ASSESSMENT OF NEGATIVE EXTERNALITIES ASSOCIATED WITH PLASTIC WASTE IN FISHING COMMUNITIES ALONG OSUN RIVER IN OSUN STATE, NIGERIA

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ABSTRACT

Although there are existing studies on the effects of mismanaged plastic waste products on the general environment in Nigeria, there is scarce information on the effects of these ubiquitous products on the aquatic areas in the country, hence this study. This study assessed negative externalities associated with plastic waste in fishing communities along the Osun River in Osun State, Nigeria. In effect, the study sought to examine types of plastic waste in the study area, assess negative externalities associated with plastic wastes, evaluate the effects of water pollution, a negative externality, on artisanal fishing and the environment, and examine methods used by the communities in mitigating the negative effects of plastic wastes. Data were generated from primary sources. Two-stage sampling technique was used to collect data from 240 respondents using a structured questionnaire. The mean age of the respondents was 37.6 years, men dominated the population of fishers, 83.3% of them were married, and 85.8% were literate. Plastic water sachets, plastic bottles, and single-use nylon were common plastic wastes in the study area, but pure water sachets were most prevalent. Water and environmental pollution were the reported negative externalities associated with mismanaged plastic waste in the area. 91.2% of the respondents reported that water pollution had negative effects on fishing enterprise, and 87.1% reported that environmental pollution had negative effects on the fishing community and environment. 62.1% of the respondents used the incineration method, 30.4% pushed the wastes further into waterbodies and 7.5% landfilled the wastes. The use of the extended producer responsibility (EPR) principle is recommended to obligate industries in the wider life cycle of plastic materials to bear financial responsibility for plastic waste management.

Keywords: ***plastic waste, externalities, fishing, pollution, extended producer responsibility.***

INTRODUCTION

Nigeria is endowed with various sizes of waterbodies that constitute robust aquatic resources for the country. The country's inland waterbodies and coastline measure over 800 km and support about 1.5 million people who work in fish-based livelihoods (Bradley *et al.,* 2020). Close to one million metric tons of fish is produced by the country per year of which a lion-share is consumed domestically while about ten percent is exported. Small-scale capture fisheries, and coastal and inland fisheries are good sources of fish in Nigeria. Statistical records show that 57% of domestic fish production in the country in 2014 came from coastal and brackish waters while 43% was from inland waterbodies (National Bureau of Statistics, 2017). In Nigeria, the major fish production system is artisanal, and the small-scale fishers operate in various waterbodies, such as lakes, reservoirs, rivers, tributaries, and floodplains. Artisanal fisheries describe a fishing method where the fishers operate in small units, using simple and hand-operated equipment

(Akintola and Fakoya, 2017). The fishery subsector of the Nigerian economy provides employment, income, foreign exchange, nutrition security, and livelihoods for people living in riverine, coastal, and inland waters communities (Selig *et al.,* 2018).

Under natural conditions, water resources are prone to environmental and man-induced stresses. These resources can deteriorate very fast, particularly when the environment and man act concurrently to limit production. One important but unnoticed man-induced challenge facing inland water communities around the world today is the prevalence of plastic waste in water bodies. All over the world, almost all aspects of daily human life involve the use of plastics (McClure, 2021). Plastics are light, easy to handle, and economical materials commonly used in many sectors of human endeavor. The production and usage of plastics are globally increasing year by year and the growing trend is projected to continue at least over the next decade (Hahladakis *et al.,* 2018). From the beginning of its production, only 9% of the 9 billion tons of plastic ever produced has been recycled while the rest ended up in landfills, dumps, the environment, rivers, lakes, and oceans (Geyer *et al.,* 2017). In 2015, mismanaged plastic waste was estimated to be 52 million tons for Asia, 17 million tons for Africa, and 8 million tons for Latin America (Lebreton and Andrady, 2019). Plastic waste pollution has caused an estimated 1-5% decline in the benefits (social, economic, and environmental) that humankind derives from oceans (Beaumont *et al.,* 2019). Plastic wastes cause major marine debris around the globe today and can amount to more than 80% of debris in waterbodies in the nearest future if not properly managed. Both sea and land-based activities are responsible for the continued input of plastic in waterbodies, making it a ubiquitous global pollutant (UNEP, 2016).

