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Water Quality Analysis of Yelimineti Vagu Watershed Area

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Abstract: To understand the hygiene state of drinking water in the rural areas of Yelimineti vagu watershed area, and to provide scientific bases for drinking water quality improvement and public health protection, 30 bore well Samples were collected for analysis. Techniques and methods followed for collection, preservation, analysis, and interpretation of water as per standard methods (APHA 1995).

Keywords: Water quality testing, pH, Electrical conductivity, total dissolved solids, fluoride

I. INTRODUCTION

Water is a limited natural resource, which is essential for human survival. Water resources that met certain water quality standards are needed in industrial and agricultural production, as well as in many aspects of people's lives. Domestic water, in particular, is closely related to people's lives, and its quality directly affects public health.

The chemical composition of groundwater is influenced by the solubility of rocks on weathering and decomposition caused by meteorological, pedological and topographic conditions. Assessment and rating of groundwater of the watershed are of prime importance in determining the suitability of water for drinking, agriculture, industry and for other purposes.

II. LOCATION OF THE WATERSHED AREA

The watershed area is located in the southern part of the Ranga Reddy district of Telangana State. The Yelimineti Vagu River is a tributary of the Krishna River rises from the south-western part of the area and flows towards the north-eastern direction and joins the Ibrahimpatnam Cheruvu near Ibrahimpatnam. It drains an area of about 424 km². The watershed area falls in the Survey of India Toposheet No.s E44M8, E44M12, E44S05 and E44S09.

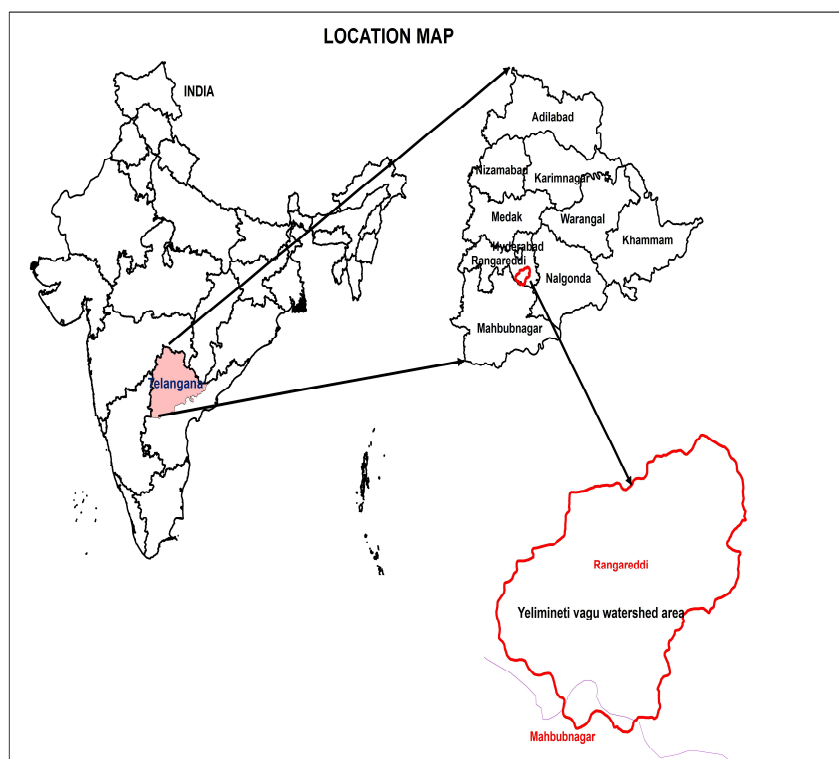


Fig.1 Location Map

III.MATERIALS AND METHODS

30 Water samples were collected Prewashed (with detergent, dil.HNO₃ and doubly deionized Distilled water respectively) in clean polyethylene bottles from bore wells. These samples were analyzed for physical and chemical tests. The major constituents like turbidity, pH, Electrical conductivity, Total Dissolved solids, P-Alkalinity, Total Alkalinity, carbonates(CO₃), Bicarbonates(HCO₃), Hydroxides (OH), total Hardness, Calcium(Ca), Magnesium(Mg), Ammonia (NH₃), Nitrogen dioxide(NO₂), Nitrate (NO₃), Chloride(Cl), Fluoride(F), Sulphates(SO₄), Iron(Fe) and Manganese(Mn) were analyzed.

