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ASSESSMENT OF SURFACE AND GROUNDWATER QUALITY FOR DRINKING PURPOSE IN GUMMULURU VILLAGE, AKIVEEDU MANDAL, WEST GODAVARI DISTRICT, A.P., THROUGH WATER QUALITY INDEX (WAWQI)

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ABSTRACT
Access to safe drinking water remains a global problem as more people in the world still consume water from unimproved sources. Water is essential for survival of any form of life. It is necessary to drink quality drinking water for survival of animals and human beings. Water is an inorganic transparent, tasteless, odorless and nearly colorless chemical substance, which is the main constituent of Earth's hydrosphere and the fluids of all known living organisms. Due to industrialization, urbanization, agriculture, aquaculture etc., water quality is deteriorating. So, it is necessary to assess the quality of water before consuming. This study was carried out to evaluate the quality of groundwater from 3 different bore wells and 2ponds in Gummuluru Village Akiveedu Mandal West Godavari District Andhra Pradesh to assess the suitability for drinking purposes. The physiochemical parameters studied includes Salinity, pH, TDS, Hardness, Alkalinity, Calcium, Magnesium, Iron. Evaluating the water quality index (WQI) by using results which are obtained by physicochemical analysis using weighed arithmetic index method, the ground and surface waters are assessed for potability. In the study area the sources of groundwater pollution are Agricultural pollution, Aquaculture pollution and the sources of surface water pollution are Wastewater runoff, Agricultural runoff. Hence in the present study the assessment of surface and groundwater for drinking purposes was done. It was observed that groundwater is of poor quality and also reported as unfit for drinking at times and pond water quality is also poor and needs to be treated before consumption through boiling, RO, filtration etc.

Keywords: groundwater, agriculture, aquaculture, pollution, water quality.

1. INTRODUCTION
Water is essential for the survival of any form of life. All biochemical reactions in the biological systems take place in water medium. In addition to various domestic purposes, water is required for irrigation, shipping, sanitation, power generation and industries.
NECESSITYOFTHEWORK:
Surface and groundwater are the main sources of drinking water for human beings. People are depending on the surface and groundwater as essential source of water where the amount of water needed is increased due to increasing of population. Due to some natural and anthropogenic activities the quality of surface and groundwater is deteriorating. Usually surface and groundwater is more mineralized and also prone to contamination due to Wastewater, waste dumps and septic tanks, also in the coastal areas salt water may intrude into freshwater aquifers. In the study area the sources of groundwater pollution are Agricultural pollution, Aquaculture pollution and the sources of surface water pollution are Wastewater runoff, Agricultural runoff. Hence in the present study the assessment of surface and groundwater for drinking purposes was done.
Objectives of the work:
1. To carryout reconnaissance survey and to select sampling sources viz: two surface water sources i.e., ponds and three bores for groundwater analysis in Gummuluru village West Godavari District Andhra Pradesh.
2. To collect representative samples from the surface water sources and from the wells.

3. To carryout physiochemical analysis for following list of parameters. Salinity, TDS, pH, Hardness, Alkalinity, Calcium, Magnesium, and Iron.
4. To compute Water Quality Index by Weighted Arithmetic Index method. This water quality index which is measured is used to decide the quality of water and its suitability for drinking.

2. LITERATURE REVIEW:

Binbin Wang., (2021) Conducted a study on Erdao Songhua River Basin in China to determine the Water pollution index for determining the spatial temporal water quality dynamics and concluded that poor water quality index during some periods is due to contamination in the middle downstream caused by pollution from point and non-point sources.

Priyanka Tiwari., (2017) Chhattisgarh, India, Conducted a study that deals with various parameters to assess water quality for drinking and irrigation purpose. The parameters used for assessing water for drinking purpose include pH, electrical conductivity. TDS, calcium, magnesium, sodium, potassium, chloride, sulphate, fluoride, carbonate, and bicarbonate.

Kartika Devi M., (2017) conducted a study on the self-purification capacity of the Bhavani River Kerala. A stretch of one km was taken for assessment of important parameters and finally self-purification capacity was determined from oxygen-sag curves.

