

Public Perception towards Plastic Pollution in the Marine Ecosystems of Sri Lanka

Ahalya Arulnayagam*

Department of Marine Bioscience and Environment, Korea Maritime and Ocean University, Busan, South Korea

*Corresponding author: ahalya.arulnayagam@gmail.com

Received February 11, 2020; Revised March 22, 2020; Accepted April 07, 2020

Abstract Plastic pollution has become a pervasive environmental issue and has gained considerable attention recently. Plastics have redefined more life more easy and sophisticated but has left harmful imprints behind. The intensity of plastic pollution along the coastal areas of Sri Lanka has been rising during the past decade that requires immediate action. Advocating for behavioral changes from society remains a daunting task that acknowledges their lifestyle. This research paper aimed to gain an understanding on the public perception towards marine plastic pollution. Questionnaire was used to accurately capture and reflect the perceptions by the coastal communities living in areas with enriched marine ecosystems. The results from the study showed that Sri Lankan people have a generally more negative perception towards single-use plastics; a high level of awareness towards their impacts on marine environment; and a strong willingness to reduce their consumption of single-use plastic. Based on the findings, recommendations emphasized the need to incentivize reusable plastic bags, promote awareness and advocacy pertaining to the marine environmental concerns of single-use plastics and further investigate the potential of a plastic ban in Sri Lanka. This research can contribute towards developing adequate, appropriate strategies to address the issues of single-use plastics and marine conservation.

Keywords: *single-use plastic, Sri Lanka, plastic pollution, marine environment, conservation*

Cite This Article: Ahalya Arulnayagam, "Public Perception towards Plastic Pollution in the Marine Ecosystems of Sri Lanka." *American Journal of Marine Science*, vol. 8, no. 1 (2020): 6-13. doi: 10.12691/marine-8-1-2.

1. Introduction

We live on a blue planet, with ocean and sea covering more than 70 percent of the Earth's surface. Marine ecosystems around the world provide a wide array of ecological services, and support ample amount of marine organisms as well as human. This includes food provision for billions of people, carbon storage, waste detoxification and cultural benefits including recreational opportunities and spiritual enhancement [1]. They also serve as the foundation for much of the world's economy, supporting sectors from tourism to fisheries and international shipping. Any threat to the continuous supply of these ecosystem services has the potential to affect the well-being of the fauna, flora and human living across the globe paving way to loss of biodiversity, food security, livelihoods, income and health [1].

Despite their importance, oceans are facing unprecedented threats, because of human activities. Overexploitation and harvesting, dumping of waste, pollution, alien species, land reclamation, dredging and global climate change have become prominent factors, which disrupts the balance of marine ecosystem [2]. Marine debris, described by UNEP, 2009 is "any persistent, manufactured, or processed solid material discarded, disposed of or abandoned in the marine and

coastal environment", have clearly become a major challenge for the whole human kind [3]. Of them, primarily plastic wastes have doomed the marine ecosystem hence putting all the organisms at risk.

1.1. Marine Plastics

Plastics are synthetic or semi-synthetic organic polymers [2] made from petroleum [4] that are cheap, lightweight, durable [2] and corrosion-free [5]. Due to its ubiquity and persistence, marine plastic waste often tends to become a potential threat to human health, economies, aquatic habitat and marine wildlife as well as to a variety of freshwater and salt-water environments [3].

The effects of plastic pollution has been ignored for a long period yet has become a pervasive environmental issue and has gained substantial attention in the recent years [6]. The total production of plastics has surpassed 10 billion metric tons [7] and is continuously increasing. Plastic Ocean Foundation (2018) reported that globally more than 8 million tons of plastic is being discarded into the oceans every year [4,6].

An estimated 150 million tonnes of plastics have accumulated in the world's ocean and the problem has been compounded by overloaded waste management and recycling systems that are unable to cope with rising plastic production [8]. The primary reasons for this could be attributed to the population density, high consumption

of plastic products, coastal urbanization, infrastructure development and the high percentage of mismanaged plastic waste in the coastal cities [6]. Unlike some other kinds of waste, plastic does not decompose. That means it sticks around wreaking havoc on marine ecosystems, almost forever.

1.2. How Plastics End Up in the Ocean

Studies have found that 80% of the plastics are land-based. Plastics from landfill enter into the ocean through poor management and improper disposal of sewages and plastic wastes, coastal landfill operations and litter carried through streams and rivers [9]. Other sources include accidental spillage during handling and other processes [5].

Remaining 20% are the litters generated by ships/boats through recreational activities, discharge of marine litters [9], nautical activities, fishing activities and aquaculture [4]. Of which commercial fishing accounts for most of the impacts. This includes discarded fishing items, together with monofilament lines and nylon netting [5].

The buoyancy of marine plastics facilitates its transport over great distances with prevailing winds, ocean currents and tides. Due to this, plastics can accumulate along shorelines, even on the most remote islands, as well as open and deep sea [10]. Plastics are transported from their sources by river systems and wastewater treatment works to the marine environment. In addition, extreme weather events such as hurricane and flooding could also increase the possibilities for the transfer of land-based debris to the sea [5]. Ocean currents converge and allow the plastic materials to accumulate over the time at the center of major ocean vortices forming huge mass of ever-lasting floating debris fields across the seas, typically called “garbage patches” [9].

