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Study of Mutha River Water Quality with Respect to its Conservation and Restoration

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Abstract: Water is life, in all forms and shapes. In the past 100 years the world population tripled, but water use for human purposes multiplied by six fold. By 2025 an estimated 4 billion people, or more than half the world population, will live in countries where more than 40% of renewable resources are withdrawn for human uses. River is an important resource of surface water for domestic and irrigation purposes. Currently, the quality of river water is a matter of serious concern due to rapid increase in the population, urbanization, industrialization and deforestation. The available river water resources are getting depleted and being adversely affected both qualitatively and quantitatively. River water quality is highly variable, which depends not only with regards to their spatial distribution over time. Assessment of seasonal changes in surface water quality is an important aspect for evaluating temporal variation of river pollution due to natural or anthropogenic inputs of point and nonpoint sources. As the resources are being depleted the supply for the water for domestic and industrial purposes whole depends on the present levels of the water.

Keywords: River, Anthropogenic inputs, industrialization, irrigation, deforestation, quality.

I. INTRODUCTION

Rivers are the one of the most important part of any civilization, Humans have begin using water from the river as the major resource of the water. Due to overuse of the river has led to the degradation of the river water quality over the last few decades. The amount of the sewage generated in Maharashtra is 8143 MLD and the capacity which is treated by the installed plants is 5160 MLD Pune, located in the State of Maharashtra lies on the western margin of the Deccan plateau, on the leeward side of the Sahyadri mountain range. The major concern of our project is the Mutha river which originates from the Khadakwasla dam and merges with the Mula river in Sagamwadi area.The river length covered by the project along the land is 10.4 kms. The growing urban activities have left these water bodies in vulnerable state. Due to lack of planning the rivers presently face growing levels of pollutants and rapid degradation, creating unhygienic conditions. Therefore, the city has turned its back to these rivers. These highly neglected rivers have raised concerns amongst the authorities and the citizens of Pune.

The impact of industrialization and urbanization had let up hazards disposal of sludge and garbage in the Mutha river which led to severe pollution of the river. Due to such irresponsible disposal of the industrial and domestic waste has disturbed the natural , biological and chemical parameters of the Mutha river, which has lead to the degradation of water quality. In order to maintain the quality of the river water various projects are initiated by various originations. For such projects detailed analysis of the river water is required for the further treatment of the water and for design of safety parameters for the disposal of industrial and domestic waste. The major problem is created by the direct disposal of untreated industrial and domestic waste is increase in toxicity of the river water and lead to reduction of dissolved oxygen leading degradation of aquatic life. The levels of various chemicals are drastically disturbed. The collection and analysis of the water sample collected from the various zones of the Mutha river will help in shaping the various safety parameters to be applied on the disposal of the untreated waste and domestic sewage in the Mutha river .This may help into restoration and conservation of the water quality of Mutha River. The application of the safety parameters will help in controlling the pollutant content of the river which will enhance the water quality, Aquatic life etc.

There are various method to determine the quality parameters of the river water such Dissolved oxygen, chemical demand oxygen, pH level, nitrates etc. For the determination of above parameters can be determined in the laboratory by the various methods.to determine such parameters the samples are taken from the different zones determined based on the various factors such as no. of the industries in the area and presence of sewage outlets in the river. There are various methods for controlling the quality of the waste disposed in the river such as construction of STP plants in the industries itself and constructing of STP in general for all the domestic sludge to be dumped in the river. The quality of the waste generated can be controlled by reducing the pollutants in at source of the waste.one of the other method is to treat the river water before it is supposed to be supplied for the further purposes.

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II. AIM & OBJECTIVES

The aim is to determine the various water quality parameters of the collected samples of the Mutha river.

A. Objectives

1) Collection of water samples from different zones of the river.
2) Experimental analysis of these samples according to various quality parameters
a) pH
b) Dissolved oxygen
c) Chemical oxygen demand
d) Electrical Conductivity
e) Nitrates content
f) Phosphate content
3) Comparison of the experimental results with standard values given by Central Pollution Control Board.
4) Suggestions for conservation and restoration of the Mutha river.

III. METHODOLOGY

A. Network Design

1) Sampling Stations

a) A-Warje bridge, Warje, Pune: This site is located near residential area resulting in disposal of domestic sewage.
b) B-Mahatre bridge, Kothrud, Pune: The Water Quality improves slightly at this station as water flows for certain distance and duration ,self-purification is observed.
c) C-RajaRam bridge, Erandwane, Pune: This site is located just downstream of the Khadakwasla and hence the sewage discharge problem magnifies in this zone.
d) D-Z bridge, Deccan, Pune: This site is located in highly populated area hence highly disposal of untreated domestic sewage in this zone.
e) E-Kasba peth bridge, Pune: This site is just located downstream of the bridge and hence slight self-purification is observed.
2) Method of Sampling: Grab Sampling: One sample is taken at a given location and time. In case of flowing river they are usually taken from the middle of the flowing stream. When the source is known to vary with time, spot samples are collected at suitable time intervals. Sampling intervals are to be chosen on the basis of the expected frequency with which changes occur.
3) Sampling Strategy
a) *Frequency of sampling:* Samples are collected in the interval of 15 days between 10am- 12pm.
b) *Sampling Preservations:* Samples for the parameter analysis of Dissolved Oxygen Is collected in Biochemical Oxygen demand bottle and preserved using Manganous sulphate and Alkali Iodide Azide reagents.

The procedure for the determination of the parameters is done according to AWWA / APHA: Standard methods for examination of water and wastewater, American Public Health Association.

IV. RESULTS AND DISCUSSIONS

A. Round 1

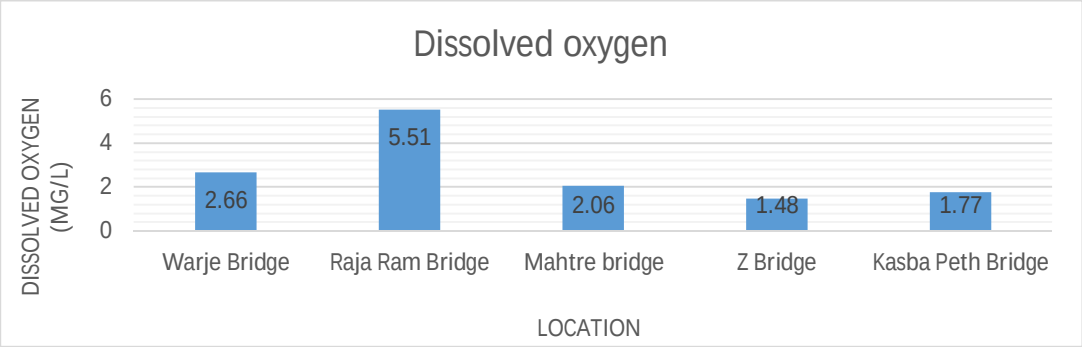

Figure 2: Variation of the Dissolved Oxygen of water sample at different locations

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1) *Dissolved Oxygen (DO):* Dissolved oxygen measurement is indicative of pollution levels and is necessary for maintenance of favourable conditions for growth and multiplication of aquatic life. It also reflects the degree of organic pollution of water. It is an indication of water with respect to balance between oxygen consuming and oxygen producing processes. The oxygen levels were at Warje Bridge (2.66 mg/L), but increases considerably (5.51 mg/L) at Rajaram Bridge suggesting that the river is underloaded with organic matter. At Mahtre Bridge site on River Mutha, low DO of 2.06 mg/L was observed, which decreased later as organic matter through sewage disposal got added and oxygen was utilized. The DO remains decreasing till Z Bridge (1.48 mg/L), but slightly went on increasing (1.77 mg/L) towards Kasba Peth Bridge.

