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Comparative study of the drinking water quality analysis of well water samples in rural, coastal and town areas

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ABSTRACT

Water is one of the most abundantly available substances in nature and hence known as elixir of life. Hence an attempt has been made to assess the well water quality status of the rural, coastal and town regions. The present study is about the comparative analysis of drinking water from three different regions – Rural, Coastal, and Town areas of Kottayam and Alappuzha districts. The physico-chemical characteristics such as temperature, dissolved oxygen, carbondioxide, pH, ammonia, chloride, residual chlorine, fluoride, iron, nutrients, and total hardness were analysed by standard methods. The study revealed that the drinking water in town area was polluted and it was harmful for use, especially in the (station IV and V). In these stations the water sample contains nitrate, iron, acidity, fluoride, total hardness beyond the permissible limits so that the water became non potable. The main reason for the water pollution is disposal of sewage, hospital waste and mainly industrial influences. When comparing coastal area with town, there is a slight decrease in pollution rate. Pollution in coastal area is mainly due to the influence of fertilizer industries and use of different chemical pesticides in crop field, sewage disposal etc. In coastal area (station VI) water sample become more polluted and almost all

parameters were beyond the permissible limits. So in this station well water samples was non potable. When comparing rural area with town and coastal area the well water is not harmful in the case of rural area and it can be safely used and all parameters are within the desirable limits due to lack of industrial influences, and in the waste produced are renewable or they use waste for promoting Biogas plant. The result obtained in the present analysis revealed that the discharge of sewage, industrial and municipal waste etc have contributed considerable pollution in well water samples in town and coastal region. There is an urgent need to protect well water samples from further water quality degradations in future. So it is necessary to protect our valuable water resources. The pollution of water causes different contaminated diseases in day to day life, so it is our duty to protect water resources from all polluting factors and save our motherland.

Key words: Dissolved oxygen, chloride, nitrite, rural, urban, coastal

1. INTRODUCTION

Kerala, the south west state of India known as 'God's own country is bestowed with 44 rivers that play a vital role in the social, economic as well as cultural life of people. Disease causing germs and chemicals can find their way into water supplies and when this happens, the water become polluted or contaminated and when people drink it or come in contact with it in other ways they can become very sick. Throughout history there have been many occasions in which hundreds of thousands of people have died because of disease causing germs that have been spread through polluted water supply (Hameed & Abbasi, 1997).

Ground water play a vital role as an important source of drinking water in rural and urban areas of India .According to some estimates, it accounts for nearly 80% of the rural domestic water needs, and 50% of the urban water needs in India (Abdual Jameel, 1998). Around 37.7 million Indians are affected by water born disease. Annually, 1.5million children are estimated to die of diarrhea and 73milion working days are lost due to water born disease each year (WHO, 1984).

In this context the present work was taken up with a view to have a short term comparative study on the drinking water quality analysis of town, coastal, and rural area.

2. MATERIALS AND METHODS

Well water sample were collected (6 from each location) from the 3 different areas covering town, coastal, and rural regions and the physico-chemical parameters such as temperature, dissolved oxygen, carbondioxide, pH, ammonia, chloride, residual chlorine, total hardness, nutrients, were analysed based on the standard methods (APHA, 1998). This study was under taken by collecting well water samples from the following 3 regions.

RURAL AREA –THOTTAKAD

Water sample was collected from rural area, Thottakad. It was a developing area but the influences of industries impart a major part. Water is mainly drowned from rocky surface of this area, so the water in this area was less polluted.

COASTAL AREA-KUTTANAD

Kuttanad which is in Alappuzha district. It is a marshy area. Various fertilizers (chemical and biological) are used in this area and daily use of different chemical pesticides in the crop field of Kuttanad regions.

TOWN AREA-CHANGANACHERRY

Water sample were collected from highly populated area of Changanacherry town. It was a well developed area and large amounts of waste were produced in the day to day life. Water samples were collected from six wells of these region (one from each), and showed 2 Km distance from each station.

