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Assessment of Musi River Groundwater Quality in Rural and Urban Areas of Hyderabad, Telangana-(India)

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Abstract

Water is a requirement for all living organisms on the earth and natural occurring main resources on the earth. Every citizen of this country has the responsibility and duty towards protecting these most precious water resources. India scenario that thousands of people from different region are deprived of this due to over exploitation, poor water management system. The major source of water is mainly oceans, rivers, lakes, ponds and 65% of human body. River water was prime resource for agriculture, industrial and drinking purpose. The river water is used for several industries may causes water pollution. The water pollution that raise problems for existence of life on the earth. The people using river water from long time, after river water contaminated suddenly moves on utilization of ground water and everyone are depends on ground water and fulfill their all needs. Surface water and ground water are connected with hydrological interaction with surface water pollution causes ground water pollution. Ground water contaminations will strongly impact on global water cycle. The study has been carried out in five sampling site locations along the river Musi in and around Hyderabad. In present study, an extensive investigation of physico-chemical parameters of water samples of river Musi located in Hyderabad was carried out. For this area sampling sites were selected and water samples were collected during pre-monsoon in the year of 2017 by collecting five bore water samples. The nighteen parameters were chosen for the analysis such as Colour, Odour, pH, EC, TDS, Turbidity, CO^{-2}_3,

HCO^{-1}_3, Cl^{-1}, F^{-1}, NO_3^{-1}, SO^{-2}_4, Na^+, K^+, Ca^{+2}, Mg^{+2}, TH, BOD and COD of samples were identified in different locations in and around Hyderabad city.

Keywords: Water sample, River water pollution and physico-chemical parameters.

INTRODUCTION

Water is a most important compound for existence of human beings and other living organism and absence of water cannot consider any things about life. Water is natural resource and it gives habitat for diverse types of aquatic life in various sources of rivers, lakes and oceans and human body contains two third percentage of water.[1] Due to globalization and industrialization increase pollution of surface water and ground water. An approximately all water bodies are get polluted including Ground Water. Polluted water is easily mixed in water and destroys the original quality of water. Ground water resource plays a very vital role drinking water by hand pump or piped water supply system. Ground water resource widely consumed by Urban and Rural areas by use of different type of water supply system. Disposal of industrial effluents and domestic sewage waste in river causes a reduction in water quality is due to disposal of effluents in river gradually deteriorate ground water.

Hyderabad is fifth largest city in India and capital of Telangana state with a population of 12 million that demands huge quantity of water to fulfill the various activities. It is a well-known fact that ground water recharge has always been linked with surface water[2]. Hyderabad is the creation of the Quthubshahi rulers and located on the Deccan plateau along the Musi river. The physiography of Hyderabad is dominated by hills, monuments, tanks with a rich and varied heritage. The Musi river originated in Ananthagiri Hills located at Vikarabad Ranga Reddy District 90 kilometers to the west city of Hyderabad. Musi River is a tributary of the Krishna River in the Deccan Plateau flowing through Telangana state in India. Hyderabad stands on the banks of Musi river, which divides the historic old city and the new city. Himayat Sagar and Osman Sagar are dams built on it which used to act as source of water for Hyderabad. It was known as Muchukunda river in olden days and the precise reason for the change of name is not known. Rising in the Ananthagiri hill in Ranga Reddy district, the Musi flows into the Krishna at Vedapally in Nalgonda district. But as it flows through Hyderabad, it turns into a giant sewer, filled with garbage and industrial

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waste from the city. Years of neglect have earned it the notoriety of being named one of the most polluted rivers in the country. Produce of waste water is due to increased population, urbanization, domestic, industrial and commercial sectors.[3-7] Day by day the world population increases the demand for food production, industrial activities and domestic purposes grows and leads to heavier withdrawals of the limited renewable fresh water resource. [8-10]

