

An Assessment of Plastic Pollution in The Coastal Areas of Balochistan

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Abstract

Coastal areas of Balochistan have remained isolated from mainstream development in Pakistan for the past decades, and it was only after 2000 that major developmental projects were implemented in the area. The construction of the Makran Coastal Highway has provided reliable access to isolated settlements, villages, and towns along the coastal area of Balochistan. A major increase in the population in some coastal towns has taken place in the wake of the development of the Gwadar Deep Sea port and the implementation of projects under the aegis of CPEC. One of the negative impacts of the development is a noticeable increase in marine pollution in the area. Due to major inadequacies in the disposal of garbage in some of the large population centers, plastic pollution has increased substantially over the past two decades. An analysis of marine debris, including plastic on some important beaches, was undertaken in 2006 and compared with the level in 2025. The study revealed a major increase in plastic pollution in coastal towns, including Damb, Ormara, Pasni, Gunz, and Jiwani, which is noticeable in the garbage heaps within the towns and also on their beaches. The quantity of plastic pollution has increased substantially in Gwadar, mainly because of the noticeable population explosion; however, the city has comparatively a better garbage collection system and disposal at the authorized dumpsite, which resulted in a major decrease in plastic pollution on the beaches of both bays of Gwadar (Demi Zur and Pedi Zur), as compared to the 2007 data.

Keywords: *Balochistan coast, pollution, marine debris, plastic, Gwadar*

Introduction

The use of plastic has increased dramatically over the last few decades as it is considered essential in our daily lives, resulting in its annual global production exceeding 8,000 million metric tons. Plastic is being widely used for packaging, consumer goods, and other sectors, which has resulted in major environmental problems, including a massive increase in plastic waste generation; of which approximately 9 percent has been recycled, 12 percent incinerated, and 79 percent

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accumulated in landfills or the natural environment. It is estimated that more than 10 million tons of plastic enter the oceans annually (Jambeck *et al.* 2015), and more than 80 percent of marine litter is plastic. A major fraction of the plastics ends up on the beaches, mainly on sheltered beaches. It is now established that the beach garbage composition is dominated by plastics to a level of 60 to 88%, including single-use items like food wrappers, bags, bottles, and cigarette butts, with significant amounts of Styrofoam (polystyrene), paper, wood, metal, glass, rubber, textiles, and medical waste, which are mainly sourced from land-based activities.

Accumulation of garbage, including plastic, was studied from various beaches along the Karachi coast, including Ahmad *et al.* (2023), Ali *et al.* (2015), Kausar *et al.* (2025), Moazzam (2023), Omm-e-Hany *et al.* (2018), and Rafique *et al.* (2019). It was only Moazzam and Ahmed (2022) who studied debris along the coast of Jiwani, Balochistan, indicating a serious issue of plastic pollution on the remotely located beaches of Balochistan at Jiwani. There is no other study that deals with debris accumulated on the beaches or the contribution of plastic in this pollution.

Materials and Methods

The Balochistan coast is located on the northern border of the Indian Ocean (North Arabian Sea), with Miani Hor (Bera) being the northernmost part of the Indian Ocean. Stretching between the eastern border of the Hub River to the west of Kuntani Hor in Gwatar Bay, the coastline has a length of 734.5 km out of 1,001 km of Pakistan coast (PN Hydrographic Dept. Letter No. HD 0628/II/938, dated April 12, 2016). Before 2003, there was no direct access to the coastal areas of Balochistan. Karachi was linked to the coastal area through RCD Highway to Bela, Jhal Jhao, Awaran, Hoshab, Turbat, Pidrak, and Pasni/Gwadar through a jeep track. Because of this isolation, the coastal area of Balochistan has been neglected in mainstream development in Pakistan for almost six decades since the creation of Pakistan. A major increase in the population of some coastal towns has occurred in the wake of the development of the Gwadar Deep Sea Port and the implementation of projects under the aegis of CPEC. An increase in the population also resulted in pollution in the area, mainly due to the disposal of solid waste. Garbage started accumulating in these towns/villages, and with the inadequacy of garbage collection and disposal, it started accumulating on the beaches. In some of these places, garbage collected by local authorities is dumped into the sea, resulting in increased debris on the beaches. Plastic was observed to be the most dominant pollutant that accumulated on the beaches.