3. RESULTS AND DISCUSSION

A rise in temperature of the water leads to the speeding up of chemical reaction. In pre- monsoon, solar radiation and clear sky condition might enhance the temperature. In monsoon cloudy sky is brought down the temperature to a minimum. Water temperature showed inverse relation with dissolved oxygen in agreement with the findings of (Bagde & Varma, 1985). In the present study the high temperature was shown in the town region and in the coastal and rural region the temperature range in between (26°Cto 27°C). Dissolved oxygen was high during monsoon and relatively low during pre- monsoon (Singh & Rai, 1991). Diffusion of oxygen is dependent on temperature. Low dissolved oxygen may be due to existing growth of aquatic plants present in it that ultimately reduced the dissolved oxygen because of either night time oxygen use by plants or the decay process that consumes oxygen. This reason may be taken as an indicator of the occurrence of eutrophication and consequent degradation of aquatic matter in well water. In this observation the dissolved oxygen maximum was obtained in the rural area (station II). The lowest oxygen range was shown in the town area (station VI). In coastal area high dissolved oxygen was shown in the (station III). In the present study the minimum carbon dioxide concentration was observed during monsoon season. The photosynthetic activities of phytoplankton may also be responsible for the decline in the concentration of carbon dioxide during the monsoon season. High carbon dioxide level associated with low dissolved oxygen and vice versa. The present study showed that maximum carbon dioxide was shown in the town region (station VI), where dissolved oxygen was very low, and lowest carbon dioxide was shown in the rural area (station II), where dissolved oxygen concentration was very low.

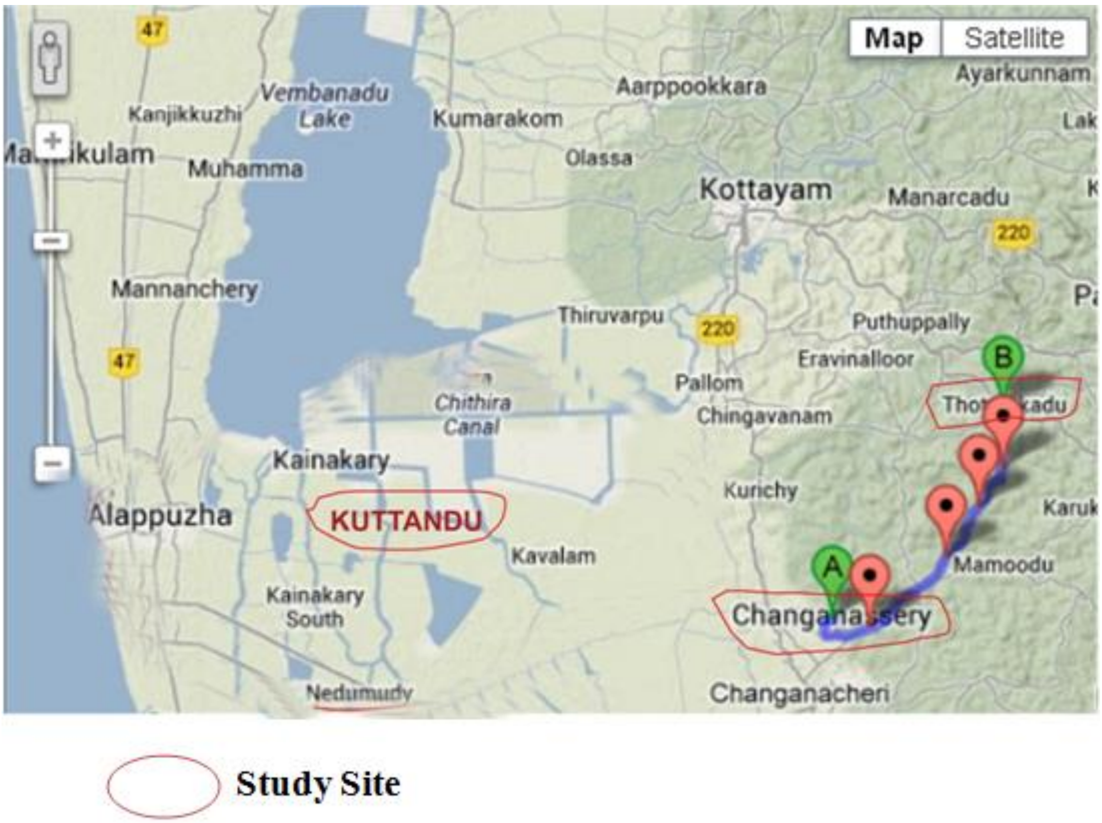


Figure 1
location map

Table 1
Hydrological parameters and nutrients of water samples in rural (Thottakad) area (Monsoon season)

