

# EVALUATING NANDINI RIVER WATER QUALITY: A SYSTEMATIC REVIEW OF PHYSICOCHEMICAL STUDIES

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**Abstract:** The quality of water is described to be the condition of the water, which includes the three basic forms of physical, chemical, and biological notions. Salinity, turbidity, the amount of dissolved oxygen and carbon dioxide, and microorganisms, herbicides, and pesticides along with the presence of heavy metals edit reminds to have a direct effect on the water quality. Because the universal solvent is a major factor affecting the lives of the humongous population of people, recognition of the quality of water is significantly important.

Due to the fact that the presence of contaminants in water can directly lead to health issues such as reproductive problems, different kinds of neurological disorders, and gastrointestinal diseases, it is of vehement importance to understand the water quality. Nandini River flows through the Nashik city of Maharashtra and it is the tributary of the river Godavari which is a vital source of water for the people of the Nashik region. Travelling from the heart of Nashik the river Nandini is faced with several issues related to its degrading water quality. Hence, the study sheds light onto the quality of water of the Nandini river, in terms of Physicochemical Studies.

**Keywords:** Physicochemical Studies, Nandini river, physical, chemical biological, water quality, dissolved oxygen, carbon dioxide, pollutants.

## 1. INTRODUCTION

The River Nandini rises from hilly areas in Trimbakeshwar Nashik and it meets to river Godavari in Tapovan Nashik. The river Nandini, flowing through Anjaneri hills to south-west of Nashik, had been inspected to be protected by the Nashik Municipal Corporation from the degrading quality of water. It has been identified that 80% of wastewater which is generated from the industrial and households of developing countries is discharged into the water bodies without any form of effluent treatment (Unwater.org, 2021). Such aspects are seen to be extremely harmful to the overall quality of water, especially aquatic life.

## 2. AIM

The aim of the study is to lay an extensive assessment of the water quality of the Nandini River, in terms of physicochemical data.

## 3. RESEARCH OBJECTIVE

RO1: To inspect the factors linked with degradation of water quality at Nandini river

RO2: To examine the reasons for the rise of water pollution at Nandini river

RO3: To analyse the methods to be applied by the Local government to increase the water quality level of Nandini river

## 4. RESEARCH QUESTIONS

RQ1: What are the various elements associated with diminishment of water quality at Nandini river?

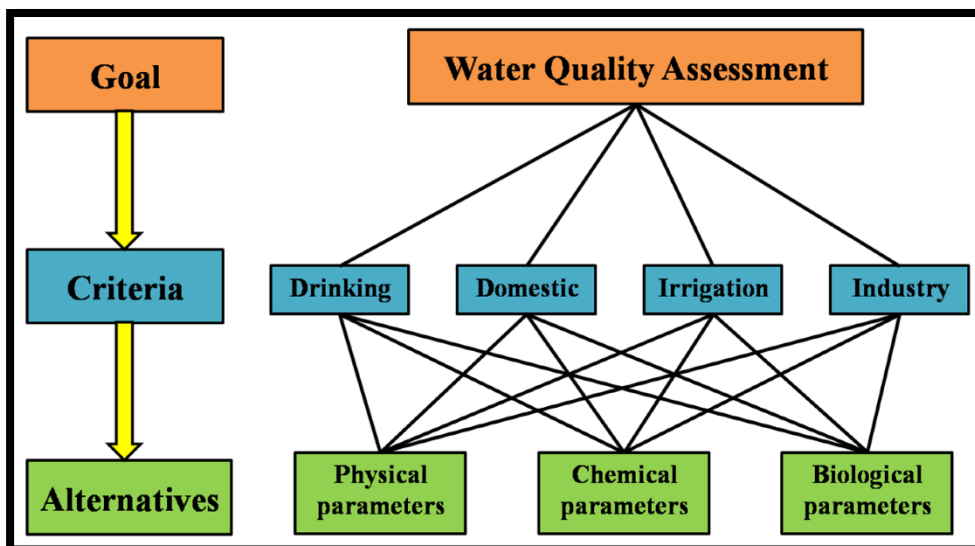
RQ2: What are the numerous reasons aligned with the growth of water pollution at Nandini river?

RQ3: What are the varying measures to be applied by the Local government to improve the water quality level of Nandini river?

## 5. LITERATURE REVIEW

### *Critical assessment of water quality*

The assessment of water quality is a potential approach that needs to be taken by the authorities to keep a check on the sanitation of the solvent. According to the opinions of Erbi et al. (2022), the inspection of sanitation of water can be segregated into three different levels, namely the low-, medium- and high- extent. On the other hand, as per the notions by Genter, Willetts & Foster (2021), the recognition of the water quality is determined to be highly impactful on the flora and fauna of the region, and hence, the contamination of the water sources by the means needs to be recognised. With the aid of significant measures, the potential of understanding water quality ought to be taken into consideration for the population to utilise water in cleaner and safer means.



