

# Water Quality Index of Mahi River, Vadodara, Gujarat

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**Abstract** - This study has been conducted to develop the Water Quality Index (WQI) of the Mahi River based on water quality parameters of DO, MPN, pH, BOD5, COD, Turbidity and Total Dissolved Solids (TDS). The study included surface water quality sampling & its analysis, rating of parameters by experts and determining the water quality using value function graphs. WQI is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers or water resource managers. WQI is calculated from the point of view of the suitability of surface water for fish, wildlife, bathing and other beneficial uses.

**Keywords** - WQI (Water quality index), Groundwater, Parameters of Water

## I. INTRODUCTION

Rivers contains highly crucial component of natural heritage and their water quality. From the starting of the life of humans, rivers are their basic requirements and only some of them are recently in natural condition. Around the world, aquatic systems mainly river is reported polluted due to disposal of untreated sewage and industrial waste water disposed directly. There is many types of materials like organic and inorganic which contain ; oils, Plastic , carbolic , solvents , grease, heavy metals, chemicals, pesticides are the results and source of waste. All these waste including storm water runoff eject from ditches and creeks, groundwater seepage, a zone of vadose leaching and atmospheric deposition. All these roots are dependent of seasons and henceforth every movement in surface water quality must be reckoned before started water quality management program.

Due to the uses of immense water quantity, stilted water and reservoirs plays significant role in domestic activities like an agribusiness, industry, and livestock production particularly in zones of arid & semi-arid. Since, activities like anthropogenic are mainly contributing to pollution now a days. Hence this is mandatory to deploy new tools and methodologies to ascertain the stage of pollution of any system at a given time. One substitute is the estimation of water quality index (WQI), an arithmetical tool to evaluate the quality of water. Integration of physical - biological- chemical to produce a unique value as an indicator of water quality is the basic of calculation of WQI. WQI tool was introduced by Mr. Horton in mid 1960s and afterwards water quality index was used as tool to determine quality of water in locations like; groundwater, rivers, lakes, and dams. Recreational water, fisheries and drinkable waters are some areas where some variations have been done in WQI. In other cases, the calculation of WQI has involved modulation or forecast due to reason of better interpretation of result. WQI tools are also very useful for identifying the different types of pollutions and recommending different preventive action measures. Brazil, Argentina, U.S., Iran, Malawi and Spain are the countries to use the method of WQI.

Human and ecological use of in-stream water requires to be considered for both the quantity and the quality of water. Without adequate quantity and quality of fresh water sustainable development will not be possible.

Nowadays, Rapid Industrial development undergoing between the Anand – Vadodara location, as a result of industrial development toxic pollutions is increased by huge amount. This toxic pollution directly throws in to the river by industries.

Hence, water quality is an important aspect for evaluating temporal variations due to seasonal changes in surface. River Pollution, Dam Pollution, Lakes Pollution and groundwater pollution are the reason of anthropogenic inputs of point / nonpoint origins like industrial, agriculture, urban, wastewater from domestic, wastewater from industries, sewage of urban center, workshop and science laboratories.

The WQI (Water quality index) calculation plays a significant role for minimizing mining, industrial or navigational accidents. To reduce secondary damages continuous monitoring is required. This is cause of short term pollution exhausts in to the directly in river.

## II. STUDY AREA OF MAHI RIVER

The Mahi is a river in western India. It originates from Vindhya Hills, Madhya Pradesh and after flowing through the vagad region of Rajasthan, enters Gujarat and meets in Bay of Khambhat. Its total length is 583km. and catchment area is 34842sq.km. Bhadar is right bank tributary and Panam, Kun and Goma are left tributaries of Mahi River. On Mahi River Kadana dam is situated at 25km. distance. Its catchment area is 25520sq.km. Wanakbori weir is situated at 102km. on Mahi River having 30665sq.km. Catchment area. (Mahi Bajaj Sagar)

There are three rivers i.e. Tapti River, Narmada River and Mahi River which flow from east to west India. Mahikantha agency from Bombay given its name of "MAHI RIVER" and also describe it as "MEHWASIS", "MARAUDING HIGHLANDERS" which

are frequently mentioned in Arabian chronicles.

