Circular economy as a mechanism for reducing waste risks and promoting environmental sustainability
- Analytical study focusing on the Global Sustainable Development Goals (SDGs-2030) -

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Summary: This study dealt with the circular economy as a new economic model that is concerned with changing unsustainable production methods and consumption patterns, so that it aims to preserve the value of products, materials, and resources in the economy for the longest possible period of use and reduce waste significantly, which would contribute to reducing the volume of waste and reducing its risks, and also enhance the sustainability of the environment, which is one of the dimensions of sustainable development and one of its purposes.

The study concluded by highlighting the circular economy as an important shift in economic thought resulting from the rapid spread of the concept of sustainable development and the large and increasing demand towards adopting the idea of developmental sustainability in various parts of the globe, and that it is considered a good starting point and an effective mechanism for reducing waste and reducing its risks and threats, as well as a mainstay and pillar for achieving environmental sustainability and enhancing it.

Keywords: sustainable development; circular economy; waste; environmental sustainability.
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I- Introduction:

Studies on the history of economic development and on the different intellectual stripes and economic orientations of each country have proven that the focus in the past was mainly on the exploitation and maximum use of resources in their various forms in order to raise growth rates in gross domestic product (GDP) and control other economic indicators, ignoring natural and human considerations. However, the rapid spread of the concept of sustainable development and the high and increasing demand for adopting the idea of developmental sustainability throughout the globe have accelerated its role in correcting the belief that prevailed at the time. Development theories and models have emerged on the horizon that include a deeper view describing development as having interrelated dimensions, aiming to meet human needs and achieve social welfare in the long term, taking into account the condition of preserving the human and natural resource base and trying to reduce environmental degradation, and constantly striving to achieve a dynamic balance between economic and social development on the one hand and resource management and environmental protection on the other.

In this context, the United Nations General Assembly unanimously adopted (September 25, 2015) the 2030 Agenda for Sustainable Development (the 17 Sustainable Development Goals and 169 targets) under the slogan "Transforming Our World," which are integrated and indivisible goals and targets aimed at achieving a balance between the three dimensions of sustainable development: the economic dimension, the social dimension, and the environmental dimension.

Accordingly, in the midst of efforts and proposals that have seen great interest in recent years in the policy of circularity or recycling, which has developed into a stand-alone economy termed the circular economy as an economic system aimed at rebuilding capital, improving resource returns, and making the most of them, this new economic approach differs from the traditional linear economy methods that look at the optimal use of material and human resources. It is a model characterized by holistic and systematic thinking regarding the flow of materials and energy. It seeks to increase economic value while reducing negative effects by closing material loops. It balances economic development with environmental protection and resources. It focuses on the use and recycling of resources in a more effective and efficient manner, as well as on environmental protection. It is characterized by low consumption of energy and other resources, low emissions of pollutants, the production of the least possible waste, and high efficiency. It is based on the concepts of industrial coexistence, cleaner production, environmental design, and sustainable consumption and production.

I.1- Problematic:

Through the above, the problem of this study revolves around:

To what extent does the circular economy contribute to reducing waste volume and mitigating its risks? Furthermore, how does it contribute to promoting environmental sustainability?

I.2- Significance (importance) of the study

The importance of the study stems from the importance of the subject variables, which are mainly represented in:

- Circular economy is an alternative economic model based on maximizing the utilization of all raw materials, minerals, energy, and resources in their various forms, as well as launching recycling, use, remanufacturing, and development processes instead of the pattern of waste and waste dumping;
- Waste: its volume, its recovery and recycling, its current risks and future threats, its management methods ...;
- Environmental sustainability is one of the dimensions of sustainable development and one of its most prominent objectives. It is also a prominent element in the 17 global goals for sustainable development contained in the 2030 Agenda, known as the slogan "Transforming Our World".

I.3- Objectives of study:

The study aims to achieve the following:

- Provide an appropriate conceptual framework for the basic research variables: circular economy, waste, and environmental sustainability, while trying to give an initial perception of the relationship between these variables;
- highlighting the role of the circular economy in reducing the volume of waste and reducing its risks;
-Clarify the contribution of the circular economy to achieving environmental sustainability and enhance its basic aspects and main requirements.

I.4- Approach used:

In guiding the methodological path of the research and in order to investigate its questions, scientific sources have been adopted by using the descriptive approach to clarify the theoretical frameworks of the study variables, while the analytical approach has been relied upon in analysing the basic aspects of the relationship between its variables. The answer to this problem was through the following main axes:

- The transition from a traditional (linear) economy to a circular economy;
- Waste: From the traditional concept...to the contemporary concept under a circular economy;
- The contribution of the circular economy to achieving and promoting environmental sustainability in light of the 2030 Global Goals for Sustainable Development.

II. Transition from a traditional (linear) to a circular economy:

The term circular economy was used for the first time by two British environmental economists, David W. Pearce and R. Kerry Turner, in their book "The Economics of Natural Resources and the Environment," where they pointed out that the common economy in the world is a linear economy that has evolved without including in its infrastructure the idea of recycling, which was reflected in the unfair treatment of the environment as a repository of waste, while the circular (non-linear) economy is based on the study of feedback-rich systems, especially vital systems. One of the main results of this is the emergence of the concept of improving systems instead of components and the concept of design for suitability to achieve the principles of economic sustainability. In general, the circular economy is based on several grounds, including (David W & R. Kerry , 1989):

- There is no waste, all components are recycled and reused;
- Diversity is powerful, as diverse products, materials, and systems are more resilient to external shocks;
- Energy must come from renewable sources;
- The supremacy of systemic thinking, that is, viewing things as affecting each other within the framework of an integrated whole and considering the elements as appropriate within the contexts of infrastructure, environment, and society;
- Prices should reflect the true cost in order to be effective.