S.I No	PARAMETERS	STATION 1	STATION II	STATION III	STATION IV	STATION V	STATION VI	BIS
1	TEMPERATURE (C °)	27.0C °	26.8C °	27.0C °	27.1C °	27.2C °	27.3C °	-
2	DISSOLVED O_2 (mg/L)	7.1	7.8	7.0	6.6	6.3	5.1	-
3	CO_2 (mg/L)	4.3	4.0	4.8	5.4	5.9	5.9	-
4	pH	5	7.1	7.3	6.2	8	7.4	6.5-8.5
5	CHLORIDE (mg/L)	20	18	15	22	18	12	1000(mg/L
6	RESIDUAL CHLORINE (mg/L)	–	–	–	–	–	–	1.0(mg/L)

7	AMMONIA (mg/L)	_	_	_	0.1	_	0.1	-
8	FILUORIDE (mg/L)	_	_	0.3	0.1	_	0.2	1.5(mg/L)
9	IRON (mg/L)		0.3		0.1		0.3	1.0 mg/L)
10	TOTAL HARDNESS (mg/L)	6	3	5	6	4	3	600(mg/L)
11	NITRATE (mg/L)	10	8	6	11	6	8	45(mg/L)
12	NITRITE (mg/L)	_	_	_	_	_	_	0.1(mg/L)
13	PHOSPHATE (mg/L)	-	_	_	_	_	_	-

'_' = Absent

Table 2

Hydrological parameters and nutrients of water samples in coastal (Kuttanad) area (Monsoon Season)

S.I No	PARAMETERS	STATION 1	STATION II	STATION III	STATION IV	STATION V	STATION VI	BIS(Mg/l)
1	TEMPERATURE (C °)	27.4C °	27.3C °	27.3C °	27.9C °	28.0C °	28.2C °	-
2	DISSOLVED O_2 (mg/L)	5.9	6.1	6.4	4.9	4.4	4.0	-
3	CO_2 (mg/L)	4.9	3.2	3.6	5.4	5.8	6.0	-
4	pH	8.0	8.4	8.6	8.1	5.9	6.4	6.5-8.5
5	CHLORIDE (mg/L)	520	532	600	648	830	765	1000(mg/L
6	RESIDUAL CHLORINE (mg/L)	0.2	0.4	0.1	0.2	0.3	0.9	1.0(mg/L
7	AMMONIA (mg/L)	_	_	_	_	_	_	-
8	FILUORIDE (mg/L)	_	0.3	0.1		1.6	1.8	1.5 mg/L)
9	IRON (mg/L)	_	0.2	0.4	_	0.3	0.9	-
10	TOTAL HARDNESS (mg/L)	130	165	325	350	500	574	600(mg/L)
11	NITRATE (mg/L)	10	35	25	38	41	47	45(mg/L)
12	NITRITE (mg/L)	_	0.1	_	0.3	_	0.4	0.1(mg/L)
13	PHOSPHATE (mg/L)	_	_	0.1	_	0.3	0.4	-

'_' = Absent

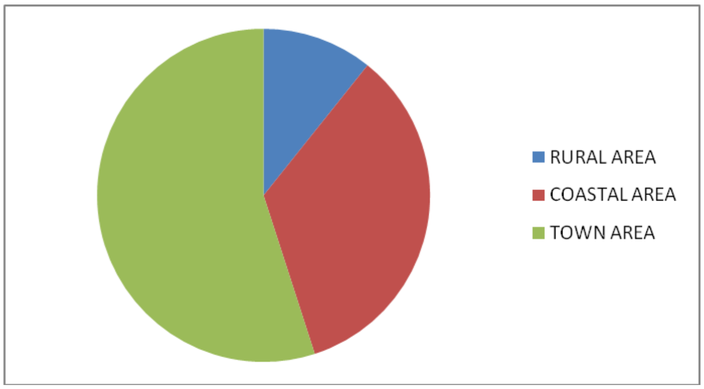
Table 3

Hydrological parameters and nutrients of water samples in town (Changanacherry) area (Monsoon Season)

