COOUM-A River's Tragedy

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Abstract - *Cooum is a river that meanders in the Indian city of Chennai. Once a majestic river that was used for boating and local use in the time of British rule in India, Madras, the river now is nothing more than the city's sewer drain. This is an active problem as the river flows through the heart of the city and causes health and environmental concerns. This paper is an attempt to understand and solve the possessed problems through scientific and social methods.*

Key Words: (Cooum, chennai)

1. A Brief history of the river

The river cooum is one of the water bodies in chennai and an infamous one at that, along Adyar river it is one of the main rivers that cross Chennai to reach the bay of bengal. The river originates from a village in Thiruvallur district called Cooum, thus the name. The river runs for 60 kilometers in total before draining into bay of bengal. Cooum starts as a decent source of water at its start in Thiruvallur district being used for irrigation and other general purposes, but deteriorates when in chennai containing high amounts of pollution making it a peril for Chennai city. The river was not always in this state, around the 1900's the river was used as a mode of transport, fishing and leisure boating as it was a fresh-water delight beautifully portrayed in the film Madrasapattinam.

Fig 1.The river being used for transport.

In the olden days the cooum river linking to Adyar was used to bring food from the north of chennai to the famished south. A series of bridges were built across the cooum river for crossing, the system provided so much shielding in the time of cyclones and played crucial roles in floods and heavy monsoon and famines. Cooum had around 49 species of fishes around 1950's but dropped down to 21 around 1970's before flatlining at the start of the 21st century.

Now there is neither flora nor fauna in the river due to its high toxicity. The river has become a sewage channel for the city taking the trash out of the city into Bay of Bengal. There has been positive tests for faecal coliform bacteria and a few heavy metals making the water absolutely unusable in any form. Of Late if you ask a considerably young person about cooum the only answer that you will recieve is that it is an open sewer drain pipe that cuts across the city which is viscid and carries a pungent smell. The tranquility of the river is completely masked by the pollution which in turn conceals its legacy. The currently living oldest generation feel broken when they see the river which they used to travel and fish being used as a drain pipe.

2. Origin and River Course

The river begins in a village called cooum hence the name of the river in Thiruvallur district which is about 70 kilometers from Chennai. The river enters Chennai at Arumbakkam and passes through Choolaimedu, Chetpet and via Egmore finally Chintadripet. The river splits into two and joins back together to drain out at bay of bengal near marina beach, Chennai. The forking and joining of the river creates a division between the main land and splits an island (The Island Grounds). There are various bridges that run over the river as it cuts the northern part of Chennai. The Wallajah Bridge, the Periamet

Bridge, the Chintadripet Bridge or the St Andrew's Bridge, Harris Bridge, Commander-in-Chief Road Bridge, College Road Bridge, Spur Tank Bridge and the Aminjikarai Bridge and Napier bridge being the major bridges that run over cooum.

Fig 2: Image of Cooum From College bridge

Fig 2.1 Drainage getting dumped into cooum near college Bridge

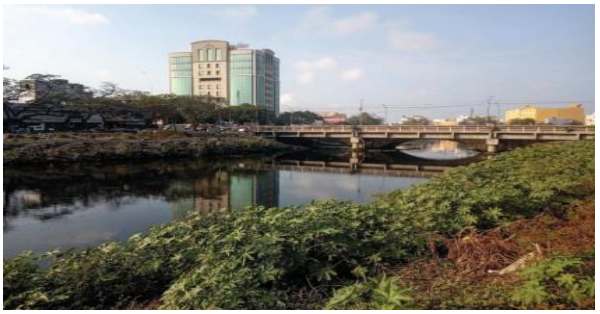


Fig 3: Cooum From Dams road looking at Aditanar Road

3. Flora and Fauna

Cooum used to support a variety of flora and fauna. Most of the flora found in the cooum and the most common phytoplanktons and Zooplanktons they are:

3.1 Phytoplankton:

Cyanophyceae

Anabaena circinalis, Anabaena constricta, Arthrospira sp. Aphanizomenon flos aquae-Aphanocapsa pulchra (Kutz)-Raben-Coelosphaerium-huetzingianum-Pleurocapsa sp.-Polycystic-Protococcus-Spirulina sp.-Spirulina gigantean-Spirulina jenneri (Stizb) geitler

Chlorophyceae

Actinastrum,sp.-Ankistrodesmus falcatus(corda) -Ralfs .-Ankistrodesmus-Chlamydomonassp.-Chlorella vulgaris -Chlorococcum,humicoli(Naeg)-Raben-Closterium,acerosum (Schrank)Her.-Scenedesmus bernardii G.M. Smith-Scenedesmus dimorphus (Turp)-Kutz-Schroeder

Bacillariophyceae

Amphora-Asterionella,japonica-Bacteriastrum- Biddulphia sinensis-Cyclotella meneghiniana-Nitzschia acicularis var-Fragilaria capucina Desmaz-Fragilaria halophile- Gomphonema parvulum (Kutz)

Diatoms

Amphiprora,gigantea,Varsulcata-(O'Meara),Cleve-Amphora proteus Greg.-Amphora terroris Ehr.-Asterionella formosa Hass

Zooplanktons

Acartia spinicauda-aracalanus parvus-Asplanohna sp.-Balanus sp.-Brachionus calyciflorus- Brachionus-Brachionus rubens Her-Calanopia aurivilli- Calanopia eliptica-Candaca bradyi - Candaciidae Candaca- discaudata- Centropages furcatus-Copepoda--longipes Hendel- Diaptomus sp.- Dipteran pupa-Eucalanus elongates-Filinia sp.-Filium longiseta-Isias tropica sewell-Labidocera acuta -Labidocera minuta-Moina sp.-Naupluis

The fauna at Cooum ranges from fishes to moluscus to reptiles.

3.2 Fishes

Acentrogobius neilli Da-Ambassis miops Gunther -Amblypharyngodon microlepis (Blkr.)-Anguilla bicolor Mc Clelland-Awaous gutum (Ham.)- Channa orientalis (Bloch & Schn.)- Channa punctatus (Bloch)- Channa striatus (Bloch)- Eleotris fusca (Sch.)- Esomus dandricus (Hamilton)- Etroplus maculatus (Bloch)- Etroplus suratensis (Bloch)- Glossogobius giuris (Ham.)- Macrognathus aral (Bl. & Sch.) -Macrognathus pancalus Ham.- Macrognatus aculeatum (Bloch)- Magolops cyprinoides (Broussonel)- Megalops cyprinoides- Mugil cephalus (Linnaeus)- Mugil microlepis (Smith)- Muraena sp.- Mystus gulio (Ham.)- Mystus vittatus (Bloch)- Oligolepis acutipennis (Val.)- Oreochromis mossambica (Peters) Oryzias melastigma (Mc Clelland) -Puntius amphibia (Valencienes)- Puntius amphibious (Val.) -Terapon jarbua (Forsskal)- Tilapia mossambica (Peters)

3.3 Insects

Anisops nivea Fieber-Diplonychus indicus-Gerrid sp.- Hydrometra sp.-Laccotrephes sp. -Limnogonus fossarum fossarum-Micromecta punctata (Fieb)- Nepa sp.-Ranatra sp -Sphacrodema annulatum Fabr.

3.4 Reptiles / Amphibians:

Rana hexadactyla- Rana syanaphlyctis Schneider- Rana limnocharis Boie- Natrix sp.

4. Tests and Results

A series of tests were conducted on the water from a range of locations (4 bridges) and one was taken from the tap as the control sample. As the results of the water from all the four locations were identical we present it as a single block. The findings and the respective pictures are detailed below. Various labs from through educational institutes were considered for the testing and analysis.

