



COMBINING EXTENDED PRODUCER RESPONSIBILITY (EPR) AND DEPOSIT REFUND SYSTEM (DRS) POLICY FOR HIGHER RECOVERY AND RECYCLING OF PLASTIC BOTTLES AND SACHET WATER WASTE: APPLICATION OF VENDING MACHINE AND DESIGNATED RETURN DEPOT CENTRE IN LAGOS, NIGERIA

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ABSTRACT

Waste management (Plastic, PET Bottle, Can, and Glass Bottle, mostly from drink and beverage packages) is an important issue in today's world, as the volume of waste increases daily. This is especially important in developing countries like Nigeria, where there are no strong institutionalized frameworks for waste management, and as a result, increasing waste poses a threat to human well-being. Given the increase in population in these countries, it is necessary to adopt sustainable and practical solutions. Especially in Lagos, where the environmental problem of plastic waste is on the rise. Although the government is making commendable efforts to reduce the increasing volume of plastic waste in the state, they are insufficient, as it has been reported that plastic waste accounts for 15% of total waste volume according to the Lagos state waste characterization index. However, with the rise in various environmental problems caused by plastic waste, this paper proposed combining the extended producer responsibility (EPR) and deposit refund system (DRS) to achieve a high rate of recovery and recycling of waste plastic bottles and sachets. The innovative approach used green technology (vending machine) as well as indigenous knowledge are practical solutions in Lagos state. The paper is also significant because it intends to implement the developed solution in a dense urban and rural setting in Lagos, which can be replicated in other states in Nigeria. Furthermore, the components discussed in this paper are elements that allow the proposed concept to function effectively and efficiently. The proposed concept will serve as a link between Lagos and Nigeria's current linear economy and the future circular economy of plastic production and management.

Keywords: *Deposit-Refund System, Extended Producer Responsibility, Nigeria, Plastic Waste, Producer Responsibility Organization, Vending Machine.*

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INTRODUCTION

Developing economies, including Nigeria, had already integrated specific environmental policies on a national level, such as the Extended Producer Responsibility (EPR) policy, to advance the management of product end-of-life cycles and environmental improvement of the plastic and other recyclable materials. Following a public consultation with various stakeholders, policymakers, and environmentalists, the Nigerian Federal Ministry of Environment adopted the EPR policy in 2014 via the National Environmental Standards and Regulations Enforcement Agency (NESREA) (NESREA, 2018). NESREA was established to ensure that Nigeria complies with international environmental agreements, protocols, conventions, and treaties. Following the adoption of the EPR framework, the agency issued detailed guidelines for its implementation in Nigeria. The guidelines' implementation requires manufacturers/producers to develop plans to improve, design, recover, and recycle plastic waste (Ajania and Kunlere, 2019). Since the publication of the guidelines for the implementation of the EPR program, none of the Nigerian states has been able to incorporate the policy into its waste management legislation. It could thus be concluded that the failure to implement the EPR program is due to the growing environmental problem of plastic waste, which includes plastic water bottles and water sachets in Lagos state. Lagos State is Nigeria's economic hub, with numerous investors in small, medium, and large-scale businesses of packaging plastic bottles and sachets of water for consumers. This plastic packaged in bottles and sachets of water is considered a desirable method of drinking water in Lagos and several other Nigerian states because of insufficient access to potable water supply, reflecting the lack of sustainable clean water supply.

Despite this, the desire for more water intake occurs primarily during the dominant dry season (hot and dry season). During this season, consumers purchase plastic packaging water for drinking from vendors, mostly to consume, and the empty plastic waste is eventually discarded indiscriminately in the environment. Then, this situation exacerbated the environmental problem of plastic waste, resulting in street littering, clogging drainage systems, and polluting waterways, among other things. This reaffirmed the declaration that plastic waste is a serious environmental problem (GESAMP, 2016; Richard, 2017; Werner et al., 2016). Because of this, the Lagos State Environmental Protection Agency (LASEPA) and Lagos Waste Management Authority (LAWMA) setup some initiatives to address the evolving environmental problem of plastic waste and to improve societal environmental literacy and responsibility, such as environmental education, advocacy, and awareness, among other things (LASEPA and LAWMA, 2022). In addition to this, LAWMA also launched the Lagos Recycle initiative by utilizing (PAKAM application), a smart waste collection and reporting software application. PAKAM operating software allows households to schedule waste pickup and drop-off, particularly for recyclable materials and offers resource recovery and recycling solutions for both small and large businesses (LAWMA, 2022). All these initiatives are commendable, but they are insufficient, as it has been reported that plastic waste accounts for 15% of total waste volume generated in Lagos state due to its various uses (see Figure 1).