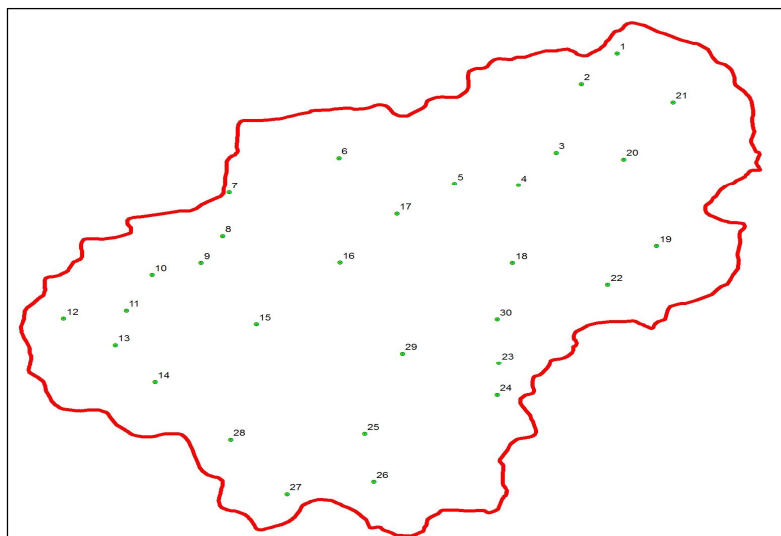


Fig.2 Water Samples collection Locations Map

Samples were collected from Groundwater for analysis. Techniques and methods followed for collection, preservation, analysis, and interpretation of water samples are those given by standard methods (APHA 1995).

TABLE I
Indian Standard Drinking water specifications (IS10500)

S.No.	Parameter	Units	Water Quality analysis Results	Acceptable limits	Max. Permissible
1	Apparent colour	-	Colourless	-	-
2	Odour	-	Odour less	-	-
3	Turbidity	NTU	0-29.7	1	5
4	pH	Value	6.7-8.2	6.5 - 8.5	No relaxation
5	Electrical Conductivity	µ Siemens /cm	652-3920		2000
6	TDS	Ppm	370 - 1940	500	2000
7	Alkalinity	Mg/l	132.3 -592.2	200	600
8	Bicarbonates (HCO ₃)	Mg/l	132.3 -592.2	200	600
9	Total Hardness	Mg/l	291-1067	200	600
10	Calcium (Ca)	Mg/l	40.8 - 260.5	75	200
11	Magnesium (Mg)	Mg/l	3.5 -129.7	30	100
12	Nitrogen(NH ₃)	Mg/l	0.0 - 0.2	0.5	No relaxation
13	Nitrites(NO ₂)	Mg/l	0.0 - 0.2058	0.9	3
14	Nitrates(NO ₃)	Mg/l	0.0 35	45	No relaxation
15	Chlorides(Cl)	Mg/l	9.6 - 509.6	250	1000
16	Flourides(Fl)	Mg/l	0.5 - 3.0	1	1.5
17	Sulfates (SO ₄)	Mg/l	14.9 - 260.2	200	400
18	Total Iron(Fe)	Mg/l	0.0 - 0.2	0.3	1
19	Manganese(Mn)	Mg/l	0.0 - 0.2	0.1	0.3