The leakage of plastic waste into the environment and rivers is a significant challenge facing developing countries, aggravated by changing consumption patterns and weak waste collection services (UNEP, 2018a). In most underdeveloped countries, there is an inadequate supply of drinkable water and so, river water serves as a direct source of drinking water, irrigation, recreation, and fishing services. Oftentimes with these combined services that it renders, water quality is often depleted in those countries.

The impairment of rivers and many waterbodies in most settlements in Africa has been shown as the major source of insidious diseases, water pollution, ozone layer depletion, troubled biodiversity, declining fish, and general agricultural productivity (Oboh and Agbala, 2017). Of the large volume of single-use plastic applications in developing countries, only about 5% is collected and retained from recycling (Ellen MacArthur Foundation, 2016). Such a low rate of reuse implies that plastic disposal constitutes a significant negative externality to global economies, with its impacts now being manifested both in terrestrial and marine ecosystems. All around the world, plastic packaging externality on the global waterbodies which receive up to 8 million tons of plastic leakage annually is about USD 40 billion (UNEP, 2018b). Plastics are used in a variety of ways and are discarded within a year of production. In Africa, as in most underdeveloped countries, plastic recycling is done on an ad hoc basis; much solid plastic waste ends up in landfills, in rivers or is subject to illegal dumping in the environment as against the situation in the developed nations (Recycling magazine, 2020). The problem of plastic waste is a global and enduring challenge of waste management which now confronts humanity and it cuts across all sectors (Graves, 2019).

Just like any other commodities, there are externalities (both positive and negative) that can affect the production, processing, distribution, consumption, and even the environment where fishery resources are located. Externalities are benefits and costs that are not financially internalized by the responsible actors/producers. Consideration of these externalities can help decision-makers take corrective measures for environmental problems (Atela *et al.*, 2017). In Nigeria, every nook and cranny in most cities is littered with plastic sachet waste and plastic bottles, constituting a serious problem for the country. Increasing demand for packaged water will always lead to an increase in environment-related challenges such as flooding, and blocked water channels and drains. All these combine to cause pollution which invariably results in negative externalities to the environment and communities.

Despite the increasing literature on marine plastic contamination, there is very little information on the dangers that plastic waste poses to fishing production in inland waterbodies in Nigeria, hence, this study. The broad objective of the study is to assess negative externalities associated with plastic waste in fishing communities along the Osun River in Osun State, Nigeria. The specific objectives are to: examine the types of plastic wastes commonly found in the study area; assess negative externalities associated with plastic wastes in the study area; evaluate the effects of the identified negative externalities on artisanal fishing enterprise in particular and the environment.

MATERIALS AND METHODS

Study Area

This study was conducted in Osun State, Southwestern Nigeria. The map of the study area is shown in Figure 1. The State shares boundaries with Oyo, Ondo, Kwara, and Ogun States in the west, east, North, and south respectively. The State has a landmass of about 9,251 km^2. The State is made up of six zones namely Osogbo, Ile-Ife, Ede, Iwo, Ikirun, and Ijesa, covering 69 Local Government Areas (LGAs), Local Council Development Areas, and Area Offices. There are three agricultural zones (AZs) in the State namely Osogbo, Ife/Ijesa, and Iwo. Osun State has an estimated population of 3,763,074 as of 2014. It lies between latitude 7º 00` N to 8º 15`N longitudes 4º 00`E to 5o 15` E. Osun State is located within the tropical climatic region characterized by alternately dry and wet seasons (Adebayo *et al.*, 2021). The mean annual temperature of the State varies between 21.1 and 31.1 ºC. Annual rainfall is within the range of 1,000 mm in the derived savannah agroecology to 1,200 mm in the rainforest belt. The dominant occupation and economic activities of the people include farming, fishing, agro-allied productions, trading, and artisanship (Adebisi *et al.*, 2019).