To elucidate the extent of plastic and other pollution on the beaches, an assessment was undertaken along the coast of Gwadar. Data were collected from 17 stations (seven along Gwadar-East Bay and 10 along Gwadar-West Bay) from August

to October 2006 and September and October 2025. In this study, the results of only four stations, each at the East and West Bays of Gwadar (Fig. 1), are presented. These stations are (Demi Zur) East Bay (1. Near Jetty; 2. Near TNT; 3. Near DCO House, and Near FC Camp) and (Padi Zur) West Bay (1. Foot of Hill; 2. Near the Boat Building Yard; 3. In front of Jamerah Rest House, and B & R Chowk).

For this purpose, samples of garbage accumulated on the beaches were collected from a 1 square meter area. In the laboratory, the samples from each location were sorted, and the speciation of the garbage (by weight in grams) was performed. Data were also collected from the same beaches in December 2025 using the same methodology, and a comparison was made with the 2006 data. Visual data on garbage accumulation in coastal towns and their respective beaches were also collected. In addition, a rapid assessment of trash was conducted in December 2025 from other major population centers along the Balochistan coast (Damb, Ormara, Pasni, and Jiwani).

Results and Discussions

Garbage disposal is a serious but unattended issue in coastal settlements, towns, and villages along the Pakistan coast. There appears to be no garbage collection system in most villages and settlements along the Balochistan coast. In most cases, garbage is dumped in community dumpsites or left alone at the mercy of natural processes. In most coastal towns, local administration or municipal services have a cursory garbage collection system from the main points of the town, and garbage is taken to some designated area, which may not be termed a dumpsite, as these are usually depressions away from the town or, in some cases, disposed of near beaches.

Fig. 1. *Sampling Stations for Quantitative Assessment of Trash in 2006 and 2025*





Garbage in almost all villages and settlements along the Balochistan coast is dominated by plastic products, mainly shopping bags. The present study revealed a significant increase in plastic pollution in some coastal towns such as Damb, Ormara, and Jiwani, whereas in those areas where garbage is being removed from the town and dumped at a designated area, such as Pasni and Gwadar, there is evident from comparatively clean beaches in these areas. Due to major inadequacies in garbage disposal in other settlements, plastic pollution has become a serious environmental concern. The plastic was observed to consist mainly of polyethylene bags, in addition to discarded fishing nets and ropes, footwear, textiles, polystyrene foam, packages (such as detergents), baby diapers, plastic bags (sugar, flour, etc.), toys, household items (cups, water pitcher, utensils, etc.), wrappers (mainly betel nuts and titbits), electric appliance parts, and insulated foams.

DAMB

Damb is the largest fishing town of the Lasbela District, which caters to fishing boats from three settlements located within the Miani Hor, including Sonmiani, Damb, and Bera. The population of these three settlements is collectively estimated to be approximately 14,000, including some temporary fishermen who migrate to this area during the peak fishing season. There is no organized system of garbage collection in the area, and in most cases, household garbage is dumped in any nearby open space (Fig. 2a-b). Trash continues to pile up in these areas and is buried in sand, whereas plastic and other wastes are blown away by the strong winds prevailing in the area. Currently, a sweeper is hired by the shopkeepers of the Damb market, who collect trash from the bazaar area and dump it in the sea (Fig. 2c). There are no official or community dump sites in the area. A rapid assessment of the trash

from some of the heaps in Damb revealed that it consisted mainly of shopping bags and other forms of domestic waste.

Table 2. *Percentage composition of Trash at Damb (Sonmiani)*

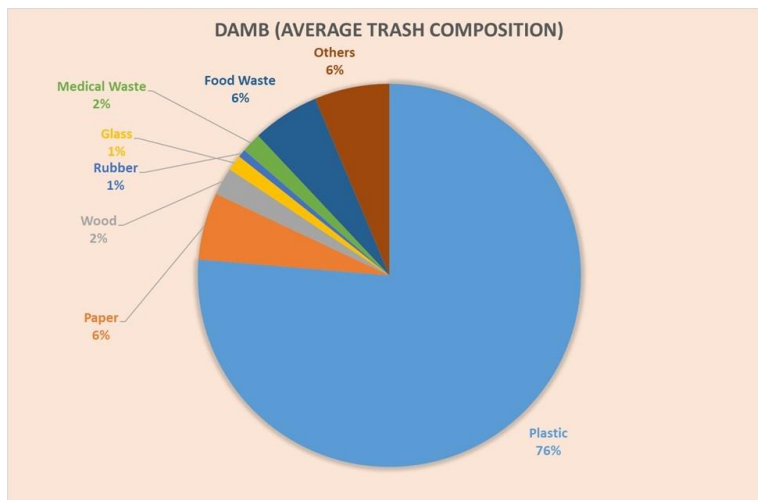
Type of Trash	Damb (Ilyasini Mohallah)	Damb (main dumping area)	Damb (Seaside near landing Centre)	Remarks
Plastic	79	66	84	Mainly polythene bags brought from Karachi and also those smuggled from Iran
Paper	8	7	2	Mainly tetra packs
Wood	3	0	4	Scrap from boat building
Glass	0	4	0	Broken bottle
Rubber	2	0	0	Tyre Part
Medical Wastes	0	0	5	Syringe
Food Wastes	3	12	2	Fish and animal bones
Other	5	11	3	Mainly crab shells
Total Weight	5,218 g/m ²	3,294 g/m ²	1,601 g/m ²	

