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ASSESSMENT OF DRINKING WATER AVAILABILITY AND DEMAND IN CITY AREA OF DUNGARPUR DISTRICT IN RAJASTHAN

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Abstract: *This study evaluates the status of drinking water sources, supply and demand in the city area of Dungarpur district of Rajasthan, a hill-dominated region facing challenges in water accessibility. Data on water source types, their capacities, daily water supply, population figures and water demand were collected and analysed. The study calculates the per capita availability of drinking water (LPCD) and compares it with national benchmarks. Findings reveal significant disparities in water distribution across different wards of the Dungarpur city, with most of the wards falling below the recommended LPCD standards. The analysis highlights critical gaps in the current water supply infrastructure and provides recommendations for sustainable water resource management tailored to the region's geographical and socio-economic context.*

Key words : LPCD Standard, Resource Management, Filtration Waste, Infrastructure Réhabilitations

Introduction

Water always remains lifeline for the many human civilizations. Without water no one can survive. We are fortunate enough that Earth has water. Earth's 71% area has covered with water and about 97% of this total water is saline and cannot be used for drinking. Approximately 2% water is in the form of snow peaks and glaciers, only 1% water is available for the purpose of agriculture, industrial and drinking use (Zaman and Sizemore, 1939). The distribution and availability of clean and fresh drinking water on the Earth is not even. In many areas of world with dense population have no or limited fresh water sources. The availability of fresh water and uneven distribution of population create major conflits and clashes (Mishra, 2023).

Clean drinking water is a master key of good health. It is found in many studies that clean drinking water improves health and protects form diarrhea, parasitic infections, malnutrition and epidemic problems. Clean drinking water is not only for hydration but also for proper hygiene, sanitation and food preparation. It is contributing to overall disease prevention, better maternal health, child health and even mental and cognitive performance.

Objectives of the study

1. To analyse the adequacy of current drinking water supply against the population demand in Dungarpur city.
2. To evaluate the per capita water availability (LPCD) in comparison with national standards.
3. To identify gaps and recommend sustainable water resource management strategies.

Study Area

Location : Dungarpur district is the southernmost district of Rajasthan state. It shares state border in south-west direction with Gujarat state. It is a part of Aravali plateau region. The study area Dungarpur city is located at $23^0$49' to $23^0$52' north latitude and $73^0$40' to $73^0$43' east longitude. The city is well connected with road and rail network. National Highway 48 passes through the district.

Climate : Climate and rainfall affect the environment, agriculture, human life and many more. Dungarpur is situated near the tropic of Cancer. Thus, the climate found semi-arid to sub-humid. As per the "Koppen" classification; Cwg climatic conditions found (Tiwari *et al.*, 2024). In the summer (March - June) temperature remains high and found between 30^0C to 45^0C. From July to September month monsoon climatic conditions found. The south-west monsoon impact heavily and the region got average rainfall of 600 mm to 800 mm. Temperature found slightly cooler 25^0C to 35^0C with average humidity 60%. Winter climatic condition found in mid-October to February. In winter temperature remains pleasant and dry. Temperature not rise more than 28^0C but night temperature sometimes falls up-to 5^0C

Population: Population is prime index to measure industrial growth and economic development. The first population census of Dungarpur city was conducted in 1901. At that time the population of the city was 6094. Official census data is available from 1951 after independence. According to the population census, the population of the city is 47706. It is the first time between 1951 to 2011 that the population growth rate has been less than 11 percent. In 2011, the population growth rate was 10.67 percent.