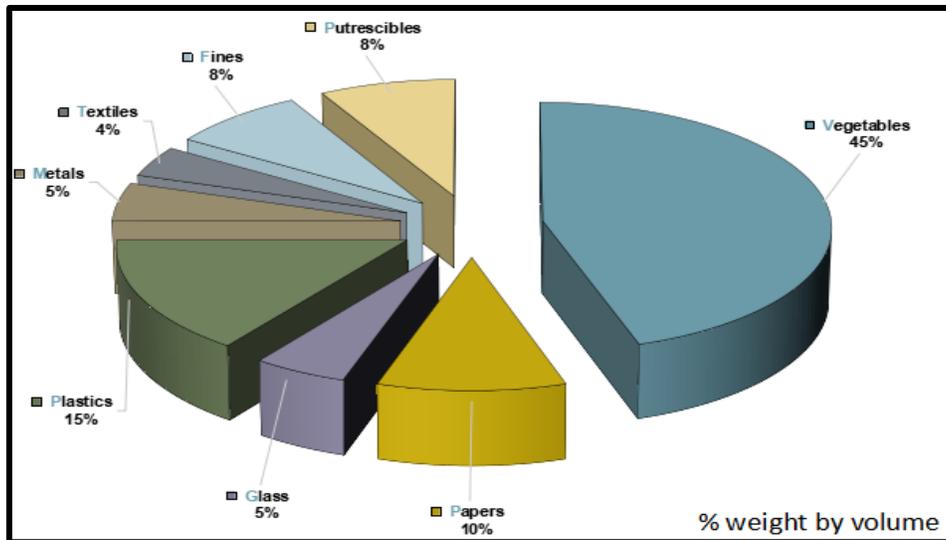


Figure 1: Lagos State Waste Characterization

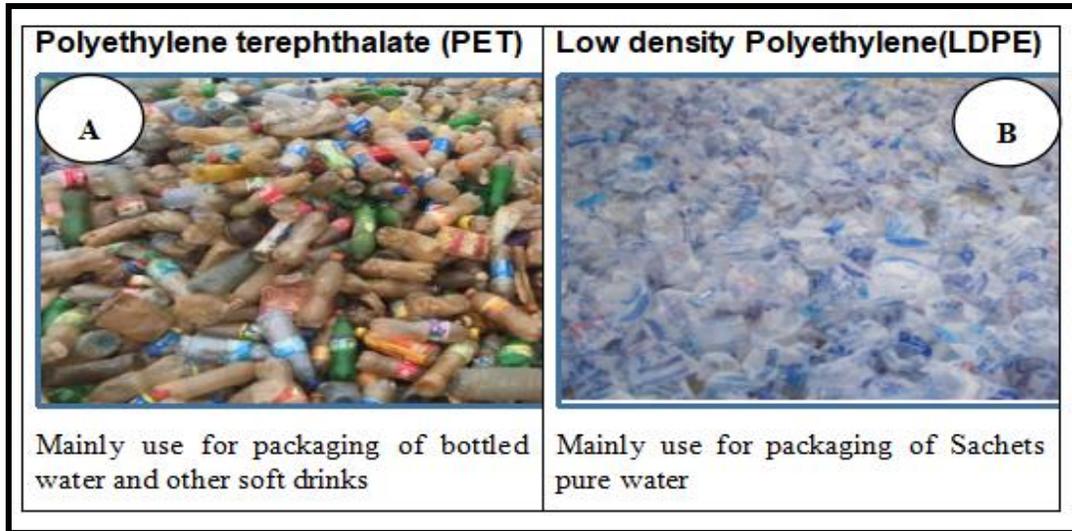
Source: LAWMA, 2015

As the state of Lagos struggles with increasing plastic waste, combining EPR and DRS to achieve a high rate of plastic waste recovery and recycling remains the preferred option. As a result, this paper is critical because it addresses how to achieve a high rate of recovery and recycling of plastic bottles and sachets water waste in Lagos state, by utilizing an innovative approach that incorporates green technology. The paper is also significant because it intends to implement the developed solution in a dense urban and rural setting in Lagos, which can be replicated in other states in Nigeria. The concept in the paper is necessary as a path to the circular economy of plastic production and management. This is the first paper of its kind to propose a policy, green technology, and indigenous knowledge approach that has the potential to solve a significant portion of Lagos state's plastic waste problem.

