 metres at MIA industrial area. According to the data gathered, water levels dropped between 55 and 122 metres. There is a rise or fall variation of 0.5 to 2 m. It has been noted that supply is lower than demand. According to the Jal Shakti Notification of September 24, 2020 (CGWA guidelines), the State Water Policy of the Government of Rajasthan of 2010, and the State Groundwater Department's directions of December 7, 2020, the groundwater community will be assessed for the necessity of constructing various types of water conservation structures. Thus, there is a clear need to develop robust mechanisms of groundwater governance, as well as participatory forms of groundwater management and development within watersheds in collaboration with local government agencies, gram panchayats, NGO if available, farmers, and SHG groups of women's.

***Index Terms*- Groundwater, Community Participation, Governance, Regulation, Hydrogeology.**

I. INTRODUCTION

India is likely heading towards a significant water crisis, as according to a 2018 report by NITI Aayog, about 600 million individuals could face severe water scarcity by 2030. The report titled "Composite Water Management Index" also revealed that India ranks 120th in the list of 122 countries when it comes to water quality index, and nearly 70% of the country's water is contaminated. The data released by the Central Ground Water Board in 2017 indicated a crisis due to overexploited groundwater levels in India. The data revealed that as many as 256 out of 700 districts in India have reached critical groundwater levels. According to one study, the presence of both man-made pollutants and naturally occurring toxic minerals has harmed groundwater quality in India's desert state of Rajasthan. Without treatment, researchers warn that the contaminated groundwater is unsafe to drink.

Given this scenario, there is a need to understand groundwater science from the people's point of view, demystify it, and transfer such science to relevant communities. Community participation in conservation efforts varies widely, reflecting a continuum from protectionist conservation mechanisms to programmes driven by local communities. For this to occur, there is a need for passionate people from the community who are willing to take responsibility to understand sufficient groundwater science to be able to utilise it for the betterment of their community. Community participation in ground water is considered a key factor for planning related to disasters and environmental issues in an international context. Local community involvement in natural resource management can be critical to conservation success. Conservation is not one event, but an iterative process

with many steps (planning, implementation, and monitoring), each with an opportunity for different levels of participation.

Numerous factors can influence the level of community participation present at the different stages of conservation projects. Some potential barriers to participation are related to issues of power. In many cases, to achieve a more participatory model of conservation, governments must be willing to cede at least some power. Studies of conservation and natural resource management have tended to focus on the outcomes of participatory processes without distinguishing how participation varies across different management stages. If greater levels of local participation are beneficial and deemed a worthy goal, then conservation managers and researchers must pay more attention to how participation varies across management stages. Conservation management frameworks are social ecological systems, which tend to be dynamic as the social, political, economic, and ecological conditions in which they are embedded change over time.

II. STUDY AREA

The present study was conducted in 2022, near Alwar town towards the south-east side, and it comprised an industrial area and surrounding villages. The study location is shown in Fig.1. These areas fall in the semi-arid region, with a mean annual precipitation of around 500 to 600 mm and a minimum and maximum average daily temperature of 20 oC and 47 oC respectively.

III. CASE STUDY ALWAR DISTRICT RELATED TO GROUNDWATER

The State of Rajasthan is one of the driest states in the country, and the total surface water resources in the state are only about 1% of the total surface water resources of the country.

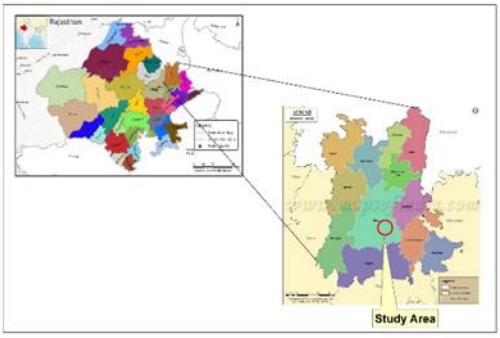

Fig.1 Location Map of the Study Area

As part of the Duke University India Initiative, researchers tested 243 groundwater wells, across the northwest Indian state of Rajasthan, the country's largest state by area, to probe the presence of multiple contaminants in groundwater. They discovered that over three-quarters of the wells (tube wells or hand pumps), that provide drinking water without any treatment contain contaminants such as fluoride, nitrate, and uranium at levels that exceed both Indian and WHO drinking water norms. A combination of geogenic (natural or geologic) and anthropogenic (or man-made) processes affect groundwater chemistry and quality in Rajasthan, Man-made contaminants such as those that leach out from agriculture and domestic sewage (for example, pathogens and nitrates) keep authorities on their toes. The geogenic contaminants, such as those coming from aquifer rocks (fluoride and uranium), can go unnoticed because they are considered natural and their health effects are not immediately detected. The average annual rainfall in this region is less than 500–600 mm. According to the CGWB report, the groundwater has been declining by 25 cm per year to 2 m per year.

