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Study of Major Sources of Pollution in the River Kaliyasot by Anthropogenic Activities in Bhopal (M.P.)

Dr Roma Silawat[1], Dr Rajendra Chauhan[2]

[1]Researcher (PhD), Department of Zoology, Govt. Motilal Vigyan Mahavidhyalaya Bhopal M.P.
[2]Professor, HOD, Department of Zoology, Govt. Motilal Vigyan Mahavidhyalaya Bhopal M.P.

Abstract:
Today, problem of environment pollution is becoming more and more severe not only in India but around the world. Out of all these the problem of availability of clean drinking water is becoming adverse globally. India is a developing country, facing many problems but the problem of pure drinking water is becoming serious issue. Climate change is also aggravating the problem. Because of anthropogenic activities, climate is so unpredictable now. It is causing adverse alterations in the water quality.
The Kaliyasot river of Bhopal (M.P.) is under environmental stress owing to siltation, human encroachment, unplanned township, eutrophication, heavy industrialization, sewage disposal and other anthropogenic activities and many more. This research work deals with the study of various pollutants coming from major drains pouring their waste into river Kaliyasot.

Keywords: Climate Change, Environmental Stress, Anthropogenic Activities, Pollutants.

Introduction: Human-made Activities and their Effects on Environment

Industrial Pollution: Effects on the Kaliyasot River from Industrial Discharges

Agricultural Runoff: Pesticides, Fertilizers and Impacts on Water Quality

Urban Growth: Urbanization and the Impact on River Pollution

Waste Management: Improper Waste Disposal and contamination of Kaliyasot River

Conclusion: Addressing Pollution for a Healthier River

Introduction:

Since beginning of life on earth human civilization develop near water resources because all communities depend on water resources for their growth, existence, development, and survival. On our planet life and water are the two faces of the same coin[1]. Water is the principle and one of the cardinal requirements for existence and no one can visualize to live life without the valuable natural resource (air

and water)[2]. In the present frame work of modernization, there is improvement in every phase of industrialization which guide to give rise pollutants causing harmful alterations in aquatic ecosystem. The broad range of pollutants discharged into aquatic environment may affects the ecosystem unfavorably[3]. The life of aquatic creatures directly or indirectly depends on the water quality in the aquatic ecosystem[4]. On account of copious factors which can bring about threats not only to the biodiversity of the river but also to the people health which are directly or indirectly depend on the resources and the aquatic life is adversely affected[5,6]. India is a huge and developing country has more than 200 rivers out of which many rivers are polluted now, due to anthropogenic activities. The government of India is doing their best for the rejuvenation of the rivers by proper Action Plans like Namami Gange from 2014 and Namami Devi Narmade from 2016 etc. Water pollution is "ANY PHYSICAL, CHEMICAL OR BIOLOGICAL CHANGE IN WATER QUALITY THAT HAS A HARMFUL EFFECTS ON LIVING ORGANIMS OR MAKE WATER UNSUITABLE FOR DESIRED USES IS KNOWN AS WATER POLLUTION."[7]

Bhopal, state capital of Madhya Pradesh, famous for its beauty of Dams and Lake. Kaliyasot Dam is one of them based on Kaliyasot river i.e., a tributary of river Betwa. The Kaliyasot is a river in Northern India, originates from Kaliyasot Dam as an over flow of the dam and flows south-east. During its flow from origin to end (before joining river Betwa near Bhojpur) travels a distance of about 29 kms. The flow in the river is seen only in the rainy season. The river is non- perennial, completely remains dry for 8-9 months. During non- rainy season water collects in pockets, mostly sewage. No bathing ghats and no domestic water supply is made. The river collects the domestic waste-water of part of Bhopal, villages in the catchment area and part of industrial area Mandideep all the year. The present research work studies about various sources of pollutants in the river Kaliyasot by major drains pouring its wastage in the source.

Study Areas: During the journey of river from its starting point to the ending point there are many sources of contamination. The Kaliyasot river serves the irrigation water for the agricultural forms falling in the catchment basin of the Kaliyasot. Simultaneously waste water from part of Bhopal town, near villages and part of industrial area Mandideep around the whole year. The waste water originated from north-eastern region of Bhopal city pass through Patra Nallah (joining Halali river) and accumulated in the Halali Dam. On the downstream of Vidisha, overflow of Halali Dam meets river Betwa. The central and southern waste water of Bhopal city is drained into river Kaliyasot before its joining to river Betwa at Bhojpur.

Kaliyasot river suffering from heavy eutrophication & urbanization in its catchment area River Kaliyasot is contaminated by domestic and industrial pollutants as it gains sewage and other waste through five major drains carrying sewage from Bhopal, Misrod and Mandideep regions. Scanning of the water quality shows at all these drains carry sewage rich water which ultimately reaches river Kaliyasot, in fact the flow in the river is seen only because of these drains specially during non-rainy season. Following are the sampling stations during the research work.

