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Water quality assessment of Ramala reservoir of Chandrapur, Maharashtra, India

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Abstract
Ramala water reservoir is located in the heart of Chandrapur city constructed by Gond king around 600 years back with a purpose to provide water to the citizens for various purpose. However, at present the condition of this reservoir is much pathetic which not only leading to death of fishes but posing threat to the citizens health. And therefore the present work was carried out to find out the chemical perspective of this lake. Almost all parameter except phosphate and nitrate were shows to contain under permissible limit and indicates water may be consume. The boom in aquatic vegetation is observed due to high degree of eutrophication. It has been concluded through the study that the water useful for human consumption and also for fisheries.

Keywords: water, chemical, eutrophication, pollution WQI

Introduction
Water is an indispensable source of nature and present in various state. About 71 percent of earth surface covered with water. Of this only 0.3 to 0.5 percent is available to mankind in the form of fresh water and therefore it is very imperative to use carefully. However, with the increasing rate of population water getting polluted due to industrialization, excessive use of fertilizers, pesticides, detergents and plastics. These days plastic pollution has been threatening the water dwelling organism which find its way in the form of nano-plastic into terrestrial organisms like human being and other domestic and wild animals. Plastic which throw out indiscriminately finally causes the soil, air and water pollution. This plastic gets broken down into very fine particle even less than 200nm nano-plastic (Besseling, 2014; Lechner, 2014 and Wagner, 2014) [1, 2, 3]. The physico-chemical nature of water would thus can affect the macro-plastic to get converted into nano-particle through effect of temperature and light. This nano-plastic by entering into living system and perhaps into cells may cause dreadful effect that could be beyond our expectation.
The overall health of any aquatic body depends on many factors like climatic, geomorphological, geochemical and pollution (Kumar *et al.*, 2021). Every aspect of aquatic organism depend on nature of water. The study of physico-chemical nature of water enable to find out whether the water is potable or can be use for aquaculture practices. For successful exploitation of water body for aquaculture it needs to study the physico-chemical parameters that influence the biological productivity in general. However, several studies are available on the limnological perspective of freshwater bodies in India (Kumar, 1995; Naganandini and Hosmani, 1998; Pandey *et. al.*, 2000; Patil and Tijare, 2001; Gupta and Shukla, 2006) [8, 9, 10, 11].
The present study was aimed at to find our whether this water is useful for human consumption and pisciculture or not.

Materials and Methods
Ramala water reservoir located in the heart of chandrapur city (Fig.1) 19°57'16.3"N 79°17'19.5"E. The water samples were collected once in the middle of month from November, 2020 to March 2021. The sampling and analysis of various physico-chemical parameters were done following the standard procedures of Trivedi and Goel (1986) [6] and APHA (4). The experimental results were compared to the permissible limit of drinking and irrigation water quality standard (BIS, 1991) [5]. In the present study, fifteen parameters were considered (pH, acidity, total alkalinity, free CO_2, Dissolved Oxygen (D.O.), B.O.D. (Biochemical Oxygen Demand), Chloride, Sulphate, Phosphate, Nitrate, Calcium, Magnesium and total hardness. Calculation of entire data was carried out by using the WPS Excel and for assessing the suitability of water consumption (WQI-water quality index) the method of Brown *et al*., 1972 was used.

Results and Discussion
Ramala water reservoir is a source of water exploited for fisheries The variations in physico-chemical characteristics with respect to the following parameters were analyzed in this study that are discussed as follows.

pH: The pH is an hydrogen ion potential of water. According to Bureau of Indian Standard (BIS) the permissible limit of pH of potable water is in the rage of 6.5 to 8.5. However, the pH of water of studied reservoir was in the

range of 6.23 to 7.41. There is slight variation in pH that incline towards acidity in some samples and alkaline to other may be due to discharge of domestic waste by the people residing nearby the reservoir. Fish are suggested to have blood pH 7.4 (Gebremichael and Fantahun, 2019) [13]. Agbaire *et al*., 2015 [14] have reported that the pH range 6.5 to 9 is good for fish production. (Table-1 and Figure-1). Thus the pH of Ramala reserviour is suitable for the growth and health of fish.