II.1- The emergence of the circular economy as a pathway to sustainable development:

The rapid spread of the concept of sustainable development and the high and increasing demand for adopting the idea of sustainability have led to the emergence of development theories that involve a deeper view that describes development as having interrelated dimensions and that any economic activity must be linked to the environment and society. The Food and Agriculture Organization of the United Nations (FAO) has defined sustainable development as "The management and protection of the natural resource base and institutional change to achieve and sustain the satisfaction of human needs for current and future generations in an environmentally appropriate, economically appropriate, and socially acceptable manner" (DONATO , 2003, p. 52). This definition indicates that sustainable development is a comprehensive concept related to the continuity of the economic, social, institutional, and environmental aspects of society. Sustainable development enables society, its individuals, and its institutions to meet their needs and express their actual existence at the present time while preserving biodiversity, preserving ecosystems, and working on the continuity and sustainability of positive relations between the human system and the biological system so as not to prejudice the rights of future generations to live a decent life. This concept also indicates the need for the world to confront the risks of environmental degradation that must be overcome while not abandoning the needs of economic development as well as equality and social justice. That is, sustainable development is a comprehensive concept related to the continuity of economic, social, and environmental aspects, as it ensures that needs are met at the present time while preserving biodiversity, preserving ecosystems, and working on the continuity and sustainability of positive relations between the human system and the biological system, so as not to prejudice the rights of future generations to live a decent life.

As a result, in the midst of the solutions offered, which have seen great interest in recent years in the policy of circularity, which has evolved into a stand-alone economy called the circular economy, this economy balances between economic development and the protection of the environment and resources. It focuses on using and recycling resources in the most effective and efficient way, as well as protecting the environment. This can be illustrated by Figures 01 and 02 :

Raw materials in large quantities, transforming them into commodities and using them until they are finally disposed of as waste, which thus does not respond to the foundations and requirements of sustainability, towards a circular economy that reduces the extraction of primary resources, converts them into commodities, shares them, and then converts and recycles them into other energy sources or raw materials so that the amount of waste that must be disposed of is reduced to a minimum, and it thus seems compatible with sustainable development and consistent with its dimensions and objectives, being the most objective and realistic to address the dilemma of global economic growth and curb climate change. It also reviews the role of technical innovation in bridging the carbon gap through a package of integrated technologies and embodies the transition from a linear economy model in which materials are used and then disposed of to a circular model based on reducing consumption, re-use, and recycling and converting carbon dioxide emissions to other forms of energy.

From the above, it can be said that, as a result of the prevalence of the idea of sustainability and its increasing importance and increasing demand for it, the term circular economy or circularity has emerged as one of the most prominent factors leading to sustainable development and the most consistent with its dimensions and compatible with its objectives. Unlike the traditional linear economy, which is based on the methodology of making, using, disposing of, and contradicting the principle of sustainability and does not respond to the conditions and requirements of sustainable development, the circular economy (we will address it in the following element) is based on reducing waste and aims at the continuous use of resources to create a closed loop, as it thus embodies conformity with the thought and philosophy of sustainability and is a direct response to the sustainable development strategy and one of its indicators.

II.2- Circular Economy: Basic Concepts:

II.2.1- Circular Economy Concept:

The economic system of societies is the general framework consisting of standards and rules through which it determines how and how to deal with human needs, natural resources, and technical and cognitive capabilities within society. By linking the economic, legal, and social relations that govern and run society and studying the development of economic systems throughout history, he finds that there are many transitions through successive periods of time, the most important of which is the transition from a linear (traditional) economy to a circular economy.

The adoption of the circular economy system by some countries did not come in vain, but was the result of studies and research that proved that the circular economy system, which falls within the so-called green systems that reduce environmental risks and achieve sustainable development, also saves many costs and provides many jobs (EL MERSAAL, 2020).

Thus, it can be said that there is an urgent need in the whole world to develop new models in the sense that the linear model of product consumption and then disposal is considered an unsustainable economic model in light of a global trend to adopt comprehensive sustainability concepts. The circular economy aims to use fewer resources in manufacturing processes and reuse the product instead of disposing of it, such as by rehabilitating, remanufacturing, or recycling it, as the products and their components can be repaired and re-manufactured and then recovered as raw materials in another manufacturing process. Interest in the concept of the circular economy has begun with the Ellen MacArthur Foundation, which cares about its standards, the scarcity of resources, and the importance of reducing waste. Therefore, the circular economy is a vital economy that aims to change the way we live by adopting development and innovation in industry and consumption, reducing waste by reducing heavy dependence on imports of raw materials, increasing resource productivity, creating a more competitive economy, creating many job opportunities, and reducing environmental problems (MACARTHUR, 2011).

- It was published in the Ellen MacArthur Foundation report that the concept of the circular economy depends on two simple ideas: the first is the awareness that what is considered waste can

be reused as a resource, and the second is the need to separate economic growth from the use of natural resources, and that the circular is an industrial system that does not produce waste or cause pollution, from the beginning of its design and since the intention to create it, which contains two types of material flow: biological nutrients designed to return to the biosphere safely, and technical nutrients that are designed to be recycled with high quality within the production system without entering into its vital design, as well as being repairable and renewable (MACARTHUR, 2018).