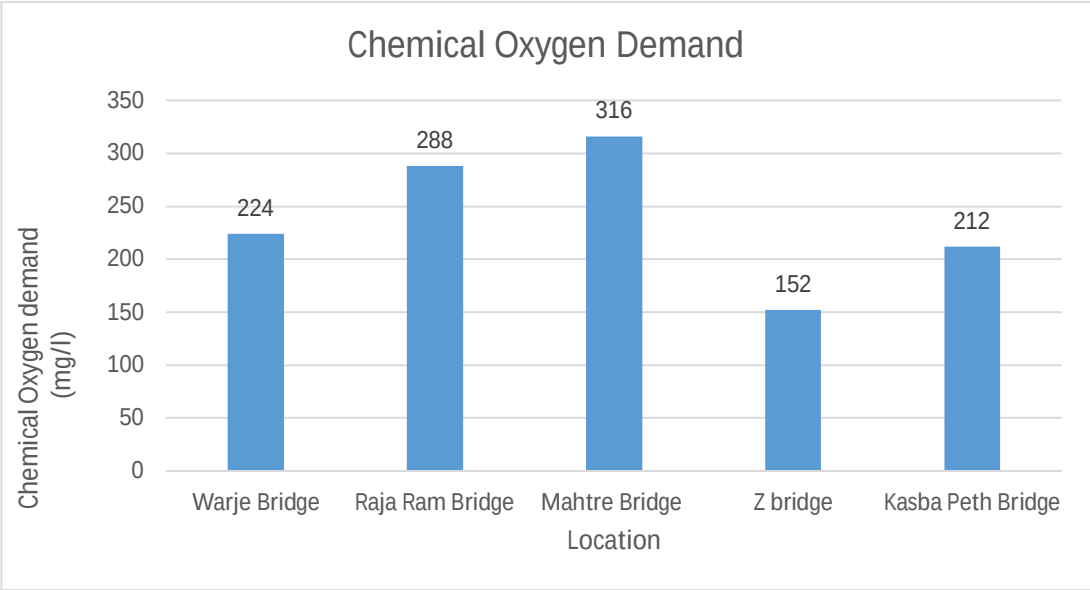

Figure 3: Variation of Chemical Oxygen Demand of the samples at different loctions.

2) *Chemical Oxygen Demand:* Chemical Oxygen Demand measurement is indicative of pollution levels and is necessary for maintenance of favourable conditions for Safe river water. It also reflects the degree of organic pollution present in the river water. It is an indication of oxygen exerted by the heterotrophic micro-organisms for the decomposition of both biodegradable and non biodegradable organic matter.The chemical oxygen demand varies from 152-316 mg/l. the Chemical Oxygen Demand went on increasing after Warje Bridge(224mg/l) upto mahtre bridge(316 mg/l). It further decreases from Z Bridge(152 mg/l) upto Kasba Peth Bridge(212 mg/l). The Chemical Oxygen Demand at Rajaram Bridge and Mahtre Bridge Indicates that the disposal of untreated sewage before Rajaram Bridge.

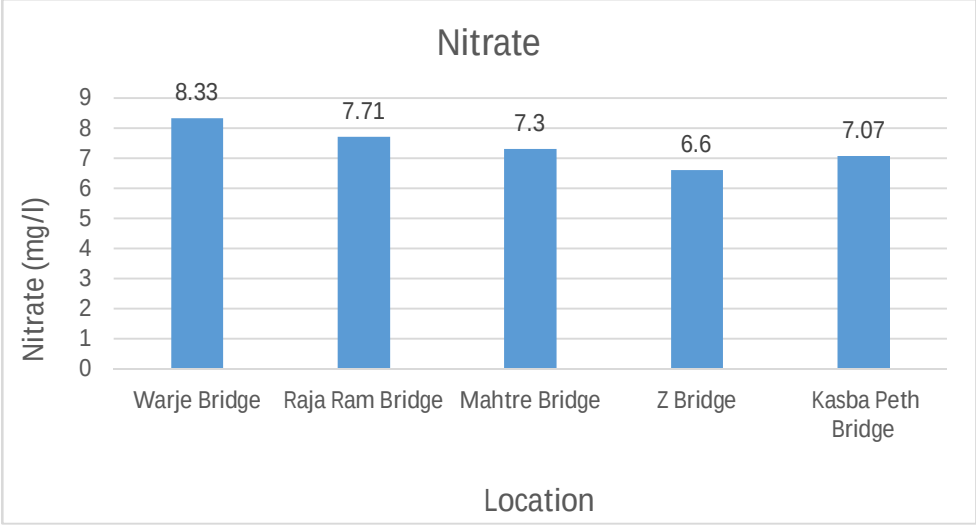

Figure 4: Variation of the Nitrate content in the sample at different location.

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3) *Nitrate:* The addition of wastewaters from chemical, fertilizer manufacturing and sewage contribute to nitrate. Nitrate concentration above 45 mg/L may cause methaemoglobinaemia (blue baby) in infants, a disease characterized by blood changes. The nitrate values varied from 8.33-7.07 mg/L. Higher values of nitrates were observed at Warje Bridge suggesting sewage addition at locations upstream. The values then went on reducing to before Kasba Peth site on river Mutha. This suggested that the decomposition of organic matter may be responsible for decreased values before Z Bridge or there was raw sewage discharge, which was not decomposed. In the Mutha river, values of nitrates were high after Warje Bridge and went on reducing for later sites suggesting that organic load has decreased, but they were slightly increased at Kasba Peth Bridge.

