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DOI: 10.4018/IJSEM.2021040103

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# Valorization of Plastic Waste in Ghana: The Circular Approach

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## ABSTRACT

Wastes from plastics are ubiquitous and have become a critical global challenge, especially in Africa. There is an urgent call to combat the menace because of its harmful impact on the ecosystem. The research methodology used is the exploratory technique. Circular economy (CE) is the answer to this global problem, especially in advanced countries. Even though some African countries have commenced recycling waste plastics, which is a contribution to circular economy, the idea is now gaining support in Ghana. The aim of this study is to propose a strategy and design a customized business model canvas for an establishment that transforms different types of waste plastics into pavement slabs and paving tiles in Ghana. The rationale is to accentuate the significance of introducing CE as a tool for effective and efficient plastic waste management in the country.

## KEYWORDS

Business Model Canvas, Circular Economy, Nelplast, Pavement Blocks, Plastic Waste

## 1. INTRODUCTION

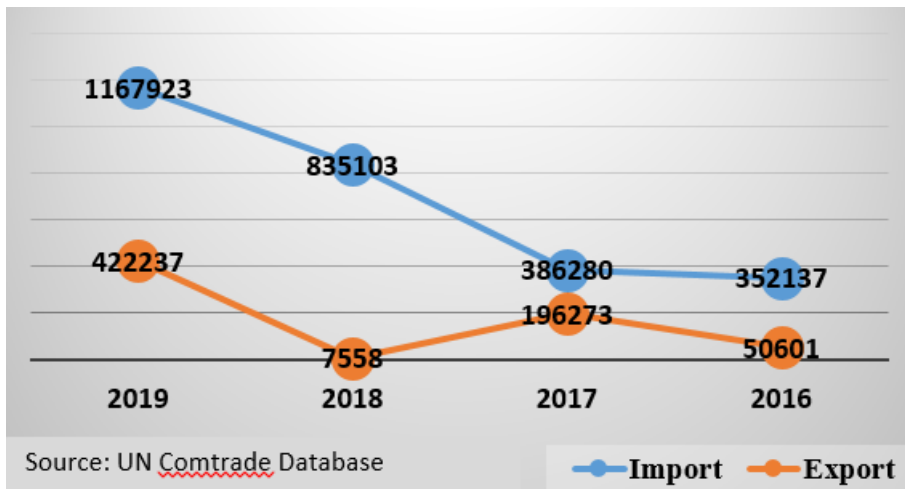
Pollution from plastic waste is a serious challenge for development in most countries across the globe. According to the United Nations Developments Programme (UNDP) Shareholder Conference Report (2019), Ghana creates about 1 million tons of waste plastics every year, out of which only 2 to 5% (22,000 tons – 55,000 tons) are reprocessed. While the remainder of the plastic waste end up in waste dump locations (38%), land (28%), sea (23%), or incinerated (11%). Ghana Environmental Protection Authority indicate that 2.58 million metric tons of raw plastics are imported into the country every year and 73% of this ends up as plastic waste. Only 19% is re-used. This implies that huge ratio of plastic waste ends up in the ecosystem. These plastic wastes litter the streets, land, gutters, sewerage, and other public places. Ghana is a net importer of plastic waste as shown in Figure 1. The net effect keeps widening on yearly bases and plastics are now occupies the 6<sup>th</sup> most dominated import in the sub region (ECOWAS).

The challenge of plastic waste cluttering in the country is worsened when it rains heavily. The floods wash the plastic wastes (sachets, polythene bags and bottles) and more substances into the streets, choked sewerage systems and water areas which lead to urban floods and spread of water-borne illness such as diarrhea, typhoid fever, and cholera. Plastic cluttering also has serious repercussions on agriculture, sources of water in addition to marine and human lives (UNDP stakeholder Conference Report, 2019).

DOI: 10.4018/IJSEM.2021040103

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Figure 1. Trade Value (\$) of Plastics in Ghana



The initial plastic film was manufactured in 1907 that marks the start of international plastics manufacturing. Nonetheless, production of plastics worldwide accelerated in 1950 and within 65 years, yearly production of plastics shot up to about 200-fold to 381 million tonnes in 2015 (Ritchie and Roser, 2019). Plastics form part of the chemical components of high polymers which are mainly consist of extended sequence of molecules comprising repetitive elements of carbons. Due to its biochemical elements, plastics do not break up easily in smaller constituents or parts (Kortei and Quansah, 2016). Kortei and Quansah, (2016), further indicate that plastics partially decay over a period of 100 to 500 years. Industrial plastics such as polyolefin, polyethylene and polypropylene appeared resilient to erosion due to its extra antioxidant characteristics. Therefore, soil micro-organisms that crumble wood and other things are unable to decompose the intramolecular force in plastics.

