iJRASET
International Journal For Research in Applied Science and Engineering Technology



# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 8 **Issue:** VI **Month of publication:** June 2020

**DOI:** http://doi.org/10.22214/ijraset.2020.6271

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429*
*Volume 8 Issue VI June 2020- Available at www.ijraset.com*

# Empirical Analysis on Water Pollution in India: A Comparative study of Ganga, Narmada and Godavari Rivers

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***Abstract:*** ***Water contamination in India is a very major problem. And it keeps on rising with the increase in industrialization and urbanization. As India is a developing country some experiments of development become successful and some fails which cause the rapid increase in water pollution in India and other Developing countries. This water pollution is affecting each and every living being on this earth whether they are plants, animals (living on land or under water) or human being. Nevertheless, this increase in water pollution ask for measures and solutions, so the objective of our research work is to analyse the data with the help of Microfit by pesharan brothers by comparing the water pollution level for year 2010 and 2016 for three major river of India - Ganga, Narmada and Godavari. All the data is collecting from the original site of CPCB (central Board of Pollution Control). For comparison we have used the different parameters of water pollution like Temperature, Dissolved Oxygen, ph and Biochemical Oxygen Demand. We have also created two dummy variables to get the accurate result of water pollution in different district from which the river flows. This research provides a comprehensive understanding of water pollution and also explains its impact on different living beings.***

## I. INTRODUCTION

From centuries human is contaminating sources of drinking water with raw sewages which cause disease like cholera, typhoid etc. unknowingly. This contamination of water has increased from past years and now it is being contaminated by human knowingly. They discharge all the industrial waste which contain very harmful chemicals and substances into rivers without treating it which affect the quality of water and make it unfit for drinking and other household purposes. This contaminated water not only affects human life but also marine life. In India, nearly 70 percent of surface water resources and its groundwater reserves are contaminated because of biological, toxics, organic and inorganic pollutants. This degrading quality of water can also contribute in water scarcity as its use will be limited for human use and ecosystem. This paper provides better understanding of the effects of water pollution on different rivers bolstered by plots, charts and time series analysis that have been constructed using excel 2016 and Microfit by pesharan brothers. In this paper we will recognize the related work done on this field before to get the better understanding and to try find the solution of this. Further there will be detailed study of methodology employed and questions like why we have used those methods and technology will be answered. Next, we have discussed the results and conclusion we have concluded from the analysis of data and this will help researchers to understand water pollution in better ways and also the seriousness of this matter. The last section contain the citations and references used in this paper. As water pollution is the serious problem not only for India but all over the world so this force us find out the difference impact of water pollution on different species. We will compare the pollution level between rivers to check which river is most polluted river among these three. We will also compare the water pollution level for year 2010 and 2016 and check whether there is increase in the pollution level of these rivers or decrease. With the help of dummy variables created it will help in to check which district add in to most of the pollution when river passes through it.

## II. RELATED WORK

Water pollution is not only increasing in India but it is affecting he rivers globally. This research informs us that with emergencies in world, awareness of that emergency also arises among the people. There are several researchers who had estimated the condition and damages of water pollution through different approaches in different time frame. Anamika Barua [1] and Klaus Hubacek [2] have presented papers in which they have tried to find that if there is any relationship of Environment Kuznets Curve with water. EKC implies that as economic growth rises environment degradation also increases. For this they used per capita income and water quality indicators for sixteen states of India. With the help of econometrics analysis for panel data for year 20 years they found that decline in pollution with economic growth is temporary because it keeps on rising with increase in per capita income. And they also found that population density, Livestock population and literacy have strong effect on the quality of water.

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Water pollution is also the major cause of various health disease as the intake of contaminated water by household make them ill mainly, they suffer from disease called diarrhoeal. Purnamita Dasgupta [3] in her study focused on health damages incurred by urban households from contaminated water supplies. In her study she adopted a theory of utility maximizing consumer behaviour for estimating the probability of household's illness.

Anju Agrawal [4], Ravi S. Pandey [5], Bechan Sharma [6], Debesh Chakraborty[7] and Kakali Mukhopadhyay [8] focused on the factors affecting water pollution like fertilizers and pesticides, industrial pollution, sewage disposals etc. pesticides helps in increasing crop productivity but with this is also a serious threat to environment and also to the health of birds, humans, animals. The effects of these factors on riverine system is discussed in their reviews.

Beside this people also came with various protection policies on how to control this increase in water pollution so that it can be sustain for future generations. JunJie Wu [9], Mark L. Teague [10], Harry P. Mapp [11] and Daniel J. Bernardo [12] in their research paper discussed various protection policies. They evaluate four water quality policies in southern high plains of united states. Producers have to make various adjustment in respect to the policies like reduction in nitrogen and water use, removal of land from crop production and conversion from irrigated to dryland production etc. various taxes have been imposed on the use of nitrogen or water to restrict their usage for productions.

