International Journal of Chemical Studies

P-ISSN2349–8528
E-ISSN 2321–4902
IJCS 2016; 4(2): 66-70

Received: 20-01-2016
Accepted: 22-02-2016

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Narmada river water: Pollution and its impact on the human health

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Abstract
River pollution has been one of the main topics in the environmental issue of Narmada river side villages and urban area of Hoshangabad, This study was conducted to find out the pollution situation of Narmada river and the health problem of the surrounding residents. The results clearly determine that the water quality of Narmada river may not be in a position to sustain the aquatic life and not suitable for using domestic purpose. This is indicated by the very low dissoloved oxygen (DO) levels and other measured parameters in the river. The maximum recorded values of pH, color, turbidity, biochemical oxygen demand (BOD), hardness, total dissolved solids (TDS), chloride (Cl_2), carbon-di-oxide (CO_2) and chemical oxygen demand (COD) were 7.1 mg/L, 625 ptcu, 97.2, 4.65 mg/L, 1816 mg/L, 676mg/L, 5 mg/L, 15.5, and 78 mg/L, respectively. The maximum concentration of turbidity, BOD, hardness, TDS, and COD found in the Narmada river is much higher than the standard permissible limit. The study also provides evidence that local communities are suffering from a variety of health problems including skin, diarrhea, dysentery, respiratory illnesses, anemia and complications in childbirth. Yellow fever, cholera, dengue, malaria and other epidemic diseases are also available in this area. Furthermore, the people are suffering by the odor pollution and respiratory problems.

Keywords: Narmada River; Pollution; Impact; Human Health

1. Introduction

Water is the most vital element among the natural resources, and is critical for the survival of all living organisms including human, food production, and economic development. Today there are many cities worldwide facing an acute shortage of water and nearly 40 percent of the world's food supply is grown under irrigation and a wide variety of industrial processes depends on water. The environment, economic growth, and developments are all highly influenced by water-its regional and seasonal availability, and the quality of surface and groundwater. The quality of water is affected by human activities and is declining due to the rise of urbanization, population growth, industrial production, climate change and other factors. The resulting water pollution is a serious threat to the well-being of both the Earth and its population.

The importance of the Narmada River as sacred is testified by the fact that the pilgrims perform a holy pilgrimage of a circumambulation of the river [1]. The Narmada Parikrama, as it is called, is considered to be a meritorious act that a pilgrim can undertake. Many Sadhus and pilgrims walk on foot from the Arabian Sea at Bharuch in Gujarat, along the river, to the source in Maikal Mountains (Amarkantak hills) in Madhya Pradesh [2] and back along the opposite bank of the river. It is a 2,600 kilometre walk [3]. Important towns of interest in the valley are Jabalpur, Barwani, Hoshangabad, Harda, Narmada Nagar, Omkareshwar, Dewas, Mandla and Maheshwar in Madhya Pradesh, and Rajpipala and Bharuch in Gujarat (Figure-1). Some places of historical interest are Joga Ka Quilla, Chhatri of Baji Rao Peshwa, and among the falls are the Dugdhdhara, Dhardi falls, Bheraghat, Dhuandhara, Kapiladhara and Sahastradhara [4].

The problem of water quality deterioration is mainly due to human activities such as disposal of dead bodies, discharge of industrial and sewage wastes and agricultural runoff, which are major cause of ecological damage and pose serious health hazards [5]. The degree of pollution is generally assessed by studying physical and chemical characteristics of the water bodies [6]. Studies related to water pollution of rivers like Godavari, Krishna and Tungbhdra [7], Cauvery [8], Jhelum [9], Kosi [10], Morar [11] (Kalpi), Alaknanda [12], Brahamani [13], Betwa [14], Ganga [15-18], Godavari [19, 20], Yamuna [21, 22], Pachin [23], Irai [24], Chambal River [25], Tansa [26], Purna [5, 27] and Korni, Anjan and Narmada [28, 29] have received greater attention from time to time and during recent years.