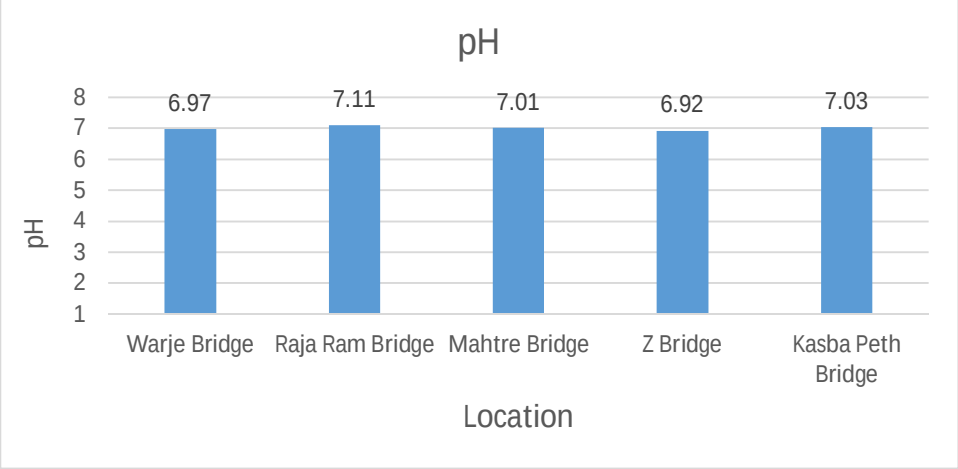

Figure 5: Variation of pH of the samples at different locations.

4) *pH:* pH is an essential parameter as it determines the acidity and alkalinity of waters. The pH at no polluted area i.e., Khadakwasla was 8.54. This pH turns into an acidic side as organic matter content of the river and pollution goes on increasing. Low pH was found near highly polluted Warje Bridge area(6.97). The pH again tends to become alkaline as the river travelled to Mahtre Bridge(7.01) through Rajaram Bridge (7.11). The pH tends to be acidic at Z Bridge(6.92) and becomes alkaline again at Kasba Peth Bridge.

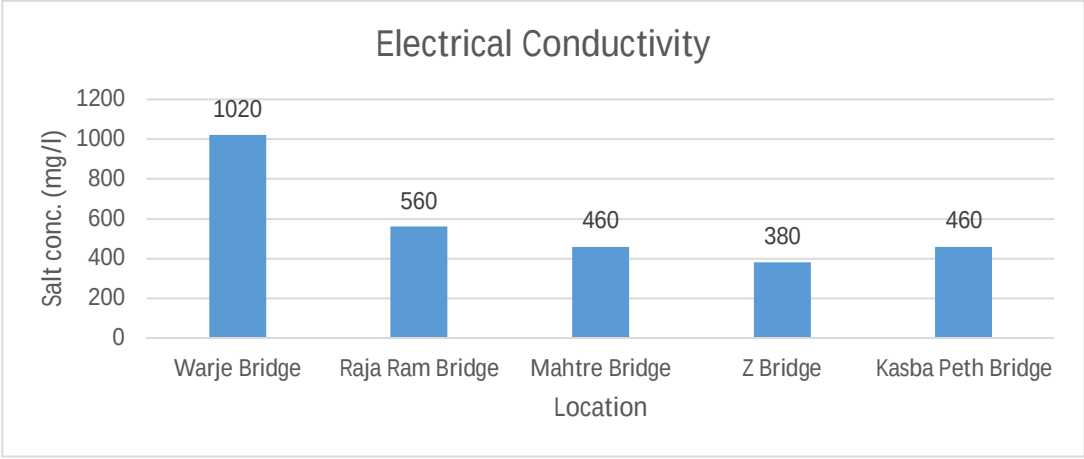

Figure 6: Variation of Electrical conductivity of the samples at different locations.

5) *Electrical Conductivity:* Conductivity gives an idea of the total salt concentration of water. The EC was low at Khadakwasla (0.098 micro mho/cm) and .This was due to low salts as these were non-polluted areas. The salt concentration went on decreasing after Warje bridge(1020) till Z bridge(380). The salt concentration then again went on increasing towards Kasba Peth Bridge as the organic matter was degraded in the process of flow and the ions either were precipitated, sediment or formed compounds.

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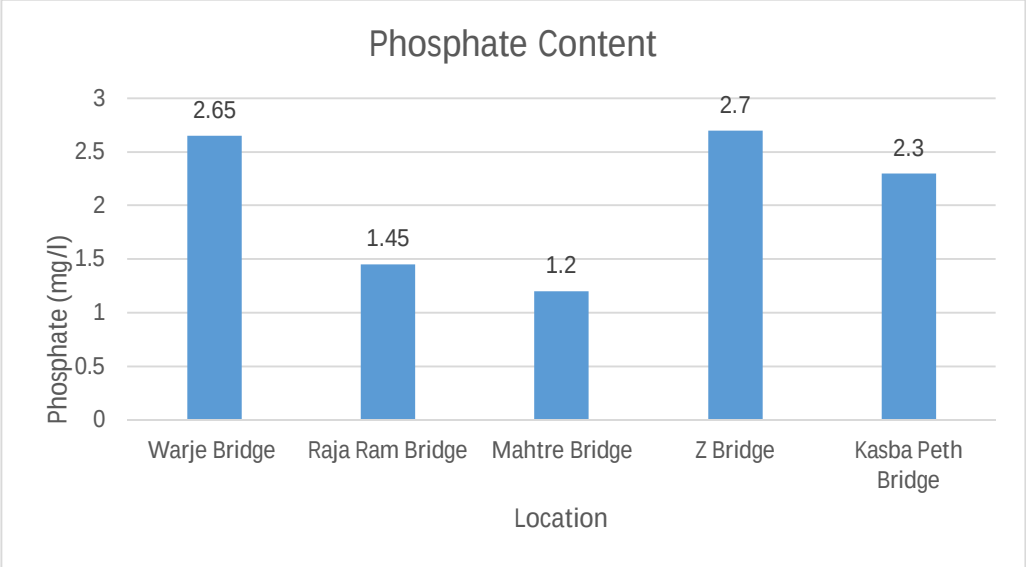

Figure 7: Variation of Phosphate Content of the sample at different locations.

6) *Phosphate:* Phosphate is useful in determining whether the pollution is due to domestic sewage. The range observed for phosphate was 1.2-2.7 mg/L. The lowest value was observed at Mahtre Bridge and highest at Z Bridge. The values at river Mutha increased gradually except at Rajaram bridge and Mahtre Bridge. This suggested that organic pollution went on increasing after Mahtre Bridge. Phosphate values were high at Warje Bridge then went on decreasing upto Mahtre and increased at and after Z Bridge, due to disposal of untreated Domestic sewage before Z Bridge.

