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RESEARCH ARTICLE

SURFACE WATER QUALITY EVALUATION OF MALAPRABHA RIVER, BELAGAVI DISTRICT, KARNATAKA

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ABSTRACT

Water quality evaluation is of paramount importance due to the population explosion and unprecedented industrial growth. In Indian context, water quality is a serious problem in many of the river basins due to unplanned development of urban and semi-urban areas. One of the major cities which is fast developing in Karnataka is Belagavi (previously known as Belgaum) which is located on the north western part of Karnataka. In the recent time, the Government of Karnataka has planned to set up many processing industries in the vicinity of Belagavi to meet the growing needs of the region and to ease out the pressure on the already existing industrial hubs in Karnataka State. Malaprabha, a tributary of river Krishna, originates in the hills of Western ghats (near Kankumbi) and flows through Khanapur and Bailahongal taluks and the water is impounded by constructing a dam at Naviluteerth in Saundatti taluk. It is planned to supply water from Malaprabha reservoir to Hubli-Dharwad city. During the last decade, lot of anthropogenic activities such as deforestation and excessive agricultural activities are ongoing in many parts of the catchment. Therefore, it is a matter of concern to the public with regard to the quality of surface water of Malaprabha river and groundwater in the adjoining catchment area. Considering the significance of water quality of the river, surface water samples were collected during Pre- and Post-monsoon seasons of 2013 and 2014. Samples were collected from selected locations and analyzed for both physical and chemical constituents in the laboratory. The results indicate that the majority of the water quality parameters which includes, bicarbonates, sulphates, chlorides, sodium, potassium, calcium and magnesium are within the permissible limits. However, water quality parameters showed spatial and temporal variations with respect to land use/land cover changes.

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INTRODUCTION

Water is the vital component of the physical environment and plays a significant role in the growth and prosperity of any civilization. Also the water quantity and quality processes constitute an integral part of the natural hydrologic environment. As such these two processes are interrelated and are said to be in dynamic interaction. As the pressure of population growth and industrialization is at the peak, it is quite important to have an assessment of the water resources both quantitatively and qualitatively. Although, water quantity has historically been the primary factor controlling the use of water resources, water quality is critical in terms of pollution control and environmental management. Water quality is highly dynamic variable which are influenced by environmental factors like climatic conditions, land use/land cover, urbanization, industrialization, natural calamities and anthropogenic activities. Apart from the above factors, the socio-economic pressure also lead to lack of sanitation and wastewater treatment facilities thereby enhancing the risk of water quality deterioration. It is a fact that, in the recent past, the scarcity of clean water and pollution of fresh water has led to a situation in which one fifth of the urban dwellers in developing countries and three quarters of their rural dwelling population do not have access to reasonably safe water supplies (Lloyd and Helmer, 1992). Water quality investigations have been carried out by various researchers with reference to urbanization and industrialization. Kang *et al*., (2010) observed that, land use/land cover change in the recent years is one of the most critical and widely discussed causes of water pollution. Dwivedi *et al*., (2011) studied the Mohand Rao river of Doon valley and found that the quality of river water is quite good for both drinking and domestic purposes. Purandara *et al* (2004) studied the chemical mass balance of water quality parameters and concluded that during lean period of flow, quality of water is affected indicating the significance of flow on water quality. Purandara *et al*., (2011) carried out water quality Evaluation and Modeling of Ghataprabha River to understand the impact of point and non-point sources of pollution and reported that the non-point source of pollution is the major source of contamination in