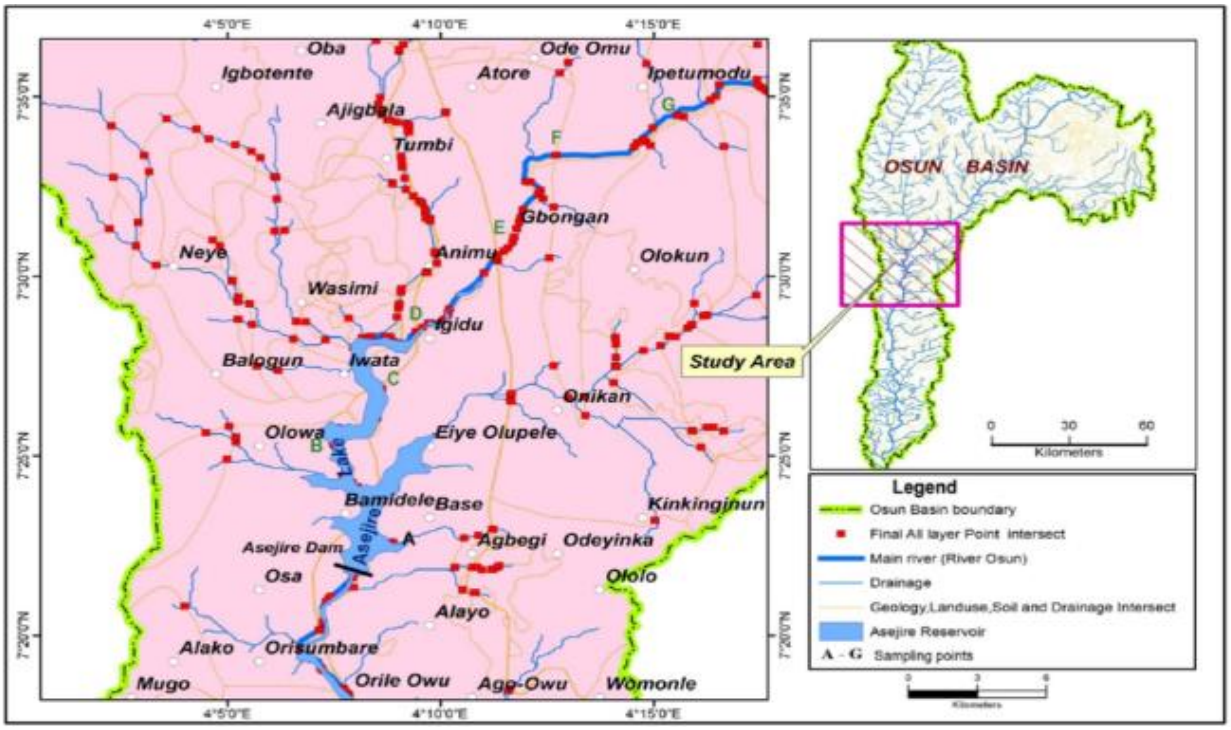

Figure 1 Map of Study Area
(Source: www.osunstate.gov.ng/geography.htm (2011))

Osun River lies on latitudes 08º 20`N and 06º 30`N and longitude 05º 10`N and 03º 25`E. The perennial river flows southwards through Southwestern Nigeria into the Lagoon in Lagos State. Osun River has its origin in Igede Ekiti, Ekiti State, and flows through many agricultural plains and cities. The drainage system of the Osun River rises in Oke-Imesi ridge, about 5 km North of Effon Alaiye on the border between Oyo and Ondo States. It flows North through the Itawure gap to latitude $7^0$53` before winding its way westwards through Osogbo and Ede and Southwards to enter Lagos Lagoon (Olayiwola *et al.*, 2019). Along the course of the Osun River are some important tributaries that allow the inhabitants of the location to engage in fishing enterprises as a means of livelihood. These tributaries include Asejire (Ikire), Osun (Ede), Gbodofon (Osogbo), Ahoyaya (Ikirun), Isin (Iree), Oyi (Oke-Ila), Osin (Ila-Orangun), Oloyo (Ibokun), Enja (Igbajo), Ashasha (Imesi-Ile), Ounseku (Oyan), Kankere (Awo), Aro (Ejigbo), Arenounyun (Otan-Aiyegbaju), Oba (Iwo), Moginmogin (Apomu), Ope (Araromi Owu), Awsein (Ifon), Ojutu (Ilobu), Anne (Okuku), Aro (Iragberi), Orufu (Bode Osi), Odoiya (Ilawo), Ishahsha (Odeomu), Adeti (Ilesha), Oni (Ijebu-Ijesha), Etioni (Ifetedo), Oyika (Iperindo), Olumirin (Erinjesha), Yeyekare (Esa-Odo) and Opa (Ile-Ife).