## III. METHODOLOGY

This analysis is based on the major rivers of India i.e. Ganga, Narmada, Godavari for the year 2010 and 2016. Basically, there is a comparison between the water pollution level of both the year.

An empirical analysis is done on the data collected from the official government site for pollution and parameters used for water quality tests are also provided by government. With the help of time series tools used for analysis we will be able give accurate results about the pollution level of these rivers. Autoregressive model is used on all the variables including dummy variable of all the rivers used in this paper.

If the model includes on or more lagged values of the dependent variable in its explanatory variable then it is called autoregression. For ex, If the value of Durbin Watson test is near to 2 and $R^2$ is near to 1 at the first lag of variable then it is AR (1) process and then if it is on another lag then it the value of AR process will be according to that. High the value of AR for that variable conclude the high amount of that parameter present in water and if the value of AR is less than the amount of that parameter is low in water.

The main aspects are source of data and representation of data.

### *A. Dataset*

Data is collected from government-approved organization's website in excel format. Information is collected from different sources to get evaluation more realistic.

Dataset used for comparing the water pollution level of three major rivers include several outlines i.e. station code, location, water quality parameters- temperature, dissolved oxygen, ph, biochemical oxygen demand.

### *B. Data Visualization*

In this paper, secondary data is collected from government-approved organization's website and statistical tools are applied oh them which include collection of data, analysis, interpretation, presentation and modelling to get the accurate results. This model classifies the water pollution level of three different major rivers of India and also shows different districts role in increasing the pollution level of rivers which passes through those districts. Besides, this model also compares between water quality of these river for two different time period i.e. year 2010 and 2016. All the graphical representation is done with the help of excel 2016 and microfit software by pesharan brothers.

## IV. RESULT

The descriptive model made in this paper provides various graphs for proper explanation of seriousness of the problem. These graphs represent the parameters sets to check the quality of water for different rivers and comparison of these parameters for year 2010 and 2016 to check whether the pollution level of water has increased from year 2010 to 2016 or decreased and if increased which parameter is affected most.

Figure 1 represents level of temperature, Figure 2 represents level of dissolved oxygen, Figure 3 represents level of ph, Figure 4 represents the level of biochemical oxygen demand of river Ganga for year 2010 and 2016.

From these graphs we can see that temperature and dissolved oxygen of year 2016 is more than 2010 but ph and biochemical oxygen demand has decreased to certain points from year 2010 to year 2016 which is very impressive. In figure 4 we can see that

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BOD of year 2010 at point 23 is very high and that point represents Varanasi. Which means pollution level at Varanasi has decreased from year 2010.

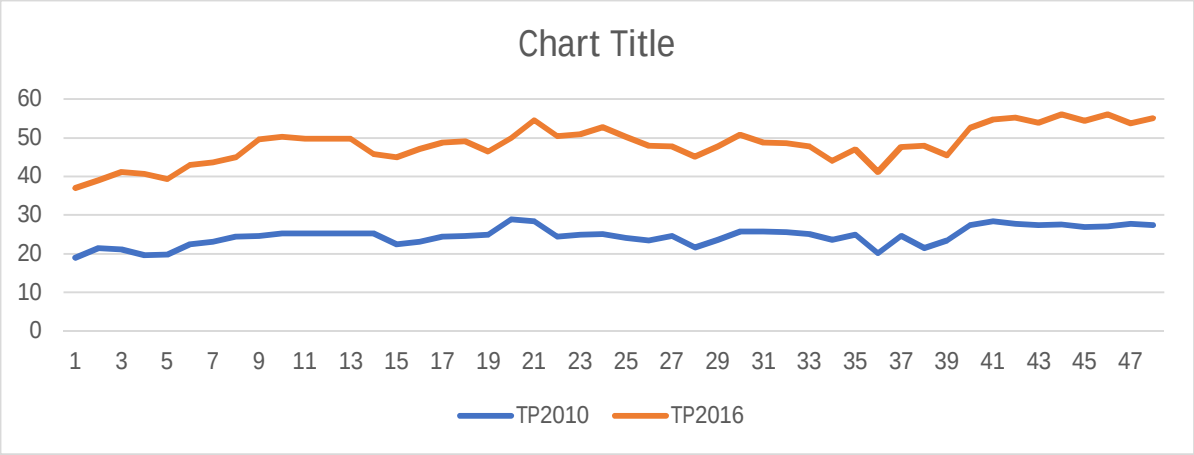



Figure 1. This graph shows the comparison of Temperature of river Ganga for Year 2010 and 2016.