The composition of trash at the three locations along the Damb is given in Table I, which indicates a preponderance of plastic (mainly polyethylene bags) in the trash. The average data from the three locations in Damb are presented in Fig. 3, which indicates that plastic (76 %) seems to be the most dominant, followed by paper (mostly packaging material), food waste (fish and animal bones), and miscellaneous items dominated by putrefied crab shells each by 6% whereas wood, rubber, glass, and medical wastes are contributing insignificantly.

Fig. 2. (a) Trash accumulated in the dump near the main settlement of Damb (b) Trash accumulated in the dump near the new area of Damb (c) Trash dumped in the sea near the landing centre in Damb.



Fig. 3. Percentage Composition of Trash in Damb (Sonmiani)



ORMARA

Ormara is the fourth-largest town in the coastal areas of Balochistan, located approximately 360 km west of Karachi. According to the 2023 Census of Pakistan, its population is 16,573 (Ormara Tehsil 27,832). Although a Municipal Committee is working in Ormara Town, whose responsibility includes the management of the town's garbage, the situation in Ormara is no different from other coastal towns and settlements. Household trash is dumped in open spaces in a highly unmanaged manner. Some of these garbage heaps are not removed and become permanent piles of trash (Fig. 4a). There is no designated dumpsite; however, collected trash from the town is dumped openly at Kogan Raig, a dune located north of the town. Additionally, a part of the trash from the town is dumped into the depression created by a small creek near Ormara (East Bay) (Fig. 4b). Trash ultimately ends up on beaches (Fig. 4c). The situation is no different in Ormara (West Bay), where several restaurants and resorts have been established. Trash from these installations is directly thrown along the high-water mark in the form of large heaps.

Table 2. *Percentage Composition of Trash at Ormara*

Type of Trash	Ormara (Near City Town)	Ormara (Creek Area on Demi Zur)	Ormara (Seaside Demi Zur off Net Mending Shed)	Remarks
Plastic	82	59	79	Mainly polythene bags
Paper	7	2	6	Mainly packaging
Wood	1	12	6	Part of boat
Glass	4	3	5	Broken bottles
Rubber	0	9	0	Tyre Part
Medical Wastes	0	0	0	
Food Wastes	2	9	1	Dried fish bones
Other	4	6	3	
Total Weight	2,110 g/m ²	1,765 g/m ²	986 g/m ²	

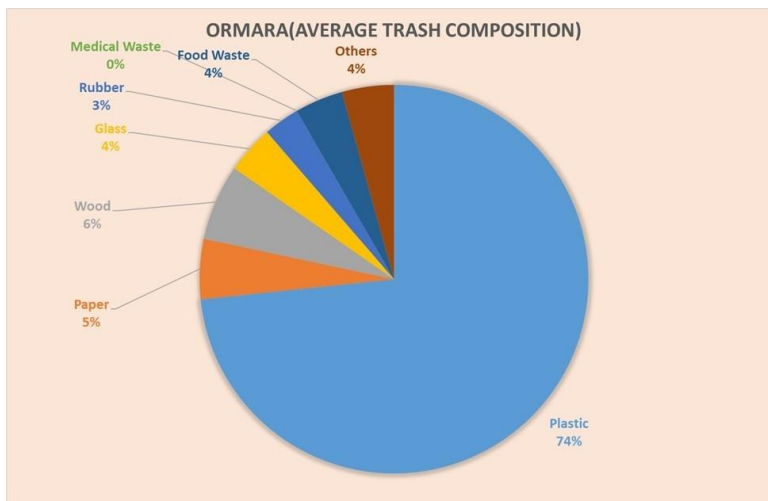
The composition of trash at the three locations along the Ormara is given in Table II, which indicates an abundance of plastic (mainly polythene bags). The average data from the three locations in Ormara are presented in Fig. 5, which indicates that plastic (76 %) was the most dominant, followed by wood (pieces of

boats), 6 %, paper (mostly books etc), 5 %, food waste (fish and animal bones), and miscellaneous items dominated by construction material each by 4 %.

