Study of water Quality in the Savitri River

Priyadarshani More

Assistant Prof. and Head, Dept. of Geography, Dr. Babasaheb Ambedkar ASC College, Mahad-Raigad

Abstract

Surface water is used for domestic, industrial, water supply and irrigation all over the world. Nature has given us plenty of water and even then we are feeling the shortage of water for drinking, washing, irrigation and industrial purposes because we have misused and decreased quality of our water resources to a great extent, which may cause harmful effects on human and aquatic life. In the present paper an attempt is made to study the water pollution in Savitri River basin in middle Konkan (Maharashtra). The present study has been carried on the pollution in River Savitri. Savitri is one of the highly polluted rivers in Konkan (Maharashtra).The total catchment area of the basin is 2899 km^2 and total length is about 99 km. It meets the creek known as Bankot creek. After the establishment of Mahad M.I.D.C. in 1982, the pollution of River Savitri became quiet severe. Near about 153 industries are working on in this M.I.D.C. zone. Among these total industries 70 are chemical industries. Half of these industries produce toxic effluents, hazardous pollutants as like HCL, S_2 SO_4 etc. So that the effluents of the industries are one of the aspect or cause of decreasing quality of water. Six samples from the field were analyzed to check the water quality parameters. Thus the probable reasons of Savitri River pollution's are domestic waste, accidental discharges from industries, washing of chemical tanks and unauthorized disposal of toxic hazardous waste on the bank of river and its vicinity.

Keywords: Water Pollution, Konkan, Savitri River Basin

Introduction

Surface water is used for domestic, industrial, water supply and irrigation all over the world. Nature has given us plenty of water and even then we are feeling the shortage of water for drinking, washing, irrigation and industrial purposes because we have misused and polluted our water resources to a great extent. Water pollution may be defined as alteration in the physical, chemical and biological characteristics of water, which may cause harmful effects on human and aquatic life. Natural Environmental Research Council (NERC, 1976), defined pollution as ''the release of substances and energy as waste products of human activities which result in changes, usually harmful within the natural environment. In India, water pollution has been taking place on a large scale and for a long time. Both surface and ground water bodies are polluted to a great extent. According to a report of NEERI, a staggering 70 % of the available water in India is polluted. The causes of water pollution in India are various but main causes are urbanization, industries, agricultural development activities particularly in relation to excessive application of fertilizers, withdrawal of water, religious and social practices etc. According to World Health Organization (WHO), about 80% of all the diseases in human beings are caused by water.

The present study has been carried on the pollution in River Savitri. Savitri is one of the highly polluted rivers in Konkan (Maharashtra). After the establishment of Mahad M.I.D.C. in 1982, the pollution of River Savitri became quiet severe. Thus the probable reasons of pollution in this river basin are domestic waste, accidental discharges from industries, washing of chemical tanks and unauthorized disposal of toxic hazardous waste on the bank of river and it's vicinity. Hence the present study is undertaken to understand the causes and effect of water pollution in Savitri River. Therefore six samples from the field were analyzed to check the water quality parameters. Nine water quality parameters were considered, these are- pH, B.O.D., C.O.D., D.O., Nitrate nitrogen, Conductivity, Amm.Nitogen, Fecal coli form and T.D.S. Each parameter is compared with W.H.O. and B.I.S. standards for the remarks.

Objectives

1. To study the causes of decresing quality of water in Savitri River.
2. To compare the quality of surface water with W.H.O. and B.I.S. standards