The origin of Mahi River is Minda village, which is located in Dhar district, Madhya Pradesh. In Madhya Pradesh state, The Mahi River flows northward to eastward which arises location of western Vindhya Range, Just south of sardarpur. Coming for north to west it enters Rajasthan Sate, then southwest to flow through Gujarat state through the Vadodara city fringe and then enter the sea after course of 360 mile nearby past of khambhat estuary in Gujarat.

A lot of people worship to Mahi River and lot more places and temples are worship by its shore. Due to the enormousness of the river, it is also known as a Mahisagar. Recently a new district announced by Gujarat government as name of MahiSagar. Mahi estuaries is facing serious issues of salinity ingress and rising saline levels in groundwater.

According to CAG Report 2011, Salinity ingress area has been increased by 15 %. Compared with the data of 1977 – 1984, there is more affected area of 88,947 hectares involved due to salinity ingress.

The Gulf of Khambhat is envisaged to be an eligible option to create a reservoir by construction of a Gulf closure dam which can store water inflows of 12 rivers (Narmada, Dhadhar, Mahi, Sabarmati and some of the Saurashtra rivers), which accounts for 25% of total surface water resources of Gujarat.

According to CPCB, the major reasons for polluted mahi river stretch in Gujarat is due to effluents are directly discharged by the factories into the water bodies. Millions of liters of untreated effluents are dumped in the river. Industries in and around Vadodara are dumping huge quantities of hazardous chemicals into river Mahi and the Gulf of Khambhat.

