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Study of aquatic environment of Khar Danda sea coast

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ABSTRACT

The seacoast of Khar Danda 18.96 N and 72.82 E is to the western edge of Mumbai shore of Bandra Suburb at an altitude of 10m to 15m. It has a tropical climate and temperature varying from min 18°C to max 37°C. The sea line is marked by black Deccan basalt sea rocks. It receives torrential Indian Ocean monsoon rains, between June and September. The Khar-Danda fishing village in the south is the oldest area where Koli community resides to the north is the Carter road Promenade. Human activities like domestic, agricultural or industrial have an impact on water and the ecosystems. Fish farming is the important occupation and several other anthropogenic activities like cremation of dead bodies, domestic sewage, and fecal discharge has tremendously affected the ecosystem of the shore as well as the sea. About 11,494 industries are located in the city and 24,554 industries are located in suburbs, contributing as the major source of industrial pollutants. Nearly half of the Mumbai's populations about 42% of residents are slum dwellers or homeless lacking sewage and sanitation facilities. They use coastal areas as a natural toilet which results in a huge amount of sewage released directly into the sea. A massive amount of these wastes enter the coastal water in and around Khar Danda which is under the grip of pollution. These pollutants carry soil and particles laden with carbon, nitrogen, phosphorus, and minerals. This nutrient-rich water can cause fleshy algae and phytoplankton to thrive in coastal areas; known as algal blooms, which have the potential to create hypoxic conditions by using all available oxygen. Moreover, a drastic depletion in faunal and floral diversity of the area has been observed causing destruction of mangroves as well as a decline in fishery catches. The Pomfret catch has declined from 24,000 tons in 1982 to 3,000 tons in 2006-07. Also, the Bombay duck catch has crashed from 80,000 tons in 1982 to 23,000 in 2006 (Times of India by S.S.Singh.2010). The Physio-chemical parameters like temperature, pH, Hardness, D.O, B.O.D, CO₂, Nitrate, Nitrite, Fecal Coliform (FC) and Total Coliform (TC) studied are presented as a minimum, maximum and mean values to assess the extent of water quality variation throughout the year from OCT. 2017 to SEPT. 2018. The result indicated that parameters were found to be greatly affected.

Keywords— Aquatic environment, Khar-Danda sea coast, Pollutants, Physico-chemical parameters

1. INTRODUCTION

Pollution of the water bodies has been reported by various ecologists Agarwal & Shrivastav 1984, Ambasht et al 1985, Mishra 2000 and Agarwal 2005[2]. Pollutants not only affect the aquatic ecosystems but due to bioaccumulation reaches the human food chain. Although there is no dispute that pollution can affect the aquatic organisms under laboratory conditions and can be responsible for the decline in their population. [26] However, it is also known that water pollution, especially in coastal waters,[35] in the past few decades has been the result of urbanization and industrialization. This has resulted in some major aquatic bodies becoming devoid of or deficient of certain aquatic species. [54]The concern that pollution may influence the health status of fish and other aquatic animal has increased over the past 20 years. [20] Various epidermal diseases, including fin-rot in demersal fish, and protozoan diseases in molluscs in the heavily polluted bays and estuaries in North America have been reported.

With the growing interest in the subject and concern, international bodies such as the International Council for Exploration of the Sea (ICES), established workshops to investigate sampling methods and disease-reporting techniques. As there are variable, interacting biological and physical influences in the aquatic environment, [59] [62] it is difficult to establish the background prevalences of diseases in populations of fish and other aquatic animals. Examples of the influences of climatic changes [14] [33] observed showed that short-term catastrophes can be directly related. However, a more longterm problem is water acidification [18] [43] resulting largely from anthropogenic activities. In parts of Scandinavia, this has, and is, leading to the decimation of fish stocks [11] in inland waters. In general, diseases in fish[7] and other aquatic animals are very localized, but there is concern amongst scientists that certain cancers, especially liver tumours, occurring in demersal fish inhabiting polluted estuaries and coastal waters, are related to the release of potentially harmful substances-e.g. pesticides, heavy metals and hydrocarbons into the aquatic environment. [44][45] When large quantities of these pollutants are released there may be an immediate impact like large-scale sudden mortalities of aquatic organisms e.g. death of fish from the contamination of waterways with agricultural pesticides. [19] Lower levels of discharge may result in an accumulation of the pollutants in aquatic organisms. The end results, which may occur long after the pollutants have passed through the include immune-suppression, environment, reduced

