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Department of Sustainable Fisheries and Marine Resources

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Comparison of litter accumulation on two beachfront types in Rabaul and Kokopo township, East New Britain Province

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M413

Marine Pollution Assessment

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Introduction

Pollution is any form of degradation of the environment as a result of contamination of some sort by chemicals, biological agents, sediment, radiation, or heat. This is largely sourced from terrestrial anthropogenic activities. Coastal waters especially are highly affected by pollution because they are heavily used, closer to sources of pollution, have shallow-water bodies and are not as well circulated as the open ocean. Coastal pollution is made up of mainly marine pollution and marine debris. **(Lloyd P. Werry 2023)**. The issue of plastics in the marine environment is one that is directly connected to waste management on land. Mismanaged land-based plastic waste can enter the coastal and marine environment as marine debris **(Jemback et al., 2015)**.

Chemicals can enter the sea from both sea-based and land-based activities. Chemicals can escape into water, soil, and air during their manufacture, use, or disposal, as well as from accidental leaks or fires in products containing these chemicals. Once in the environment, they can travel for long distances in air and water, including ocean currents. No matter how marine litter enters into the ocean (whether it is deliberately disposed or naturally drifted in the ocean), it can travel large distances by ocean currents and winds to land on beaches irrespective the political maritime boundaries or to accumulate on open oceans. As such, it can lead to a serious trans-boundary issue, causing diverse problems for both wildlife and humans **(Coe and Rogers, 1997).**

There are two main source or point of origin of marine debris. Rivers were identified as an important means of transporting mismanaged land based waste to the marine environment. Also the ocean currents were important to the transport of plastic debris. Litter accumulation refers to the build of waste material such as plastics, metals, paper, and even food scraps. Litter accumulation is becoming a global issue as the amount of waste generated by human increases. Litter not only affect the aesthetic appeal of the environment but also poses a danger to wildlife and the environment. Litter accumulation can lead to pollution of water bodies, soil degradation, and release of harmful chemicals, which can have a negative effect on plants, animals and humans. It is important to address litter accumulation through responsible waste management and educating the public on the importance of proper disposal of waste.

In this field report is about assessing and doing a comparison of litter accumulation on two beachfront types in Rabaul and Kokopo township. The purpose of conducting the field trip was to identify the types of pollutant and present and the potential risk of litter accumulation over a period of time, to the people, wildlife and the ecosystem. Much of the information will be extracted from the literature review studies in relation to what we student have been observed.

Aim

The aim of this field report is to do comparison of the litter accumulation on the two beachfront types in Rabaul and Kokopo township, East New Britain Province.

Objectives

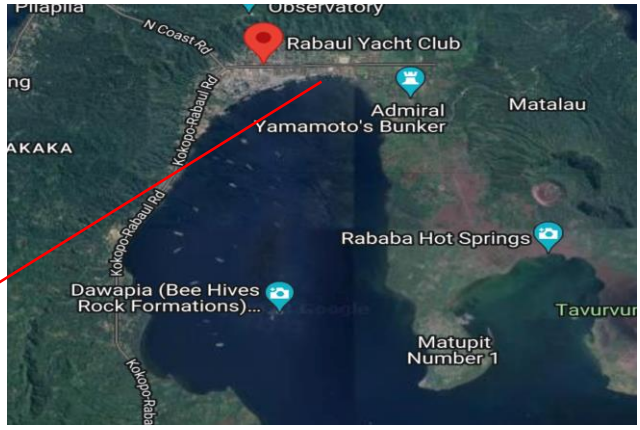
1) What are the common types of litter at both sites?
2) What are the impact of litter accumulation to the people and the environment?
3) What are the potential factors that may influence deposition of litter?