SOURCES AND CONSEQUENCES OF PLASTIC BOTTLES AND SACHETS WATER WASTE IN LAGOS STATE

Lagos has been named one of the world's fastest-growing cities (LBS, 2010). It is divided into 20 local government areas (LGA) and 57 local council development areas (LCDA), and its population in 2015 was estimated to be 23 million people. (Lagos State Government, 2015, Demographic Dividend). According to the Lagos Eko Project (2013), the metropolitan area of the state covers at least 37% of the landmass and is home to approximately 85% of the city's residents. The population, urbanization, and industrialization of Lagos state continue to increase daily. The rate, size, and density of population growth all have significant implications for waste generation and management in the state. This could explain why plastic waste accounts for 15% of the total waste volume generated in Lagos state (LAWMA, 2015). The primary type of plastic associated with waste environmental problems in Lagos state is polyethylene, under the classification of polyethylene terephthalate (PET) and low-density polyethylene (LDPE) (Figures 2 A-B). However, it is also reasonable to assume that Lagos resident's consumer a variety of plastic bottles of water, soft drinks, and sachet water throughout the day. It can therefore be assumed that plastic waste derived from polyethylene

will double the total number of municipal waste tonnes if a sustainable policy and management are not urgently instituted.



Figures 2 A and B: Common types of plastic associated with environmental problems in Lagos state

It can be argued that every day, many plastic wastes including bottles and sachets of water waste are discarded into the environment, which are not biodegradable and thus has a negative impact on the physical environment in a variety of ways. These plastics have exacerbated Lagos state's environmental waste management problem, eventually polluting waterways, clogging drains, causing water and sewage to overflow, and potentially degrading the environment (see Figures 3 A-D).



Figures 3 A, B, C, D: Plastic Bottles and Sachets Water Waste Environmental Problem in Lagos state

The current state of the environment is then assumed to be the result of increased plastic production without management of its waste end-products. To achieve a sustainable environment, it is necessary to address the current environmental problems in Lagos state caused by plastic waste, which will then be addressed in this paper.

EPR AND DRS POLICY IN NIGERIA CONTEXT

In several developed countries, EPR and DRS policies have been found to be the most effective measures for combating single-use plastic waste. The use of EPR and DRS in countries such as Denmark, Norway, and Sweden have aided in the recovery of plastic bottles and other recyclable materials. Developing countries like Nigeria, for example, adopted and implements the EPR policy in the year 2014 through the National Environmental Standards and Regulations Enforcement Agency (NESREA, 2018). The implementation of the EPR policy in Nigeria requires manufacturers/producers to be financially and physically responsible for the management of their end-of-life products in accordance with the NESREA guidelines for companies and multinationals (NESREA, 2018; Ajanja and Kunlere, 2019). The multinationals then responded by establishing collective responsibilities for the EPR program's implementation in Nigeria. They formed collective responsibilities as Producers Organization Responsibility (PRO) under the name Food and Beverage Recycling Alliance (FBRA), and they partnered with various non-governmental organizations (NGOs) initiatives and small-scale individual companies to act as collectors on their behalf (see Figure 4 below).