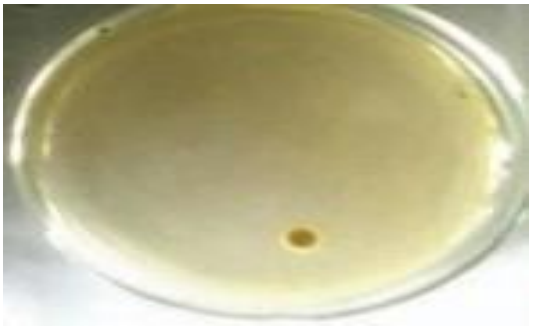


Fig: 4.0 : Bacteria test for tap water (Neg.)

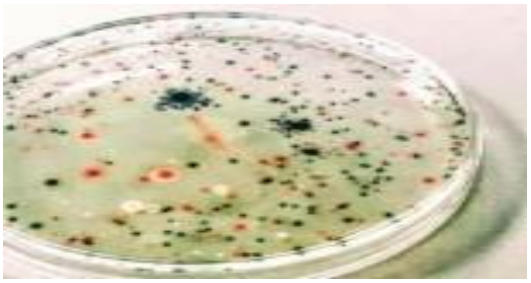


Fig: 4.1 : Bacteria test for cooum (positive)

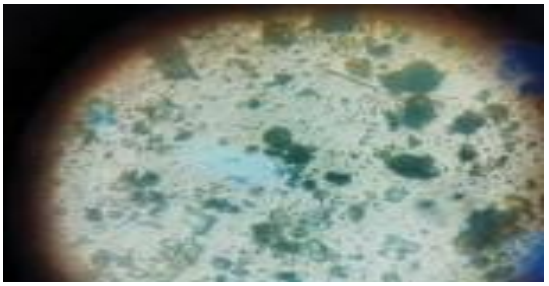


Fig: 5 : Microscope View

The results for the petri dish coliform bacteria test

Fig 6: pH test for tap water (7.0 in pH scale)

Fig 6.1: pH for cooum (9 in pH scale)

Tests Done:

Table 1. Showing the experimental results

Test For	Test Name	Cooum	Tap Water
Nitrates	Brown Ring (Lab Tests)	4.7 mg/l	0.21 mg/l
Chlorides	Precipitation (Lab Tests)	1800 mg/l	250 mg/l
Sulphate	White Precipitate	200 mg/l	231 mg/l

	(Lab Tests)		
Cu (copper)	Water testing kit	0.8 mg/l	0.07 mg/l
Zn (zinc)	Water testing kit	0.37 mg/l	5 mg/l
Pb (Lead)	Water testing kit	0.03 mg/l	0.01 mg/l
pH	pH paper	8.9 on pH Scale	7 on pH Scale
Fecal Coliform	Petri Dish Growth	Positive	Negative

Table 2. Physico-chemical parameters (mg/l) in the river Cooum at polluted stations during 1988-1990

Sl.no	Criteria	Cooum estuary					
		1988		1989		1990	
		Summer	Rainy	Summer	Rainy	Summer	Rainy
1	Air temp.°C	28.8 (28.4-31.0)	25.0 (23.4-28.4)	28.8 (23.8-31.6)	25.68 (23.4-28.5)	30.1 (26.8-31.1)	26.5 (23.6-28.5)
2	Water tem.°C	29.6 (28.6-31.8)	26.2 (23.6-28.4)	28.6 (24-32)	26.4 (23.6-29.0)	27.5 (25.2-31.2)	22.1 (23.8-23.6)
3	Colour (in units)	200 (170-240)	180 (160-220)	220 (160-250)	190 (180-240)	230 (190-260)	200 (160-220)
4	pH	8.3 (7.4-9)	7 (6.6-7.5)	8.6 (8.1-9.1)	7.2 (6-7.5)	8.8 (8.4-9.2)	7.5 (6.5-7.5)
5	Salinity	33.4 (23.6-43.5)	13.4 (8.4-20.1)	25 (12.4-44.6)	13.9 (8.4-15.8)	24.9 (14.6-43.8)	11.2 (8.6-17.4)
6	Total Suspend ed Solid	208 (192-212)	83 (72-89)	236 (212-241)	88 (78-96)	245 (192-263)	95 (85-118)
7	Free Carbon-di oxide	84.5 (72-101)	69.4 (43-93)	93.8 (79-108)	63.4 (40-90)	94 (69-112)	66 (40-90)
8	Dissolved Oxygen	4.1 (3-7)	6.2 (5.2-7.8)	4.3 (3.1-6.8)	6.4 (4.1-8.4)	3.6 (2.5-7.6)	5.6 (2.7-9.8)
9	B.O.D.	26 (25-27)	27 (25-29)	28 (25-29)	27 (26-29)	25 (24-26)	20 (25-27)

