



From Vulnerability to Sustainability: Analyzing the Dynamics of the Water Demand–Supply Gap

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ABSTRACT: In the era of rapid growth that connotes changes in consumption and production patterns of population, enormous and substantial transformation in environment and climatic conditions are threatening realities along with industrialization. The situation is considerably critical, since the natural resources are scarce hence the requisite of economizing of resources is on the highest priority. To assure smooth availability and sustainability, a resource-based management mechanism is essential for conservation and sustainable use of resources. Water is a vital element for all living as well as non-living processes. Therefore, the efficient water management is quintessential for assuring aforesaid processes. Furthermore, the study attempts to investigate and analyze the current position of water resource and demand side management with special reference to Rajasthan drought prone area in western part of India. This area faces frequent situation of critical scarcity of water and adverse climatic situations. This attempt would explore various principal variables like the Demand- Supply Gap for Water, quantum of Annual Rainfall, Surface Water, Ground Water, Cultivable Area, Irrigated Area, Per Capita availability of Water, Drinking Water Management, and Waste Water Management. Analysis based on various bi-variate and multivariate statistical techniques give important pointers for efficient water Management in the area. This study contributes and adds significant knowledge in the area of applied economics where problem-based studies are taking place. It is also beneficial for the policy makers presented in the local government to develop optimization mechanism for assuring water availability as needed by people and industries and to reduce the degree of water wastage.

Keywords: Water Resource Management, Water stress, Demand-Supply Gap, Mitigation, Annual Rainfall.

INTRODUCTION: India has made significant advancement in developing its water resources and supporting infrastructure but due to rapid development, population pressure and iniquitous division of water, the requirement for this natural resource far outweighs its supply and the crisis of access to adequate and safe water for drinking, agriculture, industry and livelihood activity is increasing in recent years. The water sector in India is facing critical and problematic issues related to management, infrastructure requirements, water use inefficiency, water quality and water pollution. India has about 16 per cent of the world's population as compared to only around 4 per cent of its water resources, the per capita water availability in India is around 1,170 cu m/person/year. Rajasthan as the India's largest state geographically, is a desert state, where agriculture accounted for more than 70 percent of water consumption, and increasing water scarcity was punctuated by recurrent droughts. Various Projections are indicating that rapidly increasing demand for water for domestic, agriculture and industrial use in Rajasthan, is the critical challenge to ensure that Rajasthan could better deal with the long-term sustainable use of its increasingly scarce water resources (Mekonnen and Hoekstra, 2016). Severe water shortages have led to increasing number of conflicts between users in the agricultural and industrial sectors and the domestic sector. The situation is

exacerbated due to the impacts of climate change. Therefore, to achieve sustainable growth and development with respect to water resource management newer strategies have to be evolved. It is necessary to resolve the need for sustainable access to water and to ensure the balance among competing water demands (Asghar *et al.*, 2019).

Aim of Study: The present piece of research focuses upon the practice of water resource management to meet supply and demand with the available precipitation, in areas of severe water stress. This explores the areas where necessary measures and mitigating strategies are required to make water resource management more efficient and sustainable, especially in the circumstances of under-predicted rainfall and drought.

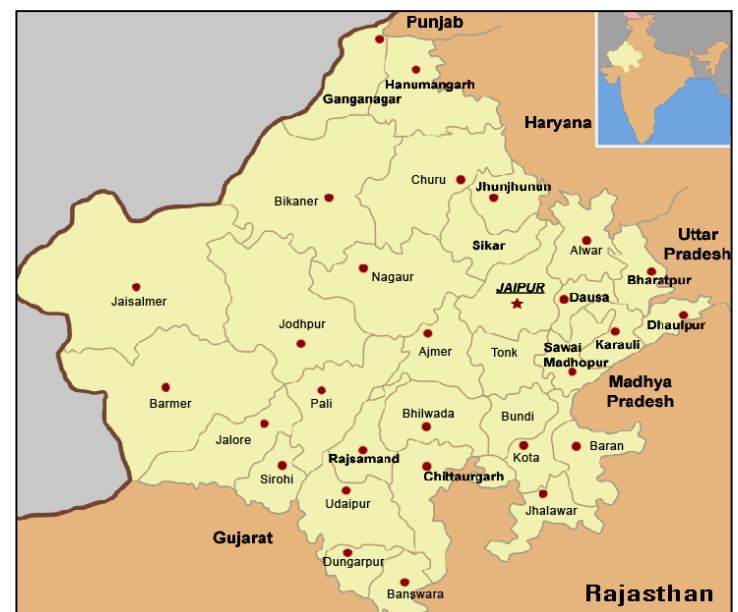
PROBLEM AND HYPOTHESES: The present study is an attempt to provide a comprehensive analysis of the state of water resource development and management in Rajasthan, based on general observations and secondary information. It highlights the current challenges and suggests reasonable alternatives amidst growing water scarcity. Moreover, this study aims at achieving a holistic and dynamic understanding of the level of demand and supply of water and looks at the strategic steps required for action. The focus is to develop an environment in the state where water is available for all in a sustainable manner- safe drinking water for domestic needs, sufficient water for agriculture and water for industry. The present study is developed through secondary sources followed by the analysis.

