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The relationship between land use and marine litter at Kuala Perlis coastal area

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The relationship between land use and marine litter at Kuala Perlis coastal area

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Abstract. Abundance of litter exist in our ocean are listed among the crucial threat to the biodiversity that caused a particular concern due to the abundance, durability and persistence in the coastal environment since the area is highly productive. This research paper is to focus on coastal pollution with the objectives of identifying marine litter to relate with the land use in Kuala Perlis, Malaysia. Marine litter is collected at three points along the shoreline stretching 30 meters in length and 5 meters in width. Collected litter varied between categories and the highest amount was plastic weighing 53.15 kg/m2 followed by fabric, wood, glass, rubber and metal. Generally, there are significant relationship between land use and accumulation of marine debris. As there is a development in the area, the accumulation of marine debris increases, in contrast with the small amount of debris found in undeveloped or nonpopulated areas. The accuracy assessment obtained from Landsat 8 year 2014 and 2018 and Kappa statistics shows value range from 0.7 to 0.9 which indicate good classification performance using ERDAS Imagine 2015. Slight changes in urban development, cultivation area and forest with 1 % while for the water bodies and unclassified or cloud with 9% and 8 %.

1. Introduction

Malaysia is an oceanic nation with lovely coastline and it is essential to protect the beach front reasonably. In any case, seaside territories logically confront the massive advancement pressure from characteristic and human components. These incorporate common occasions, fast urbanization and others. Thus, this circumstance makes issues in the beach front territory. Subsequently, this research is started by the global phenomenon of the coast, particularly the marine litter issue. Research on marine litter issues is not widely done. Despite the fact that this litter has a lot to do in Malaysia. Some of these related studies are inadequate to illustrate the level of marine pollution at the Malaysia coast. Probably, the most intensive paper about marine litter for Malaysia is the International Beach Cleaning Report [1]. It is very difficult to describe the level of marine litter in the coastal area as the area is very wide. In addition, the marine litter has many categories and takes much time to sort by categories. The floating plastic that is presently the generally abundant marine item also indirectly threatens marine biodiversity and food chains. On the other hand, the effects of fragility are mainly underestimated as most of the victims are not found in large areas of the sea when sunk or eaten by predators [2]. In Malaysia, litter found on the coastal areas was treated similar as solid waste found on any other area. Therefore, areas with public interest are only well maintained. In most cases, local government is the responsible body

in managing solid waste found on coastal areas. Most of these local authorities manage waste collection directly while others appointed private contractors [3]. Based on Malaysian Department of Environment (DOE), they had issued on water quality standard (temperature, dissolved oxygen, total suspended solid, total fecal coliform and heavy metals) as reference and for enforcement purpose [4]. However, no focus is given to the accumulation of marine litters.

Realizing the relationship between the marine litter and the land use, this study therefore is aimed to identify and categorize marine litter to relate with the land use. This study focuses on marine litter along the coastline in Perlis starting from the northern of Kuala Perlis and stretch up to Kampung Kurung Tengar.

2. Material and Methods

2.1. Study Area

Three sampling areas were identified along Kuala Perlis coastal area starting from Medan Selera Jeti Kuala Perlis and end at coastal area of Kurung Tengar. Figure 1 shows the location of study area with sampling points. The existing land use for SA1 was near to the food court area, playground and parking areas for tourists to Langkawi. The operating hours for Medan Selera Jeti Kuala Perlis was from 4pm to 2am. While, existing land use for SA2 was near to Hai Thien Seafood Restaurant and recreation areas. The operating hours for Hai Thien Seafood Restaurant ranging from 5.30pm to 11.45pm. The final points of SA3 was near to agriculture area, fishing pier and large area of housing.