Marine plastic pollution, however, is viewed as a global issue most notably given credit in Sustainable Development Goals (SDGs). SDG 14 - Life below water, ‘Conserve and sustainably use the oceans, seas and marine resources for sustainable development’ [6], provides an insight on the marine plastic pollution and advocates that the solution to marine litter can be found by transitioning towards more sustainable means of production and consumption.

Plastic pollution along the coasts of Sri Lanka has not addressed a lot, because of the knowledge gap and lack of professionals to carry out science-based solutions. Marine plastics have taken into concern for the past few years only and profound solutions on the issue is believed to be taken as soon as possible.

This paper intends to find out the public view on marine plastic pollution and how they could shift their lifestyle in order to reduce the upcoming pollution load.

2. Methodology

2.1. Study Area

Sri Lanka described as “The pearl of the Indian Ocean”, is located between latitudes 5.55’ and 9.51’ North and longitude 79.41’ and 81.54 East in the Indian Ocean. It is located to the South of the Indian Subcontinent. The island spans about 65,610 sq. km and is astonishingly

varied with a continental shelf of 44,250 sq. km. The coastline is approximately 1600 km in length. Hence, Sri Lanka enjoys wide array of marine and coastal ecosystems such as coral reefs, mangrove forests, lagoons and estuaries, mudflats, sand dunes and beaches.

The study was conducted in eight coastal districts of the island (Figure 1). These places were chosen based on richness of the marine ecosystems. These locations had either two or more marine biomes. A total of 94 participants were included in the sample. The sample population was chosen from coastal communities based on their location near to the observed marine ecosystems. This was useful as it enabled to target different members of the population within the areas to gain better understanding of the complex perceptions held towards plastics across demographic groups.

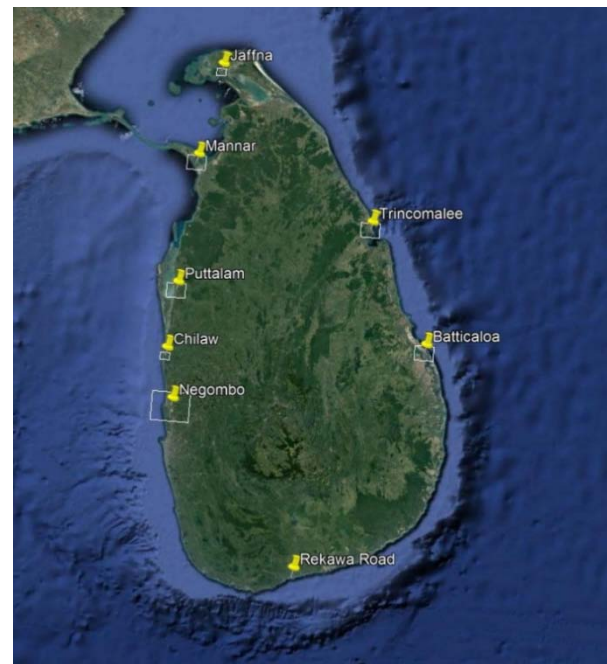


Figure 1. Map of the study area (Source: Google Earth, 2015)

2.2. Data Collection

Data for this study was collected using a questionnaire as the main research instrument. Primary data was collected through the administration of questionnaires to the coastal communities to gain an understanding of their perceptions towards marine plastic pollution. The questionnaire was the most suitable instrument to use because the information required was brief and uncontroversial. The research required standardized data and the questionnaire allowed respondents to quickly and easily understand the questions, which allowed for efficient data collection.

At the beginning, the questionnaire instructions were given to the respondents including the purpose and description of the research. The participants were also given a confidentiality statement to ensure the anonymity of their responses. The respondents were able to receive assistance from the researcher if they had any questions or needed clarification on any of the questions. Even though the questionnaire was in English, explanations of the questions were given in their native languages, whenever

necessary. To avoid the respondents losing interest and make them easily understandable, survey questions were formulated as brief as possible.

2.3. Sampling Strategy

Participants were chosen on a random basis using systematic sampling whereby every fifth person who walked past the researcher (in the relevant areas) were asked to participate in the survey. This thereby reduced the bias in the selection of participants for the study.

The data collected in the survey was analyzed using the Statistical Package for the Social Science (SPSS) version 19 and MS Excel 2016. This system allowed the researcher to analyze and transform raw data collected, to examine trends within the dataset. The findings were presented using graphs, pie charts and tables to illustrate the results of the data collection.

3. Results and Discussion

3.1. Demographics of Respondents

There were total of 96 respondents participated in the questionnaire process, from eight coastal areas selected. All 96 respondents were Sri Lankan citizens. Information pertaining to the demographics of the sample population was collected to gain a clear understanding of the sample population characteristics. Van Rensburg et al., [6] asserts that it's important to understand the characteristics and demographics of the sample population of the research study because it is an influential factor manipulating the willingness of participants to respond and, more importantly, it can impact how the participants respond to the chosen questions. The questionnaire in the study focused on four characteristics of the sample population; namely gender, age, education level and employment status; the results of which can be seen in Table 1.