Fig. 4. (a) Trash is being dumped near the houses in Ormara (b) Trash accumulated along the creek east of Ormara (c) Trash ultimately ends up on the beaches along Ormara.



Fig. 5. Percentage Composition of Trash in Ormara



PASNI

Pasni is the second-largest town along the coastal area of Balochistan, with a population of 43,494, according to the 2023 census. This coastal town has a Municipal Committee, whose responsibilities include the management of the town's garbage. In all major wards, including some of the isolated population centers like Mastani and Babar Shoor, the Municipal Committee collects garbage from door to door, as well as trash from markets and streets of the town, which is usually dumped in an area near Ras Juddi. Because of the collection and disposal of trash, the pollution situation has comparatively improved compared to Damb and Ormara. In some areas, people dump their trash outside their houses, which piles up (Fig.6a). Because the Municipal Committee manages trash, only a small quantity of trash finds its way into the sea (Fig. 6 b-c). However, because of strong winds, some plastic bags find their way into the creeks of Ras Juddi and reach the shores along Pasni Bay.

Table 3. Percentage Composition of Trash at Pasni

Type of Trash	Pasni (Near Town)	Pasni (Near flat near Mastani dune)	Pasni (Near Beach along Pasni Bay)	Remarks
Plastic	76	86	88	Mainly polythene bags
Paper	11	2	4	Mainly packaging material
Wood	4	3	3	Wood log
Glass	0	0	0	Broken bottles
Rubber	0	0	1	Tube
Medical Wastes	0	0	0	
Food Wastes	5	0	1	Goat bones
Other	4	9	3	Construction Material
Total Weight	2,109 g/m ²	1,421 g/m ²	408 g/m ²	

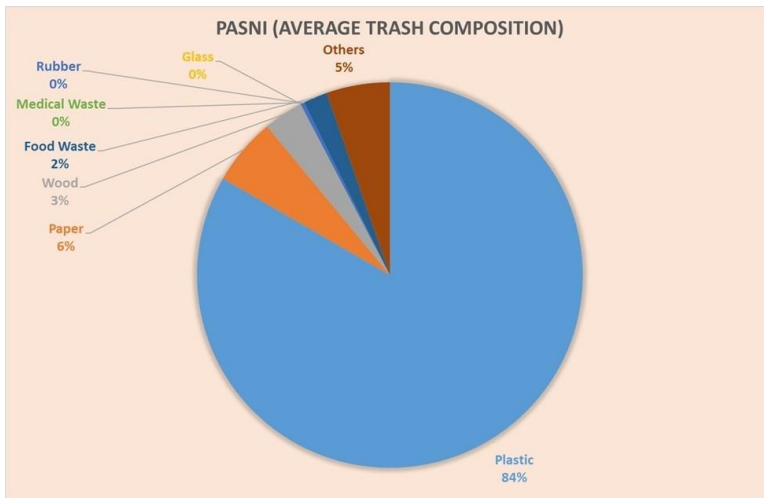
The composition of trash at the three locations along the Pasni is given in Table III, which indicates an abundance of plastic (mainly polythene bags). The average data from the three locations in Pasni are presented in Fig.7, which indicates that plastic (84 %) is the most dominant, followed by paper (packaging material) 6 % and others (mostly construction material etc.). Wood was mainly composed of trees

(3 %) and food waste 2 % (fish and goat bones). Rubber, glass, and medical waste were not represented in the trash at Pasni.

Fig. 6. (a) Trash is being dumped in some isolated places in Pasni Town. (b) Trash accumulated between Mastani and Ras Juddi (c). Small quantities of trash ultimately end up on the beaches along Pasni.



Fig. 7. Percentage Composition of Trash in Pasni.



GWADAR

Gwadar is situated on the southwestern coast of the Arabian Sea in Gwadar District, Balochistan province, Pakistan. Gwadar is situated on a natural, hammerhead-shaped tombolo peninsula, forming two almost perfect, naturally curved semicircular bays on either side. According to the 2023 Census of Pakistan, the population of the city in 2023 was 70,852. The population of Gwadar tehsil was 147,041 (2023). Gwadar is divided into five union councils, which are further subdivided into 18 wards. The Gwadar Metropolitan Corporation (or Municipal Corporation) is the primary local government authority responsible for urban planning, development, and municipal services, including garbage collection and disposal.