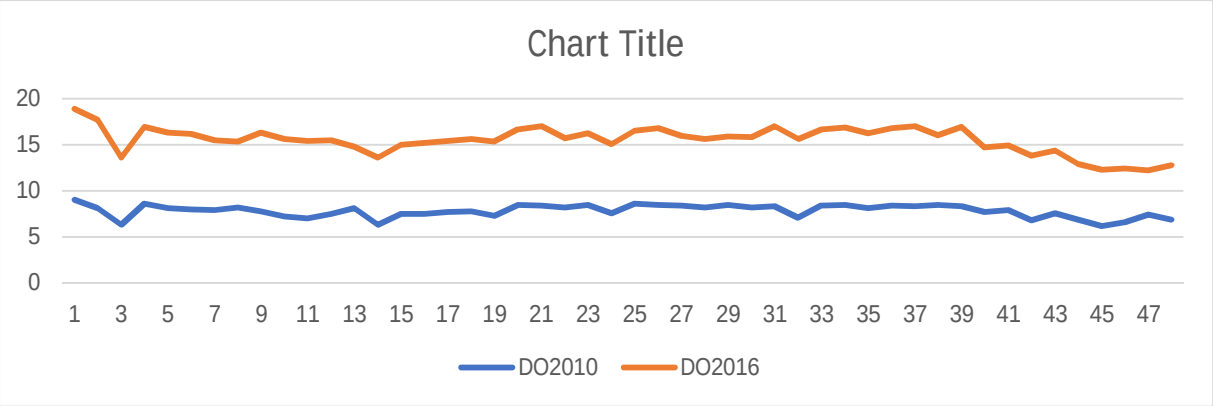



Figure 2. This graph shows the comparison of dissolved oxygen of river Ganga for Year 2010 and 2016.

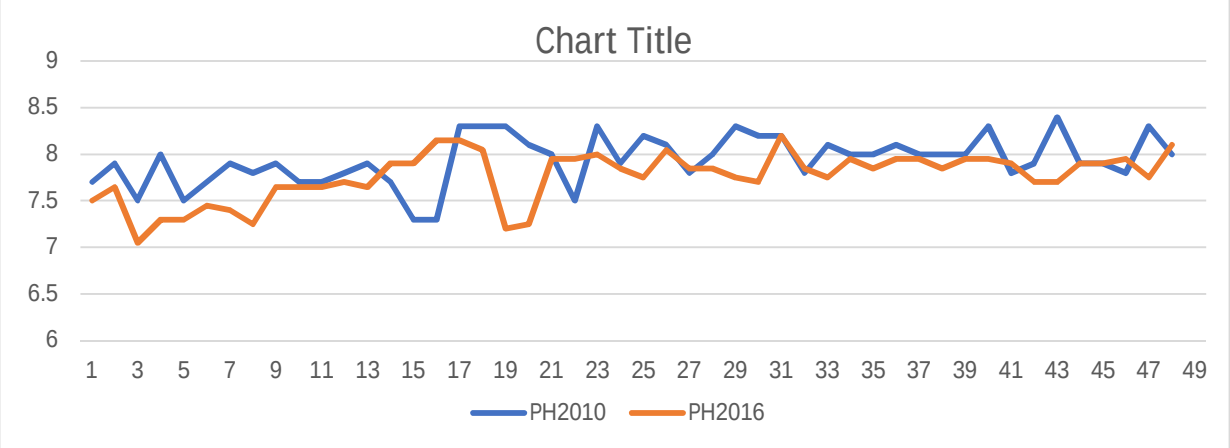



Figure 3. This graph shows the comparison of ph of river Ganga for year 2010 and 2016

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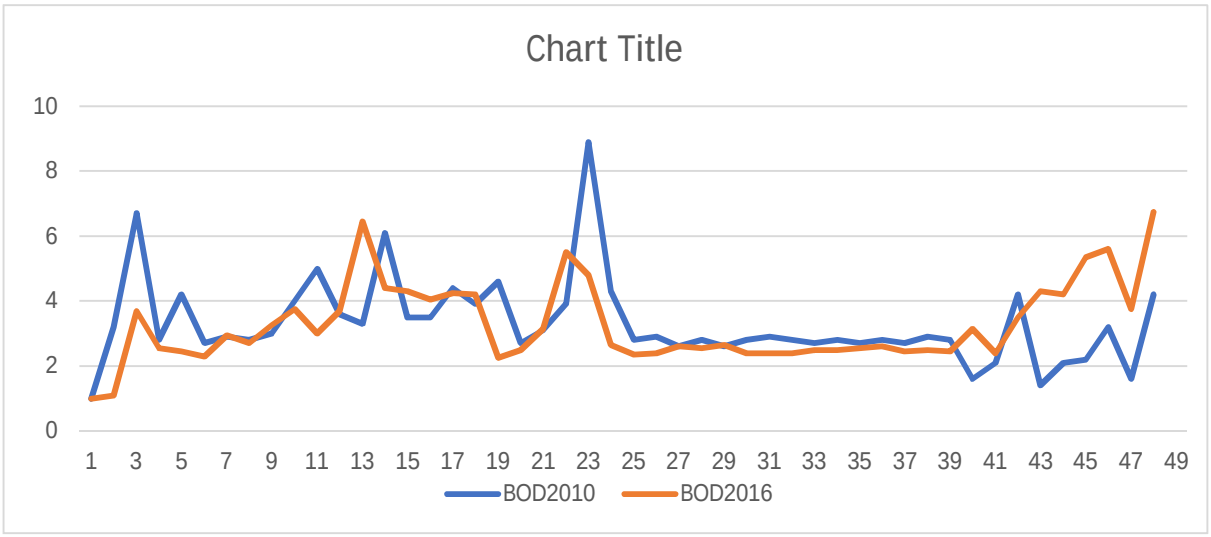