II.2.2- Definition of Circular Economy:

There are many opinions and definitions about the circular economy, some of which are discussed below:

- The Ellen MacArthur Foundation report notes that the circular economy is based on two simple ideas: the first is the awareness that what is considered waste can be used as resources, and the second is the need to separate economic growth from the use of natural resources (MONTAIGNE, 2016).
- According to this institution, this type of economy is an industrial system that does not produce waste and does not cause pollution from the beginning of its design. It is a new solution to the challenges of sustaining human systems on this planet, which suffers from an increasing scarcity of resources. The circular economy is the only way to transform the current economy into a renewable and sustainable system that allows humanity to develop and prosper (MCDONALD , NORMANDIN, & SAUVE, 2016).
- As for REMY Le MOIGNE: (A circular economy is an economy in which the value of products and resources is preserved for as long as possible and waste production is minimised) (MOIGNE, 2018).
- According to LANOIE and NORMANDIN, the circular economy is a system that is more respectful of the environment, aims to reduce negative environmental impacts, and addresses the issue of the scarcity of limited resources by improving their utilisation (LANOIE & NORMANDIN, 2015).
- As defined by AUREZ and GEORGEAULT, it is the principle of economic organisation that aims systematically to reduce the amount of raw materials and energy over the entire life cycle of a product or service and at all levels to organise society, with the aim of ensuring the protection of biodiversity and development conducive to the well-being of individuals (AUREZ & GEORGEAULT, 2019).
- The European Commission has provided a broader definition of the circular economy, which states that this alternative economic system focuses on creating products and using materials for as long as possible, and the case of this model is that when waste and resources are minimised and when the life of the product reaches its end, it must be used again, and this system leads to economic growth, along with contributing to innovation and job creation (VASILEOIS, 2017).
- World Economic Forum: circular economy as a regenerative or regenerative industrial system, through design and planning, replaces the concept of "End of life" with its regeneration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals that hinder reuse and return to the biosphere, and aims to dispose of waste through the superior design of materials and products (MYWESTE, 2020). Figure 03 reflects the previous definitions.

Through the previous definitions and the above figure, we conclude that the circular economy is an economic system that relies on changing the methods of manufacturing and consumption to reduce waste and encourage reuse and recycling of materials used in manufacturing in a circular manner, as if there were a closed loop that does not allow the introduction of new inputs into the production process but rather the use of what is available. Thus, waste is reduced and production costs are saved; that is, the circular economy is a dynamic economy that aims to change the way we live by adopting development and innovation in industry and consumption. It represents a sustainable new economic paradigm in which the goal shifts from narrow GDP growth to multidimensional progress that includes broader strengthening of environmental quality, human well-being, and economic prosperity for present and future generations and focuses on environmental regeneration.

II.3- Principles of Circular Economy:

While the linear industrial economy is based on "take, make, dispose" processes, and the lifestyles that feed on it drain the limited reserves of ores to create products that end up in landfills or incinerators, the circular economy is based on five principles as follows (NEFFAH & BETYEB, 2018):

- Organise reverse cycles;
- Be resource-effective;
- Systemic thinking (think in systems);
- Prioritise the future;
- Mutual benefit Create.

These five principles are closely related to each other, as if any institution wants to follow the circular approach in its production system, it needs to adopt these principles and achieve interdependence between them. The following is a simple explanation of each element separately, as follows (HOUT, 2017, pp. 53-56):

- **Organise Reverse Cycles:** The use of resources in circular flows, or, in other words, the exploitation of resources within a closed loop, is essential in a circular economy, and this represents a clear contrast compared to the contemporary economic system. In order to achieve circularity, the value must be collected and processed at the end of the life of the products through a system. This includes processes that allow the return of resources to the value chain, such as regeneration and recycling, where waste is considered a nutrient and the concept of waste is eliminated. Biological and technical components are intentionally designed to enter the material cycle, meaning that the outputs of one process become inputs for another process, which completely removes the concept of waste. Finally, the development of reverse cycles is primarily related to logistical supply and innovation processes, but it can be greatly supported by product development strategies that encourage resource recovery.

- **Be Resource Effective:** the circular economy aims to increase the efficiency of resource use in the economy, which means using resources to their full potential in order to create a positive impact. According to the "cradle-to-cradle" rule, circular economic activities are divided into two groups:

- **First:** those preventive works and practices that enhance the possibility of reuse of machines, buildings, and bridges that have exceeded their useful life and extend their service life to other terms instead of taking them out of service in accordance with the principles of the (traditional) linear economy through maintenance, repair, remanufacturing, upgrades, and technical improvements;

- **The second** is the set of activities that convert old goods into new resources by recycling materials for use in new activities. Considering that resources have used all their potential, they must:

- The product or service must be directed to address an appropriate social need to give it the right to exist;

- The product shall be built to use only the appropriate and necessary energy, materials, and components without waste;
- The intensity of the use of the product must be taken into account, and what is meant is the intensity with which the consumer uses the product, as products that spend most of their time outside of use are considered waste.