Methodology

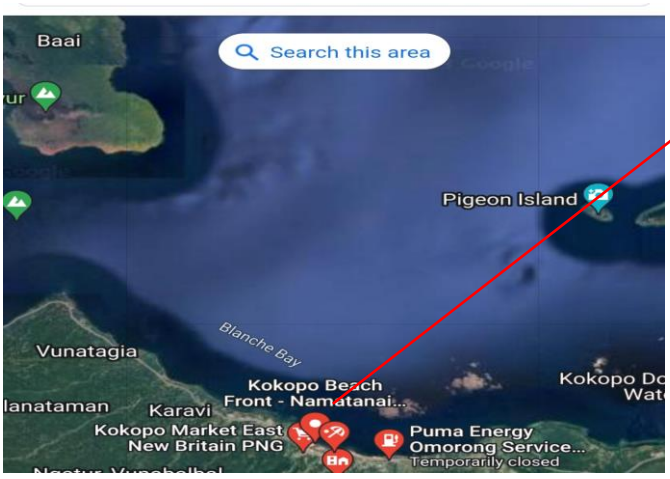
Study site:

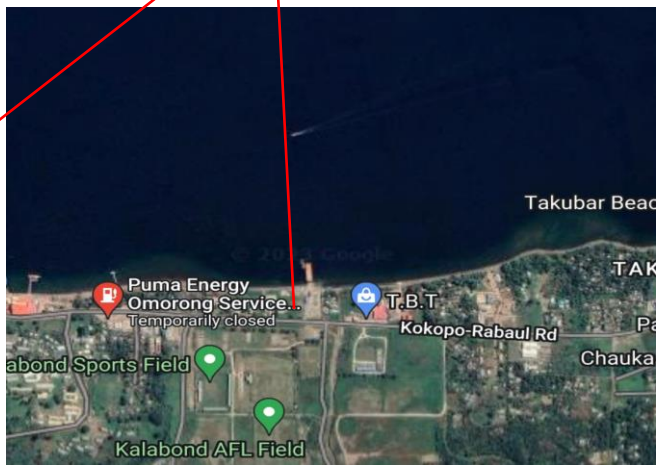
There are two areas identified as the study site by observing the accumulation of litter along the coastline. The first site is located in Rabaul Yacht club, and the second site is at Kokopo Omorong beach. Urban beaches are reported to have higher abundance of litter sourced from or related to beach-goers than rural beaches **(Nachite et al., 2019)**. The both sites are located near the urban areas, the areas are exposed to different types of pollutants, and are expected to be found along the coastline. In relation to the sites, the Rabaul Yacht Club, it is a club and definitely we were expected to see a lot of bottles, also the area is located within the Karavia bay meaning transportation of plastic debris can either comes from currents from high tide, run-offs and human activities. Unlike Kokopo Omorong beach is mostly populated with people living along the coastline, in advance the outcome result would be mostly dominate by food wrapper and plastic bags. In addition, the Kokopo Omorong beach is exposed to ocean sea meaning ocean current were important to the transport of plastic debris, drainage and anthropogenic activities.

Google map: Shows the location of Rabaul Yacht club located within the Karavia Bay.



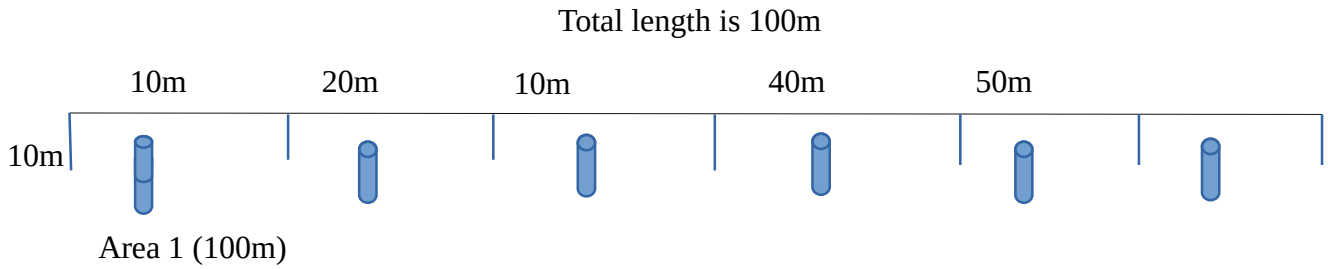
Google map: Show the location of Kokopo Omorong, exposed to the open seas.





Data collection

The field report was basically to observe the litter accumulation on the beach front of the two sites, Rabaul Yacht Club and Kokopo Omorong beach. Moreover, the data was collected by observing the coastline or beach in terms of identifying the types of pollutant present. As fisheries students we are almost 60 plus student went for the field trip and we were divided into five members in per group. Before proceeding into the data collection a transect line (10m x 10m) each marked out for each group. In addition, the total is $10m^{-2}$ area, across the beach and 5m moving away from the beach to the water and other 5m inwards moving up the ground.