**Figure 1.** Water quality parameters  
(Source: Nowicki et al. 2021)

The inspection of water sanitation is vital as the global population utilises the same. It has already been recorded that more than three billion people utilise contaminated and impure water (Timesofindia.indiatimes, 2016). On the other hand, as mentioned by Mendoza et al. (2023), metals such as lead, cadmium, chromium, mercury, nickels, and other heavy metals have been identified to dramatically reduce water quality. Therefore, the

### *Importance of understanding the water quality*

In terms of water quality, the presence of faecal contamination has been determined to be the greater source of water pollutants. As per the comments by Cai et al. (2020), such a factor has been seen to pose a significant threat to human lives and can disrupt the dissolved levels of oxygen within the sources. On the other hand, the presence of arsenic, nitrates, Heptachlor, Polychlorinated biphenyl, and runoffs containing fungicides and pesticides drastically lower the quality of water. Hence, the recognition of the different sources of water pollutants is necessary for inducing strategies to control the same.

Chemical Parameters	MAC (mg/L)
Aluminum	None
Antimony	0.006
Arsenic	0.01
Barium	2.0
Boron	5.0
Cadmium	0.007
Chloride	None
Chromium	0.05
Copper	2.0
Fluoride	1.5
Iron	None
Lead	0.005
Manganese	0.12
Mercury	0.001
Nitrate and Nitrite	10
Selenium	0.05
Sodium	None
Strontium	7.0
Sulphate	None
Uranium	0.02
Zinc	None

**Table 1.** MAC values of elements  
(Source: Cai et al. 2020)

The recognition of the water quality is determined with the aid of two main indicators, namely the Maximum acceptable concentration (MAC) and the Aesthetic objective (AO). MAC takes into consideration the various levels at which certain substances are identified to cause adverse health effects. On the contract, AO encompasses the various traits of water which have an impact on the taste, odour, or colour of the water. Hence, the identification of these elements has been seen to directly alter the quality of water negatively, and recognising the same is of great importance.

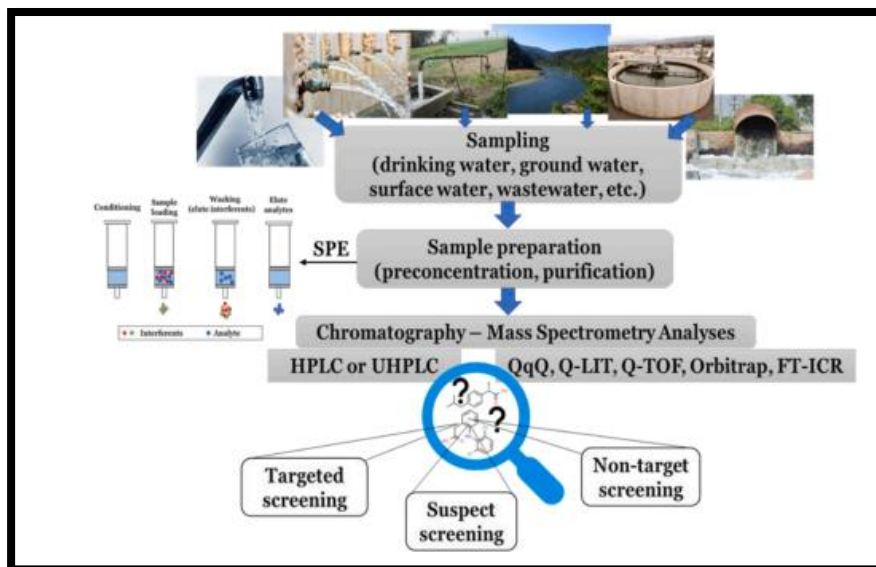
#### ***Examination of the ways which decline the quality of water***

With the identification of the exact factors and elements causing the decline in the level of water quality, the sources of the variables are to be inspected for halting the processes at the source. According to the comments by Hasan, Shahriar & Jim (2019), the runoffs containing varying degrees of pesticides and herbicides originate in the agricultural fields, as a result of protecting the crops against their predators. On the other hand, as depicted by Zamora-Ledezma et al. (2021), the harmful metals enter the water bodies as a result of untreated effluents from the factors, and sewage from households. Hence, strategic measures are to be induced within such sources of water pollutants to diminish their overall release.