- Think in Systems: systemic thinking is a method that helps to understand how parts of a system interact and how they relate to the system as a whole. Objects are seen to affect each other within the framework of an integrated whole, and elements are considered appropriate within the contexts of infrastructure, environment, and society. Based on the complex relationships that affect the interaction between both the internal and external environment variables of the business environment, it will be difficult to predict the results of actions, and the circular economy aims to improve the performance of the entire system instead of one element by recognizing the existence of complex consequences and adopting a comprehensive perspective to assess and improve the impact of the company's activity.

- Giving priority to the future or thinking about the future (Prioritise the Future): All organisations of different types and orientations in the economy work to stay and continue as much as possible and achieve growth. To achieve this goal, they must adapt to environmental variables, but there are institutions that make environmental variables, and then they must assess and predict risks, which are an appropriate engine for change from the problems of the linear economy to the solutions of the circular economy, which provides a fundamentally different approach to the contemporary current situation in the economy and industry. These changes need time to show their results, so the circular economy is working on designing a product in order to increase its value at the end of its life, and in order to benefit from the circular economy, opportunities and consequences of actions should be viewed from a long-term perspective.

- Create Mutual Benefit: the circular economy has the same goal as the linear economy, which is to meet the needs of society for goods and achieve development, but the ways of using resources and ways of achieving benefits differ. Therefore, when changing these methods, it is necessary to organise each activity to create mutual benefit between stakeholders by organising all the operations of the organisation.

To capitalise on the transition to a circular economy, as well as introduce new value propositions and revenue models that align with circular economy principles and the organisation's profit-oriented strategies. This also extends to the supply chain level, because increasing the efficiency of resources by extending the life of the product may reduce the profits that are the goal of each institution, but increasing revenues by selling more products may lead to a kind of imbalance or conflict (greater waste and higher depletion).

III. Waste: from the traditional conception... to the contemporary concept under the circular economy:

Waste is one of the most prominent environmental problems in the world and a source of environmental pollution, as it contributes significantly to the pollution of the elements of the environment, such as soil, water, and air, and works to distort the general landscape due to its increase in general and the lack of appropriate methods in the process of collecting, transporting, storing, and processing it. It presents a global challenge with serious health, financial, and environmental consequences if not properly addressed, a problem related to how societies produce and consume. This is due to increasing population growth, urbanisation, and industrial growth. Currently, the weight of waste produced per capita in many developing countries exceeds one kilogram per day. The rate of industrial waste is also very high. Economic growth aims to increase consumption and production of goods, regardless of the environmental and social dimensions and the erosion and destruction of natural resources. We need to develop new economic models aimed

at achieving sustainability by using fewer resources and changing prevailing waste product disposal practices. The problem of waste is no longer a country-specific problem but rather a global problem that requires continuous cooperation and coordination between all concerned parties, including scientists, economists, politicians, and technicians, especially since the amount of waste is constantly increasing and frightening (HEBRI, 2019, p. 02).

III.1- Definition of Waste :

Although no global consensus has been reached in this regard, there are definitions of the term waste that are generally used, and this concept reflects well on waste and also identifies materials outside the scope of this term, including:

- According to the Basel Convention, "Wastes are substances or objects that are disposed of, are intended to be disposed of, or are required to be disposed of by the provisions of national law" (BASEL, 2018, p. 08).
- The World Health Organisation considers that "The term waste means garbage, dirt, or waste, which are some of the things that the owner no longer wants somewhere and at some time and have no importance or value" (AL DEGHIRI, 2005).
- According to the United Nations Waste Statistics Section, "This term refers to materials that are not products of the first quality (that is, products intended for the market) and will not be used by the entity from which they originated for any production, conversion, or consumption work, but rather disposed of, intended to dispose of, or required to dispose of. This term does not include residues that are recycled or used directly at their place of production (i.e., entity) or wastes from materials that are disposed of directly in water or ambient air" (United Nations Environment, 2008).
- Waste in general represents a burden, a nuisance, and a problem that should be disposed of far away, so that it is completely away from social and economic communities for a long time. These remote waste disposal places have remained a deep hole in the ground or inside water bodies (whether flowing, stagnant, saline, or fresh). With the increasing population, accelerated economic growth, the diminishing availability of land and space for these purposes, and the increasing societal obsession with the issue of waste, these remote waste disposal places have become at a rapid and dangerous pace that is gradually approaching the same social and economic gatherings that generate waste globally (RANAHANSA & KNAUS, 2018).

By looking at the previous definitions, we find that they converge in one meaning, which is that waste materials in different forms and varied forms have no value at all levels, whether social or economic. On the other hand, it has negative repercussions and risks for the environment in the first place and in all other fields and frameworks.

III.2- Global Waste: Reality and Threats (as per World Bank reports):

For decades, the basic mode of production and consumption has centred on the extraction, manufacture, use, and disposal of resources, or what can be called a traditional or one-track economy, where companies extract raw materials and turn them into products purchased by consumers, and then eventually go to waste bins. But as warnings of climate change and environmental degradation have risen, people have begun to reject the continuation of this model, with many business and government leaders, including China, Japan, and the United Kingdom, arguing that the one-way economy should be abandoned in favour of the so-called circular economy based on extracting, manufacturing, and using resources, and then recycling them for use again.

Figure 04 shows the reality of global waste as well as its future risks and threats, according to the World Bank report issued by the press release on September 20, 2018, under the title "What a Waste 2.0: a look at solid waste management in the World Until 2050".

