



Identification and quantification of macro-plastics in the lagoon bays of the Abidjan district (Ivory Coast)

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Abstract : This study aims to characterise macro-waste, with a particular focus on plastics, collected in six lagoon bays in the Abidjan district (Banco, Marcory, Koumassi, Yopougon, Biétry and Cocody). Twelve sampling campaigns were conducted between June and August 2025 using the OSPAR methodology. The results reveal a clear predominance of plastics (57%) in the overall composition of waste, followed by the « other waste » category (15%) and sanitary waste (7%). The average mass of waste varies from 40.17 kg (Koumassi bay) to 62.36 kg (Yopougon bay). In terms of plastics, polyethylene terephthalate (PET) dominates with 35.93%, followed by low-density polyethylene (LDPE) with 18.93% and polypropylene (PP) with 15.36%. Brand identification reveals a predominance of Solibra (27%), followed by the « others » category (25%), Nestlé (17%), Groupe Carré d'Or (12%) and NBCI (10%). These results highlight the major role played by single-use plastics, particularly bottles and packaging, in the accumulation of solid waste on the shores of the lagoon bays in the Abidjan district. The study emphasises the urgent need to strengthen environmental regulations, in particular through the establishment of eco-organisations and the development of local recycling channels. However, these macro-plastics are only the visible part of a more widespread pollution problem. Under the effect of mechanical fragmentation, photo-oxidation and chemical degradation, these macro-plastics gradually break down into micro-plastics. It would therefore be appropriate to continue research into the characterisation of micro-plastics and their potential impacts on biodiversity and human health.

1. Introduction

Global plastic production has grown exponentially since the early 1950s (Plastics Europe, 2020). The versatility, lightness and strength of plastic materials, combined with their low price, make them a popular material among consumers (Adjalo, 2015; SEAS, 2021). It has become essential in all sectors of activity such as food, agriculture, construction and transport (Traoré, 2018; Sizing, 2024). According to these authors (Ter Halle and Perez, 2018; Anthony, 2019), every minute, the equivalent of a refuse collection lorry full of plastic waste is dumped into aquatic environments. However, plastic pollution has become a critical issue in Ivory Coast, as in many other developing countries.

This problem is mainly due to rapid population growth, accelerated urbanisation and economic development, which have led to increased consumption of plastic, often poorly managed after use. This inadequate management makes plastic pollution a major environmental and health challenge for the country (SEAS, 2021; INS, 2024). Furthermore, a study by Jambeck *et al.*, (2018) estimates that in 2010, approximately 100,000 tonnes of plastic waste were poorly managed in Ivory Coast, or about 0.80 kg per person per day. This amount could reach 613,200 tonnes by 2025 (UEMOA, 2013). Faced with the harmful effects of plastic waste on the environment, particularly in aquatic environments, the Ivorian government issued decree No. 2013-327 of 22 May 2013 to ban the production, import, sale, possession and use of plastic bags throughout the country. This decree has proved difficult to enforce due to economic interests. Also, with specific regard to the Ivorian coastline, one of the measures aimed at preserving coastal areas in Ivory Coast is Law No. 378 of 2 June 2017 on the development, protection and integrated management of the Ivorian coastline. However, despite the efforts made by the state authorities, the shores of Ivory Coast beaches continue to be littered with plastic waste, which is beyond the control of the public authorities. The district of Abidjan, a coastal city located in the south-west of Ivory Coast and bordered by the Ebrié lagoon, has several lagoon bays that are unfortunately not immune to plastic pollution. This pollution is due to poor waste management on the continent, with waste ending up in these bays through rainwater runoff. This encourages the accumulation of macro-waste, particularly plastics, on the shores of the lagoon bays. In this context, the present study aims to characterise the plastic macro-waste present on the shores of the bays of the Ebrié lagoon, in order to understand the dynamics of plastic waste in urban lagoon ecosystems and provide useful information to guide local strategies for managing and reducing plastic pollution.

2. Methodology

2.1 Presentation of the study area

The Ebrié lagoon system is located on the southern coast of Ivory Coast, stretching 125 km between 3°40' and 4°50' west longitude and 5°20' north latitude (Poubady, 1979). It is 4 to 7 km wide and covers an area of 566 km². It includes the Ebrié lagoon, as well as the Aghien and Potou lagoons, which cover areas of 523 km² and 43 km², respectively. It is separated from the Atlantic Ocean by an 8 km thick sandy coastal strip. Since 1950, it has been connected to the sea by the 370 m wide Vridi Canal (Figure 1). The Ébrié lagoon system is fed in the west by the Agnéby River and in the east by the Comoé River and the Mé River. It contains numerous bays that occupy nearly one-fifth of its total surface area (Poubady, 1979). The average depth is 4.8 m.

2.2 Choice of sampling stations

As part of this study, six (6) lagoon bays, all located within the Ébrié lagoon, were selected as investigation sites. These are: Banco bay, Marcory bay, Koumassi bay, Yopougon bay, Biétry bay and Cocody bay. This choice is supported by the FASEP (2019) study on the characterisation of floating and stranded waste deposits in the bays of the Abidjan district. These lagoon bays were chosen to be representative of the characteristics of the areas concerned by the sampling, such as anthropogenic macro-waste washed up or deposited on the banks, particularly points of accumulation of plastic macro-waste. All of these sampling stations are also easily accessible and allow for safe sampling. Figure 2 shows the location of the sampling points for anthropogenic macro-waste.