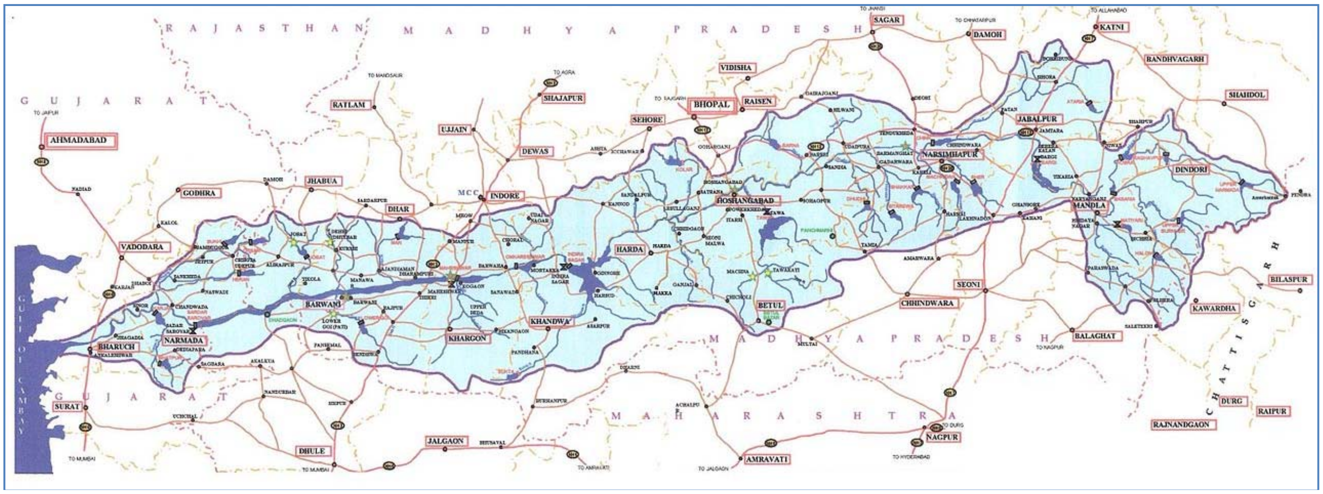

Fig 1: Narmada water supply is grown under irrigation

2. Material and methods

The sources of data are divided in to two categories. The data which were collected from the field or study area are called the primary data. Primary data were collected by the interviewing the people of study area and/or by making survey on a topic of the study. The secondary data are the data which were collected from published litereture, which contain the topics related to the study.

The steps that have been adopted to attain the objectives of the study were as follows:

1. Primary data were obtained from field observation and this was needed to know about the existing physical and environmental condition of the study.
2. Secondary data have been collected from Pollution control board, Bhopal.
3. Water Samples and photographs have been collected from different locations of the Narmada river and water samples tested in the Deprtment of chemistry, Govt. Narmada Mahavidhyalay, Hoshangabad (MP).
4. Recent surface water quality data has been collected from Deprtment of chemistry, Govt. Narmada Mahavidhyalay, Hoshangabad (MP) as test sample.
5. Water quality and pollution loads analyzed to find out the present water quality scenario, trend of water pollution and percent of increase in pollution loading. Besides, reports, thesis, journals and expert opinions were collected from different organizations and websites.
6. Focus group discussions and in-depth interviews with community members to identify their perceived current and historical health problems. The second involved the gathering of secondary data and the undertaking of interviews with health workers in the area to determine whether the perceived changes to health expressed by the local population matched the health trends observed by local health professionals. To collect this data, our tool was taking “Interview with the people” of this location. The respondent persons were fisherman, boatman, teacher, local people, farmer, health workers, health professionals and tourist

Surface water samples of the rivers were collected from four different points of the river in two seasons during the period of June, 2014 to May, 2015 covering dry and wet periods. Various water quality parameters were monitored and a detailed field survey has been conducted within the study area. Proper sampling procedure was followed while collecting the samples.