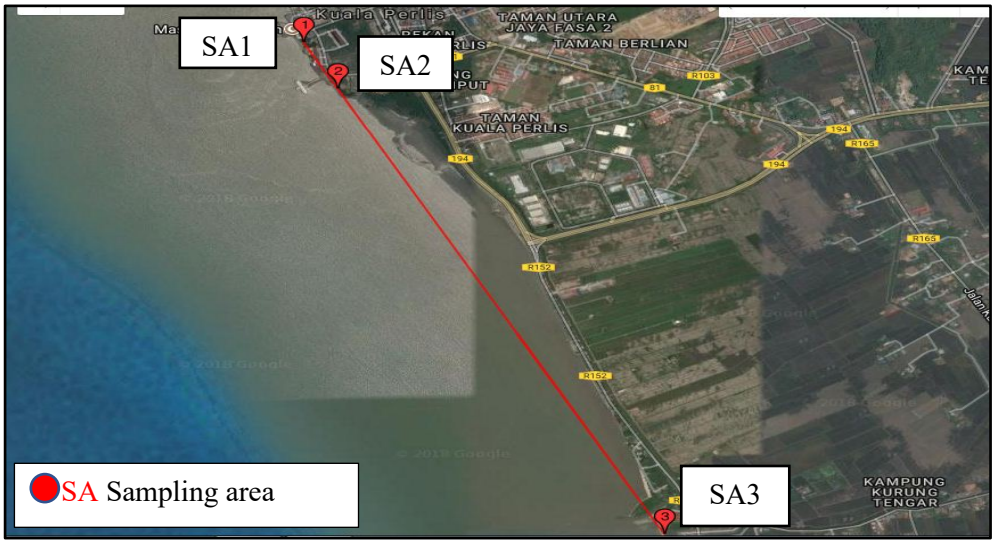

Figure 1. Location of study area with sampling point.

2.2. Characterization of Marine Litter

Sample of marine litters are gathered within the collection area only. The collection area for sampling are in the coastline with area stretches 30 meters in length and 5 meters in width from water edge to the vegetation or artificial line. The marine litter samples was then classified into six categories which are plastic, rubber, metal, glass, wood and fabric and finally are weighted to identify the mass.

2.3. Land use classification and changes

With the aid of ERDAS Imagine 2015 software, satellite image of Landsat 8 in 2014 and 2018 was utilized for land use classification and change detection in order to measure changes in land use area. Image classification helps to extract information from the satellites images. Layer stacking was used to convert three bands which are 5, 4, and 3. Before classification is carried out, each image is going through several pre-processing and processing procedure such as geometric correction, atmospheric

correction and AOI selection. Accuracy assessment of land use classification image also acquired to determine the accuracy of classified image. Percentage of changes for each land use type was the calculated by dividing magnitude change of 2018 image by the 2014 image and multiplied by 100 as shown in equation (1).

$$\text{Percentage of Changes} = \frac{\text{Magnitude of changes in 2018 image} \times 100}{\text{2014 image}} \quad (1)$$

3. Results and Discussions

3.1. Marine Litter Categories

Marine litter can be categorized into 6 types of materials after going several processes included collection, segregation and weighting. Figure 2 shows the total weight of marine litter for each category. The heaviest category is plastic with 53.15 Kg/m2 as compared to other categories. Fabric came second with 9.15 Kg/m2, followed with wood (1.5 Kg/m2), glass (1.08 Kg/m2), rubber (0.2 Kg/m2) and metal (0 Kg/m2). Plastics are frequently get degraded into little pieces after certain period of time and sooner or later get buried within the sand itself or in sediment. These cases were similar with other coastal areas where plastic got buried within the sand through beach-sand runoff during strong wind or rainfall [5]. In addition, fabric is the second heaviest weight due to the density of fabric are lighter and accumulate in small pieces, it makes the fabric easier to be transported by water to the coastal areas as well. Other type of litters collected such as metal, wood and glass were very small amount. Sources contributed to the presence of litter in the coastline involved recreational activities, smoking related activities, water activities, dumping and personal hygiene [6].

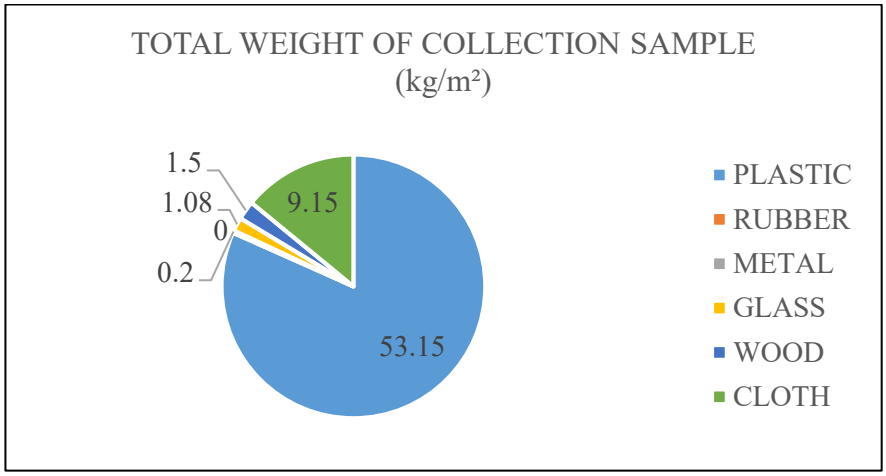

Figure 2. Total weight of marine litter for each category.

