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Drinking Water Quality Assessment in Bagepalli and Chikkaballapura Taluk of Karnataka, India

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ABSTRACT
Groundwater is a vital component of our life support system. In Karnataka majority of the groundwater resources are being utilized for drinking purposes. There is a growing concern about the deterioration of drinking water quality due to geogenic and anthropogenic activities. In the present study, 20 water samples were collected from the urban areas of Bagepalli taluk (BPT) and 133 water samples from the rural areas of BPT. Similarly, 35 samples were collected in the urban areas of Chikkaballapura taluk (CBT) and 52 samples in the rural areas of CBT. Parameters like pH, TDS, Electrical Conductivity, Hardness, Alkalinity, Turbidity, Calcium, Magnesium, Chloride, Sulphate, Nitrate, Fluoride were analyzed to assess their suitability for drinking purposes. Results show that both bagepalli and chikkaballapura taluks have reported high concentrations of chloride, fluoride, nitrates, alkalinity, hardness, TDS, EC etc. in both rural and urban areas and also exceeded the standard limits of BIS 10500:2012. Therefore, they are not fit for drinking purposes. So, there is an urgent need to combat the drinking water pollution in areas of both the taluks.
Keywords: *Ground water; drinking water quality; Chikkaballapura; Bagepalli; fluoride; Urbanization*

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INTRODUCTION
Groundwater is an essential component of the environment and economy. Ground water contributes to about eighty percent of the drinking water requirements in the rural areas, fifty percent of the urban water requirements and more than fifty percent of the irrigation requirements of India[1]. Groundwater quality deterioration can be caused by broadly two ways; anthropogenic and geogenic. Anthropogenic is caused by manmade activities like, industries, urban sewage and waste landfills, mining etc. and geogenic is due to natural causes mainly through rock-water interaction. Both the Groundwater as well as the surface water contains certain dissolved forms of chemicals, which can cause adverse health effects [2]. Drinking water contamination is one of the vital causes that can create potential health problems in human beings. According to the study by WHO, about 2.3 billion people were affected by water related diseases worldwide. Most groundwater supplies in rural and peri-urban regions are untreated, and it has been reported that it is difficult for groundwater to purify itself, and that treating it is sometimes impossible and very expensive [3]. The scarcity of water for drinking and agriculture is commonly noticed all around the world in arid and semi-arid regions [4]. The major challenge faced by the supplier and users in the realm of drinking water sector is the availability of safe drinking water from its source to the consumers.
The major water quality parameters which determine the quality of the drinking water are pH, electrical conductivity, hardness, solids, chloride, alkalinity, fluoride, iron, nitrates etc. Inland salinity in ground water is prevalent mainly in the arid and semi arid regions including Karnataka state, it is caused due to practice of surface water irrigation without consideration of ground water status. Nearly 90% of rural population of the country uses ground water for drinking and domestic purposes and due to excess Fluoride in ground water, a huge rural population is threatened with health hazards of dental and Skeletal Fluorosis [5]. High amounts of nitrates are generally indicative of pollution. Nitrates themselves have no direct effect on health. However, Nitrates in water supplies in concentration more than permissible limit

cause the adverse health effects. The main reasons for the presence of Nitrate in the ground water include minerals, sewage and industrial wastes and agricultural run-off. Quality and quantity of rainfalls, geological structure, and aquifer mineralogy are the main factors that can affect the chemical quality of groundwater [6].
Groundwater occurs dominantly under water table conditions in Karnataka and principally migrates through fractures in the hard rock's[7].According to central ground water board data, 14 districts in the Karnataka state including chikkaballapura district are affected by high fluoride content. Remote sensing studies have shown an 8.93% decrease in forest cover in the state during the period 2003–05 to 2011–13. All these land use changes have lowered the water table promoting a greater degree of water–rock interaction, especially in eastern Karnataka [8]. Although rainfall has not uniformly decreased during the last three decades, the water table has declined in several areas of eastern Karnataka. While rainfall is decreasing in north interior Karnataka, it is increasing in south interior Karnataka. However, due to urbanisation, industrialisation, and agricultural activity in Bengaluru, Kolar, Tumkur, and Chikkaballapura districts, the water table has dropped significantly in the south interior of Karnataka [9]. Major groundwater problems and issues in the Chikkaballapura district are water level depletion and yield dwindling in major parts of the district, overexploitation groundwater sources and water quality problems. Though, in Chikkaballapura district, particularly in the Bagepalli and Chikkaballapura taluks, there were very few published articles on water quality issues. These reasons made up to take the present study; the main aim of the present study is to evaluate the drinking water quality in bageppali and chikkaballapura taluks of Chikkaballapura district.