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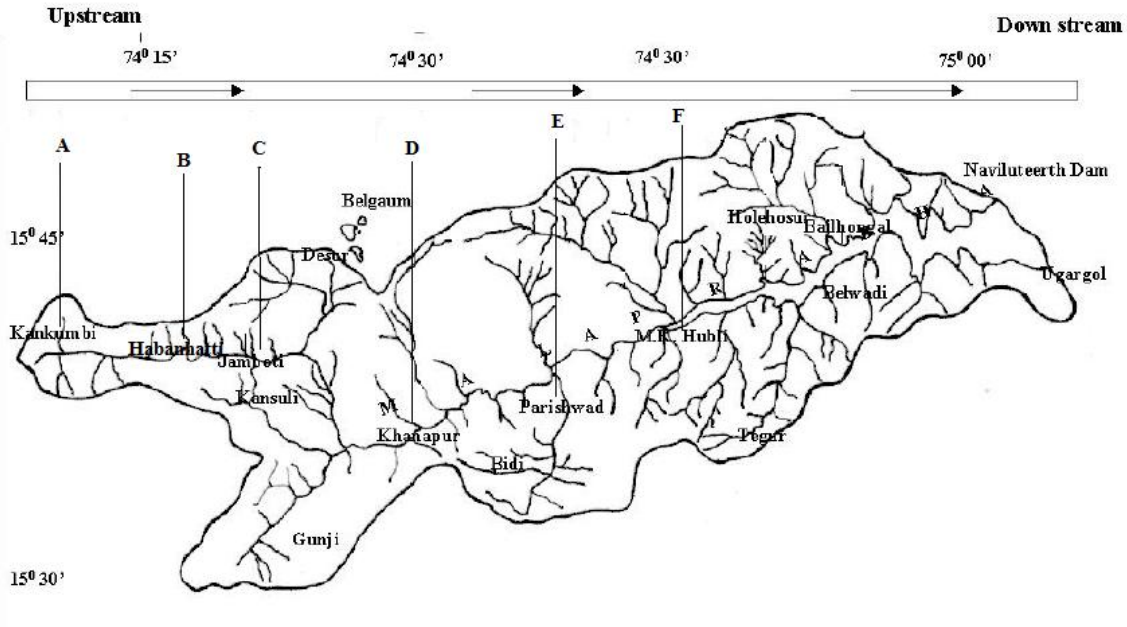
Ghataprabha river. The study further showed that although the water quality conditions are highly acceptable all along the river stretch but there is a significant increase in the DO with the increase in river flow. The study shows that water quality in the mining area gets affected due to large quantity of sediment discharge. According to the various study reports, India is facing an acute problem of water quality in many parts of the country. Therefore, it is appropriate to look into the current issues of water quantity and quality on the basis of major river basins and urban belts. In this connection, Malaprabha sub-basin in Belagavi district of Karnataka has been studied for major cations present in the river water. According to the various investigators, it is reported that there is a large scale variation of rainfall from the head water catchment to dam site (approximately the rainfall varies between 5000 mm to about 500 mm) and also there is a wide variation in land use/land cover all along the study area. This kind of situation will result in ecological imbalance in the stream channels thereby reducing the existence of fishes, flora and other fauna. In order to maintain the ecological health of the river basin it is quite essential to assess the existing quality of water flowing through the river at different stretches so that appropriate methods may be suggested to improve the quality of water.

The present investigation showed that there is a further increase in agriculture area and also change in cropping pattern. The catchment area of the Malaprabha dam is about 3000 sq.km with a semi-arid climate in major part of the catchment. The district is underlain by gneisses, schist, limestone, sandstone, basalts, alluvium etc. of Archaean to Recent age. Geologically, Malaprabha catchment is covered by gneisses, schists, quartzite and sandstone. The important soil types found in the study area may be classified into red soils and black soils. Red soils are mainly seen in Khanapur and Saundatti taluks where as black soils are distributed in Bailahongal taluk. These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions.

MATERIALS AND METHODS

Six Surface water sampling stations were identified along the stretch of Malaprabha river which extends between Kankumbi in the west to Saundatti in the eastern part. River stretches were divided based on the local factors such as land use/land cover changes, human interference and agriculture impacts. This was done in consultation with National Institute of Hydrology, Belagavi. Water samples were collected during the pre-monsoon and post-monsoon seasons of 2013 and 2014.



A= Kankumbi, B=Habanhatti, C= Jamboti, D = Khanapur, E = Parishwad, F= M K Hubli.

