Assessment of Groundwater conditions in Upper Dhudhna River basin using well inventory data from selected villages in Chhatrapati Sambhajinagar, Maharashtra.

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Abstract:

This study evaluates groundwater conditions based on well inventory data from selected villages. The dataset includes well dimensions, geology, and seasonal water levels during pre-monsoon and post-monsoon periods. The results reveal that groundwater levels fluctuate significantly across the study area, reflecting the influence of lithology, depth, and recharge conditions. Post-monsoon measurements indicate substantial recharge in most wells, highlighting the importance of monsoonal rainfall in replenishing groundwater resources. This paper emphasizes the need for sustainable groundwater management strategies tailored to local hydrogeological settings.

Keywords:

Groundwater assessment; Well inventory; Seasonal water level fluctuations; Basaltic aquifers; Recharge conditions; Hydrogeology; Sustainable groundwater management;

1. Introduction:

Groundwater forms the backbone of water supply for drinking, agriculture, and industrial activities in semi-arid regions of India. Rapid urbanization, intensive agriculture, and climatic variability have placed groundwater resources under increasing stress. Monitoring groundwater through systematic well inventory surveys provides crucial insights into aquifer behavior, recharge capacity, and long-term sustainability.

The present study focuses on the analysis of well inventory data, which includes physical well parameters, geology, and water level fluctuations. By comparing pre-monsoon and post-monsoon conditions, the study aims to assess seasonal recharge and the hydrogeological factors controlling groundwater availability.

2. Study Area:

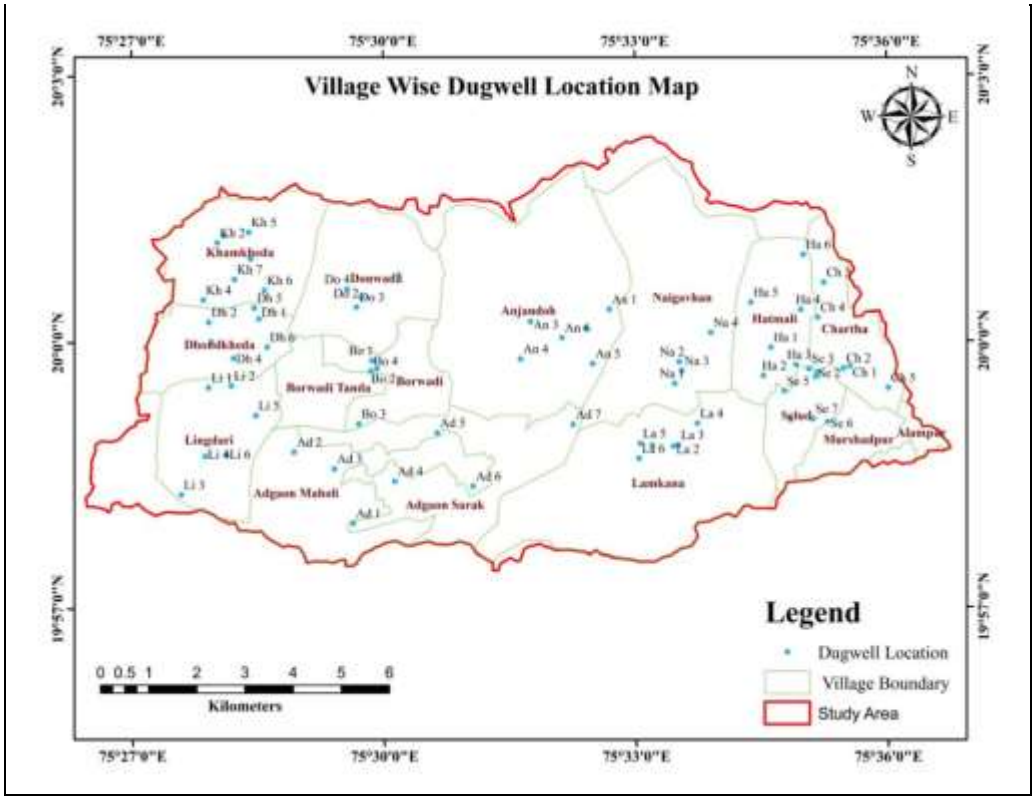

Figure No 1: Village Wise Dugwell Location Map

The study area, as shown in Figure 1, is delineated within latitudes 19°57′N to 20°03′N and longitudes 75°27′E to 75°36′E. It covers several villages including Khamkheda, Dhondkheda, Lingdari, Adgaon Maholi, Naigavhan, Hatmali, Chartha, Selud, Lamkana, Murshadpur, and Alampur.