TABLE 2
WATER Quality ANALYSIS DATA

S.No	1	2	3	4	5	6	7	8	9	10	11	
Sample Location	UPPARIGUDA	POCHARAM	YELIMINEDU	MADHAPUR	TIMMAPUR	LEMUR	BERAGUDA	KOTUR	GAFURNAGAR	JAITARAM	PHULMAMIDI	
Sample No.	A082240	A082236	A082229	A082235	A082230	A082221	A082231	A082223	A082228	A082220	A082243	
Latitude	17° 11' 22" N	17° 10' 40" N	17° 08' 43" N	17° 7' 46" N	17° 7' 40" N	17° 8' 18" N	17° 7' 18" N	17° 5' 34" N	17° 5' 12" N	17° 4' 21" N	17° 3' 57" N	
Longitude	78° 36' 56" E	78° 36' 7" E	78° 35' 47" E	78° 34' 50" E	78° 33' 26" E	78° 31' 10" E	78° 29' 51" E	78° 28' 6" E	78° 27' 6" E	78° 26' 21" E	78° 25' 28" E	
Physical Tests	colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Light Brown
	odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
	turbidity (NTU)	0	0	0	0	0	0	0	0	0	0	27.1
	PH	6.9	7.6	7.2	6.9	7	7	7	7.1	7.1	7.6	7.2
	E.C. (m Siemens /cm)	1960	2037	1530	2010	2200	1560	1310	1851	1285	687	1785
	TDS (ppm)	1060	985	794	1070	1220	786	692	916	685	370	911
Chemical Tests	P-Alk (mg/l)	0	0	0	0	0	0	0	0	0	0	0
	T-Alk (mg/l)	372.4	465.5	411.6	460.6	485.1	450.8	455.7	548.8	470.4	318.5	490.0
	CO3 (mg/l)	0	0	0	0	0	0	0	0	0	0	0
	HCO3 (mg/l)	372.4	465.5	411.6	460.6	485.1	450.8	455.7	548.8	470.4	318.5	490
	OH (mg/l)	0	0	0	0	0	0	0	0	0	0	0
	Total Hardness (mg/l)	397.7	475.3	504.4	378.3	936.1	557.8	489.9	354.1	349.2	300.7	572.3
	Ca (mg/l)	145.8	124.4	145.8	145.8	217.7	124.4	153.6	120.5	105	60.3	40.8
	Mg (mg/l)	8.3	40.1	34.2	3.5	95.5	60.2	25.9	13	21.2	36.6	114.4
	NH3 (mg/l)	0	0	0	0.2	0	0	0	0.1	0	0	0.2
	NO2 (mg/l)	0	0	0	0.0686	0	0	0	0.0686	0	0	0.2058
	NO3 (mg/l)	0	0	10	25	10	0	0	25	0	0	35
	Cl (mg/l)	296.7	224.9	217.8	236.9	354.1	222.5	134	184.3	131.6	9.6	239.3
	Fl (mg/l)	0.5	3	0.5	0.5	0.5	0.5	1	0.5	1.5	1.5	0.5
	SO4 (mg/l)	159.1	151.1	124	153.2	155.1	102.8	108	118.4	120.9	75.7	132.9
Fe (mg/l)	0	0	0	0.2	0.2	0	0	0	0	0	0.2	
Mn (mg/l)	0.2	0.1	0.1	0.2	0.2	0.1	0	0.1	0	0	0.2	

	S.No	12	13	14	15	16	17	18	19	20	21
	Sample Location	BACHPALLI	NEDNUR	KANDUKUR	MALAGUDUR	RACHLUR	CHARLA PATELGUDA	KAPAPAHAD	TULEKALAN	CHINATUNDLA	MANPET
	Sample No.	A082238	A082233	A082237	A082234	A082239	A082232	A082242	A082224	A082241	A082225
	Latitude	17° 03' 13" N	17° 2' 18" N	17° 3' 56" N	17° 4' 57" N	17° 6' 59" N	17° 10' 5" N	17° 8' 43" N	17° 5' 59" N	17° 5' 2" N	17° 2' 50" N
	Longitude	78° 26' 22" E	78° 27' 6" E	78° 29' 11" E	78° 30' 25" E	78° 31' 54" E	78° 38' 1" E	78° 36' 57" E	78° 37' 39" E	78° 36' 48" E	78° 34' 27" E
Physical Tests	colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Pale Yellow	Colourless	Colourless	Light Brown
	odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
	turbidity (NTU)	0	0	0	0	0	0	0	0	0	29.7
	PH	7.1	7	7	7.5	7.1	7.4	7	8.2	7.1	6.8
	E.C. (m Siemens /cm)	1674	1960	1385	740	1140	1819	2880	652	1930	3920
	TDS (ppm)	837	1060	728	401	588	802	1480	301	850	1940
Chemical Tests	P-Alk (mg/l)	0	0	0	0	0	0	0	0	0	0
	T-Alk (mg/l)	377.3	426.3	475.5	367.5	499.8	416.5	328.3	132.3	396.9	553.9
	CO3 (mg/l)	0	0	0	0	0	0	0	0	0	0
	HCO3 (mg/l)	377.3	426.3	475.5	367.5	499.8	416.5	328.3	132.3	396.9	553.9
	OH (mg/l)	0	0	0	0	0	0	0	0	0	0
	Total Hardness (mg/l)	422	557.8	470.5	291	412.3	630.5	785.7	305.5	698.4	1067
	Ca (mg/l)	143.3	138	106.9	73.9	64.1	73.9	155.5	42.8	141.9	260.5
	Mg (mg/l)	15.3	51.9	49.5	25.9	61.3	108.5	96.7	48.36	83.7	101.4
	NH3 (mg/l)	0	0	0	0	0	0.2	0	0	0	0.2
	NO2 (mg/l)	0	0	0	0	0	0	0	0	0	0
	NO3 (mg/l)	0	10	0	0	0	25	0	0	0	35
	Cl (mg/l)	222.5	375.7	789.6	19.1	19.1	155.5	313.4	23.9	215.3	457
	Fl (mg/l)	0.5	0.5	0.5	3	3	2	2	0.5	1.5	1.5
	SO4 (mg/l)	120.5	122.5	108.6	14.9	58.8	127.6	95.5	142.4	150	260.2
Fe (mg/l)	0	0	0	0	0	0	0.2	0	0	0.2	
Mn (mg/l)	0.1	0.1	0	0	0	0.1	0.1	0.1	0.1	0.1	

