KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

FRESH WATER SYSTEMS

FACT SHEET

A technical report to assess and quantify plastics in Lake Turkana to inform management decision making



Plastics are described as the synthesized polymer compounds mainly made from petrochemical raw materials and characterized by high molecular mass plasticity. They contribute to approximately 10% of discarded waste. Our excessive reliance on plastic materials is creating an invisible yet plastic footprints in the environment where the usage is generating considerable number of plastics wastes which ultimately endanger our environment and life within it hence considered a major threat to both wildlife and human wellbeing.

TECHNICAL REPORT

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EXECUTIVE SUMMARY

Plastics are described as the synthesized polymer compounds mainly made from petrochemical raw materials and characterized by high molecular mass plasticity. However, since its commercial development in the 1950s, plastic has been a real success but the disadvantages are also enormous. The need to find the best practices in management of the menace caused by plastics is in the top priority in the world. Estimates of global emissions of plastic waste to rivers, lakes, and the ocean range from 9 to 23 million metric tons per year, with a similar amount emitted into the terrestrial environment, from 13 to 25 million metric tons per year as of 2016. Following business-as-usual scenarios, these estimated 2016 emission rates was approximated to double by 2025. Due to its menace so far noticed in the environment, there was need to assess and quantify plastics debris along Lake Turkana shoreline in order to inform management for decision making. The area of study was along the western side of Lake Turkana. Five sites were identified for sampling around the fergusion's gulf namely Daraja, Namakat Namkuse Kenya oil, and Longe'ch while three stations were in the Northern part of the lake (Todonyang, Lopukurat and Lwarang'ak) making a total of eight stations. Preliminary results indicated that Ferguson's related sites had 76% of the plastics sampled. PETE however, gave the highest number of plastic types compared to the rest followed by LDPE. The least type of plastics in the stated sites was PVC at 3%. The areas with high number of plastics per square meter were Daraja Namakat and Kenya oil with values of 6 and 5 plastics /m2 respectively. This makes the three areas to be plastic waste hotspots. Soft drink bottles, bottled water and cooking oil packages (PETE) forms the highest composition of all plastic types disposed in most beaches at any given time. Generally, the number of plastic waste was considerably high (ranging from 1 to 6 plastics/square metre) along Lake Turkana shoreline and requires intervention. This is expected to rise with rise in population and continued use of the same. Reccommedations were that there was need to establish collection points in the area to contain the spread of plastics to the water body and that settlement be established far from the shoreline. Finally NEMA regulations on use of plastic waste be observed to reduce plastic proliferation and use in addition to building capacity of the resource users to responsibly use plastic materials.

INTRODUCTION

Plastics contribute to approximately 10% of discarded waste. They are described as the synthesized polymer compounds mainly made from petrochemical raw materials and characterized by high molecular mass plasticity. Our excessive reliance on plastic materials is creating an invisible yet plastic footprints in the environment where the usage is generating considerable number of plastics wastes which ultimately endanger our environment and life within it (Ryberg et al 2019). Considered a major threat to both wildlife and human wellbeing, plastic pollution is now widespread in the oceans [Capenter et al. 1972], causing an unprecedented environmental crisis with an estimated 10 million tons of litter leaking into the marine environment every year. According to Borrelle et al., 2020, more than half this plastic has been produced since 2004

