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WATER QUALITY ANALYSIS AND SIMULATION OF PANCHAGANGA RIVER USING MATLAB

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ABSTRACT

Panchaganga River is now facing serious problem of pollution and in present situation continuous analysis is needed to control pollution of Panchaganga River. Pollution of Panchaganga River is observed because of disposal of untreated municipal sewage and industrial effluent through various Streams. Time and money for manpower and chemical is needed for continuous sampling work. MATLAB is an interactive software that allows implementation of algorithm, graphics and creation of user interface with other computer languages. MATLAB helps to predict future water quality using present data and helps to save time, manpower and other cost for continuous analysis. Simulation programming techniques are used for model and virtual based experimentation with the help of collected data from field. The simulation environment of river includes several programming techniques, interactive graphic displays and user friendly interface. Simulation helps in environmental research for understanding research problem and helps find out remedial measures on that. There are several software's available in market for the prediction of river water quality but MATLAB provides easy and convenient user interface in the form of MATLAB GUI (Graphical User Interface).

KEYWORDS: MATLAB Software, Panchaganga River, Pollution Control, Simulation, Graphical User Interface.

INTRODUCTION

India is the most populated country after china which is also facing problem of clean water shortage. It is estimated that at present 103.8 million lac of safe water is required in India. Water demands of various sectors are fulfilled with help of ground water and surface water. India consists of 18 major rivers among which several are polluted, which flows through urban areas. According to CPCB 2015 report, more than half of rivers in India are polluted and contaminated by the toxic, organic and inorganic pollutants. River water pollution caused from different sources like domestic pollution that is waste and sewage from human, agricultural pollution and industrial pollution. The largest sources of water pollution in India are release of untreated sewage from urban areas, release of industrial effluents and organic runoffs from agricultural fields. The major water pollutants consist of physical, chemical and biological materials which lowers down the water quality. When toxic substances enters into river, they get dissolved or get suspended in water or deposited on bottom of river which results in pollution of water and quality of the water deteriorates.

1.1 PANCHAGANGA RIVER

Panchaganga River located in Kolhapur District, Maharashtra. For the simulation of Panchaganga River, four Sampling stations were selected and sampling work was carried out. Manual method of sample collection was preferred by considering all site conditions. Station-1 was at upstream of river located near Balinga pumping station which is away from Kolhapur city, Station-2 was located near Panchaganga Ghat, Station-3 was located near Kasaba Bawada. Jayanti Stream passes through central part of the city and discharges wastewater after Station-2. Station-4 was located near NH-4 Highway Bridge. This site receives industrial waste from Shiroli MIDC and population in that area. For control and monitoring water pollution of river, it is essential to carry out frequent water quality analysis from predetermined sampling stations but such entire process is time consuming and more expenditure on labour, chemical and other cost. To overcome this problem it is necessary to develop Graphical model based on MATLAB software, which includes advance programming, visualization environment and helps for solving environmental problems with the help of graphics.

1.2 MATLAB PLATFORM

In recent years MATLAB is used for modeling of river quality with BOD and DO simulations. MATLAB is interactive software that allows implementation of algorithm, graphics in the form of GUI and creation of user interface with other computer languages. MATLAB helps to predict water quality with present data and helps to save time, manpower and other cost which required for continuous analysis. MATLAB develops new techniques and methodologies for control water pollution of River. MATLAB is interactive software that allows implementation of algorithm, graphics and creation of user interface with other computer languages. The work is aimed to develop water quality prediction model by the use of MATLAB with water quality samples from 4 different sampling stations on Panchaganga river stretch.

SCENARIO OF PANCHAGANGA RIVER

Bhogawati river is renamed as Panchaganga from Prayag Chikhali, after addition with five rivers namely Kumbhi, Kasari, Tulshi, Dhamani and Bhogawati. Panchaganga river flows towards south-North side with total length is 67 Km from Prayag-Chikhali to Narsobawadi. Panchaganga River gets polluted from untreated discharge of domestic sewage, direct disposal of industrial effluent, mixing of crematorium ash and religious activities through various Streams located in Kolhapur city.

According to Kolhapur Municipal Corporation Environmental Status Report, the Panchaganga River is getting polluted because of the following causes.

- Untreated Domestic Sewage
- Industrial Effluent Disposal
- Biomedical Sewage
- Agrochemicals
- Crematorium Ash Mixing
- Religious Activities
- Other sources of pollutants are waste water from Hotels, Restaurants, sewage from different hospitals and pathological laboratories.