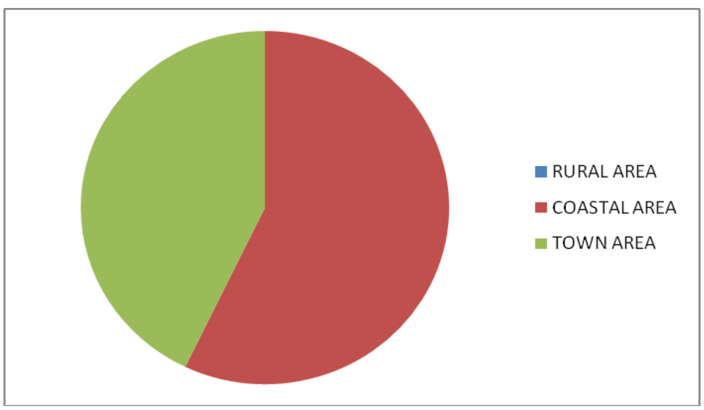
S.I No	PARAMETERS	STATION 1	STATION II	STATION III	STATION IV	STATION V	STATION VI	BIS(Mg/l)
1	TEMPERATURE (C °)	27.0C °	27.3C °	27.4C °	27.8C °	28.0C °	28.2C °	-
2	DISSOLVED O_2 (mg/L)	4.7	4.5	4.1	3.9	3.2	3.0	-
3	CO_2 (mg/L)	3.0	4.9	4.8	5.7	5.9	6	-
4	pH	5	5.3	7.3	6.2	6	5	6.5-8.5
5	CHLORIDE (mg/L)	40	42	45	58	62	75	1000 (mg/L)
6	RESIDUAL CHLORINE (mg/L)	NIL	0.1	0.3	0.1	0.4	0.5	-
7	AMMONIA (mg/L)	_	_	0.3	0.1	0.3	0.4	-

8	FILUORIDE (mg/L)	NIL	0.3	1.2	1.8	1.6	2.0	1.5(mg/L)
9	IRON (mg/L)	NIL	0.1	0.3	1.4	1.9	2.1	1.0 mg/L
10	TOTAL HARDNESS (mg/L)	355	390	400	480	510	610	600(mg/L)
11	NITRATE (mg/L)	30	35	41	45	48	52	45(mg/L)
12	NITRITE (mg/L)	_	_	0.2		0.1	0.3	0.1(mg/L)
13	PHOSPHATE (mg/L)	_	_	0.1	0.5	0.3	0.5	-

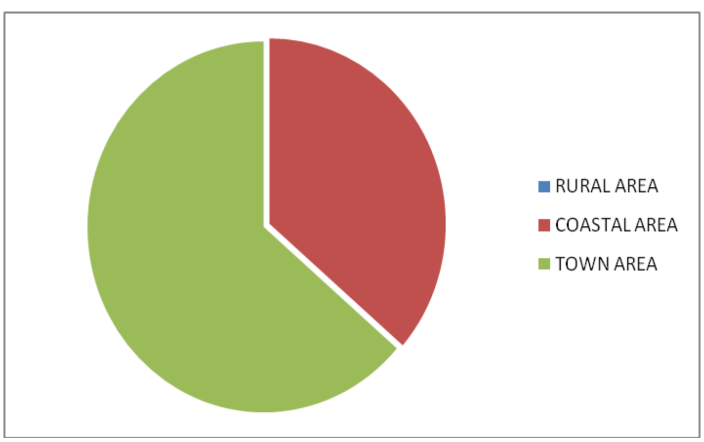
'_' = Absent



Comparative study of Nitrate in rural area, coastal area, town area



Comparative study of Nitrite in rural area, coastal area, town area



Comparative study of Phosphate in rural area, coastal area, town area

The pH of most natural water falls within a range of (4-9). The majority of water are slightly basic (generally over 7.0) because of the presence of the carbonate and bicarbonate. The pH increases (acidic) during day time due to photosynthetic activity because of consumption of carbon dioxide whereas it declines (alkaline) at night due to respiratory activity. The pH obtained was beyond this range (6.5-8.5). The present study showed that most of the stations of town water sample were acidic and the pH was obtained in the range of (5 to 6.2). This may be due to the influence of chemical and heavy metal concentration from industries. Most of the rural and coastal area water sample are basic, the pH ranged from (7 to 8).