Savved Juned A., (2010) carried a study on the ground water quality of the Nanded City area. Different borewells samples were analysed for Cl, Na, and K. This study reveals that the agriculture activities, geological formation and local environmental conditions control the groundwater quality. The groundwater in this area is mostly moderately hard. Groundwater suitability for domestic industrial and irrigation purposes were examined using WHO, Indian standards classification, which indicate that groundwater in a few sampling sites, were unsuitable for domestic purpose and irrigation. Sodium (Na) and Potassium (K+) were determined by flame photometer.

P.N. Magudeswaram., (2007) have analyzed the water quality index of river Noyyal at Tirupur, Tamil Nadu India. A study was carried out on some physio chemical characteristics was carried out. The points of critical pollution have been selected and the tests were carried out at zones at before and after Tirrupur. Water Quality Index is a prerequisite to administer the water pollution abatement.

3.METHODOLOGY

Study area is Gummuluru village located in Akiveedu Mandal West Godavari District Andhra Pradesh. The two surface water sources i.e., ponds and three groundwater sources i.e., borewells are selected for the study.

Table1: sampling locations of surface water sources

Sl.No	SAMPLE STATION	Latitude	Longitude
1	Sample1	$16^{O}37'14.9"N$	$81^{O}24'20.8"E$
2	Sample2	$16^{O}38'08.9"N$	$81^{O}25'03.9"E$

Table2: Sampling locations of Groundwater sources

Sl.No	SAMPLE STATION	Latitude	Longitude
1	Sample1	$16^{O}37'09.6"N$	$81^{O}24'09.4"E$
2	Sample2	$16^{O}37'22.8"N$	$81^{O}24'12.3"E$
3	Sample3	$16^{O}37'11.5"N$	$81^{O}24'64.5"E$

PHYSIO-CHEMICAL ANALYSIS:

Salinity:

Salinity in water can be measured by using portable refractometer. Portable refractometer consists of a prism, scale, an eye piece and focussing screw. Procedure includes

Adding3 to 4 drops of water on the prism, Read the value in the scale by using focusing eyepiece,

Fig1;Refractometer

Fig2;Salinitysample reading

Total Dissolved solids**:** TDS is measured by using TDS meter.

FIG3;TDS METER

pH: measured using pH meter.

Hardness: determined by EDTA method, titrimetry.

Alkalinity: determined by titrating with acid.

Iron: determined by 1,10 phenanthraline method

Calcium hardness: determined by EDTA method, titrimetry.

Magnesium hardness= difference in total hardness and calcium hardness

Water Quality Index(WQI):

Water quality index indicates the quality of water in terms of index number which represents overall quality of water for any intended use. It is defined as a rating reflecting the composite influence of different water quality parameters were taken into consideration for the calculation of water quality index. The indices are among the most effective ways to communicate the information on water quality trends to the general public or to the policy makers and in water quality management.

The calculation of WQI was made using weighed Arithmetic index method (Brown et al, 1972) in the following steps:

Let there be water quality parameters and quality rating (qn) corresponding to nth parameter is a number reflecting relative value of its parameter in the polluted water with respect to its standard permissible value.

qnvalues are given by the relationship.

$q=100(V_a-V_i)/(S_i-V_i)$

Va=Actual value of the i^{th} water quality parameter obtained from laboratory analysis. Vi= Ideal value of the i^{th} water quality parameter obtained from standard tables,

Qi=Quality rating for the water quality parameter

Vi=Ideal value in most cases is0 except in parameter pHis7.0

Unit weight was calculated by a value inversely proportional to the recommended standard value S, of the corresponding parameter Wi= K / S
Where,
W is weightage factor. , K is a proportionality constant which is always equal to1 Si- Standard value of the i^{th} water quality parameter.

The overall water quality index is calculated using aggregation of quality rating with Unit weight linearly

$WQI=\sum W_i q_i / \sum W_i$

TABLE 3: RATINGS BASED ON WQI VALUE

Sl.No	**WQI**	**Inference**
1	0-25	Excellent
2	26-50	Good
3	51-75	poor
4	76-100	Very poor
5	100and more	Unfit for consumption

4.RESULTS AND DISCUSSION:

SALINITY IN ppt

TABLE4: SALINITYVALUES

2022	GW S1	GW S2	GW S3	SW S1	SW S2
APRIL	25	19	21	1	1
MAY	24	20	19	0.4	0.3
JUNE	22	20	19	0.2	0.3
JULY	20	19	21	0.2	0.4
AUGUST	20	22	19	0.1	0.2

Salinity value observed varies from 19ppt to 25pptfor groundwater and 0.2ppt to 1ppt for surface Water. The salinity value in groundwater is too high so it is not recommended for drinking purpose And the salinity value in surface water is in acceptable limit less than0.3ppt except for sample 1 in the months of April and May and sample2 in the months of April and July.