The river flows through the Nalgonda district and the water is used for agricultural and horticultural purpose through small reservoirs. In the city of Hyderabad Musi flows through the telangana high court, Govt City College, Osmania general hospital, salarjung museum, state central library, Mahatma Gandhi bus station. Many bridges built on the river, which connects old and new city. The old bridge known as purana pul constructed by the Ibrahim Qutub Shah in 1579AD. New bridge at Nayapul near high court telangana other bridges at Dabirpura, Chaderghat, Amberpet, Nagole and Uppal Kalan in the city of Hyderabad. In the year of 1908 great flood was there on the Musi river. Much damage was there, 80,000 houses damaged and 15,000 people died. That is why Osman Sagar (dam) built by the engineer Nawab Ali Nawaz Jung Bhadur and later on Himayth Sagr dam was built. The water was used for drinking purpose and through this water one lack hectors is cultivating of agricultural at the down streams of the river Musi during and after the monsoon rains. In rural area the major crop is rice and grass is the crop in the city. Must River received large scale of untreated sewage from city of Hyderabad through industrial and domestic, disposal dumping, sewage waste sometimes medical wastage also dumped in the river. It is because rapid and uncontrolled urbanization. Due to water demand increased day by day in and around the greater Hyderabad, now drinking water inflows from Krishna, Manjeera and Godavari through the water pipelines to Hyderabad city and waste water release the city is disposed into the Musi river, due to these reasons water smells unobjectable odour and people afraid to touch the river water. It became 6th most polluted river in India declared by the Central Pollution Control Board (CPCB), India.

The major portion of the wastes disposed off into the atmosphere and the land is washed out by precipitation and runoff, filtration processes and human waste load accumulates in surface water bodies and ground water aquifers. Simultaneously these human activities generate wastes which are discharged into the depleted water resources despoiling them. The industrial wastage as well as domestic sewage/wastes are disposed in the rivers and release of wastes containing wide variety of organic, inorganic pollutants including solvents, Oils, grease, plastics, plasticizers, phenols, heavy metals, pesticides and suspended solids are hazardous substance into rivers, might lead to environmental disturbance.[11-13] Many studies are reported in India to analyzed of physic –chemical characteristics of ground water to detected that organic contamination[14-20].

METHODOLOGY

Water Samples were collected at five sampling sites in rural and urban areas of Hyderabad; each site has 10km distance variation. Water sampling locations are Site-1-Himayath Sagar, Site-2-Langar house, Site-3-Govt. City College, Site-4-Nagole and Site-5-Peerjadiguda. For the assessment of groundwater quality water samples of river Musi located in rural and urban areas of Hyderabad. Five groundwater samples were collected from different locations during pre monsoons of 2017(April-May month). The samples are collected from dug wells, bore wells and hand pumps distributed throughout the Musi River. A weighted sample bottle or sampler was used to collect sample from an open well. Samples from the tube wells were collected after running the well for about 5 minutes. The bottle is rinsed to avoid any possible contamination in bottling and every other precautionary measure has been taken. All the parameters were analyzed within a week.

DESCRIPTION OF STUDY AREA

Site-1-Himayat Sagar:

This place is situated at **17°18' North latitude and 78°21' East longitude**. It is major reservoir for the Musi River. Himayat Sagar was built by the 7th Nizam of Hyderabad (Who named the lake after his youngest son Himayat Ali Khan).

Site-2-Langar House:

This place is situated at **17°22'43" North latitude and 78°25'9" East longitude**. Two reservoirs water combines before this site is also known as Langar Houz.

Site-3-Government City College:

This place is situated at **17°36'85" North latitude and 78°47'4" East longitude**. Upstream of the site has partial water treatment plant at Attapur.

Site-4-Nagole :

This place is situated at **17.373576° North latitude and 78.568726°** East longitude. This site is also having partial treatment plant at Amberpet, but much sewage inflows into this site, from nearby areas of the city and through Hussian sagar, Secundrabad sewage water also inflows into this site. It is located east of Hyderabad city on inner ring road and Northern bank of River Musi.

Site-5-Peerjadiguda :

This place is situated at **17°24'25" North latitude and 78°35'17" East longitude**. Ground water collected at this site, because this ground water is affected by Musi River.

MATERIALS AND METHODS

Samples were collected from various selected sites at five sampling sites in rural and urban areas of Hyderabad in pre-monsoon, analytical methods were used to assess the water quality of samples such as Electrical Conductivity meter, pH meter, Ion meter, UV Spectrophotometer, Nephelo meter and Flame photometer was used to test the water quality parameters in pre- monsoon season.

Colour:

Colour in the water is the result of dissolved extracts from metals in rock, from organic matter in soil and plants and

from industrial products. Colour identified by visual method.

Odour:

Odour is not a direct significance but it indicates the quality of water or pollution, Dark colour water usually gives unobjectable Odour.

pH (Hydrogen ion concentration):

pH with a range of 0-14. pH meter is used to know pH of the samples.

Electrical conductivity (EC):

EC expressed in µmho/cm. Standard conductivity meter has range of 1412 µmho/cm, electrical conductivity of samples are measured with EC meter.

Total dissolved solids (TDS):

TDS concentration expressed in mg/L. A dish is evaporated at high temperature and cooled it in air and noted weight of the dish. Sample filtered through Whatmanns filter paper, the filtrate taken in evaporating dish and dried at high temperature and cooled then weight recorded.