Figure 4. This graph shows the comparison of Biochemical oxygen demand of river Ganga for year 2010 and 2016

Similarly, comparison of pollution level of river Narmada is shown below with the help of graphs. figure 5, figure 6 and figure 7 shows the level of temperature, DO, ph of river Narmada. From the graphs we can say that there is a moderate change in the temp. of river Narmada as it has decreased from year 2010 but the concentration of dissolved oxygen into has almost same because at some places it it has increased and at some places it has decreased also. According to figure 8 the concentration BOD is almost same except from Panchwatighat and Sethanighat both at point 10 and 12 simultaneously where it is highest in concentration.

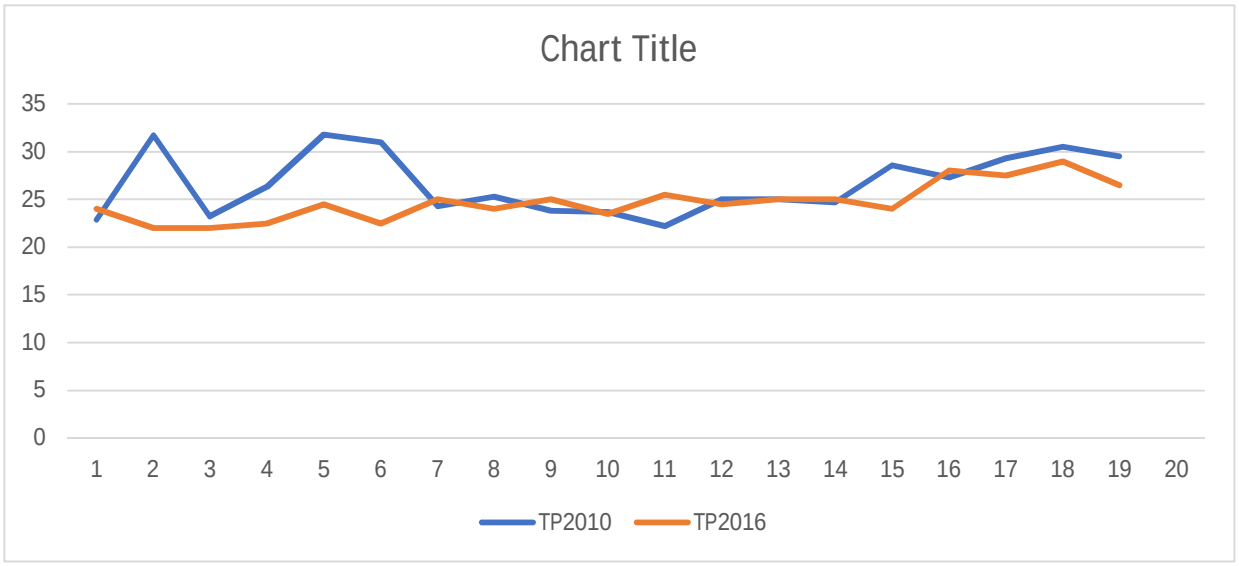



Figure 5. This graph shows the comparison of temperature of river Narmada for year 2010 and 2016

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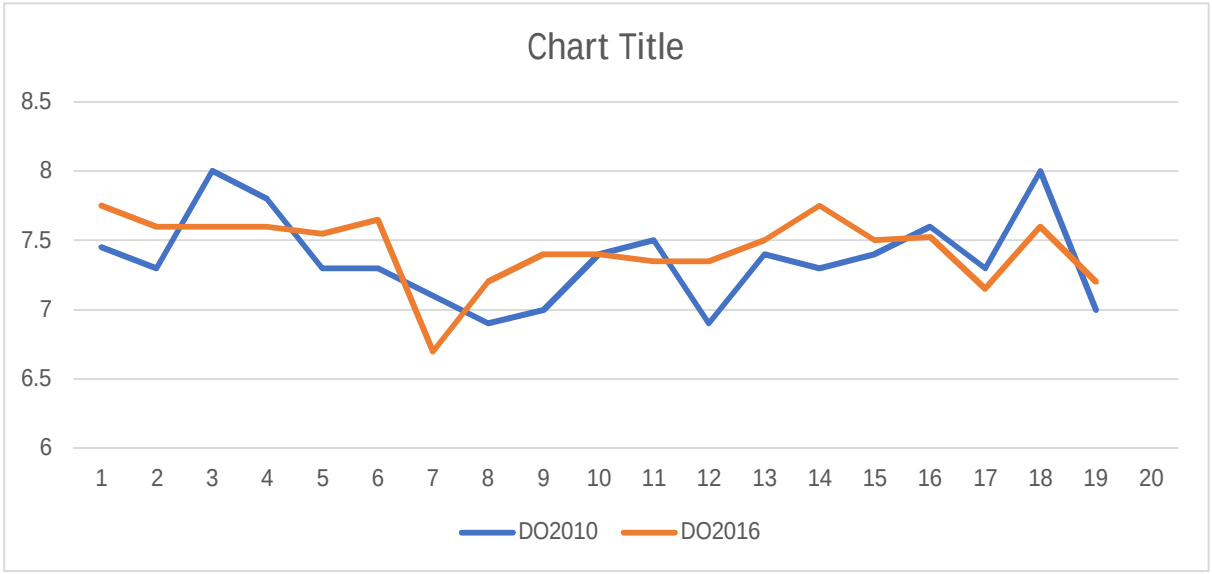