Table 1. Demographic profile of the participants

| Demographic variables | Categories | Frequency | Percentage |
|-----------------------|---------------------|-----------|------------|
| Citizenship | Sri Lankan | 96 | 100 |
| Gender | Male | 47 | 49 |
| | Female | 49 | 51 |
| Age | < 20 years | 8 | 8.3 |
| | 20 - 29 years | 43 | 44.8 |
| | 30 -39 years | 27 | 28.1 |
| | 40 – 49 years | 12 | 12.5 |
| | >50 years | 6 | 6.3 |
| Education background | Illiterate | - | - |
| | Primary education | - | - |
| | Secondary education | 8 | 8.3 |
| | Graduate | 67 | 69.8 |
| | Postgraduate | 21 | 21.9 |
| Employment status | Unemployed | 16 | 16.7 |
| | Self employed | 3 | 3.1 |
| | Government sector | 20 | 20.8 |
| | Private sector | 34 | 35.4 |
| | Academic | 23 | 24 |

All the respondents chosen for the research survey were Sri Lankan citizens. There was a fairly equal representation of male (49%) and female (51%) respondents in the questionnaire process. Most of the respondents (44.8%) were in the age group of 20 – 29 years, whilst respondents below 20 years and more than 50 years are the least of the answering groups; 8.3% and 6.3% respectively.

More than 3/4th of the respondents have a tertiary education, which indicates that general education level of respondents is relatively high. This is considered as an influential factor in the results as a higher level of education may reflect in the types of responses given by the participants.

3.1.1. Limitation of Sample Population

It is important to acknowledge limitations relative to the demographics of the sample population. A key finding was that a larger proportion of the sample had a high education level since 89 out of 96 participants (nearly 90%) had obtained a tertiary level education. The remaining participants have gained secondary education (8.3%), which leaves no one of the respondents as illiterate. Since almost all of the participants were educated this would imply that the coastal communities of Sri Lanka are moderate to highly educated, or it may imply that niche portion of the population was more willing to participate in the survey. Studies have shown that higher education levels correspond to a more extensive awareness and concern towards environmental issues [9]. It remains difficult to ascertain whether this factor influenced the results of the study here hence it has been acknowledged as a potential limitation.

3.2. Knowledge on Marine Ecosystems

This mainly dealt with understanding the respondents' familiarity with Sri Lankan marine ecosystems. The results are given in Figure 2.

Figure 3 provides and insight on the types of marine ecosystems they are aware of or they have visited. Almost all of the respondents (92%) have been to beaches or they have a renowned knowledge on beach resources. 76% of the respondents were familiar with lagoons/estuaries whilst 60.4% are aware with the coastal ecosystems mangroves/sea grasses. Sand dunes were the least (40.6%) known by any respondent who participated in the survey.

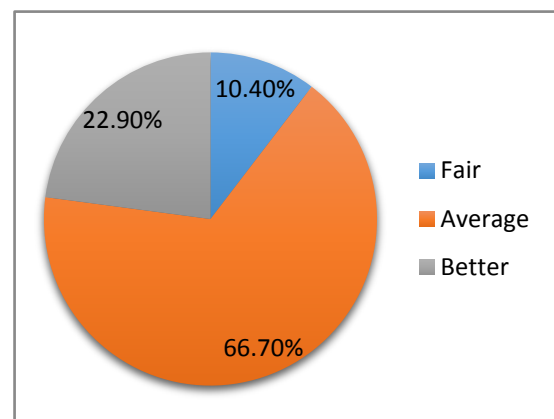


Figure 2. Respondents' knowledge on Sri Lankan marine ecosystems

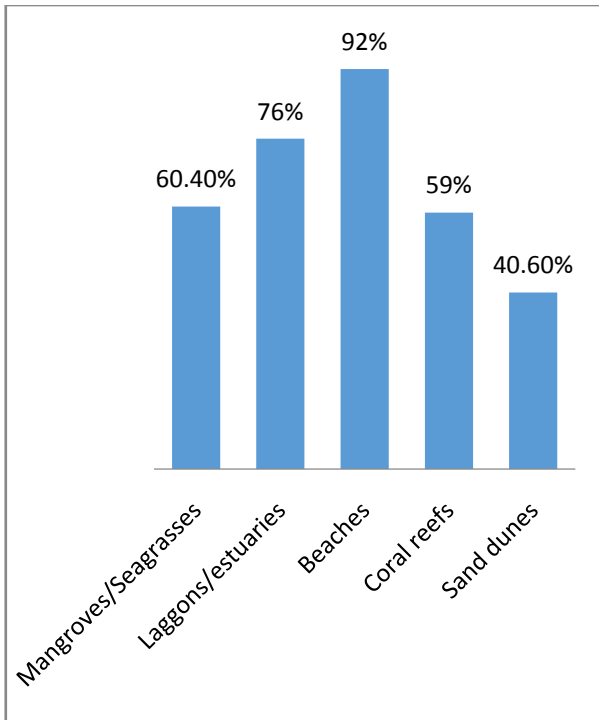


Figure 3. Type of marine ecosystems they know/they have visited

It is an irony, that although Sri Lankan coast is flourished with wide variety of coastal ecosystem, only few of them know about all of them clearly. Most of the respondents have an idea on the ecology of lagoons/estuaries and mangrove because most of their livelihood such as fisheries and aquaculture is dependent on it. Coral reefs in Sri Lanka has a unique place in the Southern coast and Eastern coast. However, most of the times it is valued only for its tourist attraction. Since the community is not dependent on the sand dune ecology and the fact that there are not much dunes in the island, might be a reason for majority of the coastal community being unaware of them.