Acidity: Acidic water is not good for the health and survival of aquatic flora and fauna. Water become more acidic in night due to respiratory end production, carbon dioxide. Besides this heavy air pollution having acid producing gas also lead to cause of acid rain fall which drained into water bodies and make them acidic. The acidic content in the present study was found to be minimum in January and maximum in December (Table-1 & Figure-2)

Total Alkalinity: Ramala reservoir shows maximum total alkalinity 76 mg/l in the month of January whereas lowest (44 mg/l) in November. In the winter season the total alkalinity was remain in the range of 44 to 76 mg/l and this is acceptable range for human consumption according to water quality standard of BIS 10500-2012.

Free Carbon Dioxide: Aquatic plants, animals and microbes all these contribute this parameter to the aquatic body through its respiratory. Free carobon-dioxide in the water forms carbonic acid which dissociate and fluctuates the pH at various level

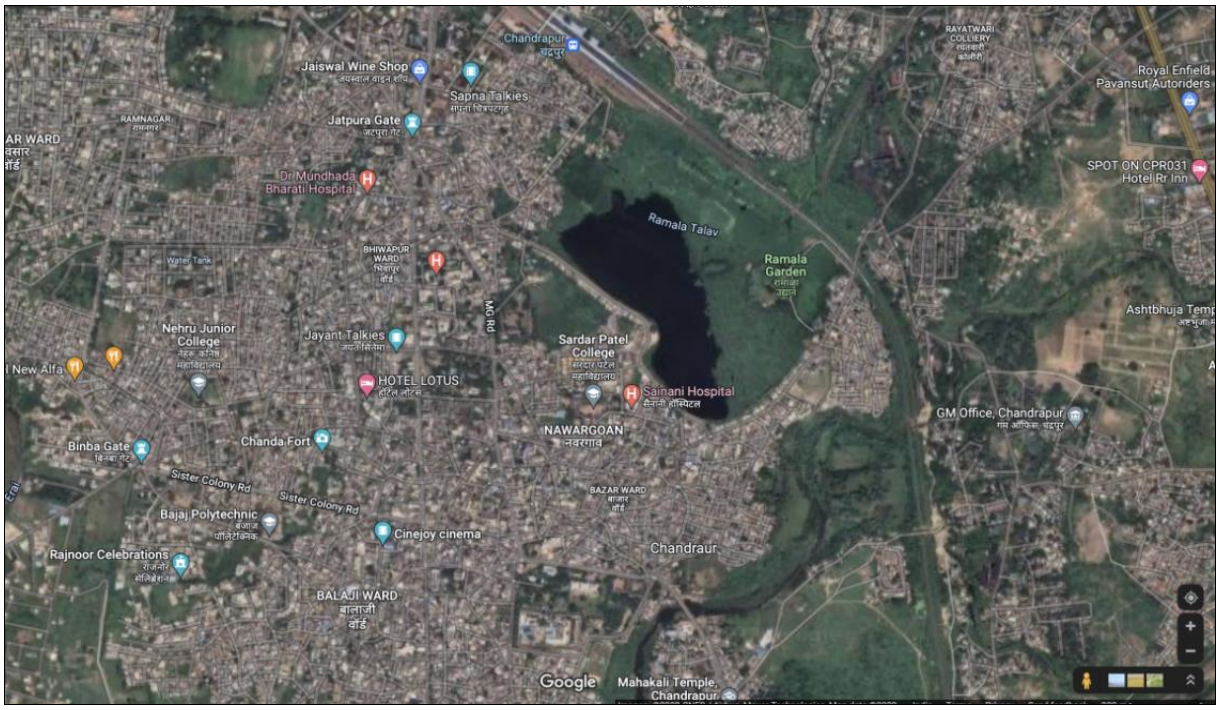

Fig 1: Google map indication location of Ramala lake in Chandrapur city.