Area 1 (100m)

After we were sorted out to group we were assign to collect anything found along the shoreline and take record of what was been observed. In relation to our module course work book is about assessment of marine pollution which is relevant to our field trip to actually assess the types of pollutant present on the two sites. Furthermore, as for my group we assign task to every member. As for myself I was the one who took pictures of what has been observed. As I was recording the tally of the type of pollutant present, it seems that most bottles are found along the beach. This does not surprise me because the site is club. And what I expect to see is the bottle and other items as well was found such as the plastic bags, food wrapper, food drink containers, fabric and more. Furthermore, after we have record all the necessary information, before we processed to the next sites. The same method of data collected still applied but in different location.

Data analysis

The raw data collected was analyze by **(MR. Lloyd. P Werry)** our module coordinator. The raw data was sorted out onto a table with the heading, number of item that appear the most, number of item per area, and the relative frequency respectively. We were asked to completed the two tables by calculating the numbers of items per area, the relative frequency and give an appropriate title to the table. After sorting the data onto the tables, the data extracted from the tables are now plotted onto a bar graph. And then it is now easier to read and understand the figures when doing a comparison between the two sites.

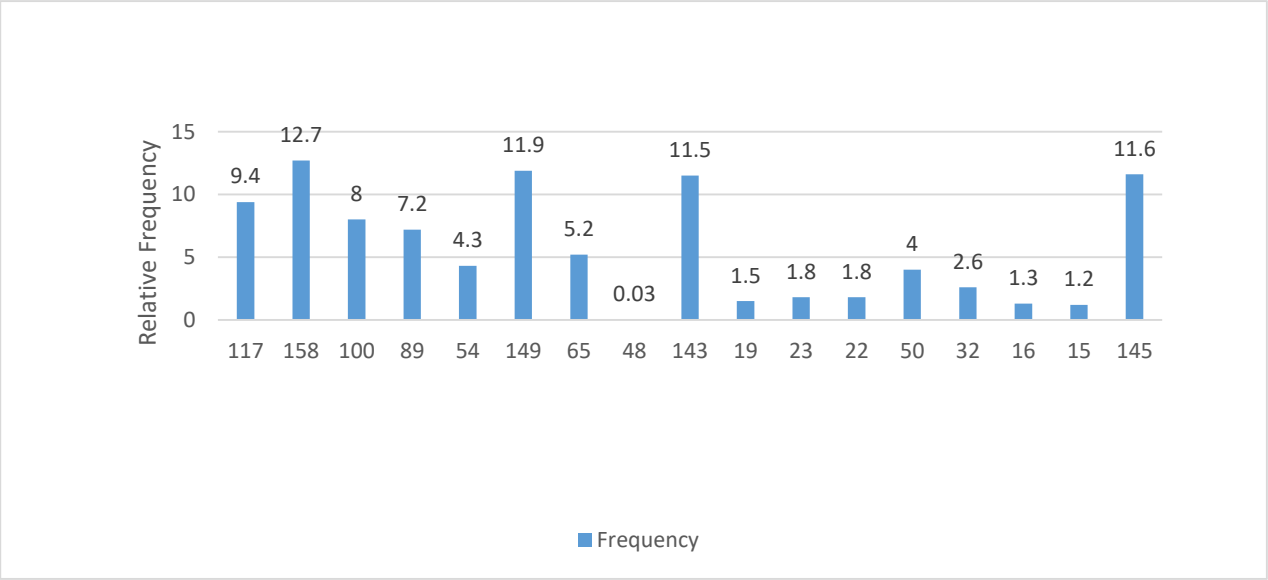
Formula used

1. Relative frequency = Number of item per area/total number of item per area X100
2. Number of item per area = Items frequency/Total number of frequency