Description of the study area

River Malaprabha originates in the mountains of Sahyadri at an altitude of 792.4 meters in a small village, Kanakumbi which is located at about 16 km west of Jamboti village of Khanapur taluka in Belagavi district, Karnataka, India. River Malaprabha flows a distance of 304 km and joins river Krishna at Kudalasangam (Bagalkot district of Karnataka). Malaprabha basin in Belagavi district, Karnataka, is one of the water deficit sub-basins in the Krishna River Basin. Total area of the Malaprabha basin till it joins the main Krishna river is 11549 sq.km. The Malaprabha reservoir was commissioned in 1974 and has a gross storage capacity of 1070 MCM and a live storage capacity of 830 MCM. The irrigated region in the Malaprabha catchment has increased from 10% in 1970s to 30% of the total cultivable land in 2003 (Statistical Abstract, Government of Karnataka, 2004) and the observations during

Preservation of samples and analysis were carried out as per the standard procedures specified by APHA (2005). The parameters analysed were pH, EC, TDS, various analytical procedures for the purpose of different parameters were adopted to get the satisfactory results.Calcium, magnesium, sodium and potassium are the cations taken for the study.

RESULTS

pH

pH is the measure of the intensity of acidity or alkalinity in water. The pH value of the surface water of Malaprabha river was found to vary between 5.5 and 6.36 with a mean value of 6.03 in 2013 and in the year 2014, it varied between 4.92 and 5.34 indicating higher acidity of the water during pre-monsoon. The standard deviations were 0.28 and

0.25 in the year 2013 and 2014 respectively. In the post monsoon 2013, pH value varies from 5.17 to 5.93 with a mean value of 5.62. The standard deviation was 0.26. In the post monsoon 2014, pH value varies between 6.64 to 7.61with a mean value of 7.2. The standard deviation is 0.337.

Electrical Conductivity (EC)

Electrical conductivity is one of the primary parameter which gives an overall assessment of the water quality of a given environment. In the present investigation, it is observed that EC of surface water during pre-monsoon, 2013 varies between 33.44 and 668.80 (micromhos/cm), with a mean value of 280.06 and standard deviation 304.27. During post-monsoon 2013, also a wide variation in EC values were observed. It varied from 31.16 to 623.20 with a mean value of 260.97 and standard deviation 283.53. Further observations taken during 2014 pre-monsoon and post monsoon showed that the EC varies from 29.64 to 592.80 (mean value 248.24 and standard deviation 269.70) and 40.0 to 800.0 (mean 335.0 and standard deviation 363.96).

Total Hardness (TH)

Total hardness in the study area during pre-monsoon 2013 varies between 16.72 and 56.85 mg/l. The mean TH is 31.49 mg/1 and standard deviation 13.47. During post-monsoon 2013, it varies from 7.30 to 44.97 mg/l. The mean Total hardness is 27.03 mg/1 with a standard deviation of 13.10. During pre-monsoon 2014, the variation observed was between 11.00 and 50.39 mg/l with a mean value of 25.79 mg/1 and standard deviation 13.82 mg/1. In the post-monsoon 2014, TH varied between 20.00 and 68.00 mg/l. The mean value is 37.66 with a standard deviation of 16.12.

Calcium and Magnesium

The Calcium and Magnesium concentration in the study area during pre-monsoon 2013 Ca varies between 5.34 to 16.72 mg/1 and Mg varies between 1.79mg/l to 5.04mg/l. The mean of Ca 11.645 mg/l and Mg is 3.18 mg/l. Standard deviation of Ca is 4.60 and Mg is 1.274. During post -monsoon 2013 Ca varies between 5.12 mg/l to 15.58 mg/1 and Mg varies between 1.67mg/l to 3.90mg/l. The mean of Ca 10.41 mg/l and Mg is 2.828 mg/l. Standard deviation of Ca is 4.66 and Mg is 0.87 during post -monsoon 2013. During pre-monsoon 2014 Ca varies between 4.96 to 14.82 mg/1 and Mg varies between 1.59mg/l to 3.81mg/l. The mean of Ca 9.91 mg/l and Mg is 2.70 mg/l. Standard deviation of Ca is 4.41 and Mg is 0.854. During post-monsoon 2014 Ca varies between 7.00 to 20.00 mg/1 and Mg varies between 2.70 mg/l to 5.44 mg/l. The mean of Ca 13.933 mg/l and Mg is 4.465 mg/l. Standard deviation of Ca is 5.70 and Mg is 1.04. The calcium distribution shows a gradual decrease in the concentration of calcium from Kankumbi to Parishwad during pre and post monsoon 2013 and pre monsoon of 2014. However at M K Hubli there is a considerable increase in the concentration of calcium. This is mainly due to the rapid developmental activities taking place at M K Hubli. Calcium concentration increases dominantly at all the sampling stations during post monsoon 2014. Magnesium distribution decreases from Kanakumbi to Habanhatti during pre monsoon and post-monsoon season of 2013 and 2014. However, there is an increase in magnesium concentration from Jamboti to M K Hubli (except at Khanapur in pre-monsoon 2013) during both the seasons of 2013 and 2014.

