The Role Of Solid Plastic Waste Recycling Operations In Achieving Sustainable Evelopment

Mr. Omar Mostafa [1], Dr. Heba Elmesmary [2], Dr. Abeer Abdelrahman [3] and Dr. Ahmed Ismail [4]

[1,2,3] Faculty of International Transport and Logistics - Alexandria. AAST&MT,

[4] Denery of admission and registration - Alexandria. AAST&MT,

1. ABSTRACT: Environmental issues have become at the forefront of international concern. Therefore, this concern has been reflected in most of the world's policies through activating rational environmental policies to achieve sustainable development between the requirements of economic and social development, and the preservation of natural resources and ensuring their survival and preserving the right of future generations. The problem of the accumulation of solid plastic waste is one of the most difficult and complex problems in Egypt, because plastic materials are widely used as they are characterized by being of light weight, multi-purpose, water-resistant. This research aims to measure the impact of the recycling operations of solid plastic waste on the economy SWOT analysis for the year 2021.

Keywords: *Solid plastic waste, Recycling, Sustainability, Blue economy.*

2. INTRODUCTION

Recycling provides the opportunity to use recovered plastic to manufacture a new product, thus achieving sustainable manufacturing, known as circular economy. Generally speaking, circular economy converts waste materials into economic value as a result of the flow of major waste quantities. Thus, it reduces the quantities of waste to be collected, disposed of, buried, or incinerated. Plastic recycling process represents an aspect of sustainable manufacturing; where the recovered plastic waste is utilized to manufacture new products and preserve the natural resources used in the production of new plastics (Mwanza et al., 2016).

Studies on plastic waste have shown that the accumulation of plastic waste in open landfills emits greenhouse gases and carbon dioxide, caused by the occurrence of the problem of global warming. Plastic is an organic material produced from petroleum petrochemical derivatives found everywhere in the global economy. Plastic is characterized by many advantages, including lightness, durability, formability, water resistance, and low production costs. In fact, plastic particles are able to survive for thousands of years and do not degrade biologically. Therefore, plastic is utilized in many industries, such as cars and other vehicles and machinery, as well as the preservation and distribution of food, goods, medical products and the like. Subsequently, this results in accumulating large quantities of solid plastic waste. In other words, the huge volume in

production of plastic leads to large amounts of plastic waste. Hence, this poses a real environmental threat, as this plastic waste mostly ends up in the oceans, and it was estimated that about 150 million tons of plastic waste was dumped into the oceans in 2017 (Bishop et al., 2020).

Plastic production has been used since 1950 and has become an important part of our daily living. Plastic is generally applied in various categories such as industry, medicine, transportation, automobiles, food packaging and other materials that carry goods from spoilage, packaging, and distribution of drinking water. In addition, it is utilized in the manufacture of clothing and medical devices. It is produced in large quantities and disposed in waste streams and often end up as ocean debris in oceans and seas. Several studies have indicated that about 40% of plastic products have an average life of less than a month; therefore, plastic waste produced in huge quantities is considered a major challenge to environmental management and sustainable development and constitutes a major threat.

Solid waste management and plastic waste is considered as a complex system. It includes environmental, social, and economic issues that must be taken into consideration to improve waste life cycle, reduce water; soil and air pollution, reduce open burning of waste and open dumps scattered all over the world. Thus, solid plastic waste recycling aims to reduce the rate of waste flow to its final disposal sites in the developing countries due to the low technological requirements and economic investments in these countries. In fact, mismanagement of solid plastic waste has many negative effects which are:

1. Local negative effects such as (pollution of soil, surface, and ground water).
2. Regional effects (pollution of water bodies used in agriculture and domestic purposes).
3. Global effects such as (global warming and marine litter) and the damage, they cause to marine organisms in oceans.

Recycling is the most environmentally useful strategy that deals with solid waste in order to reuse it. Recycling solid plastic waste leads to the reduction in oil and carbon dioxide emissions and decreases the quantities of waste that require disposal or burial, thus saving the costs of landfills for waste savings (Khoo, 2019).

Plastic production began dramatically in the fifties of the last century and reached about 359 million tons in 2018. The significant increase in tons of plastic has led to the deterioration of waste management, misbehaviour, and neglect of the consuming population, which eventually caused the accumulation of plastic waste and its abundant presence in waterways, ecosystems and in landfills waste. In the past decades, large quantities of plastic were produced until 2015; however, only 9% of them were recycled, 12% was burned and 79% accumulated in the environment, landfills or waterways, seas and oceans.

Therefore, recycling has environmental benefits compared to other options such as burial or incineration to reduce the environmental damage and threats of plastic. Actually, this places a great responsibility on the manufacturing companies and they may fail to efficiently manage the plastic materials that have expired and take advantage of the financial and social benefits of manufacturing more circular and sustainable application of the principle of Extended Product Responsibility (EPR) (Plakas et al., 2021)

In this content, environmental sustainability requires recycling plastic waste and eliminating random disposal, burning and burial of it to avoid the environmental damages of plastic waste, especially global warming and climate change which are to be reviewed below. The main objective of managing and recycling plastic waste is to reduce greenhouse gas emissions and to measure the environmental impact of these gases such as carbon dioxide and methane which increase the temperature of the earth causing the problem of melting water from the poles due to climate change as a result of burning plastic waste, whether to generate energy or use it in industry. Consequently, countries should adopt a sustainable policy to increase factories that working recycling plastic waste (Khoo, 2019).

