Status of water resource conservation and physio-chemical assessment of water quality in Nawalgarh block, Jhunjhunu.

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Abstract- **Water is essential and vital for human beings and for every creature on the earth. It is the natural source, available on the surface, in the atmosphere and as ground water. According to our need, knowingly and unknowingly, we use, store and waste this vital resource. Increasing population and development in our living and life on this planet are playing the major role in deterioration of water availability, water quality and the water level. The situation is more critical in the desert areas where the main source of water is rainfall. In this context, this study is focused on the present need of efficient water management and conservation techniques in the study area which is placed under over-exploited category by CGWB.**
This paper aims to assess the water quality on BIS and WHO standards in selected panchayats of Nawalgarh block and to analyze awareness and water conservation status, changes in conservation techniques over the time. The study is based on primary as well as secondary data. For that 22 samples were collected and analyzed on 8 physio-chemical parameters in district level PHED water testing lab to assess the quality of water in the area. Analyzed data were compared to water standards. Water conservation, its techniques and changes related data collected from the district level departments, offices, CGWB, SGWB and from village location and residents during field visits for collection of water samples. Existing conditions of water resource describe imbalance in water quality and its harmful effect on human health in the area, giving an alarming signal for urgent need of efficient water storage and conservation by traditional and scientific means with heart full community participation and awareness.

Key words: **Water conservation, Water quality, Nawalgarh block, Conservation techniques, Physio-chemical assessment.**

Introduction

Water is vital both as a solvent in which many of the body solute dissolve and as an essential part of many metabolic processes within the body. Water contains physical, mineral and organic impurities. Relatively ground water were free from such contamination because of the filtering effect of the strata of soil through which the water percolates but over the decades water level is decreasing day by day and industrial, irrigational, chemical fertilizer, pesticides, manure and mineral contaminants have begun to show up even in ground water. In the developing world, 90% of all waste water still goes untreated into local rivers, ponds, lakes and streams and as result suffering from medium or high water stress and various health problems. According to recent scenario, not only affects surface water bodies but also degrades ground water resources. Drinking water for human beings should contain some level of minerals (TDS) but these levels should not be excessive.
The standard that applies to India is the BIS 10500-1991 standard. This standard use the WHO standard as the basis and has been amended subsequently to take into account the fact that over exploitation of ground water which has the largest share of water supplied for human use has deteriorated to such an extent that the crucial parameters such as TDS, hardness, chlorides, etc. usually exceed the desirable levels substantially (CGWB). Water quality is a general term that used to describe Physical, Chemical, thermal and biological properties of water. We often define in terms of human usage for consumption, secretion and aesthetics. In broader terms the quality of water affects all components of the aquatic system. water quality suitable and desirable for use by one organism may be completely unsuitable for another. Thus, it is a kind of parameter that cannot be defined easily nor can standards be set that can meet all uses and user needs. For example water quality parameters that are suitable for human consumption are quite different from parameters suitable for a farmer irrigating a crop. (Jerry C. Ritchie and Frank R. Schiebe 2000).

Study area

Nawalgarh block is located in north-east part of Rajasthan State and one among 11 blocks of Jhunjhunu district. It lies between 27° 38'46. 59" N to 28°4'23.19" N latitudes to 75°11'6.05" E to 75°30'34.62" east longitudes in South – western part of Jhunjhunu district. It is divided into 40 gram panchayats, two towns and covers the geographical area of 696.80 km^2. Nawalgarh block is the part of Shekhawati region but except some part of North-eastern gram panchayats of Bugala, Kari, Jakhal and Newai, complete block is in the outside basin of Shekhawati river basin boundary and part of outside basin. Majority of area is covered by plains and sand dunal undulating area. Only southern most part comes under hilly area that consist highest peak of Jhunjhunu district (1051 m Lohargarh). There are small isolated hills and hillocks in the undulating area that covers the block area in south of Chhapoli fault line.

The average elevation of Nawalgarh block is 379 m (1243 ft) above mean sea level. Highest elevation is in southern part of study area and it decreases towards north. General topographical elevation lies between 300 m to 500 m above mean sea level. Hilly area of block is the part of Aravalli range that enters from extreme south of Udaipurwati tehsil of Jhunjhunu district.