The map depicts the distribution of dug wells across villages, marked as blue points, with village boundaries (green lines) and the overall study area boundary (red line). The spatial distribution highlights the widespread presence of wells, reflecting the community's dependence on groundwater as the primary source of water.

Geologically, the area is characterized by:

- Topsoil and weathered basalt at shallow depths,
- Compact basalt with fractures and joints at intermediate depths, and
- Massive basalt layers at deeper levels.

These geological features directly influence the availability and seasonal variability of groundwater.

3. Methodology:

The methodology adopted in this study includes the following steps:

1. Well Inventory Compilation: Data on well location (latitude, longitude, altitude), dimensions (depth and diameter), and geology were compiled.

2. Water Level Monitoring: Pre-monsoon and post-monsoon water levels were recorded in meters below ground level (mbgl).

3. Data Analysis: Comparative analysis was carried out to assess seasonal variation.

4. Graphical Representation: Water level data were presented through tables and Maps to illustrate recharge patterns and spatial variation.

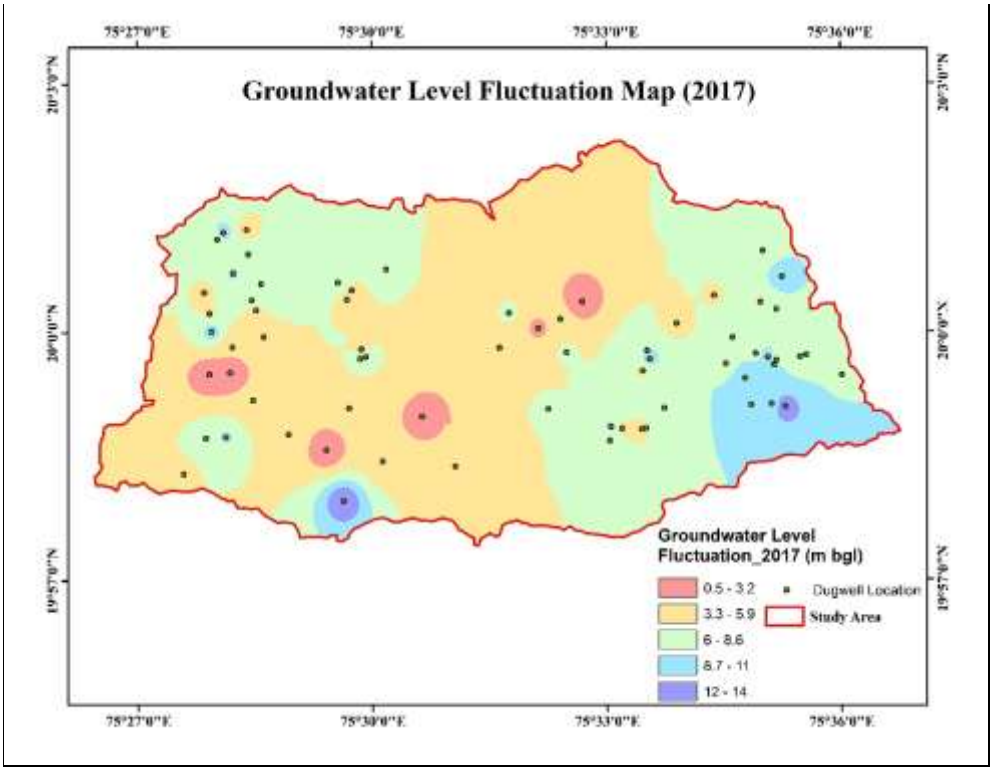

Figure No 2: Groundwater level fluctuation Map (2017).