MATERIAL AND METHODS

Chikkaballapura is a district in the state of Karnataka. It was carved out of the pre-existing Kolar district in 2007 by moving six taluks of the erstwhile Kolar district namely, Gauribidanur, Gudibanda, Bagepalli, Chikkaballapura, Sidlaghatta and Chintamani into the district Chikkaballapura. According to Chikkaballapura district at a glance report, the Bagepalli taluk (BPT) has the total area of 929 sq. km with a total population of 1,83,498and Chikkaballapura taluk (CBT) has the total area of 638 sq. km with a total population of 2,12,536. Normal rainfall in BPT and CBT were 695mm and 828mm respectively, there are no perennial rivers in Chikkaballapura district. The district is drained by three river basins namely Palar, Ponnaiyar, and Pennar. The topography of the district is undulating to plain, the types of soils distributed range from red loamy soil to red sandy soil and lateritic soil.Fig 1 shows the Chikkaballapura district map.For the present study, the water samples were collected from various drinking water sources includes bore well water, mini water supply, piped water supply, pump house, hand pump and overhead water tank in Bagepalliand Chikkaballapura taluks during the year 2018. 20 samples were collected from the urban areas of BPT and 133 samples from the rural areas of BPT. Similarly, 35 samples were collected in the urban areas of CBT and 52 samples in the rural areas of CBT. Samples were collected by following standard protocols in pre-cleaned HDPE bottles. Then the samples were stored in an icebox and transported to the laboratory for analysis. The analysis was conducted by adopting standard methods. Parameters like pH, TDS, Electrical Conductivity, Hardness, Alkalinity, Turbidity, Calcium, Magnesium, Chloride, Sulphate, Nitrate, Fluoride were analyzed to assess its suitability for drinking as per BIS 10500:2012.

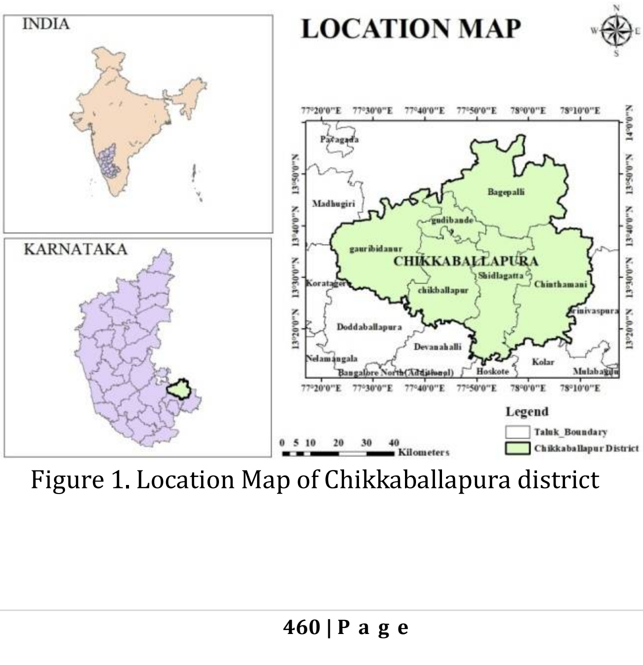

Figure 1. Location Map of Chikkaballapura district

RESULTS AND DISCUSSION

Hydrogen Ion Concentration (pH)

pH is ranged from 7.01 to 7.8, with a mean value of 7.27in the urban area of BPT and it is in the range of 6.55 to 8.12, with a mean value of 7.29 in the rural area of BPT indicating that the water is alkaline in nature. Similar results were observed in study by Kumar and Prabhu [10]. All the samples were within the standards limit of 6.5-8.5 mg/lby BIS 10500:2012 both in the urban and the rural regions of BPT. In the case of CBT, pH is ranged from 6.32 to 7.71, with a mean value of 6.874 in the urban area with 3 samples below the safe limits indicating that the water is acidic in nature. pH is in the range of 6.50 to 8.03, with a mean value of 7.25 in the rural area and all the samples were within the standards limits in the rural regions of CBT. However, pH usually has no direct impact on human health [11].