Turbidity:

Turbidity it contains mud and some minerals. It also represents and measures of the water quality. It is calculated with Nephelometer.

Alkalinity:

Alkalinity in the presence of Hydroxide ion (OH) carbonate ion (CO_3) and Bicarbonate ion (HCO3). The compounds are mostly the carbonates and bicarbonates of Sodium, Potassium, Magnesium and Calcium ions. It is calculated the units are of $CaCO_3$ mg/L by titration method.

Chloride:

Chloride ions present in the sample reads with silver nitrate ($AgNO_3$) and forms silver chloride. Chloride estimated on titration method in the laboratory. It is calculated in mg/L units.

Fluoride (F):

Fluoride measured with Ion Meter, The fluoride content in surface and ground water will depend on availability of the minerals. Which contain fluoride the porosity of the rocks and the reading is taken in mg/L.

Nitirate (NO_3^-)

Nitrates are salts of nitric acid. UV-Spectrophotometer is used, Standard wavelengths are used to obtain and determine the nitrate. If it is more than standard wavelengths 10% sample taken to determine.

Sulphate:

Sulphate measured by nephelometer the units are Nephelometer turbidity units (NTU), standard solution are used.

Sodium/Potassium (Na/K):

A flame photo meter is an instrument used for measuring of metals. The estimation of sodium and potassium is based on emission spectroscopy, System gives Na, K readings.

Total hardness (TH):

Ca and Mg

Total hardness determines the total concentration of calcium and magnesium ions reported as calcium carbonate. Hardness is due to the presence of carbonates, bicarbonates, chlorides and sulphates. TH is expressed as mg/L of $CaCO_3$ and measured by titration method.

Biochemical Oxygen Demand (BOD)

The Biochemical Oxygen Demand (BOD) is used as a parameter to express the strength of sewage and amount of organic matter. If the amount of organic matter in sewage is more, the more oxygen will be utilized by bacteria to degrade it. Domestic and industrial dumping in the river digests the organic compounds results sewage percentage increases. BOD is estimated with winkler method, BOD is measured by incubating the samples at 20ºC for the five days in the dark under aerobic conditions.

Chemical Oxygen Demand (COD)

Solid concentration is important characteristic of sewage water. COD determines the oxygen required for the chemical oxidation of organic matter. Hence chemical oxygen demand (COD) is a better estimate of the organic matter, which needs no sophistication. The amount of organic matter in water is estimated by their oxidability by chemical oxidants.

RESULTS AND DISCUSSION

Results and discussion of analyzed different parameters such as Colour, Odour, pH, EC, Total Dissolved Solids (TDS), Turbidity, Carbonate, Bicarbonate, Chloride, Fluoride, Nitrate, Sulphate, Sodium, Potassium, Calcium, Magnesium and Total hardness are within the permissible limit at some sites. BOD, COD exceeds BIS 10500 (1991) standard acceptable limits. Ground water quality-pre-monsoon in and around Musi river at Hyderabad. The colour is due to turbidity of suspended solid particles, pure water do not give any colour.site-1 and Site-5 is colourless and other sites gives coloured water due to the waste dumping in the river. The Unobjectable Odour is because of waste dumping in the river it became sewage. As per investigations highest value of pH found at site-1 and minimum pH value at site-5. Specific Electric Conductance (EC) is used as a measure of water quality it determines total dissolved solids of water and represented at 25ºC temperature. It makes unsuitable water. Investigations reported that EC at 25ºC have highest value at site-2 and minimum at site-1 and normal range is 750. Total dissolved solids can be determined by measuring the EC. It is the measure of organic and inorganic substances dissolved in water are in suspended form. Results reveal that TDS is high at site-2. The high TDS is due to domestic wastage dump into the river and the site-2 do not having partial water treatment. Turbidity more at site-4 is because of more sewage than other sites. Carbonate (CaCO3) mg/L is nil at all proposed sites. The alkalinity is due to the presence of bicarbonates in the

form of calcium carbonate. In rainy seasons the river gives low alkalinity, results shows that alkalinity is maximum at site-2 and minimum at site-1. It is due to the addition of industrial and domestic waste water.