Table -1: Description of Panchaganga River

Sr No.	Description	Units
1	East-West Length of River	108 Km
2	North-South Length of River	67 Km
3	Total Area	2730.40 Sq.m
4	Average Width	110 m
5	Average Minimum Depth	3 m
6	Average Maximum Depth	14 m
7	Average Rainfall	2501.9 mm
8	Average Minimum Temperature	28^0C to 1.2^0C
9	Average Maximum Temperature	14^0C to 22^0C

MATLAB PLATFORM

MATLAB was initially developed by lecturer in 1970 for help the students to learn linear algebra. MATLAB was later marketed and further developed under Math Works Inc. was founded in 1984. MATLAB is software package which can be used to perform analysis and solve mathematical and engineering problems. MATLAB gives excellent programming features and graphics capability. MATLAB has several toolboxes to solve specific problems and it available on Windows, Macintosh and Unix Platform.

3.1 MATLAB GRAPHICAL USER INTERFACE

3.1.1 GUI Layout

MATLAB provide graphical user interface for development of models. It consists of graphical user interfaces (GUI) and sets of tools for creation of models. GUIDE Layout Editor helps to carry out programming with the help of clicking and dragging components of GUI.

3.1.2 Generation of FIG File and MATLAB File

For generation FIG-file and MATLAB file in Graphical User Interface of MATLAB code any of following option needs to be selected.

- Generate Prototypes for Callback Function
- GUI Allows Instance to Run (Singleton)
- Use Color for System Background

3.1.3 Define Graphical User Interface Controls

Graphical user interface controls consist of toggle buttons, push buttons, sliders, radio buttons, static text controls, edit text controls, pop-up menus, list boxes and check boxes. Property Inspector from view menu used for modification of appropriate properties. Components are selected from layout area.

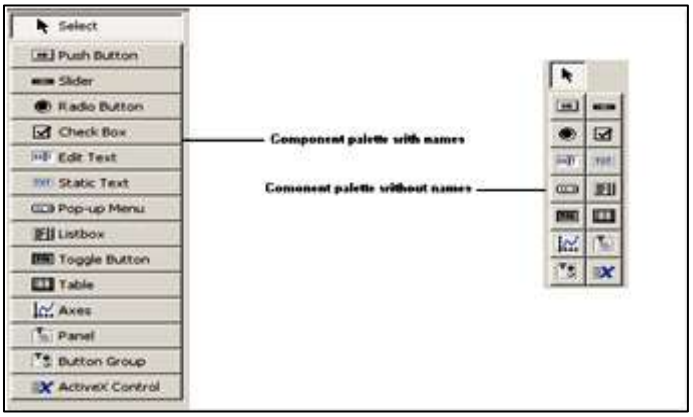

Figure 1: MATLAB GUI Controls

3.2 GUI and Its Files

GUIDE stores GUI in two files at time of file saving or run graphical user interface. First file consist of MATLAB FIG file with an extension of .fig format that consist of description of layout and components of GUI. Components of GUI consist of axes, buttons, menus, panels and many others. FIG file is generally MAT file that cannot modify except change in layout provided in GUIDE.

Second file of GUI is .m which consists of code which control GUI and consist of components callbacks. While working with GUI these 2 files are in same folder with same name. These files assign the task and programming function of GUI. Work with GUI in the Layout Editor stored in FIG file and programming work stored in code file.

RESULT AND DISCUSSION

Sampling Analysis Procedure

- P^H
- Dissolved Oxygen (DO):
- Biochemical Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD

Table-2: Water Quality Standards

Sr No.	Parameter	Range
1	P^H	6.5-8.5
2	Temperature	Less than 40^0C

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3	DO	4mg/ Lit
4	TDS	500 mg/Lit
5	BOD	5mg/lit
6	COD	Less than 10^0C

4.1 Sources of Panchaganga River Pollution and its effect

Table-3: Sources of Panchaganga River Pollution

Sr. No.	Sources of Panchaganga River Pollution	Wastewater Generated
1	Drainage waste from Kolhapur city	120 MLD
2	Drainage waste from Factory	19 MLD
3	Hotels	15 MLD
4	Hospitals	3 MLD
5	Crematorium Ash	130 MLD

4.1.1 Discharge of Untreated Domestic Sewage

The Panchaganga River pollution is observed because of tremendous amount of sewage discharge by four major Streams which are Dudhali Stream, Jayanti Stream, Line Bazaar Stream and Bapat Camp Stream in the city. It is observed that most of sewage is untreated which helps to increases organic load of Panchaganga river. Pollution caused by plastic litters, solid waste, toxicants and bacterial contamination.