The hypotheses under study are:

H₀₁: The projected Supply of water is adequate to meet-out the projected Demand for water in Rajasthan. **H_{a1}:** The projected Supply of water is not adequate to meet-out the projected Demand for water in Rajasthan. **H₀₂:** The distributions of projected Demand for water and projected Supply of water in Rajasthan are the same. **H_{a2}:** The distributions of projected Demand for water and projected Supply of water in Rajasthan are not same.

STATE PROFILE: Rajasthan, with a land covering area of 34.3 million hectares is the largest state of India. Rajasthan accounts 10.4 percent of India's total area. The state has four main physiographical regions- the Western Desert, the Aravalli hills, the Eastern Plain, and the Southeastern Plateau (Goyal, 2004). Barring the Chambal and Mahi, the 11 rivers of the state are non-perennial. Most

of them do not join any defined drainage system, and get lost in the sands or drain into inland pondage like Sambhar Salt Lake. Rajasthan is a rain fed state, precipitation being the only source of annually renewable water supply, whether it is rivers or wells or ponds etc. Rajasthan gets 29 days of rain annually, with average rainfall of 58 cm, ranging between 310 mm in the western region. The south-west monsoon (June to September) accounts for nearly 90 percent of rainfall in the state. Rajasthan is divided into 33 districts which are further sub-divided into 249 blocks and 9,177-gram panchayats. Out of 249 blocks in only 30 blocks are in safe category. The State has witnessed frequent drought and famine in the past fifty years. Around 68.6 million



people live in the state, which holds 5.6 percent of the country's total population (According to the census of 2011), of which over 75 percent belongs to rural areas (Saleem *et al.*, 2021). The decadal population growth rate of the state is 21.44 percent and around 24.8 percent of the population lives below poverty line (BPL). More than 70 percent of the state population is dependent on agriculture and allied sectors and contributing roughly 26 percent of the Gross State Domestic Product (GSDP)

WATER RESOURCES IN RAJASTHAN: The distinctive geographic features of Rajasthan are the Thar Desert and the Aravalli Range, which spreads through the state from southwest to northeast, roughly from one end to the, for above 850 kilometers. Mount Abu lies at the south-western direction of the range, separated from the main ranges by the West Banas River. About three-fifths of Rajasthan lies north-west of the Aravalli's, leaving two-fifths on the east and south direction (**Mudrakartha et al., 2010**). Climate change, and resulting increase in evapotranspiration, has a crucial impact on water resources in Rajasthan. The average annual evapotranspiration in the state is estimated at 1,701 millimeters, which could increase by 15 millimeters with a slight 1 percent increase in baseline temperature (42°C based on normal maximum temperature for the state). The result would be an additional water requirement of about 313 million cubic meters (MCM) for the entire arid zone of Rajasthan (**Dong et al., 2013**).

Table 1. Available Water Resources in Rajasthan

Category	Availability in BCM (As percentage of economically usable water)	Usage in BCM	Percentage Used
Internal Surface Water	21.71		
a. Economically Usable	16.05 (35.6)	11.29 (31.6)	70
b. Economically non-usable	5.66		
Groundwater	11.36 (25.2)	11.77 (39.3)	104
Inter-state/external water	17.88 (39.2)	12.66 (35.4)	71
Total State water Resources	50.96		70*
Total Economically usable State Water Resources	45.09 (100)	35.72 (100)	79