3. RESEARCH AIMS AND OBJECTIVES

Research aims

This research aims to define methods for reduce

production and utilization of new plastics. This is in addition to recycling solid plastic waste, which has a positive impact on the environment to reduce emissions to transfer research area into a green city and solving all waste supply chain problems and achieving economic savings that would increase job opportunities.

Research objectives

1. To reduce the production of new plastics according to study cases over the world.
2. To study the processes of supply chain for recycling the plastic solid waste and solve its problems to approach environmental efficiency through recycling, re-manufacturing, reusing, and reducing the amount of plastic, which contributes to achieving a circular economy, preserving natural resources, and achieving sustainable development.
3. To determine the impact of recycling solid plastic waste; in addition, reducing the dumping of solid plastic waste in Egypt based on the blue economy concept.

4. LITEREATURE REVIEW:

The following studies discussed the three dimensions of environmentally, economically, and socially sustainable development; drivers of sustainable plastic waste recycling, and strategies for recycling solid plastic waste. Due to the huge amount of solid plastic waste, many countries use traditional landfills for burial and final disposal of the waste produced in them. Because plastic does not decompose biologically, plastic waste remains for a long time. Some countries may also resort to using incineration to get rid of plastic waste. In fact, this method leads to the transformation of plastic waste into ash that results in many pollutants of air, such as carbon dioxide, nitrogen dioxide and many other toxic gases, which negatively affect the viability of air and human health, as well as the impact of plastic waste on soil, surface, and ground water. All of this clarifies and confirms the option of recycling plastic waste which is the most sustainable option for dealing with solid plastic waste (He et al., 2015).

Recycling is deemed as one of the best options in the hierarchy of solid waste management, including plastic, to reduce the effects of end-of-life and end-of-use of post-consumer plastic waste. This option is chosen with the aim of reducing plastic waste that is disposed of in random ways, whether in the streets, in open landfills or in landfills not subject to environmental supervision. This is performed with the aim of reducing the greenhouse gases emitted from these wastes such as methane and carbon dioxide, maintaining environmental sustainability, and ensuring that plastic waste is not dumped into waterways such as oceans and seas to maintain the marine environment free of pollution (Mwanza et al., 2016).

The accumulation of solid plastic waste has harmful effects on the environment and the human being, the quality of air, soil, surface and ground water, marine environment, marine organisms and fish. Consequently, the accumulation of waste has a detrimental effect on societies in the developing countries such as Egypt, where there are no clearly defined strategies for effective management of solid waste that poses danger to the Egyptian society and drains it (Ibrahim, and Mohamed, 2016).

In this context, Mwanza et al., (2018(stated that many African countries face challenges in managing plastic waste, although most of these countries have policies and legislation on solid plastic waste management, but there is a gap between legislation and waste management policies. All these countries aim to recycle their solid plastic waste in order to achieve sustainable industrialization, contribute to achieving sustainable development and environmental sustainability, and mitigate environmental damage resulting from the accumulation of waste.

Solid plastic waste results from homes, markets and companies and is heterogeneous and has different physical and chemical properties. Therefore, the heterogeneity of solid plastic waste is the main problem that hinders and makes the process of sorting and separating this waste tiring and time consuming. Therefore, companies resort to traditional methods in managing solid plastic waste; this

means that the process of sorting wastes, as well as the disposal of solid waste generated from rural and urban areas represents a major problem facing many developing countries.

Therefore, Abdel-Shafy and Mansour (2018) aimed to determine the role and behaviour of stakeholders, starting with consumers or companies, as well as plastic solid waste collectors, wholesalers, retailers, recycling factories, and governments, whether the public sector or the private sector. This is in terms of solid waste management, analysing the various factors that affect the waste management system, and encouraging stakeholders to adopt sustainable management systems. This is in addition to defining the economic schedule for each type of solid plastic waste to achieve economic savings that contribute to the countries' domestic product. Many countries, including Singapore, have tried to adopt a policy for recycling plastic waste to achieve certain benefits from it and its derivatives.

Their target is to achieve a circular economy and preserve natural resources, by doing some activities that add economic value to plastic waste and which enables it to be reused again instead. In fact, most countries, such as Egypt, convert waste into energy, as happens in the incinerators of cement factories. These systems are environmentally unsustainable and result in the emission of carbon dioxide, which negatively affects the earth's temperature in what is known as the problem of global warming. Thus, this policy contradicts with the goals of sustainable development that try to maintain environment and reduce global warming (Khoo, 2019).

Solid plastic waste causes environmental pollution, which has become a global issue, where open landfill and open incinerators are considered one of the most important methods of waste treatment and final disposal, especially in low-income countries. the study aims to review the pollutants resulting from the dumping of solid plastic waste in the oceans and seas and the resulting damage to fisheries and high rates of marine pollution that affected the blue economy negatively (Ferronato and Torretta, 2019).