Plastics are used to manufacture water bottles, bowls, cups, carrier bags, sachets water and for packaging etc. in Ghana. Plastics wares are very cheap, generally very convenient and cheapest resource for packaging. Sachet drinking water (“Pure Water”) is believed to be fresh and inexpensive because tap water is sometimes considered undrinkable. Waste sachet rubber and shopping bags are generally placed in waste bins or community rubbish bins or left to clutter the atmosphere.

Districts and metropolitan authorities have the responsibility to handle waste in their localities. Most of these authorities concentrate on gathering and transportation of waste to dumping sites rather than treatment and disposal of waste generated. Until recently, waste collected were not sorted. Waste compendium firms, association, and private informal individual collectors used trikes, and three-wheeled tractors to collect waste from houses, communities, and organizations. The companies charged a scheduled fee whilst the rest charged based on quantity collected. The districts and municipal assemblies provided landfills and dump sites where wastes collected were dumped at a fee. But rough road in deprived and heavily populated communities make waste disposal very difficult, leaving waste unattended to resulting in filthy and hazardous environment.

For more than a decade now, the private sector (with plastic waste pickers) has been engaged in waste disposal. Nearly 80% of waste disposal companies in the 254 metropolitan, municipal and district assemblies (MMDAs) of Ghana are managed through the private sector. The plastic waste are stored by plastic picker as shown in Figure 2 before they are sold to plastic waste recycle companies. This has enhanced rubbish collection services in the communities and metropolises (Keesman, 2019).

One of these private plastic waste collectors is the Pure Water Waste Collectors Association. It is a recognized non-governmental organization of pure water plastic waste pickers and collectors.

Figure 2. Plastic Waste



They seek to drive the collection of plastic waste within communities in Accra to assist in creating a sustainable clean Ghanaian Environment as shown in Figure 2 and Figure 3 above. Pure or Sachet water is one of the sources of plastic waste pollution in Ghana. Awareness for recycling flexible plastics have been created by government and there has been collaborations and partnerships between government, organizations like Nestle Ghana and plastic waste collectors' association to ward off the streets from plastic waste. In addition, individual street plastic waste collectors send their collected plastic waste to emerging recycling companies and charge for their services. Figure 3 also shows an enthusiastic youth in the waste collection business as living.

Plastic waste recycling is gaining grounds in the country and many businesses are involved in advancing plastics processing technologies (Keesman, 2019). More than 25 small and medium plastic recycling waste processing firm recycle plastic wastes into carrier bags, packaging bags, disposable food packs, dust bins, shoe soles, lorry and door mats, pavement bricks etc. Some of these companies are GP waste recycle co. Ltd., Universal royal paper limited, Geocrest co. Ltd., Nelplast Eco Ghana limited etc. These recycling companies processed around 320 tons of plastic waste daily (most are

Figure 3. Plastic waste picker



Figure 4. Pure water sachet packed in river bags for distribution



pure water sachets and mineral water bottles) and expend about 1.15 million Euro annually on plastic waste collection.

Figure 4 shows how these plastic waste gets into homes and offices. This truck is one the distributing medium of the sachet waste. As much as there are proper and efficient distribution of these plastic products to the final consumer, there are no effective strategies to get these sachet waste from our communities to recycle plants. Some researcher has suggested that blockchain will help in coming out with a transparent scheme to manage plastic waste collection.

Ghana joined Global Plastic Action Partnership on October 01, 2019 and became the first African country to join this initiative to end plastic pollution, particularly in the ocean. The aim of Ghana National Plastic Action Partnership is to support public, private, and Civil Societies evolutionarize into circular plastics economy. The Global Plastic Action Partnership (GPAP) is a global public-private organization that cooperate and assist governments and businesses with strategies and action plans that would eliminate plastic pollution from source to the sea by 2025 through expedite circular economy solutions (Global Environment Facility, 2019). The government of Ghana also introduced a tax system to levy importers of plastics to help in the management of plastic wastes. Moreover, National Plastic Management Policy is being implemented to leverage an extensive management of plastics sustainability developmental initiative, create green jobs, and protect the environment. A platform would be created that would allow cross-sectoral exchange of information on recycling, use and reuse of plastic materials to drive home the idea of circular economy.