Study Area

The River Savitri is one of the important rivers among the coastal Maharashtra Rivers. It originates in the Aurthorsit Point at old Mahabaleshwar. Geographically, the Savitri River extends between 18^0 9'N to 73^0 40'E. The highest altitude is 1212 m above MSL and the total length is 90 km whereas total catchment area of basin is 2899 km$^{2.}$ Savitri is seventh Order River. Savitri meets to Arabian Sea at Bankot Creek near Devgad village in Shrivardhan tahasil.
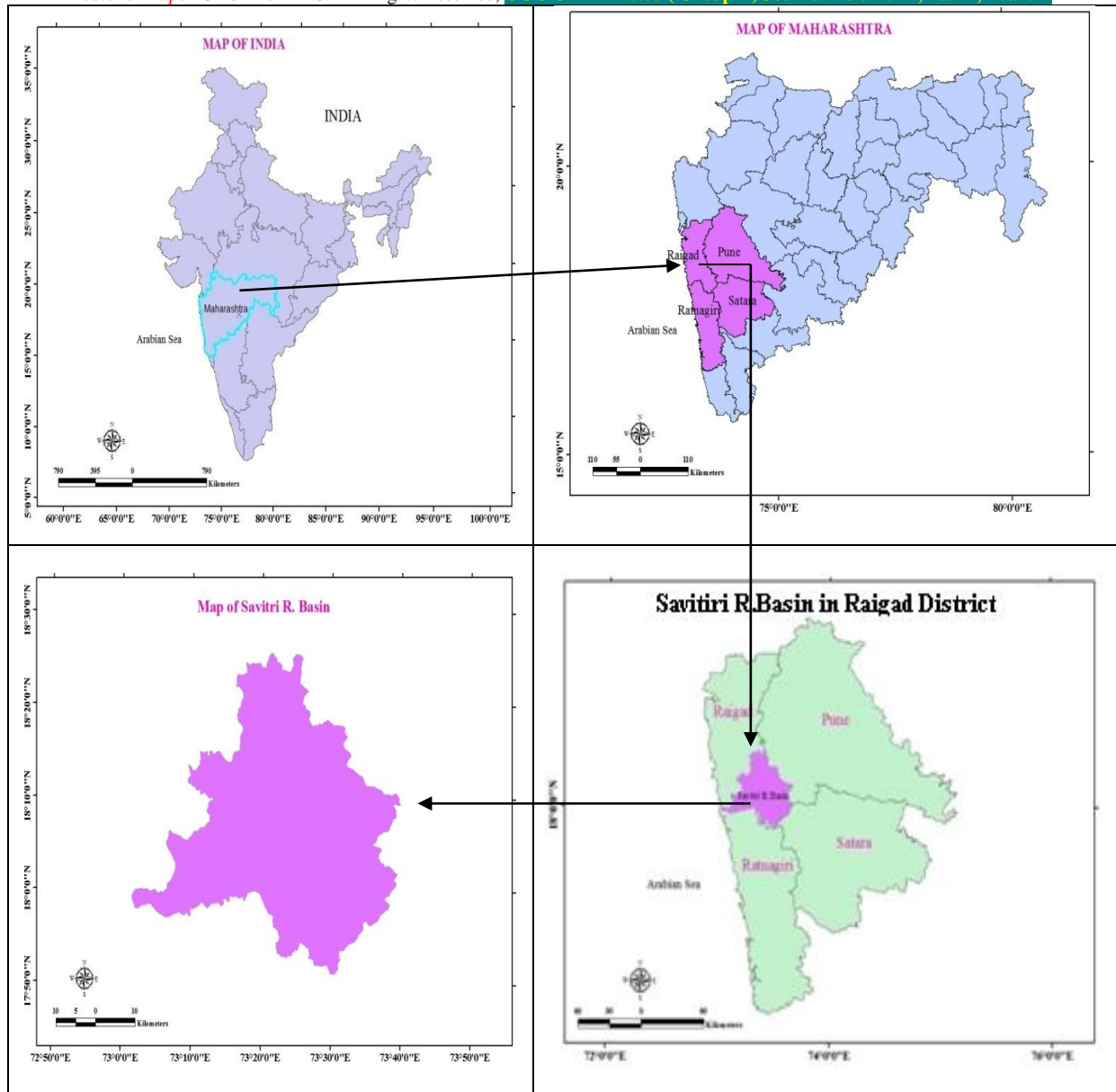
Location Map of Study Area