Oceans have a pivotal role in the global economy as they contribute a large percentage to the global economic returns, amounting to about one and a half trillion dollars in 2010 and are expected to reach three trillion dollars in 2030. With climate-related changes and the pressures resulting from climate change on all countries the world is clear that paying attention to sustainable development and achieving its goals may help to make some progress in addressing the problem of climate change. Actually, this can be made possible by adopting sustainable development strategies in all its aspects and developing processes to recycle waste, especially plastic ones, which often end up as waste and debris thrown into the oceans affecting fish, marine wealth and the marine organisms living in it. Thus, giving priority to waste recycling strategies, especially plastic, helps to preserve the marine environment and achieve the goals of the blue economy by paying attention to the safety of the oceans and marine life and achieving marine growth with strategies that support environmental sustainability and help solve the problems resulting of climate change (Bennett et al., 2019).

Many studies have been conducted in the developing economies such as Zambia, India and Nigeria, and these studies have considered recycling solid plastic waste as an important component of sustainable manufacturing in developing economies. These studies indicated that the majority of recovery and recycling operations are carried out by informal waste collectors and pickers.

Actually, they have contributions to the significant reduction in the cost of waste management in addition to the positive environmental effects as well as achieving a kind of social justice by providing income for the poor through informal recycling activities. Because of the big amount of solid plastic waste; we need to develop legal legislation to involve them in plastic waste recycling system and to help collect the largest possible amount of plastic waste present in the environment and recycle it sustainably (Mwanza et al., 2019).

Blue economy aims to separate social and economic activities and development from environmental degradation. Moreover, it opts to maximize the use and return of marine resources and the resources of the seas and oceans, such as fish, oil, natural gas, minerals, and others. Blue economy in the seas and oceans is considered a source of livelihood for many residents of the countries bordering these seas and oceans. Therefore, all countries of the world strive to achieve environmental sustainability, sustainable development and reduce marine pollution to achieve the goals of the blue economy.

To achieve this mission; a commitment of all countries in recycling of waste plastic instead of dumping it into waterways, oceans and seas to ensure that marine pollution does not occur and damage to fish stocks that may become entangled with this plastic waste or may die as a result of ingestion of this plastic waste all of these strategies aim to achieve the goals of the blue economy and increase the return from it for all countries bordering seas and oceans (Abdullahel Bari, 2019). Oceans, seas, and rivers are the final destination for poorly managed plastic waste and are considered a problem in ocean debris and the accumulation of waste in oceans, seas and rivers is a major problem affecting the blue economy (Bishop et al., 2020).

Recycling and reusing solid plastic waste is very important to ease material restrictions in several countries, including China, and to promote sustainable economic development for the country. This has resulted in an increase in the amount of plastic waste generated daily, especially in countries with a high population, and it has become an environmental problem that threatens many countries. Therefore, the population must also be involved in the recycling of solid plastic waste by participating in the activity of collecting plastic waste. This is in addition to the activity of sorting home plastic waste to reduce the cost and time of sorting this waste in factories. Subsequently, this would achieve economic savings to encourage companies working in the field of recycling plastic waste (Huang et al., 2020).

Recently, the plastic sector has witnessed a unique growth due to the numerous advantages of plastic. However, about 91% of the total plastic produced is not recycled which is considered as a major environmental disaster, as it has been found that plastic will emit 1.78 gigatons of carbon dioxide equivalent in 2050. To recycle the types of plastic used in the world, such as high and low density polyethylene, polyethylene terephthalate, polypropylene and polystyrene, with the aim of stopping the production of new plastics and achieving a circular economy by recycling as much plastic waste as possible. In fact, among the European commission's goals is to recycle 55% of plastic waste by 2030, while not restoring to use the traditional methods of waste disposal, whether by burning or burial, to avoid the resulting damage and greenhouse gases that affect environmental sustainability (Meys et al., 2020).

Solid plastic waste supply chain includes a number of logistical activities such as collecting, sorting, transporting, treating, and finally disposing of solid plastic waste. The applications of the Fourth Industrial Revolution have been used such as Internet of Thing (IoT) to raise the performance efficiency of these activities and reduce the resulting environmental pollution. It also aims to design strategies to solve waste management problems using a sustainable, intelligent, and multi-dimensional waste management system to reach environmental sustainability.

The growing economy in South Korea has led to an increase in production and consumption, which in turn has led to an increase in the amount of waste generated. Thus, new waste treatment facilities and new landfills are resorted to for waste disposal due to the generation of large quantities of solid plastic waste, especially in urban areas due to the high level of income. Korea aims to implement a system based on the participation of citizens in waste collection services as well as in local governance in order to achieve and collect the largest possible amount of plastic waste and recycle it. Waste is converted into ash and then disposed of in marine dumps (Sungmin et al, 2020).

In 2015, these types of waste plastic containers amounted to 141 million tons annually in Germany and it is expected to increase more. It has also been found that plastic production will emit 1.78 carbon dioxide equivalents in the year 2050. Therefore, the proper handling of plastic waste represents a major challenge to evolving into an environment-friendly future, by governments and official institutions in many countries adopting the goals of transition to a circular economy to achieve global economic prosperity. For example, the European Commission imposed a plan to recycle about 55% of plastic waste in 2030, as well as China and the United States which imposed the same percentage by stopping the production of new plastic to achieve a circular economy and to benefit from recycling plastic waste and to preserve the environment (Meys et al., 2020).