3.3. Consumption Habits

The objective strived to determine and assess the consumer attitudes towards the use of plastic products. The consumption habits were assessed in terms of plastic product consumption, their likeability in using plastic products and their awareness on the possible threats that plastics could cause to the marine environment. A key finding of this survey was that the respondents frequently use plastic bags and plastic bottles in their daily use (Figure 4); 80.2% and 70.8% respectively. This could be attributed to their modernizing/ changing lifestyles. This trend is significant considering that the other proportions were markedly lower in comparison.

Understanding consumer behavior towards the factors influencing the consumption of plastic products was another element considered within this study. The most prevalent reason for their usage of plastic products is its easy availability (Figure 5), whereas 35.4% of the respondents claimed that they choose plastics because of the lack of alternatives. “Plastics are very long-lived products that could potentially have service over decades, and yet our main use of these light-weight, inexpensive

materials are as single-use items that will go to the garbage dump within a year, where they’ll persist for centuries”, Richard Thompson, lead editor of Scientific American said in an interview. Evidence is mounting that the chemical building blocks that make plastics so versatile are the same components that might harm the people and environment. Over the period from 1950 to 2015, cumulative production of plastics reached 7.8 billion tonnes of plastic – more than one ton of plastic for every person alive today.

Even though, the motivation for the generally more negative perception towards choosing plastics is due to environmental concerns is unclear, Van Rensburg et al., [6] states that if consumers are aware and concerned enough about environmental impacts, they may reduce their consumption of plastics. This potential link will be explored in the following section on the consumer awareness towards environmental impacts.

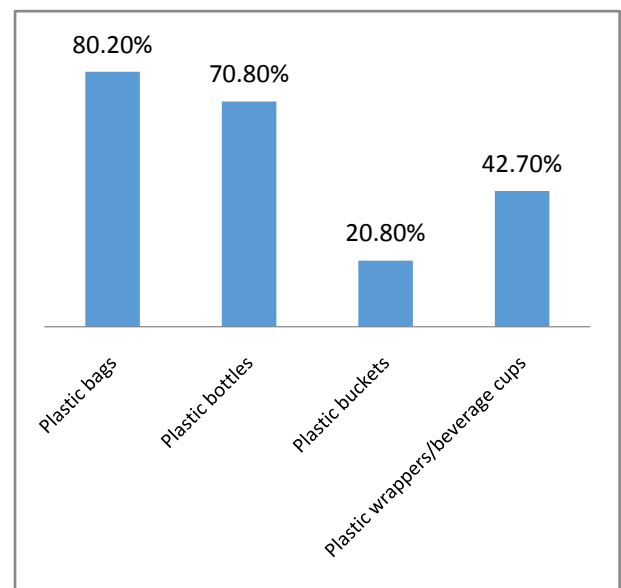


Figure 4. Consumption behavior of respondents

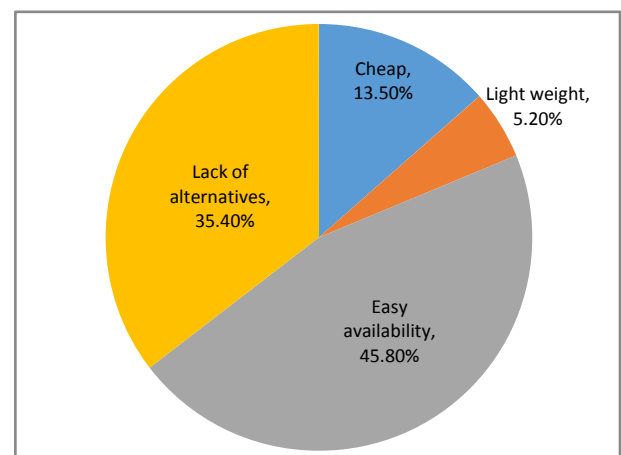


Figure 5. Factors influencing the consumption of plastic products

3.4. Awareness of Environmental Impacts

This objective pursued an understanding of the awareness held by the Sri Lankan coastal community towards the impact caused by plastics. The awareness was

studied by their understanding on the extent of marine environmental impacts, the severity of the issue and the platform through which they became informed of such issues, actions needed to be done, and their way of waste disposal. This assessment was made considering the consumption habits mentioned in section 3.3 to ascertain whether there is a link between environmental consciousness and negative perceptions towards plastic products.

A key finding was almost all of the respondents believe that plastic products can cause harm in the environment (Figure 6). This indicates that most of the respondents were aware that plastic products could harm the environment in a way or another. In Sri Lanka, plastic pollution is most commonly cited as harming rivers, lagoons/estuaries, coral reefs, beaches and marine organisms. In addition, globally rivers and ocean are commonly cited environments experiencing the plight from plastic pollution.