Appropriate sample handling and preservation is essential to ensure data quality. Factors considered are listed as:

I clean plastic containers are typically used for inorganic samples, with glass containers used for organic analyses;

II proper sample preservation is important if accurate and representative results are to be obtained from the sampling efforts. In general, all samples are placed on ice in the dark and III analyses should be initiated as soon as possible after collection to avoid sample deterioration.

Selection of sampling depth varies with the purpose of work and the parameter to be tested. In this study, the sampling depth was taken to be 15-20 cm. This was because; the main point of focus of this study was surface water pollution. Generally, heavy metal concentration analysis needs sample from a deeper section.

3. Observation

The experiment on a selected segment of the river was carried out for four months duration. The time was chosen as such that both dry season and wet season was there. To assess the water quality we conducted test on 13 water quality parameters. The lists of those parameters with the standards are listed below:

Table 1: physico-chemical parameter

No.	Parameter	Standard
1.	DO	6 mg/L
2.	pH	6.5-8.5
3.	Color	15 ptcu
4.	Turbidity	10 NTU
5.	BOD	0.2 mg/L
6.	Hardness	200-500 mg/L
7.	TDS	1000 mg/L
8.	Cl^-	0.2 mg/L
9.	CO_2	Present
10.	COD	4 mg/L

From the analysis of data it was observed that there is a distinct variation in water quality during dry and wet season. As the flow of water is less during dry season and water level goes down the quality of water become poor. As a result water remains more polluted during dry season. Again during wet season due to rainfall the flow is more, level of water increases and the water quality becomes relatively better.

Dissolved Oxygen (DO): The sample was taken in the bottle and diluted with the water. The probe of the multimeter was placed inside the bottle and the reading is taken (Table-1).

pH: The sample water is taken in small beaker then the probe of the pH meter is placed inside the water and kept for some time. The reading was shown on the pH meter but the final value took when the reading on the screen became static (Table-1).

Color: The sample water is taken on the small beaker of the spectrophotometer. The spectrophotometer is set for the color test and it is zeroed by the distilled water. Then the sample water is placed inside the spectrophotometer and reading is taken (Table-1).

Turbidity: The sample water was taken in the small tube of the turbidity meter. The switched was on and then the reading was taken from the meter (Table-1).

Biochemical Oxygen Demand (BOD): The sample was taken in the bottle and diluted with the water. The probe of the multimeter was placed inside the bottle and the reading was taken and finally the bottle was placed inside the refrigerator at 200°C of temperature for 5 days. After 5 days, the data was taken again trough the multi meter and the result was obtained (Table-1).

Hardness: The 50 ml of sample water was taken in the beaker which was diluted with 50 ml of distilled water. Then 1 ml starch in a packet of reagent was added with the water which was then titrated. However, the reading was taken when the color become purple (Table-1).

Total Dissolved Solids (TDS): The sample water was taken in the beaker and the probe of the multimeter was placed inside the beaker for few minute. The static result shown on the screen of the multimeter was the TDS of the water (Table-1).

Chloride (Cl^-): Filled a square sample cell with 10 ml of sample and another one with deionozed water sample pipette 1.0 ml of Mercuric Thiocyanate solution into each sample. Sample was then swirl to mix. Pipette 0.5 ml of Ferric Ion solution into each sample cell and kept the sample for two minutes. After that two cells were placed inside the spectrophotometer and the results were obtained (Table-1).

Carbondioxide (CO_2): First we took 100ml of the sample, 3 drops of the Phenaphtholen was added to the sample if the sample goes pink it represents no CO_2 is present, otherwise three drops of Methylorange was added with the sample. Later titration was done with NAOH. Five times of NAOH of titration was the amount of CO_2 present in the sample (Table-1).

Chemical Oxygen Demand (COD): Turned on the reactor and pre heated to 150 °C. Hold the vial at 45 degree angle and 2 ml of sample. Then the sample was mixed by inverting the vial. The sample was heated for two hours with a strong oxidizing agent. After the vial was placed inside, the spectrophotometer and compared it with the blank vial. Thus the result was obtained (Table-1).