The concept of converting plastic wastes into pavement slabs and paving tiles fall within CE and Nelplast Eco Ghana Limited (an SME), started this initiative in 2017. The aim of this study is to propose a Canvas Business Model for Nelplast and also show that it is appropriate if it would be applied and sustained in Ghana. Furthermore, we present the idea of circular economy as viable approach for managing plastic waste and other forms of waste. The methodology adopted for this article is the exploratory technique.

## 2. LITERATURE REVIEW

### 2.1 Concept of Circular Economy

A circular economy is an economic system of closed loops. It is gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system. Underpinned

by a transition to renewable energy sources, the circular model builds economic, natural, and social capital'. According to the foundation, circular economy is built on three values:

- Design out waste and pollution.
- Keep products and materials in use.
- Regenerate natural systems.

Circular economy is a standardized approach to economic growth intended to benefit companies, communities, and the environment. This approach is variance to the linear approach (traditional take-make-waste model) known and used in most countries across the globe (including Ghana).

Figure 5 shows the Circular Economy approach by remanufacturing and reusing of secondary materials to reduce pollution and promote efficiency and sustainability. De Sousa et al., (2019), state that circular economy is a process that maintains the elements, materials and energy of products manufactured and consumed. It emphasizes continuous value creation, regeneration, and restoration of materials for a long period. Chiappetta Jabbour et al. (2019), also indicate that the concept of CE has developed significantly with the rise in creating awareness of deterrence in befouling the atmosphere, effective waste management by encouraging reprocess of secondary material. It is important to note that CE is implemented to suit the prevailing conditions of a particular country and it is far advanced in developed countries. (Horvath, Mallinguh and Fogarassy, 2018) specify that CE revolve around refurbishment and reprocessing of secondary materials which turns out be cost effective and environmentally friendly. These models would help companies make huge profits and attain a remarkable improvement in resource output. Canvas Business Model is one of such business models (discussed later in the study).

A 4-member delegation came to Ghana from the Netherlands in May 2019, to create the awareness of the concept of CE in the country particularly in waste management as well as recycling and plastic waste management.

Figure 5. Concept of Circular Economy



Source: ellenmacarthur.org

## 2.2 Plastic Waste Management

The collection and disposal of plastic waste in Ghana is presented with many difficulties and problems – those that are burnt releases hazardous particles into the environment with negative health consequences.

(Teye and Holmberg, 2012) defines plastics as ‘Polymeric materials which are large molecules made by joining together thousands of small molecules units known as monomers.’ The process of linking the particles is called ‘polymerization’ and the number of these elements in the long molecules is called ‘degree of polymerization’. He again mentioned that plastics contain polymers and additives such as nylon, polyethylene, and PTFE.

Plastic wastes are generated from households, commercial and manufacturing industries. These can be further divided into main and ancillary wastes. The main wastes are from manufacturing industries and secondary waste are from the other remaining sources including domestic (Teye and Holmberg, 2012).

As indicated by (Ackah, Carboo and Gyamfi, 2012), Ghana, like most African countries use crude dumping system to dispose of their solid waste (including plastic waste), sometimes the waste is burnt openly or deposited into landfill sites with very little on-site management. Wastes are dumped into open pits and excavations stemming from quarrying and sand mining. Wastes remain uncovered making them a potential health hazard. Sustainability of effective and efficient waste management in Ghana has been a major challenge. Particularly management of the ever-increasing plastic waste generated daily.

According to a report on how to tackle plastic waste by World Bank (2019) states that nations including developed countries do not have the capacity for plastic waste management. For example, Europe shipped one-sixth of its plastic rubbish, largely to Asia in 2017. It further recommended that to curb the menace production and consumption could be reduced to manage existing waste to avoid leakage or pollution. Alternatively, industries could change their manufacturing process to lessen the number of materials needed, adopt the use of recycled material as raw material, or generate raw materials that could be recycled; by this process, circular economy is deployed. MacArthur (2016) a foundation envisioned that without proper plastic waste management, the number of plastics in the ocean would outnumber the fishes by 2050, which could be threatening to human life.