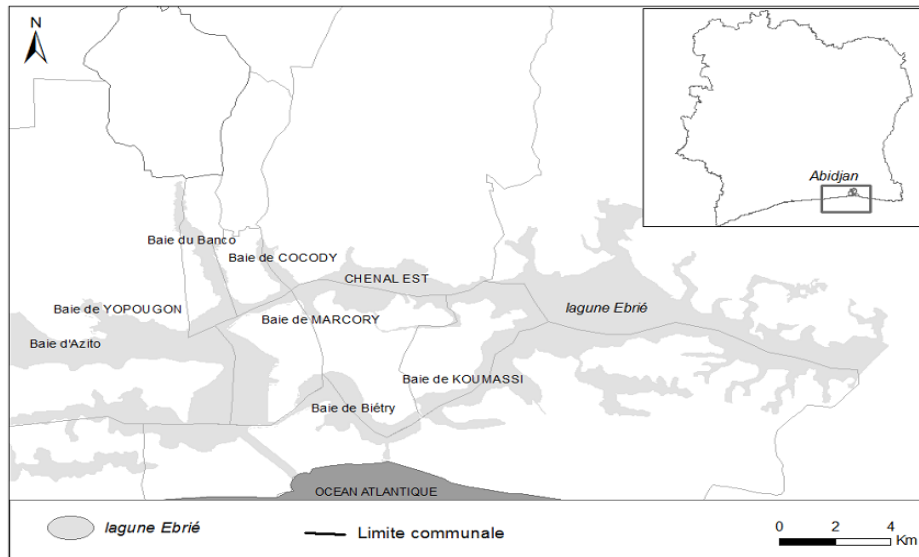


Figure 1. Map of the Ebré Lagoon showing the various lagoon bays

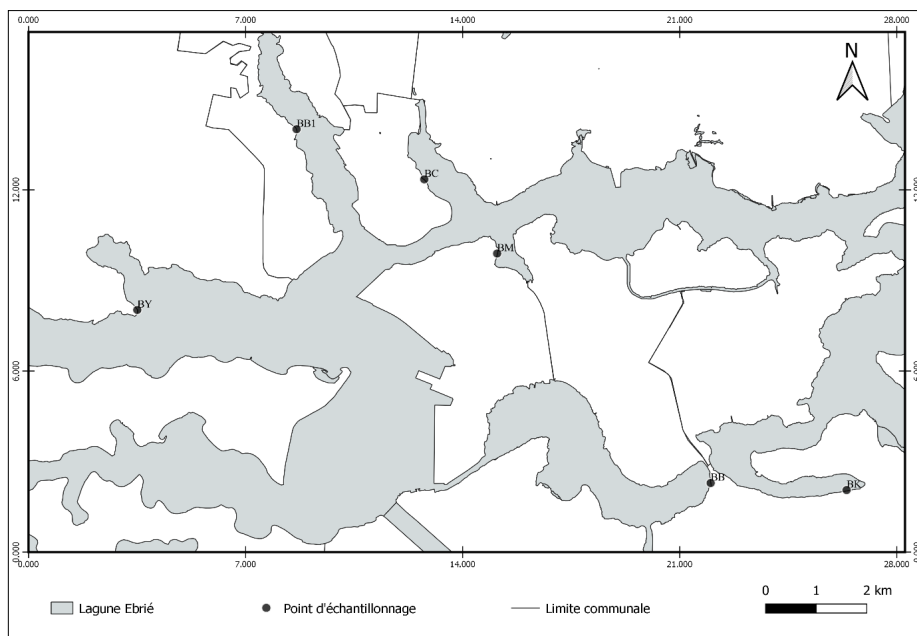


Figure 2. Location of sampling points for anthropogenic macro-waste

Table 1 shows the geographical positions of the sampling points in the various lagoon bays, as well as their geographical coordinates.

Table 1. Sample collection stations and their geographical coordinates

Bay	Sampling stations	GPS coordinates
Biétry	BB (bay of Biétry)	5°16'13''N ; 3°57'51''W
Koumassi	BK (bay of Koumassi)	5°16'25''N ; 3°57'50''W
Marcory	BM (bay of Marcory)	5°18'36''N ; 4°0'8''W
Cocody	BC (bay of Cocody)	5°19'33''N ; 4°0'54''W
Yopougon	BY (bay of Yopougon)	5°18'7''N ; 4°3'58''W
Banco	BB1 (bay of Banco)	5°20'6''N ; 4°2'16''W

2.3 Sampling

2.3.1 Sampling campaign procedure

As part of this study, each sample collected from the shores of the lagoon bays consisted of a total volume of 450 litres, corresponding to three (3) bags of 150 litres each, taken from a precisely defined perimeter to ensure the representativeness of the sampling. Bulky waste such as tyres was not taken into account due to the difficulty it would present during collection or transport. Only anthropogenic plastic waste larger than a bottle cap, considered to be anthropogenic macro-waste, was collected. From June 2025 to August 2025, 12 sampling campaigns were carried out at the six (6) stations, at a rate of two (2) campaigns per site. The sampling and characterisation campaign protocol was based on the OSPAR grid defined by the OSPAR Commission ([ADEME, 2012](#)).

2.3.2 Selection of sampling transects

For sampling, an area was identified and marked out with stakes (any object found on site that could be used as a stake, such as a metal bar, stick, etc.) before sampling began. To avoid confusion during sample collection, we worked along the baseline « x » (width of the sampling perimeter). From this line, all anthropogenic plastic objects of macroscopic size, greater than or equal to the size of a bottle cap, were collected until three (3) 150-litre bags were completely filled. Once the sample was complete, the value of « y » (length of the sampling perimeter) was measured. The samples were sealed with a tie and the sampling site was marked on them. [Figure 3](#) shows a diagram of the waste sampling method and the determination of the « x » and « y » values.



[Figure 3](#). Diagram of the method for collecting anthropogenic macro-waste

2.4 Characterisation methodology

2.4.1 Characterisation of anthropogenic solid waste

In this study, the methodology used is the OSPAR method. It consists of counting the number of macro-waste items found on the various transects and classifying them according to categories based on material ([ADEME, 2012](#)). Once the samples had been collected, the macro-waste was transported and sorted in situ: this is the sorting phase (identification and quantification). This phase consists of grouping together anthropogenic plastic waste of the same type or nature and counting it using the OSPAR method. The operation is carried out in several stages:

❖ Separating different objects by material

The collection point is located in the centre of a tarpaulin. Waste is separated according to type (bottles, bags, shoes, etc.) and material (plastic, textiles, wood, etc.) (Figure 4).



Figure 4. Sorting phase for collected anthropogenic plastic waste (Photo: Traoré, 2025)

❖ Counting and identification of marks

Here, the items were counted according to type (bottles, bags, etc.) and the data was then entered into the OSPAR grid. The brands present were also specified.

❖ Weighing and determining the surface mass per category of material

Once counted, the plastic items were grouped by material category to be weighed. The x and y data obtained at the sampling site were used to calculate the surface mass of plastic waste in order to assess its concentration at these locations. In addition, this report made it possible to estimate the quantity of different types of plastic waste that had washed up on the shores of the lagoon bays. The surface mass (σ) is the ratio between the mass (kg) of the different types of plastic waste and the surface area (m^2) of the sampling site:

$$\sigma = \frac{m}{s} \text{ (kg.m}^{-2}\text{)} \quad \text{Eqn.1}$$

Where σ = surface mass (in kg.m^{-2}), m = mass of macro-waste type (in kg), s = sampling area (in m^2).