In the water chloride concentration is varies. It is the major anion and generally available as Ca, Mg, Na chlorides. Site-2 has maximum and site-1 has minimum values. Fluorosis is the result of excess of fluorine in water, if the water contains fluoride range more than 1.5 mg/L effects on bone and teeth of human beings. Investigated values reveals that site-2 has highest value, other sites are in within range it is due to the water treatment at various locations of the river. Due to the industrial wastage and domestic wastage nitrate concentration increases. Site-5 having maximum value it is because the site is affected by Musi River. This water is polluted and not useful for drinking and agricultural purpose. In general sulphate occurs in natural water, it is also an important anion for the hardness of water. Site-4 having maximum value which is in normal range in Site-4. Generally the sodium ions in water is good for health, risk level causes many diseases like high blood pressure, high content of sodium is also not suitable for agricultural purpose. Site-2 and site-3 are having high concentrations and site-4 and site-5 values are also more than marginal range, these are of very risk levels.

Potassium concentration is lower than sodium in common and the role is same as sodium. Potassium is in water gives good health to the limiting range. Here the results shows that the potassium is within range at all sites. Calcium combines with carbonate, bicarbonate, sulphate and chloride. It is the main parameter to measure the hardness of water, it prevent the lather formation with soap. Investigating results reveals site-2 has more calcium concentration. Magnesium also causes hardness to water it is available in water as $MgCO_3$, $MgSO_4$ and $MgCl_2$ the site-2 has maximum concentration. The total hardness to the water due to the concentration of calcium and magnesium. The pollution of water is not due to total hardness, but hard water is not useful for domestic and agriculture. Given results represents that site-4 has maximum value and the range is not good at proposed sites. The BOD levels more at site-4, it is because much dumping of plastic disposal and addition of Hussain Sagar polluted water, at this levels fishes can't survive, due to this reason at down streams of Musi river fisher men stopped fishing in Musi river.

The COD levels more at site-4, it is because much dumping and addition of Hussain Sagar water. Himayath Sagar (Site-1) having all parameters are within range, the water is in marginal range for the agriculture, this water without treatment not good for drinking purpose. Langer House (site-2) has maximum values of all parameters and are in unsuitable range, results represents that the water is unsafe for agriculture. Govt. City College (site-3) has unsuitable range parameters, this water also unsafe for agriculture because it has more sodium concentration. Nagole (site-4) is also have unsuitable parameters and the water unsafe for agriculture and domestic purpose. Peerjadiguda (site-5) is also have more values of all parameters nitrate is more at the site it is harmful for the human health. This water also have marginal range for agriculture and not suitable for domestic and drinking purpose.

Table 1: Ground water quality-pre-monsoon in and around urban area of Hyderabad.

S.No	Parameters	Site-1	Site-2	Site-3	Site-4	Site-5
1.	**Colour**	Colourless	Grey	Black	Black	Colourless
2.	**Odour**	Odourless	Unobjectable	Unobjectable	Unobjectable	Odourless
3.	**pH**	8.14	7.20	7.15	7.30	7.10
4.	**EC**	465	2015	1470	1493	1157
5.	**TDS**	298	1290	945	965	741
6.	**Turbidity**	20	30	35	43	10
7.	**Alkalinity**	155	548	450	365	272
8.	**Cl**	32	263	165	183	146
9.	**F**	0.66	1.85	1.0	1.2	1.60
10.	**NO_3**	1.10	6.93	4.90	7.01	11.83
11.	**SO_4**	30	53	38	98	65
12.	**Na**	17	265	232	163	113
13.	**K**	3	4	2	2	4
14.	**Ca**	58	117	90	82	98
15.	**Mg**	21	40	18	41	26
16.	**TH**	223	445	242	567	348
17.	**BOD**	7.9	20.7	21	33	12.2
18.	**COD**	15	30.9	46	69.8	21

Site-1-Himayath Saar**, Site-2-**Langar house, **Site-3-**Govt. City College, **Site-4-**Nagole and **Site-5-** Peerjadiguda.

Results are represented in the Table 1 as pre- monsoon analytical data. This data reveals that at Langer House (site-2), Nagole (site-4) have more parameters exceeding the drinking water quality limits and they are higher than all sites in or at the time of pre- monsoon, it is may be the reason that the site Nagole is having major water polluting sources i.e. many industries are located there over. At all proposed sites maximum number of parameters is exceeding the standard limits given by BIS 10500 (1991) standard of drinking water given below in table 2. Nitrate, Chloride and Total Hardness is too high at the proposed sites; excess of Fluoride is present which effects health. Total dissolved solids, Chloride, Fluoride, Nitrate and Total Hardness is compared with BIS 10500 (1991) standard of drinking water value in pre-monsoon represented by graphical method at proposed sites which is shown in figure 1 to figure 5, because these parameters directly effect on human health mostly. In the month of April and May ground water levels are decreased due to summer or less rains, as ground water levels are decreased water pollution becomes more. In pre-monsoon season water samples are more contaminated. Due to industrialization around the city of Hyderabad, water pollution increased in pre monsoon season, it might be cause after monsoon rains also many sites are having pollution. The study of given parameters of selected sites reveals that they effected with higher contamination, the comparison is given below by graphical method, we have discussed about highly effected and health impacted parameters which are Total dissolved solids, Chloride, Fluoride, Nitrate and Total Hardness of proposed sites at both seasons and these values are compared with standard values given by World Health Organization. In the represented graphs site ground water quality parameter were taken on X- axis and volume of parameters (mg/L) was taken on Y- axis.