Microbial pathogens that may be transmitted through contaminated drinking-water are diverse. Figure-2 provide general information on pathogens that are of relevance for drinking-water supply management. The spectrum changes in response to variables such as increases in human and animal populations, escalating use of wastewater, changes in lifestyles and medical interventions, population movement and travel and selective pressures for new pathogens and mutants or recombinations of existing pathogens. The immunity of individuals also varies considerably, whether acquired by contact with a pathogen or influenced by such factors as age, sex, state of health and living conditions.

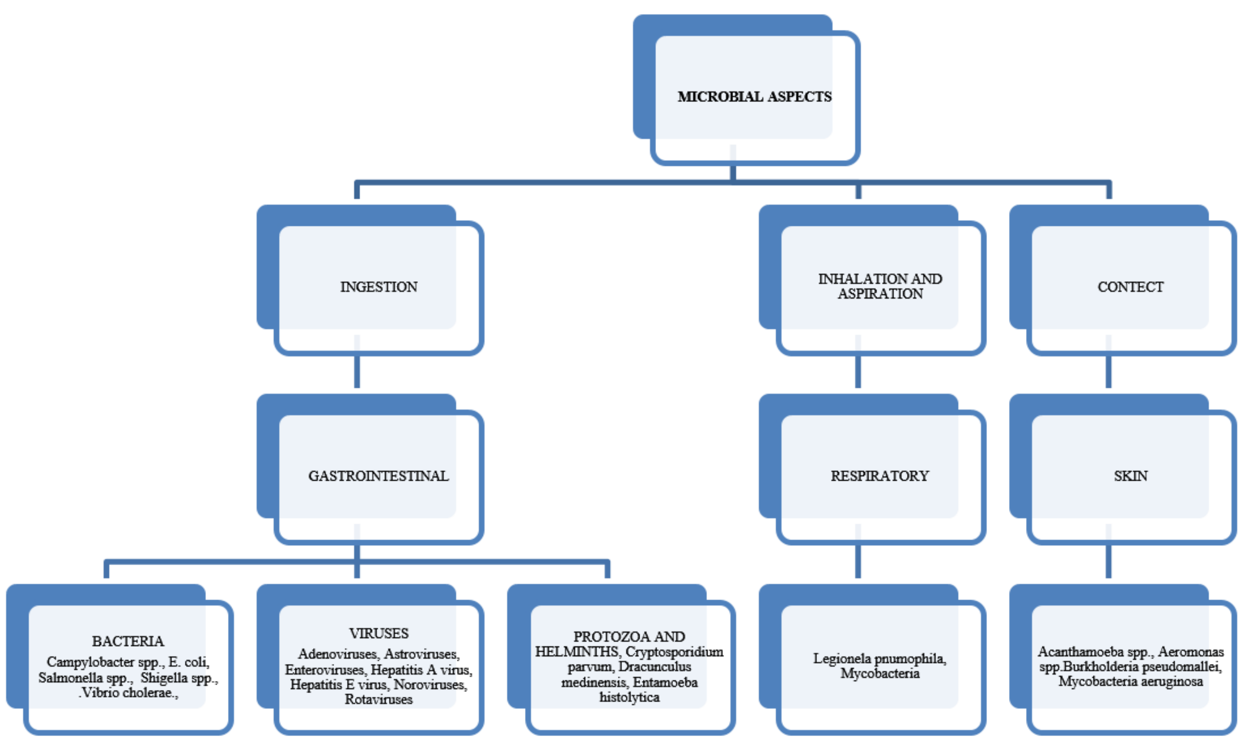

Fig 2: Microbial pathogens

There is no sign of river pollution being stopped. It is increasing day by day. There are several sources of water pollution, which work together to reduce overall river water quality. Industries discharge their liquid waste products into rivers. Our agriculture practice that uses chemical fertilizers and pesticides also contribute to river pollution as rainwater drains these chemicals into the rivers. Domestic wastes that we throw into rivers adds to pollution levels. As population grows, the size of towns and cities also grows. With that the amount of domestic wastes that we throw into river increases. In most of the towns and cities, the municipal drains carry our wastes to rivers.