2.4.2 Characterisation of plastic waste

Once the general characterisation was complete, the specific characterisation of plastic waste was carried out in order to identify the seven (7) types of plastic. The code indicated in the Möbius loop on the plastic material allows each type of plastic to be identified. For example, code 1 corresponds to PET (polyethylene terephthalate), 2 corresponds to HDPE (high-density polyethylene), 3 corresponds to PVC (polyvinyl chloride), 4 corresponds to LDPE (low-density polyethylene), 5 corresponds to PP (polypropylene), 6 corresponds to PS (polystyrene) and 7 corresponds to ORTHER (Figure 5).

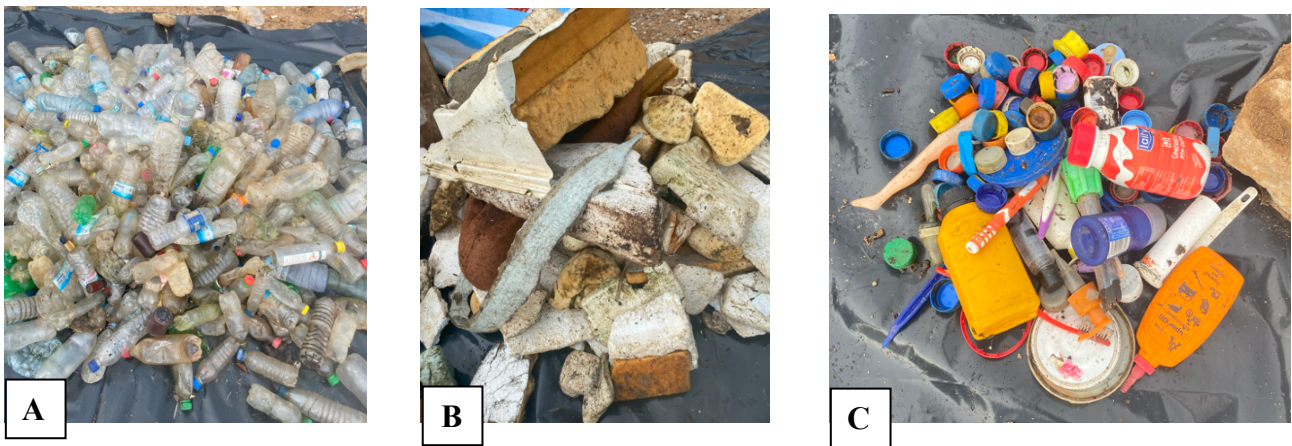


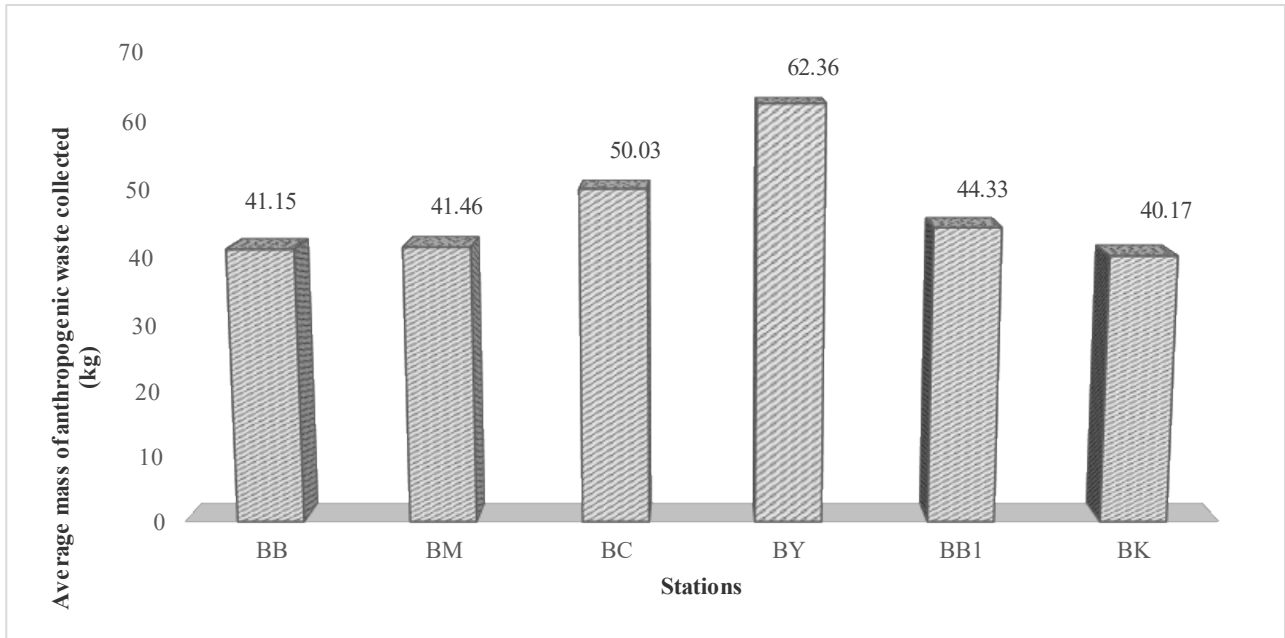
Figure 5. Types of plastic waste found on the shores of the lagoon bays in the Abidjan district (A=PET=Polyethylene terephthalate; B=PS=Polystyrene; C=HDPE=High-density polyethylene) (Photo: Traoré, 2025)

3. Results and Discussion

3.1 Results

3.1.1 Amount of anthropogenic waste collected from various lagoon bays

Figure 6 illustrates the average mass of anthropogenic solid waste collected on the shores of the lagoon bays in the Abidjan district, by site. Samples were collected until three (3) 150-litre bags were filled. In general, the quantities collected ranged from 40.17 kg at station BK to 62.36 kg at station BY.