1. Kolar Road Shahpura Lake (Site I): Near Bansal Hospital, the flow from Shahpura Lake joins the river Kaliyasot. The Shahpura Lake gets sewage from T.T.Nagar, M.A.N.I.T., Charimli, Chunabhatti, Panchsheel Nagar etc. (co-ordinates: 23.20088, 77.421968). The river also receives sewage from colonies located on Kolar Road through several small drains.
2. Mandideep Nallah No.1 (Site II): The sewage from the localities in the western part of Mandideep enclose by villages is drained into the Kaliyasot through this nallah near village Samardha Kaliyasot, Mandideep (co-ordinates: 23.1007565, 77.502030).
3. Mandideep Nallah No.2(Site III): The colonies in the south-eastern part of Mandideep region pour sewage into this river through this nallah at the back of Maxson Health Care Industry Mandideep. (co-ordinates: 23.11250, 77.51222).
4. Mandidep Nallah No. 3(Site IV): The encampment in south-eastern part of Mandideep drains the sewage into the river through this nallah beyond Satlanpur village, near Bhaskar Industries Mandideep. (co-ordinates: 23.1158683,77.524842)
5. Misrod Nallah (Site V): Misrod area colonies and nearby villages unload sewage into the river by this nallah at about 500 meters from Bhojpur road near Deepdi village (co-ordinates:23.132818,77.525439).

Materials and methods: Kaliyasot River exposed to extensive anthropogenic stress, collect heavy inputs of domestic waste and sewage. 5 sampling sites were selected for this work. The samples were collected on 02.09.2022 in the month of September in rainy season and subjected to analysis following the procedures prescribed by APHA (1985)[8] for physical parameters like pH, TDS, SS, phosphate, sulphate etc. The water samples were instantly transported to the laboratory for complete analysis. D.O., temperature, pH, were calculated on the spot.

Results: Following are the obtained outcomings of the work

pH: pH is the measure of Hydrogen ion concentration. The growth, development and appetite of aquatic organisms reduces when water is acidic in nature (less than 7). In this study values of pH from minimum 7.52 to maximum 8.3 at site I and site V respectively. (Table 1 & Graph 1.1)

Total Solids: It contain many kinds of nutrients and regulate the suitability of potable water. They restrict the passage of light and affect photosynthesis activity. In the present research work total solids found in the range from minimum 480 mg/L at site V to maximum 1641 mg/L at site IV. (Table 1 & Graph 1.2)

Total Dissolved Solids: The higher the value of TDS the more is the uncleanliness of water. The values usually increase in rainy season. In this study the values of TDS were noticed from minimum 373 mg/L

at site V to maximum 1530 mg/L at site IV. (Table 1 & Graph 1.3)

Suspended Solids: In this study the values of SS were noticed from minimum 65 mg/L at site I to maximum 110 mg/L at site IV. (Table 1 & Graph 1.4)

Chloride: Chloride occurs naturally in all waters. Higher concentration indicates pollution by organic wastes of animal origin or by industrial pollutants. Higher concentration causes health issues in man. During the research work values of chloride varies from minimum 71.2 mg/L at site IV to maximum 249.1 mg/L at site II. (Table 1 & Graph 1.5)

Sulphate: During the research work values of sulphate varies from minimum 10.04 mg/L at site IV to maximum 11.44 mg/L at site I. (Table 1 & Graph 1.6)

Dissolved oxygen (DO): One of the most important limiting factors in aquatic ecosystem. When water temperature is high there is depletion of dissolved oxygen in water because of increased microbial activity. When the value of DO id lower than the average then the environment of water becomes unfit for aquatic animals. During the research work values of DO ranges from minimum 5.5 mg/L at site III to maximum 5.8 mg/L at site I. (Table 1 & Graph 1.7)

Biochemical Oxygen Demand (BOD): During the work BOD levels of Kaliyasot river water were found in the range of 9.2 mg/L – 21 mg/L. The higher value of BOD shows the presence of decomposable organic matters in the water. Showing the water pollution caused by organic pollutants. (Table 1 & Graph 1.8)

Chemical Oxygen Demand (COD): When pollution level is increased in water system it shows the increased level of COD. In the present research work COD ranged from minimum 38.1 mg/l to 306.9 mg/l at I and II respectively. (Table 1 & Graph 1.9)

Sodium: In water examination of sodium plays a significant role. In present research work the value of sodium ranged from minimum 46.5 mg/L at site I to maximum 394.72 mg/L at site III. (Table 1 & Graph 1.10)

