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ASSESSMENT OF PHYSICO-CHEMICAL STATUS OF GROUND WATER SAMPLES OF PARBHANI DISTRICT (M.S., INDIA)

D.A. Dhale*[1] and G.L. Pachkore [2]

PG-Department of Botany, SSVPS's, L.K. Dr. P.R. Ghogrey Science College [1], Dhule- 424 005, Maharashtra, India
Padmabhushan Vasantdada Patil Art's, Commerce & Science College [2], Patoda, Dist.Beed- 414 204, Maharashtra, India

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Correspondence to Author:

D.A. Dhale

Assistant Professor, PG-Department of Botany, S.S.V.P.S.Sansthas, L.K. Dr. P.R. Ghogrey Science College, Dhule- 424005, Maharashtra, India

ABSTRACT

Ground water is the most preferred water source in recent day. Once believed to be safe from pollution as it is available many strata below the surface, is now provided to be prone to pollution by many researchers across the world. The contamination of ground water may be due to improper disposal of domestic and industrial west water. A study was carried out to assess the ground water quality of Parbhani District, one of the most important agro plantation areas of Maharashtra State (India). The present work was undertaken to assess the ground water quality and discus the potability of ground water by collecting data of physio-chemical characters of ground water. The study was carried out in years 2007 by selecting 10 spots, situated in Parbhani District. Nineteen water quality parameters of water of all sites were estimated following standard methods and procedures of sampling and estimation. Comparison of estimated values with W.H.O. The physio-chemical parameter such as Temperature, colour, odour, pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, total hardness (TH), calcium (Ca^{++}), magnesium (Mg^{++}), total alkalinity (TA), bicarbonate (HCO_3^-), sodium (Na^+), potassium (K^+), chloride (Cl^-), fluoride (F^-) nitrate (NO^-_3) and sulphate (SO^{--}_4) were studied. Variations in these values were observed. The sampling point S_6 and S_7 showed high total hardness content indicating the need of some treatment for minimization of the parameters. Other sites water under investigation was found physicochemical parameters within the water quality standards and the quality of water is good and it is fit for drinking purpose.

INTRODUCTION: Ground water is the principal source of drinking water in our country and indispensable source of our life. The problem of ground water quality is acute. The resulting degradation of water quality in water body creates a condition so that water cannot be used for intended beneficial uses including bathing, recreation and as a source of raw water supply [1].

Since, it is a dynamic system, containing living as well as nonliving, organic, inorganic, soluble as well as insoluble substances. So its quality is likely to change day by day and from source to source. Any change in the natural quality may disturb the equilibrium system and would become unfit for designated uses. The availability of water through surface and groundwater

resources has become critical day to day. Only 1% part is available on land for drinking, agriculture, domestic power generation, industrial consummation, transportation and waste disposal [2-4]. The present study was under taken to assess the extract level of Physico-chemical parameters of the ground water. This section deals with water quality of tube wells, dug wells, with special reference to suitability of water for drinking purpose.

The evaluation of ground water quality is as important as quantity, since the usability of water is determined by its chemical characteristics. The quality of ground water depends upon the nature of rock formation, physiography, soils, environment, recharge and discharge conditions in the area. Mineral water reaction is also an important criterion. Artificial pollution sources like sewerage, organic and other waste dumps, and chemical dumps too cause considerable ground water pollution particularly in the urban areas.

The people are using dug well water, tube well water as well as municipal water for their daily need. The literature survey reveals that no water quality management studies are made in this region so far. Hence the present study was planned and undertaken.

MATERIAL AND METHODS:

Preparation of Water Samples: The sample were collected from all the stations at 11.00 am to 12.00 noon for physico-chemical examinations, different methods of collection and handling were adopted based the standard procedures [5]. The samples were collected in plastic canes of five liters capacity without any air bubbles. The instruments were used of accuracy. The temperatures of the samples were measured in the field itself at the time of sample collection. The samples were kept in refrigerator maintained at 4°C. Water samples from ten sampling sites were collected in month of April-May of the year 2007. The sampling locations in Parbhani District (M.S., India) for assessment of physico-chemical parameter status of ground water are given in **Table 1**.

Physico-Chemical Analysis: Analysis was carried aout for various water quality parameters such as Temperature, colour, odour, pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, total hardness (TH), calcium (Ca^{++}), magnesium (Mg^{++}), total alkalinity (TA), bicarbonate (HCO_3^-), sodium (Na^+), potassium (K^+), chloride (Cl^-), fluoride (F^-) nitrate (NO^-_3) and sulphate (SO^{--}_4) using standard method[6-8]. All The reagents used for the analysis were AR grade and double distilled water was used for preparation of solutions.