BB : bay of Biétry ; BM : bay of Marcory ; BC : bay of Cocody ; BY : bay of Yopougon ; BB1 : bay of Banco ; BK : bay of Koumassi
Figure 6. Average mass production of anthropogenic waste on the lagoon bays of the Abidjan district

3.1.2 Proportion of different categories of solid waste on lagoon bays according to the OSPAR grid

The anthropogenic solid waste collected on the shores of lagoon bays (landings) was classified into nine (9) categories of materials, in accordance with the OSPAR grid. The results, presented in **Figure 7**, show that the composition is largely dominated by plastics (Plast.), which account for 57%

of the total. They are followed by the Other Waste (AD) category with 15%, comprising waste that cannot be identified due to fragmentation or lack of marking. In third place is sanitary waste (DH), which accounts for 7% of the total, dominated by nappies, sanitary towels and toothbrushes. Next comes clothing and textiles (V/T) with 6%, slightly higher than medical waste (DM) and paper and cardboard (P/C), each accounting for 4%. Processed wood (Bo) accounts for 3%, while metal (Me) and glass and ceramics (V/C) have the lowest proportions, with 2% each.

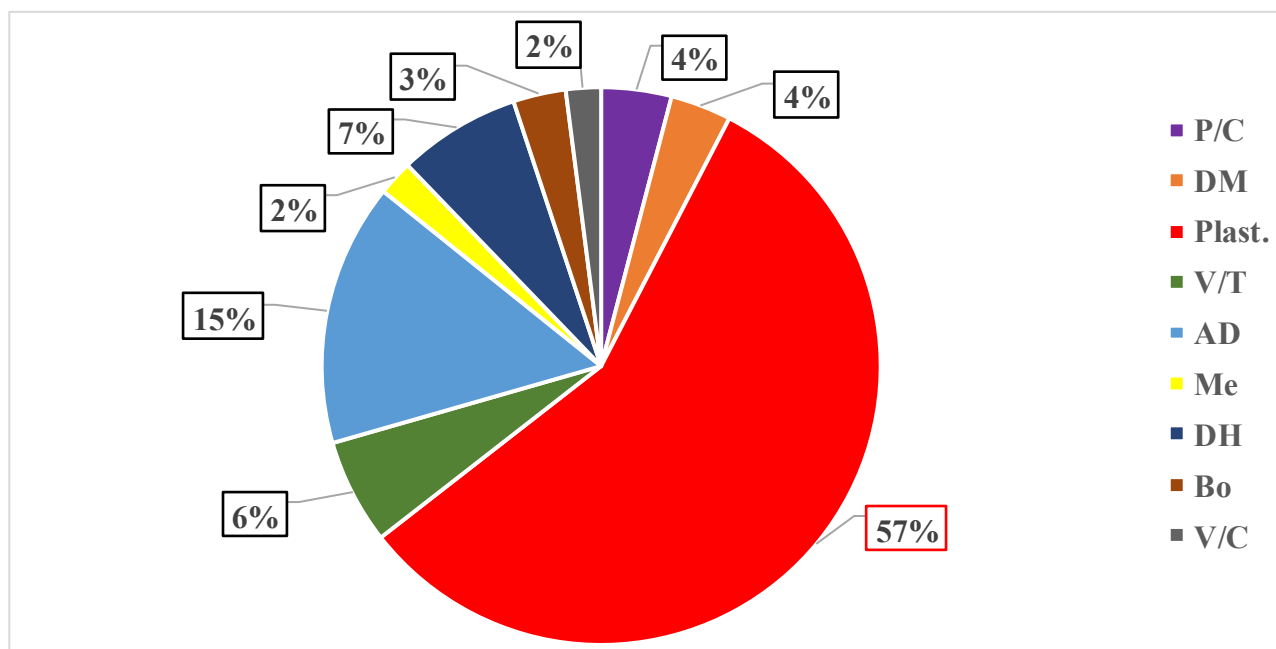


Figure 7. Proportion of different categories of solid waste on lagoon bays

3.1.3 Characterisation of plastic waste in the lagoon bays of Abidjan

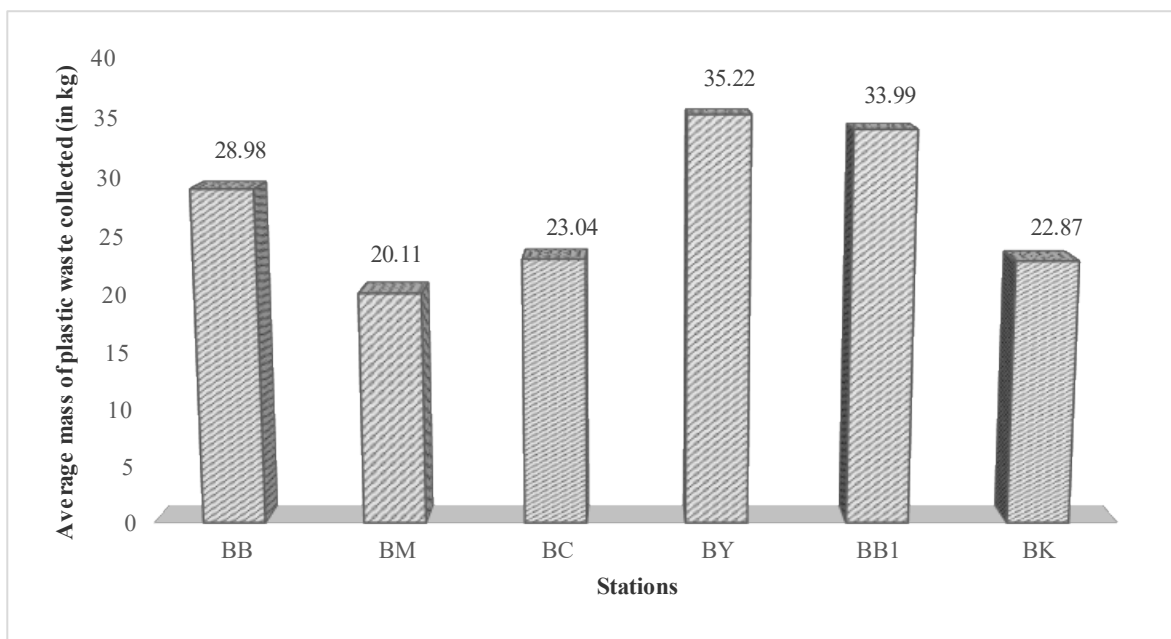
3.1.3.1 Quantity of plastic waste collected on the lagoon bays of Abidjan

The quantities of plastic waste collected on the shores of the lagoon bays in the Abidjan district are illustrated in **Figure 8**. Stations BY, BB1 and BB recorded the highest average masses, with 35.22 kg, 33.99 kg and 28.98 kg respectively. In contrast, stations BC, BK and BM show lower values, estimated at 23.04 kg, 22.87 kg and 20.11 kg respectively.