Figure 6. This graph shows the comparison of dissolved oxygen of river Narmada for year 2010 and 2016

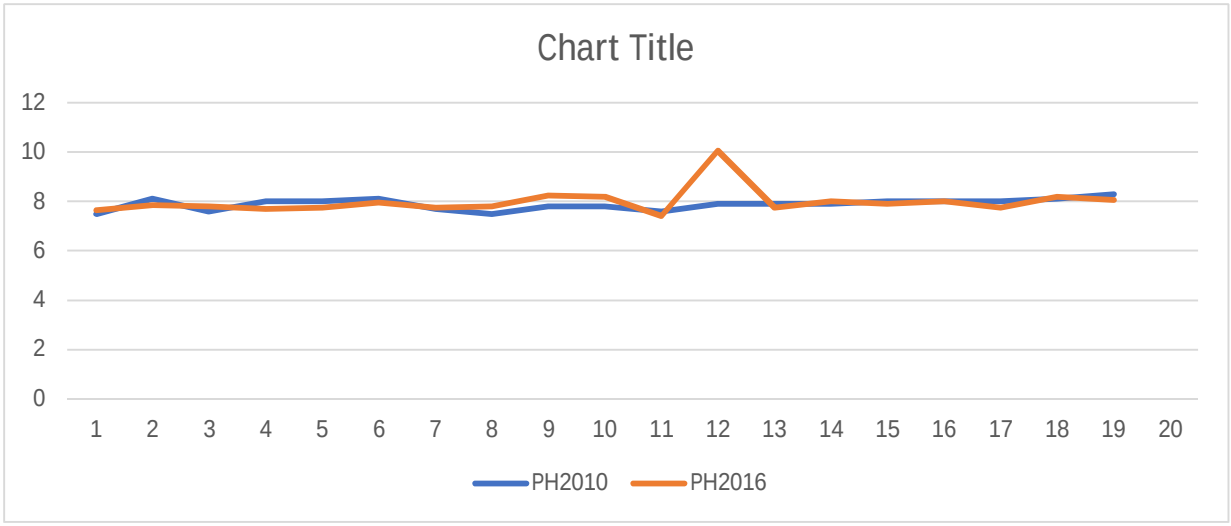



Figure 7. This graph shows the comparison of ph of river Narmada for year 2010 and 2016

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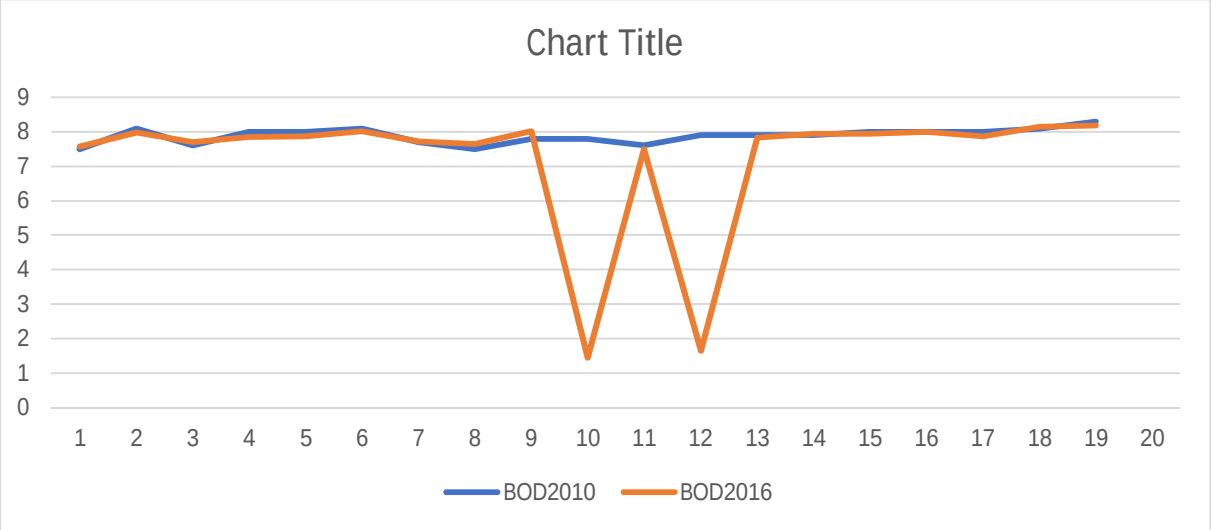