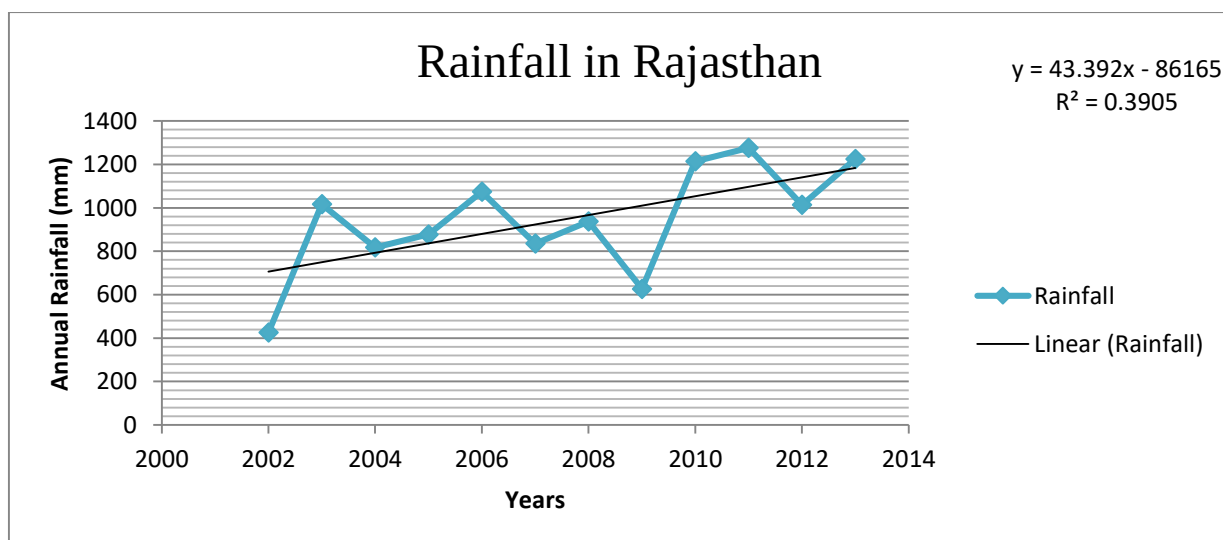
Evaporation in Rajasthan is highly variable, both in spatial and temporal terms. Annual evaporation ranges from 140 cm to over 300 cm over the State. Values exceeding 300 cm occur over western Rajasthan (observed at the IMD weather station in Jaisalmer), which mainly comprises a desert area. It is generally the highest during May (when it ranges from about 26 cm to 43 cm) over most parts of the State and continues to be high in June too. The minimum usually occurs in December and January, when evaporation ranges from about 4 cm to 12 cm per month (**Rathore, 2004**). Rajasthan has only 1.16 percent of the country's total surface water resources or 21.71 billion cubic meters (BCM). On the basis of more realistic data available for surface water at 50 percent dependability, the state has 16.05 BCM of economically usable surface water. The state has created capacity to exploit and accumulate 11.29 BCM, or approximately 70 percent of available water. Rajasthan has 1.72 percent of the country's groundwater, translating to around 11.36 BCM. Dependent on inflows into the rivers, 17.88 BCM is allocated through inter-state agreements (**Pandey et al., 2010**).

Table 2. Availability of Water in Rajasthan (in BCM)									
Purpose/Year	2005			2015			2045		
	SW	GW	TOTAL	SW	GW	TOTAL	SW	GW	TOTAL
Intra-State	5.8	7.5		8	7.5		16.9	7.5	
Inter-State	12.2			13			15		
Recycled Water									
Domestic	0.8			1.1			1.1		
Irrigation		6			6.5			7.2	
TOTAL			6.8			7.6			8.3

The above table is showing forecasted figures for the availability in the years of 2015 and 2045 respectively. The total availability of water is increasing gradually from 7.6 BCM in 2015 to 8.3 BCM in 2045. There is substantial increase in Surface Water (SW) from 8 BCM in 2015 to 16.9 BCM in 2045.