3.1.3.2 Proportion of plastic waste types in the lagoon bays of Abidjan

After the general characterisation, another characterisation was carried out specifically on plastic waste in order to determine the proportion of each type of plastic waste. The results, presented in **Figure 9**, show a clear predominance of polyethylene terephthalate (PET), which accounts for 35% of all plastics collected in the lagoon bays of Abidjan. Low-density polyethylene (LDPE) ranks second with 19%. Next come polypropylene (PP) and the « Others » category, which account for 16% and 13% of total production, respectively.

High-density polyethylene (HDPE) and polystyrene (PS) account for smaller proportions, at 7% and 6% respectively. Finally, polyvinyl chloride (PVC) appears in small quantities, accounting for only 4% of the plastic waste identified.



BB : bay of Biétry ; BM : bay of Marcory ; BC : bay of Cocody ; BY : bay of Yopougon ; BB1 : bay of Banco ; BK : bay of Koumassi

Figure 8. Mass of plastic waste collected from the lagoon bays of Abidjan

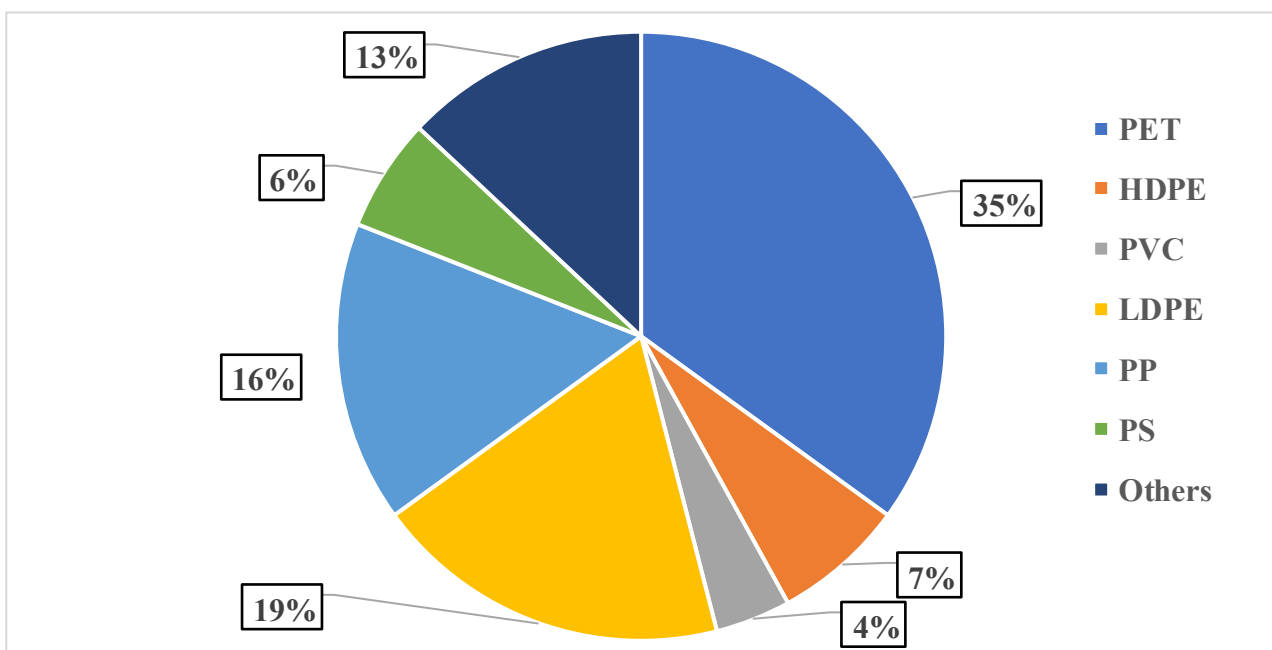


Figure 9. Proportion of plastic waste types in the lagoon bays of Abidjan

3.1.3.3 Spatial distribution of plastic waste types in the lagoon bays of the Abidjan district

Figure 10 shows the average spatial composition of the seven (7) types of plastic waste in each lagoon bay in the Abidjan district. According to the figure, the mass of PET varies from 6.12 kg at station BM to 16.33 kg at station BY. HDPE ranges from 1.88 kg at station BB1 to 2.05 kg at stations BM, BC and BK. For PVC, the masses range from 0.17 kg (stations BM, BC and BK) to 2.9 kg (station BY). The PEBD records variations ranging from 4.06 kg (station BB) to 7.16 kg (station BY). The PP ranges from 4.18 kg (station BB) to 5.02 kg (station BC). As for PS, its values fluctuate from 1.18 kg (station BM) to 2.06 kg (station BY). Finally, the Others category varies from 2.33 kg (station BC) to 5.83 kg (station BB1). In general, the BY station stands out with the highest masses for most plastic categories, with the exception of HDPE, PP and the Others category.

