

## Decaying Water Bodies – Victims of Human Neglect or Urbanization

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**Abstract:** n-Choe (choe in local language means a rain fed rivulet) a small natural and seasonal rain fed stream traverses through the first planned city of India i.e. Chandigarh which is nestling in the foothills of Himalayas in north India. At some time it was an asset to the city beautiful with its clear water flowing through the entire city along with the natural gradient, but now is an eye sore throwing up problems of unwanted parasites, mosquitoes and stench due to its degradation resulting from sheer neglect and apathy. This paper reviews the water quality of this rivulet after analyzing water from different sites in different seasons and its cause of decay. It is encouraging to note that this rivulet can be revived once again, support the aquatic and biological life and offer a refreshing site to the residents.

**Keywords:** Aquatic ecosystem, BOD, COD, DO, EC, N-Choe, Water analysis

### 1. Introduction

Reviving ecosystem and its management in natural streams is the prime concern and environmental challenge of our country. Natural water bodies not only harbor a diverse aquatic life but also add aesthetic beauty to the place it flows through. N-Choe, a natural choe and rained rivulet is one such fresh water body passing through the city beauty Chandigarh. (A township in North India). Water bodies are currently degraded by both natural and anthropogenic activities, which deteriorate their quality, and push them to the brink of extinction in the process of unplanned development, giving rise to the need for suitable conservation strategies.[1] Unfortunately, over the years, less attention has been given to small water body's losses world over, including Chandigarh's N-Choe. The degradation of the water body has altered their functions, affecting the ecological balance. Le-Corbusier, while planning the City Beautiful, very consciously retained the water bodies flowing through the natural terrain but the degradation of the water body reveals the myopic attitude of the authorities. On map, N-Choe still bears the stamp of Le-Corbusier's vision of the City Beautiful. It originates from the capital complex in north of the city and transects the entire city medianally to empty in a river near a satellite town of Chandigarh. The Choe should merge into Ghaggar river but it never reaches there as villages use the same polluted water to grow vegetables. People living near the N-Choe in the middle of the city have to bear the stench and germs from rotting vegetables, waste and protozoan parasites in the form of mosquito vectors. Basic source of water of N-Choe being rain water had a very healthy environment for aquatic and amphibian animals. The present status of Choe is miserable, although its pH values suggests it possibility of revival. Millennium meeting of UN Assembly in 2000 detected on achieving eight Millennium Development Goals (MDGs) by 2015,[2] out of which goal-7 is to ensure environmental sustainability. Management and revival of ecosystem through improvement of water quality can ensure a definite environmental sustainability. In this case study focus was on the eco hydrology which is a sub discipline of hydrology focused on the ecological aspects of hydrological cycle, developed within phase V, VI and VII of UNESCO International Hydrological Programme.[3]

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## 2. Methodology

Water is a dynamic medium and its quality varies spatially and temporally. In order to characterize and analyze water body, studies of the major components, physico-chemical and biological characteristics were carried out [4] at three sites selected along with length of N-Choe in pre and post monsoon seasons using a combination of qualitative and quantitative methods.[5]

Site selection:

(i) Site 1: Sec-10, Chandigarh (ii) Site 2: Sec-23, Chandigarh. (iii) Site 3: Sec-42, Chandigarh.

The samples were collected in thoroughly cleaned 2.5 litre inert plastic containers in the forenoon preferably in morning hours so that parameters remain almost same.

### 2.1. Physical Parameters

- Colour
- Turbidity
- Temperature
- Electrical Conductivity (EC)

### 2.2. Chemical Parameters

- pH
- Total Dissolved Solids (TDS)
- Dissolved Oxygen (DO)
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Electrical Conductivity (EC)

### 2.3. Observation and Results

Table 1

S No.	Tested Parameters	Units	Results		
			NE01 (Bottle Marked I)	NE02 (Bottle Marked II)	NE03 (Bottle Marked III)
1.	pH	mg/l	7.2	6.6	6.8
2.	BOD (3 days 27 °C)	mg/l	5.3	8.4	10.1
3.	COD	mg/l	11.5	15.0	27.5
4.	Solids (Dissolved)	mg/l	167	310	492
5.	EC (Electrical Conductance)	µS/cm	258	479	690
6.	DO (Dissolved Oxygen)	mg/l	1.2	3.7	4.2
7.	Turbidity	NTU	1.20	2.68	3.26

Table 1: Shows results of various parameters of water sample in May 2012 from three different sites.

Table 2

S No.	Tested Parameters	Units	Results		
			NE01 (Bottle Marked I)	NE02 (Bottle Marked II)	NE03 (Bottle Marked III)
1.	pH	mg/l	7.10	7.20	7.78
2.	BOD (3 days 27 °C)	mg/l	> 3	> 3	> 3
3.	COD	mg/l	19.76	11.86	31.62
4.	Solids (Dissolved)	mg/l	230	340	370
5.	EC (Electrical Conductance)	µS/cm	352	525	566
6.	DO (Dissolved Oxygen)	mg/l	1.5	4.5	5.4

7.	Turbidity	NTU	1.3	3.42	4.26
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Table 2: Shows results of various parameters of water sample in September 2012 from three different sites.