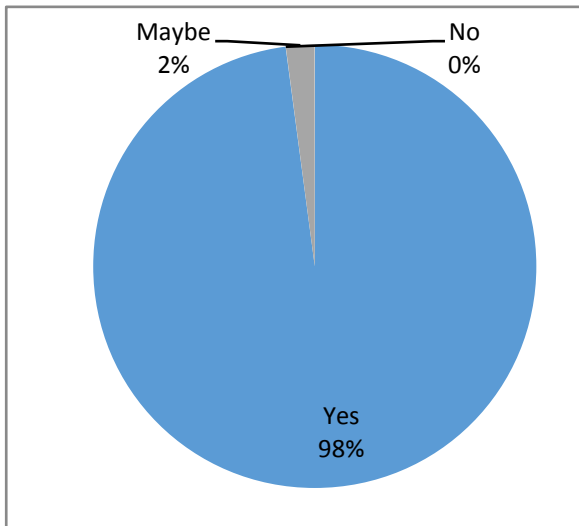


Figure 6. Public awareness about impacts of plastics on marine ecosystem

The contamination of rivers and ocean is therefore prevalent at a global and local scale. Thus, the distributions of information regarding the impacts of plastic pollution are available in all platforms. However, with the globalized society, primary platform that the respondents have gained attention was via social media (95%). Following the social media is via TV/radio/newspaper (66.3%), published materials (65.3%) and finally from professionals (64.2%). This understanding is quite significant as it suggests that the Sri Lankan coastal communities are aware of the severity of plastic pollution. This also exhibits that the community members have a high level of awareness towards the environmental devastation caused by plastic pollution. This awareness is crucial to help promote behavioral change within individuals in Sri Lanka.

It should be noted that, even though marine science and research based on marine pollution is still in its juvenile stage, Sri Lankan marine biologists make their maximum efforts to give away the required public awareness. Mainly Marine Environment Protection Agency (MEPA) is responsible for the pollution awareness and abatement activities. Apart from them, Coastal Conservation

Department (CCD), Central Environment Authority (CEA) and some other non-governmental organizations are committed to protecting the marine ecosystems and spreading awareness. What is significant is remaining cognizant of the value of being aware of the most frequently used information dissemination platforms in Sri Lankan context. Being informed of this is important so that the most effective channels identified in Figure 7 can be exploited in the future to increase the environmental awareness regarding plastic pollution.

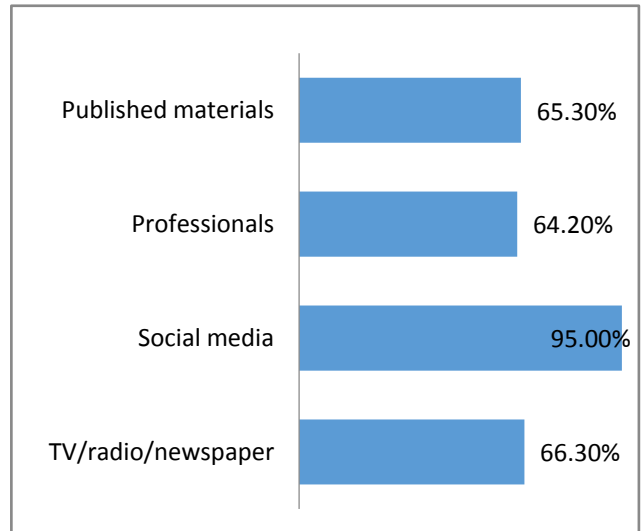


Figure 7. Platforms via the respondents received awareness

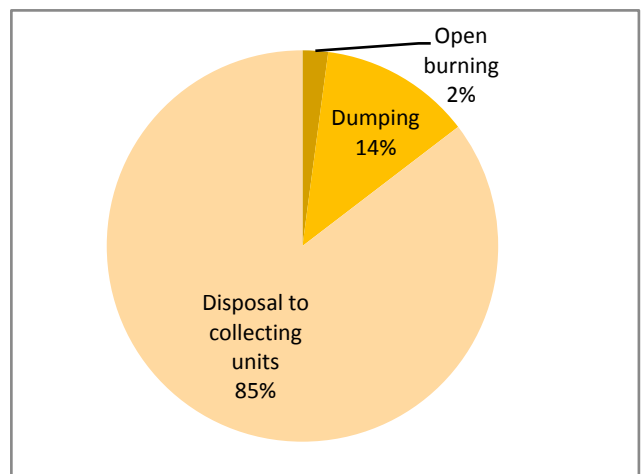


Figure 8. Mode of waste disposal

Another salient feature of measuring the care for environment by the public was tested by their mode of waste disposal. Significant amount of people (85%) follows the practice of disposing the wastes to the collection unit, which implies that most of the people do not litter the cities (Figure 8). There were no data collected whether they segregate the waste, but still, considering that the waste collection unit separates waste thus the pollution load on the marine ecosystem would reduce by several folds. On the other hand, 13% of the respondents dump their domestic wastes where as 2% burns them. Both the practices have their particular impacts in the environment; ultimately on the marine ecosystems. Verma, Vinoda, Papireddy, & Gowda, [11], implied incineration of plastic waste in an open field is a

major source of air pollution releasing toxic gases like dioxins, furans, mercury and polychlorinated biphenyls into the atmosphere. Further burning of Poly Vinyl Chloride liberates hazardous halogens and pollutes air; the impact of which is climate change. Dumping a non-bio degradable waste like plastic, could result in changing soil texture and structure and affects the soil health.

It can thus be concluded from this discussion that the Sri Lankan people have a relatively high awareness of the environmental impacts associated with plastic products. Furthermore, such awareness may rise the environmental consciousness of Sri Lankan people and potentially play a role in influencing their negative perception towards plastics.