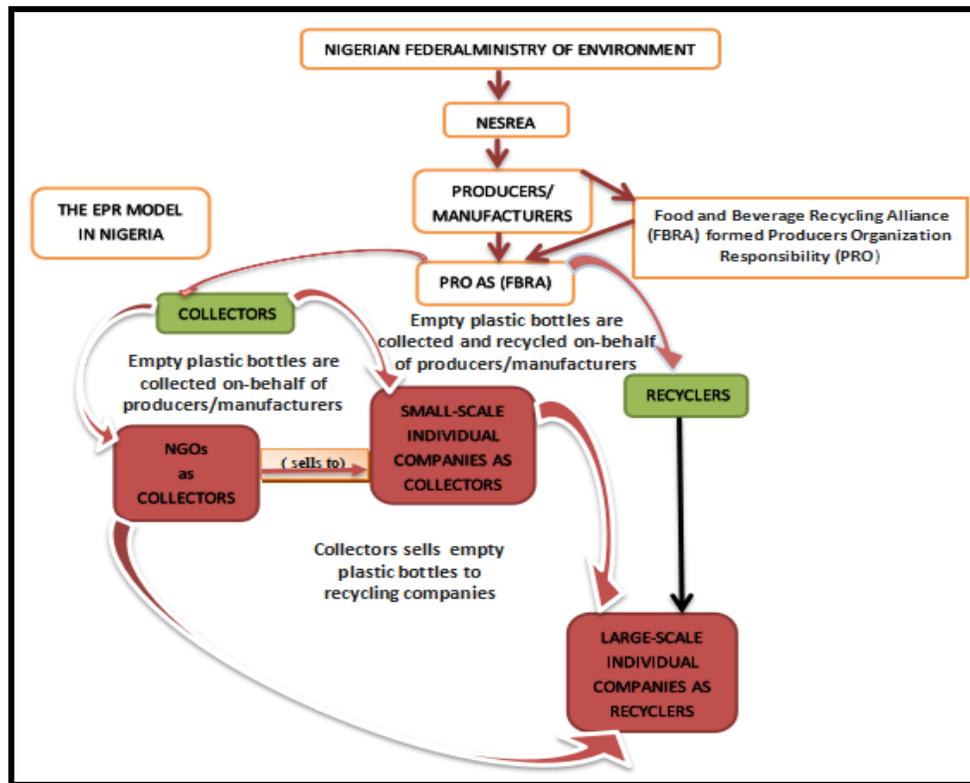


Figure 4: Summary of the PRO in place for collecting recyclable beverage containers such as plastic bottles in Nigeria

Source: Modified from NESREA, 2018

Figure 4 shows how FBRA worked with non-governmental organizations (NGOs) and small businesses to achieve their Producers Responsibility Organization. Some of these NGOs and small businesses have already developed strategies for collecting plastic bottles, aluminum cans, and other recyclable items from consumers and selling them directly to large-scale recycling companies. Recycling Point and We-cyclers are two examples of these businesses (see Figures 5 A-B below).



Figures 5 A and B: Collection Strategies for Plastic Waste Used by Recycle Points and We-Cyclers

As illustrated in Figures 5 A-B above, these businesses have successfully developed a working strategy for the recovery of recyclable items. They have successfully established a collection method that works as a bonus system with customers, with each item collected accruing happy points that can be exchanged for a reward at various designated redemption centres. Despite the efforts of non-governmental organizations and small businesses, Nigeria's environmental problem with plastic waste worsens. Therefore, combining the use of EPR as well as the DRS is critical considering Nigeria's growing plastic waste problem. The DRS is a policy that employs a deposit incentive at the point of sale, with the deposits serving as refunds on specific products purchased (ET Quartey et al., 2015). Under this policy, consumers receive their initial deposit as financial compensation for returning empty goods. Economic incentives, such as deposit refunds, encourage consumers to return empty environmentally hazardous goods, such as used empty plastic bottles, thereby closing material loops. Furthermore, the DRS is like the traditional system for returning empty bottles established by a few Nigerian multinational corporations, including Coca-Cola Company and Nigeria Breweries Plc. Thus, the EPR and DRS will be discussed as a combined concept addressing the environmental problem of plastic waste through resource efficiency, aftercare-free waste treatment, and environmental protection.

CONCEPT OF EPR AND DRS FOR PLASTIC WASTE RECOVERY AND RECYCLING IN CONTEXT OF EMPTY PLASTIC BOTTLES AND SACHETS WATER WASTE

The proposed concept for the recovery and recycling of plastic bottles and sachets of water waste is divided into two and can only be effective with the following set of supported components.

CONCEPT 1: EPR AND DRS ON EMPTY PLASTIC BOTTLES WASTE USING A COLLECTION (VENDING) MACHINE

In this concept, the producers/manufacturers will assume full management responsibility by committing all financial and operational resources to collect empty plastic bottles waste in the environment as a result of their product entering the market. With the proposed EPR program, producers/manufacturers must join a unified organized body and pay a licensing fee based on the type and amount of plastic bottles and sachets waste introduced into the market because of their product sales activities. The licensing fee will be used to cover the costs of recovering, sorting, and recycling plastic bottles and sachets waste. Similarly, the license will be issued only to producers/manufacturers who have integrated themselves into this unified organized body and will allow them to operate and sell packaged plastic bottles and sachet water. In addition, the license will include a symbolic logo that will be placed on each packaged plastic bottle or sachet water produced/manufactured for market consumption. The signifying symbol logo will inform consumers that such packaged plastic bottle sachet water is subject to a deposit and refund fee and must be recovered for recycling by the organized body. Producers/manufacturers and other stakeholders in the packaged water industry will also establish a consumer "deposit fee" as an incentive based on the initial amount purchased for a specific packaged plastic bottle and sachet water. This incentive is intended to motivate and raise consumer environmental awareness about pollution and littering, particularly with empty plastic bottles and sachet water waste. Similarly, the deposit fee must be valuable enough to achieve high collection rates to reduce consumers' waste littering and pollution from plastic bottles and sachet. The author suggests that the consumer deposit fee be refunded via a digital or retail reward system. The digital system will employ a reverse vending machine (collection machine) into which customers can easily insert their empty plastic bottles to be crushed and compressed to receive their refund. Before, crushing and compressing the empty plastic bottles, the collection machine will automatically scan for the symbol logo indicating such plastic for refund and will display a printable receipt/voucher for the total value of the inserted empty plastic bottles. The collection machine will also be useful for collecting other recycled beverage containers made of metal, glass, and aluminum, which can easily be converted into secondary raw materials. In Germany the use of a collection machine to recover empty plastic bottles has proven to be extremely successful (see Figure 6 below).