metabolism, and damage to gills and epithelia. However, the link between adverse water quality and fish diseases is not clear. In normal circumstances, there are various factors which can influence the quality of water.

Some of the factors responsible for the changes in the water parameters include:

- 1. Organic Pollutants from domestic wastes
- 2. Pollutants from run-off water
- 3. Nutrient Pollution
- 4. And Seasonal effect of Temperature

2. AREA OF STUDY

The area selected for study is the sea coast of Khar Danda which lies 18.96° N and 72.82° E to the western edge of Mumbai shore of Bandra suburb at an altitude of 10m to 15m, with the combination of tropical climate and varying temperature between 25° C to 35° C in summers it receives torrential rain almost every year by the activities of south-west monsoon wind that originates from the Indian Ocean under high pressure.

The Sealine is marked by black Deccan basalt sea rocks. The Khar-Danda fishing village is the oldest area where Koli community lives on the south and Carter road Promenade on the north. Fish farming is the important occupation of the people of Khar Danda. Due to extensive fish farming and use of fishing equipment and trawlers, waste from the fishing industries, enter into the sea water. This has increased the pollution level tremendously affecting the ecosystem of the shore as well as the sea [3]. Besides this, pollutants enter the sea from domestic sewage, faecal matters, and cremation of dead bodies as well as industries from textile to petrochemicals. [15] About 11,494 industries are located in the city and 24,554 industries are located in the suburbs. Half of the Mumbai's populations about 42% of residents are slum dwellers or homeless lacking sewage and sanitation facilities. They use coastal area in and around the city as a natural toilet which results in a huge amount of sewage releasing directly into the Arabian Sea. [39]A massive amount of industrial wastes [17] from industries (list.1) and domestic effluents [56] enter the coastal water in and around Khar Danda which is under the grip of pollution. [4] These pollutants carry soil and particles laden

With carbon, nitrogen, phosphorus, [13] and minerals. This nutrient-rich water can cause fleshy algae and phytoplankton to thrive in coastal areas; known as algal blooms, which have the potential to create hypoxic conditions by using all available oxygen is recorded in and around the coastal waters.[26] Moreover, a drastic depletion in faunal and floral diversity was also noted[51]. This has caused the destruction of mangroves as well as a decline in fishery catches.[7] The Pomfret catch has declined from 24,000 tons in 1982 to 3,000 tons in 2006-07. And the Bombay duck catch has also crashed from 80,000 tons in 1982 to 23,000 in 2006 (Times of India by S.S.Singh.2010).[14] The Physicochemical parameters like temperature, pH, Hardness, D.O (Dissolved Oxygen), B.O.D (Biological Oxygen Demand), CO2, PO4-P, Nitrate, Nitrite, Faecal Coliform(FC) and Total Coliform(TC) were studied are presented as minimum & maximum mean value to assess the extent of water quality[41] variation throughout the year from OCT 2017 to SEPT 2018. [52] In absence of DO, Nitrate and Nitrite, the oxidation of organic matter proceeds through the utilization of sulphate which is abundantly available in sea water resulting in the liberation of sulphide and ammonia (Zingdi and Sabnis, 1994). The parameters were found to be greatly affected. Krishna Kumari & Nair reported that high D.O and low BOD and nutrients suggest the prevailing good water quality. The variations of different parameters provide an exact idea of the quality of water bodies.