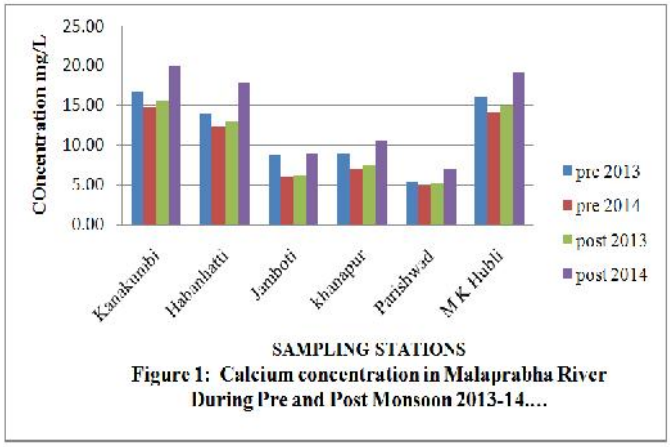


Figure 1: Calcium concentration in Malaprabha River During Pre and Post Monsoon 2013-14....

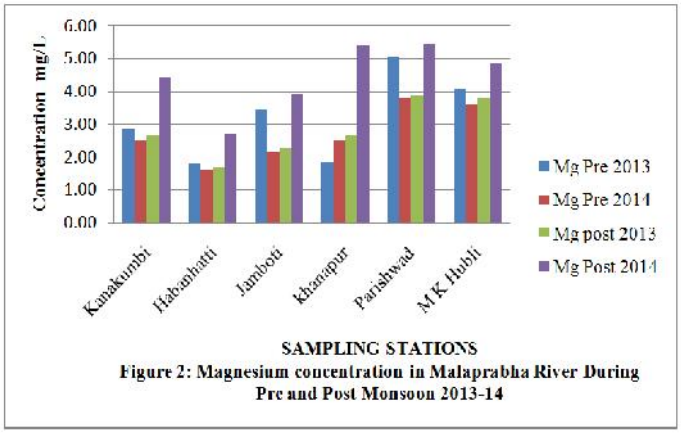


Figure 2: Magnesium concentration in Malaprabha River During Pre and Post Monsoon 2013-14

Sodium

Sodium is an important parameter which has a direct impact on salinity of drinking water. The present observations of Malaprabha river water indicate that the concentration of sodium is quite low in all the stations. However, there are marginal spatial variations from upstream to downstream. Maximum concentration (13.9 mg/l) was found in Kankumbi whereas minimum was noticed at Jamboti and Parishwad during pre-monsoon 2013. Further, the concentration of sodium remains almost constant during post-monsoon 2013 and pre-monsoon 2014. The concentration of sodium increases dominantly during post-monsoon 2014.

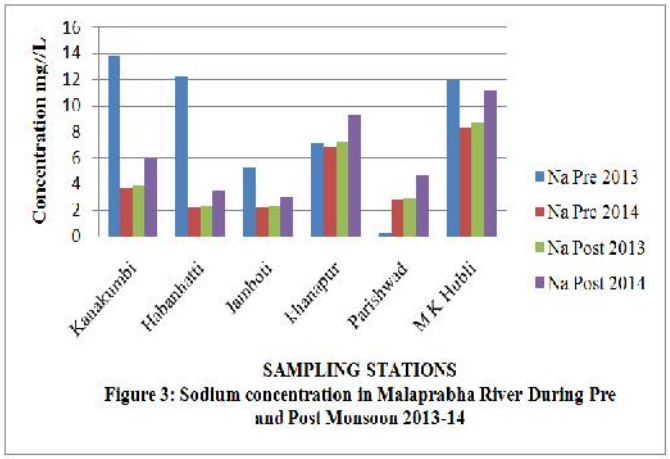


Figure 3: Sodium concentration in Malaprabha River During Pre and Post Monsoon 2013-14