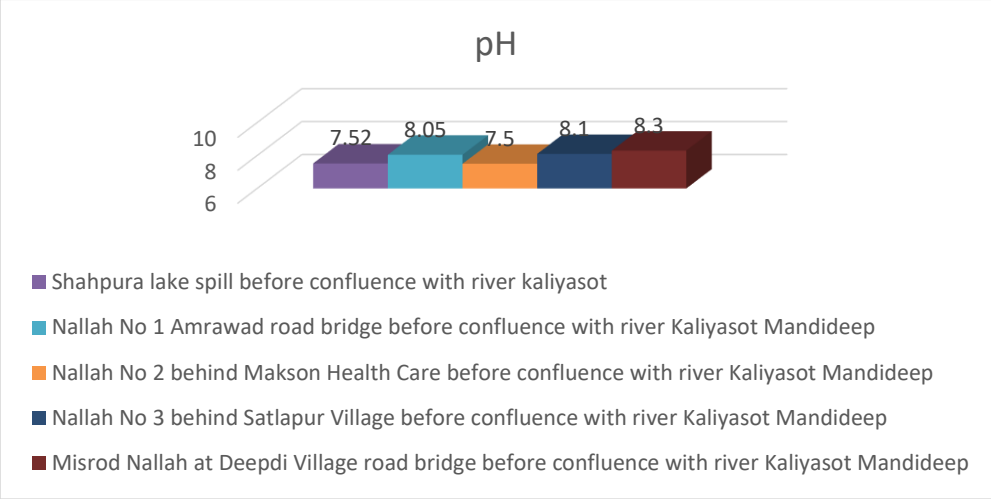
Coliform: Presence of coliform is not good for human health in the water resources. During the research work more than 1650 MPN/100 ml and fecal coliform found more than 1700 MPN/100 ml. All coliforms are not harmful but some strains are dangerous. Most strains of E. coli are not harmful, but some can cause serious issue in human infection, signs and symptoms include stomach cramps, vomiting, bloody diarrhea, fever. The bacterial infection can also cause urinary tract infection, pneumonia, and other respiratory problems. (Table 1 & Graph 1.11a & Graph 1.11b)

Phosphate: It is key nutrient for the plant growth. Its higher value in water is due to agricultural wastage and use of fertilizers in fields because of land runoff and anthropogenic wastage. It may enter through surface water run-off. In this research work lower values of phosphate recorded 0.41 mg/L at IV and higher value of recorded 0.53 mg/l at III. (Table 1 & Graph 1.12)

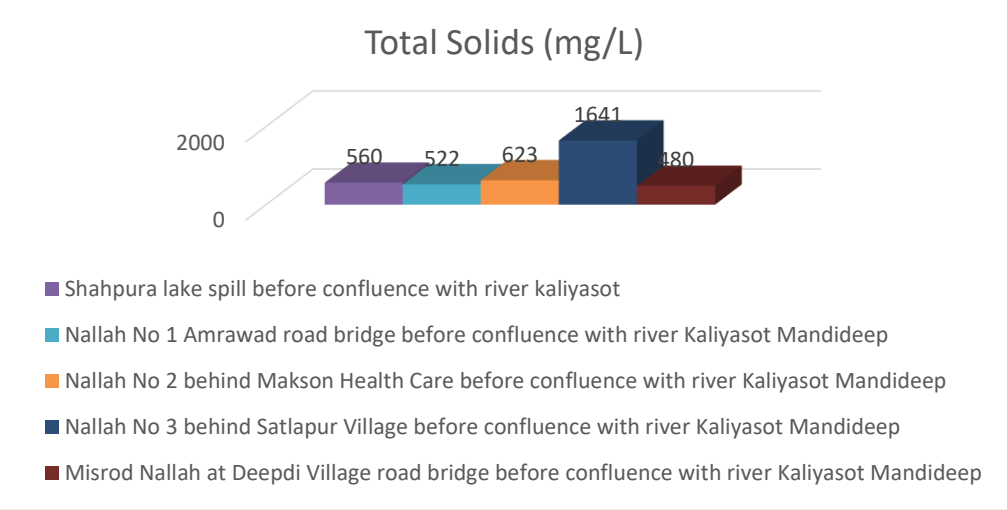
Nitrogen: Ammonium nitrogen is not detected in all the sampling sites. Nitrite nitrogen is found in the range of minimum `1.30 mg/L at site III to maximum 1.32 mg/L at site I. Values of nitrate nitrogen range from minimum 8.78 mg/L at site V to maximum 9.54 mg/L at site I. (Table 1 & Graph 1.13a & Graph 1.13b)

Sno	Parameters	Unit	Shahpura lake spill before confluence with river kaliyasot	Nallah No 1 Amrawad road bridge before confluence with river Kaliyasot Mandideep	Nallah No 2 behind Makson Health Care before confluence with river Kaliyasot Mandideep	Nallah No 3 behind Satlapur Village before confluence with river Kaliyasot Mandideep	Misrod Nallah at Deepdi Village road bridge before confluence with river Kaliyasot Mandideep
1	pH	-	7.52	8.05	7.5	8.1	8.3
2	Total Solids	mg/L	560	522	623	1641	480
3	Total dissolved solids	mg/L	495	430	545	1530	373
4	Suspended solids	mg/L	65	85	74	110	100
5	Chloride	mg/L	234.9	249.1	103.2	71.2	102.5
6	Sulphate	mg/L	11.44	-	-	10.04	-
7	DO	mg/L	5.8	-	5.5	-	-
8	BOD (3 days at 27 C)	mg/L	4.2	21	17	8.1	9.2
9	COD	mg/L	38.1	306.9	154.1	232.2	75.4
10	Sodium	mg/L	46.5	184.72	394.1	358.1	95.1
11	Total Coliform	MPN/100 ml	>1650	>1650	>1600	>1670	>1600
12	Fecal Coliform	MPN/100 ml	450	135	355	1700	1010
13	Phosphate	mg/L	0.5	0.49	0.53	0.41	0.49
14	Ammonium Nitrogen	mg/L	-	-	-	-	-
15	Nitrite Nitrogen	mg/L	1.32	-	1.3	1.31	-
16	Nitrate Nitrogen	mg/L	9.54	9.5	8.89	9.05	8.78