Table 1. Physico-chemical characterization of drinking water

S.No	Property	Range obtained
1	pH	7.27
2	Electrical Conductivity (EC)	1736 µS/cm
3	Total Dissolved Solids (TDS)	1125.8 mg/l
4	Turbidity	0.48 NTU
5	Sulphate	10.45 mg/lin
6	Chloride	248.8 mg/l
7	Hardness	606.5 mg/l
8	Calcium	142.8mg/l
9	Magnesium	60.18 mg/l
10	Alkalinity	466.65 mg/l
11	Fluoride	1.52 mg/l
12	Nitrate	88.03 mg/l

Electrical Conductivity (EC)

EC is ranged from 300 to 2600 µS/cm, with a mean value of 1736 µS/cm in the urban areas of BPT and 150 to 3900 µS/cm, with a mean value of 1236.5 µS/cm in the rural area of BPT. In the case of CBT, EC is ranged from 450 to 2340 µS/cm, with a mean value of 1584 µS/cm in the urban area and 180 to 3130 µS/cm, with a mean value of 1242.93 µS/cm in the rural area. Concentration of EC is higher BPT compared to CBT and majority of samples were high in concentration. Higher variations in the EC could be attributed to anthropogenic activity and geochemical process prevailing in the study region.

Total Dissolved Solids (TDS)

TDS is ranged from 195 to 1690 mg/l, with a mean value of 1125.8 mg/l and 95% of samples exceeds the standard limit of 500 mg/l by BIS in the urban area of BPT and TDS varied from97.5 to 2535 mg/l, with a mean value of 803.73 mg/l and 84.2% of samples exceeds the standard limit in the rural area of BPT. In the case of CBT, TDS is ranged from 292.5 to 1521 mg/l, with a mean value of 1029.6mg/l and 91.4 % samples exceeded the standard limit of 500 mg/l in the urban area and it is varied from 11.7 to 2034.5 mg/l, with a mean value of 792.60 mg/l and 75% samples exceeded the standard limit in the rural area. From the results, BPT has reported high TDS pollution than in CBT

Turbidity

Turbidity is ranged from 0.2 to 1.4 NTU, with a mean value of 0.48 NTU, 10%of samples exceeded the standard limit of 1 mg/l by BIS in the urban area of BPT and 0 to 1.6, with a mean value of 0.53, 17.3% of samples exceeded the standard limit in the rural area of BPT. In the case of CBT, Turbidity is ranged from 0.3 to 7.7, with a mean value of 1.82, 80% samples exceeded the standard limit in the urban area and 0 to 21.7, with a mean value of 1.97, 32.7%of samples exceeded the standard limit in the rural area. Turbidity is higher in CBT than BPT.

Sulphate

Sulphate is ranged from 6.58 to 26.7 mg/l, with a mean value of 10.45 mg/lin the urban area of BPT and 2.9 to 123.2 mg/l, with a mean value of 23.31 mg/lin the rural area of BPT. In both the urban and the rural regions of BPT, all samples were within the safe limit of 200 mg/l by BIS. In the case of CBT, Sulphate is ranged from 7.7 to 23.7 mg/l, with a mean value of 18.33 mg/l in the urban area and 0 to 98.4 mg/l, with a mean value of 18.93 mg/l in the rural area. In both the urban and the rural regions of CBT, all samples were within the safe limits. Similar results were seen in the investigation by Bhattacharjee et al. [12]

Chloride

Chloride is ranged from 19.2 to 408.9 mg/l, with a mean value of 248.8 mg/l,55% of samples exceeded the standard limit of 250 mg/l by BIS in the urban area of BPT and 15.7 to 578.7 mg/l, with a mean value of 147.35 mg/l, 17.3%of samples exceeded the standard limit in the rural area of BPT. In the case of CBT, Chloride is ranged from 38.4 to 504.9 mg/l, with a mean value of 266.24 mg/l, 54.2% of samples exceeded the standard limit in the urban area and 13.4 to 503.8 mg/l, with a mean value of 187.84 mg/l, 34.6%of samples exceeded the standard limit in the rural area. Chloride pollution is high in urban areas of BPT and CBT.