3. OBJECTIVES

- To assess the nature and extent of pollution in coastal waters.
- To evaluate the quality of water over a period of time.
- To understand the environmental effect of the different parameters.
- To create awareness and convey the possible measures that can mitigate the future deterioration of the water body.

4. LOCATIONS

Site 1: Jogger's Park Site 2: Hindu Samshan Bhumi Site 3: Chium Village Site 4: Khar Danda dock



Fig. 1: Satellite image of sites lining the sea coast

Tamkeen Nagma; International Journal of Advance Research, Ideas and Innovations in Technology5. MATERIALS AND METHODSjogger's park site 1 did not show any significant characteristic

Water samples are collected from 4(four) different sites/locations (as given above) of the Khar -Danda sea coast for laboratory examination, using biological methods for assessment of water quality [9] [57] the present work stretches over a period of one year i.e. OCT. 2017 to SEPT 2018. The various physicochemical parameters of water like temperature, pH, Total hardness dissolved oxygen(D.O), Phosphate, Nitrate, Nitrite, Faecal Coliform (FC), Total Coliform(TC) were determined by following the standard methods given in APHA (1971).[6]

5.1 Chemical analysis and findings of marine water of Khar-Danda sea coast

The water quality of the four sites of the Khar Danda sea coast with respect to pH, Salinity, Hardness, DO, BOD, CO_2 , Nitrite, Nitrate, Faecal Coliform (FC), Total Coliform (TC) are presented as minimum, maximum and mean value to assess the extent of water quality varies throughout the year.[25]

Below are the findings of the seasonal variations [61] in the parameters along the stretch of the sea coast of Khar -Danda at the four specific sites selected. A comparative study of the physicochemical investigation [52] during three different seasons at four different sites showed the following results. (Table.1, 2, 3) Among the four sites, the colour of the water at

jogger's park site 1 did not show any significant change, It remained unchanged that is colourless in the rainy season, light brown in winter and summer respectively. The colour of the water at site 3 and 4 showed marked changes [11] from light brown to dark brown especially in summer and winter than in rainy season. Similarly such variations were also found in the D.O level (Graph .1) ranged from 0.73 at Khar-Danda dock site 4 much lower than the normal, making it unfit for aquatic life [21] and the highest level of D.O was 7.63 mg/l at Joggers Park meeting the standard desired limit of 4-7mg/L. Other parameters like BOD level(Graph.2) ranged from 5 mg/L at site 1 to 11.9 mg/L at site 4 lesser than standard limit 20mg/L and COD with the values from 17.52 mg/L at site 4 to 69 mg/L at site 1 were far lesser than standard upper limit 120 mg/L. Nitrate and Nitrite(Graph.5&6) content were also found to be normal with the values ranging between 0.66 to 1.06 mg/L for nitrate and 0.00 to 0.19mg/L for nitrite. The level of Phosphate(Graph.4) was found to be slightly higher than normal (>0.1 mg/L)on all the four sites due to several human activities.[13] On comparing the Faecal and Total Coliform (Graph.7&8) the Faecal coliform was found to be higher at site 3 and site 4 with the values of 1380 and 1250 MPN per 100ml respectively which is higher than the standard value of 1000/100ml MPN, whereas the Total Coliform was found to be normal with the values ranging below 10,000/ml MPN.