Table 3

S No.	Tested Parameters	Units	Results		
			NE01 (Bottle Marked I)	NE02 (Bottle Marked II)	NE03 (Bottle Marked III)
1.	pH	mg/l	7.19	7.45	7.19
2.	BOD (3 days 27 °C)	mg/l	> 3	> 3	> 3
3.	COD	mg/l	20.41	24.49	20.41
4.	Solids (Dissolved)	mg/l	320	366	361
5.	EC (Electrical Conductance)	µS/cm	495	562	555
6.	DO (Dissolved Oxygen)	mg/l	5.9	9.1	7.7
7.	Turbidity	NTU	2.5	2.0	2.1

Table 3: Show results in various parameters of water samples in January 2013 from three different sites.

Table 4

Temperature	pH	EC (µS/cm)	TDS (mg/l)	SO <sub>4</sub> <sup>2-</sup>	HCO <sub>3</sub> <sup>-</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	Na <sup>+</sup>	K <sup>+</sup>	NO <sub>3</sub> <sup>-</sup>
32 °C	7.2	268	167	31.4	148	35.3	12.2	23.5	3.0	0.26
31.5 °C	6.6	479	310	39.0	190	41.7	29.2	9.6	2.8	0.35
31 °C	6.8	690	492	52	276	66.4	23.4	14.7	0.9	2.92

Table 4: Shows results of major component ion concentrations for all selected study sites in May 2012.

### 3. Result and Analysis

**pH:** In the present study the water of N-Choe showed pH from 6.6-7.8 in pre and post monsoon seasons. In pre monsoon season pH varies from 7.2, 6.6 and 6.8 at three sites (average 6.8) while in post monsoon season it varied as 7.10, 7.20 and 7.78 (average 7.36) and in winter season it showed the values like 7.19, 7.19 and 7.45 (average 7.27). Acidic pH in pre monsoon i.e., summer season is probably due to high rate of decomposition of organic waste being added to N-Choe at different points along the length.

**Electrical Conductivity (EC):** EC is mainly influenced by dissolved salts like NaCl and KCl. Most of the fresh water bodies have range of EC from 0.001-0.1 S/M (Siemens per meter). EC is also the measure of water quality parameter or salinity. Sources of salinity may be an abundance of salts due to poor irrigation management, mineral from run off water or other discharges. At about 300 µS/cm health of aquatic organisms will be affected.[6]

EC reported at three sites in different seasons varies from as low as 258 µS/cm at site 1 in pre monsoon to as high as 690 µS/cm. Similarly at site-11 and 111 these values ranges from 352-566 µS/cm and 495-562 µS/cm with an average of 478, 481 and 537 µS/cm of three sites respectively. Higher value of EC at third sites is mainly due to run off water along with pouring of domestic waste.

**Turbidity:** Turbidity or total suspended salts (TSS) affect the transparency of water or light scattering of the water. The measuring unit of turbidity is NTU (Nephelometric Turbidity Unit). The range of TSS of fresh water bodies is from 1-2000 NTU. TSS is typically composed of fine clay/ silt particles, planktons, organic or inorganic compounds or other microorganisms. These suspended particles range in size from 10-0.1 nm. The man made sources of TSS include erosion, storm water run off, industrial discharge, microorganisms, eutrophication, etc.[7]

**Dissolved Oxygen (DO):** DO is essential to all forms of aquatic life including decomposers. Amount of DO tends to decrease as the temperate of water body increases. DO of fresh water at sea level ranges from 15 mg/l at 0 °C to 8 mg/l at 25 °C. Concentration of unpolluted water is generally close to 10 mg/l. DO tends to

increase in day or light hours due to increased photosynthetic activity of aquatic in comparison to that at night hours. Addition of organic impurities tends to decrease the DO levels of water as the oxygen requirement of decomposers to decompose that waste increases.[7] The indirect measures of DO are values of BOD and COD. DO less than 2 mg/l will kill fish and other sensitive organism. Otherwise DO less than 9 mg/l level is dangerous for aquatic life.[8]

The DO levels of site 1 shows lowest levels of the value of 1.2 mg/l during pre monsoon season and higher during winter season of the value of 9.1 mg/l at site 3. The value of DO at site 1 increases from 1.2 to 3.7 to 4.2 during pre monsoon, post monsoon and winter season respectively while site 2 shows the values of DO as 1.5, 4.5 and 5.4 and site 3 shows the values like 5.9, 7.7 and 9.1 respectively. The average value of DO of N-Choe remained 3.03, 3.8 and 7.6 mg/l. It clearly indicates presence of more pollution at site 1 in comparison to site 2 and 3. Over all DO levels of all site is below danger level of 9 mg/l to support aquatic life. The organic waste added before site is slowly carried away to site 2 and site 3 where it merely act as a dumping body showing high levels of BOD and COD. More over Low levels of DO are shown in summer season showing its relationship with high temperature. Levels of DO increased comparatively in winter. High levels of DO at site 2 and 3 are also due to more presence of aquatic producers of emergent vegetation type. Over all levels of DO in N-Choe is also low due very less amount of water in the body at most of the places.

