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# SPCBIC 2021

25th – 28th October, Minna Nigeria

## 3RD SCHOOL OF PHYSICAL SCIENCES BIENNIAL INTERNATIONAL CONFERENCE (SPSBIC 2021)

# PROCEEDINGS

THEME:
THE ROLE OF SCIENCE AND TECHNOLOGY IN THE REALIZATION OF RESEARCH AND DEVELOPMENT IN THE ERA OF GLOBAL PANDEMIC

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA,
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## CHEMICAL/LIFE SCIENCE

**PHYSICAL /CLIMATE SCIENCE**

# AN OVERVIEW ON THE ENVIRONMENTAL IMPACTS OF POLYETHYLENE GENERATION AND DISPOSAL IN AFRO-TROPICAL FRESHWATER ECO-SYSTEM

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**Abstract**

*Plastics have become a modern way of life, with numerous consequences for both humans and the natural environment especially in developing and developed countries. The Nigeria fresh coastal water generally is contaminated with micro-plastic debris which floats on the surface. Plastic accumulation in our environment as a result of improper disposal or shipping splits, they are light weight, durable and are capable of travelling long distances. Soil landfill, soil leachate, unofficial recycling methods releasing chemical to the environment, burning of plastic coated wires, tyres to roast animal, nylon eating bacteria, oil and detergent containers all these contaminate are discharged into streams, river and ocean which enter into aquatic food chain causing hazardous long term carcinogenic effects to fishes, animal and human beings due to the release of diethylhexyl phythalate, lead, mercury, cadmium and as alternative materials for invasive species (barnacle, mollusc and algae , cetacean, turtle, birds) which obstruct the digestive system causing tissue damage by the toxic chemicals called polychlorinated biphenyl (PCBs). Thus, this micro-plastics waste* poses various threats to public health and adversely affects flora and fauna as well as the environment especially when it is not appropriately collected and properly disposed. *However, flavo-bacterial contributes to release of methane gas from nylon break down contributing to greenhouse gas resulting into global warming.* It is concluded that aggressive campaign and enlightenment of the masses on the threats posed by polyethylene pollution should be carried out to prevent further negative environmental impact.

**Keywords:** *Polyethylene, Pollution; environmental; impact; micro-plastic*

## 1. Introduction

The use of plastics has become a modern way of life, which has many effects on both the human and natural environment. Due to the disposable culture that is present among both developing and developed nations, a lot of plastic products become litter, waste, and pollution. Plastics are process able materials based on polymers (Baner *et al*., 2007), and to make them into materials fit for purpose, they are generally processed with a range of chemical additives. These compounds are used in order to adjust the materials properties and make them suitable for their intended purpose. Effects of plastic pollution on land and aquatic environments are relatively easy to measure, as humans can readily access these places. Therefore, stereotypical images of litter along highways, plastic bottle caps in decomposing seabirds, plastic water bottles floating along a coast or river, or a variety of animals with their heads stuck in jugs are common and well known. In addition, plastic's effects on the fresh water ecosystems are somewhat known, especially when it comes to effects with mega fauna and with

microplastics entering the food webs in the upper part of the ocean, and in streams. However, there is so much more to planet Earth than just the land, rivers, shores, and ocean surface that can be seen fairly readily. **Anthropogenic Activities**: Anthropogenic activities refer to human impact on the environment or anthropogenic impact on the environment which includes impacts on biophysical environments, biodiversity, and other resources. The term anthropogenic designates an effect or object resulting from human activity. The term was first used in the technical sense by Russian geologist Alexey Pavlov, and was first used in English by British ecologist Arthur Tansley in reference to human influences on climax plant communities. The atmospheric scientist Paul Crutzen introduced the term "Anthropocene" in the mid-1970. The term is sometimes used in the context of pollution emissions that are produced as a result of human activities but applies broadly to all major human impacts on the environment. (Huesemann, 2011)

