

The investigation of the primary source of shoreline litter invasion in Downbeach Limbe-Cameroon

Beach litter in Downbeach Limbe

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Abstract

Shoreline litter invasion poses a pervasive global environmental challenge, adversely impacting marine ecosystems, public health, and coastal economies. This thesis addresses the issue in Downbeach Limbe, aiming to identify its primary sources and propose sustainable solutions. Collaborating with ASCOA volunteers, we conducted comprehensive data collection, focusing on spatial and temporal dimensions by cleaning three different beach sites three times during one week on Tuesday, Thursday, and Saturday. The gathered information, encompassing litter types and countries of production, underwent meticulous analysis.

The investigation revealed a notable concentration of waste on Day 1 (Tuesday) and Day 3 (Saturday), indicating a link with weekend activities. Furthermore, a significant portion of the litter originated locally. This underscores the predominantly local nature of the shoreline invasion problem in Downbeach Limbe, emphasizing the need for targeted interventions involving the local community.

To address this issue, I recommend implementing strategies aimed at achieving a clean beach environment in the near future. These include fostering public awareness on proper waste management practices, substantial government investments in waste management infrastructure, and the establishment of mandatory beach cleaning initiatives for traders and business owners. By focusing on local engagement and sustainable practices, locals can pave the way for a cleaner and healthier Downbeach Limbe.

Language: English

Key Words: clean beach strategy, waste, Cameroon

LIST OF ABBREVIATIONS

IMO	International Maritime Organization
HYSACAM	Hygiene and Health of Cameroon
EPA	Environmental Protection Agency
UNEP	United Nation Environmental Programme
UN	United Nations
NGO	Non-Governmental Organization
ASCOA	Association for community awareness
EEA	European Environment Agency
USEPA	United States Environmental Protection Agency

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1 Introduction

Shoreline litter invasion has for several decades been a global environmental problem for coastal communities with a high rate of harmful impact on the environment caused by accumulation of litter on shoreline from several sources (UN News, 2022). Shoreline litter invasion often relates to waste, which comprises of items that have artificial origin and due to objective and subjective reasons appeared in the ocean, sea, river, or in a shore. The source of the litter is always related to human activities (EEA, 2023). However, the litter appear on a shoreline often due to natural ways of delivery: accidentally brought into the sea with winds, storm water, river or sewage water as well as materials lost by fishing and cargo vessel in bad weather condition (IMO, 2019). The most common, and visually detected litter include on shore worldwide are plastic bottles, food wrappers and cigarette butts which are often left behind by tourist and inhabitants (Hu, 2020).

Shoreline litter creates the risk of serious health problem for people who come in contact with water of sand affected or contaminated by waste (Campbell and Slavin 2016). It is reported that about ten percent of all water samples collected in 2013 from 3500 coastal and great lakes beaches have failed to meet EPA's high standard for swimmer safety. It is estimated by the EPA that annually, about 1.8 to 3.5 million are affected when they come in contact with untreated sewage while (Dorfman 2004). This impact has potentially bigger consequences for children because they often swallow more water while swimming (USEPA, 2011). As a result, the litter impact can cause stomach issues, hepatitis, neurological disorder, respiratory ailments, meningitis and can provoke risk of death for people with immune system (Sindermann, 2006). Results of research done in South Africa demonstrated that shorelines are invaded by litter from both local and distant source (Ryan and Perold, 2021). Another group of scholars highlight that also more than 5 trillion plastic pieces weighting over 250,000 tons afloat at sea (Erikson, 2014). On top of that, a tangible part of the waste appears in the sea water of Cameroon annually (Yenku, 2021). Furthermore, this amount of litter has affected the touristic sphere in Limbe: the city council forced to have unusual constant beach cleaning and as a result suffers financial losses. Additionally, the city the city suffers reputational damage that affect the number of tourists (Molua, 2020). Orock (2017) in his thesis stated: "The sustainability of the tourism

industry in Limbe is heavily dependent on the extent to which the municipality's environmental situation matches its image". Thus, the increase in the shoreline litter in Downbeach indicates that, the municipality's environmental situation will not be able to match its image leading to a decline in the tourism industry. Therefore, communities and individuals must take part to control the spread of diseases and maintaining a clean beach which has been destroyed by shoreline litter invasion (Meral, 2023). Cameroon as a member of UNEP tries to take appropriate administrative and political action such as developing online material to increase community sensitization for community cleanup, environmental, social media campaigns and posters to create awareness of beach litter and also to prevent future littering (Alemagi, 2006).

1.1 The issue with litter in Downbeach Limbe

This thesis focused on investigation of the primary causes of shoreline litter invasion in Downbeach Limbe, and the various ways at which it can be resolved in the long term. Over the years, the city of Limbe has been awarded several times amongst the top 10 most-cleanest cities in Cameroon (Limbe City Council, 2020). The Limbe city council in collaboration with the local hygiene and sanitation company (HYSACAM) work on preventing the issue with the is the inappropriate approach to waste management among locals. For example, they place billboards all over the city warning people of the penalty fee against anyone who will litter the highway, gutters and beach with plastic, paper, food leftover and any form of waste. Moreover, the city and waste company call local residence for collaborative effort of keeping the city clean. This effort and collaboration with the community members created country wide impression that cleanliness has always been the utmost priority in the Limbe municipality and for its inhabitants (PHCS, 2023). However, regardless of the city council effort, there is report of the increase in the litter invasion in Downbeach which is the main touristic beach in Limbe with several touristic activities. At the same time, Limbe is often called the mini seaport due to its location in close vicinity to the route for international trade between Cameroon and Nigeria (Ebot et al., 2008).