10	**C.O.D.**	236 (232-241)	236 (230-241)	234 (230-239)	235 (228-242)	234 (229-240)	235 (230-244)
11	**Acidity**	227.5 (201-211)	62.8 (54-74)	188.8 (68-246)	61.2 (59-73)	62.6 (54-76)	178.2 (69-249)
12	**Alkalinity**	566 (510-612)	101.4 (94-108)	416.7 (139-631)	119.4 (107-129)	512.5 (141-624)	119.2 (112-131)
13	**Nitrite**	0.02 (0.01-0.03)	0.015 (0.01-0.03)	0.03 (0.01-0.04)	0.018 (0.01-0.02)	0.025 (0.01-0.02)	0.018 (0.01-0.04)
14	**Nitrate**	4.5 (4.3-4.9)	3.6 (2.1-3.8)	4.7 (2.7-4.9)	3.8 (2.0-4.4)	4.8 (3.9-5.9)	3.4 (2.8-3.6)
15	**Ammonia**	2.8 (1.4-3.9)	1.9 (1.1-2.3)	2.9 (1.7-3.8)	2.0 (1.2-2.4)	3.1 (2.5-3.8)	2.6 (1.8-3.2)
16	**Phosphate**	2.6 (1.4-3.2)	2.4 (1.8-2.8)	3.2 (1.8-3.3)	2.8 (1.3-2.6)	3.8 (2.0-4.6)	2.9 (2.2-3.8)
17	**Sulphate**	85 (76-119)	54 (42-68)	200 (106-218)	65 (52-85)	185 (92-218)	72 (65-110)
18	**Chloride**	1800 (1640-920)	860 (800-980)	1920 (1760-1980)	890 (640-920)	2320 (1830-2440)	940 (826-984)

Table that was noted by Environmental Information System of India (1988-1990)