6. TABLES AND GRAPHS

Table 1: (Winter) from Oct 2017 to Jan 2018					
Chemical Parameters	SITE 1	SITE 2	SITE 3	SITE 4	
	Jogger's Park	Hindu Shamshan	Chium Village	Khardanda Dock	
Colour	Light brown to	Pale yellow to	Light brown to	Pale yellow to	
	colourless	colourless	dark brown	dark brown	
	Min23	Min22	Min24	Min25	
Temperature	Max27	Max27	Max27	Max27	
	Mean -25	Mean -24.5	Mean - 25.5	Mean -26	
pH	7.9	7.9	7.9	7.8	
Salinity(gm/liter)	3.7	3.7	3.7	3.7	
Hardness	1,803.6	1,683.36	1,723.44	1,763.52	
(mg of Ca ⁺⁺ /liter)					
Dissolved Oxygen	Min2.17	Min2.10	Min1.61	Min0.77	
(mg/liter)	Max3.43	Max3.43	Max3.43	Max3.43	
	Mean - 2.80	Mean - 2.76	Mean - 2.52	Mean- 2.10	
BOD (mg/liter)	Min5.60	Min5.02	Min6.40	Min5.00	
_	Max5.90	Max5.04	Max8.10	Max7.09	
	Mean - 5.75	Mean -5.03	Mean - 7.25	Mean - 6.04	
	Min 19.34	Min 21.37	Min 20.23	Min18.32	
CO ₂ (mg/liter)	Max 69.00	Max 61.13	Max 39.00	Max 35.12	
	Mean - 44.17	Mean -41.25	Mean - 29.62	Mean -31.22	
PO ₄ –P	Min 0.25	Min 0.29	Min 0.33	Min0.24	
(µg/ liter)	Max 0.27	Max 0.32	Max 0.36	Max 0.26	
	Mean - 0.26	Mean - 0.30	Mean - 0.34	Mean - 0.25	
Nitrate	Min 0.79	Min - 0.79	Min 0.91	Min 1.06	
(µg/ liter)	Max 0.80	Max 0.80	Max 0.99	Max- 1.06	
	Mean - 0.79	Mean - 0.79	Mean - 0.95	Mean - 1.06	
Nitrite	Min 0.01	Min 0.01	Min. – 0.15	Min 0.16	
(µgatom/ liter)	Max 0.01	Max 0.01	Max. – 0.17	Max 0.19	
	Mean - 0.01	Mean - 0.01	Mean – 0.16	Mean - 0.17	
Faecal coliform	Min 120	Min 180	Min 1120	Min. – 870	
(MPN/100ml)	Max 300	Max 400	Max 1380	Max 1200	
	Mean -210	Mean - 290	Mean - 1250	Mean - 1035	
	Min 400	Min380	Min.1200	Min1000	
Total coliform	Max 610	Max820	Max1400	Max1250	
(MPN/100ml)	Mean-755	Mean-600	Mean-1300	Mean-1125	