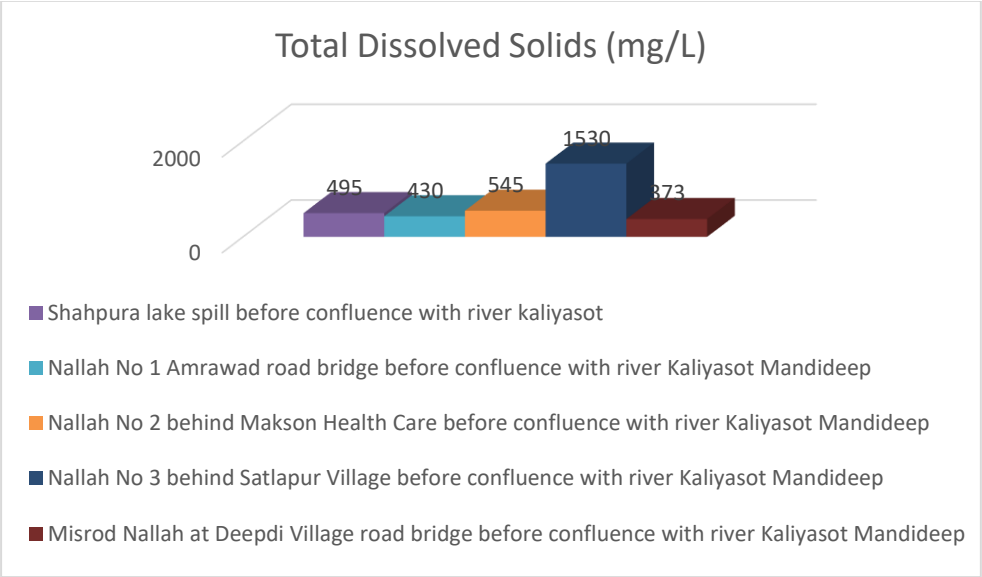
Table 1: Table showing results after taking sample on 02.09.2022 for different pollutants present in the river Kaliyasot adding up by major drains.



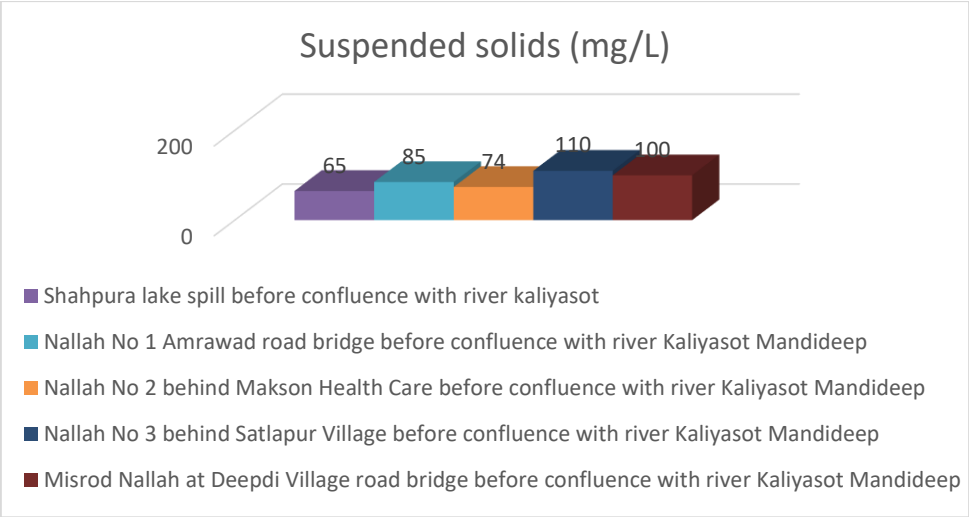
Graph 1.1 Showing results of pH levels from different sampling sites



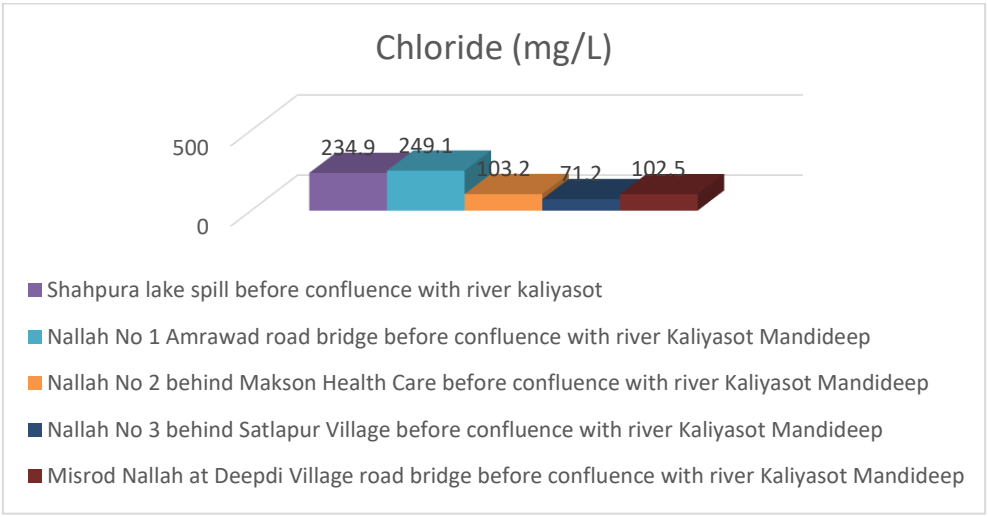
Graph 1.2 Showing results of levels of Total Solids from different sampling sites