Physiography

The Savitri river basin lithologically belongs to Deccan Trap Basalt of upper Cretaceous to lower Eocene is the major rock formation. Most of this region is covered by basaltic lava flows of the Deccan Trap of upper cretaceous to Eocene age. It is traversed by several east-west trending ridges and their tributaries with steep to moderate gradients. Savitri basin is divided mainly in three districts i.e. Pune, Raigad and Ratnagiri. The basin is formed from the Deccan Trap which is predominating rock formation with small out crops of Laterite at a few places in the Poladpur taluka and Mahabaleshwar hill. The soils are grouped as Forest, Varkas, Rice, Khar or Saline, Coastal alluvium and Laterite as per the location and topographical situation. The basin has three physiographic divisions i.e. i) Coastal zone in west part ii) Hilly zone in the eastern part highly uneven in altitude and covered with forest. This hill range is characterized by ruggedness and uneven topography, with Crestline of peaks and saddles forming the eastern horizon.

Land sat TM digital data has used to prepare False Colour Composite (FCC) and Aster DEM map. FCC has been prepared by superimposing TM bands of 1, 2 and 3. Aster DEM map (Fig.) has been prepared by using digital contouring method. Both of these images are very useful to study and analysis physiography and major geographic features. Major geographic features in this basin are ridges, low lands, hilly terrains, oval shaped depression. In this basin upper reach part (near Mahabaleshwar) is covered by High peaks of Sahyadri hill ranges, its height is more than 1200 meters. According to 3DEM map, Mahad

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region is also highly hilly and traversed by numerous ridges. The trends of these ridges are N-S, NW-SE and E-W. These ridges are dissected by numerous 'V' shaped valleys. The oval shaped low land area in the Mangaon region is surrounded by hilly terrain. The Mangaon basin is distinct lineaments which are trending NWW-SSE. Dendritic drainage pattern is mainly seen in the most eastern part of Savitri river basin. This is located east of Mahad. The trellis drainage pattern dominantly seen in the central region of coastal belt, which is located west of Mahad. The major streams of trellis pattern are in the North-South direction. Trellis drainage pattern in this region indicates structurally controlled drainage. Thus the major tributaries of Savitri River which are in North-South direction are controlled by major weak plains which are trending nearly North-South direction. The variation in altitude from source to mouth is about 1212 meters to sea level.
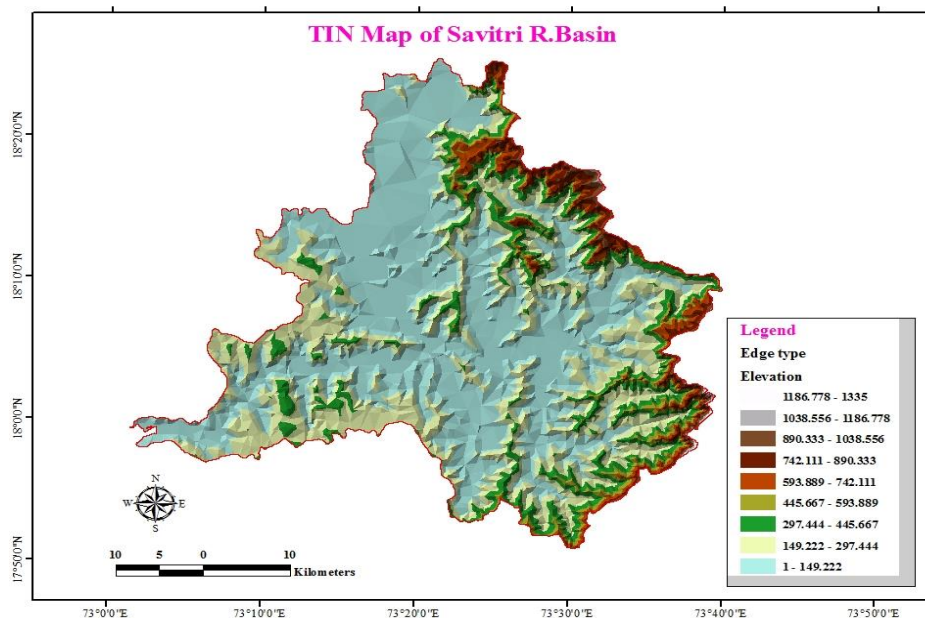
TIN Map of Savitri Basin