Plastics are present in the water environment in a wide variety of sizes, ranging from micrometers to meters (Van Cauwenberghe *et al.*, 2015). plastic pollutants are classified mainly as primary and secondary micro-plastics (MPs). Primary MPs are polymers intentionally manufactured in a microscopic scale (the size range of 1 nm to < 5 mm) through the process of extrusion or grinding, to be used as raw materials for other products (e.g., plastic pellets and microbeads associated with industrial spillages and used in cosmetics, cleaning products or drug vectors) (Cole *et al.*, 2011, Hidalgo-Ruz *et al.*, 2012, Van Cauwenberghe *et al.*, 2015, Alomar *et al.*, 2016, Peters and Bratton 2016, Solomon and Palanisami 2016, Graca *et al.*, 2017). The secondary MPs are formed during the degradation of macro plastics due to the mechanical, photolytic and/or chemical degradation of bigger plastic fragments in water environment and often result in fragmented pieces or fibers (Van Cauwenberghe *et al.*, 2015, Alomar *et al.*, 2016, Peters and Bratton 2016, Graca *et al.*, 2017, Lambert *et al.*, 2017). The smallest particles are defined as nano plastics, as the contaminants are of the size of nano-particles (< 100 nm).

**Figure 1 (above):** Microplastics, one of the most common plastic polluters in the ocean.

## 2. Literature Review

The physical and chemical properties of plastic pollutants, including particle size, shape, surface area, crystallinity, polymer type and chemical additives, determine their ecotoxicity (Lambert *et al.*, 2017). There are 7 main classes of produced plastics: polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), Polyamide (PA), polyurethane (PUR) and polyethylene-terephthalate (PET) (Andrady 2011, Laglbauer *et al.*, 2014, Avio *et al.*, 2016, Solomon and Palanisami 2016). Polymer crystallinity (structure of polymer chains) affects the physical properties of plastic pollutants such as density and permeability. This property may change with the polymers' degradation

process and result in the formation of crystallites, which might differ in toxicity compared to the parent plastics (Lambert *et al.*, 2017). The specific gravity of the plastics ranges from 0.91 (PE) to 1.5 (PA)g/cm3 (Andrady 2011, Avio *et al.*, 2016, Solomon and Palanisami 2016). Therefore, the plastic pollutants depending on the type of material and particle size can sink to the bottom sediments or float on the water surface. Apart from the main monomer, plastics contain a variety of organic plastic additives added during their manufacturing (i.e., initiators, catalysts, solvents, antimicrobial agents, surfactants, plasticizers, flame retardants, lubricants, dispersant, antistatic agents, nano-particles, fillers, fragrances and pigments) (da Costa *et al.*, 2016, Lambert *et al.*, 2017, Wright and Kelly, 2017). Plastic particles have hydrophobic nature; therefore, they can adsorb other dangerous organic and inorganic contaminants such as: endocrine-disrupting compounds, pharmaceuticals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), polybrominated diphenyl ethers (PBDEs), personal care products and heavy metals from the surrounding water and so on (Hidalgo-Ruz *et al.*, 2012, Carr *et al.*, 2016, Ma *et al.*, 2016, Solomon and Palanisami 2016, Graca *et al.*, 2017, Pinheiro *et al.*, 2017, Wright and Kelly, 2017). The degradation process of synthetic plastic pollutants is slow; therefore, the particles persist for a very long time in the water environment and become available to water organisms (Laglbauer *et al.*, 2014).

**Table 1:** showing chemical addictives used in plastics and their effect

| **Toxic Additives** | **Uses** | **Public health effect(S)** | **Plastic types** |
|---|---|---|---|
| Bisphenol A | Plasticizers, can liner | Mimics estrogen, Ovarian disorder | Polyvinyl chloride (PVC), Polycarbonate (PC) |
| Phthalates | Plasticizers, artificial fragrances | Interference with testosterone, sperm motility | Polystyrene (PS), Polyvinyl chloride (PVC). |
| Persistent Organic Pollutants (POPs) | Pesticides, flame retardants, etc. | Possible neurological and reproductive damage | All plastics |
| Dioxins | Formed during low temperature combustion of PVC | Carcinogen, interferes with testosterone | All plastics |
| Polycyclic aromatic hydrocarbon (PAHs) | Use in making pesticides | Developmental and reproductive toxicity | All plastics |
| Polychlorinated biphenyls (PCBs) | Dielectrics in electrical equipment | Interferes with thyroid hormone | All plastics |
| Styrene monomer | Breakdown product | Carcinogen, can form DNA adducts | Polystyrene |
| Nonylphenol | Anti-static, anti-fog, surfactant (in detergents) | Mimics oestrogen | PVC |