Sampling Technique

A two-stage sampling technique was adopted for the survey. The first stage was the purposive selection of the Asejire, Osun, Oba, Olumirin, Oyi, and Osin tributaries along the Osun River. This is because these tributaries constitute major communities where artisanal fishing activities take place along Osun River in Osun State. The second stage involved a simple selection of 40 fishers (fishermen and fisherwomen) from each fishing community using a snowball sampling technique. Thus, a total of 240

respondents were interviewed through the personal interview method using a pre-tested questionnaire.

Data Collection and Analysis

Primary data were used for the study and were obtained through interview schedules and structured questionnaires. The respondents used for the study consisted of fishermen and fisherwomen in the communities. Focus group discussion was also utilized. Other secondary information used in the study was sourced from internet articles and online journals. The questionnaire was administered by the researcher to the selected fishers in the study area. Proportions and percentages were used to analyze the descriptive data

RESULTS AND DISCUSSION

Socioeconomic characteristics of fisher folks in fishing communities along Osun River in Osun State

The socioeconomic characteristics of fisherfolks in the study area are presented in Table 1. The results of the study showed that the majority (75%) of the respondents were within the age (31-50) years, 11.7% were below age 30 years and 13.3% were in the age bracket (51-60) years. The mean age of the respondents was 37.6 years. This implies that the fishers in the study area are an economically active population. This result is in tandem with the finding of Benson *et al.* (2018) who reported that fishers in the coastal land of Lagos State were an economically active population. Male respondents dominated the population of the fishers in the study area with 96.7% while only 3.3% were female. The majority (83.3%) of the fishers were also married. This suggests that both men and women were involved in fishing, processing, and marketing activities. This result is in tandem with the finding of Bonjoru *et al* (2019) who reported that the majority of artisanal fishers in the Upper Benue River Basin were male. The result also is in line with the finding of Shahadul *et al* (2017) who reported that 85% of the fishers in Chapai Nawabganj District, Bangladesh were married. This could be linked to the fact that artisanal fishing activities demand some level of physical human labour, effort, and availability which can be supplied by immediate family members. The study results further showed that the majority (78.3%) of the fishers in the study area had a primary school level of formal education, 7.5% had a secondary level and 14.2% had no formal education. Education plays an important role in human life because it enhances assimilation, awareness, and receptivity of innovation. In the fishery subsector of agriculture, having formal education is an advantage to fishers. In all, 85.8% of the respondents were literate having primary and secondary education. In the comparison of capture efficiency of artisanal fishing techniques employed in River Benue at Mayo Ranewo, Ardokola Local Government Area, Taraba State, Bonjoru (2017) reported that the majority of the fishers were literate having primary and secondary education. The result also revealed that the majority (70.0%) of the fishers were involved in crop farming during the off-fishing season. 23.3% were into petty trading while 6.7% were civil servants. The fact that the majority of artisanal fishers in the study area engage in crop farming suggests that during the off-fishing season, there is always the need to sustain the livelihoods of families.

Types of plastic waste products commonly found in fishing communities along the Osun River in Osun State

Table 2 shows the various types of plastic waste that could be physically seen and/or observed in the study area. These include plastic sachet, nylon bags, and plastic bottles. The majority (53.8%) of the respondents reported that plastic sachet

waste was the common plastic waste in their communities, 28.3% reported plastic bottles while 17.9% reported single-use nylon bags. This finding is in consonant with the findings of Ohiomu *et al* (2020) who reported that 75% of the surveyed respondents in the study of the externality effects of sachet and plastic bottled water consumption on the environment in Benin and Okada, Nigeria drank sachet water and disposed the waste freely into the environment. Nyarko & Adu (2016) also reported similar findings in their study of the impact of sachet water and plastic bottle waste on agricultural land in Ada East District of Ghana, Ayisi, and Kumi. They reported that 76% of the respondents were drinking sachet water and would freely dispose of the waste in the agricultural area without caution.

Table 1: Socioeconomic characteristics of artisanal fisher folks in fishing communities along Osun River in Osun State

Variable	Category	Frequency	Percentage	Mean
Age (Yrs)	≤ 30	28	11.7	
	31 - 40	86	35.8	37.6
	41 – 50	94	39.2	
	51 – 60	32	13.3	
Gender	Male	232	96.7	
	Female	8	3.3	
Marital status	Married	200	83.3	
	Single	22	9.2	
	Divorced	18	7.5	
Education level (Yrs)	No formal educ.	34	14.2	
	Primary school	188	78.3	
	Secondary school	18	7.5	
Secondary occupation	Cropping	168	70.0	
	Petty trading	56	23.3	
	Civil service	16	6.7	