Fig. 8. (a) *Trash is being dumped in some isolated places in Gwadar.* (b) *Trash accumulated in bylanes of Gwadar Town.* (c). *Door-to-door collection of Garbage in Gwadar.*



There was no appropriate system for the collection and removal of waste approximately 20 years ago, which used to accumulate in the town and on the beaches. During that period, trash was thrown on the streets or any open space, and only small quantities were collected by the Gwadar Municipal Committee. The rest is dumped along the sea or in depressions on the outskirts of the town. Piles of trash accumulated on some of the beaches during that period, which is evident from the data of trash collected from four sampling stations each in Demi Zur and Padi Zur and presented in Fig. 10–17 and summarized in Table IV. The quantity of trash at each sampling station in 2006 was recorded to be extremely high, such as 31,298 g/m² at Station 1 in Demi Zur, which is located near the fish landing jetty (Fig. 10). Due to the prevailing currents and other hydrographic factors, trash accumulated in the area. Similarly, higher concentrations were observed at other stations (Fig. 11-13) in 2006 in Demi Zur, as these were facing major residential areas whose residents used to dump their garbage at these places. The area facing Padi Zur, Gwadar, was thinly populated; therefore, the amount of trash deposited in Padi Zur was comparatively much lower than that recorded from Demi Zur (Table IV). The highest concentration of garbage in Padi Zur was recorded at Station 3, located at the foothill of the West Bay, which can also be attributed to the prevailing currents and other hydrographic factors; trash used to accumulate in the area.

Table 4. *Summary of the Quantities of Trash and Percentage of Plastic at Gwadar (Demi and Padi Zurs)*

Station No.	Location	2006		2025	
		Quantity (g/m ²)	Plastic (%)	Quantity (g/m ²)	Plastic (%)
Demi Zur (Gwadar East Bay)					
1	Near Jetty	31,298	70	1,082	78
2	Near TNT	9,383	73	765	75
3	Near DCO House	7,602	63	1,012	76
4	at Near FC Camp	2,659	70	843	87
Padi Zur (Gwadar West Bay)					
3	Foot of Hill	9,069	63	0	0
4	B & R Chowk	5,854	85	121	89
1	Jamerah Rest House	3,622	83	519	75
2	Boat Building Yard	2,634	63	123	64

Fig. 9. (a) Clean beaches along Gwadar Padi Zur near B & R Chowk.



Fig. 10. Percentage Composition at Station 1 Demi Zur.

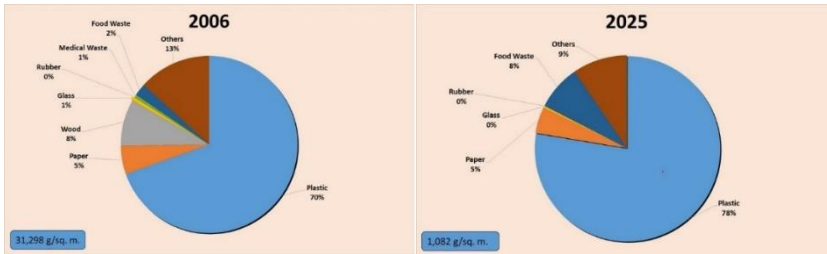


Fig. 11. Percentage Composition at Station 2 Demi Zur.

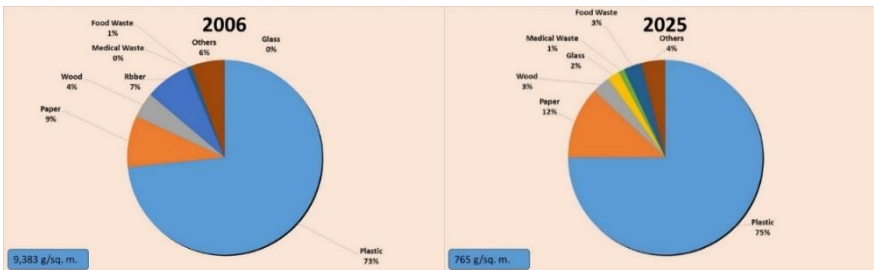


Fig. 12. Percentage Composition at Station 3 Demi Zur.