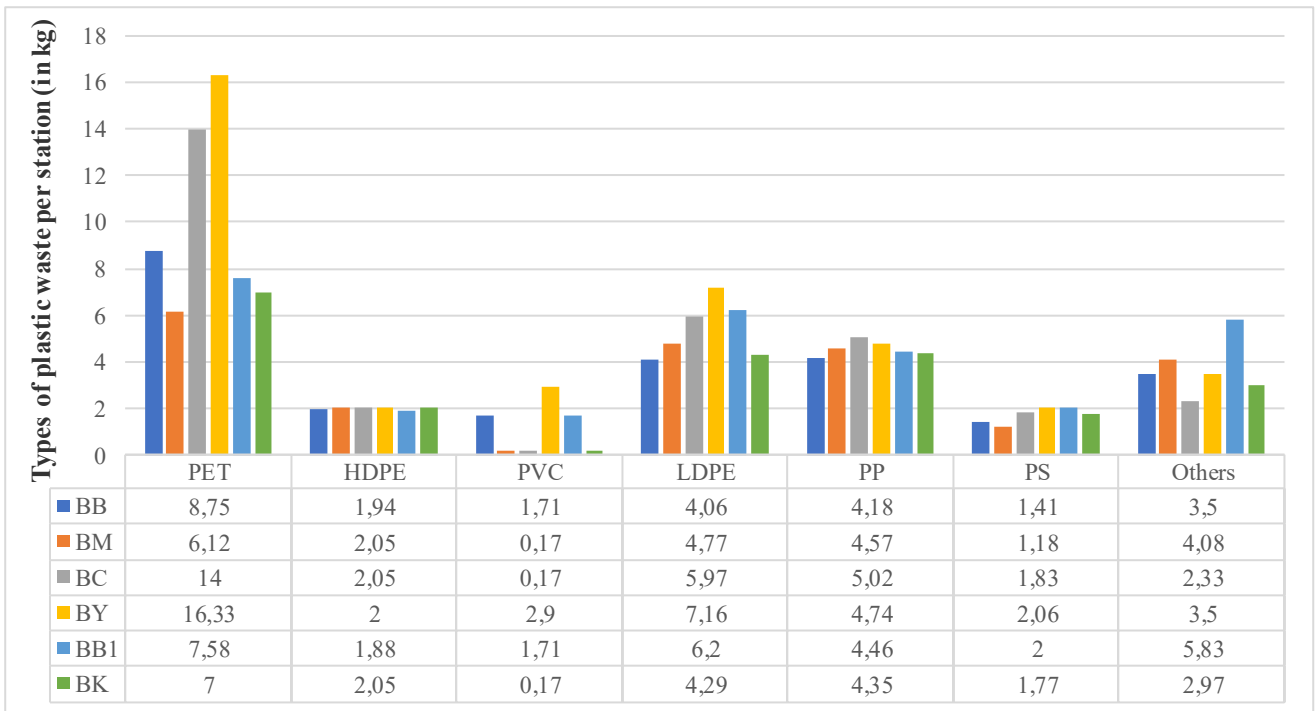


Figure 10. Distribution of plastic waste types in the lagoon bays of Abidjan

3.1.3.4 Surface distribution of plastic waste by station

Figure 11 illustrates the mass percentage distribution of the different types of plastics collected in the lagoon bays. The analysis highlights a clear predominance of polyethylene terephthalate (PET), which accounts for 35.93% of the total characterised. Low-density polyethylene (LDPE) is the second most abundant category, with 18.93%, followed by polypropylene (PP) with 15.36%.

The « Others » category accounts for 12.66% of the plastics identified. Finally, the lowest proportions are recorded for high-density polyethylene (HDPE) (6.68%), polystyrene (PS) (5.90%) and polyvinyl chloride (PVC) (4.54%).

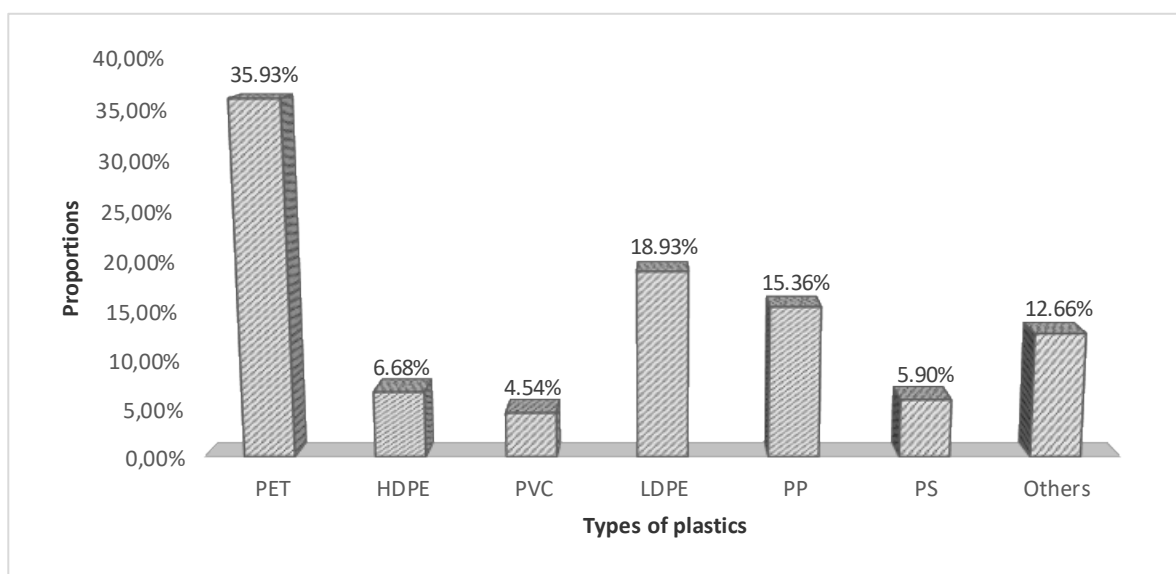


Figure 11. Surface distribution of plastic waste by type of material

3.1.3.5 Identification of brands on plastic waste

Figure 12 shows the results of the identification of brands appearing on the various items collected in the lagoon bays. Of these, the five (5) most dominant brands were selected. The Solibra brand appears to be the most represented, with 27%, mainly among plastic bottles. It is followed by the « Others » category, which includes various minority brands and represents 25%. The next three (3) brands, Nestlé, Groupe Carré d'Or and NBCI, are also among the major groups, with respective proportions of 17%, 12% and 10%. Finally, the Ok Plast brand is the least represented in this ranking, with 8% of the objects identified.