**Sources:** (Halden, 2010)

Plastic pollutants enter the water environment from various sources. Among them can be distinguished: waste water treatment plants, cargo shipping, fisheries, human waste from beaches and urban runoff (Cole *et al.*, 2011, Stolte *et al.*, 2015, Peters and Bratton 2016, Alomar *et al.*, 2016, Michielssen *et al.*, 2016, Solomon and Palanisami 2016, Graca *et al.*, 2017, Mintening *et al.*, 2017, Wright and Kelly, 2017). Often, waste water treatment plants (WWTPs) are mentioned as the main sources of microplastics in aquatic environment. Micro-plastics, for example, from cosmetics and other plastic waste, end up at the municipal WWTPs (da Costa *et al.*, 2016). It should be noted that most rivers with a high rate of plastic waste are located close to large urban centers. (Carr *et al.*, 2016) stated, that micro-plastic particles are removed in the primary treatment zones via solids skimming and sludge settling processes and they suggested that effluent discharges from both secondary and tertiary waste water treatment facilities can contain only minimal microplastic loads discharged to the surface water.

## 3. EFFECTS OF PLASTIC WASTE ON THE ECOSYSTEM

Plastic waste has several impacts on the health of ecosystems and humans. Some of these are more obvious and clearly proven, for example, the entanglement of marine wildlife. Others are subtler and not well understood, such as the transport and possible concentration of contaminants by plastic waste. Again, there appears to be more monitoring of ecological and human health impacts in the marine environment than on land. Although there is little research on the specific impacts of plastic waste on land-based wildlife, there is concern that incorrectly managed landfills could lead to either the escape of plastic waste or the escape of landfill leachate containing the chemicals associated with plastic. In addition, unofficial recycling methods, particularly in developing countries, can cause the release of chemicals into the environment, for example, the burning of plastic-coated wires to extract metal.

**Effects on Water:** Plastic contaminates the water bodies and oceans by storm-water runoff, flowing into watercourses or directly discharged into coastal waters. This pollution enters the food chain thereby causing hazardous long-term carcinogenic effect to fishes, animals and human beings due to the release of diethylhexyl phthalate, lead, mercury and cadmium. Nigeria's coastal water are generally contaminated from micro-plastic debris which floats on the surface. The accumulation of plastics in our environments is a result of improper disposal or shipping spills. Since they are lightweight and durable, plastics are capable of traveling long distances; ending up in terrestrial environments, along shorelines, or floating in the open ocean (Zbyszewski and Corcoran, 2011). For example, pill bottles from India along with oil and detergent containers from Russia, Korea, and China have been found on the southern parts of Hawaii (Kostigen 2008).

**Figure 3 (above):** Plastic bottles floating on the water.

As plastics float in the oceans, they are affecting marine wildlife. Not only do plastics end up in animals' stomachs or around their necks, but there is also growing concern that plastics are acting as a

medium for invasive species. The hard surfaces of plastics are now an alternate material for invasive species such as barnacles, mollusks, and algae to attach, compared to the natural material which previously carried invasive species for centuries (Gregory 2009). With the influx of plastics presently in our fresh waters, the accumulation of invasive species may escalate at an ever-increasing speed. **Effects on Soil:** Harmful chemicals are released by seepage in the groundwater and in the ecosystem especially in the soil from the plastics. Polymer and nylon degrading bacteria like Pseudomonas, nylon-eating bacteria and Flavobacteria contribute to the release of methane gas from the breakdown of nylon which contributes towards greenhouse gas and global warming. **Effects on Aquatic Organism**: Sea turtles are mostly affected by plastic pollution including some species of jelly fish which cause esophageal obstruction in them and also accumulate in the stomach of whales. Even small fishes also consume the tiny bits of plastic below the ocean surface. Tuna, sword fish and Lantern fish also consumes plastics by mistake which become a part of the ocean food chain. **Sea Turtles:** Numerous autopsies have shown that ingested plastic and tar are the primary culprits of stress and non-natural death for sea turtles. Debris including fishing line, ropes, nets, six pack rings, Styrofoam, and plastic bags has been extracted from turtle digestive tracts. Plastic bags floating in the water strongly resemble the shape of jellyfish, a primary food source for sea turtles, thus resulting in the ingestion of the bags (Mascarenhas *et al*., 2004). Due to anthropogenic impact, the population of leatherback sea turtles (*Dermochelys coriacea*) has steadily declined over the last two decades, placing them on the IUCN's critically endangered list (Shillinger *et al*., 2012). For the last 40 years, of the 371 autopsies conducted on leatherback turtles, 37.2 % of them had plastic in their gastrointestinal tracts (Mrosovsky *et al*., 2009). Although it is not known if the plastic ingested was the cause of death, 8.7 % of the turtles had a plastic bag presumably blocking the passage of food (Mrosovsky *et al*., 2009). Plastic has also been found to block the passage of female eggs. In a documented study, researchers removed 14 pieces of plastic from a female cloaca. This enabled the eggs to be laid, but indication of internal damage remained (Plot and Georges 2010).