	S.No	22	23	24	25	26	27	28	29	30
	Sample Location	KURUMIDA	UTLAPALLI	ANUMASPALLI	KARTAL	DASAR LAPALLI	VAILAKUNTA TANDA	AKULAMAILAWARAM	GUMADAVE LLI	KONALGUDAM
	Sample No.	A082219	A082226	A082227	A082217	A082218	A082214	A082215	A082213	A082222
	Latitude	17° 2' 4" N	17° 1' 32" N	16° 59' 42" N	16° 59' 14" N	17° 0' 41" N	17° 2' 56" N	17° 3' 58" N	17° 5' 32" N	17° 6' 13" N
	Longitude	78° 34' 27" E	78° 31' 56" E	78° 31' 40" E	78° 30' 7" E	78° 28' 48" E	78° 32' 29" E	78° 34' 19" E	78° 34' 50" E	78° 35' 26" E
Physical Tests	colour	Colourless	Colourless	Colourless	Pale Yellow	Colourless	Colourless	Colourless	Colourless	Colourless
	odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
	turbidity (NTU)	0	0	0	0	0	0	0	0	0
	PH	7.2	7.2	6.7	7.1	7	7.3	7	7.1	8
	E.C. (m Siemens /cm)	3420	1959	2020	2550	2233	1697	2400	2200	1575
	TDS (ppm)	1490	844	930	1160	934	615	1040	1180	694
Chemical Tests	P-Alk (mg/l)	0	0	0	0	0	0	0	0	0
	T-Alk (mg/l)	735	426.3	186.2	592.2	460.6	323.4	426.3	465.5	539
	CO ₃ (mg/l)	0	0	0	0	0	0	0	0	0
	HCO ₃ (mg/l)	735	426.3	186.2	592.2	460.6	323.4	426.3	465.5	539
	OH (mg/l)	0	0	0	0	0	0	0	0	0
	Total Hardness (mg/l)	708.1	538.3	649.9	582	417.1	388	819.6	771.1	527.3
	Ca (mg/l)	70	103	196.3	99.1	159.4	62.2	157.5	163.3	62.2
	Mg (mg/l)	129.7	68.4	38.9	81.39	4.7	56.6	103.8	88.4	101.4
	NH ₃ (mg/l)	0	0	0	0	0	0	0	0	0
	NO ₂ (mg/l)	0	0	0	0.0343	0	0	0	0	0
	NO ₃ (mg/l)	0	0	0	10	10	0	0	0	0
	Cl (mg/l)	509.6	189	332.6	344.57	169.89	107.68	258.4	303.9	55
	Fl (mg/l)	3	0.5	1	1.5	1	1.5	1.5	1.5	2
	SO ₄ (mg/l)	224.2	160.2	195	88.5	141	127.2	173	204.4	117.2
Fe (mg/l)	0	0	0	0	0	0	0	0	0	
Mn (mg/l)	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	

IV. RESULTS AND DISCUSSIONS

The following methods were adopted for the analysis of groundwater samples.