Water resources

Udaipurwati–Lohargarh river, Parasrampura Nadi and Budhi Nala are part of unsystematic drainage system in Nawalgarh block. All are ephemeral in nature, only flow in response to heavy precipitation in years during the monsoon season. Udaipurwati–Lohargarh river basin is part of outside Shekhawati river basin and lies in south to middle part of Nawalgarh block. There is no drainage flow in northern part of study area. Udaipur–Lohargarh river originates at the attitude of 466 m above mean sea level from Raghunathgarh hills of Aravalli hill region and near the village of Chelasi discharge water covers hill distance of 39 km in Nawalgarh block. Total area drained by this river is 5.908 km^2 that is only 0.099% of district's drained area.

Hydro Geology

Oldest Archean rocks to alluvium form geology of Nawalgarh block. Aeolian sand of sub recent age, post Delhi intrusive, Delhi super group, pre Aravalli group of Archean age form lithological strata of Nawalgarh block. Regionally, there are no exposure of minerals on top of soil, covered by Aeolian and alluvium and by low lying mounds of stabilized sand. Limestone found in the study area belongs to Delhi super group. Limestone mainly found in the belt of Khirod, Basawa, Parasrampura. Quality of limestone is grey to dark grey, granular, medium crystalline and contains 44 to 53 % CaO, 3% mgo, 0-13% silica. Limestone - granite (Cheja stone) is also found in Lohargarh area. Disticts's first biggest cement unit is in this belt of limestone. Complete Nawalgarh block has the zonal class, i.e. older alluvium and quartzite (hard rock) zone based on hydrological classification. Main water bearing formation of Nawalgarh block are older alluvium of quaternary age and quartzite hard rock of Delhi super group in some part of south and south west.

Ground Water Level and Aquifer

Ground water occurs under unconfined to semi confined condition in primary porosity. Thickness alluvial sediments increases from south to north direction, 60 m to 90 m in southern belt, 90–110m in central part and more than 100 m in northern parts. Somewhere it varies in sequence. Alluvial aquifer composed of sand, silt, clay, kankar, gravel and form potential principal aquifer system whereas hard rock aquifers include post Delhi intrusive and quartzite form ancillary aquifers. Moderate climatic conditions of semi arid to arid climate, characterized by very hot and very cold summer and winter season respectively. Normally poor and less rainfall during south-west monsoon period and high evapotranspiration rate makes the study area dependent on ground water resources only. Normal annual average rainfall is 466.14 mm whereas actual average rainfall is 411.28 mm. Generally low humidity level of study area rises up to 70% in monsoon season. . There is changing pattern of rainfall in recent years that shifts towards negative departure % and shows temporal correlation of rainfall with ground water levels.

Nawalgarh block already comes under over-exploited category for water resources. Total dynamic ground water resources are decreasing in previous twenty years and its estimated draft stage of ground water was 307.64 %in 2013 that is indicating still excess withdrawal of ground water and gaps in the practice of ground water management and mitigation in Nawalgarh block. Variation in pre and post monsoon water level is showing negative fluctuation and indicating towards declining trend in Nawalgarh block. Decadal (2011-20) water level of pre monsoon period varies between 26.1 m to 77.7 m and for post monsoon season, it varies between 25.3m to 78.5 m bgl.

Departure from normal rainfall

Actual annual rainfall in the study area is showing significant departure during 2015-16 to 2021-22. Normal rainfall for long term was considered 466.14 mm as calculated from secondary available data. Rainfall departure is calculated by the value of average normal rainfall and actual annual rainfall for the seven years time period.

Formula used for the calculation of rainfall departure from normal (in %) is as given here

$$\text{Departure of Rainfall } (\%) = \frac{\text{Actual rainfall for calculation year - Normal Average rainfall}}{\text{Actual rainfall for the year}} \times 100$$

Seven years data of annual rainfall of Nawalgarh block are deposited with the significant departure (in %) in a table below.

