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Water Quality Analysis of the Subarnarekha River in Jharkhand, India

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Abstract

Surface water is of the utmost importance in the physiological, social as well as economic life of man. However, it is very vulnerable to pollution because of its easy accessibility for disposal of wastewater, dumping of waste matter from fields as well as discharge of industrial affluent (Carpenter et al., 1998; Jarvie et al., 1998). Both the natural processes as well as anthropogenic influences may lead to water quality degradation. As rivers constitute the main inland water resources for domestic, industrial and irrigation purposes, it is imperative to prevent and control river pollution and gather reliable information on its quality for effective management (Singh et al, 2004). All these have been addressed in the current article.

Introduction

In India, under the National Rivers Conservation Program, water quality of all major rivers is regularly monitored at several sites for a large number of physico-chemical, bacteriological and hydrological parameters (MINARS Report, CPCB, 2008). It involves a huge amount of financial input and there is a need to optimize these monitoring networks and the number of water quality parameters enumerated (Massert et al., 1998).

The Study Area

The Subarnarekha River rises near Nagri village (23˚19´N, 85˚11´E) in the Ranchi district of Jharkhand. Of its total length of 395 km the lion's share of 269 km is in Jharkhand, 64 km in West Bengal and 62 km in Bihar. The river drains a total area of 19,296 sq km. The bed of the River Subarnarekha is believed to contain traces of gold (hence the name which literally means the *golden line*) It is also a ready indicator that the stream contains many metals, minerals and other substances in its churning waters (Mukhopadhya, 1980).

The river is basically a rainfed peninsular river with the wet months being from June to September. Stretches of the River in its upper course remain more or less as dry, stagnant pools often highly charged with pollutants, particularly during dry periods. The Subarnarekha and its tributaries are the main source of urban water supply with the ground water resources of the region still under-utilized (MINARS Report, 2008). Some of the important towns along its course are also significant industrial centres. None of the towns except partly for Jamshedpur and the Tatanagar Railway Colony have wastewater treatment worth mentioning (MINARS Report, 2002).

The River Subernarekha's course from Hatia (23˚41´ N, 85˚16´ E) to Bahragora (22˚16´ N, 86˚43´E) in Jharkhand has been identified as a polluted river stretch under the proposed National River Action Plan (Central Pollution Control Board, India). Data avaiable on the polluted stretches (MINARS Report, CPCB, 2000) shows that the water quality of the Subernarekha River has deteriorated mainly due to discharge of untreated, domestic and industrial effluents into it.

Objectives

The major objective is to perform a temporal analysis of water quality parameters of the Subarnarekha River flowing within the Jharkhand state for different stations using various statistical computations and assessment to find whether it is fit for human consumption.

Methodology

Required data were gleaned from the Central Pollution Pollution Control Board (CPCB) that compiled *Monitoring of Indian National Water Quality Series* (MINARS) publication series - 'Status of Water Quality', for the years 1980-1989, 1994-1998, 2000, 2002, 2006-2008 for the stations Ranchi (Tatisilwai) (23˚ 20'N, 85˚18'E) in Ranchi district, Jamshedpur (22˚48'N, 86˚12'E) and Jamshedpur (Tata Nagar) (22˚48'N, 86˚12'E) in Saraikela-Kharsawan district and finally Chandil Bridge (22˚57'N, 86˚03'E) in East Singhbhum district, all located within Jharkhand. The major parameters usedin the current analysis are—

a. Dissolved Oxygen (DO):

The DO test measures the amount of life-sustaining oxygen dissolved in the water (Mishra et al, 2008). Natural waters in equilibrium with the atmosphere will contain DO concentrations ranging from about 5 mg per litre (mg/l) to 14.5 mg/l depending on other factors such as water temperature, salinity and altitude. The DO concentrations reflect plant and animal activities that consume oxygen. DO determines the biological changes brought by such aerobic as well as anaerobic activities. The optimum value for good water quality is 4 mg/l to 6 mg/l of DO (Mishra et al, 2008).

b. Biological Dissolved Oxygen (BOD):

The BOD is the measure of the amount of food for bacteria that is found in water for their sustenance (Sawyer et.al, 2003). Normal Range of BOD in rivers is 4 mg/l to 10 mg/l.

c.Coliform Bacteria:

Coliform bacteria are a commonly used bacterial indicator of sanitary quality of food and water (American Public Health Association, 1995). They are found in aquatic conditions, in soil and vegetation as well as in faeces of warm blooded animals. Their presence indicates that other pathogenic organisms such as bacteria, viruses or parasites may be present which may cause serious illness in humans.