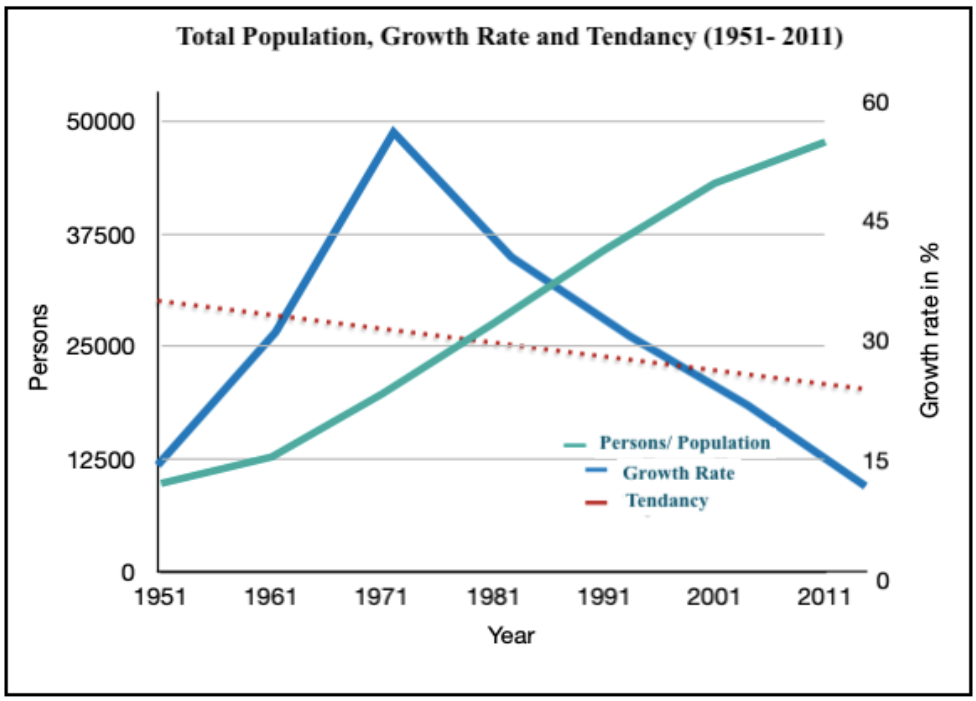
Materials and Methods

1. **Sources of Data :** In this research paper primary and secondary data were collected. Primary data were collected through personal investigation and personal interviews. The secondary data were collected by public health and engineering department and also collected from census reports and other published reports.

2. **Types of Water Sources & capacity :** Public water supply system is working in Dungarpur city since 1929 (The Chief Town Planner, 2006). In the study it is found that the dam Edward Samand and dam Vijay Chakra Sagar (Dimiya Talab) are two major sources of water. Edward Samand has capacity of 137 MCFT and Vijay Chakra Sagar has 44 MCFT capacity. Edward Samand provides 22 lakh liters and Vijay Chakra Sagar (Dimiya Talab) 18 lakh liters of water every day. There are 9 wells and 4 tubewell which also provide jointly 5 lakh liters of water every day. Thus, PHED maintain the supply of 45 lakh liters per day water supply. As per the record of PHED, there are 10,750 household government water supply connections. Every day PHED supply of water for only one hour. For the supply of drinking water there are 12 ground level storage reservoir, 14 overhead storage reservoir and 6 clear water reservoirs available in various places. To maintain the supply of drinking water 100 kilometer rising pipeline developed and approximately 155-kilometer distribution pipeline network developed.

3. **Population & Daily Water Demand :** As of the 2011 Census, Dungarpur district of Rajasthan had a total population of 1,388,552, comprising 696,532 males and 692,020 females. The district's population density was recorded at 368 people per square kilometer. According to the 2011 census, Dungarpur city population was 47706. It is notable that the city population growth rate remains high as 20% in last three decades (1971-81, 1981-91 and 1991-2001) and it slightly down in 2001-2011 to 10.6%. Overall city is very crowded and as per 2011 census data city density is 2622 persons per square kilometer. Dungarpur city has 40 wards. Each ward is different form another wards in terms of area, population and facilities.

Figure 01: Total Population Growth Rate



At the rate of 70 LPCD, public health and engineering department (PHED) supplying 45 lakh liters of water every day. The Government of India has fixed the per capita water demand for non-metro cities at 135 liters per day. As per the norms the total actual demand of water is 85 lakh liters every day in the city. Ward-wise population, water supply, actual demand and demand - supply difference of the district is shown in table 01.

Table 01: City Ward- Wise Water Supply, Demand and Difference and Supply (LPCD)

Ward No.	Population (2011)	Water Supply (70 LPCD)	Demand of Water (135 LPCD)	Difference of water demand and supply (LPCD)
1	1246	87220	168210	80990
2	889	62230	120015	57785
3	915	64050	123525	59475
4	1670	116900	225450	108550
5	1107	77490	149445	71955
6	1398	97860	188730	90870
7	1290	90300	174150	83850
8	1118	78260	150930	72670
9	1362	95340	183870	88530
10	1112	77840	150120	72280
11	1033	72310	139455	67145
12	1296	90720	174960	84240
13	1482	103740	200070	96330
14	1066	74620	143910	69290
15	1138	79660	153630	73970
16	1291	90370	174285	83915
17	1117	78190	150795	72605
18	1284	89880	173340	83460
19	1289	90230	174015	83785
20	1037	72590	139995	67405
21	881	61670	118935	57265
22	1665	116550	224775	108225
23	909	63630	122715	59085
24	1206	84420	162810	78390
25	1101	77070	148635	71565
26	1058	74060	142830	68770
27	1119	78330	151065	72735
28	1083	75810	146205	70395
29	1275	89250	172125	82875
30	1298	90860	175230	84370
31	1142	79940	154170	74230
32	1533	107310	206955	99645
33	1689	118230	228015	109785
34	1436	100520	193860	93340
35	1027	71890	138645	66755
36	1148	80360	154980	74620
37	1003	70210	135405	65195
38	1073	75110	144855	69745
39	902	63140	121770	58630
40	1018	71260	137430	66170