RAINFALL: Rajasthan's rainfall pattern is distinguished by late onset and premature extraction of monsoon as compared to the other states. Dry spells are common and the state has witnessed numerous drought and starvation conditions. Average annual rainfall of the state is 604 mm and average annual monsoon rainfall is 531 mm. The state has large variance in the climatic conditions. The distribution of rainfall, both over time and area, is highly uneven and erratic. The extreme hydrological events, floods and droughts, are usual features for the State. The highest mean monthly rainfall occurs in the middle months of July and August, with 198.4 and 164.0 mm respectively in each month, contributing about 67.1% of the annual rainfall, while June and September rainfalls contribute 10.5% and 14.0%, respectively. It is observed that contribution of the other three seasons to annual rainfall is marginal. Winter, pre-monsoon and the post-monsoon seasons contribute 2.2%, 3.4% and 2.8%, respectively (Zhang *et al.*, 2019)

Figure 1. Annual Trend of Rainfall in Rajasthan



The state is hit by drought four out of every five years, the highest incidence in the country.¹ Within the state, the probability of occurrence of droughts is highest in the western parts.² Between 1901 and 2002 there have been 48 drought years of varied intensity, which means that the chance of occurrence of a meteorological drought in the state is 47 percent. Further, only in nine out of these years, none of the districts in the state were affected by drought (**Hinrichsen and Tacio, 2002**)

GROUNDWATER: At 210 BCM, the annual extraction of groundwater in India is by far the highest in the world.³ Heavy and unsystematic dependence on ground water withdrawal, possibly to compensate for the lack of surface water, has led to declining ground water accessibility. In Rajasthan, the annual water table reduction is about 1 to 3 meters. The gross annual draft of groundwater in the state is 13 BCM against a recharge of only 10.4 BCM. In 1984, there were 203 safe water blocks whereas in 2009, the number is reduced to only 31 which are showing extraordinary exploitation of water blocks during the period from 1984 to 2009, on the other side, the number of over-exploited water blocks is continuously increasing from 12 in 1984 to 166 in 2009 (**Ray and Shewale, 2001**).

Table 3. Groundwater Trend by Block in Rajasthan					
Number of blocks in the category (Groundwater exploitation rate)	1984	1988	2001	2004	2009
Over-exploited (>100 percent)	12	41	86	140	166
Critical (90 to 100 percent)	11	26	80	50	25
Semi-critical (70 to 90 percent)	10	34	21	14	16
Safe (<70 percent)	203	135	49	32	31

SURFACE WATER RESOURCES AND RIVER BASINS: Rajasthan is divided into fourteen river basins and an outside basin. Surface water resources are scarce and confined to the south and southeast of the state. The central and western parts of the state are devoid of any drainage and have very limited surface water, which too is not replenished due to low and erratic rainfall. High temperatures and low humidity in these parts further add to rainwater loss due to evapotranspiration.

The surface water availability in Rajasthan gets limited due to the fact that western Rajasthan has no significant drainage; only eastern Rajasthan has 14 major river basins. In addition to the internal source of water from these basins in eastern Rajasthan, the State also receives water from inter State rivers namely Ravi, Beas, Sutlej, Chambal, Mahi, Yamuna, Narmada and Ganga under inter-State agreements. Chambal is the only perennial river flowing across Rajasthan with significant inter-State contributions into the State flow; hence the per capita availability is highest (1798 cum/annum) among all river basin areas. Mahi is another river with a high per capita (the third in the State after Sabarmati at 1729 cum per annum). Due to various reasons, including political, climatic and demographic, the otherwise assured flows in the Inter-State Rivers is increasingly being subjected to uncertainty in terms of temporal availability and quantity.