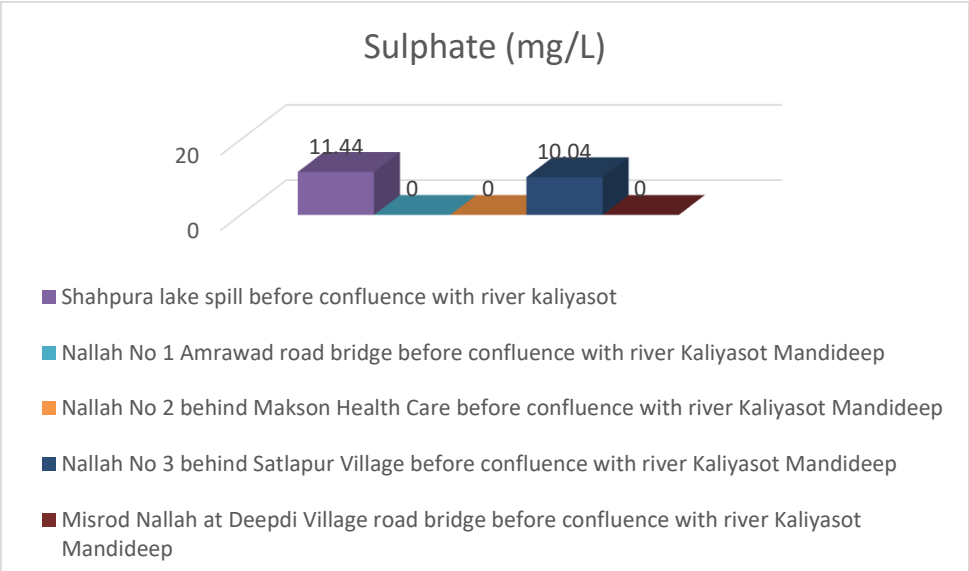
Graph 1.3 Showing results of levels of Total Dissolved Solids from different sampling sites



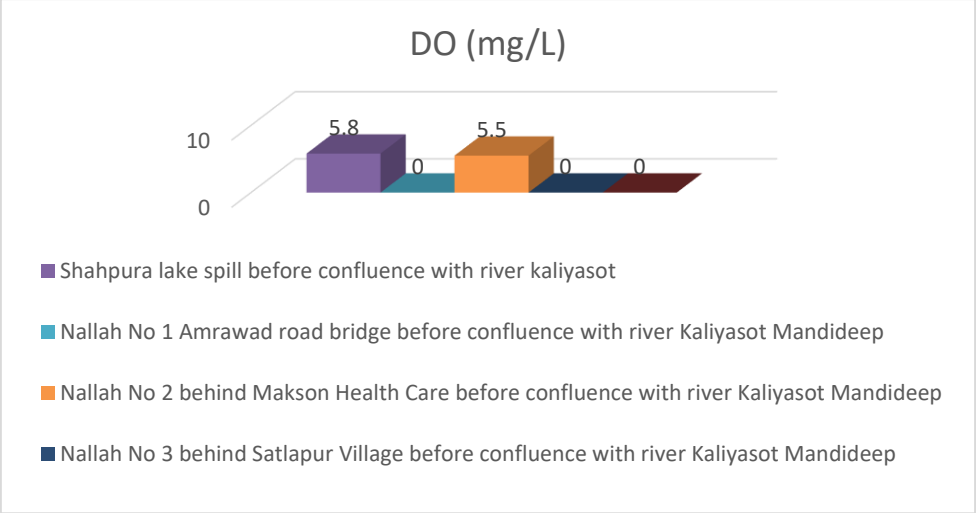
Graph 1.4 Showing results of levels of Suspended Solids from different sampling sites