B. Round 2

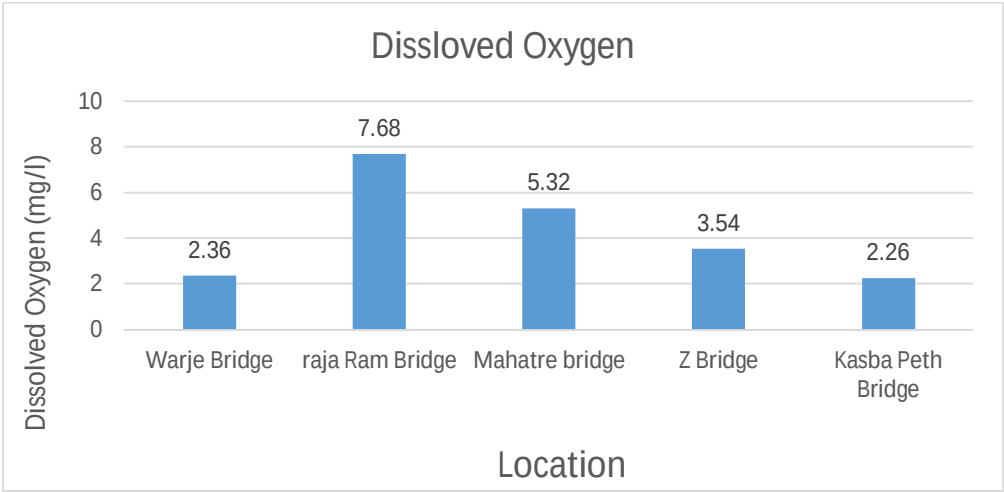

Figure 8: Variation of the Dissolved Oxygen of water sample at different locations

1) *Dissolved Oxygen (DO):* Dissolved oxygen measurement is indicative of pollution levels and is necessary for maintenance of favorable conditions for growth and multiplication of aquatic life. It also reflects the degree of organic pollution of water. It is an indication of water with respect to balance between oxygen consuming and oxygen producing processes. The oxygen levels were at Warje Bridge (2.36 mg/L), but increases considerably (7.68 mg/L) at Rajaram Bridge suggesting that the river is under loaded with organic matter. At Mahtre Bridge site on River Mutha, DO of 5.32 mg/L was observed, which decreased later as organic matter through sewage disposal got added and oxygen was utilized. The dissolved oxygen remains decreasing (2.26 mg/L) towards Kasba Peth Bridge.

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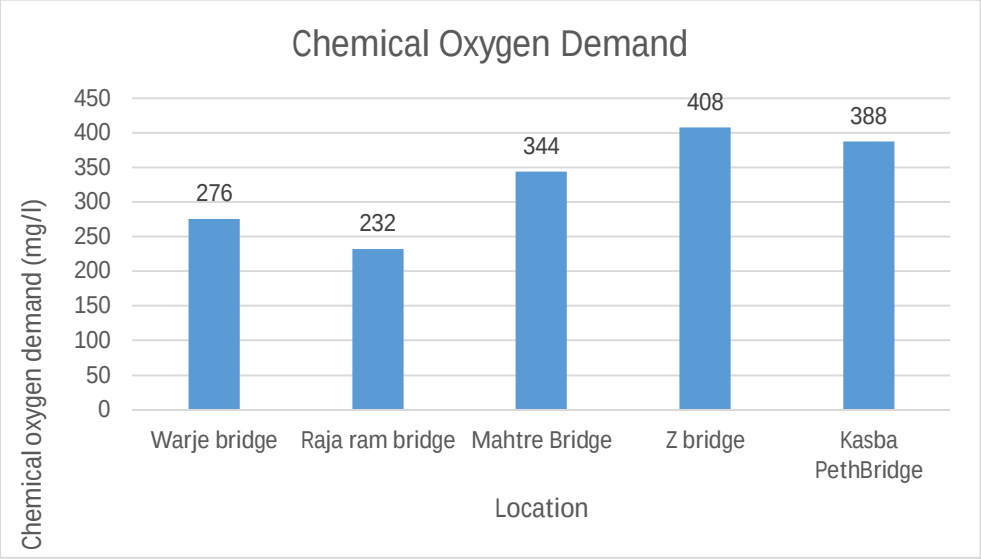

Figure 9: Variation of Chemical Oxygen Demand of the samples at different locations.

2) *Chemical Oxygen Demand:* Chemical Oxygen Demand measurement is indicative of pollution levels and is necessary for maintenance of favorable conditions for Safe river water. It also reflects the degree of organic pollution present in the river water. It is an indication of oxygen exerted by the heterotrophic micro-organisms for the decomposition of both biodegradable and non biodegradable organic matter. The chemical oxygen demand varies from 232-408 mg/l. the Chemical Oxygen Demand went on increasing after Rajaram Bridge(232mg/l) upto Z bridge(408 mg/l) and slightly decrease at Kasba Peth Bridge388 mg/l).The Chemical Oxygen demand at the Warje Bridge is (276 mg/l) and decreases further. The Chemical Oxygen Demand except at Rajaram Bridge and indicates that the disposal of untreated sewage before Rajaram Br

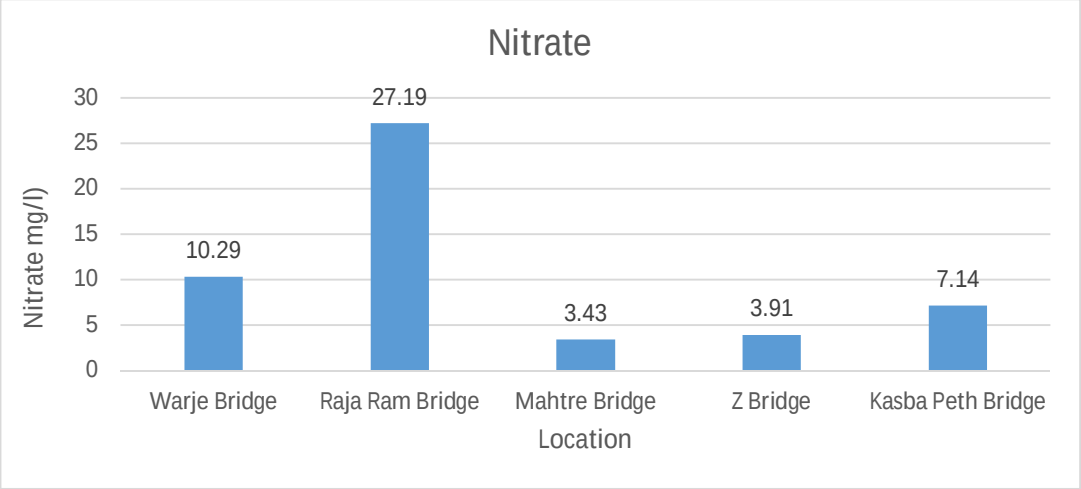

Figure 10: Variation of the Nitrate content in the sample at different location.