d. Total Dissolved Solids (TDS):

This is the measure of solid materials dissolved in the river water and includes salts, some organic substances and toxic materials (DeZuane, 1997). The amount and nature of dissolved and undissolved matter varies greatly. Water with higher solid content have laxative-like stubstances. TDS consists of oxygen demanding waste, disease carrying pathogens, which can cause immense problem to public health and organo-chlorinated pesticides such as DDT are some of the very toxic compounds. Exposure to them in high doses can affect the central nervous systems in human beings causing paralysis of the tongue, lips and facial muscles, skin irritability and dizziness. The presence of synthetic organic chemicals (fuels, detergent, paints and solvents) impart objectionable and offensive tastes, odour and colour to fish and aquatic plants.

e. Turbidity:

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particles (Environmental Protection Agency, 2005).The more there are total suspended solids in water, the murkier it seems and higher is the turbidity. It is useful in water quality measurement as it provides an estimation of Total Suspended Solids (TSS) which is otherwise a tedious and difficult parameter to measure.

f. Effects of other Elements:

Concentration of calcium and magnesium causes hardness of water where as chlorides provide some salty taste to water and excessive concentrations lead to laxative effects in human beings. The level of nitrate concentration is an important factor in public water supply because if it exceeds 45 mg/l, it may cause blue-babies syndrome (Mishra et al, 2008).The nitrate concentration in a river is associated with solution of fertilizers in water and contamination from human and animal wastes. Sulphates are indicators of the Hydrogeology and the solution of fertilizers in water.Calcium is an important element in influencing flora of the ecosystem and plays a very important role in the metabolism and growth of aquatic plants and animals.

g. PH:

This helps in the determination of acidity and alkalinity of water. pH of pure water is about 7 at 25^{0}C (Bates,1973). When the water is acidic its value is less than that of pure water and when it is basic pH is greater than 7. Excessive acidity or alkinity is not good for human consumption.

Horton's Index (1965) for water quality assessment has been computed as follows:

Step I: *Assigning of Weightage*

Unit Weight (W_n) = $W_t / \sum W_t$ ....(i)
W_n = 1 and W_t = temporary weight given to nth parameter

Weightage is given to individual parameters on the basis of their relative importance (Table - 1). A maximum weight of 4 is given to most important parameters like DO, Coliform, pH on the basis of their importance associated with human consumption as an excess of these above safe limits can cause severe illnesses in humans while a minimum weight of 1 is given to least important parameters such as hardness, alkalinity and chlorides (Horton, 1965).

Step II: *Calculation of Water Quality Index*

$WQI = \sum W_n.Q_n / \sum W_n$ .... (ii) or

$WQI = \sum W_n . Q_n$ as $\sum W_n = 1$ ………………..(iii)

Where, WQI = Water Quality Index; W_n = unit weight of n^{th} parameters; Q_n = sub-index of n^{th} parameter

Every parameter has been rated by Horton (1965) on the basis of traces detected in water (Table - 2). The ranges are different for the different parameters. The rating values range between 0 and 100. This rating value and the weightage assigned for each parameter is multiplied and summed up separately for each station to get the Water Quality Index (WQI) for that particular station.

Horton's method (1965) has been further modified and worked with so that different situations in different rivers can be more aptly captured and shown with precision. One such Index as devised by Tiwari and Mishra (1985) for Indian Rivers is a modification of Horton's Index but incorporates more parameters and is complicated as it tries to calculate the geometric mean of the indicators. However individual pollution parameters differ and Horton's generalized index gives an overall analysis of water quality prevalent in the river. Every parameter has been rated by Horton (1965) on the basis of traces detected in water (Table - 3). The ranges are different for the different parameters. The rating values range between 0 and 100. This rating value and the weightage assigned for each parameter is multiplied and summed up separately for each station to get the Water Quality Index (WQI) for that particular station.

Results and Findings

The WQI for the four stations have been calculated for the individual years as following. Table IV and Table IV a is an example of how the calculation for the individual stations have been done. In this case calculation for Ranchi has been shown. Table Va, Vb and Vc shows the final result for the WQI Values for the other three stations which are Tata Nagar, Jamshedpur and Chandil Bridge. According to Horton's method of computing the Water Quality Index, it is seen that at all four stations the measurments show moderately contaminated water as well as severely contaminated or poor quality water. This has been observed on a temporal scale as well (Fig. 2). However, all the four Stations have recorded some improvement in the Water Quality over the years as they have moved from Class D to being Class C. However they are still poor when compared to the ICMR requisite standards of Class A or Class B for human consumption.