Globally, plastic waste management challenges have led to several initiatives in both developed and developing countries to combat the menace. According to Kumi-Larbi et al. (2018), Cameroon has adopted a relatively simple technology that melts sachet plastic waste and mix it with low density polyethylene (LDPE) sheets to produce LDPE-bound pavers and sand blocks. This is a community-oriented plastic waste management enterprise. He stated that these bonded blocks are strong, durable and lasts longer compared to sand Crete. Rwanda and Kenya had banned the use of plastics. India on the other hand has also placed a ban on single-use plastics at city-level and some businesses are striving to reduce the negative impacts associated with plastic waste.

At the World Economic Forum in Davos, 2018, eleven international trademark owners, retailers and packaging businesses pledged to make their packaging 100% reusable, recyclable or compostable by 2025 (Godfrey, 2019). South Africa is the only African country with a thriving recycling model. In 2018, they were able to recycle approximately two thirds of their plastic waste. According to a study by Plastics South Africa (2019), South Africa reached a remarkable input plastic waste recycling rate of 46.3 percent in 2018 because plastic waste management is handled at the national level.

In Nigeria, a group of breweries corporations led by Coca-Cola agreed with cement maker Lafarge (LHN.S), in September 2018 to burn plastic bottles as fuel in furnaces. While in Ghana, eight breweries had begun the GRIPE recycling coalition with a Canadian firm, to establish a factory that would produce textile fibers (Reuters.com August 2019). In addition, some manufacturing companies and SMEs are transforming plastic waste into products like waste bins, baskets, shoe soles, pavement blocks etc. (Nelplast Eco Ghana Limited is a typical example and those mentioned above). The government of Ghana has recently inaugurated the board of a steering committee of Ghana National



Plastic Action Partnership (NPAP) to draw a road map for the management of the disposal of plastic pollution and develop strategies that would drive Accra (the capital city of Ghana), to become the cleanest city in Africa (Kale-Dery, Daily Graphic, 2020).

### **2.3 Transformation of Plastic Waste Into Pavers**

A lot of countries have been promoting recycling of plastic wastes into building materials such as pavement blocks and stones. Cameroon for example is applying a comparatively modest technology to convert low-density polyethylene layers to manufacture low-density polyethylene sheets bound with sand blocks and pavers (Kumi-Larbi et al., 2018). Kenya had also employed expanded polystyrene (EPS) raw material from the finesse process of crude oil as alternative to construction material. The EPS elements lowers the proportion at which raw materials such as wood and stones are unearthed from the environment, hence, supporting sustainable development and recycling (Ngugi, Kaluli and Abiero-gariy, 2018). Again, Uganda is turning plastic waste into long-lasting water-resistant pavement stones. The pavers manually melt the waste plastics in big pans, add soil and condense them in metal shaped cans to form pavement stones. These pavers however, needed the technology to expand and improve production (Ayesiga, America CGTN News, 2017). In Benin, (Allam & Jones, 2018), proposed a potential plastic waste management solution that requires efficient transformation of wastes from plastic into plastic fiber fortified sand blocks to use as viable building materials. This should be done in a closed loop economy, where the citizens of the city of Cotonou would be involved in controlling plastic waste through three main levels: a. Collection and sorting of waste; b. Transportation; and c. Conversion (transforming plastic waste into plastic-based construction bricks). Allam & Jones (2018), state that this may reduce illicit disposal of waste, reduce slums, generate employment, alleviate poverty, and promote clean environment. These may happen if the government of Benin embraces circular economy initiatives.

In India, a company uses wastes from plastics in varied quantities with excavated dust, coarse combined and ceramic waste to produce pavement blocks (Shanmugavalli et al., 2017). A study conducted in Saudi Arabia by Khan et al. (2016) recommended low concentration of polythene, high concentration polythene and crumb rubber as neat binder to enhance the elastic behavior of asphalt in the manufacturing of pavement blocks for construction. This suggestion was given because of the harsh climatic and severe weather conditions in the region.

According to Sojobi et al. (2016) developed countries like Denmark, Netherlands, USA, and India had prioritized recycling of wastes for construction in their respective countries. They identified recycled wastes as particularly important secondary material for construction of low-volume roads particularly, in rural communities. Philippine, an Asian country beset with regular natural catastrophes and constant pollution is utilizing ash emanating from volcanic eruption, mix with sand, cement, and plastic waste to manufacture 5000 bricks per day to support local building projects. Philippines generates about 60 billion waste single- used plastics and water sachets annually (AFP/Binan, Philippines, 2020).