Recycling is the most environmentally sound strategy for dealing with solid waste in order to reduce the source and reuse. Recycling solid plastic waste is an opportunity to reduce the use of oil and carbon dioxide emissions

and the quantities of waste that require disposal or burial, thus saving the costs of landfills for this waste and the achievement of a circular economy and significant economic savings (Khoo, 2019). The most important goals of sustainable development are climate action, and this can be achieved by improving the collection of plastic waste, separating waste at the source, and applying appropriate treatment technology. This is in addition to reducing the quantities of plastic waste directed to landfill through controlling and monitoring this waste using information and communication technology. Climate change and increase of carbon dioxide emissions are caused by the accumulation and burning of this waste in open landfills or from burning this waste in cement factories to generate energy (Fatimah et al., 2020).

Plastic has many economic benefits that can be achieved by including the recycling process in the concept of a circular economy, which aims to change the current linear economy model by extracting maximum values from resources during use and recovering and renewing materials at the end of their service life. The principles of a circular economy are integrated with the sustainable supply chain. This management provides many advantages from an economic perspective and contributes to achieving sustainable development. Furthermore, major companies that have a large capital must build centers or factories to recycle their waste, within the framework of the closed-loop supply chain. Through this, economic savings can be achieved reducing the number of times of re-ordering materials used in the manufacture of plastic products from suppliers. It also reduces the lead time for the production of new products and reduces the waiting time for supply from suppliers, and thus reduces the total costs for companies. Consequently, through recycling waste, raw materials can be obtained again and utilized in the manufacture of plastic products. This is new, and this, in general, achieves financial and economic savings for companies (Ren et al.,2020).

Plastic pollution resulting from the accumulation of solid plastic waste in the environment is considered a serious problem that threatens the climate, and many statistics have indicated that about 500 billion plastic bags are used worldwide annually, as 50% of this percentage is single-use plastic products, and about one million are purchased A plastic bottle every minute in the world, and about 8 million tons of plastic are thrown into the oceans every year, and the percentage of plastic that is generated from the total waste destined annually in the world is about 10% From the last century due to the increase in population and increased consumption in the world.

The population increase and the high rates of daily consumption have resulted in the accumulation of large amounts of plastic waste in the environment, emitting large amounts of greenhouse gases. Plastic ranges from 7% of nitrous oxide, 3% of fluorinated gases, and 10% of methane, in addition to 80% of carbon emissions, which negatively affect temperature and weather, affect climate stability, and are a major cause of the global warming problem. Plastics in the marine environment is one of the major concerns because of their persistence at sea, and adverse consequences to marine life and potentially human health. Rivers annually emit between 1.15 and 2.41 million metric tons of plastic to the oceans.

The international environmental association has just published a report about plastic pollution. This report is ringing the alarm again because nothing gets better despite a generalized awareness. Indeed, the plastic pollution is uncontrollable. By the year 2030, the plastic pollution of our oceans could double, threatening marine life and our own health. China and Indonesia are the main sources of plastic pollution for single use: bottles, packaging, main bags polluting the oceans (The countries polluting the oceans the most with plastic waste - Plastic Ethics, 2019).

China and Indonesia alone are responsible for around 5 million tons of plastic waste ending up at sea each year. As the Statista chart shows, they are coastal countries crossed by the largest rivers such as Yangtze, Nile, Amazon, etc. or located on islands that drain the most plastic in marine environments, annual metric tons of mismanaged plastic waste and total ending up in global water at the most countries polluting oceans; shown in the next figure (1):

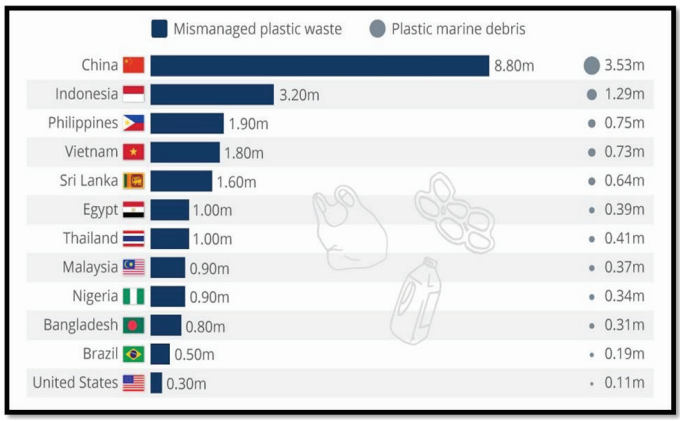

Figure (1) The countries polluting the oceans the most with plastic waste.

3.1 INTERNATIONAL EXPERIENCES IN PLASTIC WASTES

The European Union aims to achieve recycling rates of solid plastic waste at a rate of 50% in 2025 and 55% in 2030. Hence, many European Union countries such as Austria, Germany and Netherlands are trying to achieve the highest rates of recycling their plastic waste by following an integrated system for the collection, treatment, and final disposal of solid plastic waste in environmentally sustainable ways. Recycling rates of plastic waste in these three countries are 23%, 43% and 30%, respectively. Plastic waste is expected to reach billion tons by 2050, resulting in significant environmental damage. indeed, these wastes have become a threat to the environment, human beings, water and soil, and this problem has recently attracted the world's attention and trends because it is an essential element and a major cause of climate change and aggravation of the global warming problem (Picuno et al., 2021).