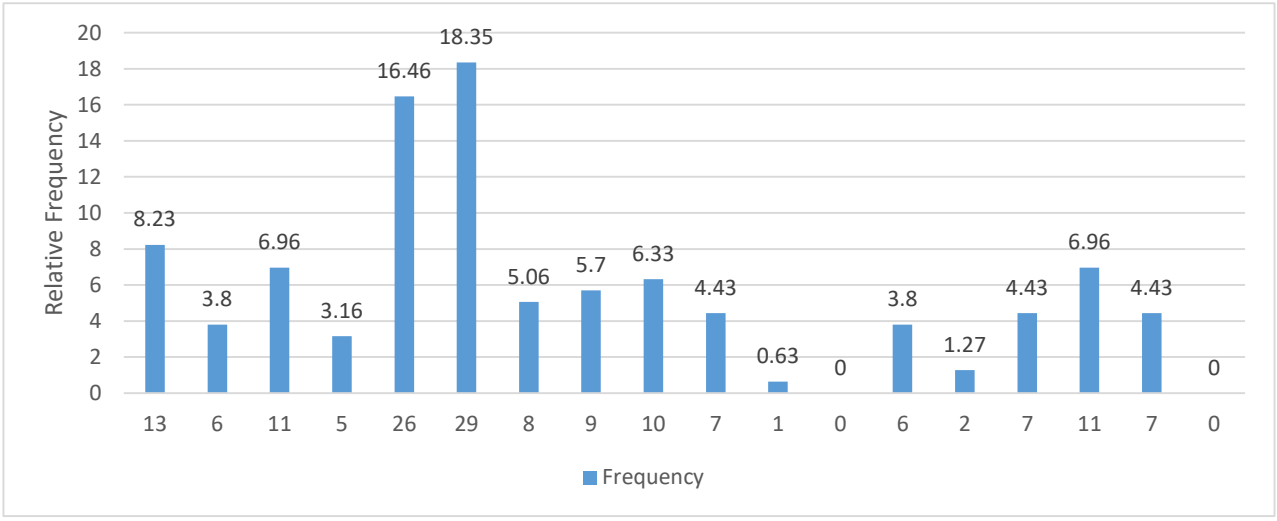
Results

Table 1: Class summary of the types of different litter found along the beach. The table below is a summary combined data of Rabaul and Kokopo beachfront data collection.

Types of Litter	Rabaul			Kokopo		
	Item Frequency	**Number of items per area (m^{-2})**	**Relative Frequency ($\%m^{-2}$)**	**Item Frequency**	**Number of items per area (m^{-2})**	**Relative Frequency ($\%m^{-2}$)**
Plastic bag	117	1.17	9.4%	13	0.13	8.23%
Bottles & Ceramics	158	1.58	12.7%	6	0.06	3.80%
Metals	100	1.00	8.03%	11	0.11	6.96%
Aluminum	89	0.89	7.15%	5	0.05	3.16%
Foam	54	0.54	4.34%	26	0.26	16.46%
Food wrapper	149	1.49	11.97%	29	0.29	18.35%
Fabric	65	0.65	5.22%	8	0.08	5.06%
Rigid plastic	48	0.48	3.86%	9	0.09	5.70%
Food drink containers	143	1.43	11.49%	10	0.1	6.33%
Straws	19	0.19	1.53%	7	0.07	4.43%
Battery	23	0.23	1.85%	1	0.01	0.63%
Rubber	22	0.22	1.77%	0	0	0%
Diapers	50	0.50	4.02%	6	0.06	3.80%
Concrete pieces	32	0.32	2.57%	2	0.02	1.27%
Nylon	16	0.16	1.29%	7	0.07	4.43%
Mattress/sponges	15	0.15	1.20%	11	0.11	6.96%
Others	145	1.45	11.65%	7	0.07	4.43%
Total	**1245**	**12.45**	**100.0%**	**158**	**1.58**	**100.0%**



Graph 1: The relative frequency graph of Rabaul Yacht Club, showing how many litter items were found along the beach of Rabaul. The horizontal bar indicates the number of each litter found in the overall area of 100m, can be referred to the table 1 for more detailed. The vertical bar indicate how often these litter items are found in each per area. [1] the graph indicates there are four litter which dominate the beachfront of Rabaul, bottles, food wrapper, food drink containers, and other litter were mention are also recorded.



Graph 2: The relative frequency graph of Kokopo Omorong beachfront, showing how many waste litter were found along the beachfront of Omorong. The horizontal bar indicate all the litter waste found along the coastline. The graph clear shown that food wrapper and foam are mostly dominate the area and least litter found is rubber.