Table 2: BIS 10500 (1991) standard value of ground quality drinking water.

S.No	Substance Characteristic	Requirement (desirable)	Permissible limit
1.	**Colour (Hazen units), Max**	5	25
2.	**Odour**	Unobjectionable	-------
3.	**Taste**	Agreeable	--------
4.	**pH value**	6.5 to 8.5	No Relaxation
5.	**EC (µm/cm)**	0.25-1	-------
6.	**Total Hardness as $CaCO_3$ max mg/l**	300	600
7.	**Turbidity, NTU, Max**	-----	10
8.	**Dissolved Solids, mg/l, max**	500	2000
9.	**Bicarbonate**	200-600	
10.	**Dissolved Solids, mg/l, max**	500	2000
11.	**Chlorides (as Cl) mg/L, Max**	250	1000
12.	**Fluoride (as F) mg/L, Max**	1.0	1.5
13.	**Nitrate (as NO_3) mg/L**	Max 45	No Relaxation
14.	**Sulfate (as SO_4) mg/L**	Max 200	400
15.	**Calcium (as Ca) mg/L**	Max 75	200
16.	**Magnesium (as mg) mg/L**	Max 30	100

Fig.1: Ground Water Quality Parameters at proposed site-1- Himayath Sagar.

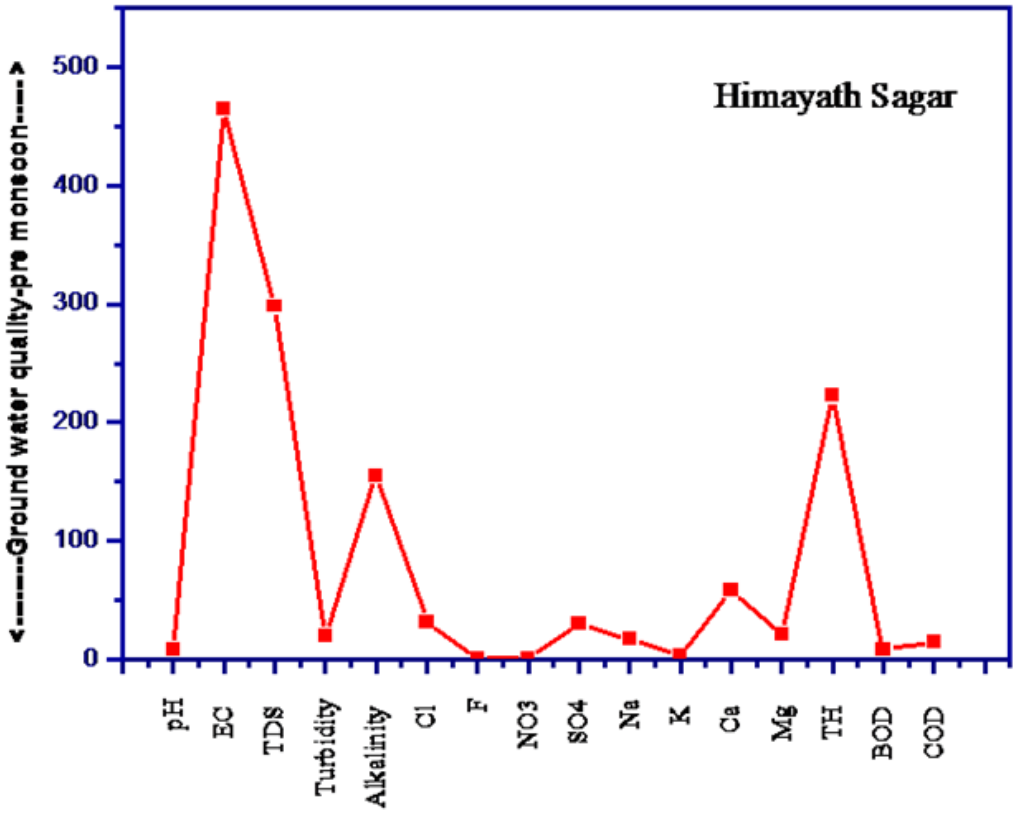


Fig.2: Ground Water Quality Parameters at proposed site-2- Langar house.