The Downbeach and the city of Limbe has just one waste management company known as HYSACAM which manages all the waste. It is assumed that with inadequate knowledge of proper waste disposal by the local residents and tourist, and also insufficient waste management facilities it is difficult for HYSACAM to meet up with the collection and

management of waste in the Downbeach Limbe (Nanje, 2021). On top of that, HYSACAM has its own approach to recycling, which ends in very limited or total absence of recycling of the collected waste. The company usually takes the collected litter to the outskirts of the city where it is either incinerated or landfilled. Often, HYSACAM is unable to collect the filled-up trash bins in the beach and it end up overflowing and it is scattered by birds on the shoreline. The increase in the population of Limbe over time without increasing the waste management facilities has set to be one of the reasons why the shoreline of Downbeach is littered.



Figure 1. Photo of the litter appeared on the Limbe beach. Source: ASCOA

Another reason of the problem can be the focus of the waste management company exclusively on the city streets and infrastructure and worn people about penalties for inappropriate waste management only in city borders. It may lead to the situation when the residents avoid dumping the waste on the streets due to the fear of penalty and dumps

them in the nearby bushes and river which still brings the litter to the beach as seen in Figure 1. Another reason can be that the residents try to dump the trash in the appropriate places, but the waste management company fails to collect the trash in time, and it is washed and deposited at the beach (Memuna, 2010). Thus, there is a gap in understanding the nature of the issue and this thesis aims to fill the gap of knowledge and find potential solutions. On top of that, in the Downbeach located one of the main fresh fish markets in Limbe. During high catch periods there is high inflow of trader from all over Cameroon to the beach as well as tourist who come to experience fresh catch (Figure 2). Again, most traders have little or no knowledge of waste disposal, they litter the beach with food plastics and other waste which leaves the beach very dirty after a successful trading day (Achamukong, 2014).



Figure 2. Fresh fish market in Downbeach Limbe. Source: Alias Ntungwe

1.2 The consequences of the litter invasion in Down beach Limbe

There are a lot of environmental and socio-economic problems faced in Downbeach Limbe caused by the littering of the shoreline. For example, it is reported that an estimate of 700 species being affected by marine pollution, with many species of birds and fish documented to have ingested plastic, and a loss of revenue due to high cost of frequent cleaning (ASCOA, 2023). It is stated by Orock (2017) that, the improvement of the situation with the litter can

potentially attract more tourists and consequently bring income to the Council and local residents. The coastline of Limbe which is known for its beautiful black sandy beach, is facing the damaging effect of shoreline litter invasion in Downbeach Limbe not only on its marine ecosystem but also on the natural beauty which used to attract tourists to the beach is at risk as it deteriorates (Achamukong, 2014).

In addition, the Limbe municipal council collaborated with Non-governmental organizations (NGOs) such as the Association for Community Awareness (ASCOA) for popularization of cleaning activities through "keep Limbe clean" exercise which is done every last Thursday of the month. During the activities, the local residents and business owners go out on the streets, river banks and to the beaches and do cleaning (Mbom, 2013). However, after the certain time, the beach continues to have issues with the litter and the understanding of the issue core and consequently mitigation of the problem is missing in Downbeach Limbe.

1.3 Research Objectives

The main objective of this thesis is to investigate the primary source of shoreline litter invasion in Downbeach Limbe, and potential solutions for how the Limbe municipal council to manage waste, the challenges faced by the waste management company in Limbe.

1.4 Research Questions

- ✚ What areas in Downbeach Limbe have a larger problem with the litter?**
- ✚ What type of waste accumulates most often on the beach?**
- ✚ What are the primary causes and sources of shoreline litter invasion in Downbeach Limbe?**
- ✚ How can Downbeach Limbe attain a clean beach in the long-run strategy?**

2 Methodology

2.1 Study Area

Limbe municipality located in the Southwest region of Cameroon lies along Ambas Bay in the Gulf of Guinea, at the southern foot of mount Cameroon. It has a population of 72,106 people with a growth rate of 2.9% as per UN projection for the urban population growth rate for Africa. Limbe is a moderate economy and Downbeach is the center of attraction for fishing, tourism and international trade. Downbeach of Limbe is surrounded by the following towns: to the north is Buea municipality which is the Sub-Divisional headquarter and Southwest Regional head quarter of Cameroon, to the northeast is Mutengene, to the east is Tiko, to the Northwest is Idenao, to the Southwest is Santiago de Baney, in Equatorial Guinea (Figure 3).

