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A study on Assimilation and Healing Capability of River Godavari

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***Abstract*— The idea of this work is to investigate the assimilation and healing capability of river Godavari, one of the major rivers of south India and also the second largest river in India after river Ganges. The physico-chemical characteristics such as pH, TDS, EC, DO, BOD, alkalinity and total hardness of water collected from the three sampling stations were determined. Sampling stations were so selected in such a way that the, two sampling stations are major cities having many industries and third sampling station is at the downstream where the river water travelled to a distance of 65 km through the non-pollution zone. The results have shown that there is an increase in water quality of the river Godavari from upstream to downstream i.e. from first sampling station to third sampling station.**

Keywords—River Godavari; Physico-chemical characteristics; river pollution; assimilation and healing.

I. INTRODUCTION

Water is one of the precious resources for the existence of life anywhere in the universe, water being a universal solvent dissolves many kinds of materials and transport them from one place to another within and outside the living system, this unique property of water is now became curse to life as water getting polluted. Among inland water bodies, rivers placed first with respect to the rate of pollution [1] as the majority of the habitations and industries are established on the banks of the rivers. In India, agriculture is the major practice and is the backbone of Indian economy. The unscientific ways of agricultural practices enhance the pollutants load on rivers. In India, river Ganges and river Yamuna are highly polluted when compared to rest of the rivers. River Godavari is one of the major South Indian Rivers, as it flows from Triambakeshwar to Antervedi, it is influenced by various kinds of anthrapogenic activities. Being an aquatic ecosystem, it has assimilating capability and healing power against pollutants. In order to investigate the assimilation and healing capability of river Godavari water, physic-chemical parameters were determined and the water quality index was calculated. Earlier studies were done on river Godavari, but they confined the physic-chemical parameters covering few kilo meters stretch with major pollutants to river Godavari. [2][3][4][5][6].

II. MATERIALS AND METHODS

Study Area

River Godavari originated from Bramhagiri mountains at the elevation of 1,067 m in Trimabakeshwar, Nashik district, Maharastra state and it flows towards south east about 1465 km and finally falls into the Bay of Bengal at Antervedi, East Godavari District, Andhra Pradesh. On the way it receives water from several major and minor tributaries.

It flows through the major urban regions like Nashik, Nanded and Rajamahendravaram (Rajahmundry), several major and minor industries, agricultural fields and also hilly regions (Papi hills) having with no agricultural practices, no industrial activities and even no anthropogenic activities.

Sampling Stations

3 sampling stations were selected on the course of river Godavari, out of which first 2 sampling stations suffering with high pollution load and other third sampling station with no pollution load in downstream.

Sampling Station -1 (*SS-1)* - Eklahare, which is downstream of river Godavari at Nashik city, this is about 61 km from the river origin and the river passes through the middle of the city, on this way it receives urban sewage and industrial effluents from Maharastra Industrial Development Co-operation (MIDC). As Nashik is known for holy city, hundreds to thousands of pilgrims perform puja and rituals at the ghats of river Godavari every day and it is high during festivals.

Though the Nashik having sewage treatment plants (STP), it doesn't meet the demands of sewage produced from the city and more over the functioning of the STPs are not up to the mark [3].

Fig.1: Satellite image of SS-1, Eklahare, Nashik. 19°59'38.8"N 73°54'25.3"E

Sampling Station-2 (SS-2) - Downstream of river Godavari at Nanded, this is about 540 km downstream to SS-1. Nanded is the second major city that the river Godavari comes across on its course and like Nashik here river passes through the middle of the city. Hence, the pollution is high. Thus the river stressed by the urban sewage as well as effluents form MIDC.

Fig.2: Satellite image of SS-2, Nanded.

19°08'39.2"N 77°20'22.6"E

Sampling Station-3 (SS-3)- Polavaram, this is about 807 km downstream to the SS-2, about 742 km from the SS-2 the river Godavari stressed by agricultural runoff, sewage from towns and villages and industrial effluents. Later it travels through the non-pollution zone i.e. hilly region called 'Papi Hills' occupied completely with various trees and plants, it is about 65 km river passes through the hill on either side of the river, during wet seasons Godavari receives water from various streams of these hills.

Fig.3: Satellite image of SS-3, Polavaram.

17°15'28.7"N 81°39'00.1"E

Collection and Analysis of Samples

Three sampling stations for two wet seasons were selected at Eklahare, downstream to Nashik city, downstream to Nanded city and Polavaram. Sampling was done on the same day at three sampling stations during winter and monsoon, with the help of coordinators so arranged for the collection nearby sampling stations. Water quality analysis was done on the same day with the coordination of nearby institutions.