Database and Methodology

The following steps have been adopted to achieve above mentioned objectives

1. Study of SOI Topographical maps (1: 50000 scale) of Savitri drainage basin
2. Collection of data from the field
3. Data collection from the field having following details
(a) Equally distributed samples of River water i.e. from the source to confluence
(b) GPS locations of each water sample
(c) Hydrological characteristics of study area
4. Preparation of study area map with the help of SOI Toposheets
5. Laboratory analysis of Surface water samples
6. Comparison of the selected parameters with W.H.O. and B.I.S. standards
7. Find out the causes of water pollution and remedial measures suggested for the same.

Instead of collecting more samples of surface water, emphasis is given on the analysis of more number of water quality parameters. In the present study, almost all important physical and chemical water quality parameters have been analyzed to get an idea about the water polluted regions of the basin. All the values obtained from laboratory analysis were compared with standards set by World Health Organization (W.H.O.) and bureau of Indian Standards (B.I.S.) W.H.O. and B.I.S. standards. The results obtained are presented in table 1.

Results and Discussion

Six samples collected from the field were analyzed to check the water quality parameters. Nine water quality parameters considered, these are – pH, B.O.D., C.O.D., D.O., Nitrate nitrogen, Conductivity, Amm.Nitogen, Fecal coli form and T.D.S. Each parameter within the study area shows maximum and minimum values i.e. range and these values are compared with W.H.O. and B.I.S. standards for the remarks. Surfacewater quality parameters are discussed below (see table No. 1&2).

Surface water Quality of Savitri Basin

Water obtained from different sources is associated with a large number of impurities and gets contaminated with sewage and industrial waste or effluents when they are allowed to flow into running water or through percolation (Sarbhukan, 2001). Growing population and increased industrial as well as domestic waste in recent decades resulted in degradation of water quality in many rivers, lakes, and wells situated near the settlements. Clean water is a crucial resource for drinking, irrigation, industry, transportation, recreation, fishing, hunting, support of biodiversity, and sheer aesthetic enjoyment.

The quality of water could be in terms of color, odor, chemical and biological qualities. The surface water of the Savitri Basin has been analyzed in order to know its quality for different uses. Results obtained from the analysis of 06 water samples collected from the study area, have been discussed. For the present study only nine important chemical parameters were selected by having discussion with the expert in this field. These are pH, B.O.D., C.O.D., D.O., Nitrate nitrogen, Conductivity, Amm.Nitogen, Fecal coli form and T.D.S. Table 1 gives the standard specifications of the groundwater water quality parameters considered for the analysis.

W.H.O. and B.I.S. Specifications for Drinking Water

Sr. No.	Parameters (Except otherwise indicated all in mg/L or ppm)	Permissible Limits			
		W.H.O.		B.I.S.	
		Highest Desirable	Maximum Permissible	Highest Desirable	Maximum Permissible
1	pH	7.0 – 8.5	6.5-9.2	7.0 - 8.5	6.5 – 9.2
2	B.O.D.	2	3		
3	C.O.D				
4	Nitrate Nitrogen	10	-		
5	Conductivity				
6	Amm.Nitrogen				
7	D.O.	6	5		
8	Fecal coliform	1	-		
9	Total Dissolved Solids (TDS)	500	1000	500	1500
10	Alkalinity	< 100 mg/L for domestic purpose			
11	Hardness	100	500	300	600
12	Chloride (Cl)	200	600	200	1000
13	Sulphate (SO$_4$)	200	400	150	400

(**Source:** WHO, 1992, Tomar, 1999)