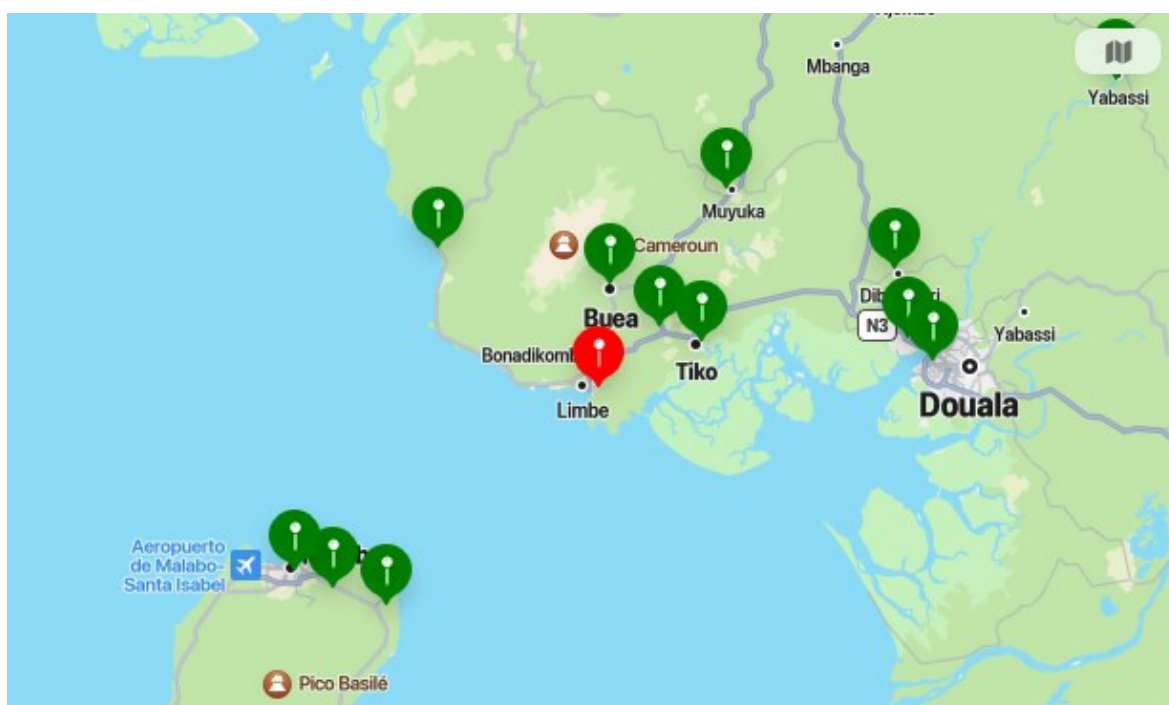


Figure 3. Map of cities around Downbeach Limbe. Source: Limbe municipality

2.2 Data collection

With the help of the guidelines (the detail guideline is presented in Appendix A), a group of volunteers from ASCOA went out to the beach for the waste collection in three given locations in three days of the week. The collection was executed on a Tuesday, Thursday and Saturday. These days were chosen according to the following reasons: Tuesday is considered the start of the week in Limbe and the Southwest and Northwest regions of Cameroon as Monday is set as a work free day; Thursday is the fresh fish market day and the beach is full of locals and tourists, especially during high catch; and Saturday is a weekend, so people take out time for leisure activities. The area of study was divided into three different sections (sites) (Figure 4). Site A is the estuary of Limbe River which runs through the city of Limbe, making it a potential source of waste. Site B is in the Boucareau area where the fresh fish market is located and, thus, popular among tourists and traders on high catch periods and festive seasons, making it potential source of beach litter. Site C is the Elijah Quarter where the fishermen reside and where the leftover fish from the fish market is smoked for the future delivery to the bigger market.