As shown in table actual annual rainfall is in varying frequency over given years. Calculated departure rainfall for given period cover values in positive and negative shift from normal. In the year 2015-16, total annual rainfall is 502 mm and departure value is 7.14%. There are all values of departure ranges between – 70.12 % to 7.14%. In the year 2016-17, total annual rainfall value is 384 mm whereas departure from normal is in negative value –21.39%. Similarly, as previous one again in the year 2017-18 total annual rainfall is 274 mm and departure percentage is -70.12%. For the year 2018-19, annual actual rainfall is 383 mm that is also below normal value and its departure percentage value is – 21.71%. In the years 2016-17 to 2018-19, there is significant difference of rainfall departure because of low annual rainfall in the year 2017-18whereas annual actual rainfall is almost equal in 2016-17 and 2018-19that is showing almost same departure value. For the year 2019-20 with total annual rainfall value of 474 mm, there is a positive departure value of 1.66% showing actual rainfall more than normal rainfall. Again there is negative departure value for two years. Annual actual rainfall for the year 2020-21 is 415 mm that value is less than normal rainfall and it shows negative departure value as-12.32%. For the year 2021-22, somewhat increase in annual rainfall resulted as 447mm but the value is below average normal rainfall value, resulted in negative departure percentage of rainfall as -4.28%. Departure of actual rainfall from average long

term normal is showing the value to calculate rainfall pattern. It also shows temporal correlation of rainfall with ground water levels. Result showing less rainfall and negative departure % is indicating towards drought like situations or change.

Table : Annual rainfall and departure from normal Rainfall in Nawalgarh Block

Year	Actual Rainfall (MM)	Departures from Normal rainfall (%)
2015-16	502	7.14%
2016-17	384	-21.39%
2017-18	274	-70.12%
2018-19	383	-21.71%
2019-20	474	1.66%
2020-21	415	-12.32%
2021-22	447	-4.28%

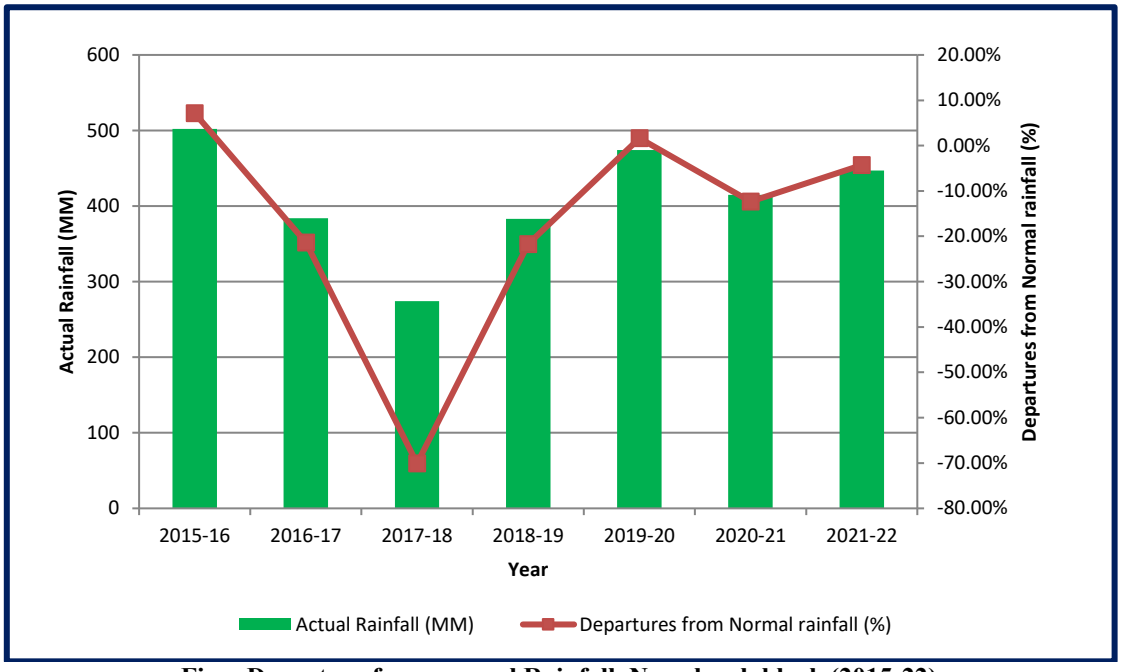

Fig. : Departure from normal Rainfall, Nawalgarh block (2015-22)

