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Depleting Groundwater Resources of Rajasthan State and its Implications

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Rajasthan has only 1.15 per cent of its water resources supporting 5.67 per cent of human population and 10.53 per cent cattle population of the country. The draft of groundwater for irrigation purpose has increased more than three times in last two and a half decade (from 1984 to 2009). The worsening water balance in the state, has resulted in the ever increasing numbers of blocks under the categories of over-exploited as of March 2009, the per cent of total blocks, under over-exploited category has gone up to around 70 per cent that were only 36 per cent in 1984.

Introduction

Agriculture is India's largest user of water as it is evident from the fact that in the year 2010 out of total water demand, 813 bcm for irrigation, industry, drinking water, energy and others, irrigation along accounted for the around 85 per cent (CWC, 2010). Groundwater irrigation, which expanded rapidly in the last few decades, has rapidly emerged to occupy a dominant place in India's agriculture and food security. It accounts for over 61 per cent of the irrigated area in the country (MOA, 2008-09). Groundwater is a vital resource, with a large fraction of the population relying on the resource directly or indirectly for livelihoods. Groundwater accounts for about 50–80% of domestic water use and 45–50% of irrigation in the country (Kumar et al. 2005). This heavy reliance on groundwater for both domestic water and irrigation purposes is now approaching its limit as an increasing number of aquifers reach unsustainable levels after decades of exploitation. A crisis situation now exists in a number of states. In India, the stage of ground water development is 61 per cent (CGWB, 2009). The status of ground water development is comparatively high in the states of Delhi (170 per cent), Haryana (109 per cent), Punjab (145 per cent) and Rajasthan (125 per cent) and UT of Daman & Diu (107 per cent) and Pondicherry (105per cent), where the Stage of Ground Water Development is more than 100 per cent, which implies that in these states the average annual ground water consumption is more than average annual ground water availability. The situation is, thus, deteriorating at a rapid pace. The gravity of the situation can be appreciated from the fact that the proportion of overexploited blocks nationwide has tripled from 5% to 15% between 1995 and 2009. In India, the stage of ground water development is 61 per cent. Further, in the country, out of 5842 assessed administrative units (Blocks/ Taluks/ Mandals/ Districts), 523 units (9 per cent), 169 units (3 per cent) and 802 units (15 per cent) are Semi-critical, Critical and Over-exploited, respectively (CGWB, 2009).

Rajasthan is the largest state in India covering an area of 34.22 Mha, i.e., 10.5 percent of the country's geographical area, and it shares 12.42 and 9.8 per cent of net sown area (141.36 mha, GOI, 2008-09) and net irrigated area (63.20 mha GOI, 2008-09) of the country, respectively. Ironically, it has only 1.15 per cent of its water resources (GOR, 2012). The tremendous pressure on water resources of state can be realised by the fact that state is supporting the 5.67 per cent of human population and 10.53 per cent cattle population of the country with this meagre share of water resource. Further, droughts are ubiquitous to Rajasthan, with erratic rainfall and extreme temperatures being common features in many areas of the state and the state is often faces the critical problems of periodic droughts (recurring droughts in 3-4 years in a cycle of 5 years; GOR, 2005) and scarcity of water. In addition to gloomy scenario on the supply side, the low water use efficiency in traditional method of irrigation is aggravating the problem to an unsustainable level.

Status of Water Resources of Rajasthan

Groundwater status of Rajasthan presented in Table 1 amply demonstrates that till the end of 19th century, the state was surplus in its groundwater resources as indicated by the positive values of groundwater balance. The situation deteriorated from the beginning of 20th century when the stage of groundwater development became more than 100 per cent and shot up 104 (2001) to 135 per cent in 2009. For this situation, irrigation was the primary contributor, as draft of groundwater for irrigation purpose has increased a most three times in last two and a half decade (from 1984 to 2009). The worsening water balance in the state, has resulted in the ever increasing numbers of blocks under the categories of over-exploited (Table 2) as of March 2009, the per cent of total blocks, under over-exploited category has gone up to around 70 per cent that were only 36 per cent in 1984.

Critical Issues in Water Sector in the State

1. Growing imbalance between demand and supply of water: The availability of water in the State does not commensurate with the requirement of water. The deficit between demand and supply is 8 BCM (2005) and likely to increase to 9 BCM by 2015. Thus the availability of water in Rajasthan is about 780 cubic meter per person per year as against the internationally accepted standards of 1000 cubic meter per person per year and is likely to reduce to 450 cubic meter per person per year by 2045 (GOR, 2010)

2. Uncertainty in availability of water: Rainfall in large parts of the State is not only inadequate but also varies sharply from year to year and place to place. The rainfall occurs only during two months of monsoon and the actual rainy days are numbered. The state has also to depend largely on the water allocated through Inter State Water Sharing Agreements, which depends upon inflows in the rivers.

3. Inequity in access of water: With vast variation in rainfall pattern and ground water

availability, some difference in access to water is inevitable.

4. Low operational efficiency of water resources systems: The problem of limited water availability is further aggravated by low operational efficiency. Two major users of water namely, drinking and irrigation both show avoidable losses.

5. Depleting ground water resources and deteriorating quality of water: With increasing dependence on ground water, the ground water resources are depleting at an alarming rate. Nearly 90% of the drinking water and 60% of the water required in the agriculture sector is extracted from ground water reservoirs. Around 80% area of the State is now witnessing ground water depletion.