3.5. Trend of Plastic Pollution

This objective intended to identify whether the Sri Lankan people are aware about the trend in plastic pollution, if so how and what might be the reasons behind it. 89.6% of respondents stated that there is an increasing trend in the plastic pollution (Figure 9). Of them, nearly 74.2% of respondents have stated it is because the low cost of the plastic products (Figure 10) and 55.1% stated it is because of its durability.

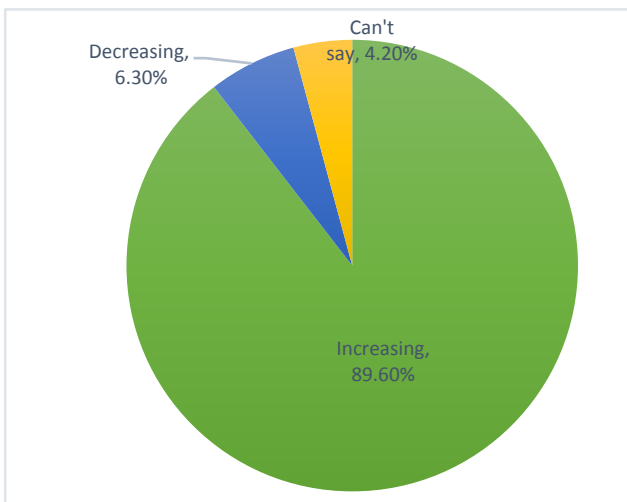


Figure 9. Trend of plastic pollution

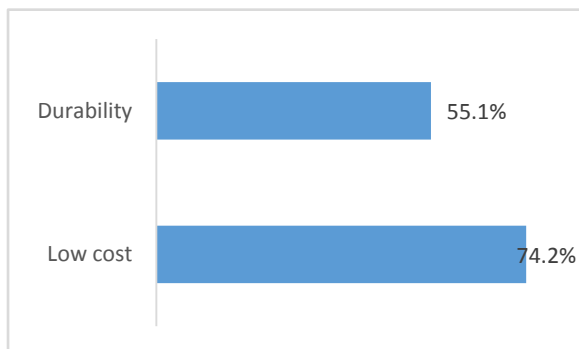


Figure 10. Reasons for the increase in plastic pollution

Plastics often contain additives making them stronger, more flexible and durable. However, many of these additives can extend the life of products, even if they become litter, with some estimates ranging to at least 400 years to break down. Durable and slow to degrade, plastic

materials that are used in the production of so many products, from containers to beverage bottles, packaging straps and tarps, and synthetic nylon materials used in fishing line, all become debris with persistence. Plastic debris accumulates because it does not degrade as many other substances do. In addition, most of these plastic waste items are highly buoyant, allowing them to travel in currents for thousands of miles, endangering marine ecosystems and wildlife along the way; hence making it as a global transboundary pollution. "Plastics are a contaminant that goes beyond the visual", says Bill Henry of the Long Marine Laboratory, USSC.

Surprisingly, about 6.3% of the respondents have stated that the trend of plastic pollution is decreasing and 4.2% stated that it could not be predicted. 35.1% of the respondents told that the trend of plastic pollution is decreasing because of the availability of alternatives and 89.2% stated that it is because of the awareness of public. This ascertains the facts discussed in section 3.4.

3.6. Willingness to Reduce Consumption

This objective sought to understand the willingness of Sri Lankan public to reduce their consumption of plastic products and determine whether they would partake in and support strategies to help minimize the plight of plastic pollution in marine environment.

The respondents demonstrated a strong willingness to reduce their own consumption and stop the plastic pollution. This is evident since 91.6% of the respondents would like to stop the plastic pollution (Figure 11).

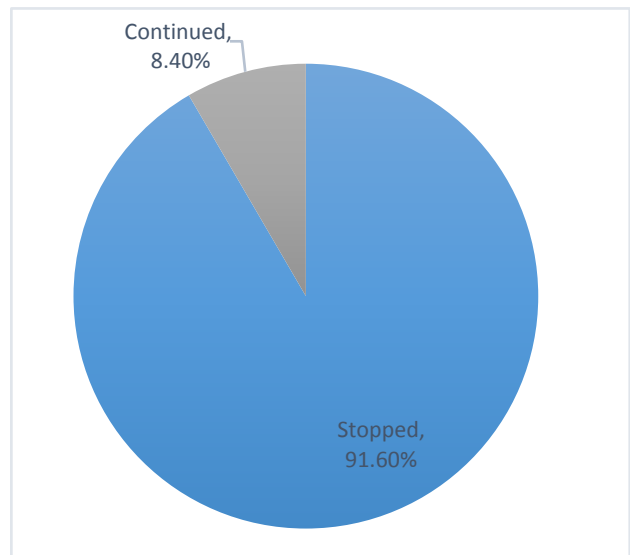


Figure 11. Willingness on the future use of plastics

These findings are significant but an understanding is required on the behavior gap cognizant of the attitude. For instance, although a large proportion of respondents in this study held the view that, they would like to reduce plastic pollution; this will not necessarily translate into a behavioral change by consumers. Around 91.7% of respondents strongly believe that the change can be only possible from the community itself (Figure 12). No matter how many rules and regulations are laid, how many plastic bans are held; it is the individual who has to be concern of the impacts and consequences of any single piece of

plastic he/she is using. This suggests that individuals with an acute awareness of environmental impacts may be more likely to favor a change in behavioral traits.