## **3. RESEARCH METHOD**

Reviewing literature plays a key role as a basis to all forms of research. It is the foundation for education, establishing standards for policies, practices and generates novelty of concepts for fields of study. The research methodology used is the exploratory technique. This study reviewed literature from secondary sources about waste management in Ghana, the initiatives of plastic waste management through the recycling and the proposed introduction of CE in the country. The study further focused on designing a customized business canvas model for an existing business that converts pure water sachet waste into paving stones and tiles by adding sand and red oxide.



## 4. BUSINESS MODEL CANVAS

Business Model Canvas (BMC) is a strategic management and a lean business startup visualization tool with nine main building blocks used to develop an existing or new business. These building blocks are value proposition, key activities and resources, key partners, customer relationships, customer segments, cost structure and revenue streams.

The BMC originated from Alexander Osterwalder, a business model expert, and Yves Pigneur, a management information systems professor. These two experts indicate that a business model illustrates the rationale behind the creation, delivery and gaining value by large and small organizations who adopt the model. Osterwalder (2010), had shown that the nine building blocks encompass four key areas of a business: customers, offer, infrastructure, and financial sustainability. The model is a plan that could be used through organizational structures, practices, and policies. Joyce and Panquin, (2016), defines BMC as a “practical tool for coherently integrating economic environmental, and social concerns into a holistic view of an organization’s business model”. Fritscher and Pigneur (2014), similarly view BMC as a visualization tool used to describe the business model of a business. It looks at the business concept and the potentials of income or profit generation.

This study adopted BMC as a business strategy to assist Nelplast Eco Ghana Ltd., an existing entrepreneurial pavement block factory to improve and expand the establishment. This is because BMC would give a pictorial view of all facets of the business (at a glance), assessing the development of each of the nine ‘building blocks’ to ensure that the objective set is achieved. Below gives detailed information of the proposed business model canvas.

### 4.1 Value Proposition

Value Proposition is crucial to the business model. Adopting business model canvas would be beneficial to both Nelplast and the country. This is because recycling plastic waste would reduce waste and ensure clean environment. According to Horvath, Mallinguh and Fogarassy (2018), one of the values proposed is that turning plastic waste into pavers would lessen reliance on natural raw materials used for cement, which would eventually lead to environmental conservation. Plastic wastes would not end up in gutters, streets, and drainage systems to cause floods particularly, during the raining season. Government could adopt the model to scale up the business to other regions of the country. This is one effective way of managing waste in the country. Furthermore, Avoidance of burning plastics that releases toxic gases such as dioxins, mercury, furans, and polychlorinated biphenyls into the atmosphere would improve human, plants, and animal health. In the economic front, implementation of the business model canvas would create jobs. Expansion means more stakeholders in waste management services would be engaged. Continuous provision of raw materials (plastic waste) is guaranteed because homes, organizations and government continue to use and generate waste plastics and increase profits making for the business. It can also make revenue for the government when these firms honor their tax responsibilities.

### 4.2 Key Activities and Resources

Three main pursuits that would guarantee the success of BMC in this context - collection of plastic waste, recycling, and reprocessing. The plastic wastes (except PVC) are delivered to the company by informal plastic waste collectors. The waste plastics are recycled through cutting the plastics into pieces, liquefying them, sand and red oxide are then added to it to produce pavement blocks that could last for more than 35 years.

Nelplast uses its own locally manufactured machines for production. However, for company needs industrialized technology to boost production to accomplish the goal of cutting plastic wastes from the environment and the country as well as meeting the increasing demand for plastic pavement slabs and paving tiles to increase profits. These three main activities require continuous supply of plastic wastes and other raw material that must be funded and supported by government and interested

financiers, for possible development. The main resources needed are, human and finance resources, production equipment and land for further extension.

### 4.3 Key Partners

Companies need strategic investors and sponsors to succeed hence, for BMC to accomplish its objective, the key investors are:

1. Commercial banks that concentrate on building (example, Investment Banks like GCB Bank, Data Bank etc.) to invest into this essential plan.
2. The Ministry of Environment, Science, Technology, and Innovation, the Municipal and Districts Assemblies should develop policies and regulations for plastic waste management and encourage CE. For example, in 2017, the Minister of Environment, Science, Technology and Innovation (MESTI) (government), visited Nelplast and assured the Chief Executive Officer of Nelplast of government soft loan under Ghana Government Flagship Industrialization Plan to purchase industrial machines to increase production.
3. The waste collectors' association, waste pickers cooperatives and other waste disposal firms are also stakeholders. They guarantee continuous provision of raw materials for production.
4. Ghana Chamber of Construction Industry who may need incessant supply of the product is also a major partner.