3) *Nitrate:* The addition of wastewaters from chemical, fertilizer manufacturing and sewage contribute to nitrate. Nitrate concentration above 45 mg/L may cause methaemoglobinaemia (blue baby) in infants, a disease characterized by blood changes. The nitrate values varied from 3.43-27.19 mg/L. Higher values of nitrates were observed at Rajaram Bridge suggesting sewage addition at locations upstream. The value at Mahtre Bridge were (3.43 mg/l) and went on increasing upto Kasba Peth Bridge. This suggested that the decomposition of organic matter may be responsible for decreased values before Z Bridge or there was raw sewage discharge, which was not decomposed. In the Mutha river, values of nitrates were high after Rajaram Bridge and went on reducing for later sites suggesting that organic load has decreased, but they were slightly increased at Kasba Peth Bridge.

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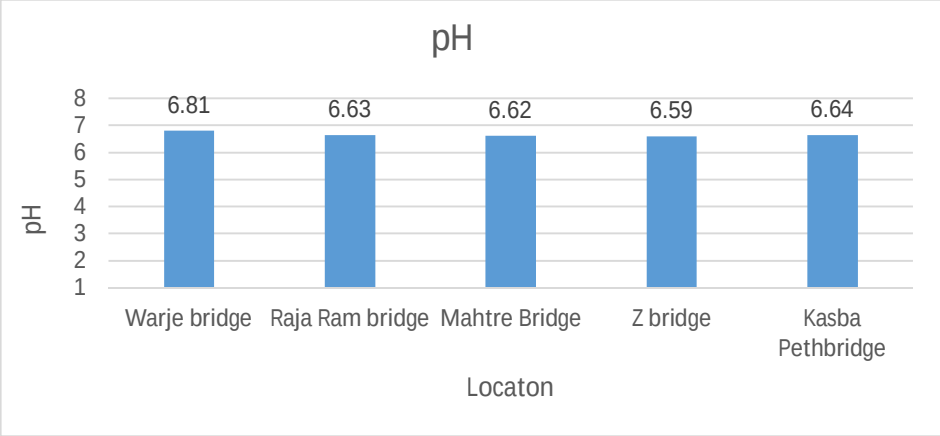

Figure 11: Variation of pH of the samples at different locations.

4) *pH:* pH is an essential parameter as it determines the acidity and alkalinity of waters. The pH at non polluted area i.e., Khadakwasla was 8.54. This pH turns into an acidic side as organic matter content of the river and pollution goes on increasing. Low pH was found near highly polluted Z Bridge(6.59). The pH throughout all the bridges is acidic.

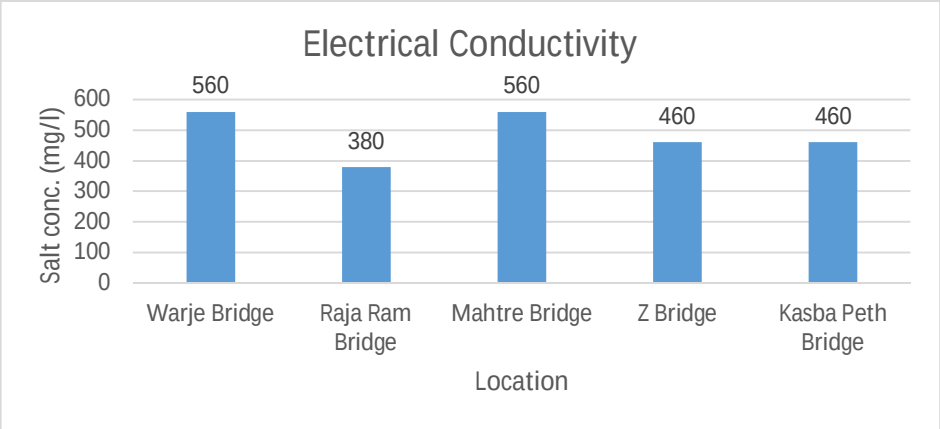

Figure 12: Variation of Electrical conductivity of the samples at different locations.

5) *Electrical Conductivity:* Conductivity gives an idea of the total salt concentration of water. The EC was low at Khadakwasla (0.098 micro mho/cm) and .This was due to low salts as these were non-polluted areas. The salt concentration went on decreasing after Warje bridge(560) till Rajaram Bridge(380). The salt concentration then again went on increasing at Mahtre Bridge as the organic matter was degraded in the process of flow and the ions either were precipitated, sedimented or formed compounds. The Salt Concentration goes on decreasing and remains constant at Z Bridge and Kasba Peth Bridge.

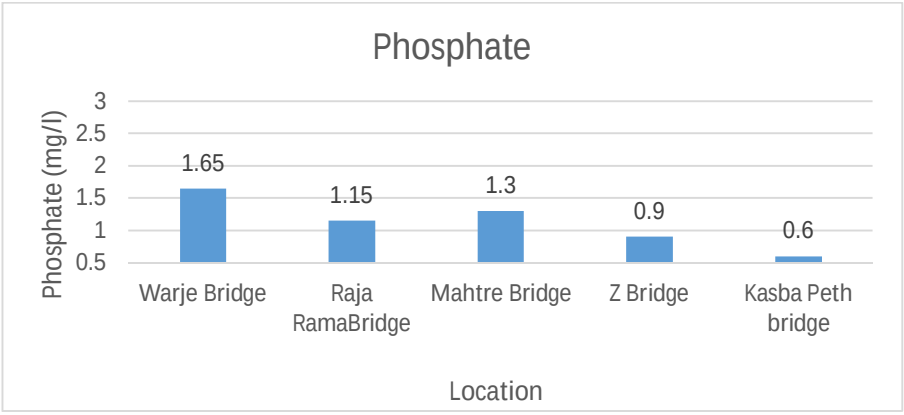

Figure 13: Variation of Phosphate Content of the sample at different locations.

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6) *Phosphate:* Phosphate is useful in determining whether the pollution is due to domestic sewage. The range observed for phosphate was 0.6-1.65 mg/L. The lowest value was observed at Kasba Peth Bridge and highest at Warje Bridge. The values at river Mutha decrease gradually except at Mahtre bridge. This suggested that organic pollution went on decreasing after Mahtre Bridge. Phosphate values were high at Warje Bridge then went on decreasing upto Rajaram Bridge and increased at Mahatre Bridge and decreases thereafter.