The Alwar region is semi-arid, with monsoons mostly occurring from June to September and the remaining months being dry. The industrial growth is dependent on groundwater, and that dependence has led to unsustainable over-extraction, which is lowering the water levels and adversely impacting drinking water security.

Based on secondary data and primary data sets gathered during field research, it is noted that the water level below the ground surface drops very far, about

more than 50 metres at MIA industrial area. According to the data gathered, water levels dropped between 55 and 122 metres. There is a rise or fall variation of 0.5 to 2 m. It has been noted that supply is lower than demand. According to the current situation, industrial growth is dependent on groundwater, and users have engaged in unsustainable over-extraction, which is lowering the water level and negatively impacting drinking water security. As a result, recharge is needed at the same rate as discharge. On October 7, 2020, the Groundwater Department of the Government of Rajasthan published a letter for the management and direction of groundwater abstraction with the permission of the district collector. Industry can execute artificial recharge through local government agencies, gram panchayat NGOs, farmers, and women's SHG groups. It depicts the groundwater resource scenario in the study area. Also, be aware of groundwater users. We need to form a groundwater community in that watershed area, which is the responsibility of all users working together to enhance the groundwater resources. Implementing groundwater management and protection measures needs a quantitative appraisal of aquifer evolution and effects based on detailed multidisciplinary studies supported by reliable data. An interdisciplinary perspective is important while managing groundwater resources in India and helping establish groundwater governance.

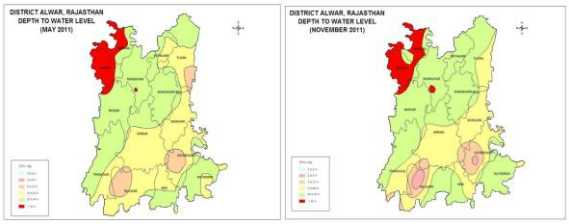

Fig.2 Showing the Depth to Water Level (2011) of Alwar District

The collected water level of the study area is given in Table1.

Table1- Water Levels of the Study Area

Sr. No.	Borewells	Location	Depth (m)	Elevation (msl)	Water level pre-monsoon (mbgl)	Water level post monsoon (mbgl)	Fluctuation
1.	BW-1	MIA Area	140	253	81	79	2.0
2.	BW-2	Goondpur	137	255	56.6	55	1.6
3.	BW-3	Jhardea	122	250	101.9	100	1.9
4.	BW-4	Naharpur	168	252	90	91	1.0
5.	BW-5	Ghegholi	152	270	122.2	122	0.2
6.	BW-6	Rundhula	146	247	83.25	82	1.25
7.	BW-7	Kairwa Jat	183	256	119.75	119	0.75
8.	BW-8	Gujuki	107	258	95	94	1.0

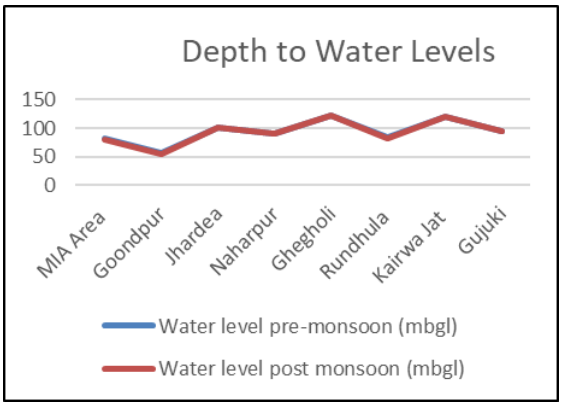

Fig.3 Graph Showing the Depth to Water Level (2022) of Pre & Post Monsoon Season

IV. GROUND WATER COMMUNITY PARTICIPATION

i. Water Management Planning: This includes the involvement of the public or people of concern during

the planning phase to help them build an understanding about the use of geo-hydrological aspects for water security plans as well as their involvement during the execution phase, especially to supervise work to meet the set objectives of the activity and to monitor the quality of this implementation.