3.2. The Relationship of Land use and Marine Litter

Studies on relationship between the accumulation of marine litter has been studied for a long time and suggested that the nature and severity of coastal pollution is often associated with human activity which can be measured in terms of land use types [7]. Based on the results obtained from the accumulation of marine litter in the three sampling points and land use map, the adverse impact of land use on coastal pollution cannot be resisted. According to [7], 80% of marine litter arises from land-based sources and the remaining 20% come from sea-based sources. The land-based source is representing the land-source litter which is derived from urban population, agriculture as well as industrial and manufacturing activities.

Figure 3 shows the Land Use Map of study area acquired from Malaysian Mineral and Land Department. The developed area of Kuala Perlis has caused a lot of accumulation of marine litter as can

be confirmed by the data collection that had been carried out. Sampling Area 1 (SA 1) is surrounded by a number of commercial buildings and residential areas has the total of 25 Kg/m2 marine litter, Sampling Area 2 (SA 2) is surrounded by seafood restaurants and recreational areas has the least total of marine litter among the sampling areas (13.83 kg/m2) while Sampling Area 3 (SA 3) is surrounded by residential, agriculture and fishing areas has the highest accumulation of marine litter with 26.25 Kg/m2. The highest accumulation of marine litter in SA 3 because there is no proper way of solid waste management in the area since some of the housing are illegal settlement. In additions, statistics also implies a risk for the resource in urban areas contributed to a number of marine litter as well as indicate that the development and urban area can affect the quality of the coastal area because it has the potential to be the route of marine litter [8].

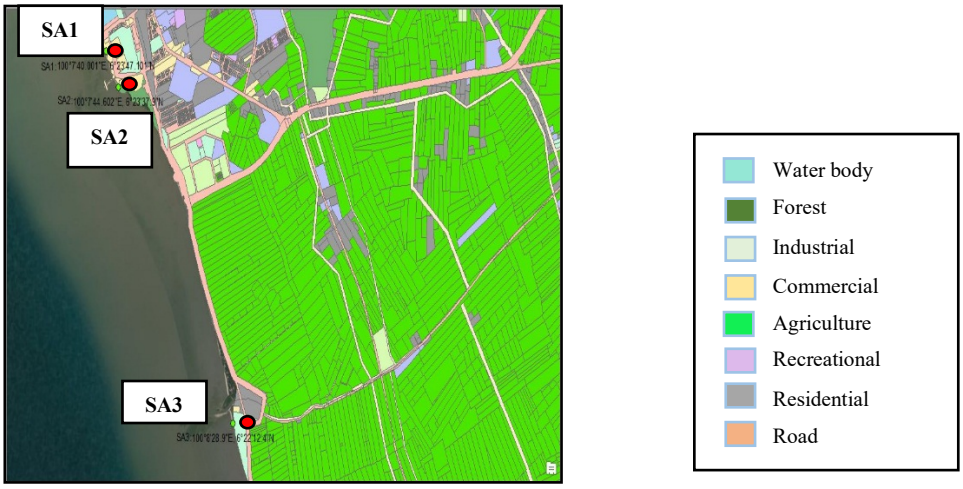

Figure 3. Land use Map of Kuala Perlis.

3.3. Land use Classification and Changes

Landsat 8 image of 2014 and 2018 was utilized in order to carried out classification of land use. The land use was classified into five types of major land use classes which are water, forest, urban and development area, cultivation area and unclassified or cloud. Kappa statistic was used to assess the accuracy of land use classification of satellite image.

3.3.1. Land use classification for 2014. The overall classification accuracy obtained was 89.36% , while 0.8563 for Kappa statistics. Figure 4 shows the land use classification satellite image for 2014.