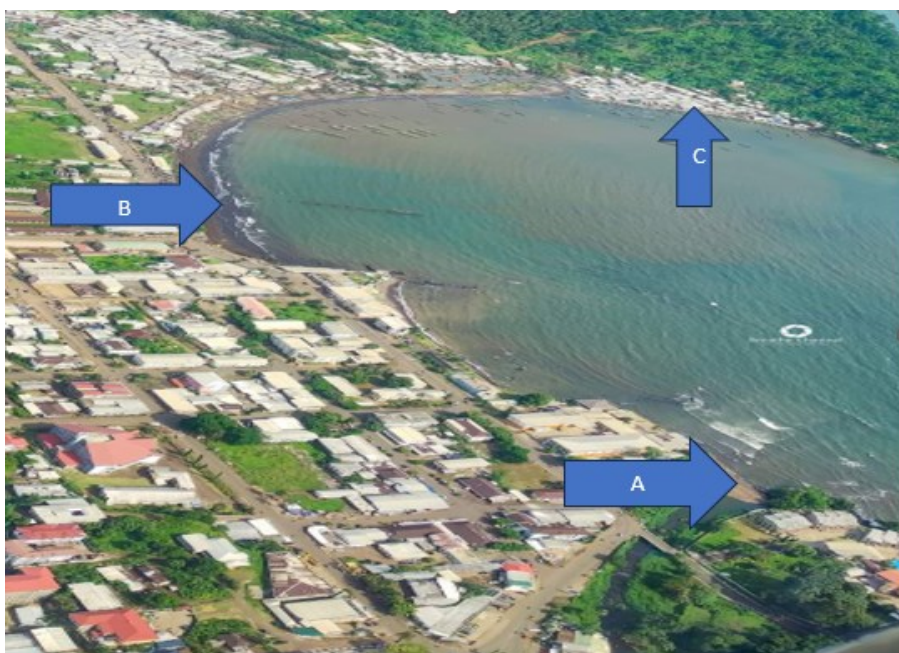


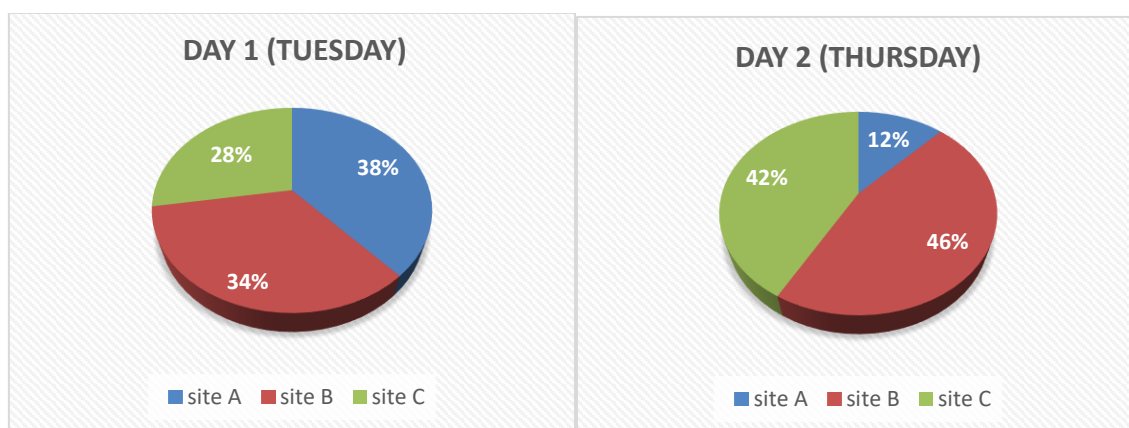
Figure 4: Site A, B and C are the selected sites where the study was carried out.

2.3 Data interpretation

The group of volunteers collected the waste from the locations separately and identified materials separately. This identification was done through the types of waste (plastic, paper, glass, can, and mixed waste being litter that can't be easily identified as either plastic, glass or paper), and the origin of the waste was extracted from labels of the litter pieces found in the beach and with attention to the potential source and the origin of the litter. The collected data was sorted according to the guideline by volunteers. They grouped the litter by type and country of origin. The further analysis of the collected data, I executed in excel where I applied descriptive statistics approach for analysis of different types of waste and locations.

3 RESULTS

The results from three sampling days demonstrated that the largest amount of waste was found in Site A during Day 1 and 3 (Tuesday and Saturday; 38% and 42% respectively), which are related to the weekend activities on the beach. The largest proportion of the waste collected on Day 2 (Thursday) was from Site B (46%; see details in Figure 5).



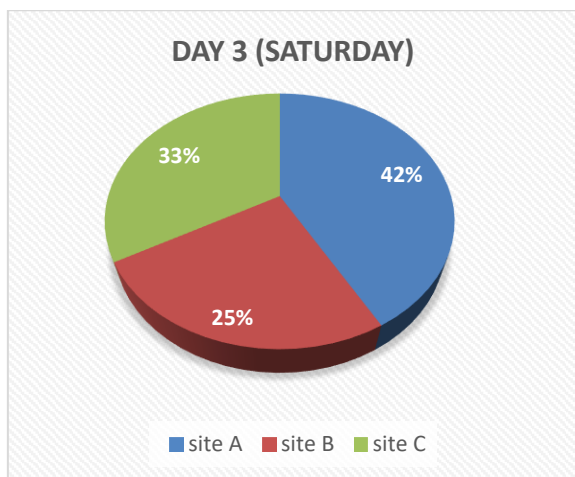
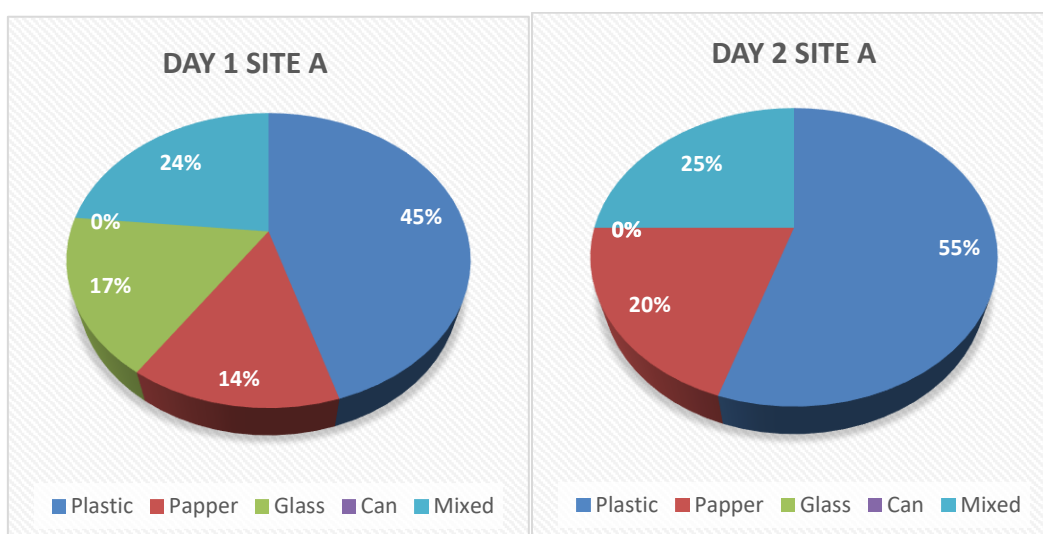


Figure 5. The proportion of litter collected by days and sites.

The detailed check of the litter collected from Site A showed the prevalence of plastic waste over others during Day 1 and Day 2 (45% and 55% respectively). However, there is a slight difference during Day 3, when the largest proportion of the waste represents mixed waste (38%; see details in Figure 6).