Traces of elements found in the water may be accounted by the presence of different mines in and around the area (Fig.3). Minerals and ores such as limestone, copper, lead and uranium are mined in this area (Fig.3 and Fig. 8). TDS is greater than 300 mg/l in the case of the Subarnarekha River which is higher than what is normaly observed for most rivers (Negrel and Lemiere, 2007). The presence of the different dissolved minerals bears testimony to the fact that the slag deposits from the different industrial units are dumped into the river water, polluting it severely (Bhusan et al., 2008).The figures (Fig.4, Fig.5, Fig.6 and Fig.7) show the dissolved mineral concentration at different stations during the studied time period. Calcium, sodium, magnesium and chloride concentration is high for almost all the years possibly due to slag deposits dumped into the river from various plants operating in this region (Bhusan et al., 2008).

The safety limit of minerals in the water along with the averages that are seen in the stations is given in the following table (Table VI). It can be stated that the dissolved minerals seen in the water are much less than the permissable amount both by World Health Organisation (WHO) standards and also by Indian Standard (IS) specifications for drinking water. Thus they do not pose a serious health hazard. Study and measurement of Water Quality at different reaches of the Subarnarekha River thus form a very important aspect for ensuring proper health of the inhabitants of this region and their economic prosperity. However, just looking into river water quality does not give an insight into holistic river basin development. In this regard, water resources can be perceived from two perspectives: as an economic resource as well as an environmental resource (Gupta and Mitra, 2004).

Water resources are often exploited keeping the former in mind whereas the latter is given less importance causing serious repurcations as discussed above. Water Management through the monitoring of both quality as well as quantity thus becomes important. The Subarnarekha River is quite an important river passing through three states of Jharkhand, West Bengal and Orissa.

The Subarnarekha basin is marked by conflicts among the alternative uses of water because of the inadequacy of the total water supply (Gupta and Mitra, 2004). Thus it is important not only to study Water Quality but to incorporate within it ideas of water and power supply, building of dams, reservoirs for watered storage and irrigation. The improvement of the quality of water and its efficient usage is closely related to pricing of water supplies to various sectors: irrigation sector, mining sector and industrial water supply. Water becomes substitutable at high enough prices and such prices can provide powerful incentives for its conservation and recycling (Gupta and Mitra, 2004). Cost-pricing of water can be done from an integrated approach towards water resource management considering the quantity and type of water supply, quantity and quality of water demand, recycling and reuse of available water and the ambient pollution levels wherein such water quality testing, indexing and parameterisation as performed in this study assumes importance.

Water Quality Issues: A brief summary of the situation in Jamshedpur

Jamshedpur is also called the *Steel City* due to the establishment of the Tata Iron and Steel Company (TISCO) here in 1907 one of the largest and oldest steel plants in India. Over time, TISCO and a number of associated companies of the Tata Group have been established along with a number of ancilliary units. In the metropolitan area, there are 13 major industrial units, 16 medium industrial units and 472 small industrial units. Out of the total water withdrawn by industrial units in 1990, 57.5 million cubic meters (MCM) and around 66 MCM were for domestic and institutional uses respectively (Bhatia et.al., 1994). Currently water is pumped free of cost from the surface sources i.e. the Subarnarekha River and its main tributary, the Kharkai. This water is not allocated for use in agriculture and is mostly used by the industrial units. TISCO is the major user of surface water as it pumps water from the Subarnarekha River for using in its own plant as well as selling it to its associated companies. The price for maintenance of the pump is lower in comparison to the revenue earned from supply of this water (Bhatia et.al., 1994). As to the type of effluents that are dumped into the Subarnarekha River, deteriorating the water quality are summarised as follows (Table VI):

industrial units in 1990, 57.5 million cubic meters (MCM) and around 66 MCM were for domestic and institutional uses respectively (Bhatia et.al., 1994). Currently water is pumped free of cost from the surface sources i.e. the Subarnarekha River and its main tributary, the Kharkai. This water is not allocated for use in agriculture and is mostly used by the industrial units. TISCO is the major user of surface water as it pumps water from the Subarnarekha River for using in its own plant as well as selling it to its associated companies. The price for maintenance of the pump is lower in comparison to the revenue earned from supply of this water (Bhatia et.al., 1994). As to the type of effluents that are dumped into the Subarnarekha River, deteriorating the water quality are summarised as follows (Table - 6).