### 4.4 Customer Relationships and Segments

Customer relations is the process and way a company communicates and handles its existing and potential clients. It is important for Nelplast to develop and maintain its customers by supplying them with superior pavement stones and tiles that would address their needs. Customers of Nelplast would include the government of Ghana, real estate companies, construction firms, individuals, and the general public.

As Nelplast tries to satisfy the demand of its customers by producing high-quality blocks, attending to their complaints, and seeing them as opportunity for growth and expansion, government should also help the business to attain its goal by ensuring constant supply of its major raw material (plastic wastes). The government must create enabling environment that would promote good relations, provide financial assistance to allow for technological advancement and improve investors' confidence in this business. It is also crucial for Nelplast to maintain cordial relationship with its employees, suppliers, and customers (Horvath, Mallingu and Fogarassy, 2018).

Furthermore, the Ghana Chamber for Construction, real estate companies, government, individual developers, and the public for the market segment for pavement blocks. The markets are already accessible and could opt for these robust pavement blocks if it is well advertised. Again, the cost of pavement blocks made from plastic wastes are high comparatively to the traditional ones made from normal cement due to the high cost of production. The government could make it inexpensive and more desirable by applying tax exemption to companies engaged in plastic waste recycling.

### 4.5 Distribution Channels

Distribution channels are the means by which customers are reached or are influenced (Coes, 2014). This could be done through publicizing about the durability and the exceptionality of pavement blocks manufactured from plastic wastes through social media, print and electronic media.

According to (Coes, 2014), channels are about how to reach the customer or have effect on a customer. Advertising through social, print, and other electronic media about the exceptionality and toughness of the pavement slabs and paving tiles. Work in partnership with key stakeholders like contractors, real estate agencies, associations in the building industry and the government for direct deliveries. Good customer relationship could also help promote the products of the company which

could be a cheap delivery channel. Another channel is the business's website; it could be a platform for adverts and sales.

#### **4.6 Cost Composition and Revenue Flows**

This business model canvas has cost and financial proposition along with making profits as shown in Table 1. Though the cost implications may be huge, the anticipated revenue may be greater. Areas of costs components consist of expenditure on plastic waste providers, employees' salaries, expansion of technology (production machines), and maintenance of website/internet platforms, other expenses are electricity, delivery systems and transportation. Income inflow would be majorly from sales of final products, government subsidies and tax exemptions.

### **5. PROFILE OF NELPLAST ECO GHANA LIMITED**

Nelplast Eco Ghana Limited is a Ghanaian own business that turns all types of plastic wastes (except PVC) into pavement slabs and paving tiles. It was founded by Mr. Nelson Boateng, an Engineer Entrepreneur based in Ashiaman Municipality, a suburb of Accra, the capital city of Ghana. The plastic wastes are processed through an innovative recycled machine invented by the entrepreneur. The recycled plastics (70%) are mixed with 30% sand and red oxide to manufacture durable and resilient pavement slabs and tiles that could last for about 35 years. The company recycles more than 570 tonnes of plastic wastes into 104,000 pavement slabs and 40,000 paving tiles annually. The company also provides income of about USD 57,192.37 to informal waste collectors every year.

The work of Nelplast Eco Ghana comes under circular economy and needs financial assistance from the government and investors to grow the business to help achieve clean environment, improve health, and create jobs for the youth. Figure 6 and Figure 7 show production processes at the company site and the output. One major challenge when it comes to financial assistance in the plastic waste industry is transparency and trust. This is because most stakeholders in the industry are not highly educated and hence easy to hide or mispresent information to them. However, with the strength in the use of Blockchain technology is believe can help address the problem of trust in financial transaction.

Table 2 discusses the internal strengths and weaknesses of Nelplasp Ghana, as well as its external opportunities and threats. Analysis of strengths, weaknesses, opportunities, and threats are common but good tool that could be used in developing business strategy for a startup company or already existing company.