C. Round 3

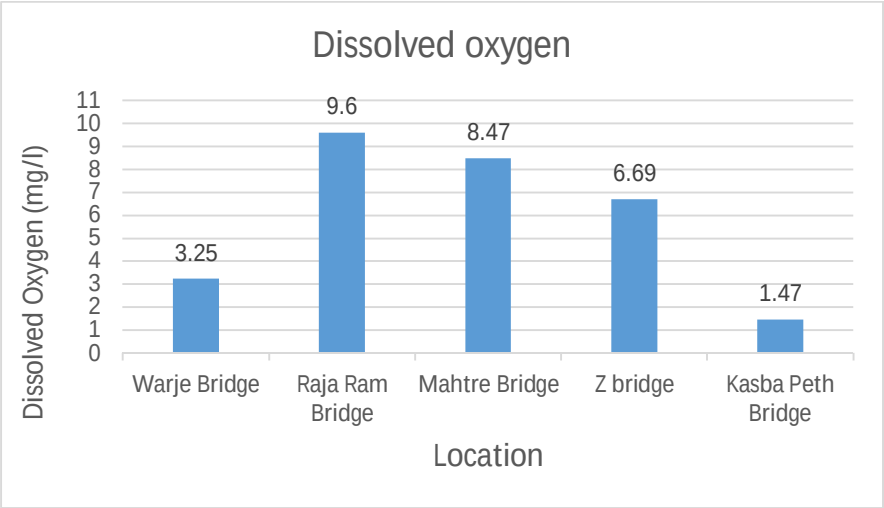

Figure 14: Variation of the Dissolved Oxygen of water sample at different locations

1) *Dissolved Oxygen (DO):* Dissolved oxygen measurement is indicative of pollution levels and is necessary for maintenance of favorable conditions for growth and multiplication of aquatic life. It also reflects the degree of organic pollution of water. It is an indication of water with respect to balance between oxygen consuming and oxygen producing processes. The oxygen levels were at Warje Bridge (3.25 mg/L), but increases considerably (9.6 mg/L) at Rajaram Bridge suggesting that the river is under loaded with organic matter. At Mahtre Bridge site on River Mutha, Dissolved oxygen of 8.47 mg/L was observed, which decreased later as organic matter through sewage disposal got added and oxygen was utilized. The Dissolved oxygen remains decreasing (1.47 mg/L) towards Kasba Peth Bridge.

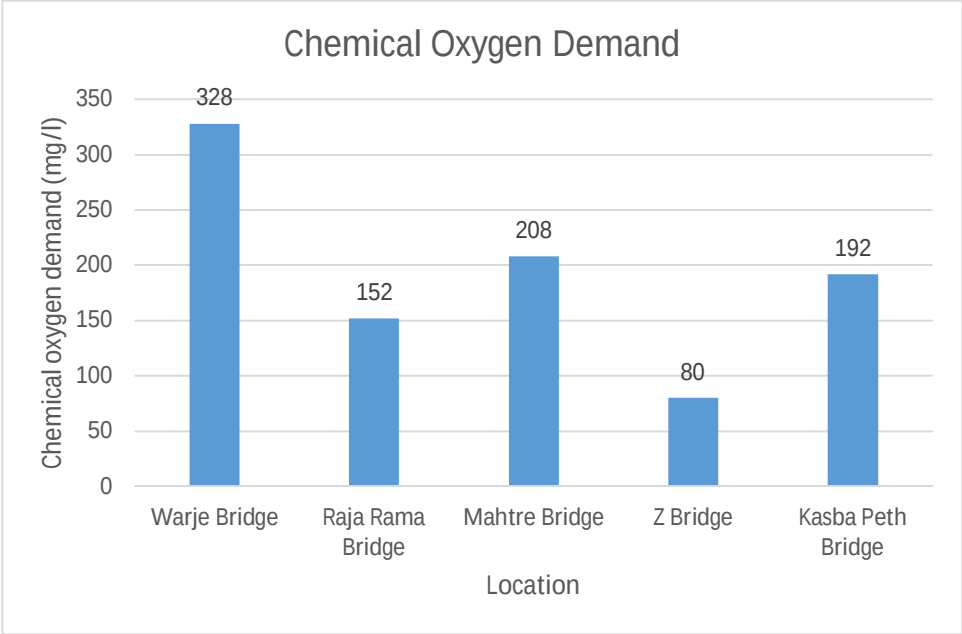

Figure 15: Variation of Chemical Oxygen Demand of the samples at different locations.

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2) *Chemical Oxygen Demand:* Chemical Oxygen Demand measurement is indicative of pollution levels and is necessary for maintenance of favorable conditions for Safe river water. It also reflects the degree of organic pollution present in the river water. It is an indication of oxygen exerted by the heterotrophic micro-organisms for the decomposition of both biodegradable and non biodegradable organic matter. The chemical oxygen demand varies from 80-328 mg/l. the Chemical Oxygen Demand went on decreasing after Warje Bridge(328mg/l) upto Rajaram bridge(152 mg/l) and slightly increase at Mahtre Bridge(208 mg/l).The Chemical Oxygen demand at the Z Bridge is (80 mg/l) and increases further. The Chemical Oxygen Demand at Warje Bridge indicates the disposal of untreated sewage before Warje Bridge.

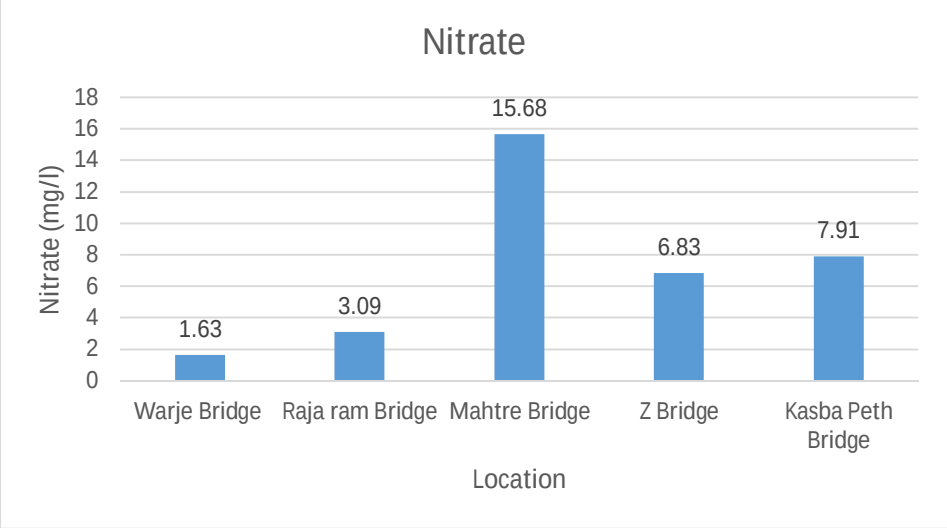

Figure 16: Variation of the Nitrate content in the sample at different location.

3) *Nitrate:* The addition of wastewaters from chemical, fertilizer manufacturing and sewage contribute to nitrate. Nitrate concentration above 45 mg/L may cause methaemoglobinaemia (blue baby) in infants, a disease characterized by blood changes. The nitrate values varied from 1.63-15.68 mg/L. Higher values of nitrates were observed at Mahtre Bridge suggesting sewage addition at locations upstream. The value at Mahtre Bridge were (15.68 mg/l) and went on decreasing upto Z Bridge and slightly increase at Kasba Peth Bridge. This suggested that the decomposition of organic matter may be responsible for decreased values before Mahtre Bridge or there was raw sewage discharge, which was not decomposed. In the Mutha river, values of nitrates were high after Rajaram Bridge and went on reducing for later sites suggesting that organic load has decreased, but they were slightly increased at Kasba Peth Bridge.