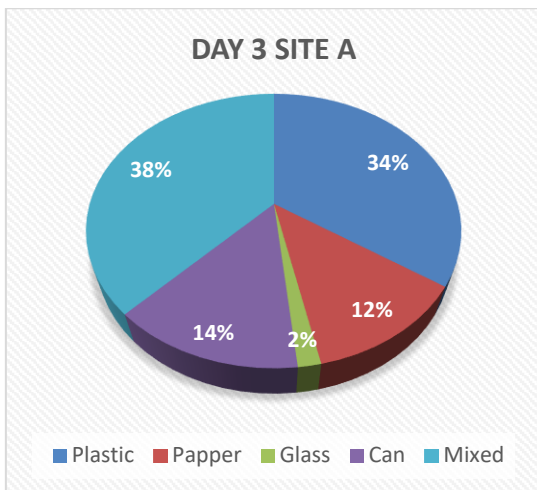


Figure 6. The proportion of litter from Site A sorted by days and types of the waste.

The litter collected from Site B showed similar to Site A trends of the prevalence of plastic waste during Day 1 and Day 3 (64% and 51% respectively). However, during Day 2, when the largest proportion of the waste was collected from Site B (Figure 5), the largest amount of the waste was represented by the paper (55%; see details in Figure 7.)

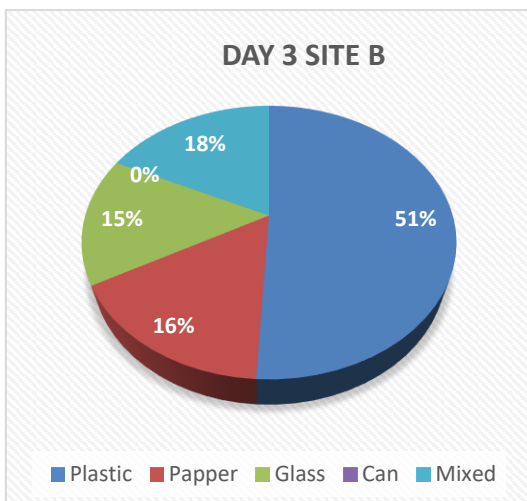
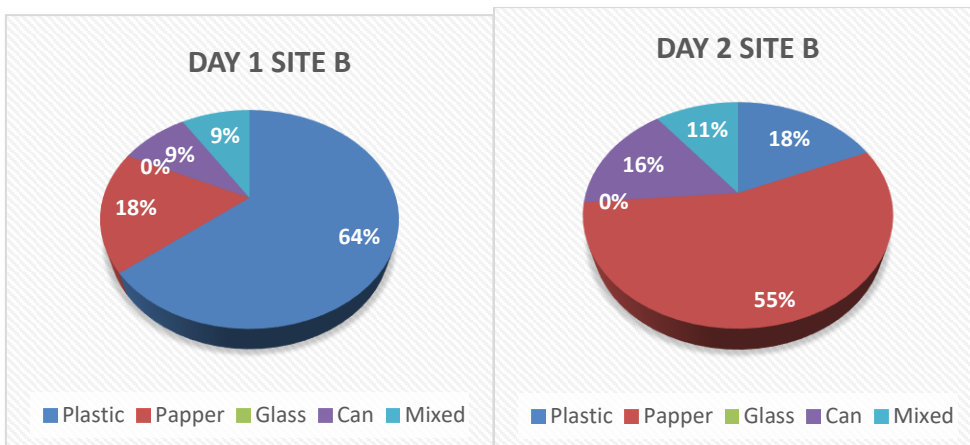


Figure 7. The proportion of litter from Site B sorted by days and types of the waste.

Interestingly that similar to the Sites A and B trend regarding the largest proportion of the waste represented by the plastic type of waste demonstrated the litter collection from Site C, but only for Day 1 (59%). The results from Day 2 and Day 3 showed that the largest proportion was the mixed type of waste (41% and 48% respectively; see details in Figure 8).