WATER DEMAND IN RAJASTHAN

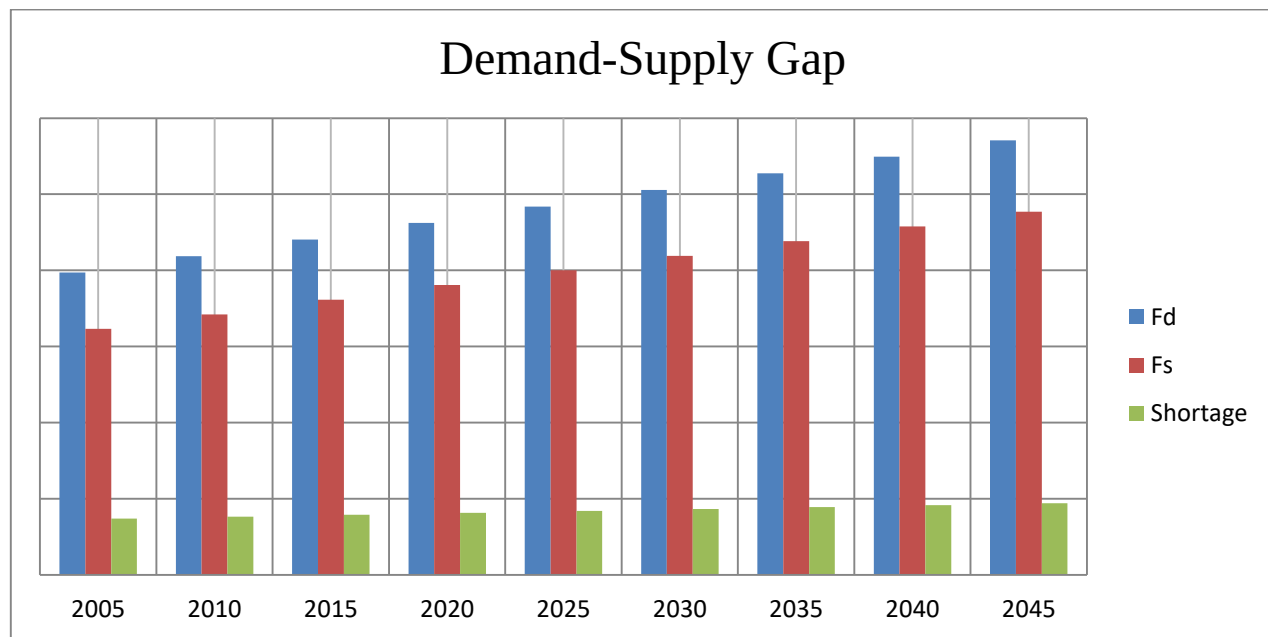
Table 4. Demand for Water in Rajasthan									
Purpose/Year	2005			2015			2045		
	SW	GW	TOTAL	SW	GW	TOTAL	SW	GW	TOTAL
Domestic	0.5	2.1	2.6	1	2.2	3.2	2.5	2.2	4.7
Livestock	0.1	0.8	0.9	0.3	0.8	1.1	0.5	0.8	1.3
Irrigation	20	15.9	35.9	26	14	40	36	13.1	49.1
Others	0.3	0.4	0.7	0.4	0.4	0.8	1	1	2
TOTAL	20.9	19.2	40.1	27.7	17.4	45.1	40	17.1	57.1

The demand side of water in Rajasthan is over-riding on the supply end as forecasted for year 2015 and 2045 as 45.1 and 57.1 respectively. The demand side is more dependent upon the groundwater availability rather than surface water availability.

WATER DEMAND-SUPPLY GAP IN RAJASTHAN: Drastic increase in over-exploited water blocks and its trickledown effect upon safe water blocks are raising risks for huge water demand and supply gap in next 30-35 years. Agricultural use of water accounts for the consumption of 83 percent of available water resources in the state, drinking water for 11 percent, and industry/other uses for 6 percent. Fuelled by rising population and improved awareness of sanitation, non-agricultural demand for water is expected to go up to 8.07 billion cubic meters (BCM) in 2045 (against 3.28 BCM in 1995). The table 5 shows the rising gap between demand and supply in the state. The current deficit is projected 7.9 BCM, and is expected to go up to 9.4 BCM by 2045 (Hooda, 2017).

Table 5. Projected Water Demand & Supply Gap of Rajasthan (in BCM)									
Demand									
Purpose/Year	2005 ⁴	2010	2015 ⁵	2020	2025	2030	2035	2040	2045 ⁶
Domestic	2.6	2.8625	3.125	3.3875	3.65	3.9125	4.175	4.4375	4.7
Livestock	0.9	0.95	1	1.05	1.1	1.15	1.2	1.25	1.3
Irrigation	35.9	37.55	39.2	40.85	42.5	44.15	45.8	47.45	49.1
Others	0.3	0.5125	0.725	0.9375	1.15	1.3625	1.575	1.7875	2
Total	39.7	41.875	44.05	46.225	48.4	50.575	52.75	54.925	57.1
Availability (Supply)									
Purpose/Year	2005	2010	2015	2020	2025	2030	2035	2040	2045
Intra-state	13.3	14.687	16.075	17.4625	18.85	20.2375	21.625	23.012	24.4
Inter-state	12.2	12.55	12.9	13.25	13.6	13.95	14.3	14.65	15
Domestic	0.8	0.8375	0.875	0.9125	0.95	0.9875	1.025	1.0625	1.1
Irrigation	6	6.15	6.3	6.45	6.6	6.75	6.9	7.05	7.2
Total	32.3	34.225	36.15	38.075	40	41.925	43.85	45.775	47.7
Shortage	7.4	7.65	7.9	8.15	8.4	8.65	8.9	9.15	9.4

Projected availability (supply end) is continuously increasing from 36.15 BCM in the year 2015 to 47.7 BCM in the year 2045 whereas the shortage is also increasing from 7.9 BCM in the year 2015 to 9.4 BCM in the year 2045, may be due to population pressure, increasing industrial undertakings and so forth.