- By looking at the figure, especially the last sentence at the bottom, "We will actually live among the piles of waste if nothing is done; what can we do? " We realise the real danger of the current and future waste problem, that threats and fears are increasing as we advance in time and terribly,

and that the circular economy aims mainly to research mechanisms and ways to address this. In this regard, the World Bank warned that the large spread of waste in the world poses an additional threat to human health and the environment, which was already weakened by climate warming. The report said: "If the necessary measures are not taken to curb this crisis urgently, the volume of waste will increase by 70% by 2050 to become three billion and 400 million tons, compared to two billion and ten million tons in 2016. "Mishandling waste is damaging to human health and the environment, adding to the climate problem," said Laura Tuck, IFAD's vice president for sustainable development. Although rich countries only account for 16% of the total population of the earth, they produce 34% of the world's waste, while East Asia and the Pacific regions export 23%. Waste production in sub-Saharan Africa is expected to more than double by 2050 and more than triple in South Asia.

- World Bank experts are particularly concerned about plastic mismanagement, as it damages ecosystems for hundreds or thousands of years. In 2016, the world produced 242 tonnes of plastic waste, accounting for 12% of total solid waste. The World Bank recommends financing developing countries that need to develop waste treatment systems and supporting campaigns to reduce plastic use and counter food waste. The World Bank has spent $ 4.7 billion financing global waste management and pollution control programmes since 2000.

- In addition, a large international study showed that pollution kills millions of people around the world, noting that the majority of deaths are caused by diseases caused by pollution, such as heart disease and lung cancer. The study pointed out that the majority of deaths resulting from pollution, about 92%, occur in poor or middle-income countries, adding that pollution is linked to about a quarter of the total number of deaths in countries where the industry is growing rapidly, such as India, Pakistan, China, Bangladesh, and Madagascar (The World Bank, 2020). "Pollution is much more than an environmental challenge, it is a severe and pervasive risk that affects many aspects of human health" said Philip LANDRIGAN, a professor at the Icahn School of Medicine in Mount Sinai, US, who was among the study's participants (Middle East Online, 2020).

- Thus, the topic of waste is an important global issue for everyone in the world. With more than 90% of waste dumped or burned in low-income countries, the poor and most vulnerable are disproportionately affected. In recent years, landfill landslides have buried homes and citizens under rubbish piles. The poorest often live near landfills and supply their city's recycling system through waste collection, leaving them vulnerable to serious health complications. In this regard, Sameh WAHBA, Director of the World Bank's Global Practices for Urban and Land Development, Disaster Risk Management, and Resilience, says, "Mismanaged waste pollutes the world's oceans, clogs water drains, causes floods, transmits diseases, increases breathing problems due to burning, harms animals that unconsciously consume waste, and affects economic development such as tourism." Greenhouse gases from waste are key factors in climate change (The Word Bank, 2018).

III.3: Waste in the Circular Economy... From burdens and threats to resources and opportunities:

From what we have discussed in the previous elements, it is clear that waste is no longer considered a burden under the circular economy model, as it is based on plans and policies that transform environmentally useful waste into resources. It looks at the creation and development of technologies and mechanisms that enable and achieve this. The circular economy model is characterised by holistic and systematic thinking regarding the flow of materials and energy, as it seeks to increase the economic value of our actions while reducing the negative effects by closing the loops of materials, activating renewable regional growth and energy potential, and ensuring community participation. This will allow for synergy between the circular economy model and the concepts of industrial coexistence, cleaner production, environmental design, and sustainable consumption and production.

III.3.1- Circular economy and waste recycling:

Direct recycling has been used for many years by producers of waste materials (scrap), which is the basic form of recycling, but with the beginning of the 1990s and the emergence of the circular economy as a new branch of economics, indirect recycling began to manufacture waste materials to produce other products that rely on the same raw material, such as glass, paper, plastic, aluminium, and other materials that are now recycled. Waste recycling is one of the four pillars on which the waste management process is based, or what is known as the 4R Plan, as shown in Figure 05:

- **Reduce:** it means reducing the raw materials used, thus reducing waste, and this is done either by using fewer raw materials, by using raw materials that produce less waste, or by reducing the materials used in packaging processes (plastics, paper, metals, etc.).
- **Waste Reuse:** any plastic reuse of mineral water after sterilisation leads to a reduction in the volume of waste.
- **Recycle:** refers to the recycling of waste, or the remnants of used materials such as empty bottles, plastic bags, damaged devices, etc., and their conversion into new products. It should be noted that the products resulting from recycling, as well as recyclable materials, must bear a certain mark that informs the customer that this product is made of recycled waste and that this product can be recycled and used after use.
- **Thermal recovery (recovery):** thermal recovery technology is used in many countries by burning these wastes under certain operating conditions, that is, under a certain temperature, by controlling emissions and their compliance with environmental laws. This method leads to the disposal of 27% of solids and their conversion into thermal energy that can be used in industrial processes, steam generation, or electrical energy. This model creates new business opportunities through the tasks of collecting, sorting, processing, recycling, and selling the resulting products, in addition to protecting the environment and preserving natural resources such as metals, paper, glass, etc., and thus leading to the strengthening of the economic sector and the achievement of development sustainability.
- In this regard, an economic study issued by the League of Arab States in 2012 indicates that the size of the losses of the Arab countries due to their neglect of waste recycling is about 5 billion US dollars annually, that its quantity is about 22.8 million tonnes annually, and that it is sufficient to manufacture about 14.3 million tonnes of paper worth 2145 million dollars, produce 1.8 million tonnes of iron worth 135 million dollars, produce about 75 thousand tonnes of plastic worth 1.4 billion dollars, as well as about 202 million tonnes of cloth. The same study also shows that Arab losses are not limited to the value of products that can be obtained from recycling operations but extend to the high cost it pays to dispose of waste and treat the damage resulting from it, as Arab countries spend about $2.5 billion annually (ESCWA, 2016).
- As stated by the World Bank Vice President for Sustainable Development, "Poor waste management harms human health and the local environment, while it increases the climate challenge. The poorest people in society are often negatively affected by inefficient waste management, and this should not be the case. Our resources must be used and then reused continuously so that they do not end up in landfills" (The Wold Bank, 2018).