Water Quality at Different Locations

Name of the sample site	Quality Parameters (Except otherwise indicated all in mg/L or ppm)												
	pH	B.O.D.	C.O.D.	Nitrate Nitrogen	Conductivity	Amm.Nitrogen	D.O.	Fecal coliform	TDS	Alkalinity	Hardness	Chloride (Cl)	Sulphate (SO$_4$)
Ovale Village	7.39	2.4	24	3.13	336	0.3	7.19	4	296				
Shedav Doh	7.6	2.8	-	0.49	87	0.27	7.23	6	-				
Muthavali	7.41	3.2	-	0.68	92	0.24	7.04	4	-				
Dadali Bridge	7.59	4.2	-	0.6	134	0.25	6.82	4	-				
Nangalwadi	7.64	4.4	-	0.62	100	-	6.88	9	-				
Ambet	7.17	28.98	121.33	0.02	14431.8	-	5.144	-	13003.7	152	2828.8	1371.7	1362.1

(**Source:** Based on Secondary data)

The study is entirely based on the water samples from open wells that are used for drinking, domestic and agricultural purpose. The water samples collected to gauge their quality and the same have been analyzed in laboratory using standard analytical procedures.

In Savitri basin six samples were collected from various sites. These sites are Ovale village, Shedav Doh, Muthavali village, Dadali Bridge, Nangalwadi and Ambet. The results obtained from the analysis are presented in above Table.

pH

The pH is the hydrogen ion concentration, which expresses the intensity of an acidity or alkalinity of the water. The pH value is the negative logarithm of the concentration of hydrogen ions in moles per liter. The pH values of surfacewater in the area are in the range of 7.17 to 7.64 indicating that the surfacewater is *slightly alkaline*.

Alkalinity

The alkalinity of water is a measure of its capacity to neutralize acids. The alkalinity of natural water is due to the salts of carbonates, bicarbonates, borates, silicates and phosphates along with the hydroxyl ions in the Free State. The alkalinity value of surface water in this basin is in the basin is **152**. This value provide guidance in applying proper doses of chemicals in water & waste water treatment processes, particular in coagulation, softening and operational control of anaerobic digestion.

Conductivity (C)

Conductivity is a measure of ability of water to carry electric current. Pure water is a poor conductor of electricity. Overall concentrations of ions present in water that influences conductivity important ions that impart conductivity in water are:

I Anions: - CI^-, So_4^- Co_3^-, Hco_3^- and No_3^-

II Gat ions: - Ca^{2+} Mg^{2+} Na^+ +and K^+

Conductivity is used to estimate total dissolved solids in water. By multiplying conductivity with an empirical factor (Which is obtained from sample of known dissolved solid concentration and conductivities) the total dissolved can be estimated. (Abbasi, 1998) The conductivity values of surface water in the Savitri drainage basin are in the range of **87 to 14431.8.** As per W.H.O. and B.I.S., there is so specific standard value of conductivity.

Total Dissolved Solids (TDS):

The maximum dissolved concentrations in the water are called as total dissolved solids (TDS). In natural water TDS generally ranges from 10 to 30000 mg/ lit. Excess amount of dissolved solids result in to high osmotic pressure. It causes unbalance of osmotic regulation and suffocation of the drain water. The TDS value of surface water in the Savitri drainage basin at Ambet is **13003.7 mg./lit**.

Hardness:

Water hardness is the traditional measure of the capacity of water to react with soap. Hard water requires a concentration amount of soap to produce a lather or foam. Scientifically hardness is defined as the concentration of multivalent metallic cat ions in solution. The hardness of water reflects the nature of geological formation with it has been in contact. The hardness value of surface water in the Savitri basin is **2828.8 mg/liter** at Ambet point indicates that the water is **slightly medium to hard** in nature.

Chlorides:

Chlorides are a natural substance present in all potable water and usually occurring in sewage as metallic salt. Concentration in fresh water is quite low and generally less than of sulphate and bicarbonates. It is found that about 8_15 grams of sodium Chloride (NaCl) is extracted by a person per day (Maiti, 2004). Chloride can be removed biologically in treatment of water, as it highly soluble with cat ions and does not sediment and precipitates. The chloride values concentrations among groundwater in this basin ranges between **13.254 to 17.986 mg/liter**.