As a result of the indiscriminate discharge of polluted effluent into the rivers, water quality has become unfit for drinking supply, aquatic life and recreation purposes. Water Quality, downstream of Jamshedpur shows high deterioration in terms of water quality parameters such as DO, BOD and faecal coliform (Bhatia et. al., 1994). However current situations have improved. Since the introduction of the Water Prevention and Control of Pollution Act in 1974, large and medium sized industries have started installing treatment plants for water pollution abatement. Currently, the town's water supply is managed by Jamshedpur Utilities and Services Company Limited (JUSCO) which was set up in 2003 to improve the quality of civic services in Jamshedpur. JUSCO provides water supply and waste water management in Jamshedpur, including treating raw water to meet World Health Organisation (WHO) norms. Raw water is extracted from surface water sources such as the Subarnarekha and the Kharkai and the volume of treated water is 55 million gallons per day (MGD). Other methods used by JUSCO along with Jamshedpur Municipal Corporation (JMC) and Jawaharlal Nehru National Urban Renewal Mission (JNNURM) are chlorination of the surface water and cleaning of the contaminated sediments of the rivers (JUSCO, Water and Sanitation Program, 2006).

Conclusion

Pollution has been a major cause in the decline of the water quality of the Subarnarekha River and this pollution is caused by effluent discharge and anthropogenic activities such as mining activities. Many important industries are located on the banks of the river and they have been a major source of the pollution.To bring about sustainability of the river environment, certain remedial measures need to be taken. Certain pollution control acts such as the Water Prevention and Control of Pollution Act of 1974 (Bhatia et. al., 1994) deals with the building of wastewater treatment plants. Such measures would lead to a fall in the TDS discharged into the river as well as lowering of the BOD and problems such as euthrophication will reduce. Cleaning up of contaminated riverine sediments may also be a good answer (Kraft, 2006; JUSCO ,WSP , 2006). This cleanup act usually faces resistance from industries and municipalities due to the high cost associated with wasterwater treatment (Kraft,2006). However it should be kept in mind that good quality water is a basic necessity for sustaning a healthy life in all aspects. Awareness has increased with more and more private public partnerships (PPP) working to provide clean and safe water to the people who are directly dependent on the river for their living (JUSCO, 2011). Capital Investments and Asset ownerships are owned by both the public and private enterprises (JUSCO, 2011). However, a lot more needs to be done in the case of the Subarnarekha River.

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References

1. American Public Health Association (APHA) (1995): *Standard Methods for the Examination of Water and Wastewater,* Washington DC.
2. Bates, R.(1973): *Determination of pH: theory and practise*, Wiley and sons.
3. Bhatia, R., Rogers, P., Briscoe, J., Sinha, B.,

Cestti, R. (1994): *Water Conservation and Pollution control in Indian Industries*, United Nations Development Programme (UNDP)-World Bank and Sanitation Programme Report.