Discussion

In table 1, the table show the summary of combined data collected from the two site, Rabaul Yacht Club, and Kokopo Omorong beach front. The table display all the litters found along the beach, the item frequency indicate the exact total figures of litter collected from all the area from 0m to 100m. The second column gives a total count of each litter found each area, and the last column indicate how often this litters are found in per area. An example is, 117 plastic bag is the figure of total count of plastic found in all area from 0m to 100m. In addition, in each area a total of 100m so therefore an approximately $1.17m^{-2}$ is the number of each item per area. The 9.4% is referred to how often the plastic bag are found in each area.

Comparison of the site and expected outcome

From the data collected were sorted out to a relative bar graph, it gives us a clear understanding of types of litter found from both site and much easier to do a comparison. The Rabaul Yacht Club is a club and definitely we are expecting a lot of bottles are to be found along beach, plastic bags, food wrapper and food drink containers. Most of the litter waste comes from the anthropogenic activities includes landfills, drainage and littering of beaches. From the observation most of the litters are not new items but old item, meaning from year to years the area was not clean up by any volunteer not worker and as a result the litter accumulate over the year until the day we went to do the observation. The accumulation of beach litter over time will depend primarily on two factors, the rate at which new litter is deposited and the retention time of litter once beached **(Hinata and Kataoka, 2016).** This have been observed with my own eyes and I believe that most litters in Rabaul comes from human activities and only few coming from sea through current transportation. From my point of view, since this is a club most litters are often thrown down to the bridge and the current transport the litters to the shoreline and as a result we are expecting to see a lot of bottles. A Joint study conducted by **(Vlachogianni, T, 2019)** support the statement I mention earlier. The distribution of litter types classified by source is supposed to be mainly related to the presence of anthropogenic structures and human activities.

Furthermore, the data collected from Kokopo site is different from what I expected. The Kokopo Omorong beach is mostly populated with people living along the beach and this includes daily activities such fishing, and relaxing site. During the observation, we mostly collected plastics bags, food wrappers, and food drink containers. The class summary of the data indicate that Rabaul Yacht Club is comprised mostly of litter accumulation than Kokopo site. From my expectation the area which mostly populated with people living in the particular area are expected to see a lot of litter along the beaches also Kokopo beach Omorong is a settlement. The result turns out differently that Kokopo beach contain less litter found than Rabaul Yacht Club. From my point of view, the reason why Kokopo contain less litter found due to fact that people in the area are conscious about cleaning the area. I believe, the urban managers of Kokopo objectives is to keep Kokopo town clean and as a result everywhere within Kokopo are clean at all times.

Common types of litters found, and their effect

Refer to graph to 1 and 2, the common types of litter found in Rabaul Yacht club is mostly dominated by bottles, plastic bag, and food wrappers unlike Kokopo beach Omorong beach are mostly dominated with plastic bag and foam. There are bad effects posed by the litter to our environment, health and living organism. As we know bottles are harmful and unsafe for people to walk on the

beach nor swimming. A 2017 study by the Central Marine Fisheries Research Institute surveyed 254 beaches on India coastline and found out that Goa's beaches had the highest quantity of litter. Glass waste such as alcohol bottles, carelessly tossed or dangerously smashed on beaches making it unsafe for people to walk or swim. Plastic bag and food wrappers also posing a threat to the marine wildlife. According to the **(UN, 2001)** plastic debris ingestion, suffocation and entanglement of hundreds of marine species such as marine turtles. Turtles can mistake plastic waste for prey. Most of them die of starvation as their stomachs becomes filled with plastics. The other litter maybe not seem quite risky but it is. The foam materials are found in the households, and it is believing that many scientist said the manufacturing of foam containers is harmful to human and wildlife, creates environmental litter that is costly and difficult to clean up, simply not environmentally sustainable. The foam can be harmful to human in terms irritation of the eyes, skin, respiratory track, headache, and fatigue. The foam is a popularity product in food service and packaging industries because of its properties. Foam is also harmful to the fish. Studies have shown that foam easily absorb toxic chemicals while floating in the waterways and these toxins are transferred to fish that eat the particles.

Are there any potential factor that may influence deposition of litter?