1 able 2: In Summer from the period Feb 2018-June 2018					
Chemical	SITE 1	SITE 2	SITE 3	SITE 4	
parameters	Jogger's Park.	Hindu Shamshan	Chium Village	Khardanda Dock	
Colour	Light brown to	Pale yellow to	Light brown to	Dark brown to	
	colourless	colourless	dark brown	grey	
Temperature	Min27	Min27	Min27	Min27	
	Max35	Max35	Max35	Max35	
	Mean - 27	Mean -27	Mean -27	Mean -27	
PH	7.9	7.9	7.6	7.1	
Salinity(gm/liter)	3.7	3.7	3.7	3.7	
Total hardness	1,803.6	1,683.36	1,723.44	1,763.52	
(mg of Ca ⁺⁺ /liter)					
Dissolved oxygen	Min 2.15	Min 2.09	Min 1.30	Min. – 0.73	
(mg/litre)	Max 3.43	Max 3.41	Max 3.10	Max 3.40	
	Mean - 2.79	Mean - 2.75	Mean - 2.20	Mean - 2.07	
BOD (mg/liter)	Min. – 7.03	Min 5.10	Min 7.00	Min 5.64	
	Max. – 8.73	Max 5.90	Max 8.28	Max7.92	
	Mean – 7.88	Mean -5.50	Mean -7.64	Mean -6.78	
CO ₂ (mg/liter)	Min 18.32	Min. – 20.35	Min. – 18.22	Min. – 17.98	
	Max. – 35.12	Max. – 60.12	Max. – 38.15	Max 35.08	
	Mean – 26.72	Mean – 40.24	Mean – 28.18	Mean – 26.53	
PO ₄ –P	Min. – 0.28	Min 0.34	Min. – 0.33	Min. – 0.24	
(µgm/ liter)	Max. – 0.30	Max. – 0.38	Max. – 0.40	Max. – 0.29	
	Mean – 0.29	Mean – 0.36	Mean – 0.36	Mean – 0.26	
Nitrate	Min 0.79	Min. – 0.79	Min. – 0.93	Min. – 0.93	
(µgatom/ liter)	Max 0.80	Max. – 0.80	Max. – 1.01	Max. – 1.03	
	Mean - 0.79	Mean – 0.79	Mean – 0.97	Mean – 0.98	
Nitrite	Min. – 0.01	Min. – 0.01	Min. – 0.12	Min 0.11	
(µgatom/ liter)	Max. – 0.01	Max. – 0.01	Max. – 0.14	Max. – 0.14	
	Mean – 0.01	Mean – 0.01	Mean – 0.13	Mean – 0.12	
Faecal coliform	Min 300	Min 350	Min 1200	Min 1100	
(MPN/100ml)	Max 350	Max 400	Max 1500	Max 1400	
	Mean - 325	Mean- 375	Mean- 1350	Mean – 1250	
Total Coliform	Min900	Min 900	Min1400	Min1200	
(MPN/100ml)	Max1210	Max1300	Max1800	Max1700	
	Mean-1055	Mean-1100	Mean-1600	Mean-1450	

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Tabl	e 2: In Summer from the i	neriod Feb 2018-J	une 2018	

Table 3: In the rainy season from the period July 2018-Sept 2018

Chemical parameters	SITE 1	SITE 2	SITE 3	SITE 4
-	Jogger's Park	Hindu Shamshan	Chium Village	Khar Danda Village
Colour	Pale yellow to	Pale yellow to	Light brown to	Light brown to Pale
	colourless	colourless	Pale yellow	yellow
Temperature	Min27	Min27	Min27	Min27
	Max30	Max30	Max30	Max30
	Mean – 27	Mean-27	Mean -27	Mean -27
PH	7.9	7.9	7.9	7.9
Salinity (gm/liter)	3.7	3.7	3.7	3.7
Total hardness	1,803.6	1,683.36	1,763.52	1,723.44
(mg of Ca ⁺⁺ /liter)				
Dissolved oxygen	Min. – 5.28	Min3.10	Min 1.40	Min 2.90
(mg/litre)	Max 7.63	Max5.60	Max4.80	Max5.40
	Mean- 6.45	Mean - 4.30	Mean -3.60	Mean -4.10
BOD	Min5.00	Min5.01	Min5.60	Min5.80
(mg/liter)	Max9.45	Max5.09	Max 9.45	Max18.0
	Mean-7.27	Mean -5.05	Mean - 7.52	Mean - 11.9
PO ₄ –P	Min. – 0.23	Min- 0.25	Min-0.31	Min- 0.24
(µgatom/ liter)	Max 0.25	Max0.27	Max0.38	Max0.32
	Mean- 0.24	Mean- 0.26	Mean- 0.34	Mean-0.28
Nitrate	Min- 0.70	Min- 0.76	Min- 0.90	Min- 0.89
(µgatom/litre)	Max.– 0.66	Max 0.78	Max0.92	Max0.92
	Mean- 0.68	Mean- 0.77	Mean-0.91	Mean- 0.90
Nitrite	Min- 0.00	Min-0.00	Min- 0.04	Min- 0.04
(µgatom/ liter)	Max. – 0.00	Max0.00	Max0.04	Max0.06
	Mean-0.00	Mean-0.00	Mean-0.04	Mean- 0.05
Faecal coliform	Min 110	Min 150	Min 900	Min700
(MPN/100ml)	Max 290	Max 350	Max 1200	Max1150