Hardness

Hardness is ranged from 75 to 1085 mg/l, with a mean value of 606.5 mg/l, 85% of samples exceeded the standard limit of 200 mg/l by BIS in the urban area of BPT and 48.4 to 1385 mg/l, with a mean value of 476.60 mg/l, 90.1% of samples exceeded the standard limit in the rural area of BPT. In the case of CBT, Hardness is ranged from 230 to 935 mg/l, with a mean value of 592.42 mg/l, 100%of samples exceeded the standard limit in the urban area and 51.4 to 1137.2 mg/l, with a mean value of 471.29 mg/l, 88.5%of samples exceeded the standard limit in the rural area. Higher concentration of Hardness was also studied by Bhattacharjee et al.[12]. Hardness pollution is more in the CBT than BPT.

Calcium

Calcium is ranged from 32 to 242 mg/l, with a mean value of 142.8mg/l, 85%of samples exceeded the standard limit of 75 mg/l by BIS in the urban area of BPT and 11.6 to 288 mg/l, with a mean value of 103.31 mg/l, 72.9%of samples exceeded the standard limit in the rural area of BPT. In the case of CBT, Calcium is ranged from 42 to 230 mg/l, with a mean value of 124.88 mg/l, 85.7%of samples exceeded the standard limit in the urban area and 9.3 to 224.6 mg/l, with a mean value of 99.27 mg/l, 71.1%of samples exceeded the standard limit in the rural area. Calcium concentration is found to be higher in urban regions of BPT and CBT.

Magnesium

Magnesium is ranged from 9.6 to 115.2 mg/l, with a mean value of 60.18 mg/l, 80%of samples exceeded the standard limit of 30 mg/l by BIS in the urban area of BPT and 2.3 to 159.6 mg/l, with a mean value of 54.46 mg/l, 81.2% of samples exceeded the standard limit in the rural area of BPT. In the case of CBT, Magnesium is ranged from 20.4 to 108 mg/l, with a mean value of 67.41 mg/l, 91.4%of samples exceeded the standard limit in the urban area and 6.7 to 138.1 mg/l, with a mean value of 53.50 mg/l, 78.8%of samples exceeded the standard limit in the rural area. Magnesium concentration is found to be higher in urban regions of CBT.

Alkalinity

Alkalinity is ranged from 80.6 to 892.6 mg/l, with a mean value of 466.65 mg/l, 85%of samples exceeded the standard limit of 200 mg/l by BIS in the urban area of BPT and 14 to 1100 mg/l, with a mean value of 409.70 mg/l,64.6%of samples exceeded the standard limit in the rural area of BPT. In the case of CBT, Alkalinity is ranged from 346 to 920.4 mg/l, with a mean value of 633.14 mg/l, 100%of samples exceeded the standard limit in the urban area and 40.2 to 1107.6 mg/l, with a mean value of 376.64 mg/l, 86.5%of samples exceeded the standard limit in the rural area. CBT has reported high alkalinity concentration than BPT.

Fluoride

Fluoride is ranged from 0.39 to 2.59 mg/l, with a mean value of 1.52 mg/l, 95%of samples exceeded the standard limit of 1 mg/l by BIS in the urban area of BPT and 0 to 3.32 mg/l, with a mean value of 2.03 mg/l, 92.5%of samples exceeded the standard limit in the rural area of BPT. In the case of CBT, Fluoride is ranged from 0.27 to 1.42 mg/l, with a mean value of 0.79 mg/l, 31%of samples exceeded the standard limit in theurban area and 0 to 2.931 mg/l, with a mean value of 1.33 mg/l,50%of samples exceeded the standard limit in the rural area. Similar kinds of observations were made by Kumar and Prabhu [10] and Bhattacharjee *et al*.[12].Fluoride concentration is more in BPT than in CBT.