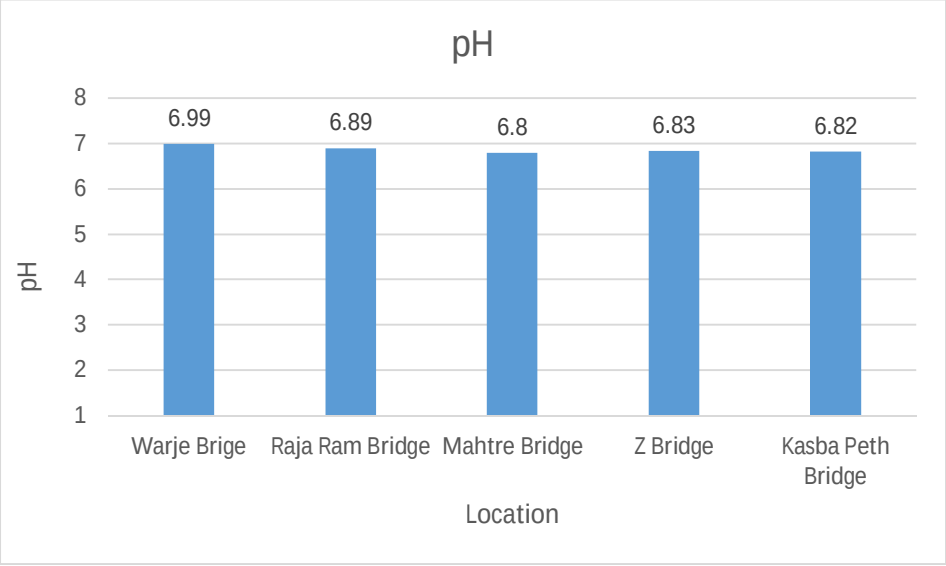

Figure 17: Variation of pH of the samples at different locations.

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4) *pH:* pH is an essential parameter as it determines the acidity and alkalinity of waters. The pH at non polluted area i.e., Khadakwasla was 8.54. This pH turns into an acidic side as organic matter content of the river and pollution goes on increasing. Low pH was found near highly polluted Mahtre Bridge(6.8). The water throughout all the bridges is acidic.

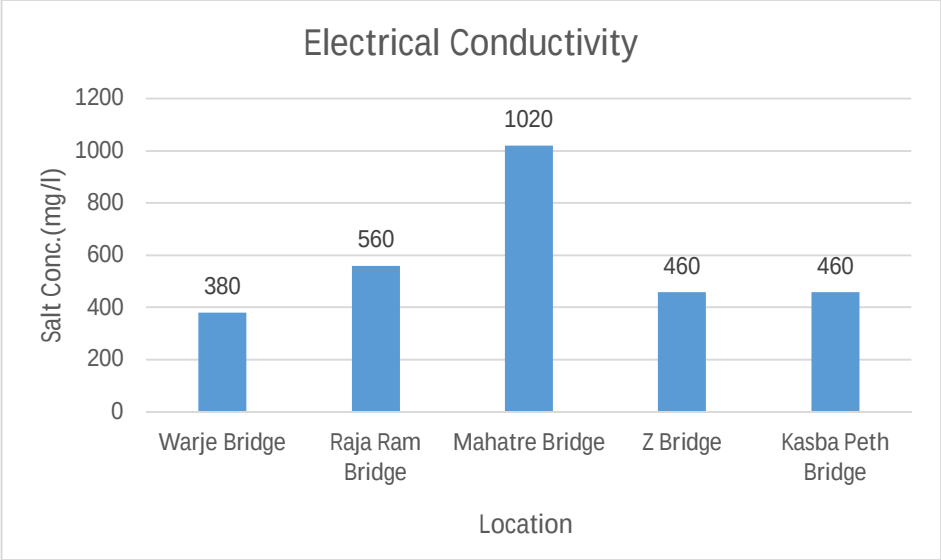

Figure 18: Variation of Electrical conductivity of the samples at different locations.

5) *Electrical Conductivity:* Conductivity gives an idea of the total salt concentration of water. The EC was low at Khadakwasla (0.098 micro mho/cm) and .This was due to low salts as these were non-polluted areas. The salt concentration went on increasing towards Mahtre Bridge(1020) as the organic matter was degraded in the process of flow and the ions either were precipitated, sedimented or formed compounds. The salt concentration went on decreasing after Mahtre Bridge (1020) and remains constant for Z Bridge and Kasba Peth Bridge.

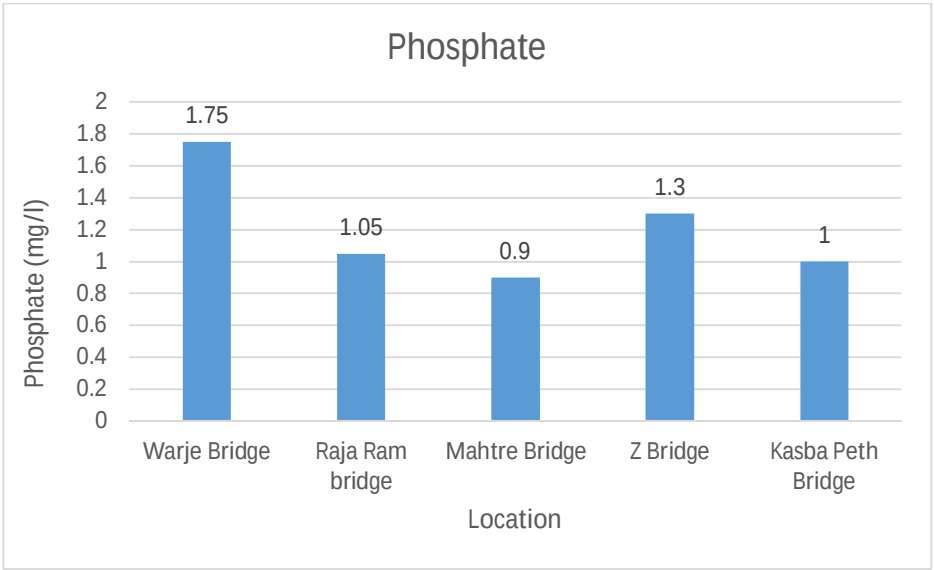

Figure 19: Variation of Phosphate Content of the sample at different locations.