Map 2017 (Groundwater Fluctuation):

- Range: 0.5 – 14 m bgl.
- Large parts of the study area show 3.3 – 5.9 m fluctuation (yellow).
- Some central and western zones have shallow fluctuation (0.5 – 3.2 m, pink).
- Pockets in southern and eastern areas show higher fluctuation (8.7 – 14 m, blue/purple).

- Groundwater stress is more concentrated in southern and southeastern regions.

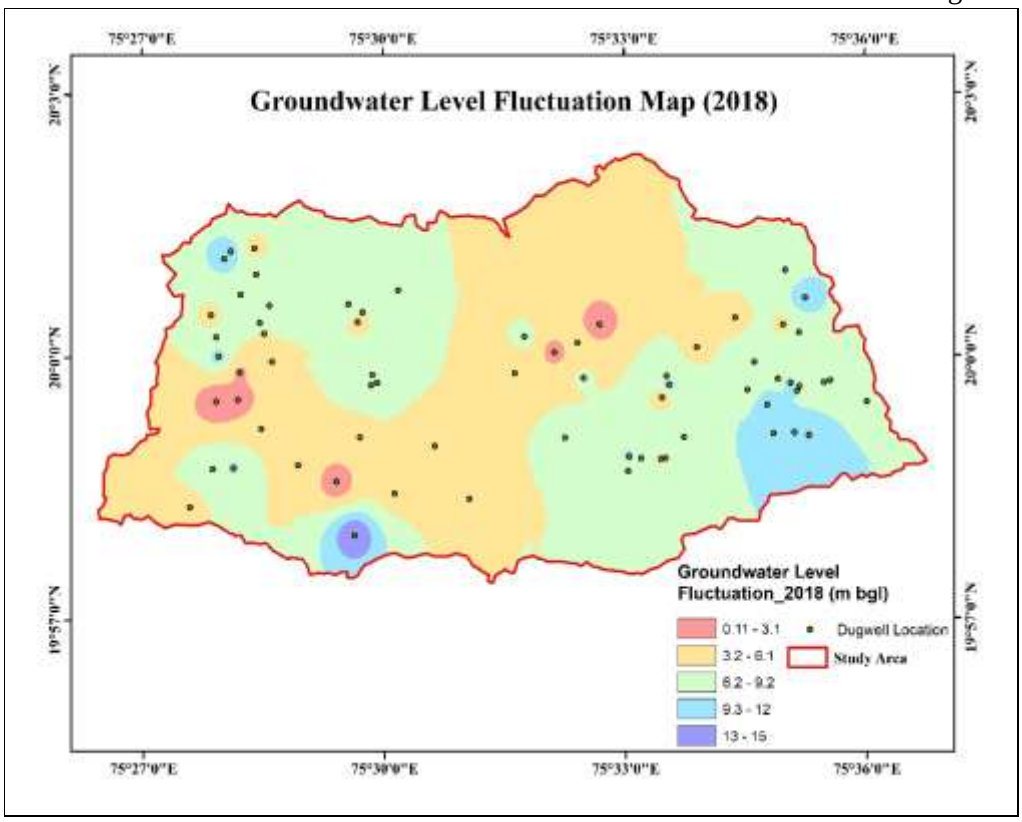

Figure No 3: Groundwater level fluctuation Map (2018).

Map 2018 (Groundwater Fluctuation):

- Range: 0.11 – 15 m bgl.
- Majority area again falls in the 3.2 – 6.1 m category (yellow).
- Shallow fluctuations (0.11 – 3.1 m, pink) appear at scattered pockets in central and western zones.
- Higher fluctuations (9.3 – 15 m, blue shades) are mainly in southern and eastern parts, similar to 2017 but slightly more widespread.
- Compared to 2017, 2018 shows more extreme fluctuation values (up to 15 m).

Conclusion:

1. General Trend:

- Both years indicate that most of the area experiences moderate fluctuation (3–6 m).
- Pockets of low fluctuation (less than 3 m) suggest stable water levels, possibly due to n recharge zones, surface water influence, or good aquifer storage.
- High fluctuation zones (>9 m) indicate groundwater stress, likely due to over-extraction, poor recharge, or less permeable geological formations.