Table 2: Types of plastic waste products commonly found in fishing communities along the Osun River in Osun States

Fishing communities	Plastic sachet waste	Plastic bottle	Nylon bag
Asejire	24	12	4
Osun	22	13	5
Oba	23	10	7
Olumirin	20	12	8
Oyi	19	11	10
Osin	21	10	9
Total	129 (53.8%)	68 (28.3%)	43 (17.9%)

Negative externalities caused by plastic waste products in fishing communities along the Osun River in Osun State

Table 3 shows the results of the negative externalities associated with plastic waste as reported by the respondents in the six fishing communities covered by the survey. The results show that the majority (63.7%) of the respondents reported that plastic waste is the major cause of water pollution in the communities while 36.3% of them reported that environmental pollution in the communities is caused by plastic waste. One important quality of plastic products is their durability. However, this quality when combined with improper waste management leads to environmental contamination on land and in freshwater environments. Plastic products degrade slowly over time, particularly when exposed to sunlight and high temperatures. This degradation leads to the breakdown of materials into smaller sizes ranging from the macroscopic to the microscopic and eventually to nanoplastics. Ingestion of microplastics has been observed in many species of aquatic organisms, including commercially important fish and invertebrates (GESAMP, 2016). The outcomes of these results suggest that since a greater proportion of plastic packaging is for single-use, either as packaging or as items intended to be used only once before they are disposed of as waste, often incorrectly, the consequential wastes found themselves in waterbodies and the immediate environment.

The incorrectly disposed items are carried by wind and flood into waterbodies, causing water pollution. Similar observation and report was given by Ellen MacArthur Foundation (2016). The Foundation reported that only 5% of the large volume of single-use plastic applications in Europe is retained from recycling and such low rate of reuse implies that plastic disposal constitutes a significant negative externality to global economies, with its effects now being manifested both in terrestrial and marine ecosystems. Ohiomu *et al* (2020) also reported that the production and consumption of sachet and plastic bottled water pose serious harm to the environment and river channels. Ferronato and Torretta (2019) equally reported that rapid urbanization in many African cities, compounded by failure or lack of appropriate waste management infrastructure and policy implementation, has resulted in plastic waste not being properly collected, causing increasing water and environmental pollution. McClure (2021) reported that the waters of Lake Victoria and Lake Nkuru in Nairobi, Kenya are being choked to death by pollution that is caused by illegally and improperly disposed of plastic waste, agricultural contaminants, and raw sewage.

Table 3: Negative externalities caused by plastic waste products in fishing communities along Osun River in Osun State

Fishing communities	Water pollution	Environmental pollution
Asejire	27	13
Osun	24	16
Oba	28	12
Olumirin	26	14
Oyi	23	17
Osin	25	15
Total	153 (63.7%)	87 (36.3%)

Effects of water pollution caused by plastic wastes on fishing enterprise in the fishing communities along Osun River in Osun State

Results from this study show that water and environmental pollution are the most common negative externalities associated with improperly disposed and mismanaged plastic wastes in the study area. The perceived negative effects of water pollution on fishing enterprises are presented in Table 4a. The results show that the majority (91.2%) of the respondents reported that water pollution has significant negative effects on the fishing business, 6.3% of them reported that the pollution has moderate effects while only 2.5% said it does not affect the fishing business. There are global concerns that fish and fishery products may be contaminated with microplastics and their associated contaminants. The concerns are based on potential implications for food safety and human health, marketability as well as potential impacts on food security in local contexts.

The results of this section suggest that the effects of water pollution are thoroughly catastrophic, causing harm to plant and animal life and greater vulnerability to vulnerable people and communities. The reason for this unpleasant occurrence is that Africa's population is consistently increasing while infrastructural development is crawling. The burgeoning population is causing a massive rise in the production and consumption of single-use plastics, improperly disposed wastes, and the resultant increase in water pollution. The pollution is slowly killing waterbodies throughout Africa. Water pollution causes fish species to die off in massive numbers, thus having catastrophic effect on the food chain as local populations rely on these waterbodies for survival and their livelihoods. In the course of the in-depth interview with the respondents, some important negative effects of water pollution on fishing enterprise include an increase in algae abundance in rivers which harmfully affects planktons, macrobenthos, macrophytes, and other numerous fish species and general aquatic life. These results implied that water pollution leads to the reduction or loss of aquatic species because they are sensitive to pollutants. Pollutants are active in damaging aquatic organisms both morphologically and metabolically. According to the respondents, deoxygenation due to water pollution decreases the light level and settling materials, leading to drastic mortality of aquatic organisms.