Several tests and indicators can be applied for the recognition of the water quality. With the test of TDS or Total Dissolved Solids, the monitoring of the various degrees of inorganic salts such as calcium, magnesium, and potassium, dissolved in water, can be identified. On the other hand, as stated by Qu et al. (2020), the testing of the pH levels also indicates the quality of the solvent. Water contains a neutral pH of 7.0, however, with slight alterations, the pH of drinking water can range from 6.5 to 8.5 (Reyes-Toscano et al 2020). The presence of fluctuating pH or sustained pH, which goes beyond the threshold of 6.5 to 8.5 can dramatically decline the quality of water, and turn it harmful for consumption (Reyes-Toscano et al 2020).

### ***Analysis of the measures increasing the water quality***

Because the maintenance of water is directly related to the health and longevity of the flora and fauna, the inclusion of tactical measures is to be noted in society. According to the suggestions of Chen et al. (2020), sanitation methods are to be included at various levels for keeping track of water pollution. For instance, in cities and metropolitan areas, the treatment of household sewage can be enabled with the aid of segregation of the waste products for the removal of the contaminants from sewage and the production of effluent which can be discharged into the water treatment plants. On the other hand, as per the views of Pasika & Gandla (2020), factories have to abide by the rules and regulations taken by their respective countries to treat their waste products before being released into the water bodies. Hence, the inclusion of stringent norms and pathways are to be implemented to meet the goals of creating a sustainable environment.



**Figure 2.** Measurement of water quality  
(Source: Chen et al. 2020)

Several international bodies such as WHO and UN are integrating strict measures for reducing the negative impact of effluents on the water bodies. For example, the UN established an Open Working Group (OWG) to improve the water quality by the end of 2030 through the reduction of pollution, and the elimination of waste dumping (Un.org, 2018). In addition to such, OWG has taken the pledge to reduce the release of hazardous chemicals into the water bodies without any treatment. Such aspects are to be considered to see an improvement of the water-related ecosystems, and overall increase the quality of the biosphere.

## **6. METHODOLOGY**

The techniques and methods that are included during the gathering of research evidence fall under the research methodology (Pandey & Pandey, 2021). In the case of the respective article, information was gathered from secondary qualitative sources present on the digital platform. The search database of Google Scholar was sieved for the collection of evidence towards the examination of the core topic of study. With the aid of qualitative research, data analysis of the obtained information was performed.

## **7. FINDINGS AND RESULTS**

### ***Level of pollution at Nandini River***

Maharashtra, located in by the Arabian Sea to the west, the Indian states of Karnataka and Goa to the south, Telangana, is a region with diverse flora and fauna. However, with the growing incidences of deforestation and water abrasion in Trimbakeshwar Nashik, a gradual decline in the diversified ecosystem is noted (Kumkar et al. 2023). Nandini River, originating at Nashik, has been turned into a turbulent ecological system due to the dramatic decline in the water quality. According to the National Sanitation Foundation Water Quality Index or NSFQWI, water quality

can be segregated into Good, with a score of 70-90, medium, from 25 to 50, and bad, from 0 to 25 (Ghorbani, Afshar & Hamidifar, 2021). For the Nandini River, the NSFQI ranged from 50-0, indicating that the water quality was medium to bad, depending on the area of assessment (Bhamare, 2019). The inclusion of Chlorophyll Fluorescence is seen to measure the levels of nitrogen and minerals in the solvent. Alongside, as per the opinions of Clark et al. (2020), the utilization of coloured or chromophoric dissolved organic matter (CDOM) can be implemented for recognising oxygen levels. Hence, various tests are to be performed for the examination of the quality of water at various levels.

Physical Parameter		P1	P2	P3	P4	P5	P6	P7	P8	P9
1	Temperature	14.8	14.6	19.4	19.2	20.2	32	26	12	9
2	Turbidity	3.4	30.1	11.3	8.8	8.0	0.1	3.1	0.2	4.1
3	pH	8.40	7.57	7.60	7.68	7.75	7.78	8.23	8.20	7.85
4	Total Dissolved Solid (TDS)	130	274	288	164	181	278	389	291	183
5	Total Suspended Solid (TSS)	59	189	203	171	217	109	135	196	153
6	Total Solids(TS)	189	463	491	335	398	387	524	487	336
7	Dissolve Oxygen(DO)	7	3	5.6	2	4	2.2	4.7	5.1	5.7
9	COD	128	192	288	64	32	192	224	288	160
10	Conductivity	0.2	0.8	0.5	0.4	0.5	0.6	0.4	0.4	0.5
11	Alkalinity	0.1   1.1	0   2.5	0   1.4	0   1.4	0   2	0   1.9	0   2.5	0   1.5	0   1.9
12	Hardness	0.157	0.345	0.172	0.180	0.336	0.220	0.272	0.292	0.344