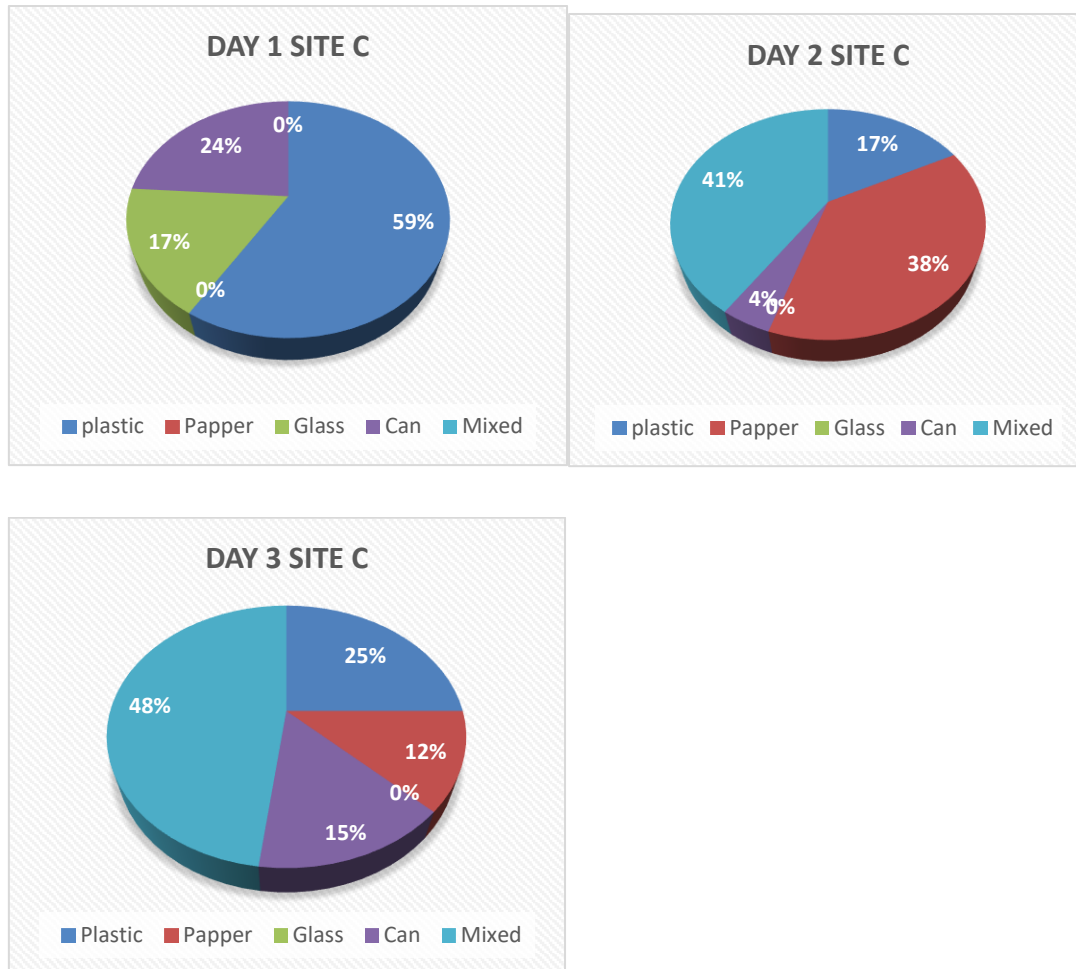


Figure 8. The proportion of litter from Site C sorted by days and types of the waste.

Finally, all collected waste was sorted by the potential source of the waste. The results from all locations demonstrated that the largest amount of the waste has a local origin (see details in Figure 9).

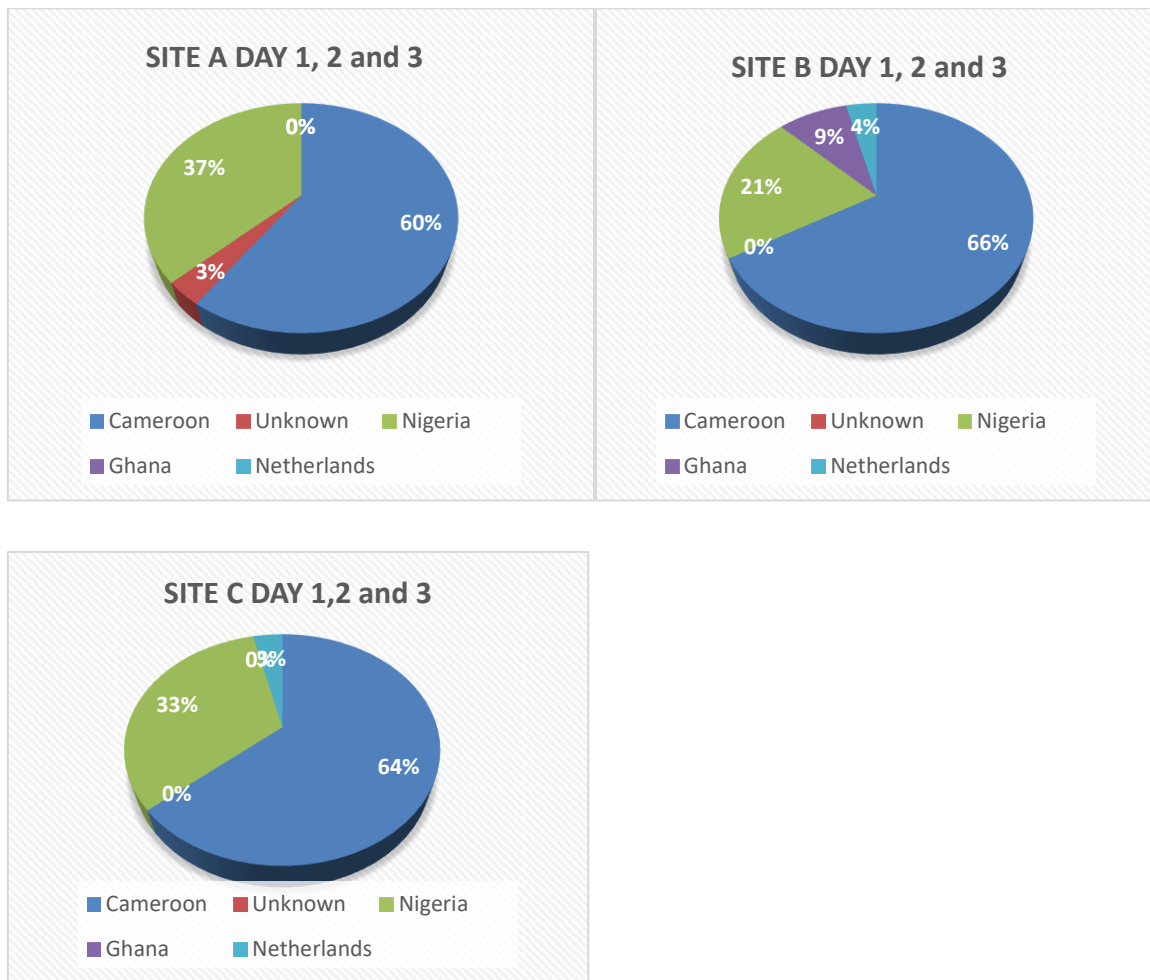


Figure 9. The proportion of litter sorted by the potential source of the waste.