The respondents further reported that water pollution through plastic waste has negative effects on nutrient and water flow, the surface temperature of sand and sediment, as well as on food webs such as zooplankton and crustaceans. They equally reported that ecosystems are destroyed by the rising temperature in the water. The warm water forces indigenous water species of various types to seek cooler water in other areas, causing an ecologically damaging shift and reduction in the aquatic populace of the affected fishing communities. Many times, plastic bags, sachet water nylon, and plastic bottle wastes can get aquatic animals caught and killed from suffocation. The immediate consequence of this is a decline in artisanal fish production with a resultant decline in the livelihoods of the local fishing communities. These arguments are supported by published articles such as Galloway and Lewis (2016); Villarrubia-Gomez *et al.* (2018); McClure (2021) and Suleiman and Abdulkadir (2017) who separately reported that unwanted items through water pollution leads to changes in habitat, breeding conditions and food availability of various marine species which could result in marked population declines of aquatic animals and loss of livelihoods of

fishing communities. UNEP (2016) also reported that economic impacts of waterbody litter include loss of income, cost of cleanup, reduced fisheries stock or reduced tourism.

Table 4a: Effects of water pollution caused by plastic waste products on fishing enterprise in fishing communities along Osun River in Osun State

Fishing communities	Significant negative effects on the fishing enterprise	Moderate negative effects on fishing enterprise	No negative effects on the fishing enterprise
Asejire	36	3	1
Osun	39	1	0
Oba	32	6	2
Olumirin	35	3	2
Oyi	37	2	1
Osin	40	0	0
Total	219 (91.2%)	15 (6.3%)	6 (2.5%)

Effects of environmental pollution caused by plastic waste products on fishing communities along Osun River in Osun State

Table 4b presents the results of the respondents' perceived negative effects of environmental pollution associated with plastic waste on the fishing communities along the Osun River in Osun State. The results show that the majority (87.1%) of the respondents reported that environmental pollution caused by plastic waste constitutes significant negative and damning effects on the communities, 9.2% of them believed that the negative effect is moderate while only 3.7% said the pollution does not have any negative effect on the communities.

According to the majority of the respondents in all the fishing communities, improperly disposed of plastic wastes causes blockage of water channels, land pollution, air pollution, and water pollution (Table 4c). The blockage of water channels results in flooding due to the accumulation of solid wastes in streams and rivers. These results suggest that the plastic waste materials in the study area are randomly and improperly discarded, creating waste-disposal problems for the communities. As reported by the respondents, the economic and environmental implications of these plastic wastes are increasing very significantly as they block domestic sewage systems, choke water drains, threaten aquatic life in receiving water systems, cause soil degradation, and reduce biodiversity and the aesthetic of the rural communities.

When the wastes are burnt, they constitute air pollution to the immediate communities. This finding is in consonant with the finding of the United Nations Environment Programme (2018) where it was reported that the leakage of waste plastic into the environment is a significant challenge facing developing countries, aggravated by changing consumption patterns (which includes increased consumption of packaging, in particular, plastic) and weak waste collection. Also, Suleiman and Abdulkadir (2017) reported that plastic waste materials cause water and environmental pollution which leads to recurrent flooding in many local communities in most parts of Nigeria. Philips *et al.* (2020) reported that the United Nations Environment Programme (UNEP) estimates show that plastic packaging externalities now amount to USD 40 billion,

for which a major share is attributable to impacts on the world's oceans which receive up to 8 million tonnes of plastic leakage annually. They also reported that mass production and consumption of plastics have led to the accumulation of plastics in natural habitats and adverse impacts on biota and the economy. According to their report, environmental impacts include habitat damage, entanglement and ingestion of marine litter by biota, and the introduction of non-native species.