III.3.2- The future of waste in the circular economy:

The shift towards a circular economy requires the sensitive and serious handling of waste, and this is necessary to build a circular economy where products are designed and optimised for reuse and recycling. Adopting a circular economy will help promote effective economic growth while minimising the volume of waste and reducing its risks and threats.
- In addition, the circular economy, as a new economic model, is interested in changing all unsustainable production methods and consumption patterns. It aims to save the value of products,

materials, and resources in the economy for the longest possible period of use and reduce waste significantly. The circular economy contributes to enhancing efficiency and reducing electricity consumption and carbon dioxide emissions, in addition to modernising the economic system and creating sustainable job opportunities (ELAIZOUE, 2019).

- The circular economy will also contribute to the emergence of a different type of consumer who is interested in an innovative model of ownership, which is the ownership of services instead of individual ownership of a commodity or product. This type of business offers many opportunities, including preserving raw materials by transferring ownership from the consumer to the producer. This is a solution to a number of challenges, such as the issue of climate change, resource scarcity, and steady global population growth.

- The application of circular economy standards is also expected to contribute to reducing the environmental footprint, reducing accumulated waste in dumping and landfilling areas, reducing air pollution, and providing a strategic solution to address climate change. It contributes to reducing the amount of energy needed by industrial production processes to convert raw materials into usable products. The idea of buying a service instead of a product also contributes to the significant reduction of waste that accumulates and, over the years, causes environmental problems. The circular economy is also expected to contribute to decoupling economic growth from the use of natural resources and ecosystems by using those resources more effectively at both the economic and environmental levels. It is a driving factor towards innovation in the areas of reusing materials, components, and products more effectively by creating more value through reducing costs and developing new markets or existing ones (United Nations Environment, 2019).

III.3.3- Methods and mechanisms of waste treatment in the circular economy:

There are many solutions and mechanisms proposed in the circular economy to address the waste phenomenon in order to benefit from them by viewing them as real resources and opportunities, and this is based mainly on the intensive use of knowledge, new technology, and innovations, including, but not limited to, the following (Future Observatory, 2020):

- **Waste-to-energy:** technical progress contributes to the promotion of waste-to-energy initiatives that support the circular economy and encourage the treatment of different types of waste. Most initiatives rely on burning waste to convert it into electricity, heat, and fuel. However, this method poses some drawbacks, such as producing toxic gases and wasting reusable materials. Therefore, there are promising technologies, including the catalytic cold transformation process, rapid gasification systems, and organic vertical growth systems, that may provide energy to waste treatment plants in the future, reducing the need for waste incineration;

- **Using robots:** sorting represents the most difficult stage of the correct treatment of garbage. This task is carried out by low-wage workers in developing countries. The use of technology in the sorting process began in conjunction with the development of robots. Helsinki-based Zen Robotics uses robots to sort metal and wood from rubbish, and another Swedish company uses a combination of infrared rays and air currents to sort plastic from organic waste;

- **Block-chain technology:** a large part of the waste problem relates to the tendency of developed countries to export their waste to developing countries. But that doesn't solve the problem; it just moves it somewhere else. The Canadian company Plastic-Bank uses Block-chain technology to encourage customers to recycle their plastic waste by replacing it with secure Block-chain tokens that they can use to buy different goods. The company then recycles the plastic and converts it into different products. Companies participating in this initiative can use Block-chain technology to track their investments and encourage others to join;

- **Waste-secreting Nano-robots:** traditional rubbish bins have no place in future homes. Because the disposal of waste will start at home by analysing the garbage into its chemical compounds using the Infiniti-Cycle technology, Nano-robots then secrete these electronic micro-compounds and assemble them to be ready for reuse in industrial applications;

- **Electronics recycling kiosks:** electronics recycling kiosks have begun to be launched in the United States of America and are operated by private companies such as Eco-ATM, where they provide solutions to recycle electronics, preventing them from reaching landfills. They are being refurbished and recycled for further use. So far, electronics recycling kiosks have saved 14 million devices before they reached landfills;
- **Smart garbage bins:** smart garbage bins use robots, sensors, cameras, and artificial intelligence to identify the type of waste, whether it is glass, plastic, or paper. When it is full, it alerts the waste collection company. These bins solve the sorting problem and collect data, supporting the development of smart waste disposal systems. The BINE - A initiative exemplifies this;
- **Robots based on renewable energy to clean water from waste:** to solve the problem of waste being disposed of in rivers, seas, and oceans, Australia has developed a robot that uses solar energy and artificial intelligence to remove plastic from water. The robot is called Wendy Blue, and it proves the effectiveness of robots in the future to manage waste and carry out tasks that are difficult for humans.
- In addition to new technologies and innovative mechanisms, waste can also be treated by addressing the behaviour of individuals and institutions towards waste, by abandoning wrong behaviours and random behaviours on the one hand, and by creating and encouraging every behaviour that would contribute positively and effectively. As an example, we find that Philips allows its customers to rent lights instead of buying physical light bulbs, which ensures that when developing newer models, the customer does not generate any waste, and the lights can be returned to the company instead of the updated models. This approach can be applied and expanded to many other technological tools and devices. With the rapid development of products, it becomes longer as the consumer looks to own the latest versions. The circular economy aims to ensure that products are designed in a flexible and adaptable manner to developments and improvements, whether through the business model or the actual design of the product itself.