Figure 8. This graph shows the comparison of BOD of river Narmada for year 2010 and 2016

And at last, figure 9, figure 10 shows the level of temperature, DO, ph of river Godavari. From the graphs we can say that there is a moderate change in the temp. of river godavari as it has also decreased from year 2010 but the concentration of DO has decreased from year 2010 to 2016. The ph of river Godavari is almost same from year 2010 to year 2016 as we can in the graph below in figure 11. According to figure 12 the concentration BOD is almost same as the places where it was high in 2010 it has decreased in 2016 and at places where it was low it has increased at those places.

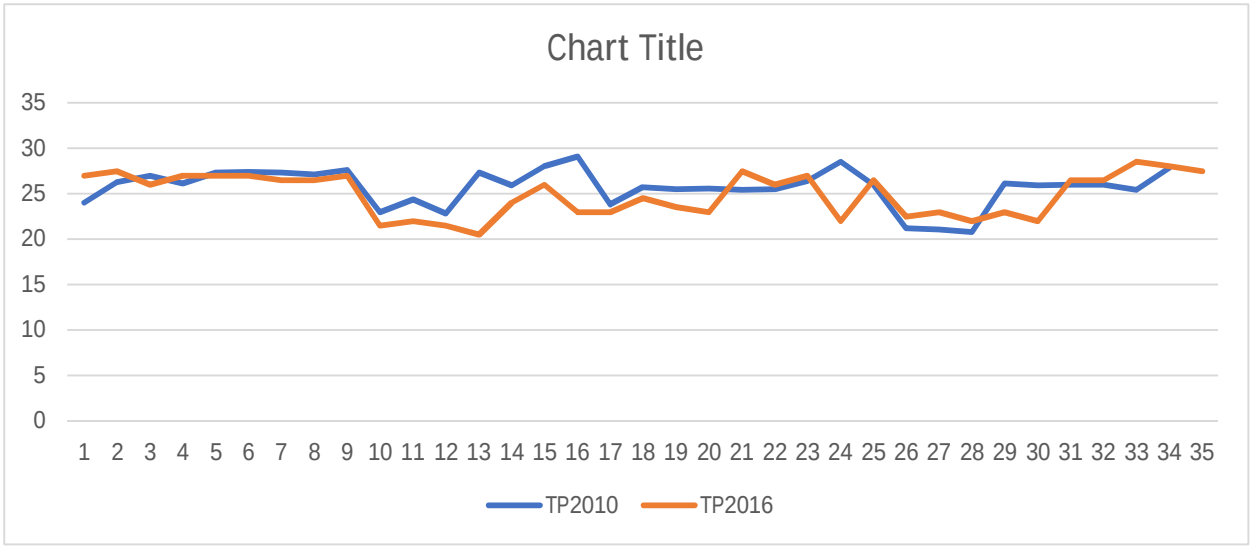



Figure 9. This graph shows the comparison of temperature of river Godavari for year 2010 and 2016

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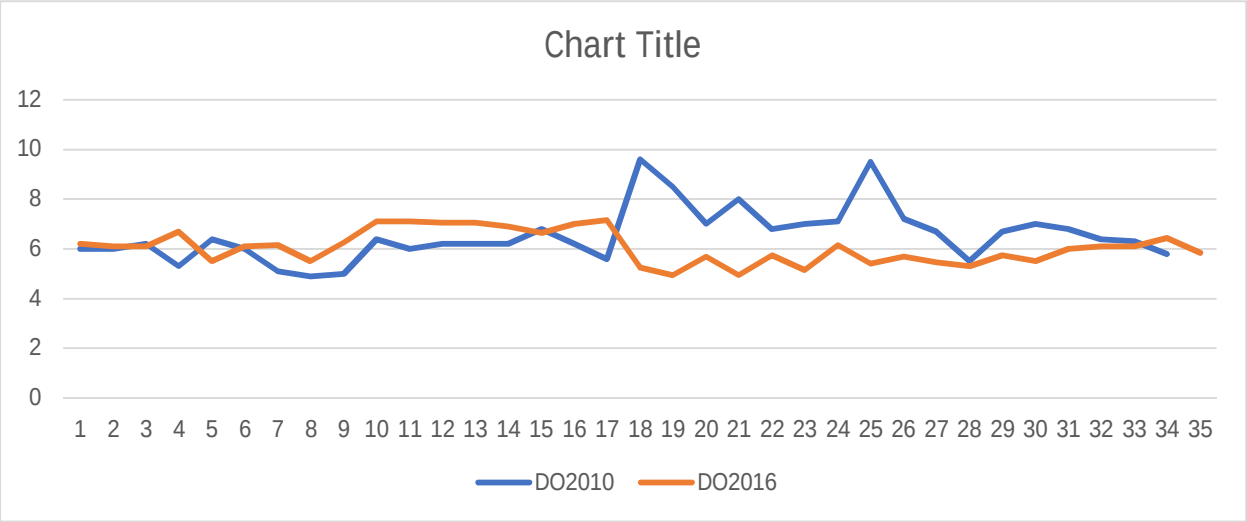