- 1) *Turbidity (NTU)*: Turbidity estimated in Systronic digital nephelo-turbidity meter 132 which is calibrated daily using stabilized formazin standard made by HACH. NTU=Nephelometric Turbidity Unit. Most of the water samples of the watershed area fall in permissible limits. The Turbidity values in Phulmamidi and Manpet villages are high due to contamination.
- 2) *pH*: pH value as measured by Lab India PICO (pH Conductivity) instrument The pH values in the watershed area range from 6.7 to 8.2. The pH values of all the water samples in the watershed area are in acceptable limits.

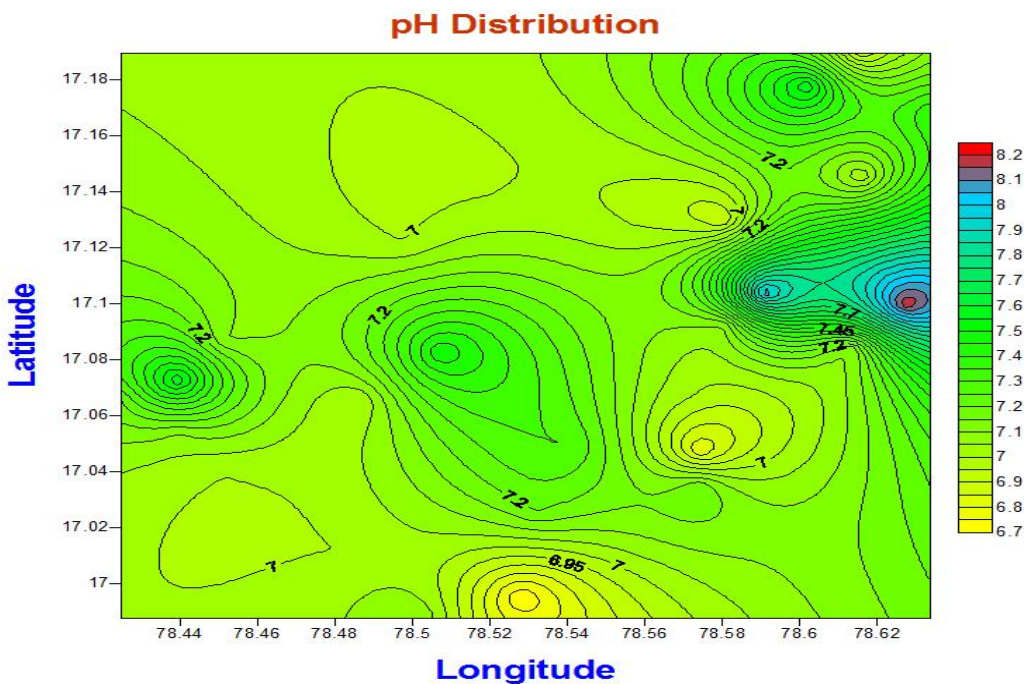


Fig.3 pH Distribution

3) *Electrical conductivity (E.C)*: Electrical conductivity in micro Siemens/cm, reading from Lab India PICO (pH Conductivity) instrument. Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides, and carbonate compounds. The Electrical conductivity values in the watershed area range from 652 to 3920. The E.C values of 19 samples are in the permissible limits (652-1960). The remaining 11 samples are more than Permissible limits (2010-3920).