There are examples of rivers catching fire because of high pollution levels. This shows how seriously polluted our rivers are. In our everyday life we can easily see symptoms of river pollution. The floating dead fishes in our river, any coloured water in the river, or a bad smell from the river point towards river pollution. The study provides evidence that local communities are suffering from a variety of health problems that could be a direct or indirect such as skin problems, stomach problems, gastric ulcers, diarrhoea, dysentery, yellow fever, cholera, dengue, malaria and other epidemic disease also available in this area. The people lives in the aria are also suffering by the odor pollution and by the respiratory problems. If you see or feel any of these things in a river be sure that the river is a victim of pollution. River pollution can be due to the causes below:

1. Acid rain
2. Industrial pollution
3. Agricultural pollution
4. Oil Pollution
5. Solid waste

4. Conclusion

The results of the sampling programme clearly determine that the water quality of Narmada River may not be in a position to sustain the aquatic life as well as not suitable for using for domestic purpose. Due to lack of time and resources, the sampling programme was limited to four months duration, from June, 2014 to May, 2015. The water samples were analyzed that includes DO, pH, color, turbidity, BOD, hardness, TDS, chloride, CO_2, COD etc. The disposal of industrial waste effluent into riverine system has given rise to heavily localized pollution and threatens seriously to the environment. The present data on the status of river water will help to establish water processing plants in future, the requirement of which increases at a tremendous rate due to growth of population, industrialization and arsenic contamination in ground water. The maximum concentration of turbidity, BOD, hardness, TDS and COD found in the Narmada River is much higher than the standard permissible limit. The pollution level of the river is increasing sharply and can cause serious problem in near future. From this study, the surface water quality of the major rivers Narmada river side villages and urban area of Hoshangabad, is a great threat to ecosystem though some parameters may not in the deteriorate level but the condition of the river side urbanization and industrialization may cause all kind of water pollution in the near future. On the other hand, the study provides evidence that local communities are suffering from a variety of health problems that could be a direct or indirect result of the discharge and flow of waste water. Skin problems may for example be related to the high pH of the water, which could certainly irritate the skin and result in sores. The high pH levels are likely to be the result of the large quantities of caustic soda and soda ash used in the dyeing process. It is more difficult to attribute the stomach problems to industrial pollution as people in the area do not drink surface water. However gastric ulcers and other similar gastric problems may be related to diet and the impacts of the pollution on crops and fish consumed by people living around Narmada river. It is also possible that groundwater is being polluted by infiltration of industrial effluent but similarly there has been no empirical research into this. The problems of diarrhoea and dysentery are unlikely to be caused directly by the industrial effluent, as they are usually the result of microbial contamination. However, the high level of in-migration to the area is putting considerable pressure on poor sanitation infrastructure and may be increasing the risk of contracting communicable diseases. By using of river water for washing clothing and bath many water born disease spread man to man. However, yellow fever, cholera, dengue, malaria and other epidemic disease also available in this area. The people lives in the aria are also suffering by the odor pollution and by the respiratory problems. For the polluted situation of the river maternal and child health of nearby riverbank slam are in a danger position.

How to control river pollution?

Controlling river pollution is in our own interest. As citizens of India we have constitutional duty to protect our environment. Similarly, the government also has a duty to protect the environment for the welfare of its citizens. There are many ways we can protect the river from pollution. Some immediate ways to control pollution are:

Industries should install machineries to remove contaminants from their effluents and wastewater. One way to do so is installation of Effluent Treatment Plant. This way we can control pollution at the source itself [30].

The towns and cities should also have facilities to clean the sewage effluent. All towns and cities must have Sewage Treatment Plants that clean up the sewage.

Farmers should give up chemicals and pesticides in farming and should instead adopt organic methods of farming thus reducing chemical pollution of rivers.

We should stop our religious practices that pollute river water.

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