Table 1: Physicochemical Profile of Ramala Reservior of Chandrapur, Maharashtra through Winter Season from Nov-2020 to Mar-2021.

Parameters	Months of Winter Season in India				
	November	December	January	February	March
pH	6.51	6.23	7.18	7.41	6.38
Acidity (mg/l)	32.3	34.7	28.2	32.4	32.4
Total alkalinity (mg/l)	44	58	76	66	64
Free CO2 (mg/l)	4.6	5.2	7.7	4.8	6.2
D.O. (mg/l)	3.7	4.8	5.6	6.4	5.2
B.O.D. (mg/l)	4.6	4.3	1.4	1.7	2.3
Chloride (mg/l)	142	152	87	105	127
Sulphate (mg/l)	86	94	87	83	117
Phosphate (mg/l)	0.48	0.47	0.59	0.62	0.47
Nitrate (mg/l)	62	59	72	73	68
Calcium (mg/l)	63.2	68.7	54	63	32.9
Magnesium (mg/l)	42.8	33.2	45	42	28
Total hardness (mg/l)	106	128	112	144	168

WQI	159.6	180.9	115.67	93	128.29
Remark	Fit	Fit	Fit	Fit	Fit

Depending upon its concentration in water. In the present study free carbon-dioxide was calculated to be 4.6 to 7.7 mg/l. However, the excessive carbon-dioxide is lethal to fish and interfere with growth of fish by decreasing pH of water body to acidic.

Dissolved Oxygen: Water gets oxygen through diffusion from the surrounded atmosphere and photosynthetic activities of aquatic plants. Kumar and Puri (2012) [16] have mentioned oxygen level above 13-14 mg/l can be harmful to aquatic life and its excessive amount may cause death of fish due to gas bubble disease. However, Oli, 1990 suggested below 2.5 mg/l of dissolved oxygen is lethal to the fish commodity. And low concentration of it amount to be organic pollution of aquatic body (Verma and Agrawal, 1989). In the present study we observed 3.7 to 6.4 mg/l from November-2020 to March-2021 and this level permits water for human consumption and of course it is also good for fish culture.

Biochemical Oxygen Demand: It is an amount of oxygen utilized by microbes in stabilizing organic matter of the water body and hence, it reflects the amount of organic pollutants in water. High value of BOD reflects the high level of pollution due to higher number of microorganisms in the water body (Martin and Hine, 2000). BOD in Ramala reservoir was recorded to be 1.4 mg/L to 4.6 mg/L. The minimum value was in the month of January and maximum in the month of November. This level comes under permissible for human water consumption as it is less than 5.