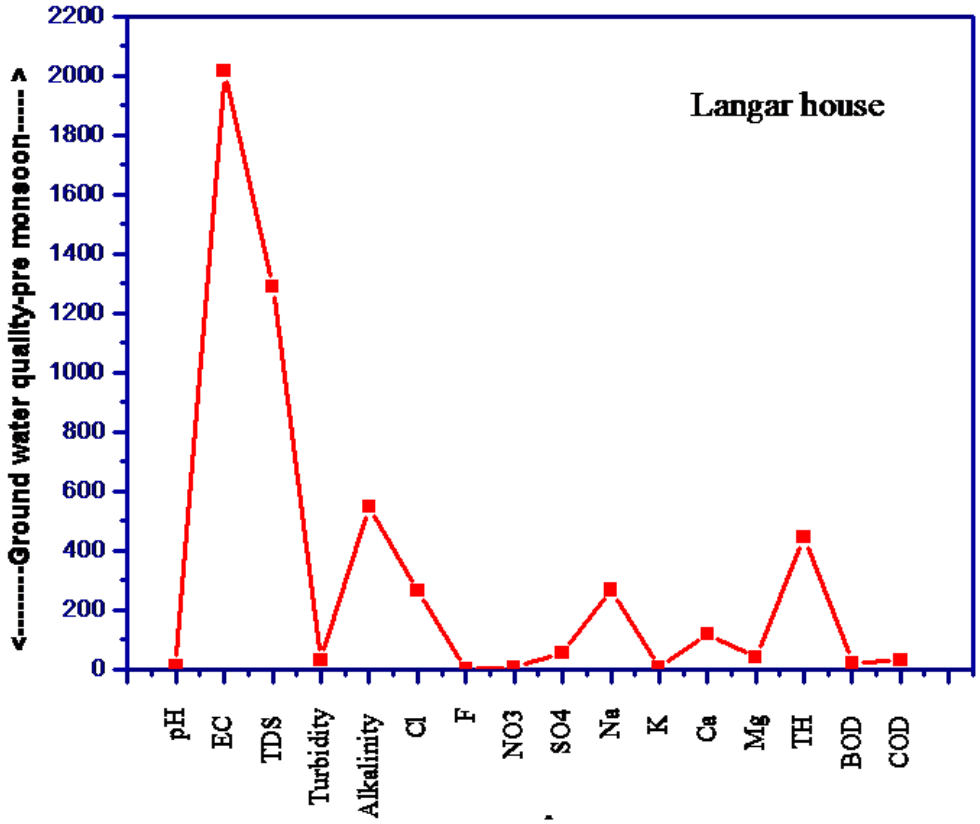


Fig.3: Ground Water Quality Parameters at proposed site-3- Govt. City College.