water is considered with less contaminants and comparatively good condition because of filtering effect of soil strata through that water percolates. Change in lifestyle and materials in daily use, land use change affecting water quality. Use of various chemicals in daily life showing effect on water sources now. Water quality can be measured according to water standards by BIS Bureau of Indian Standards Is: 10500: 2012. BIS classified the ground water in categories as desirable, permissible and unfit for human consumption. Quality of ground water in unconfined aquifers can define based on physiochemical parameters like odour, TDS, pH, chloride, fluoride, nitrate, hardness, alkalinity, calcium, etc. These parameters affect human health directly with consumption of water. Quality affected by these parameters cannot be changed easily, it requires plenty of resources over the long period of time to change the scenario.

Water quality

As being a vital element water contains physical, mineral and organic material. Among surface and ground water, ground

Physiochemical Parameters for water quality assessment

Water quality can be tested based on water standards prescribed as per BIS and considered by CGWB. Physical parameters include temperature, taste, odour, etc. where chemical parameters include the presence of minerals, materials, chemical ions in water sample such as P^H, chloride, Fluoride, Nitrate, etc. For the study of water quality assessment in Nawalgarh block, total 9 physiochemical parameters considered among which one parameters is in physical category whereas all 8 are chemical parameters. Odour is considered as physical parameter. Chemical parameters considered in study are P^H, TDS, Fluoride, Chloride, Nitrate, Hardness, Alkalinity and Calcium. Sample collected randomly from villages on gram panchayat level. Physiochemical parameters represent the water quality scenario in Nawalgarh block, area under permissible and desirable limit shows quality of water and requirements of attention and improvement in affected belt. There are 40 gram panchayat in study area, water sample considered for five years duration (2015-2020) based on random sampling method. For the year 2015-16 all chemical parameters are depicted in table showing variation in gram panchayats. Average of all chemical parameters calculated for depicting data on gram panchayat level.

For the year 2015-16 P^H value ranges between 6.760 to 8.500 that is showed variation in study area. Further all calculated values are assessed on Indian standards for water quality.

For 2015-16 lowest P^H value found in Chirana gram panchayat whereas highest in Gothra gram panchayat that shows presence of or concentration of acidic and basic components, ions in water samples. Fluoride concentration ranges between 0.166 mg/l to 1.340 mg/l. Considered lowest in Khirod whereas highest in Nawaldi gram panchayat. Nitrate concentration varies between 21.250 mg/l to 110.330 mg/l whereas some gram panchayat sample is not showed any nitrate concentration for this year 2015-16. Lohargarh has 21.250mg/l nitrate concentration whereas Bagoriya ki dhani has 110.330 mg/l. Total dissolved solvents are ranges from 436.000 mg/l to 1700.800 mg/l in the year 2015-16. Lowest TDS value measured in Khirod whereas highest TDS value in Nawaldi gram panchayat. Alkalinity ranges between 184.290 mg/l to 540.000 mg/l. Kolsiya gram panchayat consist lowest alkalinity whereas Dhigal consists highest alkalinity value. Concentration of chloride varies in the block between 112.000 mg/l to 452.670 mg/l. Highest chloride concentration found in Nawaldi whereas lowest in Khirod for year 2015-16. The concentration of calcium is also found in some samples that is in below permissible limits but emerging in samples. It ranges between 80.000 mg/l to 171.670 mg/l. It is found lowest in Lohargarh whereas highest in khirod gram panchayat. Hardness parameter is not found in all areas but emerging in below and above permissible limits category. Hardness ranges between 121.330 mg/l to 326.670 mg/l. Highest value is showed in Bagoriya ki dhani whereas lowest in Khirod.