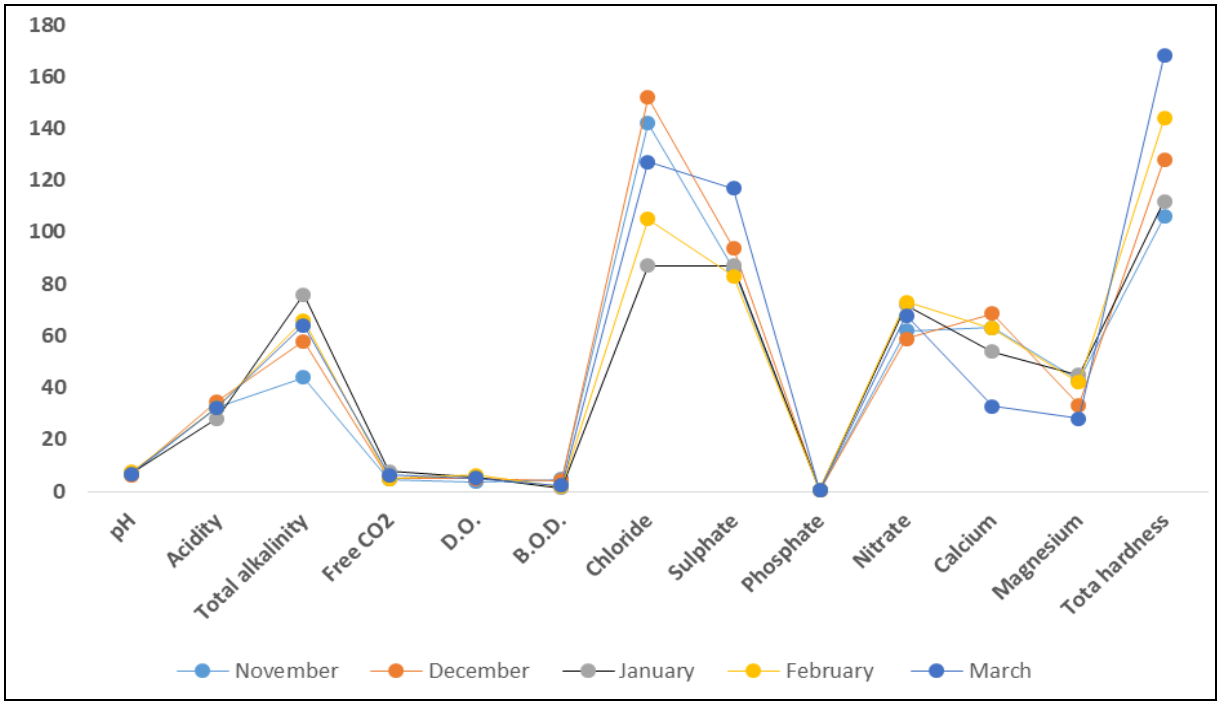

Fig 2: Chemical Profile of Ramala Reservior of Chandrapur, Maharashtra through Winter Season from Nov-2020 to Mar-2021

Chloride: Chloride in present in form of salt. It is essential for maintaining the osmotic balance in fish, but high chlorine content of water is lethal to fish fauna. Sources of chloride could be the domentic sewage of the city comes to this reservoir in more or amount. In the present study the chloride was estimated to be 152 mg/l in December and lowest in January. This concentration of chloride is not harmful to the fish culture. According to WHO (1971) this range of chloride in water is suitable for drinking purpose. Kumar and Puri (2012) [16] reported that the public drinking water should not exceed 250mg/l. However, fish and aquatic organism cannot withstand in high level of chlorides.

Sulphate: According to Public Health Engineering Department (PHED) of Government of Himalaya the permissible limit of sulphate in drinking water is 200 mg/l and rejection level is 600 mg/l. In the present investigation, the Ramala reservoir was recorded to contain 83 to 117 mg/l of sulphate in the month of February and March, 2021 and this indicates the water is quite good for human consumption.

Phosphate: Increase in phosphate in water leads to heavy growth of algae and also the aquatic vegetation together with nitrate due to eutrophication. Environmental Protection Agency (EPA),1986 suggested limit of phosphate in the reservoir should not be more than 0.024 mg/l. Ramala reservoir was recorded to have between the range of 0.47 to 0.62 mg/l during entire winter season (Table-1 and Figure-2).

Nitrate: Nitrate is very important inorganic substance that need to produce varieties of amino acids and nitrogen bases of genetic and non-genetic materials through metabolism in all sort of organism. Increased amount of nitrate is dangerous as it leads to excessive growth of aquatic plants in water body. During study period amount of nitrate was measured to be within permissible rage as far its human consumption is concerned. EPA, 1986 suggested 10 mg/l of nitrate in drinking water. In the present study it was estimated to contain 59 to 73 mg/l through entire winter season.

Calcium: The amount of calcium was measured from November, 2020 to March, 2021 was in the range of 32.9 to 68.7 mg/l. This range is under permissible limit for human consumption and also fish can also tolerate this much amount of calcium present in the water.

Magnesium: Permissible limit of magnesium in drinking water is 30 mg/l (PHED, Govt. of Meghalaya) and is rejected limit is 150 mg/l and above. The Ramala reservoir contains magnesium in the rage of 28 mg/l to 45 mg/l in entire winter season. It can be concluded with respect to amount of magnesium level in studied reservoir can be use for human consumption as the rejection limit is 150 and above.