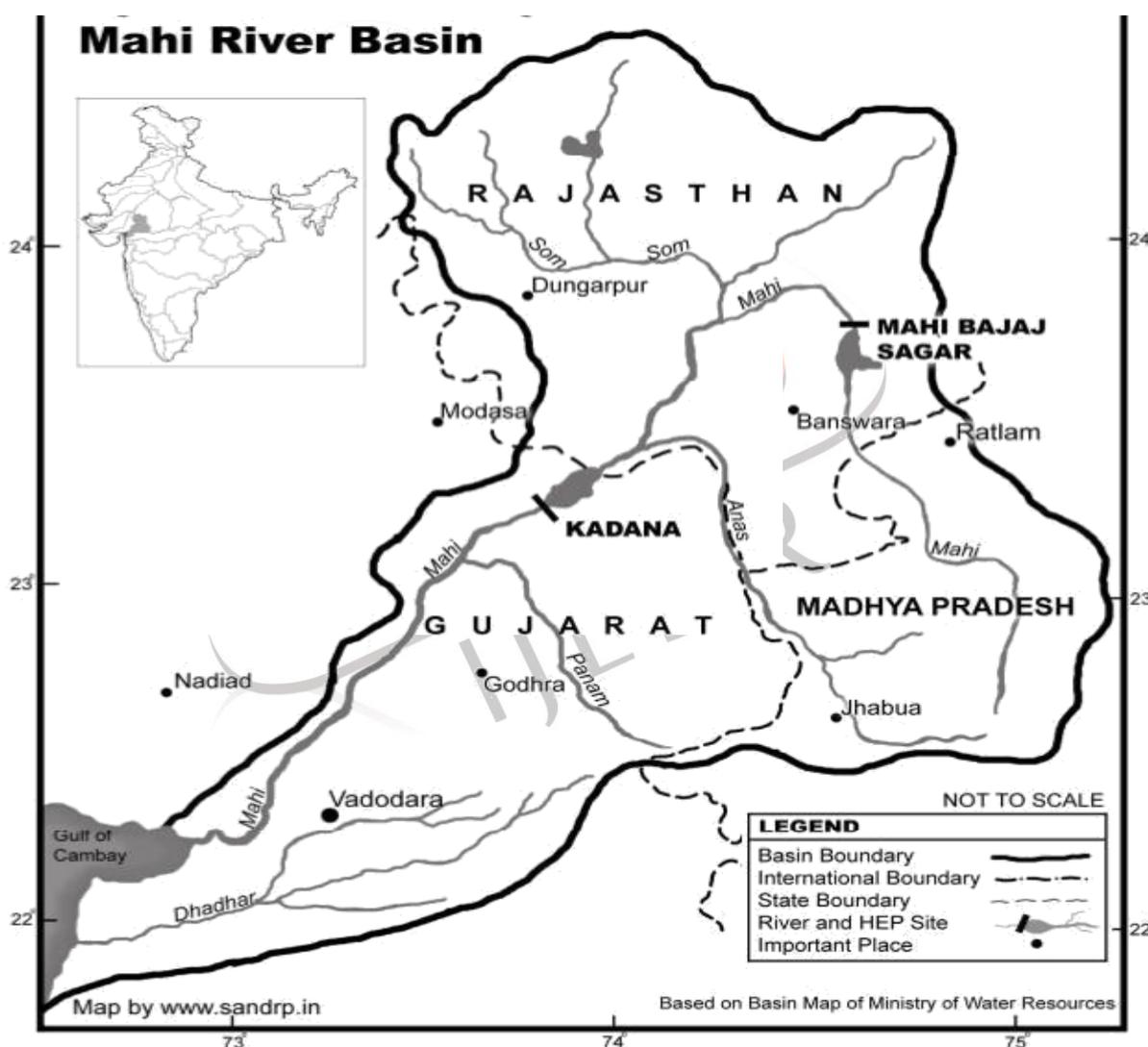


Fig.1 Area of Mahi River

Seven Stations (i.e. Seven Sampling Stations (i.e. Poicha Gam, Rayka French Well, Fazalpur, Kotna, Bamangam, Mujpur, Dabka) have been decided along the course of the river with mutual consultation with water quality experts, in order to give a comprehensive idea of overall water quality of the river. The water quality at these points has been monitored. The locations of the sampling stations selected are shown in figure 2.