Figure 10. This graph shows the comparison of dissolved oxygen of river Godavari for year 2010 and 2016

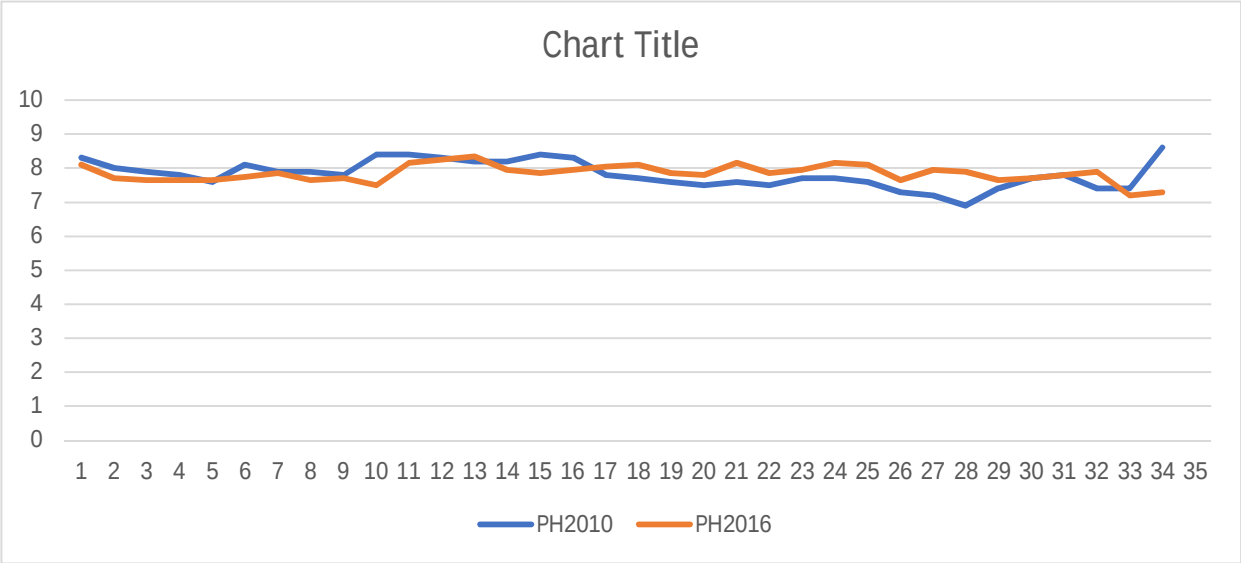



Figure 11. This graph shows the comparison of ph of river Godavari for year 2010 and 2016

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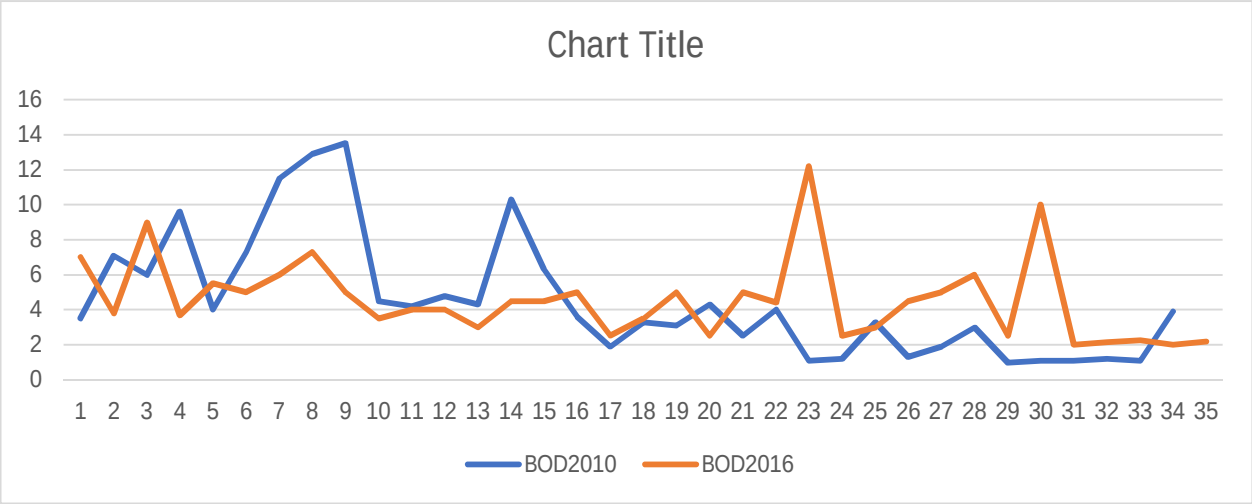