According to Kolhapur Municipal Corporation's environmental status report, Jayanti Streams is main Streams running through city of Kolhapur. Jayanti Streams originates from Kalamba Lake and connects to Panchaganga River at Dasara Chowk this Streams is blocked and wastewater is pumped to STP located at Kasaba Bawada. Jayanti Stream covers largest catchment of Kolhapur city and carries more than 60% of the total sewage of Kolhapur city. The second Stream after Jayanti Stream is Dudhali Stream which flows from Sakoli corner and is merged into Panchaganga River. This Stream contains small gutters and drains. This Stream consist of sewage from Lakshatirth, Shivaji peth, Phulewadi, Raviwar peth etc.

At Kasaba Bawada Line bazaar Stream originates and sewage is generated in Kasaba Bawada flow through Line Bazar Stream. This Stream joins Panchaganga River at upstream of intake well which is supplying drinking water to Bawada Water Treatment Plant. On the eastern side of Kolhapur city Bapat camp Stream is located. Generated sewage from this region flows to this Stream from small several Streams. Except this some small Streams are present in the Kolhapur city are Dandgaiwadi, Panchaganga Picnic Spot, Juna Budhawar Talim, Sidhharthnagar, CPR, Rajhans Press, Behind New Palace, Raman Mala, Chhatrapati Colony, and Vikram Nagar which have significant effect on aquatic ecosystem.

4.1.2 Disposal of Industrial Effluent

The industrial effluent is coming from different small industrial units, foundries spray painting units in Udyamnagar area and Tanneries from Jawahar Nagar alters the quality of river water.

4.1.3 Sewage from Different Hospitals and Pathological Laboratories

There are total 498 hospitals and dispensaries (governmental, semi-governmental and private) and 31 pathological laboratories in Kolhapur city. The untreated sewage about 1,00,000 liters per day mixes in to the river through Stream which is highly dangerous to the revering ecosystem.

4.1.4 Effluent from Other Sources

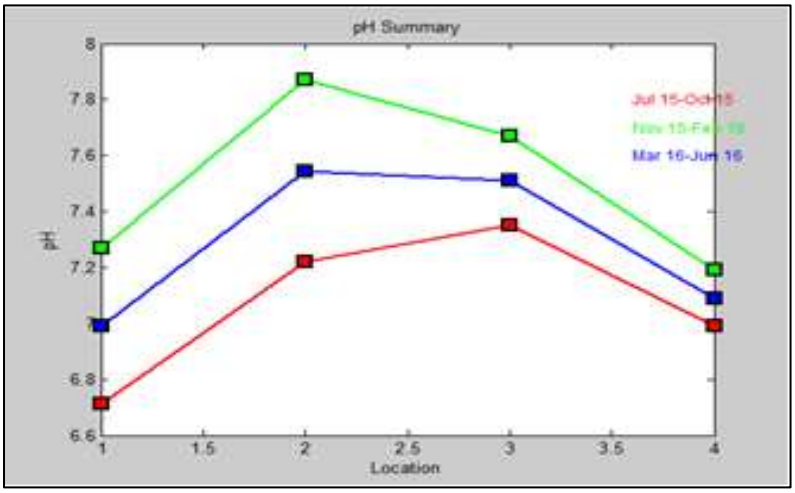
There are about 49 servicing stations in the city which generates 49,000 liters of waste water. The quality of water alters because of oil and grease content, petrochemicals and colors. The waste water coming from slaughter houses

and fish markets are having high organic load which is directly discharged into the nearby sewer which finally ends into the river through Stream. The sources like hotels, restaurants, hawkers, etc. also contribute for the water pollution of Panchaganga River.

4.2 Effects of Pollution on Panchaganga River

1. In year 1989 two pregnant ladies were died because of infection of Jaundice (Daily Sakal, 16th January 2011, Local Supplement, Kolhapur Today, page1)
2. Due to the disposal of Bhogawati Sugar Factory wastewater thousands of fishes were died in Panchaganga River (Daily Sakal, 9th March 2012, Local Supplement, Kolhapur Today, page1)
3. Due to polluted water in Panchaganga River thousands of fishes have died and the people's life has come in danger. Affected areas are namely Terwad, Ichalkaranji, Herwad, Shirdhone, Takawade, Abdullat, Shiradwad, Nandni and Dharangutti. There is decrease in soil level in 600 acre agriculture land area and more than 3,803 cases of jaundice patient were found. (Daily Sakal, 19th January 2012, page5)
4. Because of disposal of polluted water in Panchaganga River, various diseases like skin diseases, problem of asthma were observed and decreased in oxygen in water. Because of polluted water, diseases like Gastro infection starts in the following areas Survenagar, Salokhenagar, Kalamba etc. in Kolhapur city (Daily Pudhari, 24th March 2009, Local Supplement, Aple Kolhapur, page1)