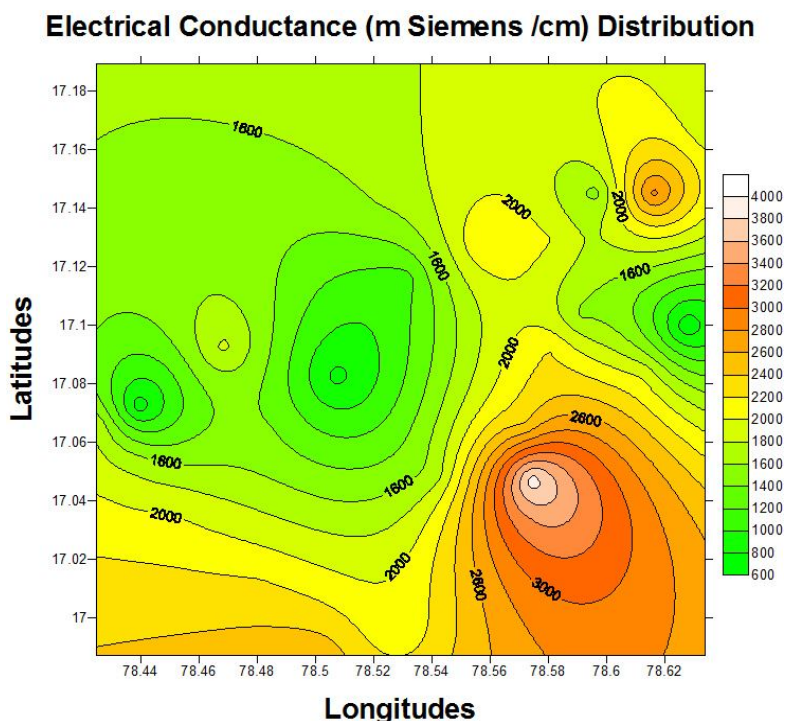


Fig.4 Electrical Conductance Distribution

- 4) **Total Dissolved solids (TDS):** Total Dissolved Solids. TDS is estimated from Electrical conductivity by HM-Digital TDS-3, in mg/Ltr i.e. ppm: parts per million. The TDS values in the watershed area range from 301 to 1940. As per IS10500, all samples are in Max. permissible limits.

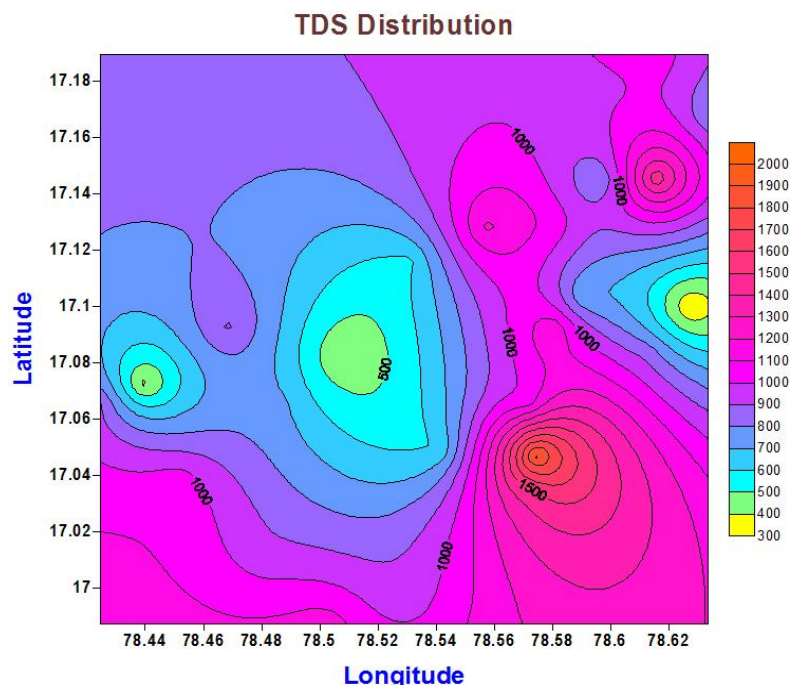


Fig.4 Total Dissolved Solids Distribution

- 5) **P-Alkalinity:** Phenolphthaleine alkalinity as equivalent mg CaCO₃/Litre The Phenolphthaleine alkalinity values in the watershed area are 0.
- 6) **Total Alkalinity:** Total alkalinity in mg CaCO₃/Ltr. Alkalinity titration as in IS3025Pt23 by Sulphuric acid titration, using 20ml of sample & mixed indicator. Results expressed as equivalent to mg of CaCO₃ / liter. If P=0, TAlk=HCO₃. If P<1/2T, 2P=CO₃&T-2P=HCO₃. If P=1/2T, TAlk=CO₃. If P>1/2T, 2P-T=OH, 2T-2P=CO₃ No HCO₃. If P=T, TAlk=OH. The total Alkalinity of water samples ranges from 132 to 735. Most of the samples are in permissible limits.
- 7) **Carbonates (CO₃):** Carbonates as equivalent mg CaCO₃/Litre. There are no carbonates in the water samples.
- 8) **Bi Carbonates (HCO₃):** Bicarbonates as equivalent mg CaCO₃/Litre. The Bicarbonates of water samples range from 132 to 735. Most of the samples are in permissible limits.
- 9) **Hydroxides (OH):** Hydroxides as equivalent mg CaCO₃/Litre. There are no Hydroxides in the water samples.
- 10) **Total Hardness (TH):** Total hardness (TH) is estimated by EDTA titration, using a 50 ml sample & EBT indicator as in IS3025Pt21. The Total Hardness in water samples ranges from 291 to 1067. 21 samples are in permissible limits. Others are having more Hardness. The principal natural sources of hardness in water are dissolved polyvalent metallic ions from sedimentary rocks, seepage, and runoff from soils. Calcium and magnesium, the two principal ions, are present in many sedimentary rocks, the most common being limestone and chalk.
- 11) **Calcium (Ca):** Calcium As Ca⁺⁺ mg/L, estimated by EDTA titration using a 50 ml sample with NaOH, P&R indicator as in IS3025Pt40. The presence of Calcium in the watershed area ranges from 40 to 260 mg/l. All the samples are almost in a permissible limit.
- 12) **Magnesium (Mg):** Magnesium As Mg⁺⁺ mg/L, estimate is derived from TH & Ca est. Following IS3025Pt46. The presence of Calcium in the watershed area ranges from 3.5 to 129 mg/l. All the samples are almost in a permissible limit.
- 13) **Ammonia (NH₃):** Ammonia or azane is a compound of nitrogen and hydrogen with the formula NH₃. Ammoniacal Nitrogen, NH₃/4-N mg/L, estimated by Nesslerization method as in IS3025 part-34 using a 50 ml un distilled sample. The presence of Ammonia in the watershed area is an acceptable limit(0.5mg/l).