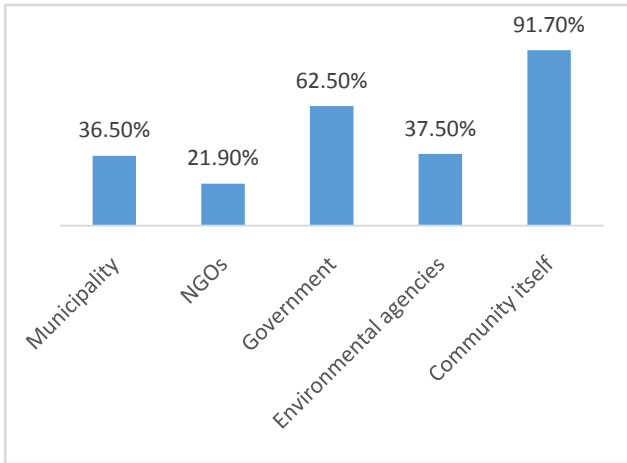


Figure 12. Parties responsible for a behavior change/reducing plastic pollution

3.6.1. Alternatives to Plastics

Fairly Equal number of respondents showed preference towards paper and cloth; 32% and 30% respectively; to be used as an alternative for plastics (Figure 13). Having their pros and cons individually, a clean and green solution. Paper bags are bio gradable and easy to recycle or compost. However, producing them in large quantities requires a lot water, fuel and cut down trees. Cloth bags are typically made from cotton, a particularly pesticide-intensive and water-guzzling crop. Reputation aside, plastics have smallest carbon footprint at least in terms of single-production. However, that is only the beginning. How we use and dispose of bags matters even more.

during their shopping and 76% promised to use refillable water bottles instead of single-use plastic bottles (Figure 14). This embarks a beginning of the reduction in single-use plastic era and thereby a sustainable future. Whilst acknowledging this type of alteration may not directly reduce the consumption of single-use plastics; it would, however, increase eco safety and reduce the risk of the polluting the marine environment. The apparent willingness is, however, heavily dependent on whether the attitudes held by the sample population manifest into actions.

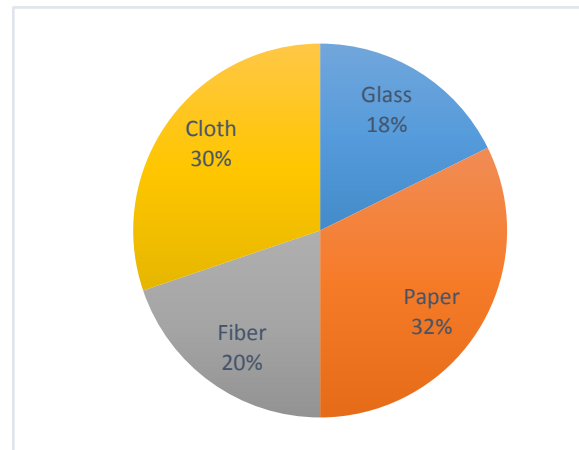


Figure 13. Alternatives for plastics

3.7. Willingness to Change Behavioral Traits

This part of the questionnaire focused on whether the respondents were prepared to do alterations in their daily usage of plastics. It turns out that most of the respondents are ready to alter their lifestyles. The limitation lying behind this is that there is no proper and continuous supply of an alternative for plastics. 77.1% of the respondents accepted to bring their own shopping bag

This research study focused intently on the root causes of plastic pollution and fills gap within the behavioral traits and attitudes of individuals towards making a change. This issue does however; need to be tackled in conjunction with other facets of the problem including the improvement in waste management, providing financial incentives to manufacturers as well as enacting stronger policies to allow more circular mode of plastic production. The value of this study lies in the fact that it provides an important starting point to understand the consumer perceptions towards single-use plastics in Sri Lanka. Dismantling the unsustainable consumption of plastics is not an easy task but it is highly dependent on the willingness of citizens to change their consumption habits. Understanding the social perceptions of Sir Lankan residents is therefore of utmost importance to achieve tangible benefits in relation to reducing the consumption of single-use plastics.

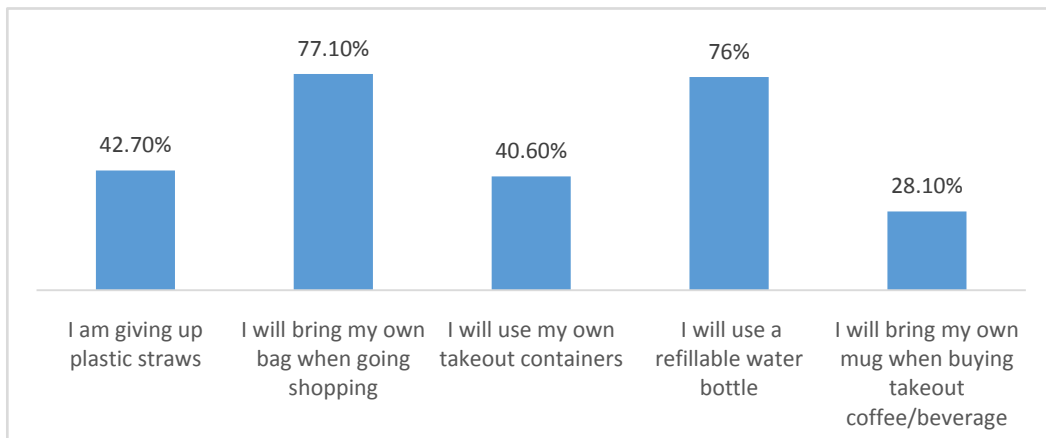


Figure 14. Willingness to change their routine lifestyle to reduce individual plastic footprint

4. Conclusion and Recommendation

This research found there to be a generally more negative perception towards single-use plastics and a relatively high awareness of the environmental impacts caused by them. Strategies such as incentivizing the use of reusable bags, promoting education and awareness, implementing policies to execute a plastic ban should be considered in Sri Lanka to reduce the issues of single-use plastic pollution in the coastal environments of Sri Lanka.