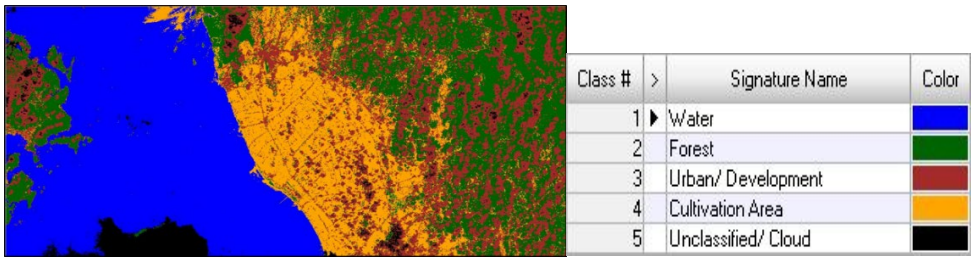

Figure 4. Land use classification satellite image for 2014

3.3.2. Land use classification for 2018. Based on Figure 5, overall classification accuracy for year 2018 land use classification was calculated as 87.23% with Kappa statistic of 0.7959. Figure 5 shows the land use classification satellite image for 2018.

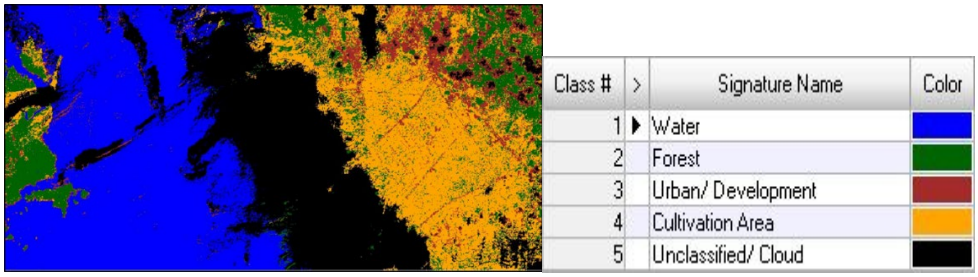

Figure 5. Land use classification satellite image for 2018

As a conclusion, based on the results, the image satellite for Kappa statistics value more than 0.8 indicate good classification performance. On the other hand, Kappa coefficient was defined as a statistical measures of accuracy that ranges between 0 and 1, is measures how much better the classification is compared to randomly assigning class values of each pixel [9]. For Kappa values greater than 0.8 indicates good classification performance. Kappa values between 0.40 and 0.80 to perform simple classification and Kappa value is less than 0.40 indicates a poor performance classification [10].

3.3.3. Land use change. It was expected that the result of different year of land use classification would provide information on aerial distribution of land use categories as well as the estimation and identification of land use changes over the past 4 years. Table 1 shows the percentage of the changes in landxuses. Land use for water and unclassified/cloud have significant changes because some of the water area in image 2018 has missing scanline which lead to increase changes in unclassified area. Slight changes in forest and urban/development land use shows there is development in the area. The changes in development has related with the marine litter amount collected in the area. The more developed the area or increasing in human activities within the area lead to increase the amount of litter in the coastline.

Table 1. Percentage of changes in Land use

	2014 Image		2018 Image		
Land use Category	Area (km^2)	%	Area (km^2)	%	Changes
Water	325.6	37	246.4	28	-9
Forest	220	25	211.2	24	-1
Urban/Development	105.6	12	114.4	13	+1
Cultivation Area	167.2	19	176	20	+1
Unclassified/Cloud	61.6	7	132	15	+8

4. Conclusion

Based on the results and analysis done, the heaviest category of marine litter is plastic with a weight of 53.15 Kg/m^2 as compared to other categories such as, fabric, wood, glass, rubber and metal. The accumulation of marine litter at three sampling areas with the aid of land use map, shows there is significant relationship between land use and the amount of marine litter at Kuala Perlis coast. This study also indicates that the highest amount of plastic in marine litter plays an important roles in further research of small plastics particles as threat to environment as well as human and animals. Kappa Statistic for both image satellite value in range of 0.7 and 0.9 indicates that a good classification performance. The slight change in the areas of urban development and cultivation shows that there is a significant relation between land use and marine litter. The more developed the area or increasing in human activities within the area lead to increase the amount of litter in the coastline.

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