Figure 2. Water Demand and Supply Gap

The pictorial presentation of demand for water (Fd), supply of water (Fs) and the shortage or difference between them, is showing the disproportionate changes are taking place in the upcoming years.

WATER QUALITY: The per capita availability of freshwater resources is declining in Rajasthan due to increase in population, reduction of available freshwater resources and declining ground water levels. Deteriorating water quality is also posing challenges in managing Rajasthan's water resources. Erosion in the water resources of the state due to the growing development and poor land management practices is rising siltation and altering stream hydraulics. Groundwater is becoming more and more depleted as surface water is too polluted for human use. Water quality would be further forced by receding of glaciers, irrigation, industrialization and urbanization. The major problems related with groundwater quality are fluoride, nitrate, and salinity. Large areas of Rajasthan have such high salinity that the water is unhealthy for cattle and other domestic use. Intensive surface water irrigation often causes water logging and increased salinity and people drink saline water during the summer in many parts of the state (**Karimi and Ardakanian, 2010**).

The two main problems related to surface water quality are sewage water and industrial effluent. In Rajasthan towns do not have sewage collection, treatment, and disposal systems. Textiles, cement, distilleries, pharmaceuticals, fertilizers and thermal power plants are highly polluting industries in Rajasthan. Industrial effluents discharged from these industries contain alkalis, residual dyes, starches and cellulose, soluble salts with mainly sodium and calcium, silicates, oils, and other impurities. The effluents are discharged untreated due to the lack of economically viable technologies. Due to the increasing impact of industrial effluents, a large number of wells have now been abandoned and a large area of cultivated land has been degraded and turned into wasteland. The use of polluted water for growing food and fodder, and for drinking, has created health hazards for humans and livestock (**Colosimo and Kim, 2016**).

Table 6. Use based Classification of Surface Waters in India

Designated-Best-Use	Class of Water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 200C 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 200C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 200C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5 Electrical Conductivity at 250C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l

Table 7. Water Quality Analysis of Rajasthan

Criteria	DO			pH			Conductivity			BOD			FC			TC		
Source	Violating Records	Count	% Violation	Violating Records	Count	% Violation	Violating Records	Count	% Violation	Violating Records	Count	% Violation	Violating Records	Count	% Violation	Violating Records	Count	% Violation
Surface Water	46	387	11.9	72	389	18.5	1	390	0.3	62	388	16	0	390	0	0	390	0
Ground	-	-	-	9	142	6.3	70	143	49	21	143	14.7	0	143	0	0	143	0

Water																		
Rivers	24	19 0	12. 6	1 8	19 1	9.4	0	19 1	0	2 2	18 9	11. 6	0	19 1	0	0	19 1	0
Lakes	22	16 8	13. 1	5 2	16 9	30. 8	1	17 0	0.6	4 0	17 0	23. 5	0	17 0	0	0	17 0	0

*DO- Dissolved Oxygen *BOD-Bio-chemical Oxygen Demand *FC-Faecal Coliform *TC-Total Coliform

Water Quality (surface water) data analysis of 387 observations points out that 12% is violating to DO, out of 389 observations 19 % is not complying to pH, out of 388 observations 16% is not confirming to BOD whereas FC and TC are confirming to the desired levels require in riverine environment. Water Quality (ground water) data analysis of 143 observations points out that 49 % are violating to Conductivity, 6 % are not complying with pH, 15% are not confirming to BOD whereas, FC and TC is confirming to the desired levels required. Water Quality of river water data analysis of 191 observations points out that 13 % are violating to DO, 9 % are not complying to pH, 12% are not confirming to BOD whereas 25 Conductivity, TC and FC is confirming to the desired levels require in riverine environment. Water Quality of lake water data analysis of 169 observations points out that 13 % are violating to DO, 31 % are not complying to pH, 1 % are not complying with conductivity, 24% are not confirming with BOD whereas FC and TC is confirming with the desired levels. 2.4.26.