Recommendations are made in relation to the findings of this research paper. Many of the solutions are practical and could play a role in reducing the consumption of single-use plastic and additionally minimize the prevalence of plastic in Sri Lankan coastal areas. Focal areas include incentivizing the use of reusable shopping bags; utilizing popular media platforms to raise awareness of plastic pollution, promoting recycling culture, and further investigating the potential of a plastic ban in Sri Lanka.

Efforts should be made to offer economic incentives to customers for using reusable shopping bags. Offering incentives might provoke a behavioral change in individuals that reduces the consumption of single-use plastics. Effective incentives may be in the form of offering loyalty points or discounts on total purchases when using reusable shopping bags in store [6]. In addition, it is suggested that alternatives such as paper, cloth or any other substances to be used instead of plastics should be sold at a very reasonable price so that everyone could afford it. This could allow consumption practices to move away from a linear and towards circular model.

Awareness raising pertaining to the environmental issues associated with single-use plastics should be through the most popular platforms identified in the study. Social media such as Facebook, Instagram, Twitter, Pinterest, Tumblr etc. can be used as channels to reach out public and give out the conservation news. Further, newspaper and radio/TV can also be used wisely to inform and draw attention to pertinent environmental issues.

Lastly, this research recommends further investigation into the viability of a plastic ban in Sri Lanka. This research indicated a potentially strong support from community members in favor of reducing plastic consumption. The researcher thus suggests that a plastic ban is explored in greater depth as a potential legislative avenue to reduce the consumption of single-use plastics. Banning plastics can also become a powerful education tool and a gateway to provoke greater change within individuals towards the many other single-use plastics that

exist. One of the biggest challenges associated with the plastic ban is the absence/unavailability of alternatives, which are cost-effective. It is therefore recommended that a corresponding analysis if viable alternatives to plastics should be researched in the Sri Lankan context.

Acknowledgments

I wish to thank the respondents who willingly participated in the questionnaire survey. In addition, I wish to express my gratitude towards the anonymous reviewers who have their remarks on the paper.

References

- [1] Beaumont, N. J., Aanesen, M., Austen, M. C., Börger, T., Clark, J. R., Cole, M., ... Wyles, K. J. (2019). Global ecological, social and economic impacts of marine plastic. *Marine Pollution Bulletin*, 142(January), 189-195.
- [2] Sciences, H., & Zealand, N. (2002). *The pollution of the marine environment by plastic debris: a review*. 44, 842-852.
- [3] Kandziora, J. H., Toulon, N. Van, Sobral, P., Taylor, H. L., Ribbink, A. J., Jambeck, J. R., ... Platform, I. W. (2019). The important role of marine debris networks to prevent and reduce ocean plastic pollution. *Marine Pollution Bulletin*, 141(January), 657-662.
- [4] International Union for Conservation of Nature. (2018). Marine Plastics: What is the issue? Why is this important? What can be done? *International Union for Conservation of Nature Issues Brief*, 1-2.
- [5] Li, W. C., Tse, H. F., & Fok, L. (2016). *Science of the Total Environment Plastic waste in the marine environment A review of sources, occurrence and effects*. 567, 333-349.
- [6] Van Rensburg, M. L., Nkomo, S. L., & Dube, T. (2020). The 'plastic waste era': social perceptions towards single-use plastic consumption and impacts on the marine environment in Durban, South Africa. *Applied Geography*, 114(May 2019), 102132.
- [7] Galloway, T., Haward, M., Mason, S. A., Hardesty, B. D., & Krause, S. (2020). *Voices Science-Based Solutions to Plastic Pollution*. 5-7.
- [8] Wysocki, I. T., & Billon, P. Le. (2019). Plastics at sea: ready design for a global solution to marine plastic pollution. *Environmental Science and Policy*, 100(June), 94-104.
- [9] A., G. K., K., A., M., H., K., S., & G., D. (2020). Review on plastic wastes in marine environment – Biodegradation and biotechnological solutions. *Marine Pollution Bulletin*, 150 (May 2019), 110733.
- [10] Jang, Y. C., Ranatunga, R. R. M. K. P., Mok, J. Y., Kim, K. S., Hong, S. Y., Choi, Y. R., & Gunasekara, A. J. M. (2018). Composition and abundance of marine debris stranded on the beaches of Sri Lanka: Results from the first island-wide survey. *Marine Pollution Bulletin*, 128(January), 126-131.
- [11] Verma, R., Vinoda, K. S., Papireddy, M., & Gowda, A. N. S. (2016). Toxic Pollutants from Plastic Waste- A Review. *Procedia Environmental Sciences*, 35, 701-708.