In conclusion, modern and innovative technologies in the circular economy will be a pillar to solving the problem of waste in the future, and until this is achieved, everyone (individuals, families, institutions, countries, etc.) must be educated to reduce the rate of waste production while encouraging recycling processes to reduce landfill growth rates. It is expected that the application of circular economy standards will contribute to reducing the environmental footprint, reducing the accumulated waste in landfills, reducing air pollution, and providing a strategic solution to address climate change. It contributes to reducing the amount of energy needed by industrial production processes to convert raw materials into usable products. The idea of buying a service instead of a product also contributes to the significant reduction of waste that accumulates and, over the years, causes environmental problems.

IV. The contribution of the circular economy to achieving and promoting environmental sustainability in light of the 2030 Global Goals for Sustainable Development:

The environment is the general framework that is affected by and influences economic activities. The environment is also affected by the behaviours of community members, which affect their health conditions and various activities. Therefore, any successful sustainable development programme must achieve compatibility and harmony between its three elements (economic, environmental, and social) and fuse them all in one crucible aimed at raising the quality levels of those elements together: achieving economic growth, meeting the requirements of community members, and ensuring environmental sustainability, while preserving the rights of future generations of natural resources and enjoying a clean environment. The relationship between sustainable development and environmental protection is close. In this regard, environmental protection is the first goal of sustainable development programmes, due to the fact that the

environment is the primary source of all resources required by sustainable development programmes and projects. Because disturbance of the ecological balance leads to the destruction of ecosystems, the deterioration of the state of natural resources (living and non-living), and the acceleration of the depletion of some of them or their corruption so that they cannot be used economically appropriately.

IV.1- Environmental sustainability:

The word sustainability is applied to all aspects of life that are desired to survive and to prevent their depletion, such as natural resources, for example. However, the term may also be applied to comprehensive systems, whose elements affect the sustainability of the system, so it is necessary to pay attention to them, determine their priorities, and work to maintain them and keep them from depletion.

- **Sustainability** is one of the most common words these days, and it is used a lot in different fields, so let's start with the meaning of the word in the inclusive lexicon of meanings: "The definition and meaning of the sustainability of a prosperous life: its permanence and continuity" (ELDJAMAA, 2000).

- It is a concept that calls the biological environment the diversity of living organisms and the natural factors that maintain their existence for the longest possible period, also known as "Maintaining the quality of life by adapting to the environment by exploiting natural resources for the longest possible period of time leads to maintaining the continuity of life. Another definition of the concept of sustainability is a set of vital processes that provide the means of life for living organisms of all kinds, which helps them, maintain the succession of generations and develop the means of their growth over time" (EL CHIHI, 2019).

- Sustainability is one of the things that take many of us to reach, as sustainability is one of the things that many of the sciences of philosophy can be put about, and it means by sustainability: an environmental term that contributes to describing the survival of biological systems and explains to us how diverse they are over time, while the concept of sustainability for humans means their ability to maintain the type of life they live in for a long time. It depends on the world's preservation of the resources that God Almighty has blessed us with. This term has taken on a wide scope as it relates to all aspects of life on the surface of the earth, from local levels to international and global levels. An example of biological systems that have achieved the concept of sustainability is wetlands, as chemical cycles are based on the redistribution of water and oxygen as well as nitrogen and carbon in living and non-living systems around the world. However, the population increase of humans has turned things in the opposite direction for the concept of sustainability (BADAOUI, 2020).

- **Environmental sustainability** is a term that has recently emerged with the aim of preserving environmental resources and using them in a way that maximises their utilisation for current and future generations. It means the ability of the environment to continue to work properly while trying to reach the lowest degradation in the surrounding environment. The concept of sustainability in this way can be achieved when planning the development process so as not to damage natural capital at a minimum (ELITR, 2018).

- Environmental sustainability refers to achieving integration between the different dimensions of sustainable development, and this translates into systems, procedures, and resources to reconsider the ecosystem and integrate the environmental and social dimensions into the decisions taken in order to ensure integrated, balanced, and sustainable development. The term also refers to the global development juncture in that the resource-intensive and waste-generating pattern of development, which treats its promotion of financial and economic growth, social justice, and environmental protection as separate issues, is unsustainable. In fact, there is no alternative to dealing with resources in a manner that reflects their scarcity, the environment, and respects their sensitivity, their limited absorptive capacity, and human beings as a source and goal of