4. Bhushan, C., Hazra, M. Z. and Banerjee, S. (2008): Sixth Citizen's Report (SOE-6) , *Rich Lands Poor People - Is 'Sustainable' Mining Possible?* CSRD, New Delhi.
5. Carpenter, S.R., Caraco, N.F., Correll, D.L., Howarth, R.W., Sharpley, A.N., Smith, V.H. (1998): Nonpoint pollution of surface waters with phosphorus and nitrogen. *Ecol. Appl*. Vol.8, pp. 559 - 568.
6. De Zuane, J. (1997): *Handbook of Drinking Water Quality* (2nd ed.), John Wiley and Sons.
7. Dwivedi, S.L. and Pathak, V. (2007) : A Preliminary Assignment of Water Quality to Mandakini River, Chitrakoot, *Indian Journal of Environmental Protection*, Vol. 27, No. 11, pp 1036 38.
8. Environmental Protection Agency (EPA) (2005): "National Management to Control Nonpoint Source Pollution from Urban Areas"; Ch. 7 and 8.
9. Gupta D.B. and Mitra, S. (2004): Sustaining Subernarekha Basin, *International Journal of Water Resources Development*, Vol 20, no.3 ,pp 431-444.
10. Horton, R. (1965): An index number system for rating water quality, *Journal of Water Pollution Control Federation*, Vol 37 pp. 300-306.
11. Jarvie, H.P., Whitton, B.A. and Neal, C. (1998): "Nitrogen and phosphorus in east-coast British rivers: speciation, sources and biological significance", *Science of the Total Environment*, Vol. 210 211, pp. 79 109.
12. Jamshedpur Utilities and services Company Limited (JUSCO) (2006): *Improving WSS Sevices through Private sector Partnerships*, The Water and Sanitation Program (WSP).
13. Jamshedpur Utilities and services Company Limited (JUSCO) (2011): *Experience on PPP in Urban Supply and sanitation sector.*
14. Kraft, E. M. (2006): Sustainability and Water Quality: Policy Evolution in Wincosin's Fox-Wolf River Basin, *Public Works Management and Policy*,Vol 10 no.202 , pp 202-213.
15. Latha, P. S, Rao, K. N, Kumar, P.V. R and Harikrishna, K (2007): 'Water Quality Assessment at Village level-A Case Study', Indian Journal of Environmental Protection, Vol. 27, no. 11, November 2007, pp. 996-1000.
16. Massart, D.L., Vandeginste, B.G.M., Deming, S.N., Michotte, Y., Kaufman, L., (1988): *Chemometrices: A Textbook*, Elsevier, Amsterdam
17. Mishra B.B, Chaturvedi G.B, Tewari D.D (2008): Water Quality Index and Suitability of water Kohargaddi Dam at District Balarampur, India , *Enviromedia* ,Vol. 27 no. 3, pp. 497-500.
18. Mukhopadhya S.C. (1980): *Geomorphology of the Subarnarekha Basin*, The University of Burdwan, Burdwan.
19. Negrel, P. And Lemiere, B. (2007): Hydrogeochemical processe, mixing and isotope tracing in hard rock aquifers and surface waters from the Subarnarekha River Basin, (East Singhbhum District, Jharkhand State, India), *Hydrogeology*, Vol 15, pp. 1535-1552.
20. Sawyer, C., McCarty, P., Parkin, G. (2003): *Chemistry for Environmental Engineering and Science*, McGraw- Hill, New York.
21. Tiwari, T.N. and Mishra, M. (1985): A preliminary assignment of water quality to major Indian rivers, *Indian Journal of Environmental Proceedings*, Vol 5 No.4, pp. 276-9.on Child Immunisation in the District of West Bengla, India, Singapore Medical Journal, Vol 51 (5), pp 406-412.

Table – 1: Weightage Assigned to different Parameters

Parameter	Weight Assigned	Unit Weight (Wn)
TDS (g / l)	2	0.09
Turbidity (NTU)	2	0.09
Total Hardness (mg/l)	1	0.05
BOD (mg / l)	3	0.14
DO (mg / l)	4	0.18
Total Alkalinity (mg / l)	1	0.05
pH	4	0.18
Coliform (NTU)	4	0.18
	22	1

Source: Horton, 1965

Table – 2: Ranges for Rating the Water Quality Parameters

Parameter	Range				
TDS	< 500	500 – 700	701 – 900	901 – 1000	> 1000
Turbidity	< 5	5.0 – 10.0	10.1 – 17.5	17.6 – 25.0	> 25.0
Total Hardness	< 300	300 – 400	401 – 500	501 – 600	> 600
Chlorides	0 – 50	51 – 100	101 – 150	151 – 250	> 250
BOD	0 – 1	1.1 – 3.0	3.1 - 4.0	4.1 – 5.0	> 5.0
DO	> 7	5.1 – 7.0	4.1 – 5.0	3.0 – 4.0	< 3
Total Alkalinity	21 – 50	16 – 20	11.0 – 15	5.0-10.0	< 5
		51 – 70	71 – 91	91 – 120	> 120
pH	7.0 – 8.5	8.6 – 8.7	8.8 – 8.9	9.0 – 9.2	> 9.2
		6.9	6.8	6.5 – 6.7	< 6.5
Coliform	<= 1	2.0 – 4.0	5.0 – 7.0	8.0 – 10.0	> 10
Rating (Q_i)	100	80	60	40	0

Source: Horton, 1965

Table – 3: Water Quality Classes based on WQI

WQI Values	Water Quality	Class
100	Permissible or Excellent for drinking purpose	A
99.99-80	Slightly Contaminated or Good for drinking purpose	B
79.99-60	Moderately Contaminated or Poor for drinking purpose	C
59.99-40	Severely Contaminated or Very Poor for drinking purpose	D
<40	Excessively Contaminated or Undesirable for Drinking purpose	E

Source: ICMR, 2007

Table – 4: Calculation of WQI at Ranchi Station using Horton's Method (Year 1980)

