

Marine litter: post-flood nuisance for Chennai beaches

Anthropogenic litter on the coastal beaches, sea surface and seabed has increased in the recent decades across global oceans¹. Also, massive plastic production and usage have accumulated plastic waste of 4.8–12.7 million metric tonnes (MMT) annually², posing a serious threat to marine ecosystem and beach aesthetics³. Recently, production and usage of plastic in India have increased manifold. Nearly 8 million tonnes of plastic products is being used annually, generating about 1.5 million tonnes of plastic waste with less than a quarter of it being collected and treated⁴. Marine litter originating from untreated urban sewage, tourism, fishing, ports and other activities usually finds its way to the coast through rivers, creeks and waterways. Hence, it becomes necessary to quantify the amount of solid waste that contributes towards polluting the coastal environment. Usually, after a spell of heavy rains, flooding of waterways causes huge amounts of garbage to pile up along the coastline. As a part of the coastal clean up programme under the aegis of the Swachh Bharat Abhiyan (Clean India Mission) campaign, an attempt was made to quantitatively and qualitatively assess the litter reaching Chennai beaches, so that the on-going management practices can be suitably adapted.

The Chennai Metropolitan Area has a population sprawl of 26,903 km² generating 4500 metric tonnes of solid waste garbage daily, which is being segregated and transported to dumping yards located at Kodungaiyur and the marshy lands of Perungudi. During excessive rainfall, it is observed that at Perungudi dumping site, the Oggiyam Madavu channel connecting to Kovalam estuary through Oggiyam Thoraipakkam and Buckingham canal, carries plastics and other garbage to the coastal water. It is commonly observed that after a heavy spell of rain, the two rivers – Cooum and Adyar – that crisscross the city get flooded fetching large volume of litter to the coast from the upstream regions. This litter is ultimately transported along the coast under local hydrodynamics regime and gets trapped in and around the sandy beaches of the Marina, Elliot and Thiruvanmiyur (Figure 1). The Marina, 6 km long and 300 m wide, is one of the crowded

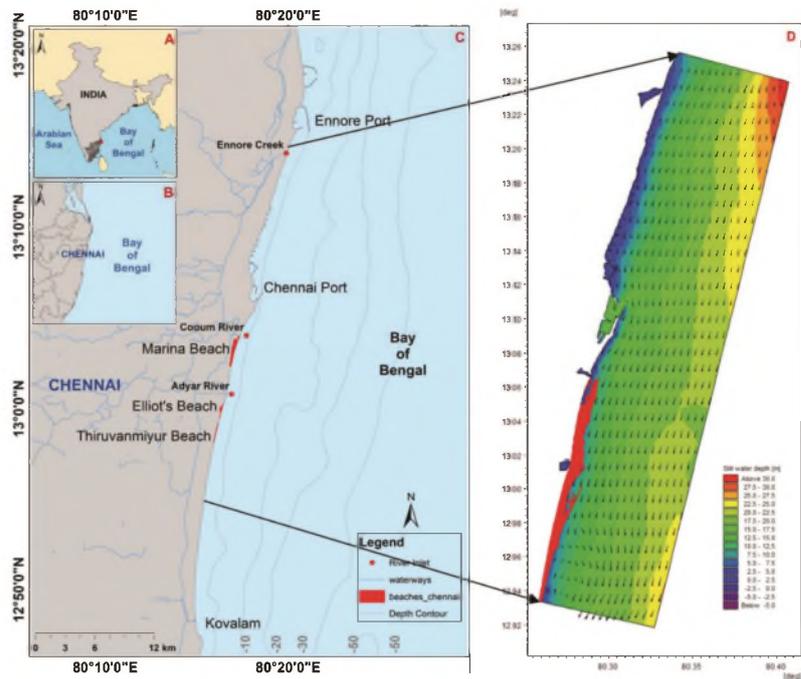


Figure 1. Study area and model domain with simulated surface currents and particle tracking.



Figure 2. a, Cooum river; b, c, Adyar inlet beaches; d, Marina Beach; e, Elliot Beach; f, Thiruvanmiyur Beach.