Implications of the Depleting Ground Water Resources

Accelerated depletion of groundwater resources can have adverse effects on the livelihoods of the rural poor that rely on agriculture, especially in semi-arid areas where supplemental irrigation is critical for crop growth (Reddy, 2005). Some studies indicate that up to 50 per cent of wells once in use have completely dried-up (Shah, 2002; Reddy, 2005). The decline in water table gives rise to technological externalities in terms of rising costs of installing new wells, deepening of existing wells and pumping and other maintenance activities.

1. Inequity in profit margin: The profit margins across all landholding classes decline with the decline in water table and the marginal and small landholding classes are the worst sufferers of groundwater depletion. This indicates the fact that the cost of natural resource depletion is disproportionately born by the resource poor farmers because they are unable to invest in technology, and hence, remain excluded from its beneficial ambit. The inequality in the net returns, especially in the completely groundwater dependent agricultural economy, becomes inevitable with groundwater depletion.

2. Increasing cost of water extraction: With fall in the water table, the cost of extraction increases, as it is clearly evident from a study of central belt of Punjab, wherein it was found that cost of pumping out water has increased as the power required for lifting water from deeper surface is much higher than that from the shallow one and Submersible pumps are replacing the centrifugal pumps.

3. Aggravate vulnerability to drought: As we know, Rajasthan is vulnerable to drought, where, if the groundwater table falls at alarming rate then no longer it would remain as assured source of irrigation; that situation may lead to more vulnerable to drought.

4. Change in the quality of water: Due to tremendous use of ground water for irrigation and other purposes, it has resulted in sharp decline of ground water levels and brought about adverse changes in the geochemistry of ground water. Natural contaminates such as fluoride, nitrate, and chloride salts are increasing in ground water making it unfit for drinking and posing risk to health. There are many key concerns with respect to quality of ground water.

Table 1. Groundwater resource estimation in Rajasthan (bcm)

Year	1984	1990	1995	1998	2001	2004	2009
A. Gross groundwater recharge	16.22	12.71	13.16	12.60	11.16	11.56	11.86
1.Irrigation	4.93	5.42	9.09	11.04	10.45	11.60	12.86
2.Domestic & Industrial	2.11	1.99	0.70	0.98	1.18	1.39	1.65
B. Gross draft(1+2)	7.04	7.42	9.78	12.02	11.64	12.99	14.52
Groundwater balance (A-B)	9.19	5.29	3.38	0.58	-0.48	-1.43	2.66
Stage of groundwater development (%)	36	54	59	69	104	125	135

Source: State Water Policy Draft 2008, Government of Rajasthan and CGWB, 2006 and 2011.

Table 2. categorization of blocks based on the stage of groundwater development

year	Block (area unit)	Safe (white)	semi-critical (semi-gray)	Critical (Gray)	over-exploited (dark)
1984	236	203(86)	10(4.2)	11(4.7)	12(5.1)
1988	236	122(54.0)	42(18.6)	18(8.0)	44(19.5)
1990	236	148(62.7)	31(13.1)	13(5.5)	44(18.6)
1992	236	149(63.1)	19(8.1)	15(6.4)	53(22.5)
1995	236	127(53.8)	35(14.8)	14(5.9)	60(25.4)
1998	236	135(57.9)	34(14.6)	23(9.9)	41(17.6)
2001	236	49(20.8)	21(8.9)	80(33.9)	86(36.4)
2004	237	32(14)	14(6)	50(21)	140(59)
2009	236	30(13)	8(3)	34(14)	164(69)

Note: In the parenthesis percent of total blocks under a particular category.
Sources: M.S. RATHORE (2005) and Central Ground water Board (2006 and 2011)

The districts of Churu, Bharatpur, Barmer, Jhunjhunu, Nagaur and Ajmer where about 21190 villages/habitations mostly suffer from the problem of excessive salinity. About 23297 villages/habitations suffer from excess fluoride problem. This problem has serious proportions in the districts of Jaipur, Tonk, Nagaur, Ajmer, Bhilwara, Sirohi and Pali. Excess nitrate is another problem for about 20659 villages/habitations of Jaipur, Nagaur, Barmer, Udaipur, Jodhpur, Churu, Alwar and Tonk which are the worst affected districts (GOR, 2005).

5. Inequity in access to groundwater irrigation: As depleting water table is beyond the reach of poor farmers, under such circumstances, they have to depend upon other well-owners for groundwater irrigation. Otherwise, they would be deprived of the access to groundwater on one hand and the resource- rich individuals would chase water table by making heavy investment in extracting water on the other. It may be inferred that increased use of groundwater results in inequitable distribution of this precious resource (Dalbir, 2007).

6. Impact on Groundwater Markets: It is seen that with water tables receding, a larger number of marginal and small landholding households depend on groundwater market for irrigation (Sarkar, 2011). When groundwater resources deplete and the cost of well construction and pumping increases, thus, the system of trading water provides

greater economic opportunities to well owners having large holdings, and lesser opportunities to well owners having smaller holdings and water buyers. This is due to the fact that for a large farmer, the implicit unit cost of water is much lower as compared to small farmers. At the same time, a small farmer will not be able to raise the water charges to match with the implicit cost of pumping, as the prices are determined by the market forces (Kumar et al., 2005).

Conclusion

Water table in the state is continuously falling over the years and the blocks under the critical and over-exploited categories are increasing at alarming rate. Over-exploitation of groundwater leads to reduction in water yield in the wells, increase in pumping depth and cost of pumping, contamination of groundwater. The groundwater management rather than development is the major challenge facing the water resources, particularly in the dry land areas. Therefore, a focus on the development activities must be balanced by integrated management mechanism to achieve a sustainable utilization of groundwater resources, which is an important driver for the management of watersheds for sustainable development in the state.

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