There are several methods for treating solid plastic waste which have been implemented in many countries such as the United States of America, Japan, Germany, and Denmark in order to reduce the accumulation of plastic waste in our environment. Synthetic crude oil or refined fuel produced using pyrolysis technology Plastic to Fuel (PTF) to obtain a high-calorie fuel can be used to operate machinery and cars, where plastic waste is converted into fuel through pyrolysis and thermal catalysis. In fact, there are two companies in the United States of America that have the capacity to process 25.000 tons of plastic waste annually. In Japan, there is a factory called Sapporo, which has been operating since 2000, with a production capacity of 15.000 tons annually. It is the largest factory of its kind in Japan in treating plastic waste turning it into high-calorie fuel (Khoo, 2019).

Plastic recycling can reduce environmental pollution and carbon dioxide emissions by reducing the accumulation of waste in the environment, whether in the streets, in open landfills or in water resources, seas and oceans. This research aims to achieve a green supply chain for solid plastic waste free from any emissions or environmental damage. These may result from any logistical activity in the solid plastic waste supply chain, starting from the places of plastic waste production, whether in homes or companies, to the recycling centers and passing through other activities of collection, transportation, sorting and classification of plastic waste along the supply chain.

This is performed so as to reduce or mitigate the problem of global warming and change the economic model of the current line to a circular economy in order to achieve sustainable development. Furthermore, this would contribute to the companies that have large capital to establish their own collection centers and recycling centers to recycle plastic waste to achieve the so-called model of the supply chain with a link closed to reduce the consumption of raw materials and the cost associated with it. Thus, the end of this is to achieve a circular economy, so the production companies will be more environmentally sustainable; as shown in the next figure number 2 (Ren et al., 2020).

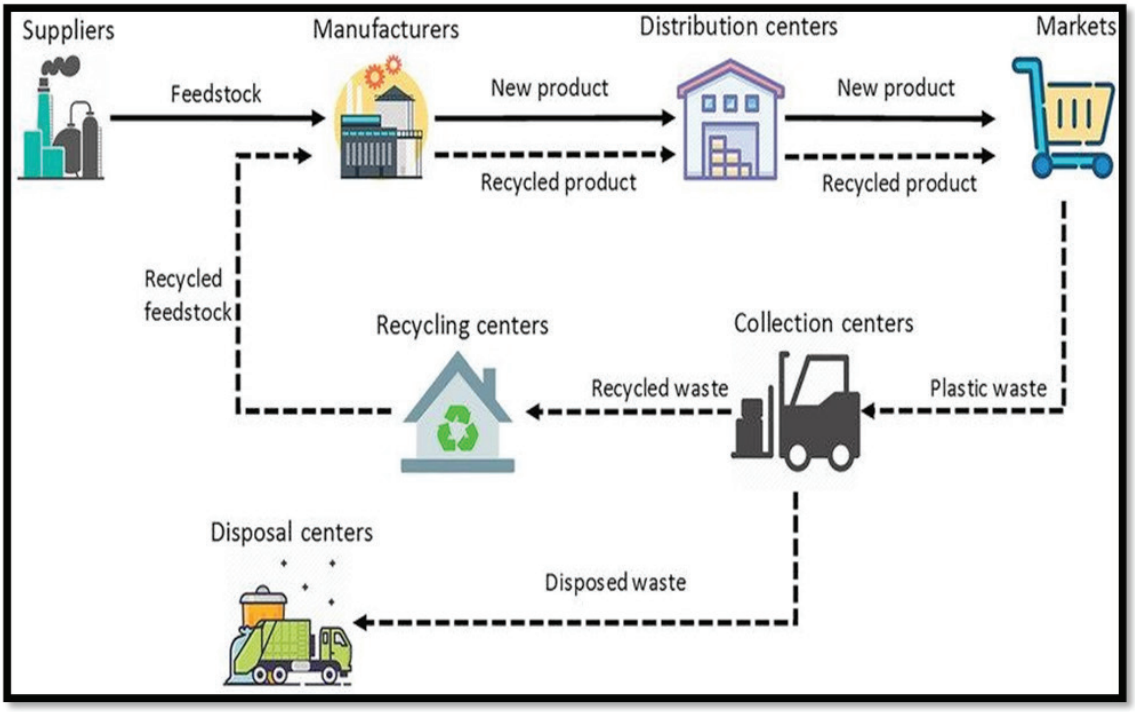

Figure: (2) Diagram of the proposed CLSC network.

Source: Ren, et al., (2020).