Table 4b: Effect of environmental pollution caused by plastic waste products on fishing communities along Osun River in Osun State

Fishing communities	Significant negative effects on fishing communities	Moderate negative effects on fishing communities	No negative effects on fishing communities
Asejire	33	5	2
Osun	35	4	1
Oba	38	2	0
Olumirin	34	3	3
Oyi	32	6	2
Osin	37	2	1
Total	209 (87.1%)	22 (9.2%)	9 (3.7%)

Table 4c: Effects of improper disposal of plastic wastes on the environment in fishing communities along Osun River in Osun State

Fishing communities	Blockage of water channels and its attendant negative effects	Land pollution and its attendant negative effects	Air pollution and its attendant negative effects	Water pollution and its attendant negative effects
Asejire	36	35	38	33
Osun	33	39	33	35
Oba	38	37	36	36
Olumirin	37	40	34	32
Oyi	34	36	37	37
Osin	38	33	35	36
Total	216	220	213	209

Methods adopted by the fisher folks to mitigate the physical negative effects of plastic waste products in the fishing communities along the Osun River in Osun State

Table 5a shows the results of the methods used by the respondents to reduce the physical negative effects of plastic waste in the surveyed fishing communities. The results show that the majority (62.1%) of the respondents collect plastic wastes and incinerate them directly, 30.4% of them push the wastes further into waterbodies while only 7.5% of them collect the waste and landfill. The findings of this study suggest that incineration of plastic waste is a cheap means of mitigating the menace of single-use plastics in the study area. Plastic incineration is followed by pushing plastic wastes further into waterbodies since it is another cheap method of getting rid of the plastic packaging materials that are wrongly discarded into water channels. Landfilling of plastic wastes is the least method practiced

by the respondents in the study area. This might be because of the cost implication of digging up land for waste disposal.

From Table 5b, although the majority (88.8%) of the respondents confirmed that they are aware of the negative environmental effects of incineration (burning) of plastic waste, such as air pollution, fire disasters, and ozone layer depletion, they still could not help but continue with this seemingly simple but illegal method, as it is a cheaper option when compared with other methods. This finding is in line with the finding of Geyer *et al* (2017) who reported that in 2015, about 26% of the plastic waste produced worldwide was incinerated, usually along with other municipal and industrial solid wastes. This could have been a good source of energy for the country, given the right technology. This is because plastic wastes have a notable potential for energy generation. After all, the calorific value of plastic is similar to that of hydrocarbon-based fuel (Sun *et al.,* 2018). Also, for the iron and steel industry, the use of plastics instead of conventional energy sources reduces the carbon footprint by 30% and leads to energy savings, given the higher hydrogen content of plastics (Devasahayam *et al.,* 2019).

The method of pushing plastic wastes further into waterbodies appears to be the cheapest method of overcoming the problems associated with plastic waste for the respondents in the surveyed area at least in the very short run. From an environmental point of view, this method is crude, unhygienic, environmentally unfriendly, and illegal. It is another way of creating environmental and water pollution for the people at the receiving end. Such a method should be timely discouraged by policymakers.

Table 5a: Methods adopted by the fisher folks to mitigate the physical negative effects of plastic wastes in the fishing communities along Osun River in Osun State

Fishing communities	Collect and incinerate	Collect and landfill	Push further into waterbodies
Asejire	26	2	12
Osun	27	4	9
Oba	24	1	15
Olumirin	25	5	10
Oyi	22	3	15
Osin	25	3	12
Total	149 (62.1%)	18 (7.5%)	73 (30.4%)

Table 5b: Fisher folks awareness of the negative environmental effects of incineration of plastic waste in the fishing communities along Osun River in Osun State (examples of the negative effects are air pollution, fire disaster, ozone layer depletion)

Fishing communities	Aware	Not aware
Asejire	38	2
Osun	33	7
Oba	37	3
Olumirin	34	6
Oyi	35	5
Osin	36	4

Total	213 (88.8%)	27 (11.2%)

CONCLUSION AND RECOMMENDATIONS

The study revealed that the commonly found plastic waste in the study area was plastic sachet. Water pollution and environmental pollution were the negative externalities associated with plastic waste. These pollutions had significant negative effects on fishing enterprises and fishing communities in the study area. Fishers only collect and incinerate plastic waste to mitigate the physical negative effects of plastic waste. From the findings of this study, it has become evident that the persistence of plastic pollution in aquatic environments could have profound implications for the long-term subsistence of aquatic animals in the country.

The study therefore made the following recommendations: Firstly, policymakers should make use of the principle of extended producer responsibility (EPR) for the packaging of plastic waste. Secondly, the users of disposable plastic products should be educated on the proper way of disposing of plastic waste products after use. Thirdly, local and state governments should employ casual workers as packers of plastic waste products that are improperly disposed into the environment for recycling purposes.

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