The sources of chloride in water bodies include bedrocks containing chloride, oil refineries, industrial waste water discharges and effluent from treatment plants (Aravindhakashan & Joseph, 1990). In the observations, the high chloride concentration was obtained in the coastal area (station V) and lowest concentration of chloride obtained in the (station I) in coastal area. Chloride concentration was showing low range in rural area and in town area concentration was shown (4 to 7.5 mg/l). The residual chloride was absent in the drinking water sample of rural area. In coastal and town regions the concentration of residual chlorine obtained was from (0.1 to 0.9 mg/l). Nitrate will reduces the oxygen levels in water bodies and to toxic nitrites in the human intestine, and many babies have been seriously poisoned by well water containing high level of nitrate. The study shows that nitrate concentration is higher in coastal and town area. In coastal area higher nitrate concentration was shown in the (station VI). In this area concentration of nitrate obtained beyond the permissible limit, this is due to the coastal area contain heavy fertilizers (biological and chemical) in crop and paddy field this action influences the ground water body as a result the ground water contain heavy concentration of nitrate. But in town region heavy discharge of sewage, municipality and hospitality waste in surrounding earth surfaces that directly led to the increase of the nitrate concentration in the ground water sample in town area. In rural area comparatively nitrate concentration was between (8-11mg/l). In rural area well water sample nitrite concentration was absent. But in coastal and town area nitrite concentration shown in between (0.1 to 0.4 mg/l).

Higher concentration of phosphate was shown in the town and coastal regions. The local population of Kuttanad used the water bodies for their daily households for lack of protected water supply facilities which may also contribute to the high phosphate level, use of detergents with long chain phosphate compound and use of water bodies are receptacle for waste disposal have also resulted in excessive phosphorous loading. It showed that in the rural area water sample, phosphate was absent. But low phosphate concentration was exhibited in the coastal and town region. The study showed that rural and coastal areas contain low range of iron. But in town area (station VI) iron concentration was higher than the permissible limit.

Even higher intakes of fluoride taken over a long period of time can result in change to bone, a condition known as skeleton fluorosis. This can cause joint pain, restriction of mobility, and possibly increase the risk of some bone fractures (Mitra, 1982, 1995). In some stations of costal and town showed higher amount of fluoride than the permissible limit, this is due to the influence of sewage treatment and waste from industrial sources. Study observed that hardness was higher in the town area water sample. In town area (station VI) total hardness was beyond the permissible limit But in certain stations of coastal area there was a increase in total hardness this indicate that water sample was become hard. Hardness increase was mainly due to the influence of industries and chemicals. In rural area the total harness is present in the range between (3 to 6 mg/l); this result shows that soft water is present in the rural area.

4. CONCLUSION

The present work showed the comparative analysis of drinking water from 3 different regions – Rural, Coastal, Town. This study showed that the drinking water in town area is polluted and it is harmful to use, especially in the (station IV and V). In this station the water sample contain Nitrate, Iron, Acidity, Fluoride and total hardness beyond the permissible limits so that the water became non potable. The main reason for the water pollution was disposal of sewage, hospitality waste and mainly industrial influences. When comparing Coastal area with Town, there is a slight decrease in pollution rate. Pollution in coastal area is mainly due to the influence of fertilizer from industries and use of different chemical pesticides in crop field, sewage disposal etc. In coastal area (station VI) water sample become more polluted and almost all parameters were beyond the permissible limits. So in this station well water samples was non potable. When comparing rural area with town and coastal area the well water was not harmful in the case of rural area and it can be safely used and all parameters were within the desirable limits due to lack of industrial influences, and in the waste produced are renewable or they use waste for promoting Biogas plant. Today water is facing different pollution problems. So it is necessary to protect our valuable water resources. The pollution of water causes different contaminated diseases in day to day life, so it is our duty to protect water resources from all polluting factors. A proper awareness has to be given to the common people for the sustainable use of these ground water sources.

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