Plastics that act as pollutants are categorized by size as micro-, meso-, or macro debris (Borrelle et al., 2020). Of the three categories, plastics have seven types mainly Polyethylene Terephthalate (PET or PETE), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC or Vinyl), Low Density Polyethylene (LDPE), Polypropylene (PP), Polystyrene (PS or Styrofoam) and Other plastic forms. Plastics are inexpensive and durable, making them very adaptable for different uses; as a result, manufacturers choose to use plastic over other materials. However, the chemical structure of most plastics renders them resistant to many natural processes of degradation and as a result they are slow to degrade. Being the ideal material for packaging, plastic is basically everywhere. Emissions of plastic are increasing and will continue to do so even in some of the most optimistic future scenarios of plastic waste reduction. Estimates of global emissions of plastic waste to rivers, lakes, and the ocean range from 9 to 23 million metric tons per year, with a similar amount emitted into the terrestrial environment, from 13 to 25 million metric tons per year as of 2016 (Borelle et al., 2020). Following business-as-usual scenarios, these estimated 2016 emission rates will be approximately doubled by 2025. Plastics themselves contribute to approximately 10% of discarded waste. Many kinds of plastics exist depending on their precursors and the method for their polymerization. Depending on their chemical composition, plastics and resins have varying properties related to contaminant absorption and adsorption. Polymer degradation takes much longer as a result of saline environments and the cooling effect of the sea.

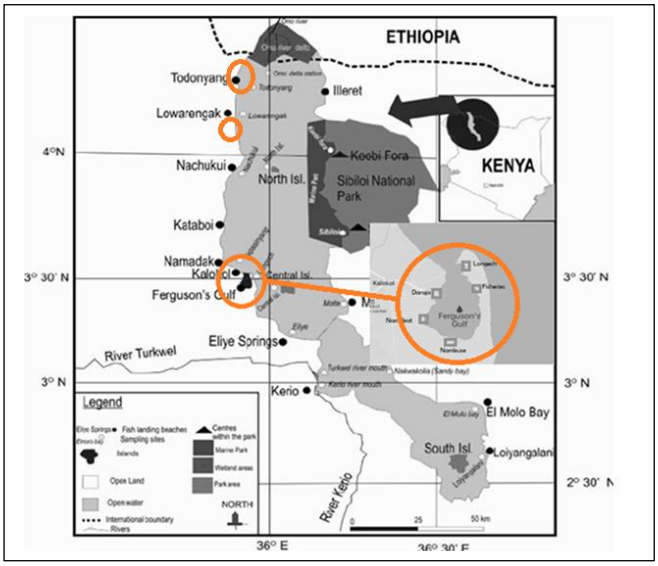
These factors contribute to the persistence of plastic debris in certain environments. It is estimated that a foam plastic cup will take 50 years, a plastic beverage holder will take 400 years, a disposable nappy will take 450 years, and fishing line will take 600 years to degrade. Of all the plastic discarded so far, 14% has been incinerated and less than 10% has been recycled. In Lake Turkana, especially along the Ferguson's Gulf, there are a number of activities that involve the purchase and use of plastic products in the informal settlement areas. A number of small and micro enterprise activities serve the fisher communities around the Gulf. These enterprises sell products that involve use of plastics or are plastic in nature. Water containers, sweet's rappers, cold drinks etc are major products. Fish nets especially monofilaments are always found everywhere. Scarcity of portable water has even exacerbated the situation with most of portable water containers being plastic adding to the already worse situation. These activities are a pointer to plastic pollution and hence the need to assess the level of their pollution. The main objective of this study therefore was to assess the level of plastic pollution along the Ferguson's Gulf to provide information for sustainable management of the same. Specifically, the study was to assess the major sources of plastic pollution, identify and quantify forms of plastics in the study areas and also to identify major hotspots along Lak Turkana

METHODOLOGY

Study area

Lake Turkana, is lying within the Great Rift Valley Northern Kenya. The Lake is 250 km long, having an elevation of 360 m above sea level and a maximum depth of 120 m. It has a surface area of 7,500 km2 making it the largest Lake in Kenya. Within the western side of Lake Turkana lies the Ferguson's Gulf. Ferguson's Gulf lies 30 30' 51'' N and 350 54' 58'' E in the midwestern part of Lake Turkana. Its surface area fluctuates depending on the lake levels at any given time. It is a major fishing ground with the fishers plying the whole of the gulf. It is completely surrounded by informal settlements with various activities including small and medium enterprises being undertaken. Shopping centers and entertainment sites are found scattered all along the Gulf area. Eight sites were identified for sampling of plastic pollutants, that is five stations along the ferguson's gulf (Daraja, Namakat Namkuse Kenya oil, and Longe'ch) and three stations in the Northern part of the lake (Todonyang, Lopukurat and Lwarang'ak.

with fishing activities at the shore. Shopping stalls and kiosks for refreshments characterize the area. Entertainment joints like bars and whisky shops are available as well. All these activities use plastics containers in one way or another to sell the products.