**Biological Oxygen Demand (BOD):** BOD is the amount of oxygen required for microbial metabolism of organic compounds in water. This demand depends upon the water temperature, nutrient concentration and enzymes available to indigenous population of microbes. BOD and COD are two common measures of water quality that reflects the degree of organic pollution of a water body. BOD is a measure of DO in mg/l necessary for the decomposition of organic matter by microorganisms. According to WHO BOD limit for drinking water is 6 mg/l. Until 1971 no limit is recommended.

Most pristine rivers have a 5 day carbonaceous BOD below 1 mg/l. Moderately polluted rivers have a range of 2-8 mg/l. municipal sewage that is efficiently treated by 3 stage process would have a value of about 20 mg/l or less. [9] Value of BOD can also be expressed in ppm (parts per million) which indicates parts of oxygen consumed per litre of solution. Site 1 shows minimum of 5.3 and maximum of 10.1 mg/l during different season like pre monsoon, post monsoon and winter. Higher levels of BOD at site 3 show accumulation of organic waste from site 1 and 2 along with slow moving water of N-Choe. Even the amount of water at all sites shows very less water leading to further DO levels and increased BOD values. Site 2 and 3 shows more than 3 mg/l BOD during all seasons, which indicates presence of organic waste in the water body throughout the year.

**Chemical Oxygen Demand (COD):** COD is a water quality measure used not only to measure the amount of biologically active substances such as bacterial but also biologically active organic matter present in the water. It is the oxygen equivalent to total organic matter present in the water sample that is susceptible to oxidation by a strong chemical oxidant such as potassium dichromate. COD is a measure of total (toxic and non toxic) organics while BOD is that of non toxic ones. Therefore COD is an indirect measures of organic wastes. It is also measured in mg/l or ppm. For drinking water COD levels should be 10 ppm. As per CPCB norms COD of raw sewage should be less than 250 ppm.

COD levels of three sites during three different seasons indicates increasing levels from 11.5, 15.0 and 27.5 mg/l while site 2 indicates higher level in pre monsoon season i.e., 19.76 mg/l but little decline in post monsoon to 11.86 and again increase in winter to 31.62 mg/l. Levels of COD lightly decreased in winter owing to low chemical oxidation rates at low temperature to 20.41 in both pre and post monsoons and slightly increased to 24.49 mg/l at site 3. These results indicate that there is addition of both toxic as well as non toxic wastes in N-Choe at different levels along its length but definitely there is accumulation of all types of organic waste at site 3.

**Total Dissolved Solids (TDS):** It is a measure of the combined content of all inorganic and organic substances in water. It is an indicator of the presence of chemical contaminants. The chemical constituents like calcium, phosphate, nitrate, sodium, potassium, and chloride are usually from nutrient runoff. Electrical conductance (EC) of water is directly related to the concentration of dissolved ionized solid in water. Table

no. 4 clearly shows by  $\text{HCO}_3^-$  concentration to be more than half of the TDS values.  $\text{HCO}_3^-$  concentration disturbs the equilibrium of pH and tends to shift towards alkalinity. Excess is harmful to aquatic life except for a few species of fresh water oligochaetes, gastropods and ostracods. Other sensitive aqua fauna is not able to tolerate acute  $\text{HCO}_3^-$  concentration increase.

#### 4. Conclusion

All samples of water from the N-Choe in all the seasons show presence of fine and very fine suspended particles which indicates that the water of the body is categorically turbid. Over than all the amount of water in the body has receded too low that at places almost shows starting of eutrophication.

The values of BOD, already estimated in Jan. 2010 (41 mg/l) and March 2011 (72 mg/l), [10] if compared with present study indicates that organic load has increased in 2012-13 (Max. 101 mg/l at site 3 – May 2012). Similarly COD levels of 148 mg/l and 166 mg/l in Jan, 2010 and March 2011 respectively has again shows increased level in present study (275 mg/l at site 3 May 2012). This results support the evidence of accumulation of organic waste. DO levels were reported nil at site 1 during Jan, 2010 and 0.5 mg/l in March 2011 has shown improvement (Max 9.1 mg/l at site 3 in Jan. 2013) now indicates Chandigarh administration has taken some measures to plug some inlets of pollution points. Overall still the levels of DO are below required levels to support aquatic life (Danger level below 9 mg/l). The values of pH fluctuates of either side of normal pH which indicates that the body can be revived back of glory if suitable measures are taken up by administration along with awareness among citizens. At places the flow of N-Choe has been blocked to be replaced by concrete structures leading to stagnation of water. Such lentic water becomes breeding centres of mosquitoes inviting vector borne diseases.

Thus present study indicates the unhealthy present condition of N-Choe and proposes that some corrective measures should be taken by city administration to revive the water body so that dual benefit can be derived, first to regain the natural beauty of the city and second by providing healthy and refreshing environment to the citizens.

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