Gürel and Tat (2017) referred to SWOT analysis as an important mechanism for analyzing situations in an organization being it at the departmental, project, plan or even at the organizational level. It assists managers to detect prospects in their internal and external environment and how they could be harnessed for success and competitive advantage.

Strengths are the abilities, expertise and assets of the organization that could help achieve its set goals. From Table 2, Nelplast has the expertise in manufacturing pavers using recycled plastic wastes. By doing so, the company is contributing towards clean environment (one of the main objectives of the government of Ghana is to make Accra, its capital the cleanest city in Africa) and promoting good public health. Particularly in its area of operation, Nelplast is also contributing to the realization of sustainability through the promotion of eco-friendly waste management practices and creation of jobs for waste collectors.

Weaknesses means the inabilities, inadequacies which could impact on the growth of the company. Nelplast would need financial support from commercial banks to expand this laudable initiative. Expansion requires availability of more plastic wastes, acquisition of more land, increase in the number of employees, more advertising and promotion activities.

Opportunities are advantages outside the organization that Nelplast could capitalize on to promote its business. Available opportunities are government support, apply for tax exemption, take

Table 1. Business Model Canvas for transmuting Waste Plastics into Pavement Blocks in Ghana (NELPLAST GHANA LIMITED)

Key Partners	Key Activities	Value Proposition	Customer Relationships	Customer Segments
<ul style="list-style-type: none"> <li>Specific financial investment institutions</li> </ul>	<ul style="list-style-type: none"> <li>Delivering of waste plastic materials to production site.</li> </ul>	Green environment:	<ul style="list-style-type: none"> <li>Retain clients by provision of high-quality pavement blocks</li> </ul>	Consumers:
<ul style="list-style-type: none"> <li>Interested investors and stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>Recycle of polyethene bags and pure water sachets (secondary material) by cleaning and melt them down</li> </ul>	<ul style="list-style-type: none"> <li>Clean environment, no choked gutters, no floods, improved health and plastic waste management</li> </ul>	<ul style="list-style-type: none"> <li>Delivery of blocks to customers' sites</li> </ul>	<ul style="list-style-type: none"> <li>Entrepreneurs, Estate developers, Contractors</li> </ul>
Suppliers:	<ul style="list-style-type: none"> <li>Mixing the liquify plastics with sand and red oxide to manufacture pavement blocks</li> </ul>	<ul style="list-style-type: none"> <li>Reduction of plastic waste</li> </ul>		<ul style="list-style-type: none"> <li>Individuals builders</li> </ul>
<ul style="list-style-type: none"> <li>Plastic waste pickers</li> </ul>	Key Resources	<ul style="list-style-type: none"> <li>Economic</li> <li>Provision of jobs, consistent supply of materials,</li> </ul>	Channels	<ul style="list-style-type: none"> <li>Ghana Chamber of Construction Industry</li> </ul>
<ul style="list-style-type: none"> <li>Waste pickers cooperatives</li> </ul>	<ul style="list-style-type: none"> <li>Startup capital: financial, equipment, land and human resource.</li> </ul>	<ul style="list-style-type: none"> <li>Provision of robust and long-lasting pavement blocks</li> </ul>	<ul style="list-style-type: none"> <li>Advertising through social, print and other electronic media.</li> </ul>	<ul style="list-style-type: none"> <li>The government of Ghana</li> </ul>
<ul style="list-style-type: none"> <li>Waste management companies</li> </ul>	<ul style="list-style-type: none"> <li>Reuse of secondary materials</li> </ul>	<ul style="list-style-type: none"> <li>Assure suppliers of regular payment to ensure constant supply of plastic waste.</li> </ul>	<ul style="list-style-type: none"> <li>Advertising and selling on social media and the firm's website</li> </ul>	
<ul style="list-style-type: none"> <li>Ghana Chamber of Construction Industry</li> </ul>				
<b>Costs</b>		<b>Revenues</b>		
<ul style="list-style-type: none"> <li>Cost of machines for extension</li> </ul>		<ul style="list-style-type: none"> <li>Sales of durable pavement blocks</li> </ul>		
<ul style="list-style-type: none"> <li>Expenditure on secondary materials from suppliers</li> </ul>		<ul style="list-style-type: none"> <li>Tax exemptions</li> </ul>		
<ul style="list-style-type: none"> <li>Remunerations for workers</li> </ul>		<ul style="list-style-type: none"> <li>Government subventions</li> </ul>		
<ul style="list-style-type: none"> <li>Adverts and promotions</li> </ul>				

advantage of the growing interest and demand for eco-friendly products, fair competition locally as well as availability of ready market.