4. Issues

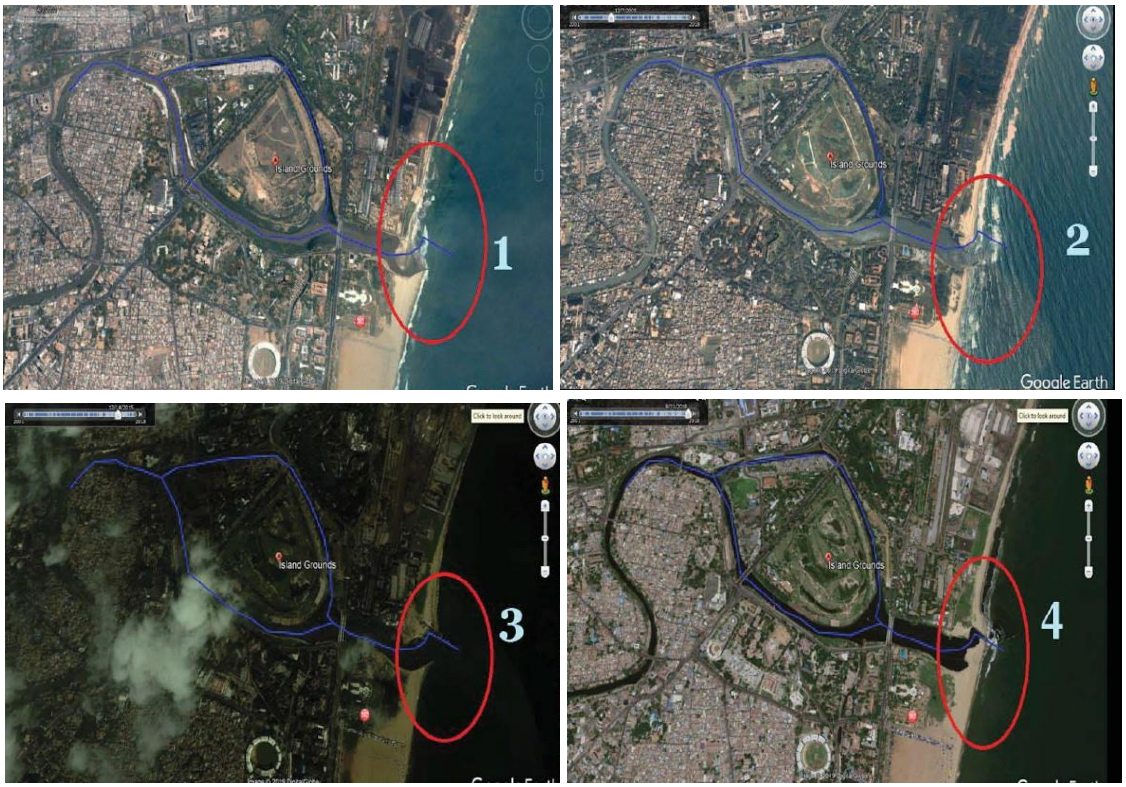
The above section holds proof of the illness of the river, toxicity ,heavy metal contamination, plastic dumps and a strong alkalinity in the water which are the major contributors. Cooum even after being the smallest river to join the Bay of Bengal has excellent utilitarian potential. The one question in the way being how does one clean the river and possibly introduce the ecosystem that it once was in the 1900's. There is a lot of garbage that gets dumped into the river from the banks of the river and there used to be groups of families that were moved due to the health hazards from the river, most of the city's drainage gets directed into cooum causing most of the problems associated with smell and the viscous nature of the river.

Fig 7

Fig 7,7.1:Trash being dumped in cooum

When we look at the structure and estuary (Place where river meets water) of cooum, at first glance we encounter another huge issue, the sand deposits close the mouth for the most part creating a bottleneck. This is one of the problems that needs to be tackled if the river is to be restored.

The google earth screenshots shared below from various timelines demonstrate the same. It is clearly visible how the floods removed the bottle neck.



This collage of the cooum estuary at years 2002,2005,2015 and 2018.

The figure helps us understand that at the time of the 2004 Tsunami and 2015 Floods in chennai the cooum cleared up on its own when the estuary opened up and the dumps drained completely. But cooum returned to its original state just after months of the clearing. In pic 1 we see the sand barriers fill up and close up the estuary, in pic 2 after a month of chennai Tsunami we have a clearing same with pic 3 but again in 2018 the estuary is closed up with sand barriers.

Fig 9: Flood map showing affected regions

Fig 10: Construction work at place

There are plans for more bridges to be constructed across cooum aiding crossing which is essential, the banks need to be made larger and sturdier as when at the time of floods all the houses close to cooum were flooded with its sewage water creating atmost chaos to points when residents had to leave their homes till the water receded.