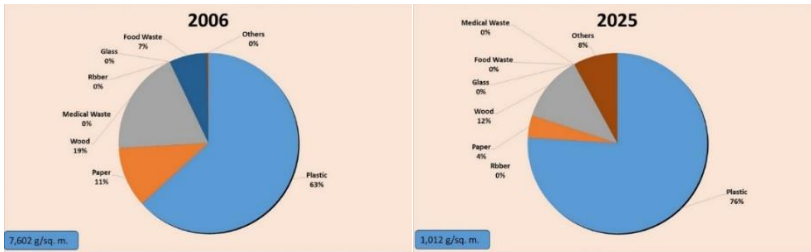
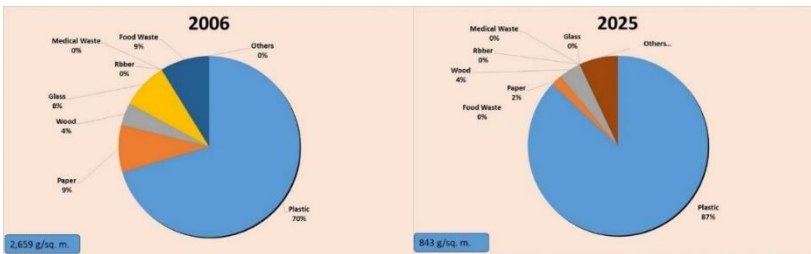


Fig. 13. Percentage Composition at Station 4 Demi Zur



The situation changed in 2025, as the Gwadar Metropolitan Corporation now collects trash door-to-door in most Wards of Gwadar (Fig. 8c) and removes accumulated garbage from bylanes using machinery (Fig. 8b). Additionally, trash bins were placed in most wards of Gwadar Town. Collected garbage is taken to the dumpsite located in the northern part of the New Town, where it is dumped into natural depressions; some of it (mainly plastic bags) is blown away by wind. In some wards in the old town, garbage is dumped in open spaces (Fig. 8a), which is removed periodically, but small heaps can be seen in such areas.

Fig. 14. Percentage Composition at Station 1 Padi Zur.

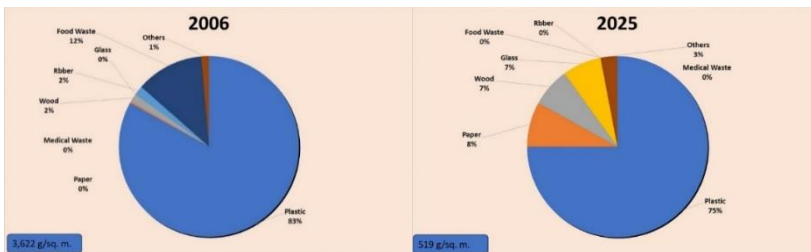


Fig. 15. Percentage Composition at Station 2 Padi Zur.

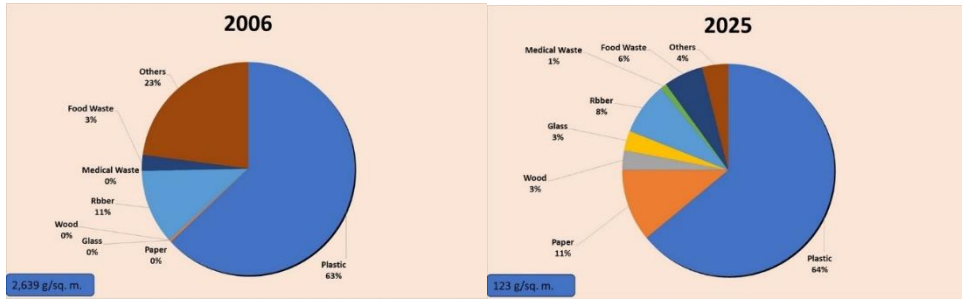


Fig. 16. Percentage Composition at Station 3 Padi Zur.

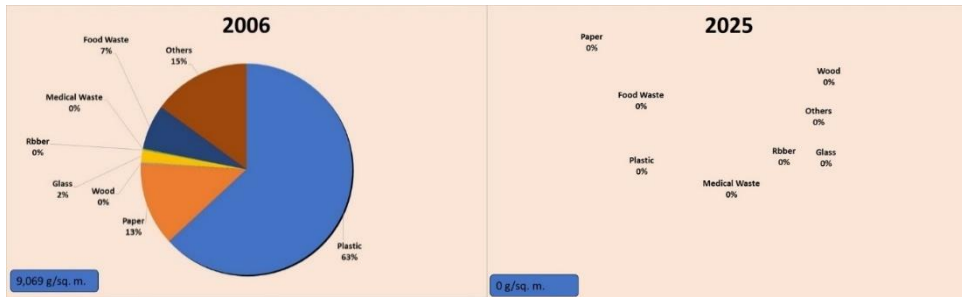
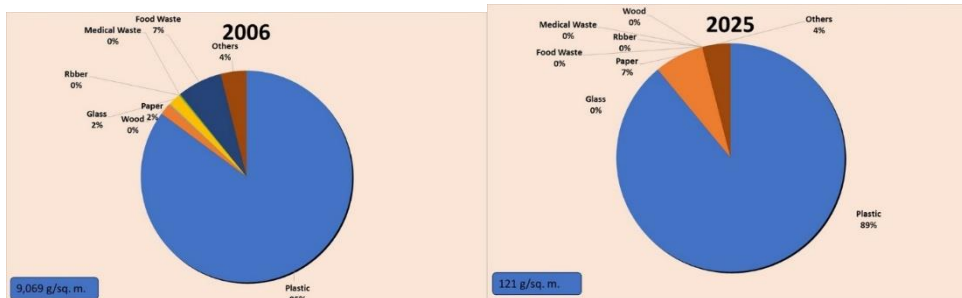