Nitrates (NO$_3$):

Nitrates are widely present in substantial quantities in soil, in most waters and in plants, including vegetables. High level of nitrates concentration (>40mg/lit) may cause blue baby disease. Nitrates have greater affinity for hemoglobin in the blood stream than does oxygen, a condition is known as methemoglobinemia (Maiti 2004). The nitrate concentration range is 1.896 to 2.435 mg/liter is observed in the Savitri basin.

Sulphates (SO$_4$):

The sulphate ion is one of the major anions occurring in natural water. Sulphate may be present in natural water in concentrations ranging from a few to several thousand milligrams per liter. It is important in drinking water because of its cathartic effect upon humans when present in excessive amount. Sulphate

is one of the least toxic anions. The sulphate values of groundwater in the basin are in the range of 11.245 to 15.624 mg per liter.

The analysis of water samples collected from open wells reveals, pH value ranging from 7.2 to 7.64 that is within the range of permissible limit. The electric conductivity (EC) denotes the characteristics feature of water as a medium of the passage of electricity. The EC measured for all the samples at ambient temperature, ranges from 125 to 272 μS/cm indicating that the water can be used for drinking purpose in the Savitri Basin. In case of Alkalinity, the value ranges from 72 to 95 mg/L. It indicates that salts like carbonates, bicarbonates, phosphates along with hydroxyl ion are in a free state which is not so hazardous to drinking purpose.

As regards the hardness of the water, the value doesn't exceed desirable and maximum permissible limit of 500 mg/L. All the values are below 150, indicating that the water possesses temporary hardness and is suitable for drinking purpose. Chloride and Sulphate, Nitrate content in all samples is also within the range of permissible limits. Quantity of total dissolved solids in all samples is below highest desirable limit of BIS.

Majority of the samples analyzed fall in the permissible range with the exception of doubtful to unsuitable groundwater occurring in the alluvial tracts of lower reaches of the Savitri Basin. The analyzed data also reveals that the upper reaches of all four sub basins can be categorized in moderate to good quality of water. The low lying valley plains, lower reaches of the rivers and the wells located near to alluvium may be getting polluted from the pesticides and fertilizers used by farmers.

From the foregoing analysis of the well water, it is important to note that it requires further research work that will enlighten on the details of pollutants and causes of pollution.

Conclusions

In the present study of water quality of Savitri River, almost all values of water quality parameters are within the limits of W.H.O. and B.I.S. standards. There is an increasing trend of all values of analyzed parameters from source of Savitri River to its confluence with river Gandhari and Kal. Though the quality of water is within the permissible limits, there is gradual increase in Hardness, TDS and nitrate content in water due to application of pesticide and fertilizers in agricultural fields in post-monsoon season. Contaminated water from agricultural fields percolates into nearby wells, which are used for drinking and domestic purposes.

Recommendations

1. Domestic and industrial sewage should not be allowed to enter in the river wells as well as nearby wells.
2. Landfills along the bank of river, wells and other places should be designed scientifically.
3. To encourage the Grampanchayats and Panchayat Samities for the development of green belt along the bank of the river Shivganga and its tributaries.
4. Mass awareness should be generated about the quality of water.

References

1. **Abbasi, S. A.** (1998). 'Water quality-sampling and Analysis. Discovery Publishing House, New Delhi.
2. **Babar, Md.** (2005). Hydrogeomorphology, Fundamentals, Applications, Techniques, New India Publishing Agency, New Delhi.
3. **Maiti, S. K.** (2004), Hand book of Methods in Environmental Studies (Vol-I: Water and waste Water Analysis).
4. **Sankara, P.** (1995). Groundwater. Edited by P. Sankara. Pitchaiah, Scientific Publishers, Jodhpur, India.