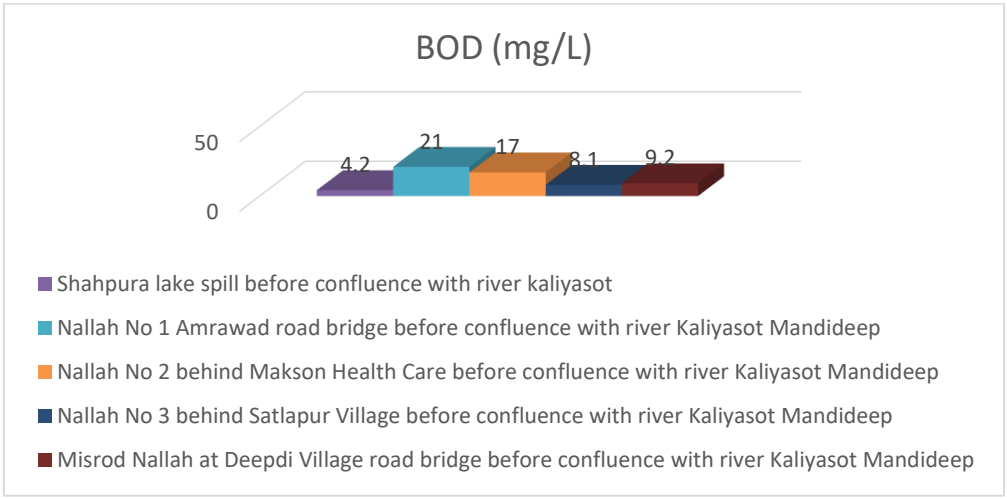
Graph 1.5 Showing results of levels of Chloride from different sampling sites



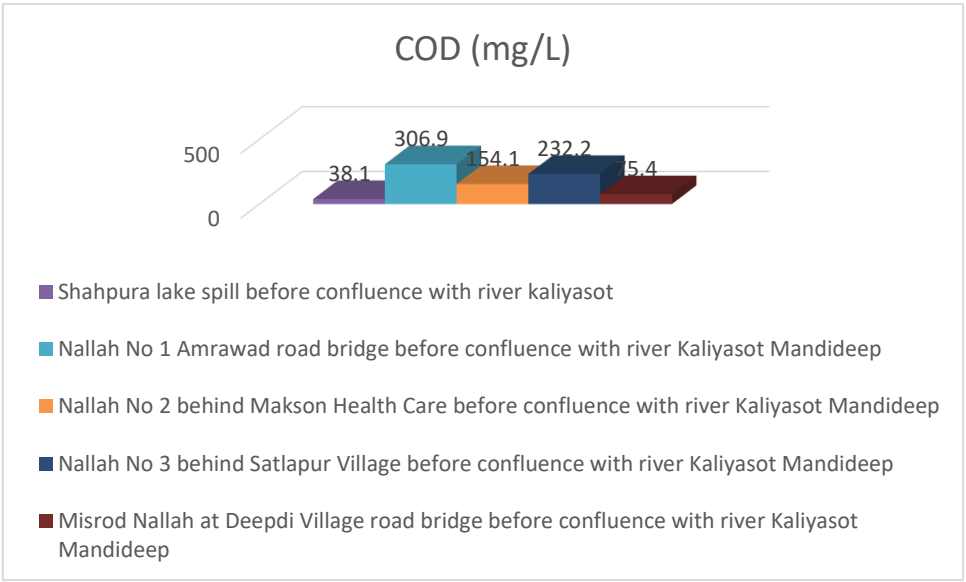
Graph 1.6 Showing results of levels of Sulphate from different sampling sites



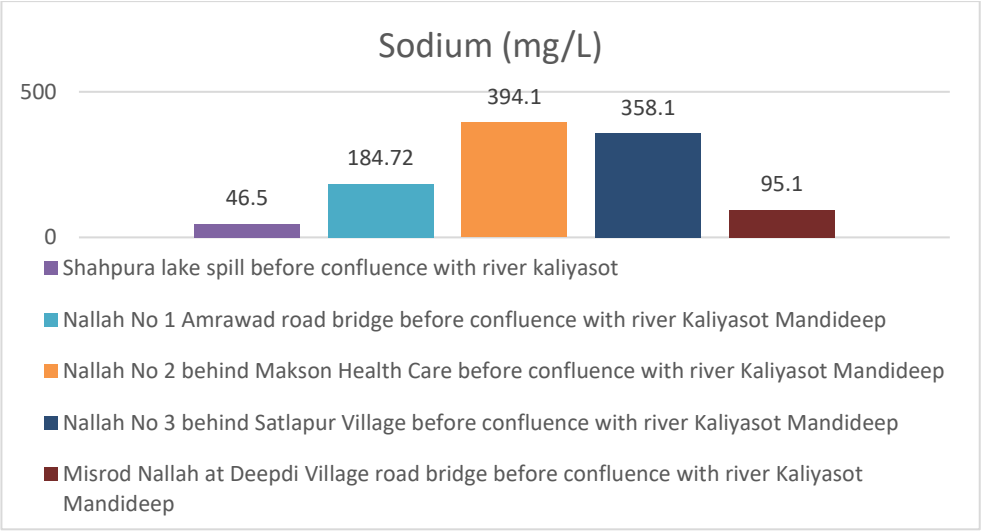
Graph 1.7 Showing results of levels of DO from different sampling sites