ANALYSIS OF RELATIONSHIP BETWEEN DEMAND FOR WATER AND SUPPLY OF WATER

Table 8. Correlations

	Fd	Fs
Fd	Pearson Correlation	1
	Sig. (2-tailed)	.999**
	N	9
Fs	Pearson Correlation	.999**
	Sig. (2-tailed)	.000
	N	9

** . Correlation is significant at the 0.01 level (2-tailed).

Table 8 is depicting the correlations between the demand for water and supply of water which is 0.999 and this significant at 0.01 level of significance. The correlation is also favoring the situation of increasing supply with increasing demand by over-exploiting water blocks in Rajasthan.

Table 9. Model Summary^b

Model	R	R Square	Adjusted Square	R	Std. Error of the Estimate	Change Statistics	
						R Square Change	F Change
1	.999 ^a	.998	.998		.28172	.998	3549.000

a. Dependent Variable: Fd

Table 10. Model Summary^b

Model	Change Statistics			Durbin-Watson
	df1	df2	Sig. F Change	
1	1 ^a	7	.000	1.600

a. Predictors: (Constant), Fs

b. Dependent Variable: Fd

The value of R Square is showing the variance of demand for water (dependent variable) by the supply of water (independent variables) which is 99.8%. Here, R explains the correlation between the observed and expected values of demand for water.

The Std. Error of the Estimate is referred to as the root mean squared error. This is the standard deviation of the error term and the square root of the Mean Square for the Residuals in the ANOVA table which is 0.28172.

Table 11. ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	281.667	1	281.667	3549.000	.000 ^b
	Residual	.556	7	.079		
	Total	282.222	8			

a. Dependent Variable: Fd

b. Predictors: (Constant), Fs

The ANOVA is given in the Table 11 and the significance value is 0.000 which is less than critical value of 0.05, hence the dependent variable (Fd) has significant different mean than independent variables (Fs). The Sum of Squares associated with the three sources of variance, Total, Model and Residual. The Total variance is divided into the variance which is possibly explained by the independent variables (Fs) and the variance which is not explained by the independent variables (Residual) which is 0.556.

Table 12. Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.111	.733		6.969	.000
	Fs	1.083	.018	.999	59.573	.000

In the Table 12, the beta value in the unstandardized column the constant is higher than the supply of water that means the constant makes the strong unique contribution to explaining the dependent variable i.e. demand for water. In the Sig. column, we can observe the same; the corresponding value to Fs and constant are 0.000 which are less than the critical value of 0.05.

Table 13. Coefficients^a

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant) Fs	1.000	1.000

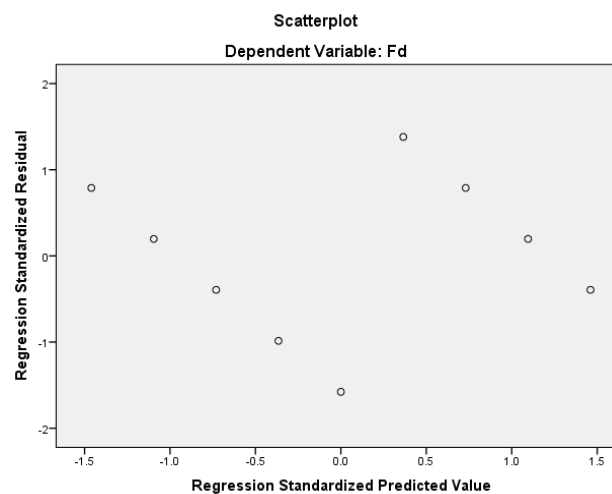
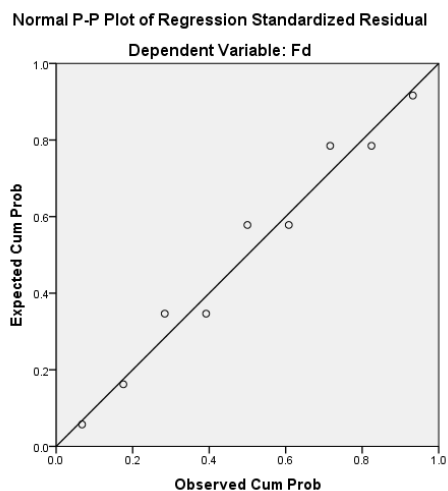
a. Dependent Variable: Fd

In Table 13, in the tolerance column, the value is not less than 0.10 which is indicating that the multiple correlations with other variables is low and the VIF (Variance Inflation Factor) are 1.0 for independent variable (Fs) showing multicollinearity.