- 14) *Nitrite (NO₂)*: Nitrite Nitrogen, NO₂-N mg/L, estimated by naphthyl ethylenediamine (NEDA) method using Orlab's color chart comparator test kit OR-NO₂-01. The nitrites present in the water samples are 0.03 to 0.20mg/l. The acceptable limit as per the WHO Standard is 0.9 mg/l.
- 15) *Nitrates (NO₃)*: Nitrates, As NO₃ mg/L, estimated by Orlabs Nitrate Test kit OR-NO₃ -01. The nitrates present in the water samples are 0.0 to 35 mg/l. The acceptable limit is 45 mg/l.
- 16) *Chlorides (Cl)*: Chlorides are widely distributed in nature as salts of sodium (NaCl), potassium (KCl), and calcium (CaCl₂). Chlorides, Cl⁻ mg/L, estimated by titrating 50 ml water sample with 0.0141N AgNO₃ solution & potassium chromate as an indicator as in IS3025, part 32. The chlorides present in water samples of the watershed area is range from 9.6 to 789 mg/l. All the water samples are in permissible limits(1000mg/l) as per IS10500 standards.
- 17) *Fluoride (F)*: Fluorine is the lightest member of the halogen group and is one of the most reactive of all chemical elements. It is the most electronegative of all the elements (Hem, 1989) which means that it has a strong tendency to acquire a negative charge, and in solution forms F⁻ ions. Fluoride, F⁻ mg/L, estimated by ORLABs OR-F-01 color chart comparator kit based on Zirconium Xylenol Orange method developed by the BARC. This is a semi-quantitative method. The fluorides present in water samples of the watershed area is range from 0.5 to 3 mg/l. Most of the water samples are in permissible limits (1.5mg/l) as per IS10500 standards.
- 18) *Sulphates (SO₄)*: Sulphate, SO₄ mg/L, estimated by IS3025 Pt-24 Turbidity method based on nephelometry & calibration with known standards. The Sulphates present in water samples of the watershed area is range from 14 to 260 mg/l. All the water samples are in permissible limits (400mg/l) as per IS10500 standards.
- 19) *Iron (Fe)*: Total Iron is estimated by ORLABs OR-Fe-01 color comparator based on the 1,10-Phenanthroline indicator.
- 20) *Manganese (Mn)*: Mn mg/L, estimated by ORLABS OR-Mn-01 color chart comparator kit. All the water samples are in permissible limits (0.3 mg/l) as per IS10500 standards.

V. SUMMARY AND CONCLUSION

The water quality analysis and study in the area are known that most of the groundwaters are good for domestic and irrigation needs. The irrigation of this area is mainly under groundwater irrigation.

Groundwater recharge should be given immediate priority for boosting the groundwater levels and also for the storage of groundwater. Mini percolation tanks will have to be constructed across the yelimineti vagu river course which will improve the water levels in and around surrounding areas. In the upstream areas, check dams are recommended to improve water levels. The fact that low agricultural yields are a result of using poor quality groundwater for irrigation should be brought to the notice of the people.

VI. ACKNOWLEDGMENT

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