4 Discussion

The shoreline litter invasion in Cameroon is a big problem which has a lot of consequences on the entire country and, specifically, to Downbeach Limbe which is one of the main touristic destinations in the country. As a result, municipality is losing more tourists by the day due to beach litter and, thus, does not receive additional income that could be used for development. In this thesis, I investigated the scale of the issue and potential sources of the litter appeared on the Downbeach Limbe. I discovered that, the proportion of the litter is larger in Site A (Limbe river) during Day 1 (Tuesday) and day 3 (Saturday). Due to its location, it can be potentially the litter from households and from the city streets that has been washed into the river by the rain water or blown by the wind. This finding is going in line with the results of the study executed in 2012, where Mbeng and his colleagues related the waste issue in Limbe with increasing of population and, consequently, increasing of

household waste production (Mbeng et al., 2012). The results from Day 2 (Thursday) and contrary larger proportion of the waste in Site B and Site C is related to the trading activities from the fish market. This trend is similar to the impact of fish markets in other African countries and Asia (Mwangi et al., 2017; De Ungria et al., 2023).

Next, I analysed the waste by type and found that, all the waste types (plastic, paper, glass, can and mixed) was found in almost all sites A, B and C (Limbe river, Boucareau and Elijah quater) and during all waste collecting days (Tuesday, Thursday and Saturday). A larger proportion of plastic litter (45%, 55% and 38%) was found on Day 1 and Day 2 respectively in Site A. Since Site A corresponds to the Limbe river, this proportion of waste is potentially appeared in the water due to wind blowing and its lightweight and delivered to the beach by river. Similar cases of litter appearing on the beach through of river water and wind are recorded worldwide (Suner, 2020). Furthermore, I found that Site B and Site C also had relatively larger amount of plastic (64%, 59% and 51%) during Day 1 and Day 3 respectively, which could be explained by the leisure activities of tourists and locals who visited the beach during the start of the week (Tuesday) and the weekend (Saturday). Contrary, during Day 2 in site B (which is related to the fish market day activities) recorded a larger proportion of paper waste. This could be related to the restrictions of the use of non-degradable plastic bags by traders introduced by the Government of Cameroon (Kindzeka, 2023). Finally, the analysis of the litter showed that the largest proportion of the waste has local origin, and, thus, the risk that a large amount of waste washes up from the open sea in Limbe is minimal.

To conclude, the largest source of the waste in Downbeach Limbe is related to the local households and residential activities. Additionally, the problem with the litter on the beach has caused by improper disposal of waste along the beach by tourists and fish market visitors. Considering the findings, my suggestion on the long-run strategy for the municipality are:

- The Limbe municipal council should start by informing the general public on proper waste disposal by introducing it as a subject in pre-schools and elementary schools, and also having outreach programs on radio and TV.
- The government should invest in the waste management company so that they can afford good waste management equipment and increase its work efficiency.

- The city council should propagate/inform people about penalties for improper litter not only in the city but also use such approach on the beach for tourists.
- Finally, regular beach cleaning should be done by business owners around Downbeach Limbe

5 Conclusion

Shoreline litter invasion is a large problem in Cameroon, and it affects many spheres of human life. This thesis is studied the problem of litter invasion in Downbeach Limbe which is significantly dependent on touristic activities and traders from the fish market. In my study, I found that, most of the litter is locally produced and the main source of it related to household consumption and tourists and traders who visit the beach. The state of the beach can be improved by sensitizing the public on proper waste disposal and also by introducing proper waste management strategies (e.g., providing enough waste bins in all corners of the beach and timely garbage removal).

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7. Appendix A

GUIDELINES FOR SHORELINE LITTER COLLECTION IN DOWNBEACH LIMBE



LOCATION

From the picture above the arrows are clearly showing the sites of studies or sites where the shoreline litter will be collected.

- That is the site A being the shoreline litter from the Limbe river that empties itself into the sea,
- Site B being trash from down beach white chair up till Boucareau and
- the C site is Elijah quarter

TOOLS

- Good safety shoes or boots
- Big plastic bags
- A good camera for pictures
- A measuring devise to weight the biowaste
- A notebook and pen for taking down data and notes

METHOD OF COLLECTION

- All team members will assemble according to the team agreement time

- Choose which location to start with either A, B or C
- Collect the litters appropriately
- These activities were done 3 times a week: in the beginning of the week (Tuesday), in the middle of the week (Thursday) and at the end of the week (Saturday)

NB: litters from the various locations are collected separately in order to get accurate results when submitting data

SORTING

In this case sorting here refers to categorizing the different waste collected into different waste types such as mixed waste, plastic, bottles, and paper.



- After separating the waste properly
- it should be identified and result taken down
- Identify the origin of the waste for example where it was produced
- Take down all data and record it

CONCLUSION

All results should be documented appropriately, sent and finally leave a comment on the current state of the beach.

Appendix B

14th - 11 - 23.