Table 14. Collinearity Diagnostics^a

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions	
				(Constant)	Fs
1	1	1.992	1.000	.00	.00
	2	.008	15.556	1.00	1.00

a. Dependent Variable: Fd



The above “Normal P-P Plot of Regression Standardized Residual” ensures normality and the dotted points of dependent variable (demand for water) are following the straight line. The above scatter-plot of standardized residuals against predicted values is a random pattern concentrated around the line of zero standard residual value. The above scatter-plot depicts no clear relationship between the residuals and the predicted values which is steady with the assumption of linearity. The above analysis leads to the rejection of Null Hypothesis; the projected supply of water is not adequate to meet out future demand for water in Rajasthan.

ANALYSIS OF DISTRIBUTION PATTERNS OF DEMAND FOR WATER AND SUPPLY OF WATER:

For the confirmation of the disparity existed between the projected demand and supply of water in Rajasthan in upcoming years, the authors applied Kendall’s Coefficient of Concordance to check whether the distributions of demand and supply of water are same or not.

Table 15. Kendall's Coefficient of Concordance				
Hypothesis Test Summary				
	Null Hypothesis	Test	Sig.	Decision
1	The distributions of Fd and Fs are the same.	Related-Samples Kendall's Coefficient of Concordance	.003	Reject the null hypothesis.
Asymptotic significances are displayed. The significance level is .05.				

Table-15 representing the output of Kendall's Coefficient of Concordance in which the significance value is 0.003 which is lower than the critical value of 0.05, henceforth there is significant difference between the projected demand for water and supply of water in upcoming years.

CONCLUSIONS AND SUGGESTIONS: The present study leads to that the Rajasthan state has different forms of geographic distribution, henceforth; the composition of climatic variables is significantly different from normal ecological variations. Thar Desert and Aravalli Range are the two significant constraints in water block distribution. The exploitation of water blocks in Rajasthan is increasing with the rapid rate and now very few blocks are existed in the safe zone. The trend of rainfall is not so satisfactory, since it is showing increasing and successive trend. The demand for water is quite over-burdened upon the availability of water, specifically on the groundwater. It is also found that the supply of water in coming years is increasing by exploiting safe water blocks but the demand is also increasing with more quantum as compare to the supply, henceforth the deficit between the demand and supply is showing significant upliftment.

The suggestions on the behalf of the conclusions are as follows:

1. There is need of new indices to measure available water resources in Rajasthan. The measurement of water availability does not include inequality in water allocation and acces, therefore new indices should be developed and used which are able to confine the underlying differences in water access.
2. Present study suggests that multiple uses of water and the traditional water allocation priorities also need to be revisited. Area where rainfall is limited rainwater harvesting must be a part of watershed planning and undertaken to meet water for drinking, domestic, agriculture, and industrial needs. The concept of scarcity and surpluses of water must look beyond State Boundaries, as with a more disaggregated assessment.
3. There is no model in the state which can show best way to tackle the waste water generated through the industrial and domestic sectors. Models should be developed and this situation needs to be addressed soon.
4. Involvement of beneficiaries & other stakeholders in project planning and at subsequent stages of development must be integrated effectively.
5. Effective coordination is needed to optimize efficiency of all programmes and projects planned and implanted dealing with water for Rajasthan decisions and actions by concerned departments.

6. Research and academic institutions need to be involved in identifying the issues of complex water problem and addressed through advances in technology and science. The research and academic agencies need to be properly incorporated in project management with clearly defined roles and functions.
7. Promotion of water conservation in the state must be needed and awareness of scarcity value of water should be spread. It is essential to provide platforms for knowledge sharing on water issues and creative ways of information dissemination to promote people to implement water conservation.
8. It has been observed that in the smaller municipalities or local bodies, appropriate expertise in the field of water supply or manpower is not available. It is recommended that State should develop capacity of these institutions in terms of manpower and technical knowledge.
9. Methods such as zero discharge industry, adoption of water efficient process technologies, adoption of water less urinals, dual piping systems, dual flushing toilets, retrofitting, etc. must be encouraged through required enabling provisions in the Town Planning Acts, Building Bye-Laws, etc.

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