Nitrate

Nitrate is ranged from 8.1 to 209.1 mg/l, with a mean value of 88.03 mg/l, 70% of samples exceeded the standard limit of 45 mg/l by BIS in the urban area of BPT and 0.6 to 572 mg/l, with a mean value of 82.06 mg/l, 53.4% samples exceeded the standard limit in the rural area of BPT. In the case of CBT, Nitrate is ranged from 4.2 to 413.8 mg/l, with a mean value of 171.41 mg/l, 85.7% of samples exceeded the standard limit in the urban area and 0 to 461.1 mg/l, with a mean value of 113.61 mg/l, 52% samples exceeded the standard limit in the rural area. Similar kinds of observations were made by Kumar and Prabhu [10]. Higher concentration of Nitrate was also highlighted by Bhattacharjee *et al*.[12]. Nitrate pollution is higher in CBT than BPT from the results.

CONCLUSIONS

From the Results, it was concluded that most of the water samples exceeded the drinking water quality standards; therefore, they are not fit for drinking purposes. Both bagepalli and chikkaballapura taluks have reported high concentrations of chloride, fluoride, nitrates, alkalinity, hardness, TDS, EC etc. but the concentration of sulphate and pH in both urban and rural areas are within the safe limits. So, there is an urgent need to control the drinking water pollution in areas of both the taluks. Considering the scenario of the drinking water condition, it was suggested that, constant monitoring of ground water quality should be carried out in the contaminated areas to prevent further deterioration and related problems and rainwater harvesting practices may be encouraged so that it will help in reducing the load on urban and rural water supply systems.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCES

1. CGWB. (2012) Ground Water Information Booklet Chickballapur District, Karnataka
2. Sankararamakrishnan, N., Sharma, A. K., & Iyengar, L. (2008). Contamination of nitrate and fluoride in ground water along the Ganges Alluvial Plain of Kanpur district, Uttar Pradesh, India. Environmental monitoring and assessment, 146(1), 375-382.
3. DWAF. (2000). Quality of domestic water supply. Volume 2: sampling guide: 3,4,17
4. Singh, P., Thakur, J. K., & Singh, U. C. (2013). Morphometric analysis of Morar River Basin, Madhya Pradesh, India, using remote sensing and GIS techniques. Environmental earth sciences, 68(7), 1967-1977.
5. Raj, D., &Shaji, E. (2017). Fluoride contamination in groundwater resources of Alleppey, southern India. Geoscience Frontiers, 8(1), 117-124.
6. Mirzabeygi, M., Abbasnia, A., Yunesian, M., Nodehi, R. N., Yousefi, N., Hadi, M., &Mahvi, A. H. (2017). Heavy metal contamination and health risk assessment in drinking water of Sistan and Baluchistan, Southeastern Iran. Human and Ecological Risk Assessment: An International Journal, 23(8), 1893-1905.
7. Radhakrishna, B. P. (2004). Groundwater in Hard Rock Aquifer of South India, Geological Society of India, Bengaluru, p. 16.
8. Dharumarajan, S., Lalitha, M., Hegde, R., Janani, N., Rajawat, A. S., Sastry, K. L. N., & Singh, S. K. (2018). Status of desertification in South India–assessment, mapping and change detection analysis. Current Science, 115(2), 331.
9. Srinivasan, R., Pandit, S. A., Karunakara, N., Salim, D., Kumara, K. S., Kumar, M. R., ... & Ramkumar, K. D. (2021). High uranium concentration in groundwater used for drinking in parts of eastern Karnataka, India. Current Science (00113891), 121(11).
10. Kumar, T. M., & Prabhu, N. (2019). Geochemical Modelling of Kushawathi Watershed Area Chikkaballapur District, Karnataka. International Journal of Scientific & Technology Research, 8(12), ISSN 2277-8616.
11. WHO. (2008). Guidelines for Drinking Water Quality, third ed. pp. 20 Avenue Appia, 1211 Geneva 27, Switzerland.
12. Bhattacharjee, S. P., Vashistha, R., Sooryanarayana, K. R. (2016). Evaluation Of Suitability of Ground Water for Drinking and Its Sustainable Management - A Case Study from Chikballapur District, Karnataka, India. International Journal of Research in Engineering and Technology, 05, Special Issue 18

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