Map of Lake Turkana showing study area

The eight sites are located at different point along the western side of Lake Turkana. Amenities like schools and churches are in the vicinity of the Gulf and one ice making.

Data collection and analysis

Random sampling using a 10 m x 10 m (100 m^2) quadrat was applied in the sampling to quantify and identify the types of plastic in the selected areas. Each site was randomly sampled in triplicate by marking the quadrat area and then the plastic of all forms collected, placed in gunny bags, weighed using electronic weighing balance and put together in one place for sorting according to the seven types of plastics as per the identification chart developed. After sorting the types, each were weighed again separately and recorded.

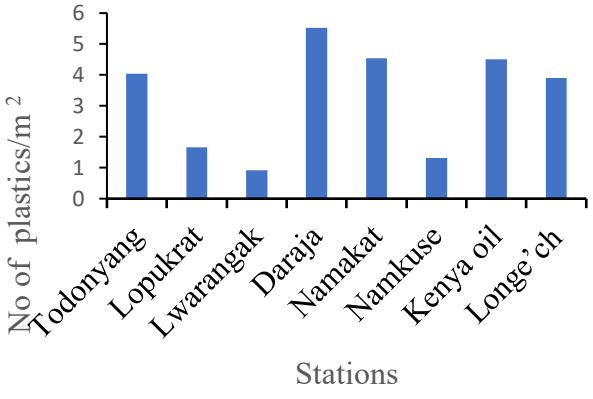
RESULTS

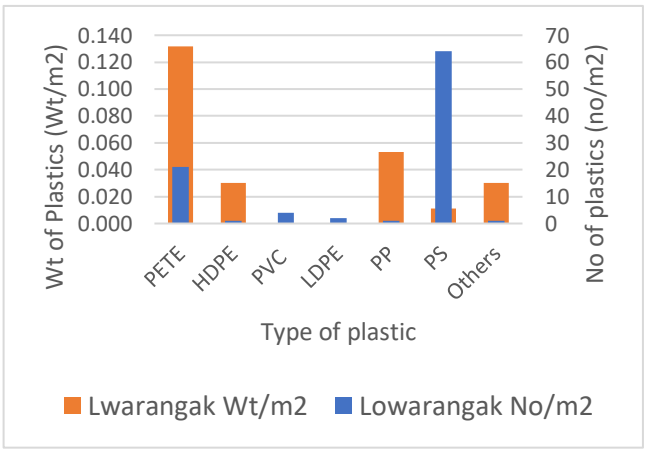
Plastics were found to be scattered along the beaches specifically concentrated at the upper water mark except in Todonyang where the plastics were characterized by wind scattering. The plastics occurrence along the water mark indicated that most of the plastics was being shifted by water waves from either water body or pushed and dumped by the water waves along the shoreline. These plastics were mainly as a result of dumping of plastic waste along the vicinity of the Lake hence are either pushed by water waves to upper water mark or are carried by wind action and are trapped by water

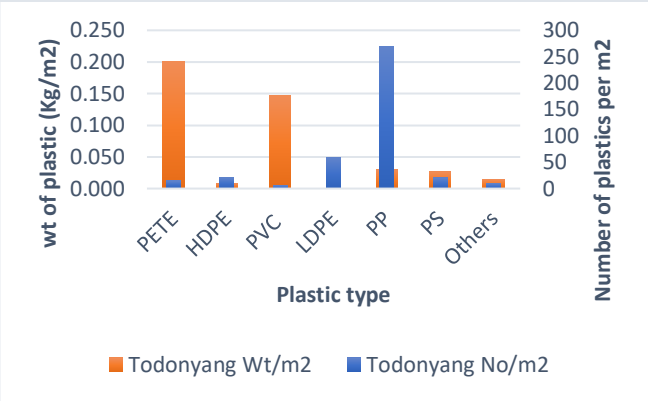
at the shoreline. Most of plastics were characterized to be caused by human activities especially water, food, oil and condiments used along the lake shore.