TABLE5:pH values

2022	GW S1	GW S2	GW S3	SW S1	SW S2
APRIL	7.5	7.5	7.8	8.8	8
MAY	8.6	7.6	8.5	7.4	7.9
JUNE	8.2	8.3	7.6	8.6	8.2
JULY	7.8	7.5	8.6	7.8	7.8
AUGUST	7.6	8.2	7.5	8.5	8.2

pH value for both surface and groundwater varies from 7.2 to 8.8. The value 7 means neutral and as per Drinking water standards it should not exceed 8.5.

TOTAL DISSOLVEDSOLIDS(TDS):

TABLE6:TDS values in mg/l

2022	GW S1	GWS2	GW S3	SW S1	SW S2
APRIL	7040	8120	7560	650	550
MAY	6850	7800	7230	500	520
JUNE	6800	9210	7252	600	580
JULY	8000	7500	7600	650	520
AUGUST	8200	7600	6700	520	550

TDS value observed from 6700 mg/1 to 9210 mg/1 for groundwater and 500 mg/1 to 650mg/l for surface water Highest TDS value 9210mg/l observed in month of June for groundwater sample 2 and lowest TDS value of 6700 mg/1 observed in the month of augustforgroundwatersample3 And highest TDS value 650mg/1 observed in month of April for surface water sample 1 and lowest TDS value of 520 mg/l observed in the month of may for surface watersample1. TDS value is too high in ground waters and it is not recommended for drinking WHO standard for TDS in drinking water is 500 mg/l so surface water can be used for drinking after proper treatment to reduce TDS value 650 mg/1 to 500 mg/l .

Total Hardness in mg/l TABLE7: TOTALHARDNESSVALUES

2022	GW S1	GW S2	GW S3	SW S1	SW S2
APRIL	4860	3960	5920	240	200
MAY	4620	4020	5700	210	180
JUNE	4820	3860	5500	200	170
JULY	6000	5680	5200	260	240
AUGUST	6200	5800	5200	250	230

Total Hardness value observed from 3860 mg/1 to 6200 mg/1 for groundwater and 170 mg/1 to 260 mg/l observed for surface water Highest value of 6200 mg/l observed in the month of august for ground water sample1 and the lowest value of 170mg/l observed in the month of June surface water sample2.WHO recommends Total hardness should be less than 200 mg/l .So ground water have high total hardness value so it is not recommended for drinking but surface waters can be used.

Total Alkalinity in mg/l

TABLE8: TOTALALKALINITYVALUES

2022	GW S1	GW S2	GW S3	SW S1	SW S2
APRIL	850	900	510	170	170
MAY	920	850	720	180	175
JUNE	900	890	750	190	200
JULY	750	786	820	120	160
AUGUST	780	980	730	130	150

Total alkalinity value varied from 510 mg/l to 980 mg/1 for groundwater and 120 mg/l to 200 mg/l for surface water Highest value of 980 mg/l is observed in the month of may and lowest value of 120 mg/l is observed in the month of July for surface water sample 1.WHO recommends Total Alkalinity value should be less than 200 mg/1, so groundwater in Gummuluri village is not recommended for drinking but surface water can used for drinking.

Iron in mg/l

TABLE 9 : IRON VALUES in mg/l

2022	GW S1	GW S2	GW S3	SW S1	SW S2
APRIL	0.1	0.1	0.1	0.2	0.1
MAY	0.1	0.2	0.1	0.1	0.2
JUNE	0.2	0.1	0.3	0	0
JULY	0	0.2	0.1	0	0
AUGUST	0.1	0.1	0.1	0	0.2

Iron should be less than 0.3 mg/l as per WHO standard both ground and surface water in Gommaluru village iron value less than 0.3 mg/1.