The following graphs show the variation of results with respect to locations of sampling on Panchaganga River. First location is Balinga pumping station, second location is Panchaganga Ghat. Third location on Panchaganga River is at Kasaba Bawada and forth location is at NH4 Bridge. Red color line joining sampling readings points is indicated for period July 2015 to October 2015. Green color line joining sampling readings points is indicated for period November 2015 to February 2016. Blue color line joining sampling readings points is indicated for period March 2016 to June 2016.



Graph 1: PH Results of Four Locations on Panchaganga River

This graph shows the relation between P^H vs. sampling locations on Panchaganga River.

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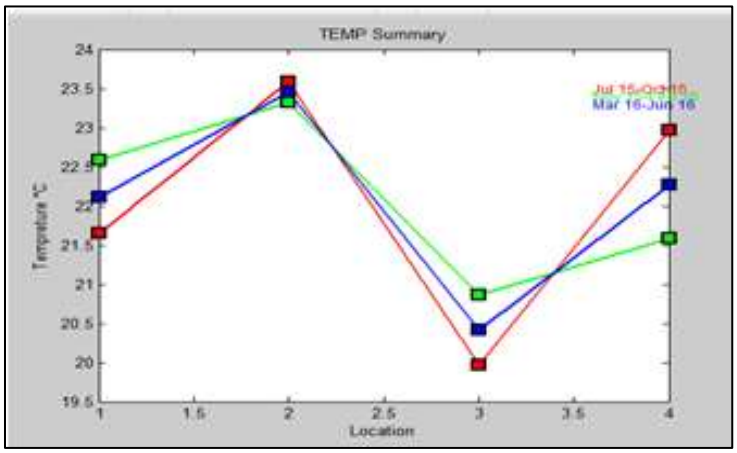
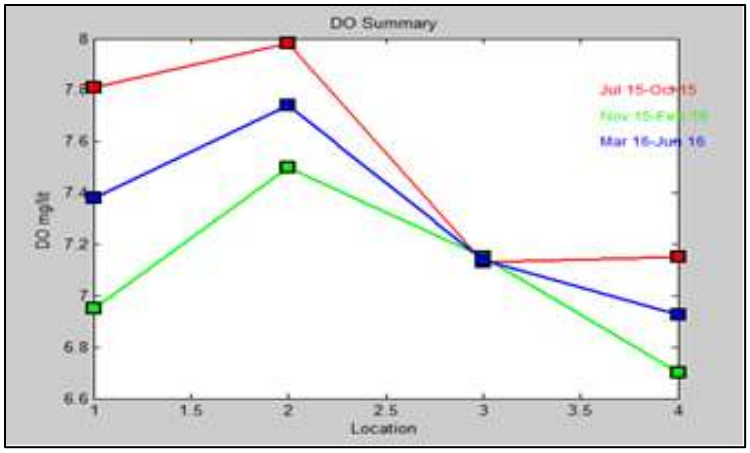


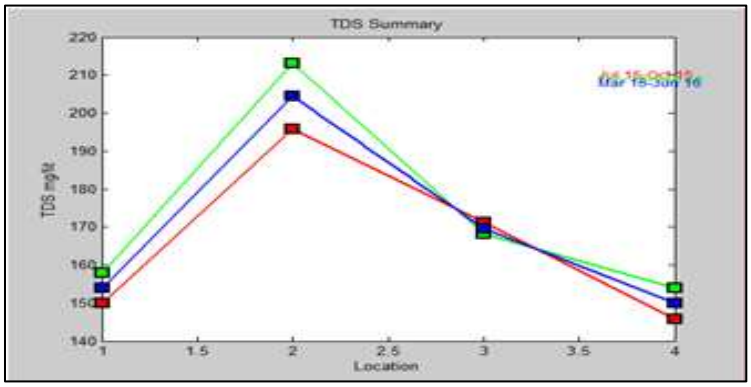
Graph 2: Temperature Results of Four Locations on Panchaganga River