3.2 GAP ANALYSIS AND CONTRIBUTION

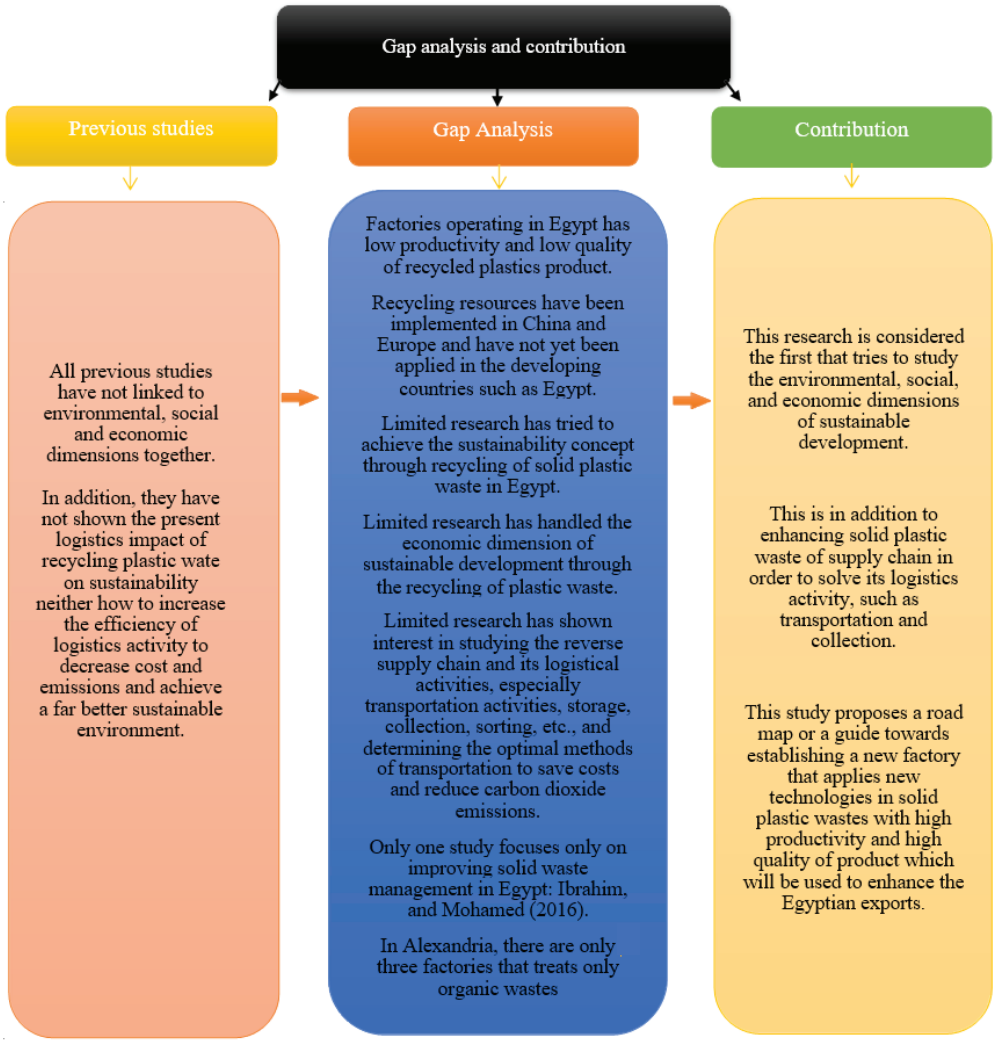

Figure (3) Gap analysis and research contribution.

Source: By authors.

5. RESEACH PROBLEM

Massive quantities of solid plastic waste are produced daily in major cities in Egypt; Cairo and Alexandria, which have a harmful impact on our health and on the environment as a result of carbon dioxide and methane emissions, which causes the rise in global temperature and leads to ice melting at the poles, as well as the spread of diseases and epidemics. Moreover, what aggravates this problem also is the absence of mechanisms and integrated factories with high technologies that can deal with the huge recycling capacity due to the daily consumption that produces these amounts of waste, which poses a threat to the environment, man, animals, marine organisms, and the blue economy.

6. RESEARCH AREA

Alexandria is one of the main cities in Egypt; therefore, large quantities of solid plastic waste are produced daily. Researcher found that Alexandria produces daily from 3500 to 4500 tons of waste. The governorate wastes 65% of the waste and goes to sanitary landfills without benefiting from it due to the low capacity of the three factories, which ranges between 350 to 750 tons per day. There are three factories engaged in solid waste recycling operations: APIS One, APIS Two and Elzayateen. Their field is dealing with organic materials such as food waste from solid waste to be used in the production of organic fertilizers or as an alternative fuel to generate energy in the incinerators of cement factories. Alexandria has international ports such as Alexandria port which is considered the main port in Egypt, and it has large areas of land on which investment projects of recycling plastic waste can be established, which can achieve an economic return and provides job opportunities and reduces its harmful effects.

7. RESEACH METHODOLOGY

This research follows an analytical approach as the researcher has had interviews with managers of plastic recycling factories. Researcher made interviews with six managers in plastic recycling factories in Alexandria; in different sectors in these factories; using structured questions in order to define strengths, weaknesses, opportunities, and threats to achieve research aims and objectives. In addition, the SWOT analysis is applied to determine strengths, weaknesses, opportunities, and threats facing recycling solid plastics waste generated from factories in Alexandria.

Strength points

1. Increasing interest in studying the supply chain and studying logistics activities by specialists who can find solutions to all the problems facing the efficient performance of logistics activities in Egypt such as transport activity by choosing the optimal methods of transport to reduce transport costs and reduce carbon dioxide emissions from transport as well as solving the problem of waste collection through the container system application to collect waste and the inability of the diggers to tamper with it.
2. Study area presented in Alexandria is devoid of factories with a highly competitive ability in this field.