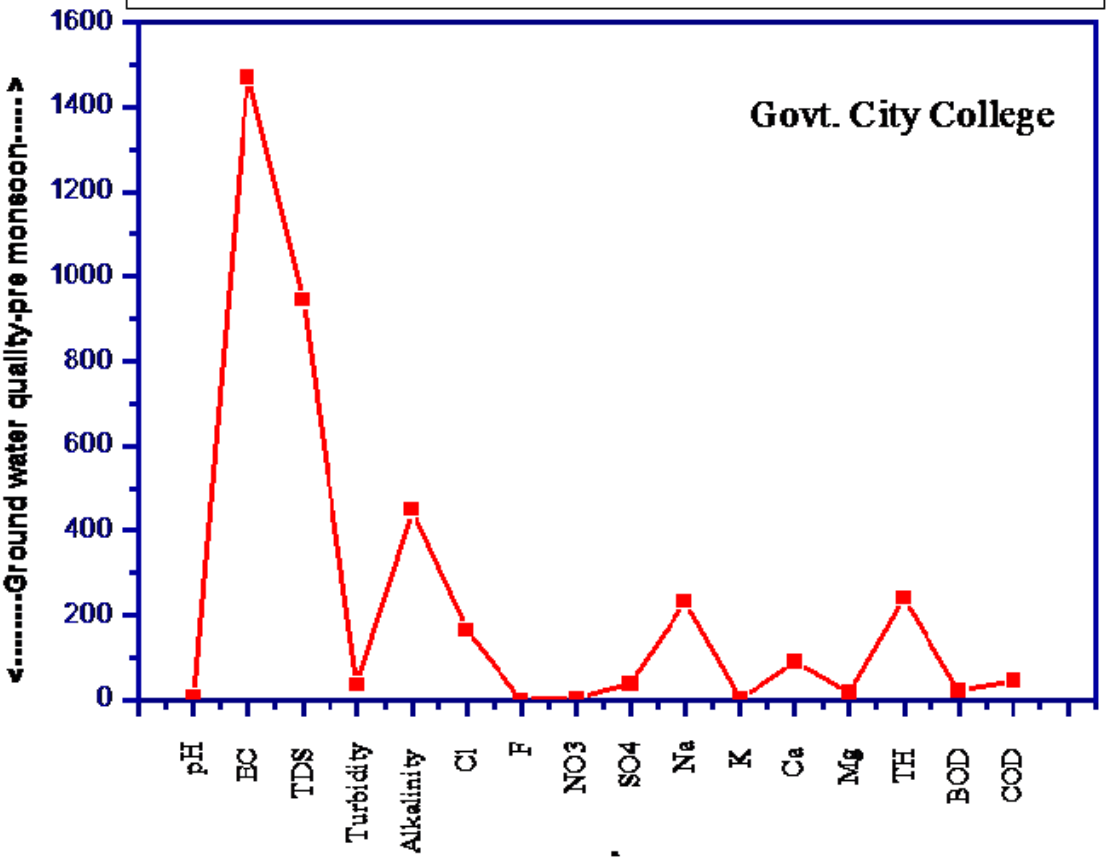
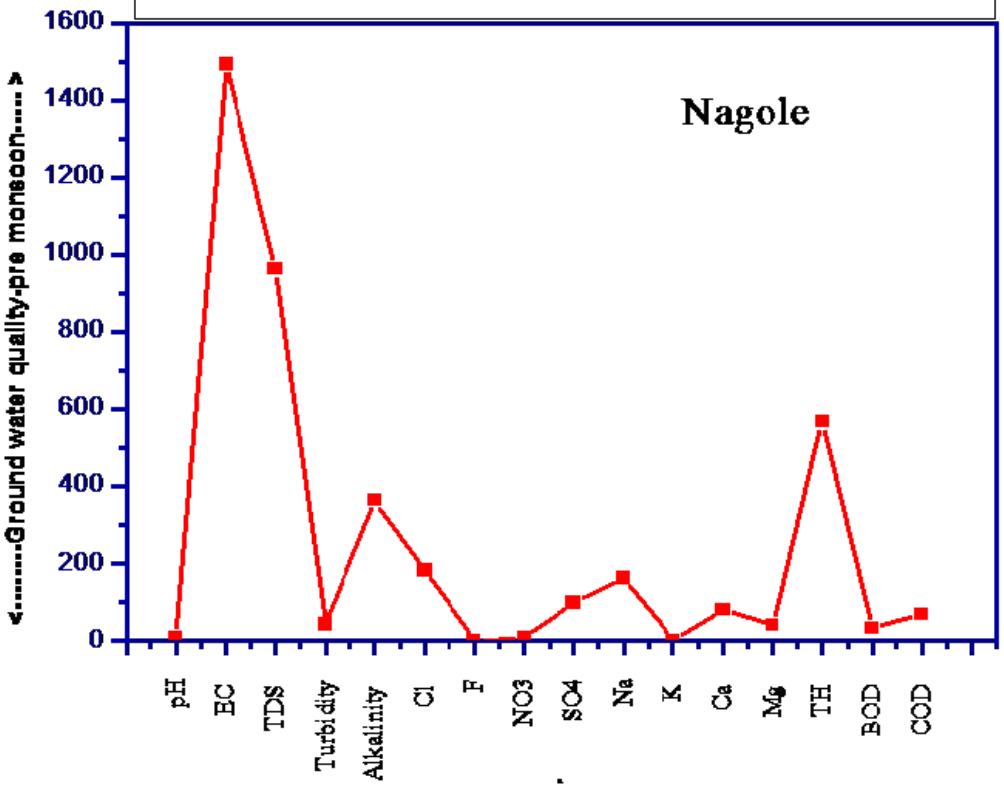
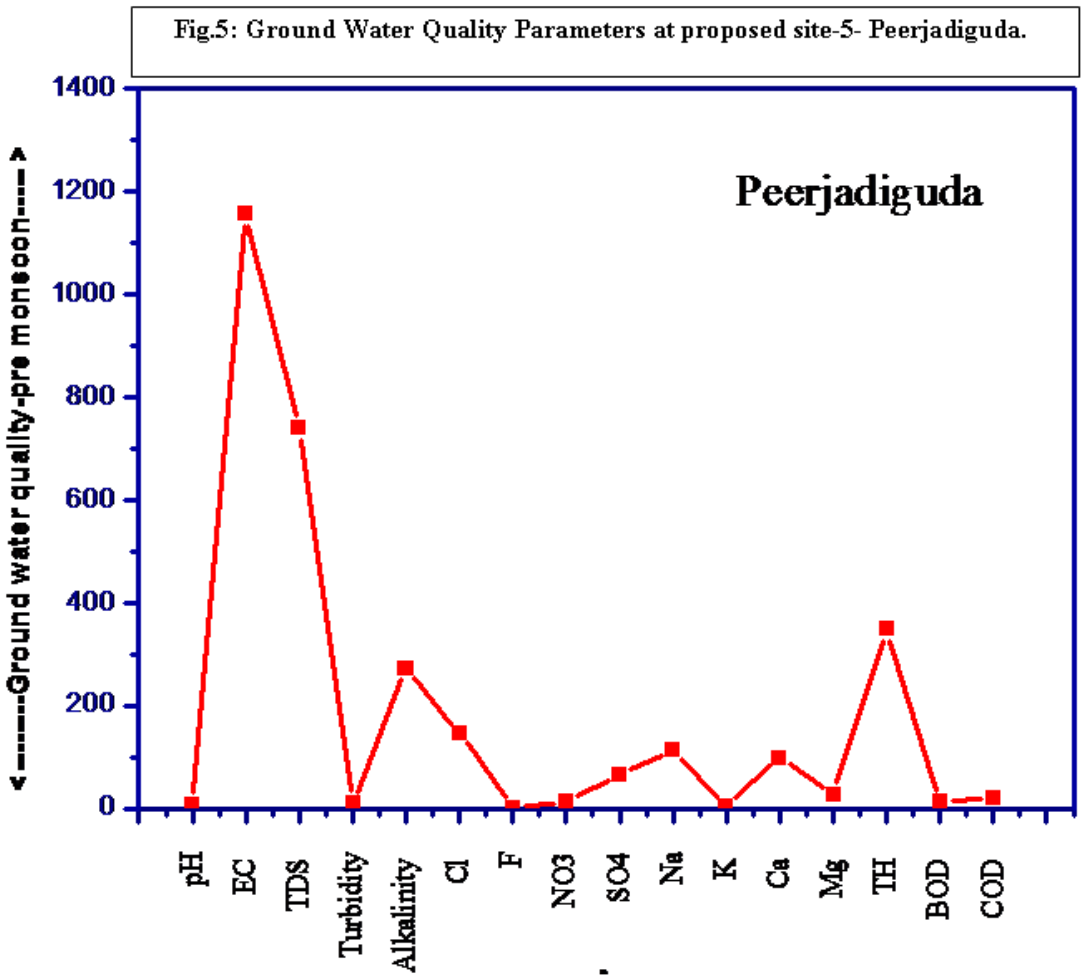