Fig. 17. Percentage Composition at Station 4 Padi Zur.



A comparison of the data collected during 2006 and 2025 is shown (Fig. 10-17 and Table IV), which revealed that at almost all stations in Gwadar (east of West Bay), the situation has changed as the quantity of trash is either reduced substantially (Fig. 14, 15, 17) or eliminated (Fig. 16) owing to the proper handling of garbage by the Gwadar Metropolitan Corporation. Since the dumpsite for garbage from Gwadar is a shallow natural depression, the dumped trash (mainly plastic bags) is blown away

by the wind, which may end up on the beaches outside Gwadar or be dispersed to hinterland areas north of Gwadar.

It is important to note that plastic is the most important component of the trash being accumulated on the beaches of Gwadar (Table IV). The percentage composition of plastic was observed to range between 63 % (at station 3, Demi Zur, and Station 4 at Padi Zur) and 85 % (at station 2 in Padi Zur) in 2006. However, the system of garbage collection and disposal has improved, as evident from the data on garbage found on some beaches. No garbage (therefore, no plastic) was found at Station 3 in Padi Zur, whereas the highest percentage of plastic (89 %) was found at Station 4 in Padi Zur. The plastic in the trash consists mainly of polythene bags, followed by fishing nets and ropes, footwear, textiles, polystyrene foam, packages (such as detergents), baby diapers, plastic bags (sugar, flour, etc.), toys, household items (cups, water pitcher, utensils, etc.), wrappers (mainly betel nuts and titbits), electric appliance parts, and insulated foams.

JIWANI

Jiwani is a tehsil of Gwadar District in Balochistan, which is subdivided into two Union Councils - Jiwani and Suntsar. According to the 2023 census, its total population is 35,004. Jiwani is the largest settlement in the tehsil, a coastal town with a population of 24,332 (2023 Census). Although a Municipal Committee is working in Jiwani Town, whose responsibility includes the management of the town's garbage, the situation in Jiwani is no different from other coastal towns and settlements. Household trash is dumped in open spaces in the town in a highly unmanaged manner (Fig. 18a). Some of these garbage heaps are not removed and become permanent piles of trash, whereas plastic and other pollutants accumulate on some important rocky shores (Fig. 18b). Garbage collection and sweeping are usually performed in the main market area and other prominent parts of Jiwani. There is no designated dumpsite; however, trash collected from the town was dumped in the cove near the entrance of the town. Through the persuasion of the environmental NGO, trash is now dumped in a depression south of the town (Fig. 18c). In Jiwani, the Municipal Committee burns the dumped garbage at the dumpsite. The environmental consequences of the pyrolysis of garbage dominated by plastic are innumerable; however, this practice continues in Jiwani, Pakistan. Part of the trash is still dumped in the sea, making the beaches of Jiwani heavily polluted with trash dominated by plastic (Moazzam and Ahmed, 2022).

Table 5. *Composition of Trash at Jiwani*

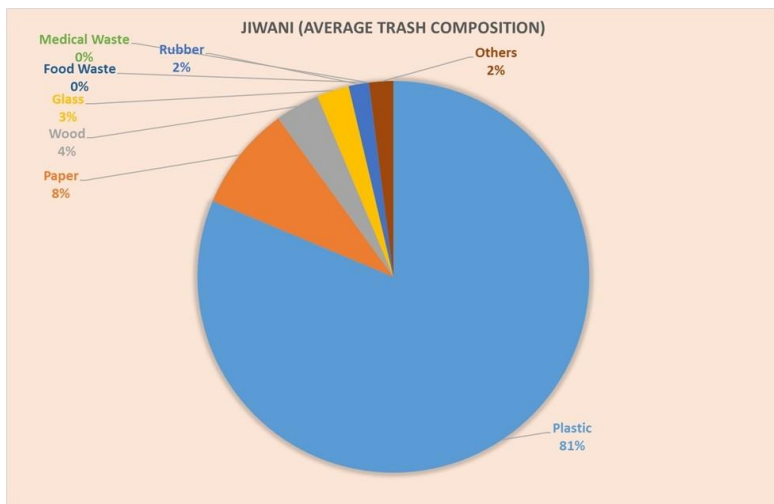
Type of Trash	Jiwani (Near Town Bazar)	Jiwani (Nawab Residence)	Jiwani (High Water Mark near Rocky Shore)	Remarks
Plastic	82	88	74	Mainly polythene bags
Paper	11	7	8	Mainly packaging material
Wood	5	1	5	Crate and window part
Glass	1	3	4	Broken bottles
Rubber	0	0	5	Tube
Medical Wastes	0	0	0	
Food Wastes	0	0	0	
Other	1	1	4	
Total Weight	4,176 g/m ²	8,202 g/m ²	3.165 g/m ²	