Assessment of these physiochemical parameters for given five years varies in concentration of parameters found below and above permissible limits. For comparative analysis and assessment, there are data for the year 2020 depicted in table.

P^H range varies 7.18 to 8.44. Lohargarh has average 7.18 P^H whereas Kairu has 8.44 P^H. Concentration of fluoride ranges between 0.166 to 1.910 mg/l, lowest in Tonk Chillari whereas highest showed in Bay. Concentration of nitrate varies between 22.400 mg/l to 131.270 mg/l, lowest showed in Lohargarh and highest in Pabana. Total dissolved solvents in water sample ranges between 432.000 mg/l to 1100.900 mg/l. Bagoriya ki dhani is showed lowest TDS value whereas highest in Devgaon nua. Alkalinity of water value is showed between 180.000 mg/l to 556.920 mg/l, lowest in Bagoriyo ki dhani and highest in Dhigal. Concentration of chloride value ranges between 100.000 mg/l to 356.000 mg/l that showed lowest in Bagoriya ki dhani and highest in Chirana. Concentration of calcium is not above permissible except Mandasi (280.000 mg/l). Hardness value ranges from 103.333 mg/l in Pujari ki dhani and up to 392.000 mg/l in Chirana.

Except all these chemical parameters one physical parameter, odour considered that was agreeable for all considered water samples of Nawalgarh block.

Table: **Physiochemical assessment of selected water quality parameters (Values in mg/l except pH)**

S.No.	Gram panchayat	No. of Sample	pH	Fluoride	Chloride	Calcium	Nitrate	TDS	Alkalinity	Hardness
1	Badwasi	14	7.85	0.707	153.57		26	647.71	318.57	154.79
2	Basawa	24	7.9	0.687	181.67		57.04	645.71	328.75	165.42
3	Bay	9	7.98	1.91	186.67		25.44	733.78	404.44	170
4	Birol	15	7.58	1.06	207.33		71.46	820.53	397.33	179.33
5	Bugala	15	8.3	1.13	118.67		48.06	409.47	238	140.67
6	Bagoriya ki dhani	2	7.55	0.4	100		32	432	180	130
7	Chelasi	9	8.24	0.98	201.11		72.67	791.78	384.44	180
8	Chirana	10	7.46	0.48	356		40.9	1026.8	343	392
9	Devgaon nua	12	8.15	0.74	275		114.83	1100.9	490.83	220.83
10	Devipura	9	7.8	0.25	126.67		73.89	514.22	228.89	148.89
11	Dhaka ki dhani	12	7.93	0.816	181.67		79.75	726.17	342.5	166.67
12	Dhigal	13	8.04	1.05	296.15		57.53	1096.2	556.92	193.08
13	Dumra	11	8.12	0.47	190		93.182	726	330	172.73
14	Dundlod	16	8.2	1.41	243.13		88	893.88	422.5	212.5
15	Ghoriwara khurd	21	8.2	1.13	258.1		51.42	928.1	436.67	210.95
16	Girdharpura Shahpura	6	7.93	0.33	153.33		30.5	646	345	158.33
17	Gothra	12	7.95	0.691	155.83		52	621.17	302.5	155.83
18	Jakhal	11	7.75	0.57	137.27		106.73	584.91	239.09	144.55
19	Jejusar	10	8.08	0.6	273		70	1018.1	497	204
20	Jhajhar	2	7.8	0.5	210		86.5	816	395	170
21	Kairu	11	8.44	1.33	158.18		79.09	660.73	302.73	163.64
22	Kari	7	7.71	0.385	162.86		36.857	670	350	162.86
23	Kaseru	3	8.43	2.033	193.33		85.667	794.67	383.33	176.67