Cetacean do aquatic mammals constitute the infraorder Cetacea. There are around 89 living species, which are divided into two parvorders. The first is the Odontoceti, the toothed whales, which consist of around 70 species, including the dolphin (which includes killer whales), porpoise, beluga whale, narwhal, sperm whale, and beaked whale. The second is the Mysticeti, the baleen (from Latin: balæna, lit. 'whale') whales, which have a filter-feeder system, and consist of 15 species divided into 3 families, and include the right whale, bowhead whale, rorqual, pygmy right whale, and gray whale. Most cetaceans live far from the shoreline which limits the amount of research on the ingestion of marine debris. If plastic causes unnatural death, cetaceans will most likely sink to the bottom of the ocean (Baird and Hooker 2000). Occasionally, cetaceans will wash ashore allowing for postmortem examinations. Due to cetaceans' echolocation capabilities, mistaken consumption of plastic is not probable (Secchi and Zarzur 1999). Ingestion is most likely because the debris was mixed in with the desired food. Two sperm whales (*Physeter macrocephalus*) were found off the coast of northern California in 2008 with a large amount of fishing gear in their gastrointestinal tracts (Jacobsen *et al*., 2010). One of the sperm whales had a rupture in the third compartment of the stomach caused by nylon netting; the other had netting, fishing line, and plastic bags completely blocking the stomach from the intestines (Jacobsen *et al*., 2010). **Birds:** Plastic pollution also affects the birds like Seabirds, which obstruct their digestive tract causing tissue damage by the toxic chemicals called polychlorinated biphenyls (PCBs). Marine plastic pollution can even reach birds that have never been at the sea through the food habits.

The plastic particles were found intact within the birds' gizzards and proventriculus along with the plastic debris, such as Styrofoam mixed with their feed. Small plastics such as bottle caps are often

mistaken by seabirds (*Procellariiformes spp*) for food. In several studies, it was found that diving birds that fed on fish in the water column had less plastic in their stomachs compared to those that were surface eaters (Blight and Burger 1997; Provencher *et al.*, 2010). This could be because birds that maintain a diet of zooplankton may not be able to distinguish between plastics and their primary source of food due to the color or shape of the plastic pieces (Avery-Gomm *et al.*, 2013). Since most adult birds regurgitate what has been ingested as a way to feed their chicks, they pass the bolus containing the plastic pieces onto their young. Birds such as the albatross and shearwater had more plastic in the first region of their stomachs and gizzards, indicating that when these plastics were regurgitated, they would be passed to their young during feeding (Moser and Lee 1992). Juvenile albatross and shearwaters were found to ingest more plastics than adults (Avery-Gomm *et al.*, 2013; van Franeker *et al.*, 2011). Similar to other marine life, swallowed plastic can obstruct and damage a bird's digestive system, reducing its foraging capabilities. (Ryan 1988) concluded that ingested plastics could reduce the fitness, growth rate, and food consumption of seabirds, based on the results from a study using domestic chickens (*Gallus domesticus*).

**Fish**: There have not been any found published studies about the effects of plastics on fish; nonetheless, there is plenty of evidence supporting that fish are consuming plastics. Many aquatic creatures use filter feeding as a passive way of feeding, and collect particles from the water that float by. This is energy efficient, which is good for such a remote area, but this also means that the microplastics that float by become a food source as well. The filter feeders at the bottom of the ocean would be primary consumers, and are vital to higher levels of the food chain. If they become disturbed by the microplastics, either due to clogging of filter feeding abilities or due to toxic effects from chemicals or pollutants in the plastics, then the deep aquatic ecosystem balance and biodiversity could be thrown off.

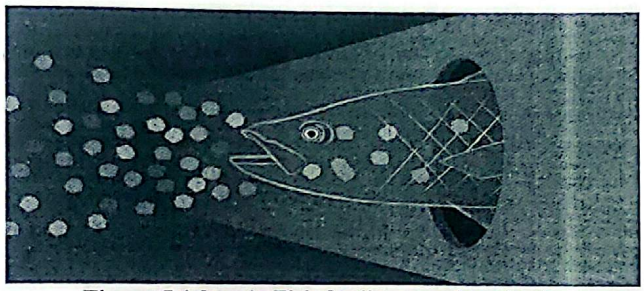

**Figure 5 (above):** Fish feeding on microplastic.

Microplastics present in the water makes it difficult for fish to distinguish because of their small sizes and color. Fishes tend to feed on the microplastics thereby causing damages to their digestive system.