Total Hardness: Permissible limit of magnesium in drinking water is 200 mg/l (PHED, Govt. of Meghalaya) and according Indian Standard (IS 10500-1991) desirable limit is 300 mg/l and permissible limit is 600 mg/l. However the total hardness of Ramala reservoir was estimated to be 106 to 168 mg/l during winter season from the month of November, 2020 to March, 2021.

WQI: Water quality index (WQI) suggest consumability of water by human. According to result obtained during winter season from the month of Novermber, 2020 to March, 2021 was in the rage of 93 to 180.9 and the range between 91 to 100 indicates the water is more suitable for human consumption. Thus from the present investigation we concluded that the water is fit for human consumption and also for fish culture in general.

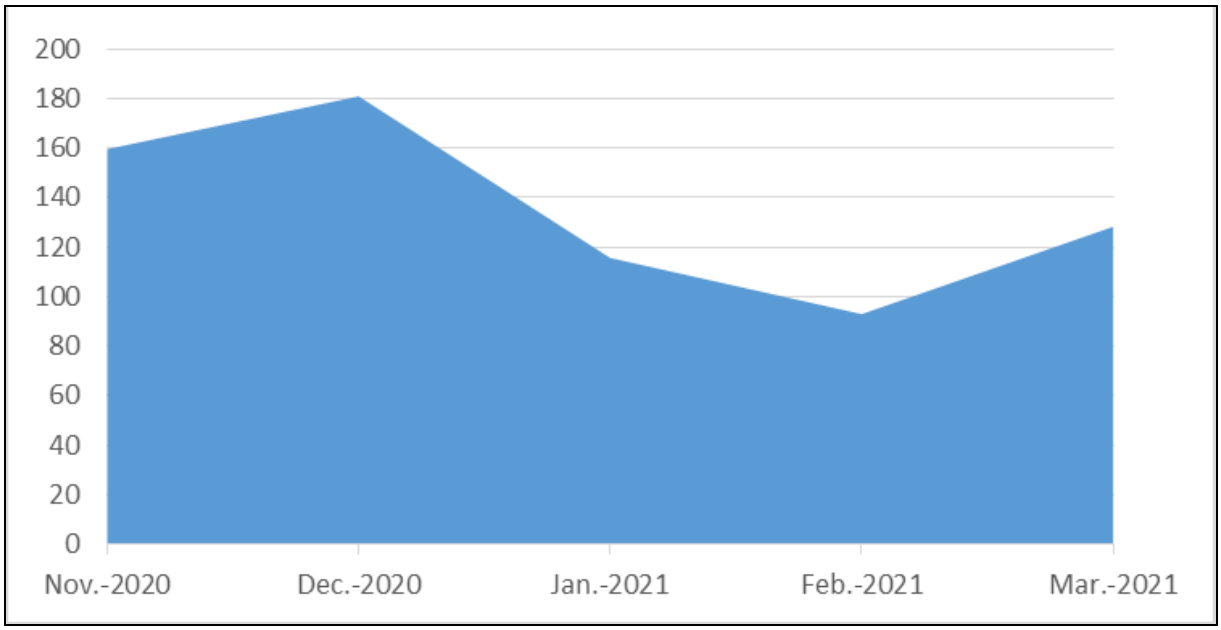

Fig 3: Water Quality index (WQI) during months of Winter

Table 2: Showing Water Quality Index (WQI)

Excellent (91-100)
Good (71-90)
Average (51-70)
Fair (26-50)
Poor (0-25)

Conclusion

As per our study carried out from the months of November, 2020 to March, 2021 the quality of water found to be suitable for human consumption because the calculated water quality index was greater than 100 except in the month of February, 2021. Heavy growth of aquatic vegetation is due to eutrophication. Heavy aquatic vegetation in the ponds could prove lethal to fishes and hence reservoir needs extensive water treatment. It has been observed that, Ramala reservoir receives domestic discharge and plastic waste from some part of the city which add pollutants to water body, such practice should be not allowed by the people either or municipality.

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