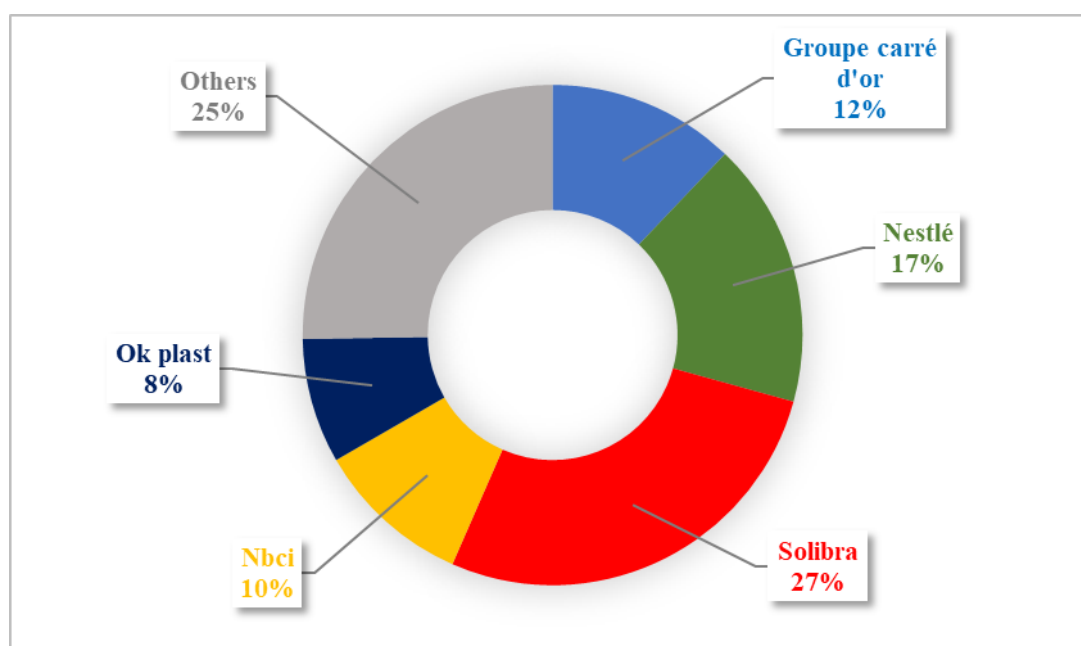


Figure 12. The most frequently encountered brands during the sampling campaigns

3.2 Discussion

The campaign to identify and quantify macro-waste was conducted on the basis of twelve (12) samples taken from six (6) lagoon bays in the Abidjan district. The samples were taken specifically in areas where macro-waste accumulates, i.e. on the banks where floating waste washes up or piles up. The total mass collected averaged around 280 kg, spread over a sampling area of 115 m².

Analysis of the samples reveals significant spatial variability in macro-waste in the lagoon bays of Abidjan. The Yopougon bay station (BY) recorded the highest average mass (62.36 kg), due to its direct connection to open drainage networks and the high population density of the municipality (RGPH, 2021). This accumulation, linked to poor waste management, confirms the observations of Galgani *et al.* (2015) and GESAMP (2016) on the correlation between waste density, population density and urban proximity. Conversely, the Koumassi bay station (BK) has the lowest mass (40.17 kg), probably due to reduced anthropogenic pressure and, according to Oni *et al.* (2020), this could be linked to the hydrodynamic conditions of the bay, which favour the dispersion of waste. The composition according to the OSPAR grid reveals a dominance of plastics (57%), followed by other waste (15%). The proportion of plastics is similar to that reported by Betty *et al.* (2014) (64%) in Slovenia and low compared to the 88.1% reported by FASEP (2019) in the bays of the Ebrié lagoon. In all cases, these results are in line with the global trend described by Derraik (2002), according to which plastics account for between 60 and 90% of solid waste in aquatic ecosystems.

After general characterisation, specific characterisation was carried out on plastic waste to determine the proportion of each type of polymer. The results show that the Yopougon bay station (BY) has the highest concentration of plastic waste, followed by the Banco and Biétry bays stations (BB1 and BB). This spatial variability can be explained by local uses and surrounding infrastructure (drainage networks, population density, proximity to markets, etc.). Similar findings have been made in the Ganges estuary (India), where [Napper *et al.* \(2021\)](#) report an increased concentration of plastics in areas close to urban centres. Similarly, the Cotonou lagoon (Benin), studied by [Tossou *et al.* \(2020\)](#), reveals an accumulation dominated by direct urban inputs. These comparisons confirm that the situation observed in Abidjan is not isolated, but reflects a general dynamic of African urban lagoons.

With regard to the composition of plastics, the results show a predominance of polyethylene terephthalate (PET) (35%) and low-density polyethylene (LDPE) (19%).

The high proportion of PET can be explained by the rapid development of the bottled water industry, as well as the gradual replacement of glass bottles with plastic packaging for soft drinks in a context where collection and recycling channels remain limited. This result is consistent with the observations of [Oni *et al.* \(2020\)](#) in the Lagos Lagoon (Nigeria), which indicate PET proportions of 35 - 40%. As for LDPE, its high prevalence is due to its widespread use as a packaging material and in everyday urban activities ([Traoré, 2018](#) ; [Sizing, 2024](#)). However, its prevalence remains paradoxical, as decree No. 2013-327 of 22 May 2013 prohibits the production, import, marketing and use of plastic bags in Ivory Coast. In practice, according to [Téya *et al.* \(2023\)](#), these products continue to be manufactured and distributed. This explains their persistence in the environment. Furthermore, they are both considered single-use plastics, responsible for a significant proportion of global plastic pollution ([Geyer *et al.*, 2017](#) ; [EEA, 2021](#)).

In terms of space, PET, LDPE and PP polymers appear to be the most dominant across all sampled stations. PET, in particular, stands out with an average rate of 35.93%, mainly in the form of plastic bottles, a result close to that reported by [FASEP \(2019\)](#) (24%). LDPE ranks second with 18.93%, confirming its widespread use in packaging, as also shown by [Sizing \(2024\)](#) work on waste characterisation in Lomé (Togo).

Finally, analysis of brands reveals that Solibra is the most represented, with 27% of items collected, followed by the « others » category (25%), which includes several smaller companies (Siagro, Europlast, Cotiplast, Plastica-CI, etc.). The brands Nestlé (17%), Groupe Carré d'Or (12%) and NBCI (10%) complete the list of the top five. These results corroborate those of the report [FASEP \(2019\)](#), which also identified Solibra and the « others » category as dominant, with approximately 28% each. The importance of the Solibra brand can be attributed to its status as the historic leader of the Ivorian beverage market since 1955 ([AAEN-CI-News, 2017](#)), reinforced by the successive acquisition of other local brands.

Conclusion

The characterisation of macro-waste in the lagoon bays of Abidjan highlights an accumulation of solid waste largely dominated by plastics, particularly polyethylene terephthalate (PET) (35%) and low-density polyethylene (LDPE) (19%), mainly from single-use bottles and packaging. The results reveal significant spatial variability, with higher accumulations in areas of high anthropogenic pressure, particularly in Yopougon bay, where the amount of waste reaches 62.36 kg. The identification of brands indicates a significant contribution to this pollution by the beverage and plastic packaging industries. These findings are consistent with trends observed in other African

urban lagoons and highlight the need to strengthen efforts to combat the threat posed by plastic pollution and waste dumping.