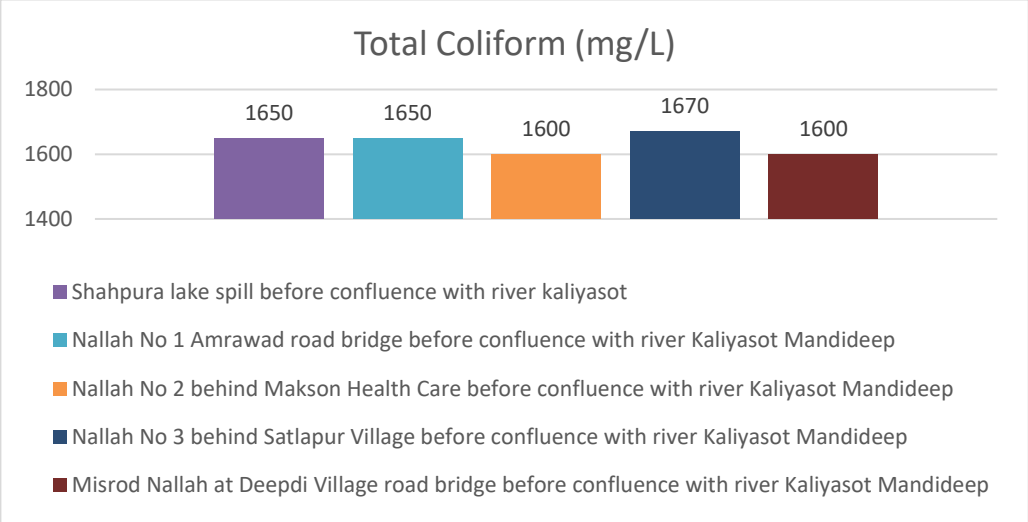
Graph 1.8 Showing results of levels of BOD from different sampling sites



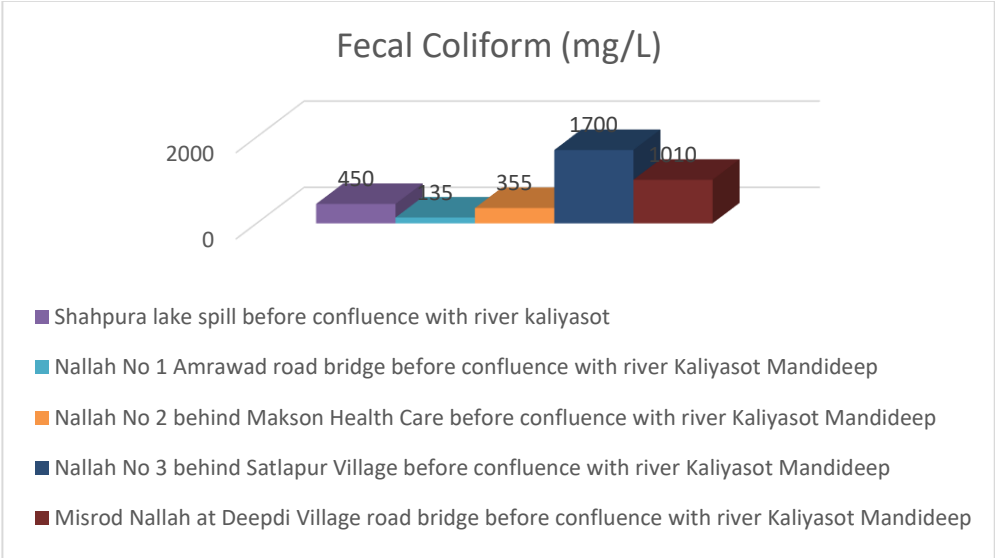
Graph 1.9 Showing results of levels of COD from different sampling sites



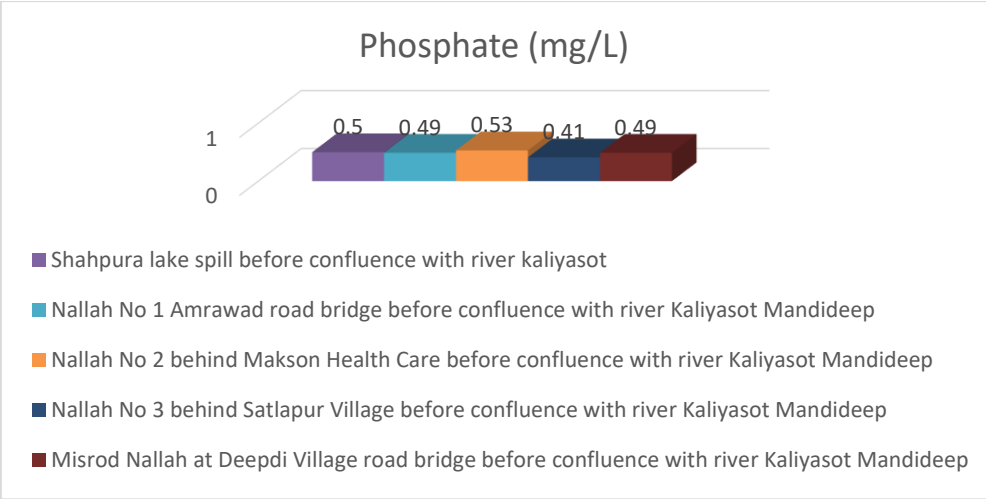
Graph 1.10 Showing results of levels of COD from different sampling sites