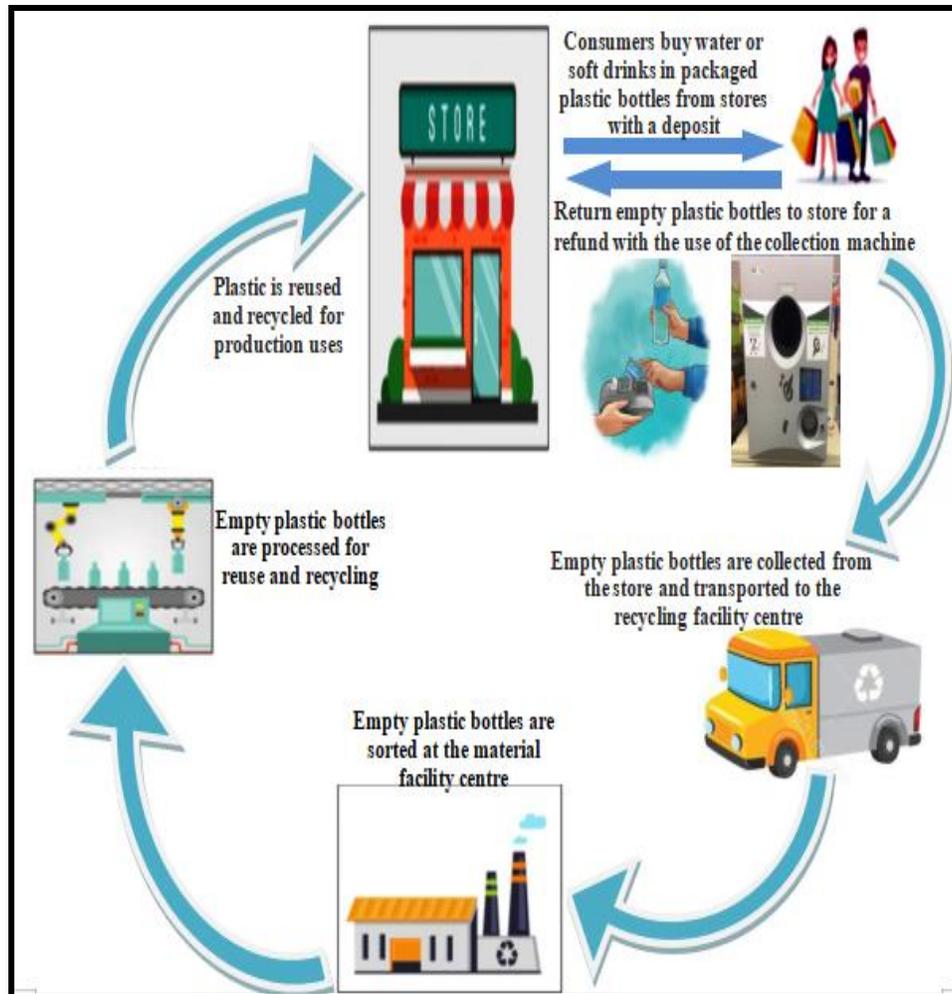


Figure 6: EPR With Deposit-Refund System on Empty Plastic (Drinking) Bottles Waste Using a Collection (Vending) Machine.

The collection machine, as seen in Figure 6, is used to recover empty plastic bottles, and this process can be repeated across all Nigerian states. To achieve a high recovery rate of plastic bottles waste in Lagos state, the collection machine will be placed at strategic waste-inclined points such as public and private schools, central bus stations, and marketplaces.