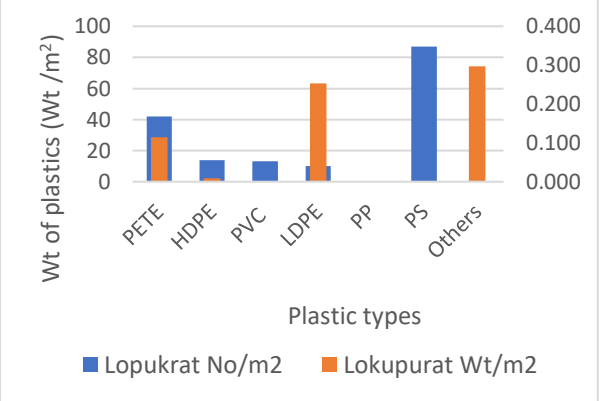
Table 1: The number and %Composition of Plastics along the sampling sites of Lake Turkana

Plastic types	Todonyang	Lokupurat	Lowarangak	Daraja	Namakat	Namkuse	Kenya oil	Longe' ch	Total Types	% Composition
PETE	16	42	21	346	224	58	152	112	**971**	**37**
HDPE	21	14	0	16	36	21	43	5	**156**	**6**
PVC	6	13	4	2	3	15	22	11	**76**	**3**
LDPE	59	10	2	51	22	23	217	192	**576**	**22**
PP	270	0	0	64	39	1	3	1	**378**	**14**
PS	21	87	64	26	29	0	1	6	**234**	**9**
Others	10	0	0	47	101	13	12	64	**247**	**9**
Total Plastics	**403**	**166**	**91**	**552**	**454**	**131**	**450**	**391**	**263**	
Composition (%)	**15**	**6**	**3**	**21**	**17**	**5**	**17**	**15**	**100**	









Plastics were weighed according to types and the results were as shown in figure 4. In Todonyang PETE exhibited the highest weight of about 0.2kg/m^2 with only 16 pieces collected contrary to 6 pieces of PVC with a weight of 0.147 kg/m^2. While LDPE was having a significant number of 59 pieces/m^2, with a negligible weight (> 0.000kg/m^2). In Lokupurat (Figure 5), 42 pieces of PETE weighed 0.115 Kg/m2. This indicates that the plastics pieces were of different sizes hence the difference in number and weights. The same phenomenon was observed in Lowarangak.

CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

Soft drink bottles, bottled water and cooking oil packages (PETE) forms the highest composition of all plastic types disposed in most beaches at any given time. The extent of plastic waste in the environment is related to settlement areas and hence the far the settlement to the shoreline the lower the waste along the Lake. Daraja leads in plastic waste disposal than the rest of the stations/sites sampled. However, Todonyang to the northern part of the Lake is most affected site and the fourth overall. The number of plastic pieces collected do not correlated to the weight of the plastics in a given unit area but mainly related to the sizes.

Generally, plastic waste was a menace along Lake Turkana shoreline and requires intervention.

4.2 Recommendations

There is need to establish collection points in the area to contain the spread of plastics to the water and settlement areas.

BMUs in collaboration with County Government should come up with ways of managing plastic wastes / debris in the respective beaches to reduce this plastic menace in their respective jurisdiction.

NEMA regulations on use of plastic bags be observed with enforcement to reduce plastic proliferation and use.

Capacity building and sensitization exercise should be undertaken involving all stake holders as a way of reducing the use of plastic materials