Spatial and Vertical Distribution of Plastic Pellets along the Gampaha Coastline Three Years after the X-Press Pearl Incident

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The X-Press Pearl Maritime Disaster in May 2021 released large quantities of plastic pellets (nurdles) into Sri Lanka's marine environment, causing persistent shoreline contamination along the western coastal belt. Limited research has examined the long-term spatial distribution and vertical persistence of plastic pellets within coastal sediments. The Gampaha coastline, located near the disaster site and influenced by monsoonal and sediment transport processes, was identified as a highly impacted region. This study investigated the distribution and retention of plastic pellets along the Gampaha coastline three years after the incident. A shoreline survey was conducted in May 2024 across 28 coastal sites and 60 sub-sites covering intertidal, supratidal, and vegetation zones. Surface sediments were collected using 1 m² quadrats, while subsurface samples were obtained using sediment cores (5 cm diameter) up to 1 ft depth with three replicates per location. Samples were sieved, and plastic pellets and burnt fragments were separated, counted, and weighed. A total of 704 samples (176 surface, 528 core) yielded 3,436 plastic pellets (92.2 g). Surface sediments contained 2,937 pellets (77.8 g; 85.5%), while cores contained 499 buried pellets (14.4 g), confirming vertical migration and sediment retention. Additionally, 67 thermally degraded fragments (85.97 g) were recorded across 12 sites. The highest contamination was observed at Kapungoda (387 pellets), followed by Moya (372) and Poruthota (363), with a maximum single-quadrat abundance of 272 pellets recorded at Poruthota. Persistent hotspots included Kapungoda, Moya, Poruthota, Dungalpitiya, and Thalahena, whereas Aluthkuruwa, Pitipana, and Morawala showed no detections. Despite repeated community-led cleanups, contamination persisted at Sarakkuwa and Kapungoda, with Sarakkuwa recording the highest subsurface burial ratio (32.2%). Vegetation zones showed nearly twice the pellet density of non-vegetated areas (27.6 vs. 13.3 pellets/m²). Overall, the findings confirm long-term persistence of plastic pellet contamination and highlight the need for integrated surface-subsurface monitoring and targeted remediation.

Keywords: *Plastic Pellets, Gampaha Coastal Belt, Shoreline pollution, X-Press Pearl incident*