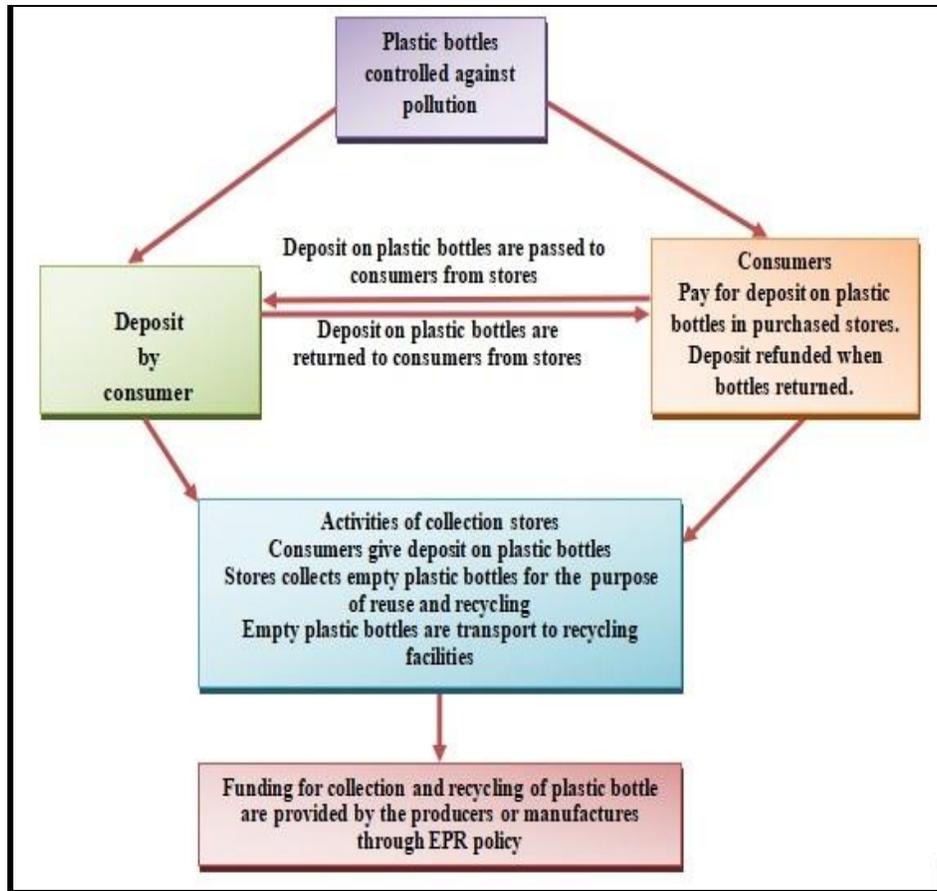


Figure 7: Empty plastic Bottles Controlled Against Pollution and Littering Through the concept EPR and DRS Program

Figure 7 indicates how plastic bottles will be controlled against pollution and littering through the concept EPR and DRS program on plastic (drinking) bottles using a collection (vending) machine.

CONCEPT 2: EPR AND DRS ON EMPTY PLASTIC BOTTLES AND SACHETS WATER WASTE WITH DESIGNATED RETURN DEPOT CENTRES

This concept allows consumers to return their plastic bottles and sachets of water waste to designated depot, drop-off, or purchase return centres via a retail reward system. Consumers will receive a printable receipt/voucher after returning their empty plastic bottles and waste sachets to the designated depot, drop-off, or purchase return centres under the retail reward system. Also, consumers who return their empty plastic bottles and sachets will receive a printable receipt/voucher, which can then be used to redeem points instantly or store accumulation of points for purchase goods at some strategic shopping centres like ShopRite, food centres like Mr. Biggs, and KFC. Example of drop-off return centers, which allow people to return empty plastic bottles to a designated depot, have proven to be successful in Canadian provinces such as Alberta and Saskatchewan (see Figure 8 below).