The analysis of solid waste collected from three locations along the Jiwani coastline (Table IV) reveals that plastic materials—primarily polythene bags—constitute the majority of the waste. The average composition data, illustrated in Figure 19, show that plastic accounts for 81% of the total trash, making it the most dominant category. This is followed by wood waste, mostly in the form of boat-building scraps, contributing 11%, and paper waste, primarily packaging materials, which make up 8%. Notably, food and medical wastes were absent from the surveyed sites, suggesting that Jiwani’s coastal trash is predominantly composed of non-biodegradable materials associated with fishing, local commerce, and coastal activities.

Fig. 18. (a) Trash is being dumped near the houses in Jiwani (b) Trash accumulated along the rocky shores in Jiwani (c) Trash is taken to the dumpsite near the sea along the Jiwani coast and is being burnt.



Fig. 19. Percentage Composition of Trash in Jiwani



Conclusion

The establishment of the Makran Coastal Highway in 2003 provided reliable access to the remote settlements, villages, and towns situated along the coastal region of Balochistan, leading to significant developmental activities along Pakistan's coast. This development has also contributed to a rise in the population of these coastal towns, which in turn has led to a marked increase in marine pollution, including the disposal of waste along the Balochistan coastline. In larger towns such as Pasni, Ormara, Jiwani, and Gwadar, municipal authorities do collect garbage from the towns; however, they often dispose of it in open spaces. In Jiwani, for instance, waste is incinerated at the dumpsite, which poses serious environmental risks. The predominant presence of plastic, particularly polythene bags, is blown by the wind and ultimately finds its way to the beaches or barren inland areas, leading to its own environmental repercussions. The necessity for effective management of dumpsites along the Balochistan coast cannot be overstated. Furthermore, it has been observed that plastic constitutes approximately 70 to 85% of the waste in most areas along the Balochistan coast, a figure that is comparable to other regions along the Sindh coast (Ahmad *et al.*, 2023; Ali & Shams, 2015; Kausar *et al.*, 2025; Omm-e-Hany *et al.*, 2018; Qari & Shaffat, 2015; Suhail *et al.*, 2024). It is worth noting that the contribution of plastic to waste in neighboring countries is similarly significant. According to Stoffen-O'Brien *et al.* (2022), the proportion of plastic in waste among Gulf countries varies considerably, ranging from 5.3% in Iraq to 21% in Oman, with an average of 13%, which is close to the global average of 12%. Iraq, Bahrain, and Iran exhibit the lowest percentages of plastic in their waste streams, at 5.3%, 7.4%, and 8.5%, respectively. Neelavannan *et al.* (2025) indicated that the floors of mangroves along the Persian Gulf coast of Saudi Arabia are similarly impacted by this problem, with plastic litter comprising 80% of the debris. Yona *et al.* (2023) noted that over 60% of all litter found on beaches in South Java, Indonesia, was attributed to plastic. Kaladharan *et al.* (2017) found that the proportion of plastic items in beach debris along the Indian coast was highest in Maharashtra at 81%, while the lowest average from the beaches of Andhra Pradesh was 7%. They also reported that in the two island territories of India, plastic made up 40% of debris in Lakshadweep and 47% in the Andamans, in contrast to the national average of only 14% for plastic in debris across India. Mishra *et al.* (2023) stated that plastic was the predominant type of litter (65% in 2019; 74% in 2021), with single-use plastics being the most common. The research suggests that plastic pollution and the buildup of debris along the shores of coastal towns can be effectively managed through proper garbage collection and management, as demonstrated in Gwadar and Pasni. Conversely, it can also accumulate on beaches despite efforts in trash collection and disposal, as seen in Jiwani.

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