Weak points

1. Lack of strategies and mechanisms that bring together all stakeholders, starting from the consumer, waste collectors, retailers, wholesalers, and recycling plants with each other, which may lead to a conflict of interests and failure to perform logistics activities efficiently.
2. Weak community participation in adopting more sustainable behaviour in disposal of their waste.
3. Inability of citizens to rationalize consumption and cooperate with municipalities in waste collection operations by disposing of them in roadside collection systems set by localities, which leads to random accumulation of waste in narrow streets that municipalities may not reach, which means the accumulation of large quantities on the long run.
4. Absence of binding laws for the community to sort their waste at home, which reduces time and cost of sorting plastic waste in recycling factories.

Opportunities

1. Recycled products can be exported to Europe and North African countries, and they can also be distributed locally to achieve a good return on the Egyptian economy.

2. INCREASE OF JOB OPPORTUNITIES.

Threats

The main threat is posed by the limitation of Stakeholders who control plastic waste produced daily from the study area and the surrounding governorates, as it is used to generate energy after burning in cement factories, due to the low cost of a ton of waste compared to other expensive alternatives to fuel.

8. CONCLUSION AND RECOMMENDATIONS

Blue economy is closely related to sustainable development and recycling of solid plastic waste, as many studies have shown that most plastic waste ends up as ocean debris thrown into the oceans and seas. Definitely, this affects the fish population that may become entangled with this waste or swallow it, and eventually leads to its death. It negatively affects particular economic activities such as fishing, which is a source of livelihood for many residents of coastal cities overlooking the seas and oceans. Several studies have recently shown that there is an entire continent near the United States of America that has plastic waste floating on the surface of the ocean. Therefore, the application of sustainable development strategies techniques of recycling solid plastic waste to recover plastic instead of dumping it in the oceans greatly contribute and have a pivotal role in achieving sustainable development and maintaining the blue economy based on the wealth that these oceans contain such as fisheries, gas, oil, etc.

Recycling solid plastic waste is very important to achieve sustainable development and reduce emissions of greenhouse gases such as methane and carbon dioxide, which have caused the problem of global warming. This is in addition to the damage caused by plastic waste accumulated in areas of random accumulation and in open landfills on human health, air quality, surface, and ground water. Moreover, it increases the salinity of the soil, and therefore recycling of solid plastic waste and the reuse of plastic can protect the environment from all these damages through applying the techniques of plastic recovery and recycling to preserve natural resources such as gas and oil. This is in order to stop the production of new plastic and attain economic savings, which contributes to achieving a circular economy instead of a front linear economy.

The interest in reverse logistics and supply chains has recently increased, and it has become necessary to study solid plastic waste supply chain from the consumer, who must rationalize consumption and adopt more sustainable behaviour as well as sorting and classifying his plastic waste. Next comes a collector or waste collector, through retailers and wholesalers, to recycling factories, solving all the problems facing the logistical activities in the supply chain of solid plastic waste, especially the collection and transportation activity. The purpose is to perform these activities at the highest rates of efficiency and effectiveness, and collecting the largest possible amount of plastic waste from cities

and rural areas. This is followed by transferring these quantities in the most optimal ways that depend on Internet of things technology, tracking technologies and choosing the best transportation paths to reduce time and cost as well as decrease carbon dioxide emissions resulting from transportation. Accordingly, this contributes to achieving sustainable development and reducing global warming.

Researchers have concluded to some recommendations through which the concept of the blue economy will be applied, which will help to increase the national income of the Arab Republic of Egypt as follows:

1. The necessity of paying attention to studying the solid plastic waste of supply chain, starting from the consumer to the recycling plant. This is in order to solve all problems facing the logistical activities that occur in this chain, whether these are transportation, collection, sorting, treatment, or final disposal activities to achieve the highest performance rates of these activities efficiently and effectively.
2. Developing a strategy that aims to implement plastic waste recycling operations to achieve sustainable development.
3. Applying Extended Producer Responsibility (EPR) method, which means that the role of companies

is not limited to distributing their products to the consumer and making profits; rather, these companies have a societal role in order to preserve the environment. This can be achieved through the companies' responsibility to collect their waste from the consumer to their own collection centres especially in the state to recycle this waste to achieve sustainable development, circular economy and the preservation of natural resources. This can only be performed in the presence of a legal framework binding on productive companies with this role towards the environment.

4. Establishing collecting centres, whether affiliated to the state or the private sector, with the aim of collecting, classifying, and recycling waste again in advanced factories that have effective treatment techniques which serve to recycle the largest possible amount of plastic waste.
5. Enforcing the law at the national level regarding recycling plastic waste and setting penalties for those who dispose of plastic waste indiscriminately, whether in open dumps or in waterways such as seas and oceans.
6. Legalizing the informal collection carried out by waste pickers from homes, open dumps, and areas of random accumulation of waste with the participation of retailers, wholesalers, etc., and linking all stakeholders, starting from the consumer, then a collector or waste picker, wholesalers, retailers, and recycling factories in an integrated system aiming at recycling as much as possible of the plastic waste generated on a daily basis.
7. Enforcement of environmental awareness programs about the importance of plastic and recycling of waste and the damages resulting from the accumulation of plastics in the environment and the damage resulting from throwing plastics into waterways and the weakness it causes to the blue economy and the revenues of the oceans and seas.
8. The need to involve the Community to participate in sorting waste at the household level to facilitate and reduce the time and cost of sorting it in recycling plants.
9. Applying quality standards for plastic recyclers in order to obtain recycled and high-quality plastic that has a high respiratory capacity in the local and international markets.
10. Forming final markets for recycled products and encouraging citizens to buy and reuse them to encourage companies working in this field.