**Table 2.** Physicochemical determinants of the water quality of Nandini River  
(Source: Bhamare, 2019)

The above table portrays the different physical properties of the water collected from Nandini River, to assess its quality. Based on the above table, it can be identified that the Nandini River is seen to be highly polluted in several places. The optimum water temperature at the river ought to be between 0 to 25, which has crossed at part p-6 of the river, indicating aquatic life is unsuitable in such an area (Bhamare, 2019). Similarly, the optimum TSS of river water ought to be less than 20 mg/l, which is dramatically high in the river water (Bhamare, 2019). Hence, the extent of pollution in the Nandini River is seen to be at extreme levels.

#### **Causes of water pollution in Nandini River**

The major sources of water pollution of the river have been identified to be the gradual urbanisation of the nearby areas, and the occurrence of other man-made, anthropogenic activities. As per the point of view of Bhamare (2019), in addition to such, domestic pollution has accounted for about 18% of the total water pollution for the Nandini River. Based on the water analysis conducted by the Maharashtra Pollution Control Board (MPCB), Aurangabad, the quality of water in the river had been noted to range from bad to medium, in terms of sanitization. The release of partially treated sewage from households in Maharashtra, especially in the Nashik region, in addition to industrial wastewater, had been regarded as the chief source of water pollution. In the thoughts and beliefs by Rafiq et al. (2021), different household activities such as the washing of clothes and utensils, anthropogenic causes such as soil excavation and construction of dams, alongside industrial discharges from Trimbakeshwar sector have increased the extent of water

pollution at Nandini river. Hence, keeping track of the water quality needs to be considered for the overall improvement of the ecosystem.

### ***Measures to be taken by the Maharashtra government to reduce water pollution***

Strict norms are to be integrated by the government of Maharashtra and Nashik Municipal Corporation, for the reduction of water pollution in the Nandini River. 100% collection of wastewater needs to be performed by the governing bodies, especially from the municipal area and Trimbakeshwar sector in Maharashtra, as these regions have accounted for the highest levels of water pollution (Bhamare, 2019). The inclusion of different water treatment tactics is to be enabled within the cityscape to improve the overall water quality. For instance, the application of the in situ nalla treatment needs to be applied by the administrative bodies to note a betterment in their sewage water treatment.

On the other hand, as dictated by Sagar & Sangami (2022), the establishment of soak pits and protective walls for the rural and semi-urban areas, especially the villages in Maharashtra, needs to be performed. Such measures would be important for the reduction of any direct sewage in the Nandini River, improving the quality. A Common Effluent Treatment Facility needs to be erected by the governing bodies, especially at Satpur MIDC, to keep track of the sewage water being discarded into the river (Bhamare, 2019). With the initiation of goods and materials with several recyclable materials, the overall requirement for water will be lowered for the population. Such an aspect will be significantly important for heightening the overall water quality, and the formulation of novel by-laws will allow the government to keep track of the effluents being discharged.

## **8. CONCLUSION**

Hence, it can be established that there is a gradual decrease in the water quality on a global scale. As noted in the study, a humongous amount of the population, more than 3 million people, are already being subjected to the use of untreated sewage water for their daily chores on the global basis. Without the strategic application of methods and strict norms, the improvement of water quality will not be reached. In the case of Nandini, the government of Maharashtra and Nashik Municipal Corporation needs to consider potential measures for reducing the effluent from the urban site to be dumped into the surface water. As noted in the study, the drastic rise in the level of pollution in the Nandini River at the Nashik region needs to be controlled by running acute tests in a periodic manner. Tactical measures such as the treatment of sewage in the household being released into the sewage treatment plans, or the purification of the toxic chemicals from the industries, are to be adhered to the working of the social and the corporate sectors. Without the strict observation from the ends of the governing bodies of the nations, improvement of the water quality cannot be induced.

### **Future scope**

The stringent generation of goals and targets by the companies ought to be taken into consideration for the establishment of good water quality. In terms of the future scope of the study, the examination of the norms and the regulations which serve to have a positive effect on the production of good quality of water, and reduction of the levels of water pollution, can be approached. The exact situation on the society and the industries, whether the norms are actually being maintained, ought to be studied. The position of the regulations for the creation of sustainability and climate improvement needs to be checked and examined in a regular manner, for bringing about the necessary, forthcoming changes. Based on such considerations, the future endeavours regarding the following of the rules and the regulations are to be determined by the researchers.

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