2. Yearly Comparison:

- In 2017, fluctuations were slightly lower (maximum ~14 m).
- In 2018, extreme values increased (up to 15 m), showing rising variability and stress on aquifers.

- This suggests increased dependency on groundwater or reduced recharge conditions in 2018.

3. Management Implication:

- Areas with >9 m fluctuation needs priority groundwater management, artificial recharge, and sustainable withdrawal practices.

SR. NO	NAME OF VILLAGE	Dug Well No.	GUT NO	ALTITUDE(m)	DEPTH (m)	DIA (m)	GEOLOGY	PRE-MONSOON WATER LEVEL (m)	POST-MONSOON WATER LEVEL (m)
1	LINGDARI	Li 1	9	670	4	4.5	0-1.5 SOIL., 1.5-3 Highly weatherd amygdoloidal, 3-4 compact basalt moderately weathered	10	3.5
2		Li 2	30	672	2.5	3	0.5-2 Lining, 2-2.5 compact basalt moderately basalt	4.5	2.5
3		Li 3	67	670	8.5	7	0-3 Lining, 3-5.3 compact basalt moderately weathered, 5.3-8.5 CB M-H weathered	7.5	2
4		Li 4	82	670	13	5	0-3 lining, 3-13 CB MW broadly jointed, MW Closely to B jointed, C-B Jointed	9.5	2.5
5		Li 5	43	664	11	7	0-2.6 lining, 2.6-11 CB C-B Jointed	9	5
6		Li 6	63	667	16	7.5	0-3 Lining, 3-16 CB BJ	16	7
7	KHAMKHEDA	Kh 1	44	675	12.5	7.5	0.4.4 Lining, 4.4-12.5 CB CJ	11.9	1.5
8		Kh 2	6	669	18	3.5	0-4 lining, 4-18 CB	7	1.2
9		Kh 3	84	646	13	6.8	0-4.2 lining, 4.2-13 CB MW	12	4
10		Kh 4	129	676	8.6	6.9	0-2 lining, 2-8.6 CB MW	6.4	1.5
11		Kh 5	52	673	6.9	6	0-3.3 lining, 3.3-5.4 CB HW, 5.4-6.9 CB	6.3	2.3
12		Kh 6	106	674	10.4	6.9	0-2.1lining, 2.1-4.4 CB HW, 4.4-6.6 CB BJ, 6.6-10.4 CB	10	1.5
13		Kh 7	119	674	10.7	6.2	0-3.4 lining, 3-11.7 CB	10.5	1.6
14	DHONDKHEDA	Dh 1	13/14	685	9	6.1	0-2.6 lining, 2.6-9 AB HW	8.5	3
15		Dh 2	2	666	10.3	6.8	0-1.1 lining, 1.1-10.3 CB	9.5	4
16		Dh 3	Gavthan	695	15	5.9	0.6.1 LINING, 6.1-15 AB MW	15	4.5
17		Dh 4	29/31	661	4.8	4.9	0-2.2 lining, 2.2-4.8 CB	4.8	1.5