24	Khirod	6	8.08	0.366	123.33		58.167	517.67	255	133.33
25	Kolsiya	5	7.74	0.32	138		51.4	547.6	205	138
26	Kumawas	6	8.38	0.716	202.67		71.33	866.33	420	181.67
27	Lohargarh	5	7.18	0.24	122		22.4	526.4	270	170
28	Mandasi	11	8.42	1.2	259.09	280	58.9	882.91	426.36	195.45
29	Mohanbari	4	7.9	0.475	127.5		51	534.25	242.5	130
30	Nawaladi	12	8.22	1.783	163.33		40	684.83	333.33	165
31	Nawalgarh rural	1	7.8	0.7	180		87	796	410	170
32	Newai	12	8.35	0.7	187.5		77.667	738.17	340	174.17
33	Pabana	11	8.3	1.1	270		131.27	937.45	404.55	176.36
34	Parasrampura	9	7.97	0.42	133.33		39.44	541.32	261.11	133.33
35	Pujari ki dhani	6	8.1	1.3	121.67		29	505	246.67	103.33
36	Ranasar	3	8.2	1.066	153.33		66.33	640	280	203.33
37	Sotwara	7	7.77	0.457	221.43		98.286	823.71	388.57	221.43
38	Todpura	4	7.82	0.325	115		52.5	501.5	260	107.5
39	Togra kalan	9	8.41	0.666	237.78		64.667	886.89	441.11	180
40	Tonk Chillari	9	7.74	0.166	150		87.111	615.78	291.11	127.78

BIS standards for water

Bureau of Indian standards (BIS) has recommended quality standards for water. Standards and parameters considered are different for drinking water and irrigation water. Natural ground water is categorised on the basis of BIS standards as desirable, permissible maximum limits and unfit for humans. Main parameters for ground water in unconfined aquifer are considered to assess the quality for drinking purpose. There are 8 chemical and 1 physical parameters considered for assessment. Its document after second revision in 2012 is considered here for standard values according to BIS (IS: 10500: 2012: and IS 10500:1991, IS 11624:1986). If total dissolved solids are higher than ranges in acceptable and permissible limit, it can cause Gastro intestinal irritation disorder in humans. Fluoride can affect dental parts and high concentration can cause fluorosis. Nitrate concentration beyond limits leads to methemoglobenamia. Every parameter considered has significant value in water for human life. All data related to standard ranges are depicted in table, basically categorised by BIS (2012). There are three categories as maximum acceptable limit, maximum permissible limit in case of absence of alternate source of water and some guideline value if there is no alternate source and no progressive step available in some condition like emergency. Quality of water is essential for every living being that can lead a healthy progressive ecosystem.

Water quality rating according to Mishra and Patel, 2001 are as follows in below table.

Table: Water quality rating with corresponding water quality index values

S. No.	WQI	WQ Rating
1	0-25	Excellent
2	26-50	Good
3	51-75	Bad
4	76-100	Very bad or Poor
5	>100	Unfit

Comparative analysis of water quality in Nawalgarh block

Togra Kalan, Newai, Nawalgarh rural, Kumawas, Jejusar, Gothra, Dhaka Ki Dhani, Devgoan nua, Badwasi, Basawa indicate water quality of poor category. Bay, Birol, Bugala, Chelasi, Dhigal, Dundlod, Ghoriwara khurd, Kairu, Kaseru, Mandasi, Nawaladi, Pabana, Pujari Ki Dhani, and Ranasar total 14gram panchayat have quality of water under unfit category and WQI value is highest in Nawaladi gram panchayat. There is a change in water quality index values of gram panchayat during 2015 – 20 and some panchayat have same water quality value during this period. Comparative analysis reveals result of overall deteriorating water quality in Nawalgarh block.

Conclusion

Based on statistical analysis outcome of high values of Parameters- Nitrate, Fluoride P^H, TDS, alkalinity and chloride observed in Nawalgarh block and comparative study of these parameters according to BIS Standards reveal their level above permissible limits for drinking purpose.WQI of 40 gram panchayats is indicating the rating categories and zone of quality water for drinking and domestic use in complete study area. All kind of manure, fertilizers, sewage, polluting materials by industries and solid and liquid domestic waste are responsible to affect the heath and composition of soil and water. For long time span all practices are helpful to deteriorate the quality of these vital sources. Use of Chemical fertilizers is one among all these affecting factors for water quality.

It is alarming for citizens to understand the situation of quality of drinking water and work with government participation to deal with scenario of Nawalgarh block .

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