Calcium in mg/l

TABLE 10:CALCIUM VALUES

2022	GW S1	GW S2	GW S3	SW S1	SW S2
APRIL	336	760	840	48	40
MAY	410	820	830	42	41
JUNE	280	730	790	38	42
JULY	672	800	700	40	38
AUGUST	680	820	780	52	56

The calcium values varies from 280 mg/1 to 840 mg/1 for groundwater and 38 us 56 mg/l for surface water. The highest value of 840 mg/l is observed in the month April for the ground waters ample3 and the lowest value of 280mg/l is observed in the month of June for groundwater sample1 WHO recommends calcium should be less than 75mg/1. Groundwater in Gummaluru village have high calcium so not recommended for drinking But surface water have acceptable limit.

Table 11. Magnesium in mg/l

	GW S1	GW S2	GW S3	SW S1	SW S2
April	976	500	928	28	24
May	956	520	963	26	22
June	960	620	890	28	27
July	1049	894	764	29	26
August	1010	890	820	24	26

Magnesium for surface waters is <30 mg/l, but for groundwaters it is in the range of 500 to 1049 mg/l, hence, it results in hardness and salinity.

Table12: Standard value(Si), Ideal value(V) and weightage factors as per WHO

Sl.No	**Parameter**	**Standard Values (Si)**	**Ideal Values (Vi)**	**Weightage factor (Wi)**
1	PH	8.5	7	0.1176
2	TDS	500	0	0.00200
3	Hardness	200	0	0.005
4	Alkalinity	200	0	0.005
5	Iron	0.3	0	3.33
6	Calcium	75	0	0.0133
7	Magnesium	30	0	0.033

Table13:Calculated WQI Values

Sl.No	Sampling source	April	May	June	July	August
1	GW S1	69.96	56.70	72.25	68.84	**105.19**
2	GW S2	**103.7**	91.22	74.83	**102.5**	66.54
3	GW S3	**105.13**	62.16	**133.53**	99.58	81.18
4	SWS1	43.87	**101.10**	67.91	64.48	62.39
5	SWS2	74.04	72.12	67.43	93.70	67.48

5.0 Conclusion related to suitability of surface and groundwater in Gummuluru village for drinking purpose:

WQI for Groundwater: In the months of April, May, June, July WQI values for Groundwater sample source 1 are 69, 56, 72, 68, respectively these values are lies between 56-75.So, Groundwater sample source1 is comes under Poor category in the months of April, May, June, July . In the month of August WQI value for Groundwater sample source 1 is 105.19 and it is comes unsuitable for drinking category.

In the months of May, June, August WQI values for Groundwater sample source 2 are 91.22, 74.83, 66.54 respectively these values are lies between 56-75 .So, Groundwater sample source 2 is comes under Poor category in the months of May , June, August. In the months of April and July WQI values for Groundwater samplesource2 are103.7and 102.5respectively so the Ground water sample source 2is unsuitable for drinking in the month of April and July.

In the months of May, July, August WQI values for Groundwater sample source 3 are 62.16, 99.58, 81.18 respectively these values are lies between 56-75. So, Groundwater sample source 3 is comes under Poor category in the months of May, July, August. In the months of April and June WQI values for Groundwater sample source2 are 105.13 and 133.53 respectively so the Groundwater sample source 2 is unsuitable for drinking in the month of April and June.

WQI for Surface water: In the month of April the WQI for Pond 1 is 43.87 which is comes under Good category. In the months of June, July, August WQI values for Pond 1 are 67.91, 64.48, 62.39 respectively these values are lies between 56-75.So, Pond 1 is comes under Poor category in the months of June, July, August. In the month of May WQI values for Pond1is101.10.So the Pond1is unsuitable for drinking in the month of May.

In the months of April, May, June, July, August WQI values for Pond2 are 74.04, 72.12, 67.43, 93.70, 67.48 respectively these values are lies between 56-75.So, Pond 1 is comes under Poor category in the months of April, May, June, August and in the month of July it is very poor.

Hence it can be concluded that the ground water quality is rated from Poor to Unfit for drinking and surface water quality is also poor due to agriculture, aquaculture and sewage pollution.

References:

1. Bureau of Indian Standards (BIS) for drinking water specification IS:10500, BIS, New Delhi, India.
2. Central ground water board- Brochure, Visakhapatnam, AP.
3. Water and Waste Water Analysis-by SN Kaul.
4. Water Pollution in India. An Economic Appraisal M N. Murty and Surender Kumar.
5. Water Pollution Causes, Effects and Control by PKGOEL.

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