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	Mean- 200	Mean – 250	Mean-1050	Mean-925
Total coliform	Min250	Min320	Min1280	Min1200
(MPN/100ml)	Max600	Max800	Max1370	Max1300
	Mean-425	Mean-560	Mean-1325	Mean-1250



Fig. 2: Dissolved oxygen



Fig. 3: Biological Oxygen demand



Fig. 4: Dissolved Carbon Dioxide







Fig. 6: Nitrate Content



Fig. 7: Nitrite Content







7. RESULTS AND DISCUSSIONS

The water quality criteria with respect to one or more parameters are identified as polluted and require action for restoration [28] of water quality. The above tables and Figures give a comparative account of water quality parameters of the Khar Danda sea water like pH, Conductivity, DO, BOD, Total Coliform(TC), Faecal Coliform(FC), Nitrite and Nitrate, presented as minimum, maximum and mean value to assess the extent of variation in water quality throughout the year.[25] DO varies from 0.0 to 7.6 mg/l and BOD is observed in the range of 0.7 mg/l to 296 mg/l at the four different sites along the stretch of the Khar Danda sea coast is not meeting the desired criteria. The level of DO is observed to be more than 4 throughout the year to sustain aquatic life whereas, the values less than 4 are observed in stretches at a number of locations downstream of urban settlements due to the discharge of untreated / partially treated municipal wastewater [15] which is responsible for high

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oxygen demand. During 2010 the lowest DO was observed which one of the most important indicators of pollution is). Conductivity is observed very high and it ranges from 22-62690 μ mhos/cm. The Nitrate (NO3-) concentrations are observed in the range of 0.02-6.85 mg/l. The Total and Faecal Coliform count is meeting the criteria limit except at Site 4 (140000 MPN/100ml &110000 MPN/100ml) & at Site3 (12000MPN/100ml&6400MPN/100ml)

The monitoring results obtained during 2017-18 indicate that organic pollution continues to be the predominant pollutant of the aquatic resources. The organic pollution [44] measured in terms of Bio-Chemical Oxygen Demand (BOD) & Coliform bacterial count was observed and found that nearly 60% of the observations are having BOD less than 3mg/l, 22% between 3-6mg/l & 18% above 6mg/l. Similarly Total & Faecal coliform which indicate the presence of pathogens in water is also a

major concern. About 46% observations are having Total Coliforms and 68% observations are having Faecal Coliform less than 500 MPN/100ml gives the indication of the extent of water quality degradation CPCB (Ministry of Env & Forest 2010).

8. CONCLUSION

Today, approximately 40 percent (748bcm) of available water resources are considered to be utilizable due to a variety of factors. Probably, this is a blessing in disguise, as it caters to the requirements of the ecosystems. Hence water conservation measures [55] must receive the highest priority, followed by renovation and recycling. The environmental challenges of water resources are expected to be sorted out in the coming years. These environmental challenges to the marine water bodies [26], [30], [31] can be addressed under the following approaches: [34]

- (a) Improving the quality of water by reduction and treatment of pollution.[28]
- (b) Reuse and recycling of wastewater.
- (c) Contributing to food production (Aquaculture), medicines and other goods.[38]
- (d) Providing water for, recreation and waterways transport [47].

Due to the complexity and urgency of the environmental challenges, these approaches need to be simultaneously pursued. However, it is evident that an essential prerequisite for water and human security is ecological security. Hence, water resources have to be urgently dealt [62] with because of the requirements of water for the ecosystem. In each of these approaches, appropriate policy, institutional technological and economic interventions and instruments may be adopted.[29] Most of these instruments have fortunately been tried or tested at least on a pilot scale. The challenge is to institutionalize systems for these interventions and instruments to work on a large scale.[59]

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