TABLE 1: SAMPLING LOCATIONS IN PARBHANI DISTRICT

Name of Station	Source	Sample Code
Parbhani	Hand pump	S_1
Zari	Hand pump	S_2
Daithana	Hand pump	S_3
Pingli (Koth)	Dug well	S_4
Takli (Kumb.)	Dug well	S_5
Asola	Dug well	S_6
Pedgaon	Dug well	S_7
Balasa (Bk.)	Bore well	S_8
Pingli (Bazaar)	Dug well	S_9
Borwand (Bk.)	Bore well	S_{10}

RESULTS AND DISCUSSION: The physicochemical parameters of the above mention sites in Parbhani District can be calculated and it is describe as bellow.

TABLE 2: AVERAGE RESULTS OF THE PHYSIC-CHEMICAL PARAMETERS OF DIFFERENT SITES IN PARBHANI DISTRICT

Sr. No.	Station	Samples	Temp.	colour	Odor	Turbidity	pH	E. Cond.	TDS	T.H.	Ca	Mg	T.A.	HCO_3	Cl	Na	K	F	SO_4	NO_3
1	Parbhani	S_1	28	Colorless	Odorless	0.3	7.6	1044	668	372	83	39	304	304	142	129	1	0.35	71	28
2	Zari	S_2	29	Colorless	Odorless	0.1	7.8	1213	776	276	72	23	204	204	144	173	1	0.46	210	5
3	Daithana	S_3	29	Colorless	Odorless	0.1	7.6	1054	675	340	101	21	228	228	198	125	2	1.45	100	15
4	Pingli (Koth)	S_4	26	Colorless	Odorless	0.4	7.8	764	489	268	48	36	312	312	42	92	6	0.46	57	24
5	Takli (Kumb.)	S_5	29	Colorless	Odorless	0.1	7.8	874	559	332	86	28	308	308	88	95	1	0.64	49	28
6	Asola	S_6	28	Colorless	Odorless	0.1	7.4	1848	1183	700	136	86	380	380	252	179	4	0.52	253	9
7	Pedgaon	S_7	29	Colorless	Odorless	0.1	7.8	1417	907	760	157	88	288	288	228	47	1	1.07	115	43
8	Balasa (Bk.)	S_8	27	Colorless	Odorless	0.1	7.7	1358	552	472	82	64	280	280	220	159	2	0.35	117	28
9	Pingli (Bazar)	S_9	29	Colorless	Odorless	0.1	7.9	500	970	196	38	24	216	216	48	46	1	0.35	27	9
10	Borwand (Bk.)	S_{10}	29	Colorless	Odorless	0.3	7.7	863	869	348	59	48	364	364	96	80	20	0.2	69	11
WHO Standards		Highest Disrable Limit				5	6.5	500	500	300	75	30	200	-	250	-	-	1	200	-
		Max.Permisiable Limit				10	8.5	2000	2000	600	200	100	600	-	1000	200	-	1.5	400	45

E. Cond.= Electrical Conductivity; TDS=Total Dissolved Solid; T.H.= Total Hardness; Ca= Calcium; Mg= Magnesium; T.A.= Total Alkanity
HCO_3= Bicarbonate; Cl= Chlorine; Na= Sodium; K= Potassium; F= Fluorine
SO_4= Sulphates; NO_3= Nitrates

Note: All the values expressed in mg/l except pH, temperature and Electrical Conductivity

Temperature (T): Temperature is an important biologically significant factor, which plays an important role in the metabolic activities of the organism. The temperature was ranging from minimum 26°C at S_4 to maximum 29°C at six different station during the study period. Property of water is that with change in temperature, its density varies and it becomes less with warming up and more with cooling. Colour having the colourless and odour having odourless for all the collected samples.

Turbidity: In most waters, turbidity is due to colloidal and extremely fine dispersions. The turbidity values varied between 0.1 to 0.4 NTU and found within the limits prescribed by WHO [13].

pH: The pH of a solution represents the negative base 10 log of the hydrogen ion activity in moles per litre. At pH7, the concentration of H^+ or OH^- ions is equal. The highest desirable limit of pH as per WHO standards for drinking purpose is 6.5 to 8.5. The pH value of drinking water is an important index of acidity and alkality. The pH values of all the samples were within the permissible limits i.e., water samples were slightly alkaline in nature. Deviation in this range indicates the entry of acidic or basic medium causing lot of health problems. In the present investigation the pH was recorded as 7.2 to 7.9. The higher range of pH indicates higher productivity of water [9].

Electrical Conductivity (EC): Electrical conductivity (EC) is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts [10]. EC values were in the range of 500 micro-ohms/cm to 1848 micro-ohms/cm. High EC values were indicating the presence of high amount of dissolved inorganic substances in ionized form.

Total Dissolved Solid (TDS): The desirable Total Dissolved Solid (TDS) range for drinking water is 500 to 2000. The TDS values of all the samples were within the permissible limits. In the present investigation the DTS range was recorded as 552.00 mg/l to 1183.00 mg/l. Similar observations were by Singh, worked on water quality index of major river Pune [11].

