Marine litter monitoring studies in India – gaps and challenges

Vipin Joseph Markose and E. V. Ramasamy

Monitoring litter in the marine environment is a challenging task for researchers all over the world. The litter accumulates all in parts of the marine environment such as beaches, open ocean and seafloor. Kumar and Sivakumar[1] have emphasized the importance of marine debris monitoring along beaches, coastal waters and seabed regions of India. While analysing research articles related to marine litter monitoring in India (excluding microplastics), we noted that majority (67%) of the studies had been carried out in beaches and only a few on creeks (9%), mangroves ecosystem (9%) and on shallow sea litter (15%) (Figure 1). This indicates the gap existing in floating and deep-sea litter monitoring studies in India. Globally however, the number of research publications on seafloor litter is increasing since 2012 (ref. 2). As limited studies have been carried out in deep-sea litter in India, priority needs to be given to locate litter accumulation on the seafloor.

The reasons for more studies in beaches are mainly due to the ease in conducting such studies and availability of standard protocol. However, in the case of floating and seafloor, monitoring requires advanced technologies and it is expensive. The accuracy and time taken are major factors in monitoring litter studies in marine environment. Even though manual observation is the most accurate method, it requires manpower, is time-consuming and there are other hurdles in conducting surveys in deep sea such as cruise support, analytical facility and research grants. In this situation researchers need to take support of modern technologies such as unmanned aerial vehicles (UAVs), remotely operated vehicles (ROVs), human occupied vehicles (HOVs), satellite images, aircraft surveys and scuba diving.

As India is one of the fast growing countries with regard to the UAV market, researchers need to utilize this technology for monitoring litter along the beaches of the country. We have noticed that about 30 studies in the world successfully used UAVs for beaches and floating litter detection. Most of the UAVs are capable of taking red, green and blue (RGB) images, and a hyperspectral sensor can be replaced by an RGB camera to provide more details about the type of litter. As UAV start-ups in India are increasing, in future it will be a tool for cost-effective debris monitoring. For seafloor litter monitoring, one should depend upon ROVs and HOVs. The National Institute of Ocean Technology (NIOT), Chennai has developed two ROVs, ROSUB 6000 and PROVe, for different oceanographic applications, including seafloor imaging[3]. The archived images and videos taken by these ROVs need to be checked for the possibility of debris monitoring. Scuba diving has not been well explored in India for litter monitoring in shallow depth areas. Geophysical methods will help identify large submerged items on the seafloor. Multibeam data collected for seafloor mapping need to be rechecked for possible litter detection on the seafloor. Fishing trawlers are an option to obtain litter data on the seafloor. Awareness campaigns will provide an opportunity for the fisherman to get information about the litter trapped in their fishing nets.

Researchers have successfully used satellite data for floating litter detection in the ocean since 2020 (ref. 4). The identified potential bands for plastic detection are placed at NIR (890–970 nm) and three at SWIR (1160–1250, 1360–1440 and 1680–1760 nm). At present no Indian satellite sensor is available in the above wavelengths. In future remote-sensing satellite missions, a sensor with the above-mentioned wavelengths needs to be developed for plastic debris detection. At present, Sentinel-2 Multispectral Instrument (MSI) sensor is considered the most suitable for marine debris detection. Medium-sized debris can be monitored using high-resolution satellites such as WorldView-3. Multispectral satellite sensors with high spatial resolution are required for debris monitoring by visual interpretation. Artificial intelligence/machine learning is used for automatic debris detection from different data sources such as satellite images, UAV, ROV and HOV data products.

All monitoring methods and protocols have several advantages and limitations, which may affect some of the sampling strategies. The observers must give top priority for maximum debris detection in an area without any misinterpretation. Large debris is easy to detect using all the technological approaches, when the debris size decreases, the observation time and cost of technology will increase. In order to acquire qualitative and quantitative data, India needs to utilize the existing methods and more research must be carried out in developing new technologies, especially for seafloor litter monitoring.

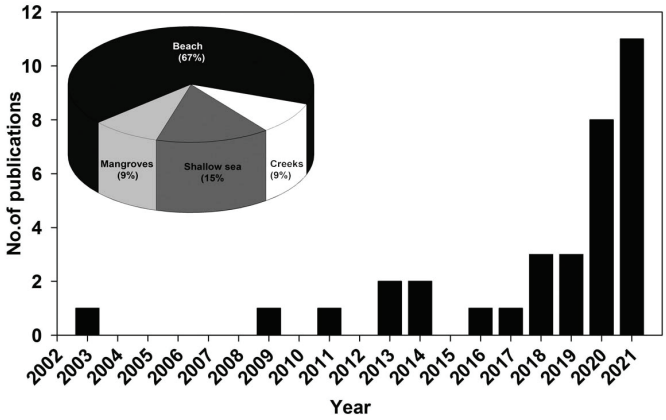

Figure 1. Graph showing the number of publications related to marine litter (excluding microplastics) in India. Inserted pie chart shows percentage of studies carried out in beaches, shallow sea, creeks and mangroves.

1. Kumar, A. A. and Sivakumar, R., *Curr. Sci.*, 2016, **110**(7), 1153–1154.
2. Canals, M. *et al*., *Environ. Res. Lett*., 2021, **16**(2), 1–29.
3. https://www.niot.res.in/niot1/dst_intro.php
4. Biermann, L., Clewley, D., Vicente, V. M. and Topouzelis, K., *Sci. Rep.*, 2020, **10**, 5364.

Vipin Joseph Markose and E. V. Ramasamy are in the School of Environmental Sciences, Mahatma Gandhi University, Kottayam 686 560, India.*
**e-mail: evramasamy@mgu.ac.in*