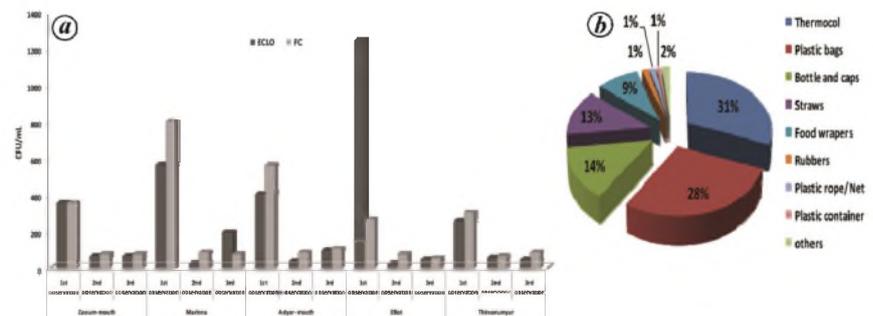


Figure 3. a, *Escherichia coli*-like organisms (ECLO) and faecal coliforms (First observation: 8 November 2017; second observation: 22 November 2017; third observation: 28 November 2017). b, Percentage frequency composition of plastic debris 100 m² area of the beach.

beaches, interlocked between the Cooum and Adyar rivers, and visited by 30,000–50,000 tourists daily. The Elliot and Thiruvanniyur, two relatively narrow beaches of 1.5 km long each, are located south of the Adyar river mouth. These beaches are mostly visited by tourists for swimming, bathing, picnicking and other recreational activities, who leave behind litter which includes plastic bags, cups, trash bags, product containers and floats.

In December 2015, the incidences of flood swept away nearly 0.1 million tonnes of debris, including plastic, rubber and thermocol to Chennai coast. A similar event of heavy rainfall occurred during the first week of November 2017, triggering a flood-like scenario. Rainfall of 77 mm, i.e. 66% departure from the normal occurred (IMD data⁵) within a week and huge quantities of marine trash got accumulated along the coast (Figure 2 a–f). An exploratory sampling was carried out adjacent to two river mouths and three beaches. Each sampling included 10 m × 10 m area from the low tide line towards the vegetation line. Water quality parameters at river mouths and beaches for three different dates, i.e. 8, 22 and 28 November 2017 were estimated to examine the post-rain status. Water temperature ranged from 26°C to 30.5°C, pH from 7.2 to 8.2 and salinity from 1.1 to 27.3. Minimum salinity was recorded at river mouths on the first day of observation. Dissolved oxygen varied between 5.4 and 8.1 mg/l. Bacterial population of *Escherichia coli*-like organisms (E.CLO) and faecal coliforms (FC) was 5–6 times higher on 8 November than the other two dates of observation (Figure 3 a).

The collected debris was segregated item-wise, and their percentage of occurrence was calculated. Plastic items formed the majority of all debris collected. Thermocol (30.82%) was the most abundant debris found in all beaches followed by plastic bags (28.30%); bottles and caps (13.84%), straws (12.83%) and food wrappers (8.97%) were also collected at Elliot and Thiruvanniyur beaches (Figure 3 b). The

major source of waste material was of residential origin (68%) followed by commercial (16%), marriage halls, institutions, offices (14%) and industries (2%), as reported by the Greater Chennai Corporation. Larger debris breaks down into meso particles (5 mm–2.5 cm) and micro particles (<5 mm), causing more abundant and floating litter carried over long distances by winds and currents³. In order to assess the dispersion and distribution pattern of these particles in coastal water, a particle-tracking simulation was carried out for one week (28 October to 5 November 2017) following MIKE-21 numerical model. The current pattern is found to be southerly, indicating that debris/land-driven material from the Cooum river reaches Marina beach, and from Adyar river to Elliot and Thiruvanniyur beaches (Figure 1). Most of the debris and litter deposited at the beach front are a nuisance to tourists and beach-goers. A major part of the solid waste collected by rag-pickers living along the river banks of Adyar and Cooum are recycled. The un-priced collected waste materials are usually disposed in the neighborhood of low lying areas and river banks.

With the increased use of plastics, the concept of 3 Rs – reduce, recycle and reuse of garbage can be adopted. There should be a returnable deposit on all recyclable items. Overflow of solid waste through the rivers to Chennai coast makes these beaches unhygienic and hazardous. Although a number of coastal clean-up programmes are being undertaken by a number of organizations, lack of waste management strategies, planning and facilities is the major hindrance in solid waste management in the terrestrial and marine environments. It is observed that the recycling effort of solid waste for Chennai region is meagre or lacking. Segregation and processing of solid waste at household level is highly essential, which can be achieved through public participatory approach, awareness activities, educating at school and college levels and through print and audio-visual media. Installation of debris

booms, fin deflectors at upstream and bridges along the Cooum and Adyar rivers will help in the reduction of solids waste entering the coastal waters. In the absence of a National Marine Litter Policy for the country, it is highly essential to frame a policy that can control and manage litter at the land boundary and prevent its entry into the marine environment to maintain its pristine nature.

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