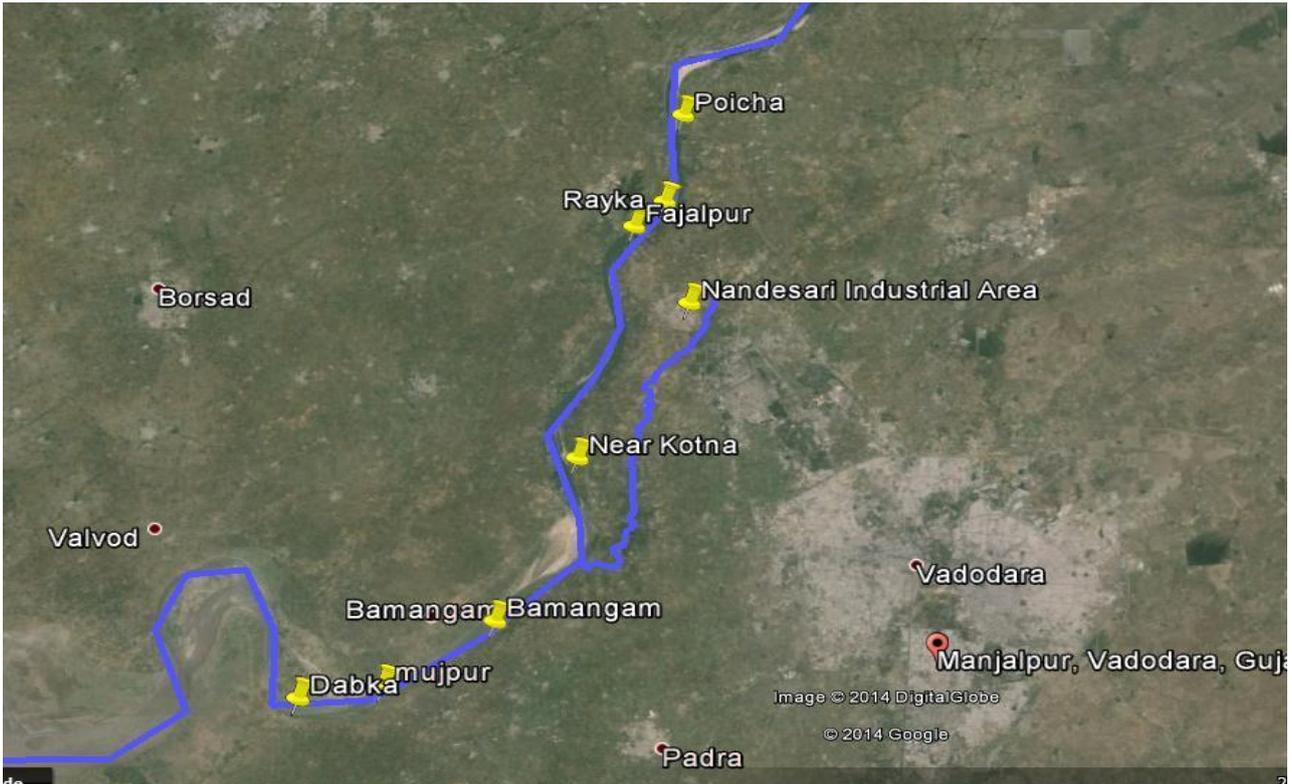
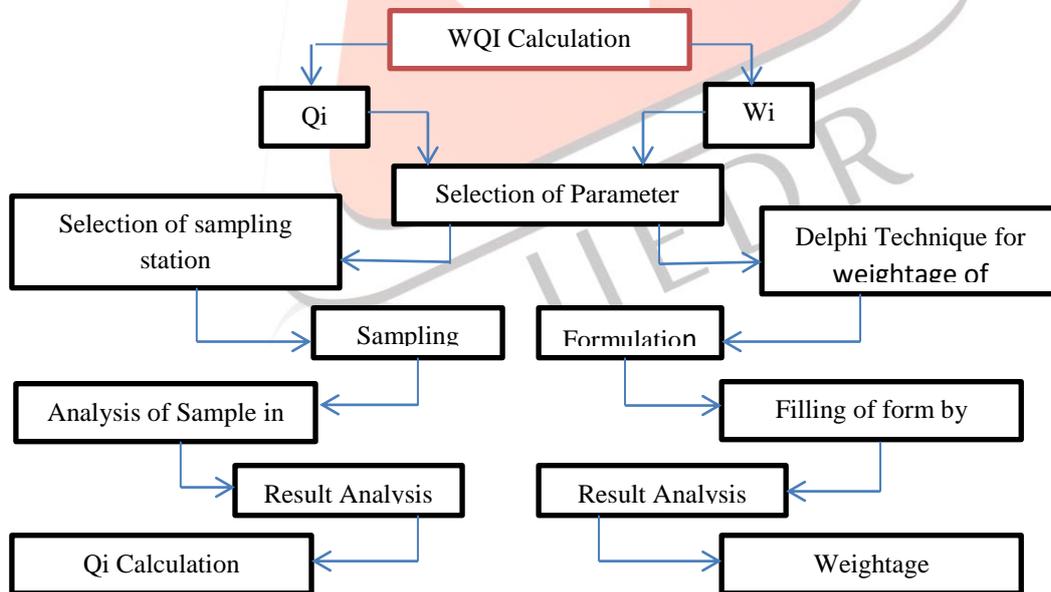