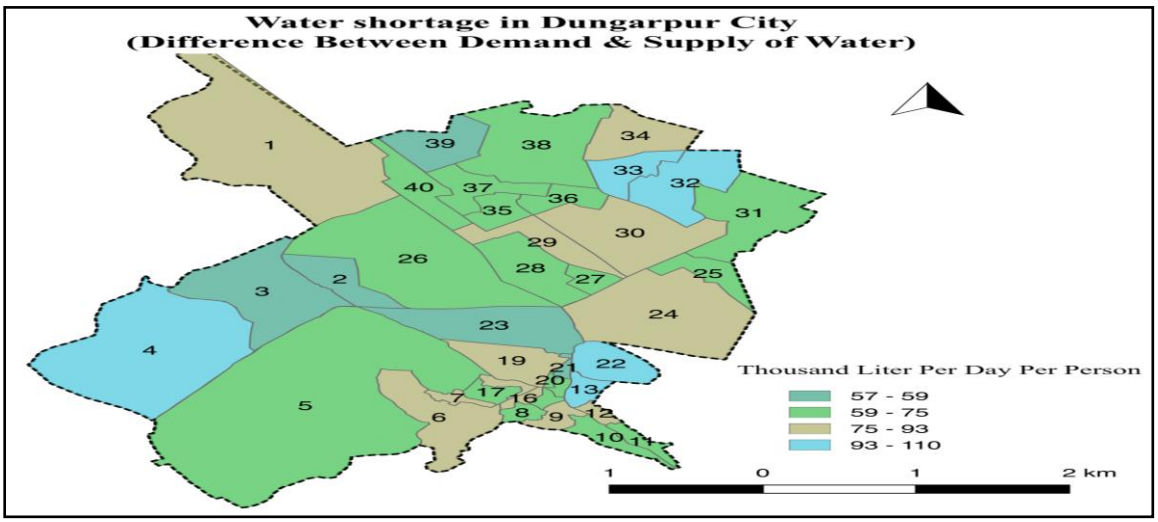
Source : Calculated by researcher.

There is a big gap between demand and supply of water. Like every Indian city, Dungarpur city is also facing more water scarcity in summer season. The requirement of the water considering the current population of the city is about 83 lakh liters per day. The PHED is supplying 45 lakh litres of water every day for 1 or 2 hours. An estimated 3 percent of total water supply is lost due to pipeline leakages while an additional 5 percent is lost during treatment processes at filtration plants. Only 43 lakh liters of water available per day resulting in a deficit of around 40 lakh liters per day.

Results

1. Sources of water : Dam Edward Samand and dam Vijay chakra Sagar are only two major sources of water near the city. Both water bodies are facing maintenance issues. At present both Edward Samand and Vijay chakra Sagar are filled with silt and sand and their capacity has been decreased. There is another main issue with the pipeline. The pipelines are very old and made up of asbestos cement, cast iron and HDPI. In long term use asbestos cement and cast-iron pipes decreases the quality of water. It is notable that asbestos has poisonous property and long-term use can be harmful for the health. To mitigate the demand of water PHED working on to get water supply from Som Kamla Amba Dam.
2. Total daily supply and total demand : There are 10,750 household has tap connection in Dungarpur city. PHED supplied everyday 45 lakh liters of water but according to the current population the demand of the water as per norms is 83 lakh liters per day. The supply and demand have a vast gap. Population growth, urbanization and change in life style are the major cause for increasing the demand of water in the city.
3. LPCD across ward - wise : Dungarpur city has 40 wards. The demarcation of wards is basis on the population. Hence, one ward has more than one colony. PHED collects water from the sources and pump to the filter plant and then clean and purified water stored in 12 ground level storage reservoir, 14 overhead storage reservoir and 6 clear water reservoir which are situated in various parts of city. From these reservoir PHED supplies water in city wards. Clean and safe water supplies in wards at the rate of 70 LPCD. Ward no. 33, 4, 22, 32 and 13 has critical condition because in these wards the demand and supply gap of water is more than 96 thousand LPCD. Ward no. 21, 2, 39, 23 and 3 has less population so demand and supply gap of water is less than 59 thousand LPCD. The whole Dungarpur city is facing shortage of water problem. It is a very interesting fact that Dungarpur is hilly area and many rivers are flowing there but the initiation to preserve, protect and conserve the rivers in not followed.