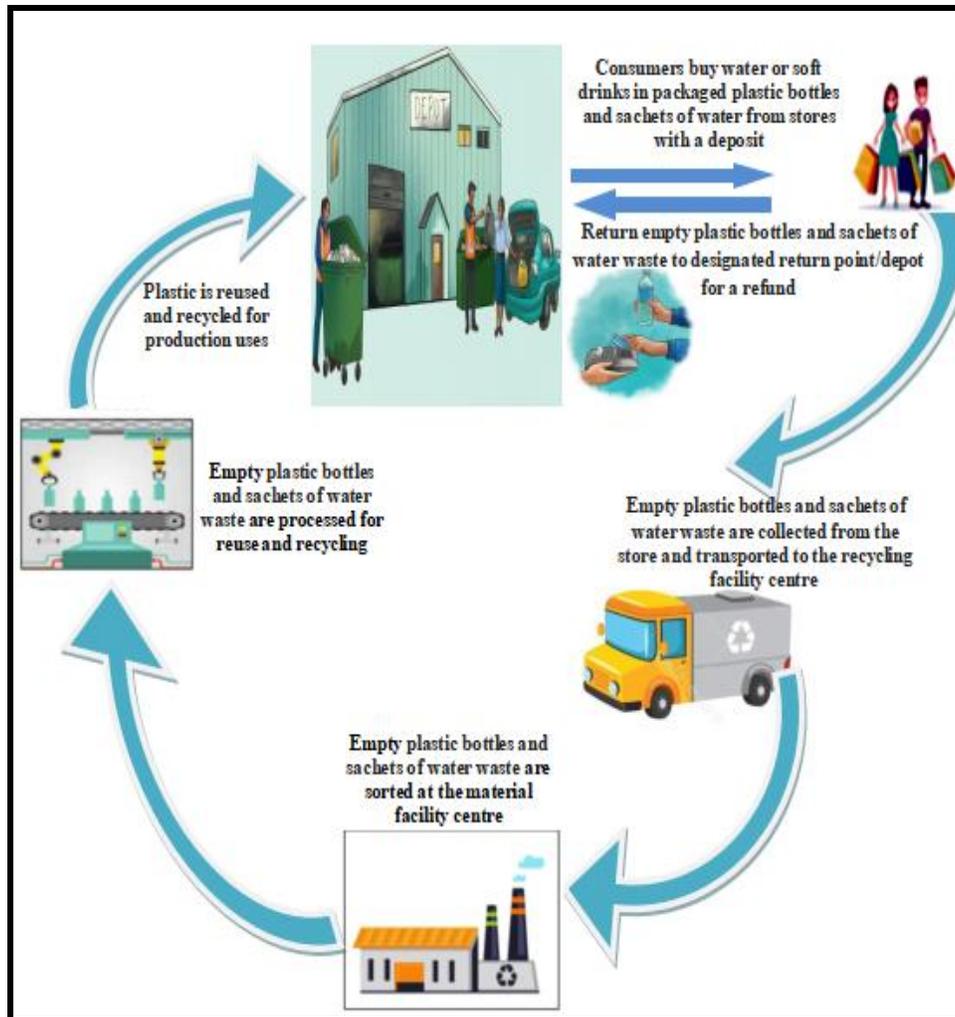


Figure 8: EPR With Deposit-Refund System on Empty Plastic (Drinking) Bottles and Sachets of Water Waste with Designated Return Depot Centres

As illustrated in Figure 8, the designated return depot can be used in all Nigerian states to recover empty plastic bottles and sachets of water waste, with depot or purchase return points assigned near the consumer's convenience.