Fig.2 Study area of Mahi River

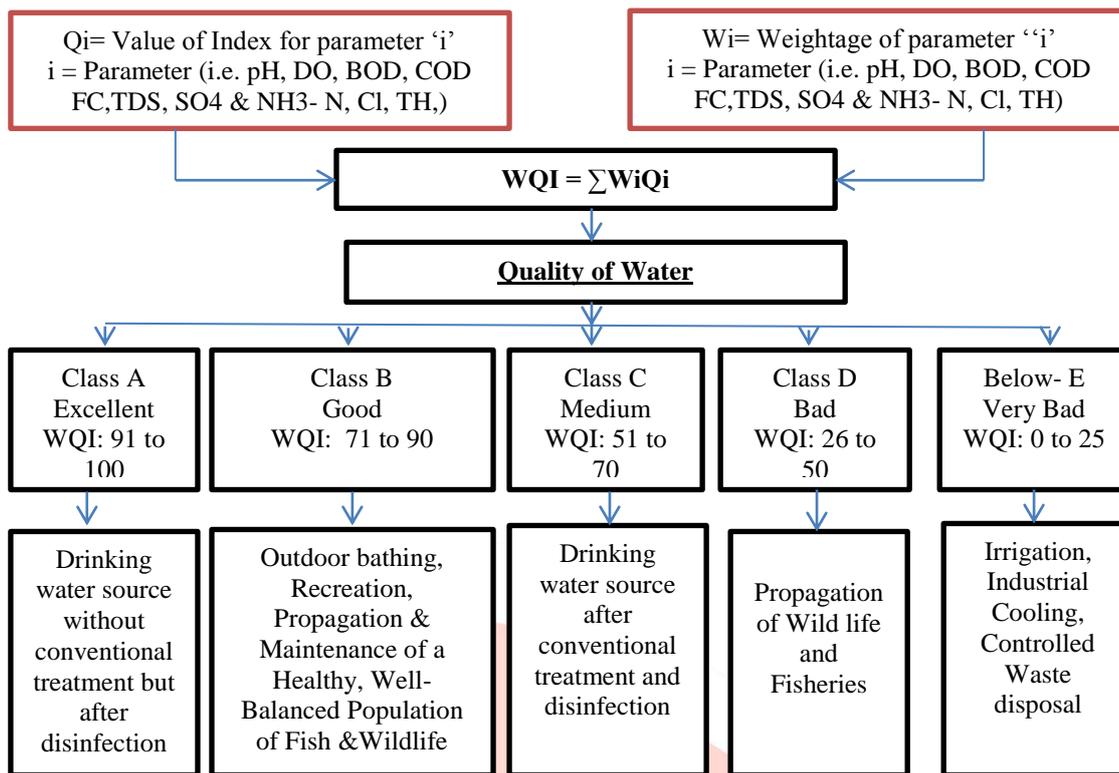
### III. METHODOLOGY



### IV. CALCULATION OF WQI

WQI is an excellent management and general administrative tool in communicating water quality information. This index has been widely field tested and applied to data from a number of different geographical areas all over the world in order to calculate Water Quality Index (WQI) of various water bodies critical pollution parameters were considered.

WQI has been calculated using Delphi Techniques or Weighted Arithmetic Index method (A structured process for collecting knowledge from experts using questionnaires combined with controlled opinion feedback). The quality rating scale for each parameter [Qi] would be calculated with the help of 5 water quality experts.



Following table, the receipt of results from questionnaire, the three water quality parameters of greatest importance from were identified as MPN, turbidity and pH.

Table 1 Water Quality Parameter & its Weightages

Water Quality Parameter	MPN	Turbidity	pH	DO	TDS	BOD	COD
Weight	0.18	0.17	0.16	0.15	0.15	0.1	0.1

### V. RESULTS & ANALYSIS OF EXPERIMENTS

As per Government and CPCB (central pollution control board) norms. There are twenty six parameters for calculation of water quality index of river water. Out of which we have selected seven parameters for calculation of water quality index of Mahi River and the test were conducted and results were obtained. The selected parameters are DO (dissolved oxygen), turbidity, total dissolved solids, BOD (biochemical oxygen demand), COD (chemical oxygen demand), MPN (most probable number) and pH.

By using standard methods results were obtained for calculating water quality index of Mahi River. Table shows the results of experiments.