5. Cause and Effect

There are various causes for the problem at cooum like garbage dumping and more, but chemically speaking we can separate what makes the water unfit for use and how it has and how it is still affecting the ecosystem and physiology of the basin. We need to understand that unlike the major rivers cooum runs completely inside a city, which means there isn't going to be flooding often in the meandering sides even though the river meanders quite a lot. Which means the garbage isn't going to get washed up to the banks but is going to stay in the river. The sewage that gets dumped may contain water; nutrients (nitrogen and phosphorus); solids (including organic matter); pathogens (including bacteria, viruses and protozoa); helminthes (intestinal worms and worm-like parasites) ; oils and greases; runoff from streets, parking lots and roofs; heavy metals (including mercury, cadmium, lead, chromium, copper) and many toxic chemicals including PCBs, PAHs, dioxins, furans, pesticides, phenols and chlorinated organics.There are so many industrial wastes that gets dumped into the water causing issues. These chemicals quite literally wiped out the fishes that swam at cooum, fishes are cold blooded animals meaning that they do not have internal body temperature regulators which means that when there is a change in the surrounding their body cannot adapt to it and they die. Even after the chemicals were treated the fishes that were used for testing only survived for hours. That is the intensity of pollution in the river and the effect it has had on the ecosystem. This breaks the chain and the mollusca and the insects to go extinct as well.

6. Cause and Effect

The most obvious solution for the problems faced by cooum can be schemed into 3 phases, where each phase contributes to one section getting treated.

● Physical ● Chemical ● Water Treatment

In the physical phase the mission is to remove most of the physical objects like plastic pieces, covers and such alongside fabric, this can be accomplished by the bridges. If we design and employ rigs that sieves the physical objects that float we

can deploy them from the bridges. There are over 9 main bridges in the cooum that are of sturd construction that can support such rigs. The second mission is to deploy submersibles that look for metal chunks or anything that has sunk to the bottom. This mission might seem tedious but the stretch of cooum is only 40 km which makes the tasks simple enough, this also serves as a pivotal opportunity to hire engineers, physicist, chemist and biologist for work. If this becomes a success there could be a board that takes care of rivers and cleans them up. And once the river is cleaned there could be filters that stop out the contaminants at a higher point in the river The second phase is to chemically treat the water with bleaching powder and then a round of chlorine treatment with chlorine dioxide (ClO_2). And because the water is treated chemically does not mean it is ready for any kind of use. The chemical phase is to remove the existing chemical harm done to the water and kill all the pathogens that reside in the water. If this phase is followed by opening the estuary of cooum, it will result in amazing flow. Chennai is not in a hilly region meaning there can't be beastily flowing rivers but it is a plateau nonetheless which does not allow water to stagnate. The Third Phase is one of the most important phases of all as the first two phases were already accomplished by nature twice as mentioned above, it is the third phase that ensure that cooum as a river can sustain its state as a freshwater source. It is a no brainer that cooum serves as our sewer channel and if we are to make it a clean water source then we need to make arrangements for our sewer to drain this is where water treatment comes into play. We need to ensure that the sewer that leaves our home goes through natural grey water treatment plants (combination of gravel, sand stones, pebbles and charcoal) before entering cooum although not directly mixing with the river water but on a parallel channel running along with plumbing.

Fig 11: Bio Water Treatment Plant

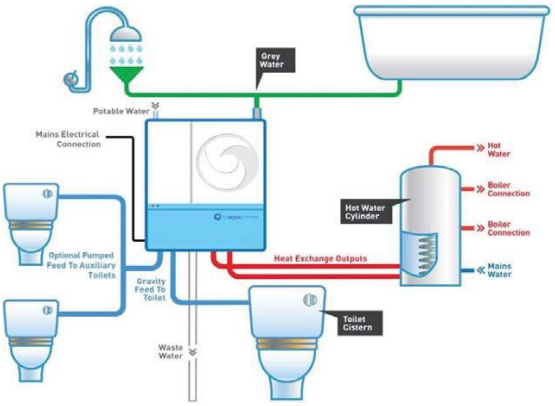


Fig 12: Greywater treatment system

If these three phases are to be executed without a hitch then we could revive a river that was once beautiful and resource full instead of looking at it as a sewer dump. The river can be used for various purposes including leisure and even transportation as in a metropolitan city like chennai any way to avoid traffic and fossil fuel vehicles are welcome!

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