Due to the limitation of data, the researcher could not collect the official data required from the Egyptian Environmental Protection Affairs Agency for solid plastics waste, their quantity, and other vital data. More studies need to be done for Egypt in this topic because this project has a great impact on the national income.

9. REFERENCE

1. Abdel-Shafy, H. I. and Mansour, M. S., (2018). "Solid waste issue: Sources, composition, disposal, recycling, and valorization". Egyptian journal of petroleum, 27(4), pp. 1275-1290.

2. Bennett, N. J., Cisneros-Montemayor, A. M., Blythe, J., Silver, J. J., Singh, G., Andrews, N., Calò, A., Christie, P., Di Franco, A., Finkbeiner, E.M. and Gelcich, S., (2019). "Towards a sustainable and equitable blue economy". Nature Sustainability, 2(11), pp. 991-993.

3. Bishop, G., Styles, D. and Lens, P. N., (2020). "Recycling of European plastic is a pathway for plastic debris in the ocean". Environment International, 142.

4. Fatimah, Y. A., Govindan, K., Murniningsih, R. and Setiawan, A., (2020). "Industry 4.0 based sustainable circular economy approach for smart waste management system to achieve sustainable development goals: A case study of Indonesia". Journal of Cleaner Production, 269, pp.122263.

5. Ferronato, N. and Torretta, V., (2019). "Waste mismanagement in developing countries: A review of global issues". International journal of environmental research and public health, 16(6), pp.1060.

6. He, Z., Li, G., Chen, J., Huang, Y., An, T. and Zhang, C., (2015). "Pollution characteristics and health risk assessment of volatile organic compounds emitted from different plastic solid waste recycling workshops". Environment international, 77, pp. 85-94.

7. Huang, Q., Chen, G., Wang, Y., Xu, L. and Chen, W. Q., (2020). "Identifying the socioeconomic drivers of solid waste recycling in China for the period 2005–2017". Science of The Total Environment, 725.

8. Ibrahim, M. I. M. and Mohamed, N. A. E. M., (2016). "Towards sustainable management of solid waste in Egypt". Procedia Environmental Sciences, 34, pp. 336-347.

9. Khoo, H. H., (2019). "LCA of plastic waste recovery into recycled materials, energy and fuels in Singapore". Resources, Conservation and Recycling, 145, pp. 67-77.

10. Meys, R., Frick, F., Westhues, S., Sternberg, A., Klankermayer, J. and Bardow, A., (2020). "Towards a circular economy for plastic packaging wastes–the environmental potential of chemical recycling". Resources, Conservation and Recycling, 162.

11. Mwanza, B. G. and Mbohwa, C., (2016). "Drivers to sustainable plastic solid waste recycling: a review". Procedia Manufacturing, 8, pp. 649-656.

12. Mwanza, B. G., Mbohwa, C., Telukdarie, A. and Medoh, C., (2019). "Value addition to plastic solid wastes: Informal waste collectors' perspective". Procedia Manufacturing, 33, pp. 391-397.

13. Mwanza, B.G., Mbohwa, C. and Telukdarie, A., (2018). "Strategies for the recovery and recycling of Plastic Solid Waste (PSW): A focus on plastic manufacturing companies". Procedia Manufacturing, 21, pp. 686-693.

14. Picuno, C., Van, E., Brouwer, M. T., Kuchta, K. and Thoden, E., (2021). "Factors Shaping the Recycling Systems for Plastic Packaging Waste—A Comparison between Austria, Germany and The Netherlands". Sustainability, 13(12), pp. 67-72.

15. Plakas, G., Ponis, S. T., Agalianos, K. and Aretoulaki, E., (2021). "Reverse Logistics of End-of-Life Plastics Using Industrial IoT and LPWAN Technologies–A Proposed Solution for the Bottled Water Industry". Procedia Manufacturing, 51, pp.1680-1687.

16. Ren, H., Zhou, W., Guo, Y., Huang, L., Liu, Y., Yu, Y., Hong, L. and Ma, T., (2020). "A GIS-based green supply chain model for assessing the effects of carbon price uncertainty on plastic recycling". International Journal of Production Research, 58(6), pp.1705-1723.

17. Sungmin, K., Woojae, S. and Sang-Cheol, J., (2020). "The economic value of sustainable recycling and waste management policies: The case of a waste management crisis in South Korea". Waste management (New York, N.Y.).

18. The countries polluting the oceans the most with plastic waste — Plastic Ethics (2019). Plastic Ethics. [online] Plastic Ethics. Available at: https://www.plasticethics.com/home/2019/3/17/the-countries-polluting-the-oceans-the-most-with-plastic-waste.