Items	Production Center.	SITA A	No ^o of item Seen	total
Dalait Sachet Papper cam	D'la		6 IIII	7
King Arthur Plastic Papper Sachet tomatoes Plastic	cam Iy FERMENAM D'la cam.		IIII	6
Nido milk sachet Plastic bag	Nigeria		III III IIII	19
Omo pls-tic bag	Nigeria		IIII	4
Biscuit Plastic bag	Nigeria		II	2
Maggi Plastic bag	cam		III	3
Fanta letter	Nigeria		IIIIII I	11
Oral toothpa	Nigeria		III I	6
			Sum total =	<u>64</u>

10th - 11 - 2023.

SITA A

Name of Item	Production Center	NR of Litter Collected	total
Fighter Plastic L.	D'la Cameroon	HH III	8
Dolait	D'la Cameroon	IIII	4
Djino Litters	D'la Cameroon	II	2
Orangin Litter	Imported	II	2
Omo plastic	Nigeria	I	1
Ut-Fresh	Nigeria	III	3
			Sum: total
			20

8.

16th - 11 - 2023

SITA B

Name of Item	Production Center	HR of Litter Collected	Total
Dalait Cifiers	D'la Cameroon	### ### ### ### ### ### ### III	39
Balania Cifiers	Imported	IIII	4
21-Fresh	Nigeria	### ### II	12
Djano Ciffer	Cameroon	II	2
Fighter Plastic	Cameroon	### III	8
Dudu Cifiers	Nigeria	III	3
Matter Plastic	Nigeria	### III	8
			Sum: 76

14th-11-23.

Site C

Name of items	Production center	No of Items Seen	total
Basaria litters		III	3
Klisky litters	Nigeria	III-III	8
4-Fresh Plastic litters	D'la Cam	III-III-1	11
Mattar litters	Nigeria	III-III	8
Omo Plastic	Nigeria	III-III-III	13
Reactor Plastic litters	Nigeria	III	3
Sum total:			46

16th - 11 - 2023 .

SITA B

Name of Item	Production Center	HR of Letter Collected	Total
Delait Ciffers	D'la Cameroon	HHH HHH HHH HHH HHH HHH HHH III	39
Bavaria Ciffers	Imported	IIII	4
U-Fresh	Nigeria	HHH HHH II	12
Djano Ciffers	Cameroon	II	2
Fighter Plastic	Cameroon	HHH III	8
Dudu Ciffers	Nigeria	III	3
Matter Plastic	Nigeria	HHH III	8
			Sum: 76

Site B 14th - 11 - 23

Items	Production center	No of items seen	total
Dudu milk litters	Nigeria	III 1	6
Dolait Plastic litters	cam D'la	III III III III	20
Bavaria litters		IIII	4
Tamiam	D'la cam	IIII	4
Fighter litters	D'la cam	III III II	12
U-Fresh		III III III II	17
Omo litters	Nigeria	II	2
Matter liter	Nigeria	II	2
Reactor litter	cam	II	2
Sum total =			69

Scanned with CamScanner

16th
- 11 - 2023

SITA C

Name of Item	Production Center	No of Litter Collected	Total
Reactor litters	Cameroon	HHHII	7
Bavaria litters	Imported	III	3
Dudu milk litters	Nigeria	II	2
Dobait	Cameroon	HHH-III-III	13
Djino	Cameroon	III	3
U-fresh litters	Nigeria	HHH-III-III	13
Fighter Papper	Cameroon	HHH-III-III-III-III HHH-III	28
			Sum: 69

		SITA A	18 th -11-2023
Name of Item	Production Center	No of Litter Collected	Total
Overfone Plastic	Nigeria & Cameroon		19
Top Litters	Cameroon		45
Sofa Plastic	Cameroon		22
Nido milk Plastic	Cameroon		18
omo Plastic	Cameroon		17
Hero Plastic	Imported		25
Air Litter			
matter Litters	Nigeria		
Sachet	Cameroon		38
tomato Pepper			Sum: 184

SITA A

18th-11-2023

Name of Item	Production Center	No of Litter Collected	Total
Arefone Plastic	Nigeria & Cameroon		19
Top Litters	Cameroon		45
Do Saut Plastic	Cameroon		22
Nido milk Plastic	Cameroon		18
Omo Plastic	Cameroon		17
Hero Plastic Litter	Imported		25
Matter Litters	Nigeria		
Sachet Tomato Pepper	Cameroon		38
			Sum: 184

SITE B 18th - 11 - 2023

Name of item	Production center	NO of Litter Collected	Total.
TOP plastic Litters	Cameroon	###-###-###-###-### ###-###-###-###	45
Dolait Plastic	Cameroon	###-###-###-###	18
Reactor Litters	Nigerian S Cameroon	###-###-###-###	17
Decorative plastic	Nigeria	###-###-###	12
TOMATOES Litters	Cameroon	###-###-###	13
El vino Plastic L.	Y'de Cameroon	###-###	7
			Sum: 112

SITE C

18-11-2023

Name of Item	Production Center	No of Litters collected	Total
Dino Litters	Cameroon	III III III III	18
Reactor Litter	Nigeria S ¹ Cameroon	III III III III	19
Fighter Plastic	Cameroon	III III III III III III III	38
Juice Litters	Cameroon	III III III III III III III	38
matter litter	Nigeria	III III III III II	22
Refresh litter		III III III III	18
			Sum total 148