A considerable portion of marine litter pollutes the world's coastlines. Its accumulation on beaches represents the product of deposition and retention, processes which are not well understood **(Solbakken V.S. 2022).** A mark-recapture study was performed with a two-week sampling interval at three sites in Lofoten, Norway. Deposition and retention vary over relatively small spatial scales (approx. 13 km radius). No correlation was found among sites in the timing of high and low deposition events, suggesting these are governed by local factors. According to their finding or the result of sampling of the three sites in Lofoten, and Norway. The results underline the importance of customizing cleanup frequency for different beaches as spatiotemporal variation in the relative importance of deposition and retention dictate the optimal frequency for maximal removal of litter from circulation in the local marine environment, which cannot be discerned from accumulation (i.e., standing stock) alone.

Beach litter accumulation and the litter standing stock at a location reflects the sum of these processes over time (i.e., the relationship between litter arriving at the beach and the duration of its stay there). High retention increases accumulation, while accumulation will be limited even with high deposition if retention is low **(Bowman et al., 1998; Brennan et al., 2018).** Which process dominates may vary seasonally, and a beach which accumulates litter in one season may show a net loss of litter in another **(Bowman et al., 1998)**. Beaches with high deposition and low to moderate retention will show high turnover rates of accumulated litter (**Blickley et al., 2016; Bowman et al., 1998).** Furthermore, in relation to the study conducted in East New Britain, a comparison of the two study site Rabaul Yacht Club, and Kokopo Omorong beach. In relation to the statement mention above, it is believing that Kokopo beach is high with deposition due to clean-up, and volunteer work and lead to low retention of litter accumulation along the coastline. Beach cleanups, on the other hand, are much less resource intensive, can be conducted by volunteers, locations are generally more easily accessible, and methods less environmentally disruptive (**Haarr et al., 2020; Zielinski et al., 2019).** Volunteer participation in beach cleanups also increases awareness and attitudes towards littering and waste management **(Locritani et al., 2019; Rayon-Vina et al., 2019).** The spatiotemporal variation in deposition and retention, and thus accumulation, of beach litter may be driven by a variety of factors, such as beach morphology and gradient, weather, and season **(Bowman et al., 1998; Brennan et al., 2018)**. These factors furthermore operate over different scales, thus potentially driving both

variability and similarities among and within sites over time. Factors with highly localized impacts on beach litter accumulation include beach shape, substrate and gradient **(Brennan et al., 2018; Haarr et al., 2019)** According to **(Bowman et al., 1998)** mention that the main factors that would influence the deposition of litter its accumulation over time depends primarily on four factors **(Bowman et al., 1998) [1]** the beaching rate of litter as it is redistributed by oceanographic currents (i.e., deposition) [2] its residence time once beached (i.e., retention), [3] direct littering by beach-goers and [4] cleanup actions. However, this example changes though if beaches are considered temporary holding facilities for circulating litter, in which case regular beach cleanups may prove an extremely effective mitigation strategy, not only temporarily cleaning an individual beach, but also removing litter from surrounding waters **(Haarr et al., 2020; Lebreton et al., 2019).**

Recommendation

Litter accumulation on beaches is a significant environmental problem that affect marine life and human health. To address this issues, here are some recommendation

1. Improve waste management: Government and private stakeholders should invest in waste management infrastructure, including bins, recycling facilities, and proper waste disposal system to reduce litter accumulation
2. Organize beach cleanups; local communities can organize regular beach cleanup to remove litter and prevent it from accumulating on beaches.
3. Promote litter-free beaches: Education and awareness campaigns and aimed at reducing litter and increasing recycling and proper waste disposal can go a long way in preventing littering in public spaces likes beaches
4. Use eco-friendly products: Encourage the use of eco-friendly product by beach attendants, vendors and tourist to reduce the amount of litter generated.

By implementing these measures, we can reduce litter accumulation on beaches and preserve our oceans for generation to come.

Conclusion

To conclude, from the data collected and analyses proven that there is an issue of the amount of litter waste generated by human increases in both sites. Its a good news that Kokopo town council has established strategy plan on how to clean and keep Kokopo town clean at all times. In comparison to Rabaul, the town council maybe or do not consider areas outside the town to be clean and involve volunteer to participate and as a result, Rabaul Yacht Club contain most litter accumulate along the coastline. It is important to address litter accumulation through responsible waste management and educating the public on the importance of proper disposal of waste. Litter not only affect the aesthetic appeal of the environment but also poses a danger to wildlife and the environment. Litter accumulation can lead to pollution of water bodies, soil degradation, and release of harmful chemicals, which can have a negative effect on plants, animals and humans.

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