6) *Phosphate:* Phosphate is useful in determining whether the pollution is due to domestic sewage. The range observed for phosphate was 0.9-1.75 mg/L. The lowest value was observed at Mahtre Bridge and highest at Warje Bridge. The values at river Mutha decreased gradually till Mahtre Bridgde and slightly increase and Z Bridge and Kasba Peth Bridge. This suggested that organic pollution went on decreasing after warje Bridge Bridge. Phosphate values were high at Warje Bridge then went on decreasing upto Mahtre and increased at and after Z Bridge, due to disposal of untreated Domestic sewage before Z Bridge.

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V. CONCLUSION

Increasing Water pollution is a major problem in all the rivers. Contaminated water is the biggest health risk and continues to threaten both quality of aquatic life and public health. From our analysis on Mutha River we concluded following points:

A. The analysis and results clearly shows that river water quality has deteriorated mainly due to Domestic sewage in case of Mutha river.

B. It is clear from the present analysis that the environment of the Mutha River showed Increasing load of pollution. There is need to have proper collection and treatment of waste and need to regulate the flow.

C. It is clear from the analysis that the phosphate content in the Mutha River is more than the permissible limit which indicates the disposal of untreated domestic sewage.

VI. RECOMMENDATIONS.

According to our research, the major sources of pollution of river Mutha are presence of dissolved salts and phosphate waste from temples, additional flow of domestic waste, and which is mainly organic matter, and other solid waste in to the water.

To reduce the pollution level of river, some measures should be implemented. Some kinds of measures which will help in reducing the degradation and pollution level of river are as follow:

1) Training cum Awareness program on waste reduction and disposal of untreated waste and their consequences, the program should invite allied units along the river. The programme should initiate basin wise approach for the reduction of sewage and waste.

2) *River Front Development:* River front development helps in increasing interaction of the people with river leading to the reduction in misuse of the river in terms disposing garbage dumping etc. There are many ways of development of river front such as:

a) Development of Parks, eateries, promenades along the banks. This structures should be at feasible heights to prevent the risk of flooding. This kind of development provides a barrier preventing people from directly interaction with river hence reducing the misuse such as bathing, washing of cloths, washing of vehicles etc.

b) Development of trenches along the Banks reducing direct misuse of the river.

3) Inspection of domestic waste discharged by various residential areas along the river and some limit should be fixed for parameters causing pollution.

4) Prohibiting the public entries and interference with water quality at river banks. Implementation of fines on dumping of garbage, Bathing, washing of vehicles etc.

5) Periodic checking and inspection should be done for wastes discharged from hotels and other small scale industries and households along the river.

6) Provision of small sewage treatment plants in the societies itself can help in treatment of sewage at the source hence reducing the untreated disposal of sewage and reducing the load on common STP plants in the surrounding area. Provision of common seage treatment plant around the residential area helps in reducing the the sewage disposal in river.

7) Festival issues: The major festival celebrated is Ganesh Chaturthi which leads to extensive idol immersion which leads to the increase in the pollution level to a greater extent. To prevent such actions separate sections should be provided for such activities. The other festival which increases the pollution level is Holi, to prevent such actions some rules should be implemented.

8) Implementation of rules and fine on the disposal of the sewage and other wastes should be implemented in order prevent extensive misuse of the river.

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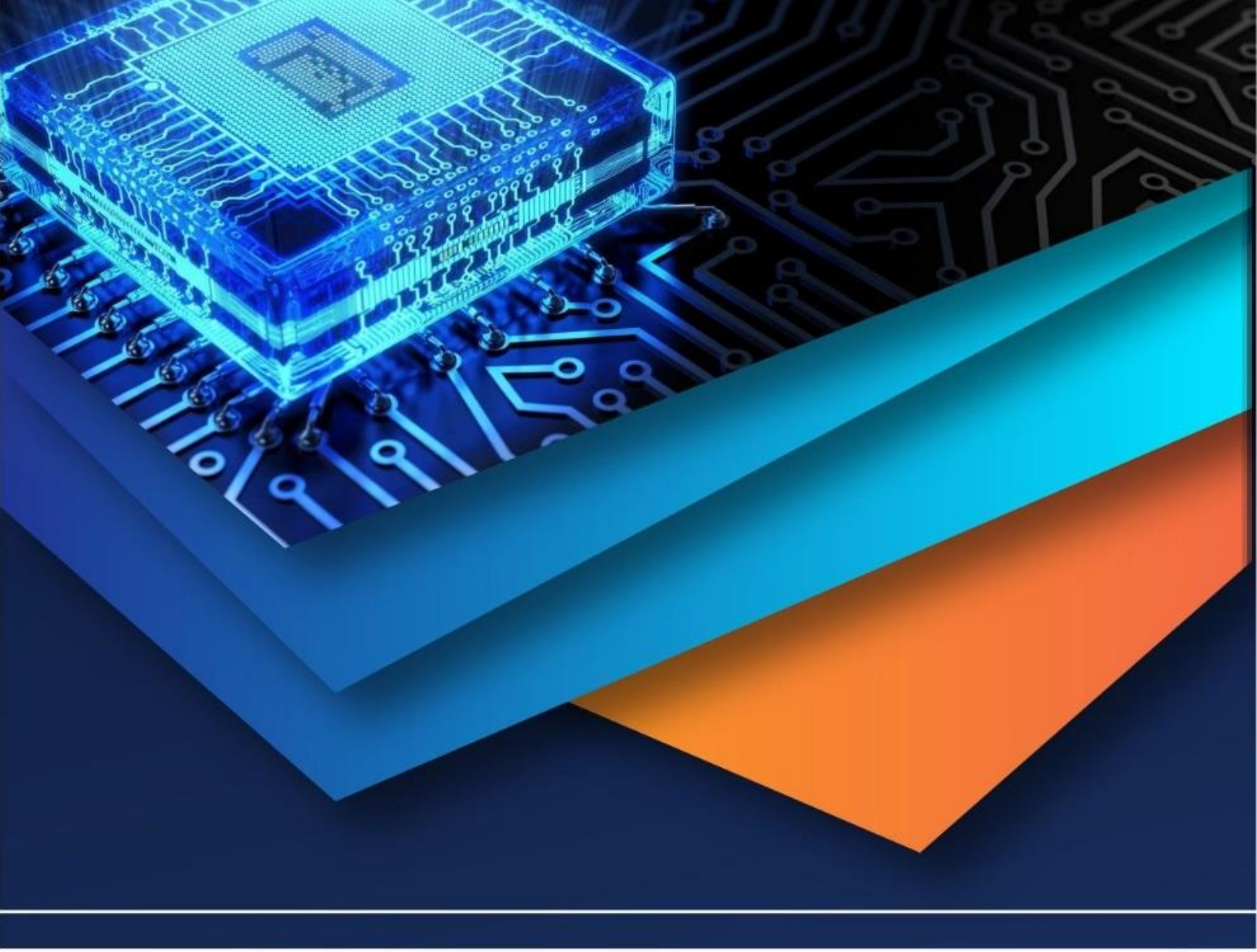

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