## 4. Economic Importance of Plastic waste

Growing plastic consumption raises important challenges regarding environmental and health security. For what regards the environment, plastic is dangerous in a twofold way, both in its production and its disposal. At the production level most plastics are produced using petrol and natural gas, these sources, other than being non-renewable, are highly pollutant for ecosystems. Furthermore, due to the complexity and the costs of the recycling process, the great majority of the world's plastic ends up in landfills (ex. in the US 50%). Also, great quantities of plastic are dispersed into the open environment, and being plastic non-biodegradable, it can be around for a very long time. A consequence of this problem is plastic pollution in the oceans, with disastrous effects on the marine environment and its ecosystem. Furthermore, there are growing evidences connecting usage of many kinds of plastics to

some health-related issues. The two main health issues derived from plastic are the use of plastic polycarbonate, present in most food and drinks packaging and anything requiring clear and hard plastic, which has been linked to health threats such as chromosomal abnormalities, cancer and resistance to chemotherapy and the use of phthalate plasticizers, widespread softening agents (with very high quantities contained in PVC) that are considered carcinogen and dangerous for the endocrine system.

Plastic is considered a mono-use material, which is used for one purpose and immediately disposed, meaning that all its value goes immediately waste after its first use. In this regard, I will also analyze the idea of Circular Economy and how it would be possible to create a system in which non-recyclable plastic consumption is diminished, and the remaining plastic is fully recycled in a way to preserve all its value over time. Today, growing plastic production and consumption is posing serious threats, especially to developing countries, who often lack adequate facilities to dispose of such a difficult material, with tones of plastic being thrown in the open environment every year. Solving this issue is a need of primary importance in matters of environmental protection.

**Method of Safe Disposal of Non-biodegradable Waste: (a) Recycling:** Recycling is the process of converting waste materials into reusable objects to prevent waste. The materials from which the items are made can be reprocessed into new products. Recycling such material saves product and it also reduces the amount of manufacture to make new products. It also helps in energy saving and reducing global climate change. **(b) Incineration with energy recovery**: Most commodity plastics have gross calorific values (GCV) comparable to or higher than that of coal (Davis & Song 2006). Incineration with energy recovery is thus a potentially good option after all recyclable elements have been removed. It is argued that petrochemical carbon, which has already had one high-value use, when used again as a fuel in incineration represents a more eco-efficient option than burning the oil directly (Miller 2005). Reports by the Environment Committees of the UK Parliament (House of Commons 1993; House of Lords 1994) have supported the view that energy recovery for some types of household plastic wastes is an acceptable waste management option.

Trials conducted by the British Plastics Federation demonstrated that modern waste-energy plants were capable of burning plastic waste, even those containing chlorinated compounds such as PVC without releasing dangerous or potentially dangerous emissions of dioxins and furans (BPF 1993). **(c) Landfill:** Landfill refers the disposal of waste material by burying it. Landfills are extended storage area for non-biodegradable waste. Landfill is an area, which prevent contamination from the waste entering the area surrounding by soil and water and it also helps to reduce odour and pests. Landfills are dangerous to the environment as well as human health. Most landfills are open dumps that contaminate ground water, rivers, and lakes. When water is contaminated by landfills and consumed by animals and humans, it can lead to disease and death (Sutton & Turner, 2012). For example, a survey that was conducted in 2008 shows that 82% of landfills had openings that emit toxins into ground and surface water (Waste and Recycling Facts).

**Managing the Effects of Plastics:** The movement of plastics in our fresh water environments and the effects on wildlife has been researched for over 30 years. Knowledge about ocean currents gained from satellite-tracked Lagrangian drifters have been used to predict the trajectories of floating marine debris (Maximenko *et al.*, 2012; Martinez *et al.*, 2009). Lagrangian drifters are instruments that have been used in oceans, lakes, and rivers to measure water currents and to collect other environmental data such as temperature and salinity. Despite the ability to track waste movement, a solution to ridding our Earth's waters of plastic waste to minimize its effects on marine wildlife remains a challenge. These plastics inevitably make their way to the sea through networks of rivers and streams and then into the ocean gyres. Since the gyres are found in international waters, no country is taking responsibility for

cleaning up the oceans. Instead, several private organizations are working to solve the problem. Innovative technologies have been piloted by private companies to help identify, minimize, and eliminate plastics in our ecosystems including tracking trash through radiofrequency identification (RFID) tags and cellular transmitters, using drones or barriers to collect plastic debris, and turning plastics back into oil.