Threats are unfavorable circumstances or situations external to the organization. Continuous and consistent organization of supplier to ensure incessant flow of raw material is key to the survival of this

Figure 6. Pavement blocks from plastic waste (Source: Design Indaba)



business, influx of inferior well packaged pavement slabs and tiles from foreign countries like China, which may be cheaper might shift Nelplast out of business, the relatively high cost of electricity and erratic power supply may interrupt production and hamper sales. The difficulty in land acquisition and threat by local land guards during development and is are also an external threat.

## 6. CONCLUSION

The ever-increasing devastating effects of plastic wastes both on land and in the ocean demands a global action to reduce the threat to the barest minimum. Debris from plastics had caused the death of several species of marine mammals. It is projected that about 400,000 fishes die every year in the oceans because of entanglement from plastic pollution. Lack of proper waste management has led to choked drains, littering streets, and caused health implications to humans.

CE has been found to be one of the main solutions to this problem. Because CE involves sharing, reuse, repair, remanufacturing, recycling, and refurbishment of materials to build a closed-loop system. It discourages the use of resource inputs, generation of debris, pollution of the atmosphere and the environment. CE focuses on using products, paraphernalia, and infrastructure for a long period. It

Figure 7. Plastic waste Recycle Unit (Nelplast) (Source: Getty Images)



Table 2. SWAT Analysis on Nelplast Eco Ghana Limited

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"> <li>● Recycles all kinds of plastic waste into pavement tiles and slabs.</li> <li>● Contribution to environmental cleanliness and indirectly promoting public health.</li> <li>● Has the technical expertise.</li> <li>● Promoting ecofriendly waste management practices.</li> <li>● Has its own customized machinery for production.</li> <li>● The final output (pavement slabs and tiles) stronger and more robust than normal concrete pavers.</li> <li>● Job creation.</li> <li>● A growing number of the youth are enthusiasts of the environment and so make a living out of waste collection and recycle</li> </ul>	<ul style="list-style-type: none"> <li>● Enforcement and implementation of laws are difficult for the municipal assemblies.</li> <li>● Lack of funds for expansion.</li> <li>● Needs advanced industrial technology to enhance production.</li> <li>● Lack of raw materials (plastics) in large quantities to increase production.</li> <li>● The waste management sector is under financed making implementation and enforcement work cumbersome.</li> <li>● Technical expertise to produce different types of building construction blocks.</li> </ul>	<ul style="list-style-type: none"> <li>● Has great potential for expansion.</li> <li>● Government support.</li> <li>● Tax exemptions.</li> <li>● Availability of ready market.</li> <li>● Growing interest in the use of environmentally friendly products.</li> <li>● Various success stories of the circular economy strategies in the country prove its viability</li> <li>● Rapid interest in the sector by foreign and Ghanaian entrepreneurs has led to growth</li> </ul>	<ul style="list-style-type: none"> <li>● Organize the distribution system to ensure continuous supply of plastic waste.</li> <li>● Instability of the Ghana Cedis to the USD.</li> <li>● Competition particularly cheaper substitute from foreign countries which make the local product expensive and unattractive.</li> <li>● Cost of electricity and erratic power supply.</li> <li>● Difficulty in land acquisition and development because of threats/harassment from local land guards</li> <li>● Getting loans from commercial banks with high interest rate and collateral as security for the loan</li> </ul>

is a system that enhances the use of energy and waste materials as raw materials or input from one process to other processes. This method of regeneration is a contrast to the traditional linear economy of ‘take-make-dispose’. (Ghisellini, Cialani and Ulgiati, 2016), emphasized that CE can acknowledge and implement entirely new patterns and support society reach sustainable development and wellbeing at insignificant or no energy, material, and environmental costs.

Implementation of CE needs the backing from inventive managers and designers who would drive and design the entire process, using the appropriate mechanisms, policies, practices, and practical decision-making instruments. CE is gradually gaining grounds in Ghana and this is what triggered the recommendation and design of using business modal canvas for Nelplast Eco Ghana Ltd., as a tool for expansion.

If the government of Ghana could pilot this model in other regions in support of the concept of CE in plastic waste management, it would be a resolution to the country’s plastic waste management challenges and as well as create jobs and business prospects for the unemployed.

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