ii. Water Resource Mapping using GIS: Internet GIS, serving spatial data and GIS functionality on the web, offers a special and potentially important means to facilitate public participation in the planning and decision-making processes. GIS techniques will be used to analyse the various parameters that are responsible for the decline of groundwater levels, such as structural geology, slope, aquifer, lineament density, rainfall, soil characteristics, etc. Geographic Information Systems (GIS) have proven to be essential to the efforts of community organizations. GIS enables the storage, analysis, and mapping of geographic data such as demographic, housing, land-use, or environmental quality information, at multiple scales. Ease of visualising and analysing neighborhood-based spatial data.

iii.Watershed and water balance Management: The science of groundwater is used in context to understand aquifers and their characteristics, as well as to develop efficient and equitable supplies and manage recharge through programmes like watershed development. Public participation has been one of the key factors in the success of watershed management. The conflict between watershed management and the basic rights of local people has raised the important issue of establishing a framework for public participation in watershed management. India's diverse groundwater typology implies that aquifer scales vary over different orders of magnitude. In the absence of both temporal and spatial data, decisions on the management of groundwater are often 'ad hoc'. Lack of data and information at the appropriate scales often precludes decision support systems that otherwise exist in the form of village governance councils, watershed committees, or drinking water and sanitation committees.

V. REGULATORY MEASURES

The role of social norms in regulating groundwater usage and ensuring the security of groundwater resources is critical in managing India's highly decentralized and disaggregated groundwater use. For one, social norms can be customized to a location and/or a situation. It often evolves through participatory processes that combine science, technology and influence social behavior. A command-and-control type of legislation is not only difficult to implement and scale up, but it is also ineffective due to the conflict between decentralized and complex patterns of groundwater use and the centralized forms of groundwater legislation that States in India are empowered to develop and implement. However, if legislative reforms in groundwater law consider protecting participatory-social processes through instruments of law, it will enable a more 'legal' status for social processes. Hence, legislation and social processes can be complementary to each other. Moreover, unless and until groundwater legislation includes protecting resources, including the environmental role that aquifers play, rather than the more direct sets of norms like depths of wells and distances between wells for different purposes, the purpose of groundwater governance would be partially served. Therefore, one must return to some tenets of conventional legislation, albeit in a reformed version.

CONCLUSION

After evaluating the current situation of groundwater abstraction and analysing data in the Alwar district of Rajasthan, it was concluded that groundwater users must participate to restore the balance of sustainable groundwater resources. It should be the moral responsibility of all industrial users who abstract groundwater in the same watershed. They can form committees cluster-wise with one or two representatives from each. The entire process of controlling groundwater abstraction involves different efforts, such as the implementation of a system to measure the water consumption, levels, and quality, reduction of water consumption, adoption of water-efficient technology; rainwater harvesting, artificial recharge, water audit, abstraction and restoration charges; and finally, a penalty. The Rajasthan Government's State Water Policy, launched in 2010, aims to use available water wisely, equitably, and economically. Participation at different levels has been common to all these processes, and participation remains the key to building institutions that can carry

forward and sustain groundwater governance systems, especially at the scale of villages and small towns where it is needed most. The role of social norms in regulating groundwater usage and ensuring the security of groundwater resources is critical in managing India's highly decentralised and disaggregated groundwater use. The following regulations and rules can be adopted:

1. To regulate iniquitous groundwater, use and distribution to ensure that the safe and secure drinking water/domestic needs of every person and irrigation needs of small and marginal farmers can be met;
2. To regulate groundwater over-extraction in order to ensure the sustainability of groundwater resources, equity in their use and distribution, and satisfaction of ecosystem needs;
3. Promote community-based, participatory mechanisms of groundwater management that are adapted to specific locations;
4. Prevent and mitigate contamination of groundwater resources promote and protect good conservation, recharge, and management practices;
5. Protect areas of land that are crucial for sustainable management of groundwater and ensure that high groundwater consuming activities are not located in areas unable to support them

Thus, from considerations of health, ecology, and livelihoods, there is a clear need to develop robust mechanisms of groundwater governance along with participatory forms of groundwater management, both of which use aquifer-based approaches that have begun to find their way into the practises and policies dealing with groundwater in India.

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