Fig.4: Ground Water Quality Parameters at proposed site-4- Nagole.





CONCLUSION

In conclusion analyzed different parameters such as Colour, Odour, pH, EC, Total Dissolved Solids (TDS), Turbidity, Carbonate, Bicarbonate, Chloride, Fluoride, Nitrate, Sulphate, Sodium, Potassium, Calcium, Magnesium and Total hardness are exceeded drinking water quality limits at many sites. Total dissolved solids are most at Langar house and Nagole which is to harmful for human health. Chloride is high contaminated at Langar house and Nagole. More Fluoride is present at Langar house and Peerjadiguda. BOD, COD exceeds BIS 10500 (1991) standard of drinking water standard value is acceptable limits. The high level indicates that there could be low oxygen available for living organisms in the waste water. Whereas the high value of BOD is an indication of the contamination. The BOD levels in Musi at Nagole is 32.4 mg/L and at Govt. city college 22 mg/L and COD levels are 68.4 mg/L, 28.9 mg/L at respective sites. The more nitrate is harmful, excess of Fluoride causes fluorosis and BOD levels has an impact on the flora and fauna of the river and underground water surrounding it, Fishes in the river can't survive in this conditions and marine life is affected. Because of this polluted water people have major health problems in the city of Hyderabad and at the down streams of Musi river, are like arthritis, diarrheic, stomach pain, malaria, food poison, body pains, knee pains, kidney problems, skin allergies and jaundices diseases, poor eyesight, skin lesions, Many had miscarriages and also fisher men stopped fishing in the river, ground water also effected and are not useful for the cultivation with the pollution of Musi river.

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