18		Dh 5	109	678	9.7	5.7	0-1 lining, 1-.2.7 murum, 2.7 -9.7 CB	9.2	3
19		Dh 6	84	676	7	7	0-2.6 lining, 2.6-7 CB VJ	6.5	1.6
20	DONWADA	Do 1	78	608.41	11.2	6.2	0-3 soil, 3-8.5 AB, 8.5-11.5 CB	9.5	3
21		Do 2	5	656.42	112	6	0-5.2 lining, 5.2-7.5 AB, 7.5-11.5 CB	10.5	5
22		Do 3	1	631.44	10.6	6.4	0-1 alluvium, 1-5.6 bricks lining, 5.6-8.5 **AB, 8.5-10.5** CB	10.5	5.5
23		Do 4	27	630.51	13.7	6.3	0-2.5 lining, 2.5-7 AB, 7-11 CB	13.5	5.7
24	BORWADI	Bo 1	66	607.53	8.4	5	0-2 lining, 2-4 AB H-MW, 6-8 CB C-BJ MW	7.8	2.5
25		Bo 2	40	608	10	4	0-8 lining(AB), 8-10 CB	9	2.5
26		Bo 3	20	613.34	8.8	5.2	0-6 lining stone, 6-10 CB HW	8.5	4.5
27		Bo 4	50	608.41	15.5	8.2	0-7.4 linng, 7.4-8.4 AB, 8.4-10.5 VB, 10.5-15 CB BJ	9.5	2.8
28	ANJANDOH	An 1	146	570	4.5	5	0-2 lining, 2-4.5 CB BJ fresh	4	3
29		An 2	13	569	6.5	5.7	0-5.1 lining, 5.1-6.5 CB BJ	6	2
30		An 3	46	588	12	7	0-2.5 lining, 2.5-5 CB BJ fresh, 5-12 AB HW thick	11	4.5
31		An 4	228	579	8.1	5	0-3.6 lining, 3.6-8.1 CB CJ HW	7.5	3.5
32		An 5	161	585	12	7	0-5 lining, 5-12 CB 3set of jointing,	11.5	5
33		An 6	GAOTHAN	571	4.6	8	0-3.2 lining, 3.2-4.6 CB BJ	4	1.5
34	NAIGAVHAN	Na 1	229	580	18	3.5	0-2.5 lining BRICKS, 2.5-12 AB HW, 12-18 CB BJ	12.6	7.5
35		Na 2	GAOTHAN	575	18	3	0-5 LINING, 5-13 AB HW, 13-18 CB C-BJ	17	8.5
36		Na 3	219	530	18	5.5	0-7 lining, 7-12AB HW, 12-18 CB BJ	17	7
37		Na 4	139	579	8.5	6.7	0-3 SOIL, 10-20 AB HW 20-28 CB C-BJ	7	3
38	HATHMALI	Ha 1	1	540	17	4	0-4 LINING, 4-8 AB MW, 8-17 HTAB at top AB	11.5	4
39		Ha 2	216	537	12.2	4	0-6 LINING, 6-8.4 AB MW, 8.4-12.2 CB BJ	9.2	2.5
40		Ha 3	177	526	18	5.5	0-5.5 LINING, 8.5-17 AB MW, 17-18 CB	14	6
41		Ha 4	113	533	10	6	0-3.6 LINING, 3.6-10 AB M-HW	9.5	4
42		Ha 5	69	542	12	5	0-7.9 LINING, 7.9-9.8 AB MJ, 9.8-12CB BJ	11.5	6
43		Ha 6	98	520	15	7	0-4 lining, 4-10 AB MW, 10-15 CB BJ	13	7
44	ADGAON	Ad 1	GAOTHAN	635	22	9.8	0-9.4 LINING, 9.4-22 CBBJ	20	6