Parameters	Actual Value	Quality Rating	Unit Weight	$W_i \cdot Q_i$	WQI
DO	7.7	100	0.182	18.2	67.16
BOD	1.4	80	0.136	10.88	
pH	7.6	100	0.182	18.2	
Turbidity	165	0	0.091	0	
TDS			0.091	0	
Alkalinity	60	80	0.045	3.6	
Chloride	43	100	0.045	4.5	
Coliform	9.91	40	0.182	7.28	
Total Hardness	71	100	0.045	4.5	

Source: Computed by the author

Table – 4A: WQI Values and Classes for Station: Ranchi, Jharkhand

Year	WQI Value	Class	Remarks
1985	68.98	C	Moderately Contaminated or Poor
1986	56.28	D	Severely Contaminated or Very Poor
1987	64.44	C	Moderately Contaminated or Poor
1988	42.68	D	Severely Contaminated or Very Poor
1989	50.86	D	Severely Contaminated or Very Poor
1994	46.32	D	Severely Contaminated or Very Poor
1996	49.94	D	Severely Contaminated or Very Poor
1997	54.52	D	Severely Contaminated or Very Poor
1998	58.12	D	Severely Contaminated or Very Poor
2000	53.56	D	Severely Contaminated or Very Poor

Source: Computed by the author

Table – 5A: WQI Values and Classes for Station Tata Nagar, Jharkhand

Year	WQI Value	Class	Remarks
1980	67.16	C	Moderately Contaminated or Poor
1981	65.36	C	Moderately Contaminated or Poor
1982	57.18	D	Severely Contaminated or Very Poor
1983	45.36	D	Severely Contaminated or Very Poor
1984	57.2	D	Severely Contaminated or Very Poor
1985	58.1	D	Severely Contaminated or Very Poor
1986	67.16	C	Moderately Contaminated or Poor
1987	59.92	D	Severely Contaminated or Very Poor
1988	63.52	C	Moderately Contaminated or Poor
1989	59.02	D	Severely Contaminated or Very Poor
1994	41.68	D	Severely Contaminated or Very Poor
1996	57.2	D	Severely Contaminated or Very Poor
1997	60.84	C	Moderately Contaminated or Poor
1998	57.14	D	Severely Contaminated or Very Poor
2000	76.3	C	Moderately Contaminated or Poor

Source: Computed by the author

Table – 5B: WQI Values and Classes for Station Jamshedpur, Jharkhand

Year	WQI Value	Class	Remarks
1980	66.26	C	Moderately Contaminated or Poor
1981	76.46	C	Moderately Contaminated or Poor
1982	70.8	C	Moderately Contaminated or Poor
1983	70.8	C	Moderately Contaminated or Poor
1984	67.16	C	Moderately Contaminated or Poor
1985	67.16	C	Moderately Contaminated or Poor
1986	75.36	C	Moderately Contaminated or Poor
1987	68.98	C	Moderately Contaminated or Poor
1988	59.92	D	Severely Contaminated or Very Poor
1989	68.08	C	Moderately Contaminated or Poor
1994	76.26	C	Moderately Contaminated or Poor
1996	65.4	C	Moderately Contaminated or Poor
1997	59.1	D	Severely Contaminated or Very Poor
1998	64.48	C	Moderately Contaminated or Poor
2000	76.26	C	Moderately Contaminated or Poor

Source: Computed by the author

Table – 5C WQI Values and Classes for Station: Chandil Bridge, Jharkhand

Year	WQI Value	Class	Remarks
1985	58.98	D	Severely Contaminated or Very Poor
1986	59.88	D	Severely Contaminated or Very Poor
1987	59.02	D	Severely Contaminated or Very Poor
1988	65.4	C	Moderately Contaminated or Poor
1989	65.8	C	Moderately Contaminated or Poor
1994	69.02	C	Moderately Contaminated or Poor
1996	68.12	C	Moderately Contaminated or Poor
1997	70.04	C	Moderately Contaminated or Poor
1998	69.02	C	Moderately Contaminated or Poor
2000	69.02	C	Moderately Contaminated or Poor

Source: Computed by the author

Table – 6: Dissolved Minerals along with their Safety Limits

Minerals	Ranchi	Tata Nagar	Jamshedpur	Chandil Bridge	WHO standards (in mg/l)	IS Standards,1993 (mg/l)
Calcium	55.2	51.40	37.40	26.8		75 (can be extended up to 200)
Chloride	26.73	3.53	14.67	2.13	200- 300	250 (up to 1000)
Magnesium	29.53	28.47	57.87	17.40		30 (upto 100)
Sodium	17.80	8.93	11.40	5.33	200	
Sulphate	17.73	13.33	18.00	7.47	250	150 (upto 400)