This graph shows the relation between Temperature vs. sampling locations on Panchaganga River



Graph 3: Dissolved oxygen Results of Four Locations on Panchaganga River

This graph shows the relation between DO vs. sampling locations on Panchaganga River



Graph 4: Total dissolved solids Results of Four Locations on Panchaganga River

This graph shows the relation between TDS vs. sampling locations on Panchaganga River

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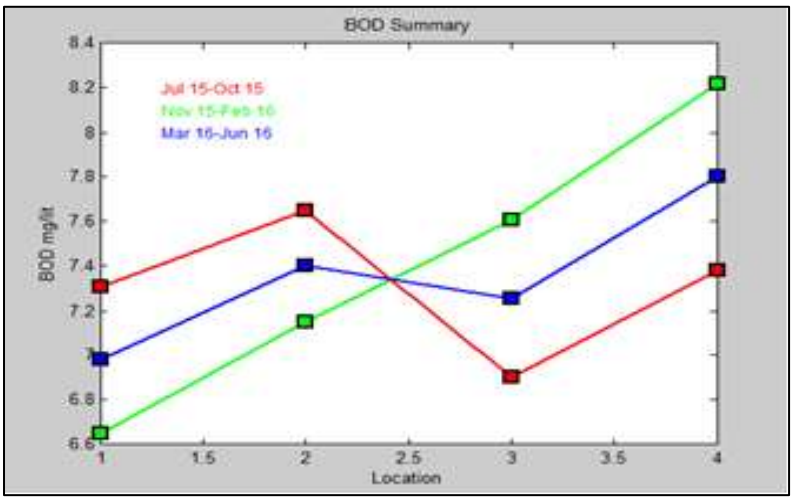
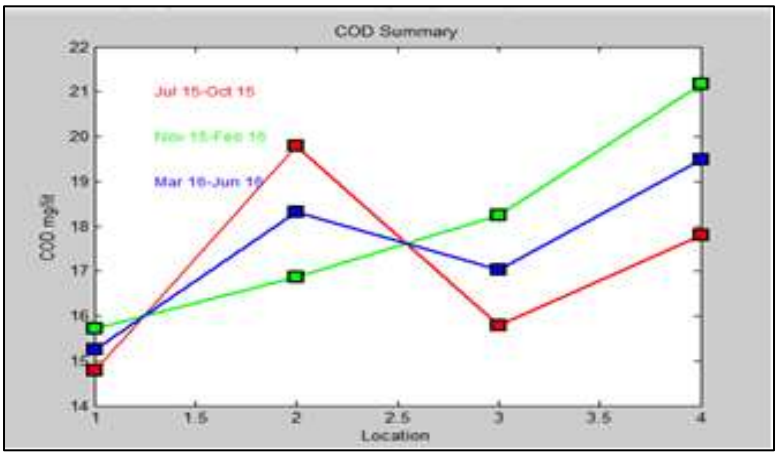


Graph 5: BOD Results of Four Locations on Panchaganga River

This graph shows the relation between BOD vs. sampling locations on Panchaganga River



Graph 6: COD Results of Four Locations on Panchaganga River

This graph shows the relation between COD vs. sampling locations on Panchaganga River

CONCLUSION

The study presented in this research paper briefly describes how MATLAB programming tool can be used for prediction of water quality in river. In this work an effort is taken to use MATLAB for stretch of Panchaganga River from Balinga Pumping Station to NH4 Bridge, Kolhapur.

Following conclusions can be drawn based on this study.

Balinga Pumping Station location is less polluted as compare with other sites.

1. High degree of pollution is observed at Panchaganga Ghat location.
2. The water at midstream location and downstream location is highly polluted because of direct disposal of domestic sewage and industrial waste.
3. The variations in various parameters are changed according to season.
4. MATLAB helps to predict future water quality with present data and save time, manpower and other cost for continuous analysis.

RECOMMANDATIONS

1. Wastewater and sewage line should be underground in all area. Sewage treatment plant should be provided for treatment of domestic wastewater.
2. Industries causing water pollution should consist of effluent treatment plant or common effluent treatment plant.
3. Hospitals should consist of effluent treatment plant in their premises.
4. Wastewater should be treated separately (DEWATS) that is wastewater in Kolhapur city should be treated at different location.
5. There should be ban on washing clothes, vehicles, animals and disposal of crematorium ash in river water.
6. Improve public participation for avoid pollution from ganapati visarjan in Panchaganga river.
7. Continuous flow is required to reduce pollution level in Panchaganga River to some extent.

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