45		Ad 2	64	636	8.5	5	0-2.3 LINING, 2.3-3.8 AB MW, 3.8-8.5 CB	7.5	2.5
46		Ad 3	80	645	6.2	5	0-3 LINING, 3-6.2 HCB HW	5.2	6.2
47		Ad 4	52	630	11.8	6	0-4 LINING, 4-5 ABMW, 5-11.8 CB BJ	11	7
48		Ad 5	104	603	8.3	6	0-4.3 LINING, 4.3-8.3 CB MW	8.3	6.5
49		Ad 6	165	598	11	4	0-9 LINING, 9-11 CBBJ	10	6.5
50		Ad 7	120	598	13.5	8	0-4 LINING, 4-13.5 CB BJ	12.5	6
51		La 1	111	537	14	8	0-5 LINING, 5-8 AB MW, 8-10 CBBJ, 10-14 AB MW	13	8
		La 2	88	559	15.8	4	0-5 LINING, 5-15.8 ABMW	14.8	10
53		La 3	75	550	15.4	5	0-5 LINING, 5-13 AB HW THICK, 13-15.4 CB BJ MW	14.4	8
54	LAMKHANA	La 4	37	554	15.8	6	0-6 LINING, 6-15.8 CB VJ	15.3	7
55		La 5	GAOTHAN	555	13.7	4.6	0-8.2 LINING. 8.2-13.7 CBBJ	13	3.5
56		La 6	159	558	14.7	5	0-4.4 lining, 4.4-14.7 CBHW V3SET J	12.7	7
57		Se 1	166	533	11	7	0-5.6 LINING, 5.6-11 CB MW	11	4
58		Se 2	139	532	15	6	0-7.4 LINING, 7.4-12 ABMW, 12-15 CB BJ FRESH	15	5
59		Se 3	161	540	15	2.5	0-5 LINING, 5-8 ABMW THIC, 8-15 CB BJ FRESH	15	5.5
60	SELUD	Se 4	121	530	15	4	0-6 LINING, 6-15 CBBJ MW	13	3.5
61		Se 5	109	535	16	5	0-8 LINING, 8-10.5 AB HW, 10.5-16 CB CJ MW	15	4.5
62		Se 6	38	525	16	4	0-6 LINING, 6-12 MW AB, 12-16 HTB FRESH	16	2.5
63		Se 7	50	530	17	4	0-7 LINING, 7-11 AB MW, 11-17 FRSH BJ CB	17	7
64		Ch 1	133	536	13.5	6.3	0-4.1 LINING, 4.1-13.05 ABMW THICK	12	4
65		Ch 2	1	535	10.6	3.6	0-7.9 LINING, 7.9-10.6 AB MW THICK	10.6	5
66	CHARTHA	Ch 3	43	555	16.3	5.9	0-3.5 AB HW 3.5-5.8 HTAB 5.8-7.8 AB MW, 7.8-16.3 CB BJ	15.3	4.5
67		Ch 4	36	569	13	6.3	0-4.5 LINING, 4.5-6.5 AB MW, 6.5-13 CBMW BJ	10.4	2
68		Ch 5	83	533	13	4	0-4.1 LINING, 4.1-6 ABMW THICK, 6.5-13 CBMW	12.5	4.5

4. Results and Discussion:

4.1 Well Distribution:

According to the dugwell location map (Figure 1), wells are spatially distributed across all major villages. The highest concentration of wells is observed in villages such as Khamkheda, Hatmali, Selud, and Adgaon Sarak, while relatively fewer wells are seen in villages like Lingdari and Murshadpur.

This spatial variability suggests differences in groundwater extraction pressures and aquifer potential across the study area. Villages with higher well density likely depend more on groundwater for agriculture and domestic use.

4.2 Seasonal Water Level Fluctuations:

- **Pre-Monsoon:** Water levels were generally deeper, with some wells recording 7–10 m below ground level, indicating depletion during summer.
- **Post-Monsoon:** Water levels rose significantly, in many cases by 4–6 m, due to recharge from rainfall infiltration and percolation through fractures.

This pattern demonstrates the strong dependence of groundwater on monsoonal rainfall.

4.3 Comparative Analysis:

A comparison between pre-monsoon and post-monsoon conditions highlights:

- Wells located in fractured basalt zones show greater recharge response.
- Shallow wells (<5 m) exhibited quick response to rainfall, while deeper wells (>10 m) showed gradual recovery.
- Variability between villages suggests local differences in aquifer characteristics.

Table 1. Sample Well Data (to be inserted in Word) Figure 1. Pre- vs Post-Monsoon Water Levels (line chart with wells on x-axis, water levels on y-axis).

The figure illustrates the rise in groundwater levels following the monsoon, with the highest recharge observed in wells tapping weathered and fractured basalt.

5. Conclusion:

The analysis of well inventory data highlights significant seasonal variability in groundwater availability. Pre-monsoon levels reflect depletion, while post-monsoon levels demonstrate recharge efficiency of basaltic aquifers. Geological controls, including weathered and fractured zones, play a crucial role in storage and transmission of groundwater.

For sustainable management, the following measures are suggested:

- Regular monitoring of groundwater levels.
- Promoting artificial recharge structures in high-extraction zones.
- Implementing water-use efficiency measures in agriculture.

This study demonstrates the utility of well inventory data as a reliable tool for understanding aquifer dynamics and supporting groundwater management strategies.

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