Figure 02: Water Shortage in Dungarpur City



Discussion

1. Adequacy of supply vs demand : There is need of sufficient and clean water for daily use in domestic, agriculture, industrial, environmental and entertainment. Dungarpur district is not getting proper amount of rainfall since 7-8 years and moisture in soil and water table is going down year by year. Presently Dungarpur district is in grey zone as per the consideration of water table (Badola, 2022)The demand of water is already high and decreasing of water table and rainfall every year might be a big disaster in near future for the city. The PHED and government does not take interest to increase the storage capacity of water sources Edward samand and Vijay Chakra Sagar. The current supply of water is only 45 lakh liters per day and the actual demand is 83 lakh liters. Through the scheme of "Jal Jeevan Mission (JJM)" which is also known as "har ghar nal", government has developed a plan to bring "Som Kamla Amba" dam water to Dungarpur city to mitigate to problem of water scarcity. The project has been started on testing mode.
2. Reasons for shortage : Geologically Dungarpur district is a part of Aravali mountain region and rocks of schist, gneiss and granite confirm this (Census of India, 2011). Due to hot- humid environmental condition weathering and erosion activities run fast. Thus, the layers of soil are very porous. Over extraction of ground water, cutting trees and expansion of concrete structure create water crisis in the city. The city surrounding is full of river catchment area and city center has a big lake "Gap Sagar" but the lack of water conservation activities, awareness and illegal construction activities lead in direction of water shortage. It is also notable that 8% of water is wasted during filtration process and transportation.
3. Comparison with recommended LPCD standards : Presently there are 10,750 household tap connections maintained by PHED. The tap connections are distributed in various part of city and people are benefited with only 45 lakh liter of water every day at the rate of 70 LPCD. The government of India recommended 135 LPCD water for nonmetro cities. The difference between supplied water and recommended water is very big. It is a herculean task for the government not only mitigate the demand and supply but also increase the supply of water considering the future demand.

Recommendations

1. Strengthening Existing Infrastructure
   - Rehabilitation of Water Supply Systems: Many wards rely on outdated or inefficient supply systems. There is requirement of repairing and upgradation of pipelines, storage tanks and pumping mechanisms to minimize leakage and enhance efficiency. There is also need to replace the asbestos cement and cast iron-based pipeline.
   - Expansion of Piped Water Coverage : In Dungarpur city many colonies' households have not piped water connections. The availability of clean and safe drinking water is fundamental right of people. The department should install food grade pipeline to supply clean and safe drinking water.
2. Enhancing Water Source Sustainability
   - Groundwater Recharge Measures : Each house owner has to motivate to build setup for rainwater harvesting structure to recharge groundwater aquifers.
   - Watershed Management : Implement integrated watershed management practices in hilly areas to improve infiltration and reduce surface runoff.
   - Protection of Traditional Water Bodies : Revive and conserve traditional tanks, wells, and step-wells that have historically supported local communities. There is need to develop surface water sources near the city to mitigate the demand of water.
3. Demand Management
   - Promote Water Use Efficiency: Encourage the use of low-flow taps, community awareness on water conservation and timely repair of leaks at the household level.

- Rational Distribution: Ensure equitable distribution by prioritizing water-stressed wards and monitoring water tankers to reduce pilferage or misuse.

4. Institutional and Community Involvement
   - Capacity Building of Local Institutions: Train Nagar parishad/local institutions and committees to manage, monitor, preserve and conserve local water sources and supply systems.
   - Community Participation: Promote active involvement of local communities in planning, maintaining, and conserving water infrastructure.
5. Monitoring and Evaluation
   - Establish Real-Time Monitoring Systems: Use digital tools (like mobile-based water supply apps or sensors) to track daily supply and detect shortages or faults quickly.
   - Annual Water Audits: Conduct audits at ward-wise to evaluate performance and ensure transparency in water distribution.
6. Policy and Planning Support
   - Water Security Plans: Develop detailed plans based on water availability, demand, and population projections to guide future investments.

Conclusion

In the last one decade the urban periphery of Dungarpur city is expanding and new urban colonies has been developed. The city has not enough water supply as per the demand. This problem persistently for last many years. Due to the change in local environmental conditions city and Dungarpur district not getting proper rainfall. In the name of development, the Municipal Council has installed cement tiles on the roadsides and mud places throughout the city. The cement tile works as a barrier to infiltrate the water in soil and also increase the surface runoff. In whole scenario water bodies have not getting enough water and their recharge capacity also decreased. Due to the immigration in city, the population density increasing and day-by-day the demand of water is also increasing. City wards 20, 14,15, 16 and 21 have very high population density (3400 > person/sq.km.). These wards are situated in the part of old city and there is a big challenge for PHED to provide water. PHED is in high pressure to maintain the water supply in the city. Due to this reason the department is barely able to provide clean water in all the wards. The PHED has to take tree steps; first department has to achieve the target to provide standard supply of 135 LPCD, secondly develop the existing water sources and third create new water sources.

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