Figure 12. This graph shows the comparison of BOD of river Godavari for year 2010 and 2016

## V. CONCLUSION

In this paper first we demonstrated the pollution level of major river in different district with the help of graph and on basis of water quality parameters set by government. With the help of graphs and statistical tools used on data we can conclude that quality of water of river Ganga, Narmada and Godavari is not in position to sustain marine life and also not good for household purposes. We also conclude that the concentration of BOD in river Narmada is very high as compared to other two rivers used in this analysis. The use of dummy variable in our analysis turns out to be very helpful as it helped to give accurate results of different district which are responsible for water pollution because of the industries in those districts.

After study we are also able to conclude that the oxygen dissolve in water is important for both plants and animals but high level of oxygen in water can be dangerous for marine animals and dissolved Oxygen level has increased at high rate in river Ganga, Narmada and Godavari according to my analysis.

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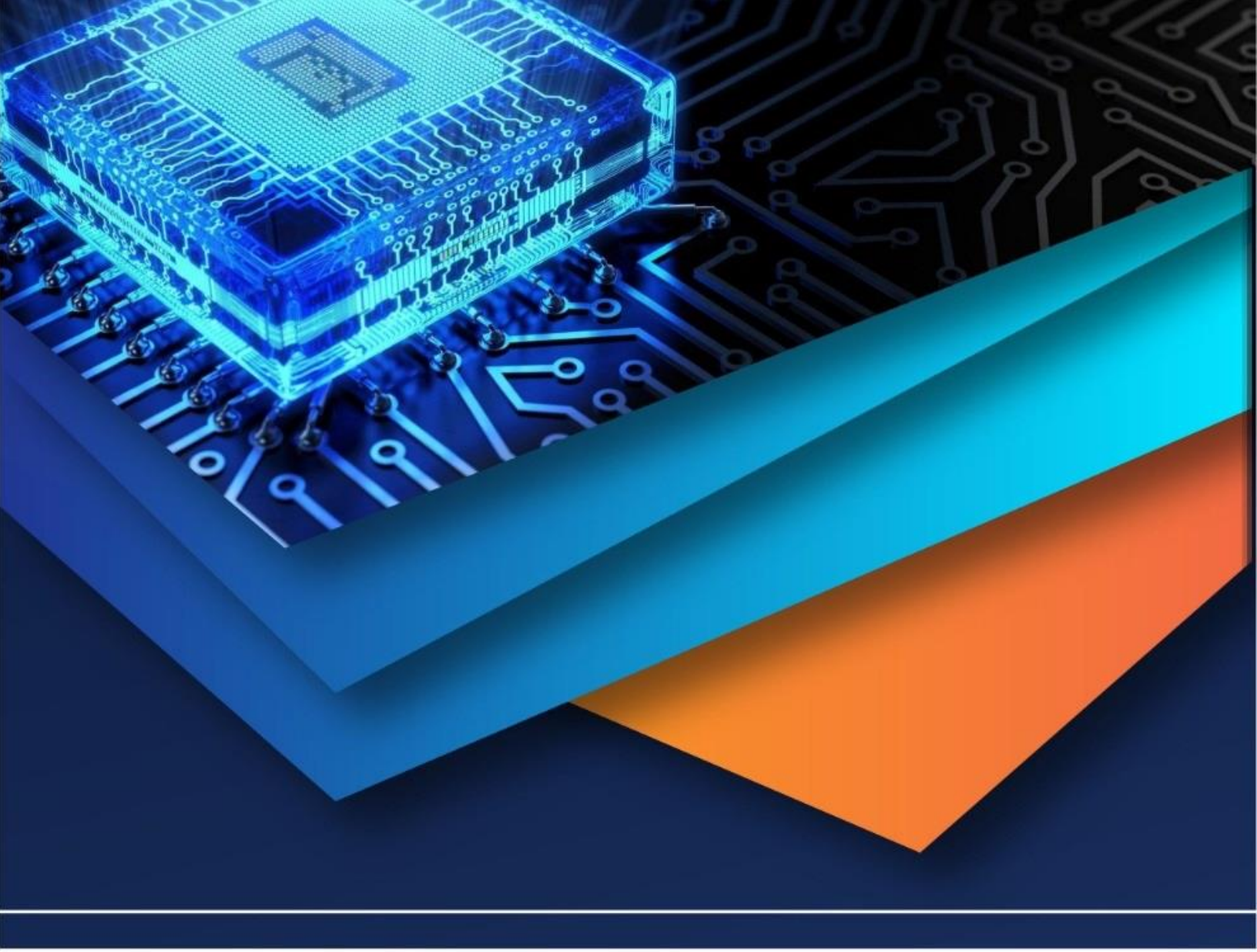
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