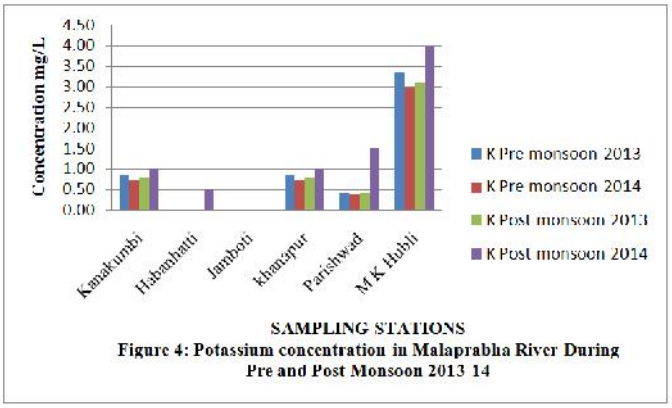


Figure 4: Potassium concentration in Malaprabha River During Pre and Post Monsoon 2013 14

Potassium

The distribution of potassium shows that, there is no significant change all along the river stretch of Malaprabha. The concentration of potassium is negligible at Habanhatti and Jamboti in all the seasons. However at M K Hubli the concentration of Potassium increases during pre and post monsoon of 2013 and 2014. The marginal increase of concentration at M K Hubli could be attributed to the extensive agriculture activities on the banks of Malaprabha.

Sodium Adsorption Ratio

The sodium hazard is typically expressed as the Sodium Adsorption Ratio (SAR). The SAR quantifies the proportion of sodium to calcium and magnesium ions in a sample. There is a significant relationship between SAR values of irrigation water and the extent to which sodium is engrossed by the soil. When the SAR and Specific conductance of water are known, the classification of the water for irrigation and drinking can be done.The Sodium Adsorption Ratio (SAR) were estimated at different sampling stations using the following formula

$$\text{Sodium Adsorption Ratio } (SAR) = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$$

The suitability of surface water at various stations were evaluated using Sodium Adsorption Ratio and were categorised based on salinity hazards. From the study it is concluded that the water falls in the category of Excellent which can be used for drinking and irrigation purposes.

Sodium Adsorption Ratio for the Pre and post monsoon 2013

Sodium Adsor ption Ratio (SAR) in epm	Water Class	No. of Water Samples	
		Pre-monsoon	Post-monsoon
Less than 10	Excellent	4.43	1.29
Less than 10	Excellent	4.35	0.86
Less than 10	Excellent	2.13	1.13
Less than 10	Excellent	1.32	3.22
Less than 10	Excellent	0.06	1.36
Less than 10	Excellent	1.19	2.85

Sodium Adsorption Ratio for the Pre and post monsoon 2014

Sodium Adsor ption Ratio (SAR) in epm	Water Class	No. of Water Samples	
		Pre-monsoon	Post-monsoon
Less than 10	Excellent	1.26	0.49
Less than 10	Excellent	0.32	1.09
Less than 10	Excellent	1.10	1.18
Less than 10	Excellent	3.14	3.29
Less than 10	Excellent	1.31	1.89
Less than 10	Excellent	2.78	3.23

Conclusion

The water quality analysis carried out during the pre-monsoon and post monsoon seasons of 2013 and 2014 shows that there is a gradual decrease in calcium concentration from upstream to downstream. The maximum was observed at Kankumbi and minimum at Parishwad. The highest concentration observed at Kankumbi could be attributed to the increase in sediment concentration found during the study period. The high concentration was mainly due to the manmade activity, i.e. a canal work was ongoing to connect Mahadayi to Malaprabhariver. However, in the downstream of M K Hubli, the increase could be due to reasons such as agriculture inputs and urban activities related to road construction and transportation activities. Though the river water is not found to be disturbed based on the water quality parameters, the present study will as act as a baseline data of water quality of river Malaprabha which is under severe threat by human activity.

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