Total Hardness (TH): Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water [12]. Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. The hardness values shown range from 196 mg/l to 760 mg/l. The values for sample from point S_6 and S_7 were higher than the prescribed limit.

Calcium (Ca^{2+}): Calcium are directly related to hardness. Calcium concentration ranged between 38.00 mg/l to 157.00 mg/l and found below permissible limit of WHO in samples point S_4 and S_9. Hypocalcemia (hypo=too little) is usually associated with eating disorders or lack of parathyroid hormone. Symptoms include weakness, muscle spasms, and heart rhythm disturbance.

Magnesium (Mg^{2+}): Magnesium are directly related to hardness. Presence of magnesium in the water is totally unhygienic because it causes diarrhea and irritations in gastro-intestine. Magnesium content in the investigated water samples was ranging from 21.00 mg/l to 88.00 mg/l. It is below at point S_2 and S_9 than the prescribed limit. More than half of hospitalized patients in ICUs may become magnesium deficient.

Total Alkalinity (TA): Alkalinity of water is its capacity to neutralize a strong acid and it is normally due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium. Total alkalinity values for all the investigated samples were found to be in the standard limit during course of investigation. It is in range of 204 mg/l to 380 mg/l.

Bicarbonate (HCO_3^-): This electrolyte is an important component of the equation that keeps the acid-base status of the body in balance. The lungs regulate the amount of carbon dioxide, and the kidneys regulate bicarbonate (HCO_3^-). This electrolyte helps buffer the acids that build up in the body as normal byproducts of metabolism. It is in range of 216 mg/l. to 380 mg/l.

Chloride (Cl^-): The chloride concentration serves as an indicator of pollution by sewage. People accustomed to higher chloride in water are subjected to laxative effects [10].

In the present analysis, chloride concentration was found in the range of 48.00 mg/l to 252.00 mg/l. All the values are below the limit except water sample collected from sites S_6.

Sodium (Na^+): Sodium is most abundant alkaline metal. It is more in igneous rocks and less in sediments. Its concentrations were found in between 46.00 mg/l to 179.00 mg/l. Sampling of all sites showed the concentration prescribed limit by WHO.

Potassium (K^+): The major source of potassium in natural fresh water is weathering of rocks but the quantities increase in the polluted water due to disposal of waste water [12]. An essential element for both plants and animals, principal sources of potassium are orthoclase, microline, biotrite, lencite etc. Potassium content is less than sodium in water. Potassium content in the water samples varied from 1.00 mg/l to 20.00 mg/l.

Fluoride (F^-): The concentration of fluoride in ground water is due to solubility of fluoride bearing minerals like fluorite, cryolite, topaz, mica etc. As per WHO Standards 1.0mg/l is the desirable limit whereas 1.5mg/l is the permissible limit in the absence of an alternate source. Above 1.5mg/l. It causes fluorosis disease. In the present analysis, fluoride concentration was found in all samples sites within concentration prescribed limit i.e. 0.20 mg/l to 1.07 mg/l.

Sulphate (SO_4^{2-}): As the ground water passes through the minerals, concentration of sulphate is possible. Recommended desirable limit is 200 mg/l and the maximum limit for drinking purposes is 400mg/l. Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals [8]. The sulphate concentration varied between 27.00 mg/l and 253.00 mg/l and found within the prescribed limit.

Nitrate (NO_3^-): Nitrogen is a major constituent of atmosphere. Soil bacteria convert it into nitrite and nitrate. Nitrate is a minor constituent of rocks. Part of the nitrate is fixed by the plants before the rain water percolates below the root zone. Natural ground water contains less than 5mg/l of nitrates. But the polluted waters contain high concentrations of nitrate. The concentration of nitrate range from minimum 5.00mg/l to maximum 43 mg/l. whereas the WHO norm, the nitrate concentration upto 45mg/l is desirable limit for drinking. Beyond this limit, Methaemoglobinaemia takes place, mostly in babies. The maximum permissible limit is 100mg/l. Nitrates may find their way into ground water through teaching from soil and also by contamination.

CONCLUSION: From the analysis data in Table 2 it is concluded that the water samples are well within the prescribed limit. However a few parameter like total hardness, Calcium, magnesium, chlorine shows marginal increase or decrease from the specific limit. The sampling point S_6 and S_7 showed high total hardness content indicating the need of some treatment for minimization of the parameters. Keeping the other conditions of localities like forest density of population etc. in mind we conclude that the physico-chemical parameters are appeared to be a normal, but it requires a thorough investigation of biological parameters. Except sampling sites S_6 and S_7 other sites water under investigation was found physicochemical parameters within the water quality standards and the quality of water is good and it is fit for drinking purpose.

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