Samples were collected in polythene containers with 1000 ml capacity and analyzed for pH, dissolved oxygen (DO), biological oxygen demand (BOD), total dissolved solids (TDS), Nitrates, total alkalinity (TA), total hardness (TH) and electrical conductivity (EC). APHA (1998) [7] standard methods were followed for determining the physico-chemical parameters.

III. RESULTS AND DISCUSSION

The results were obtained from the analysis of samples were taken during the month of November-2016 and July -2017 at the sampling stations and given in tables 1 & 2.

Table 1. Water quality of river Godavari during winter.

Parameter	SS-1	SS-2	SS-3
Temperature ºC	28.8	30.4	27.5
pH	7.9	7.73	7.76
EC (µS/cm)	515	414	341
TDS (mg/l)	324	282	128
DO (mg/l)	6.4	6.7	6.8
BOD (mg/l)	22	4.5	1.5
Nitrates (mg/l)	0.95	2.33	1.23
Alkalinity (mg/l)	78	122	196
Hardness (mg/l)	230	154	106
Ca^{+2} (mg/l)	40.1	37.6	24.2
Mg^{+2} (mg/l)	31.3	14.5	11.4

Table 2. Water quality of river Godavari during monsoon.

Parameter	SS-1	SS-2	SS-3
Temperature ºC	27	28	25
pH	7.47	7.27	7.4
EC (µS/cm)	623	445	363
TDS (mg/l)	724	407	404
DO (mg/l)	6.1	6.5	7
BOD (mg/l)	29	9.7	1.7
Nitrates (mg/l)	3.56	2.9	1.21
Alkalinity (mg/l)	145	143	211
Hardness (mg/l)	347	174	154
Ca^{+2} (mg/l)	75.5	38.2	36.7
Mg^{+2} (mg/l)	39.3	19.1	15.1

From SS-1 to SS-3, all the physic-chemical parameters are showing significant decrement in values, except alkalinity, in both the seasons.

SS-1 (Nashik) is located near to the river origin where the quantity of the water in the river is very less compared to the rest of the sampling stations, consequently pollution is getting concentrated.

Though the river is stressed by the pollution at SS-2, there is a significant enhancement in the water quality when compared to SS-1, in electrical conductivity (in both the seasons) and total hardness (in monsoon) which exceeded

the permissible limits as per the BIS (1991) [8] standards at SS-1, but dropped to normal when it reaches SS-2.

The river flows from SS-1 to SS-2 a distance of 540 km. There are no significant industrial and urban pollution sources on the way to SS-2 and the pollutants are diluted by the waters poured by tributaries (rivers Pravara and Purna). Hence, river has enough time to assimilate and heal the pollutants of the upstream.

While the river flowing towards SS-3 from SS-2, up to a stretch of 807 km, the Godavari constantly receives agricultural, domestic and industrial pollutants. However, the water quality of the SS-3 is improving. It has been attributed to the assimilation and healing mechanisms operating especially in intact ecosystems at the non pollution zone about 65 km as mentioned above and the pollutants are more diluted as the major tributaries (rivers Manjira, Pranhita, Indravathi and Sabari) are joined between SS-2 and SS-3. The quality of river Godavari at SS-3 is good and better than the previous sampling stations. While passing through the 'Papi Hills' a related intact forest ecosystem, the river water is subjected to assimilative and healing mechanisms.

IV. CONCLUSION

When all the pollutants received by the river get accumulated, the pollutants will exceed the tolerance limits and water in the downstream of the river is not suitable for the consumption and also for agricultural as well as industrial purpose.

But the habitations situated at the downstream of the river Godavari especially the people of East Godavari and West Godavari districts of Andhra Pradesh are blessed with quality water for different uses.

Though the tributaries certain amount of pollutants, assimilative and healing mechanisms operating in the aquatic ecosystem, are reducing the pollutants impacts.

Surprisingly the river water quality has improved after passing through Papi Hills ecosystem. It may be because of the following reasons,

- Improvement of water quality is possible because of dilution effect,
- Flowing water get enriched with beneficial bacterial and oxygen,
- And enough time given to operation of assimilative and healing mechanisms.

However, a holistic study on river Godavari i.e. physico-chemical characteristics, concentration of heavy metals and microbiology are determined from its origin to the end where it draining into Bay of Bengal by selecting sampling stations with different environments would further support the assimilative and healing mechanism of the river.

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