Table - 7: Status of Industrial Discharge at Jamshedpur

Firm	Type of Waste	Outlet Point	Pollutants	Receiving Waterbody
TISCO	Acidic waste from pickling Fly ash laden plant From coke oven and blast furnace	Jugsalai Nala Ram Mandir Nala Susangarhia Nala	pH < 5 Suspended sediments Suspended sediments	Kharkhai / Subarnarekha
TELCO	From electroplating section, pickling wastes	Kumaria Nala	Cyanide, pH value less than 5, Grease, Oil, Chromic Acid	Subarnarekha
Tin Plate	From tinning plant and pickling	Open drain to Subarnarekha	Hexavalent Chromium Acid, Suspended Sediments, Oil, Grease	Subarnarekha
Others	Pickling plants and waste from washing	Open drain to Subarnarekha	Oil and Grease, Acid, Suspended Sediments	Subarnarekha

Source: UNDP and World Bank Report, 1994

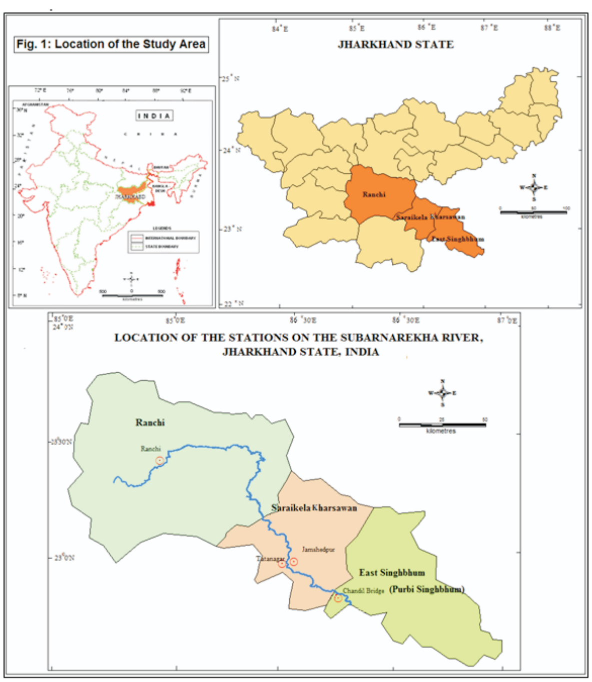

Fig. 1 : Location of the Study Area

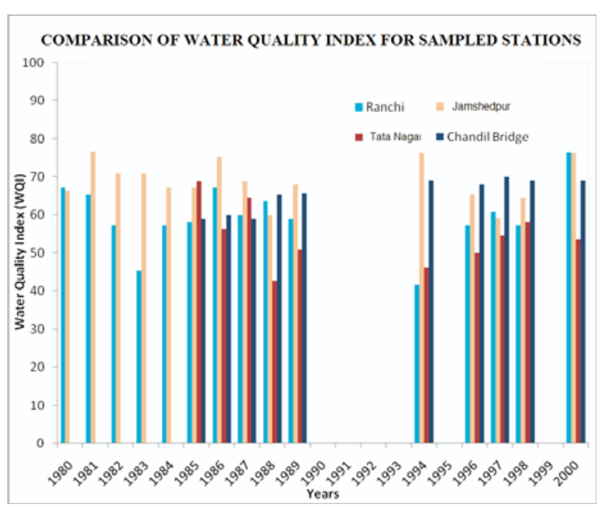

Fig. 2

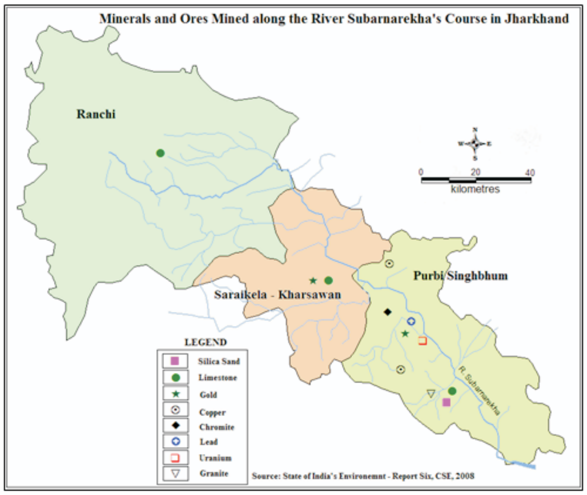

Fig. 3

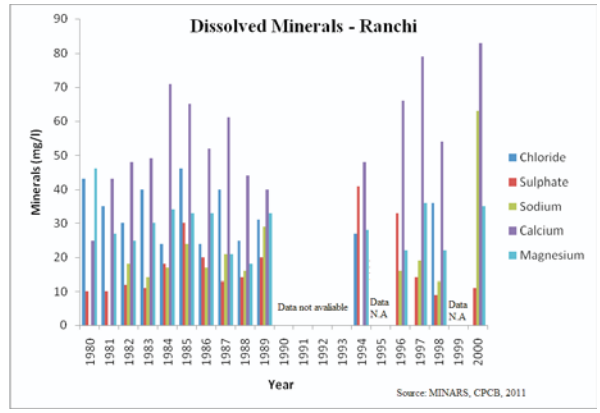

Fig. 4

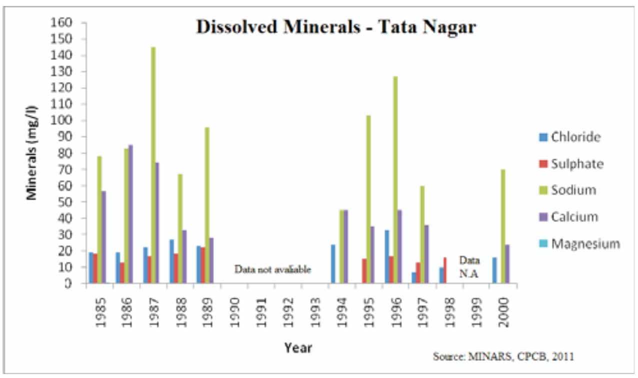

Fig. 5

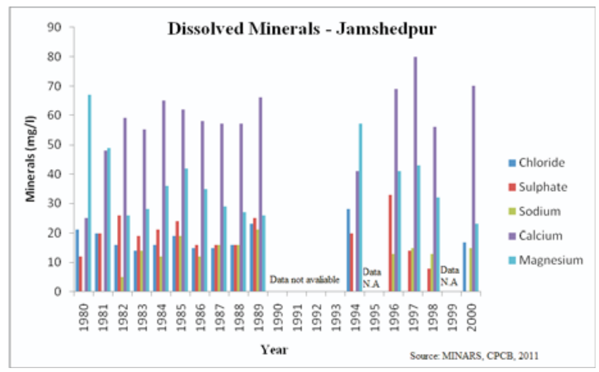

Fig. 6

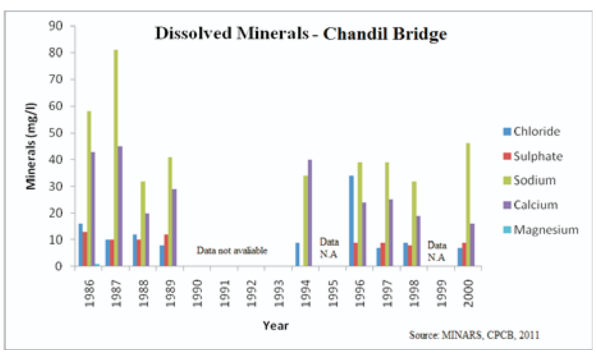

Fig. 7

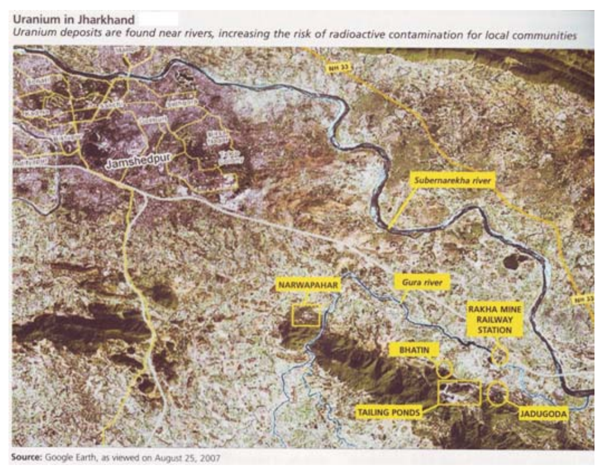

Fig. 8

Plate 1 and 2: Pollution of the Subarnarekha River from Copper Smelting at Moubhandar, Jharkhand

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