Table 2 Results of Experiments

St No	Location of Station	Temp	pH at St	pH meter	DO mg/lit	Turbidity mg/lit	BOD mg/lit	COD mg/lit	TDS	MPN/100 ml
1	Hanuman Temple Poicha Gam	29.00	7.80	8.17	6.50	0.90	2.80	2.00	300.00	67.06
2	Rayka French Well Rayka	26.00	8.00	8.61	5.20	2.60	1.50	2.40	250.00	2.39
3	Mahisagar Temple, Fazalpur	24.00	7.80	8.46	8.20	0.30	3.30	0.80	325.00	27.36
4	Mahi River Bridge Kotna	27.00	7.80	8.84	4.10	0.60	1.00	2.40	400.00	25.82
5	Gambhira Bridge Bamangam	33.00	7.00	8.71	5.30	44.00	1.00	2.00	235.00	22.77
6	Mahisagar Bridge Muipur	30.00	8.00	8.42	6.20	20.00	2.20	2.40	288.00	35.97
7	Mahadev mandir, Dabka	31.00	7.80	8.73	6.40	23.80	1.40	2.80	300.00	18.08

### VI. WQI CALCULATION FROM RESULT

An equation of water quality index has been found by using weighted factor of individual parameter and sub-index of each

water quality parameter based on their respective testing values which can be found by water quality index curve or value function graph of respective parameters. The water quality index of individual parameter was calculated from water quality index curve. According to water quality index, following equation was has been used for the calculation.

The water quality index has been determined by using the water quality index equation. To find the water quality index of individual parameter, the mathematical average of the concentration of all the locations have been taken. Using water quality index, some predictions would be made for the uses of the water at different purposes.

$$WQI = 0.18 * Q_i(\text{MPN}) + 0.17 * Q_i(\text{T}) + 0.16 * Q_i(\text{pH}) + 0.15 * Q_i(\text{DO}) + 0.15 * Q_i(\text{TDS}) + 0.1 * Q_i(\text{BOD5}) + 0.1 * Q_i(\text{COD})$$

Sr no	Parameter	S1	S2	S3	S4	S5	S6	S7	Wi	Avg	WQI
										Qi	
1	P <sup>H</sup>	8.17	8.61	8.46	8.84	8.71	8.42	8.73	0.16	76	12.16
2	DO	6.50	5.20	8.20	4.10	5.30	6.20	6.40	0.15	73.14	11
3	Turbidity	0.90	2.60	0.30	0.60	44.00	20.00	23.80	0.17	75.57	12.84
4	BOD	2.80	1.50	3.30	1.00	10.00	2.20	1.40	0.10	78.85	8
5	COD	2.00	2.40	0.80	2.40	2.00	2.40	2.80	0.10	59.43	5.9
6	TDS	300.00	250.00	325.00	400.00	235.00	288.00	300.00	0.15	60.28	9.00
7	MPN	67.06	2.36	27.36	25.82	22.77	35.97	18.08	0.18	61.7	11.1
										WQI	70
										Descr - iption Class	Mediu m C

## VII. CONCLUSION & RECOMMENDATIONS

### Conclusion

Based on the research study, following conclusions can be drawn:

- The water quality index for post winter season at the upstream and downstream of the Mahi River is 70 (medium).
- It is clear from the research study that the overall water quality of the Mahi River falls under category medium to bad.
- Water Quality Index suggests that the water quality is not suitable for recreational purposes without taking any corrective steps and is only fit for other purposes like non sensitive pisciculture, livestock drinking and irrigation. Generally, once a trend in pollution sets in, it accelerates day by day. So, there is a possible risk of water quality deterioration in near future.

### Recommendations

- No litter / Disposal zone
- Building Public Awareness about River Pollution to the surrounding community
- Use of Information Communication Technology for decision makers to identify the critical parameters
- Forming local communities/groups for regular monitoring and facilitate complaint registration
- Preventive Actions and Public Awareness
- To maintain the water quality of the river the public realm and to prevent further deterioration it is important to invoke awareness of the masses along with policy level initiatives from the Municipal Corporation.
- Policy level interventions may include declaration of “No Plastic Zones” and punitive and incentive actions for littering.
- Public awareness may include activities to involve the stakeholders in cleaning the river stretch, mass campaigning through different media viz. newspapers, local channels, radio etc.. These activities should be institutionalized. Involving the locals would ensure sustainability of the initiatives.
- Information education and communication materials in the form of posters, slogans and hoardings should be used. The design of the same may be realized through completions involving school children.

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