This fight requires strengthening the regulatory framework and ensuring its effective enforcement, so as to cover all problematic plastics, as well as enforcing the Environmental Code, in particular through the establishment of eco-organisations dedicated to the collection, transport and treatment of plastic waste. In addition, the development of local recovery channels, raising consumer awareness of plastic pollution and promoting sustainable alternatives are all essential levers for reducing the influx of plastics into the Ébrié lagoon. However, macro-plastics are only the visible fraction of a much more complex and insidious form of pollution. Under the combined effect of physical factors (wave action, friction, abrasion), chemical factors (photo-oxidation, hydrolysis) and biological factors (enzymatic degradation), these plastics undergo progressive fragmentation, leading to the formation of microplastics. Further research into the characterisation of microplastics and their potential impacts on biodiversity and human health would be appropriate.

References

- AAEN-CI-News (2017). The magazine for the environment and green tourism. News and practical information, 40p.
- Adane L. and Muleta D. (2011). Survey on the usage of plastic bags, their disposal and adverse impacts on environment: A case study in Jimma City, Ethiopia. *J. Toxicol. Environ. Health Sci.*, 3(8), 234–248.
- ADEME (2012). Study on the characterisation and flows of waste in aquatic environments, 47p.
- Adjalo D. K., (2015). The development of the plastic sector and its socioeconomic and environmental impact in the city of Lomé. PhD thesis, University of Lomé, Lomé, Togo, 342p.
- Anthony B. M., (2019). Analysis of the most appropriate measures for a single-use plastic waste-free Quebec. Master's thesis. University of Sherbrooke, Sherbrooke, 88p.
- Betty JL, Laglbauer, Rita MF-S, Miguel A-C, Lisa B, Maria P, Andreja P, Mateja G and Tim D (2014). Macrodebris and microplastics from beaches in Slovenia. *Marine Pollution Bulletin*, 89, 356–366.
- Derraik JGB (2002). The pollution of the marine environment by plastic debris: A review. *Marine Pollution Bulletin*, 44(9), 842–852.
- Durand, J.R. and Guiral, D., (1994). Hydroclimat et Hydrochimie In Environnement et Ressources aquatiques de Cote d'Ivoire. Tome II. Milieux lagunaires, Ed. ORSTOM. 59-90.
- European Environment Agency (EEA, 2021). Plastics, the circular economy and Europe's environment – A priority for action. EEA Report n°18, 75p. [doi: 10.2800/5847](https://doi.org/10.2800/5847)
- FASEP (Fonds d'Études et d'Aide au Secteur Privé), (2019). Study to define a system for collecting and processing floating and washed-up macro-waste on the shores of the lagoon bays of Abidjan. Task 3: Characterisation of floating and washed-up waste deposits, 40p.
- Galgani F, Hanke G and Maes T (2015). Global distribution, composition and abundance of marine litter. *In Marine Anthropogenic Litter* : 29–56.
- GESAMP (2016). Sources, fate and effects of microplastics in the marine environment: Part two of a global assessment. IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP.
- Geyer R, Jambeck JR & Law KL (2017). Production, use, and fate of all plastics ever made, *Science Advances*, 3(7), e1700782.
- INS (2024). Potential elements of a national inventory of plastic sources, 75p.

- Jambeck J., Hardesty B.D., Brooks L.A., Friend T., Teleki K., Fabres J., Beaudoin Y., Bamba A., Francis J., Ribbink J.A., Baleta T., Bouwman H., Knox J. and Wilcox C. (2018). Challenges and emerging solutions to the land-based plastic waste issue in Africa, *Marine Policy*, 96, 256-263, <https://doi.org/10.1016/j.marpol.2017.10.041> .
- Jambeck JR, Geyer, Wilcox C, Siegler TR, Perryman M, Andrady A, Narayan R and Law KL (2015). Marine pollution. Plastic waste inputs from land into ocean. *Science*, 347, 768-771.
- Napper, I. E., Davies, B. F. R., Clifford, H., Elvin, S., Koldewey, H. J., Mayewski, P. A., Miner, K. R., Potocki, M., Elmore, A. C., Gajurel, A. P., and Thompson, R. C. (2021). Reaching New Heights in Plastic Pollution—Preliminary Findings of Microplastics on Mount Everest. *One Earth*, 3(5), 621–630.
- Oni BA, Hassan A and Adeogun AO (2020). Microplastics in a tropical lagoon/ox-bow lake system: Seasonal comparison of abundance and composition. *Marine Pollution Bulletin*, 150, 110695. <https://doi.org/10.1016/j.marpolbul.2019.110695>
- PlasticsEurope (2020). Plastics-the Facts 2020 : An analysis of European production, demand and waste data, 31p.
- Poubady, R.B. (1979). The Ebrié lagoon system in Côte d'Ivoire. Functioning, hydrodynamics and salinity. Doctoral thesis in Engineering. University of Abidjan (Ivory Coast), National Polytechnic Institute of Toulouse (France). 247p.
- RGPH (Recensement Général de la Population et de l'Habitat), (2021). Overall results 2021, 37p.
- SEAS (2021). Plastics in the environment. Report of the Academy of Sciences, March 16, 2021, 29p.
- Sizing B (2024). Marine pollution from plastic waste in Togo: characterisation and appropriate recovery in the context of developing countries. Doctoral thesis, University of Lomé, Togo, 155p.
- Ter Halle A. and Perez E. (2018). Plastic pollution at sea: the seventh continent, Encyclopedia of the Environment. Accessed December 03, 2020, <https://www.encyclopedie>.
- Téya KB, Effebi KR, Niamké KH and Gbossou KC (2023). Monitoring of Plastic Waste on the Beaches of Grand-Bassam, Ivory Coast. *International Journal of Innovative Science and Research Technology*, 3, Issue 2, 897-908.
- Tossou, T., Aina, M. P., Gnandi, K., et al. (2020). Assessment of microplastics pollution in the lagoon of Cotonou (Bénin).
- Traoré B (2018). Development and characterisation of a composite structure (sand and recycled plastic waste): improvement of strength through clay fillers. Doctoral thesis, University of Cocody, Abidjan, Ivory Coast, 138p.
- UEMOA (2013). Study on plastic waste management in the WAEMU space. Final report, 253p.

(2025) ; <http://www.jmaterenvirosci.com>