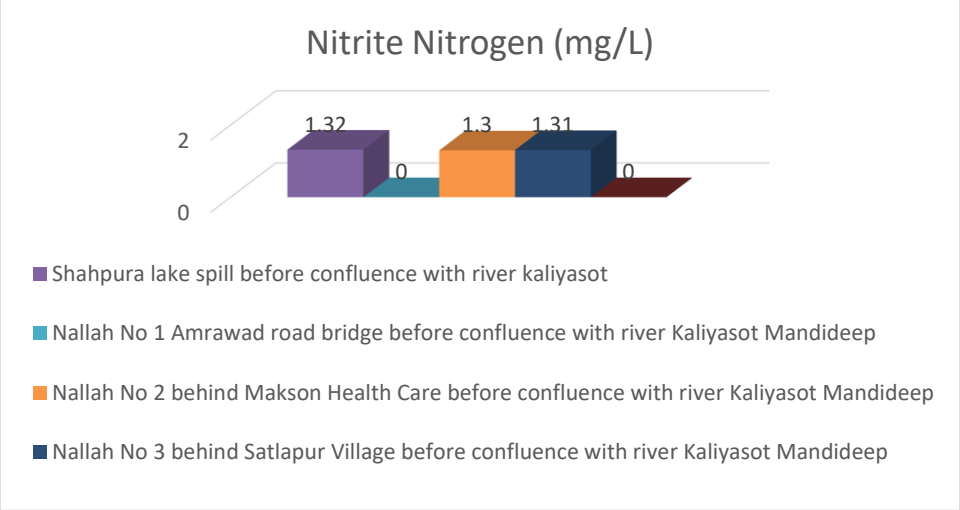
Graph 1.11a Showing results of levels of Total Coliform from different sampling sites



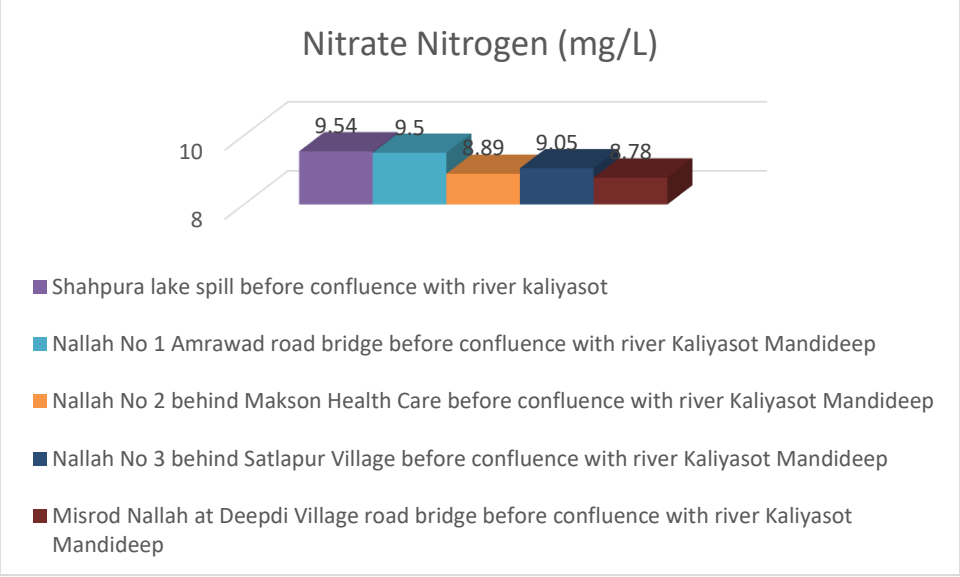
Graph 1.11b Showing results of levels of Fecal Coliform from different sampling sites



Graph 1.12 Showing results of levels of Phosphate from different sampling sites



Graph 1.13a Showing results of levels of Nitrite Nitrogen from different sampling sites



Graph 1.13b Showing results of levels of Nitrate Nitrogen from different sampling sites

Action Plan: The action plan will comprise components like spotting of polluting sources including operating/ status of STPs/ETPs/CETP and solid waste supervision and processing facilities, quantification and enacting of solid waste, trade and sewage generated in the drainage basin of polluted river extend. The action plan will mark issues connecting to; adopting good irrigation practices ground water extraction, rain water harvesting, ground water charging, protection, and management of Flood Plain Zones (FPZ), maintaining minimum e-flow of river and riverine plantation. Establishment of biodiversity parks on flood plains zones by removing encroachment shall also be contemplate as a significant element for river rejuvenation. The action plan should pivot on proper capturing and diversion of sewage carrying drains to the Sewage Treatment Plant (STP) and prominence should be on fulfillment of treated sewage to minimize extraction of ground or surface water. The action plan should have definite, speedy, or specific timelines for implementation of steps. Supply may be made to utilize funds from State budgets, to pool the resources, State Pollution Control Board/ Committee and out of Central Schemes, local bodies[9].

Conclusion: When there is flow in the Kaliyasot river during post-monsoon season the average water quality is “C.” after from the month of November the flow in the river is non-adjoining and at the same point where the river has no flow, then the water quality of the stagnant water in pockets may go down to “D” or “E” category. The Kaliyasot river water is polluted to such a extent as its water can only be used for irrigation purposes not for domestic uses. Therefore, Regular, Reliable, Effective and Continuous monitoring of water quality is mandatory for the good aquatic ecosystem.

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Conflict of Interest: There is no financial, personal, institutional, intellectual editorial conflict during the work done.

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