**Bans:** To reduce the use of plastic bags, some countries have banned plastic bags. Examples of countries and cities that have plastic-bag bans include Rwanda, Kenya, Bangladesh (ban on thinner plastic bags), Mexico City, China (ban on free plastic bags), Austin (Texas, USA), San Francisco (California, USA), and Oakland (California, USA). In 2007, San Francisco became the first U.S. city to ban the use of plastic bags (Clapp & Swanston, 2009). In Africa, Kenya and Rwanda have banned plastic bags, in 2017 and 2004, respectively. The Kenyan ban disallows producing, importing, or using plastic bags (Dunn, 2012). The ban on plastic bag in Kenya became effective in August 2017. The ban focuses on the production, importation, and uses of plastic bags. There is severe punishment for anyone who violates the rules of the ban. The first penalty is a jail time, and the second is an exorbitant fine. Violators must either pay the fine of $38,000, which is equivalent to 32,000euros, or 4-year jail sentence (BBC, 2017). Nigeria is the most populous country in Africa. It has a population of over 190 million people (UN, 2017). As such, Nigerians generate tons of waste daily, which includes single-use plastic bags. Traditional African societies, which had smaller populations, used native leaves use for wrapping items. Increase in the number of populations in Nigeria brings about the use of polyethylene in wrapping items (Akinro *et al.*, 2012; Aziegbe, 2007). In Nigeria, polyethylene is used in wrappers such as table water, biscuit, salt, and ice cream. Polyethylene bags are use in all markets, restaurants, homes, and shopping centers in Nigeria. These bags are found in the entire streets and corners of the country, for example in Edo State and Ondo State in Nigeria (Akinro *et al.*, 2012; Aziegbe, 2007). In Nigeria, most states and cities such as Ado-Ekiti encounter waste management problems as a result of poor management of waste (Adefemi & Awokunmi, 2009).

A study was carried out to investigate the seasonal variation of polyethylene generation and disposal in Akure City in Nigeria (Akinro *et al.*, 2012). In the study, five daily markets were randomly selected and, in each market two sites were used: the processed food section and raw food section. The results of the study showed that polyethylene is generated more during dry season than rainy season. The results also showed that sachets of table water are the major contributors to polyethylene waste followed by ice cream sachets and biscuits sachets. This is because sachet water is very cheap (ranging from 5 Naira to 10 Naira); therefore, it is consumed throughout the year (Akinro *et al.*, 2012). In 2017, during the 10th Global Environment Facility National Steering meeting in Abuja, Nigeria, the head of the Ministry of Environment noted the negative impacts of plastic bags and the government's wish to ban plastic bags (Sustyvibes, 2017). Although the government has not implemented this proposed ban, it would, when implemented, have widespread impacts across the country, given the reliance of millions of Nigerians on plastic bags for daily activities. The ban may be ineffective if the government does not enforce it or if the general public does not support it.

## 5. Recommendation

The future of aquatic ecosystem at local, national, and global scale depends on investments of individuals, communities, and governments at all political levels to ensure that our aquatic ecosystem are protected and managed in a sustainable manner, this includes not only practical solutions to the plastic waste problems, but changes in human behavior through public awareness and capacity building to better preserve the ecosystem, but various method of waste disposal should be implemented in every settlement.

## 6. Conclusion

Researches on worldwide production of plastics and the accompanied environmental pollution have shown that plastic wastes have constituted a major environmental issue. The effect of plastic wastes on fresh water organisms, humans and the environment at large are of public concern, and calls for the need to salvage the ecosystems and lives. Despite the fact that plastics are very useful in everyday life, the chemicals used in the production need to be thoroughly monitored so as to ensure environmental and health safety. Further research should be done on the effect of the chemicals, toxins, and invasive that can be a part of the plastic pollution and their effect on aquatic biota. The organisms which have a sessile nature and which feed opportunistically or through filter feeding have the biggest chance of being negatively affected by the plastic pollution. Further research is vital to discover even more about the effects of plastics on aquatic ecosystem, and to discover ways to mitigate certain harmful effects.

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