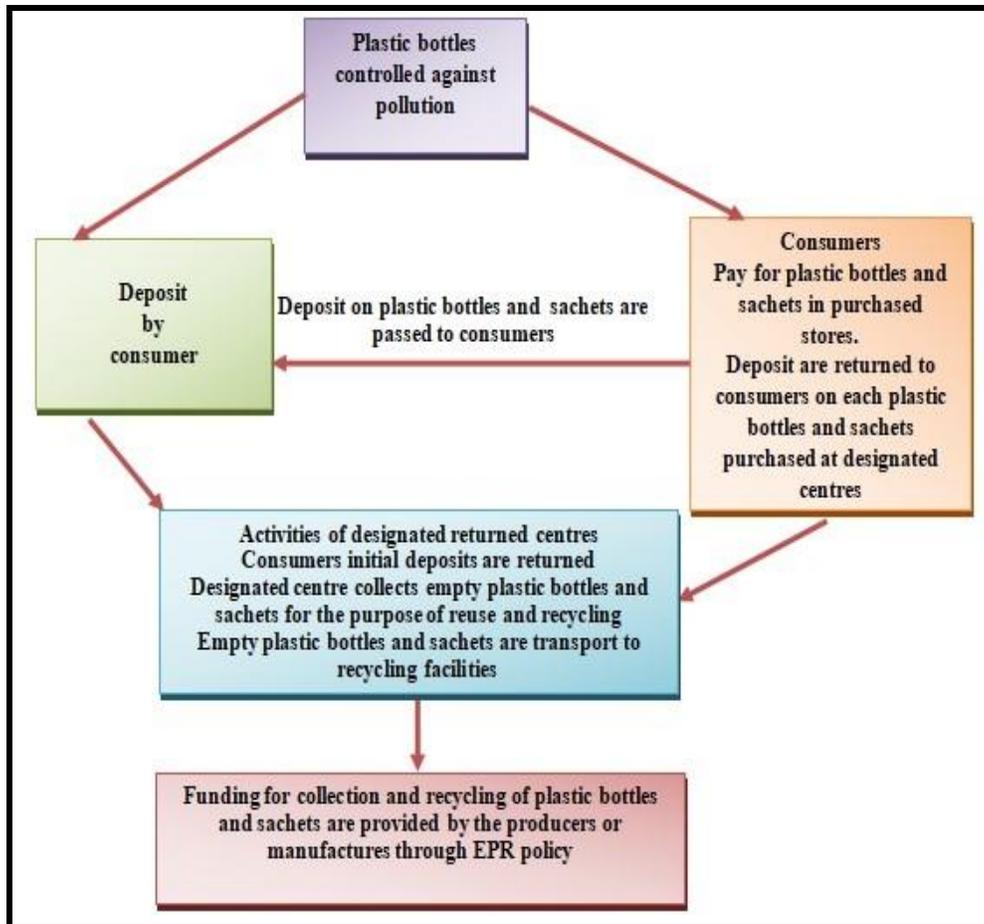


Figure 9: Empty Plastic Bottles and Sachets of Water Waste Controlled Against Pollution and Littering Through the concept EPR and DRS Program

Figure 9 depicts how the proposed EPR and DRS program will control pollution and littering from plastic bottles and sachets of water waste. Furthermore, the strategy is like the current scheme established by a few multinational corporations in Nigeria, including Coca-Cola Company and Nigeria Breweries Plc as earlier mention. These multinational companies collaborate with their current distributors by establishing a collection system for the return of their empty bottles. This collection system takes place after supplying their distributors with needed consumable full bottles of coke or beer, they transport the collected empty bottles back to their station, which is more sustainable than returning empty with their trucks. There are existing platforms, but they are not identical to the Author's presented approach. As simple as this concept appears to be, it is necessary to discuss the components that will enable sustainable plastic waste management in the paper is as follows.

ADOPTING THE EPR AND DRS POLICY INTO THE WASTE MANAGEMENT LAW

To put the proposed approach into action, the EPR and DRS policies must be incorporated into Lagos state's existing environmental law after thorough consultations and dialogues with relevant stakeholders. The Lagos State Environmental Protection Agency (LASEPA) oversees enforcing compliance with the concept's implementation.

While the Lagos Waste Management Authority (LAWMA) will oversee informing relevant stakeholders about the management aspect. Furthermore, as previously discussed, the initiatives of a few multinational corporations, including Coca-Cola and Nigeria Breweries Plc, have created some platforms on which the presented approach can be implemented to achieve sustainable plastic waste management.

PRIVATIZATION OF PLASTIC WASTE COLLECTORS.

Privatization will allow private innovations to drive the waste management sector with modern technology that has recently been developed. Private investors in developed countries such as Germany and Canada have made significant investments in the management of various types of recyclable materials, including plastic waste collection. Concerning this, privatizing the Lagos state waste management sector will allow interested private investors to invest in various areas of the sector and will help overcome the rising environmental challenges caused by plastic waste.

FUNCTIONAL RECYCLING PLANT

A functional recycling plant is one method of achieving long-term waste management. The recycling plant must be outfitted with modern technical support and know-how. These recycling plants must be able to collect, process, and recycle waste in an environmentally sound manner, as well as have the full operational capacity to process all categories of recyclable materials. Recycling allows waste to be diverted from landfills. The market recycling business is an advantage for investors looking to invest in Lagos state as the population grows at an exponential rate.

ENFORCEMENT AND MONITORING

Enforcement is critical to ensuring that producers/manufacturers adhere to the legal framework outlined in the paper. Monitoring is also required to provide adequate guidance to producers/manufacturers when needed. In Lagos state, enforcing and monitoring legal frameworks on various policies has been a major challenge. Regardless, prudence, caution and transparency must be allowed during the implementation of the proposed approach to achieve sustainable plastic waste management in Lagos state.

CONCLUSION

Given the environmental issue of plastic waste in Lagos state, it is necessary for the government to establish proper consultation and dialogue channels on how to facilitate the implementation of the proposed concept by exploring this paper. Furthermore, the components discussed in this paper are elements that enable the proposed concept to function in an effective and efficient manner. The proposed concept will act as a bridge between the current linear economy and the future circular economy of plastic production and management in Lagos and Nigeria.

CONFLICT OF INTEREST DISCLOSURE

Authors declare that no conflict of interest exist.

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