development. This does not differ from what all humanity faces, except for the severity of the evidence. The world is currently witnessing a demographic transition that has affected the increase in energy and water consumption, growing unemployment, and the consequent economic and political effects. In addition to the elements of this dangerous scene, the expected effects of global climate change and its effects on health, economy, desertification, biodiversity, and the availability of water and food. This objective takes into account the fact that it is in the nature of the stages of transformation that many of the issues raised do not have ready-made solutions, so innovative and creative capabilities must be mobilized to the maximum extent possible and a more sustainable formula for development must be restored. If this transformation is necessary to ensure a better future for society, it inevitably leads to a redistribution of benefits and costs. There are those who benefit from the status quo, and there are those who lose from change. Resources are also the resources of society, and pollution falls on them, so achieving efficient and effective management of environmental affairs that deal with the public sphere with excellence in public goods and external influences is not possible through a closed management system without the participation and control of society and without adhering to international agreements and maximising the benefit from them. Therefore, the national agendas do not deal with this issue from the perspective of whether it is possible to continue its development pattern as it is, but rather how to make a safe transition as soon as possible to a sustainable pattern. National interests dictate what their environmental policies should be in the next phase, which is (United Nations Environment, Environmental sustainability for human well-being in the post-2017 development agenda 2015, 2014).

In summary, the membership relationship between the circular economy and environmental sustainability has been proven. The circular economy seems more sustainable than the traditional (linear) economic system that uses linear industrial processes that "Take, manufacture, and dispose" and the lifestyles that depend on them, limited reserves to create products of a specific age, which end in landfills or in incinerators. In contrast, the circular approach takes insights from living systems. It considers that our systems must operate like living organisms and process foodstuffs that can be feedback into the cycle, whether biological or technical, by adopting the "closed or regenerative loop" rule. It depends on reducing the resources used and the waste resulting from the leakage, and it saves resources and helps to reduce environmental pollution (KADI, 2020).

IV.2- Overview of the Sustainable Development Goals (2015–2030):

The Sustainable Development Goals (SDGs) represent a new set of goals, sub-goals, and indicators formulated by the United Nations in the context of setting global development priorities for the period 2015–2030. These have thus replaced the “Millennium Development Goals” (MDGs) that had set global priorities for the period 2000–2015. However, unlike the MDGs, which were developed by a limited group of experts, the SDGs are the product of the largest UN consultative effort in its history. In fact, following the United Nations' Rio +20 Conference on Sustainable Development in 2012, the UN formed an open working group with representatives from 70 countries to come up with a draft agenda. The United Nations also launched a series of global discussions that included 11 consultative rounds on specific topics and 83 national consultative rounds that included representatives of governments, civil society organisations, activists, academics, the private sector, and others, as well as opinion polls among the public, not to mention a global online survey during which participants were asked about the issues that should be covered by the goals. The OWG presented a draft agenda covering these priorities, the outcomes of the global discussions, and the results of the global survey to the UN in late 2014, which was the basis for the negotiations with governments that took place from January to August 2015. In September 2015, after seven months of negotiations, the United Nations General Assembly unanimously adopted Resolution 70/1 entitled “Transforming our world," the 2030 Agenda for Sustainable Development, which included 17 goals and 169 sub-goals (17 Goals to Transform Our World, 2018) (UNDP, 2020).

These 17 goals build on successes in achieving the Millennium Development Goals (2000–2015) and include new areas such as climate change, economic inequality, fostering innovation, sustainable consumption, peace, and justice, among other priorities. As illustrated in Figure 06:

The 17 goals highlighted in the figure above include five core groups: people, planet, prosperity, peace, and partnership. The Sustainable Development Goals (SDGs) officially came into force in January 2016, and as a whole, they are the product of the most consultative and inclusive process in the history of the United Nations. It serves as the overarching framework to guide development work at the global and national levels over the next fifteen years.

- Observed through the figure and in connection with what we discussed in the previous axes of this study, it is clear that the circular economy contributes to achieving the goals of sustainable development, its goals and sub-goals, whether directly or indirectly, and that this contribution seems more clear and higher related to the goals related to the environment and maintaining the balance of the natural system of all kinds, and serves environmental sustainability, especially with regard to the goals in which the environment or its elements are mentioned in an explicit and direct manner, as shown in Figure 07:

Thus, we conclude that the circular economy contributes significantly to achieving environmental sustainability and works to promote it in the long term, as it is a model that is keen to achieve economic goals while at the same time being keen on the environmental aspect and considering it. It works to achieve sustainable consumption and production models, as it is concerned with natural capital and thus with the productivity and ability of our planet to meet human needs and sustain economic activities in light of the increase in population numbers and the growth of a middle class of consumers. The shift to sustainable consumption and production patterns through valuing, maintaining, and increasing natural capital, sustainable innovation, and dematerialization processes such as industrial ecology, resource substitution, and bio-mimicry are already creating new opportunities for poverty eradication, green jobs, and business, and enhancing prosperity for current and future generations. The application of circular economy standards contributes to reducing the environmental footprint, reducing waste accumulated in landfills, reducing air pollution, and providing strategic solutions to address climate change. It aims to reduce the amount of energy needed by industrial production processes to convert raw materials into usable products and stimulates the idea of buying the service instead of the product, which contributes to the significant reduction of waste that accumulates over the years, which reduces environmental problems related to human and economic activity such as greenhouse gas emissions, toxic chemicals, particulates, and the release of excess nutrients that can harm human health and deteriorate ecosystems. All of this is within the framework of achieving and upgrading environmental sustainability.

V-Conclusion:

Through this study, we tried to highlight the role and contribution of the circular economy in reducing the volume of waste and reducing its threats, as well as its role and contribution to achieving environmental sustainability and upgrading it. The linear economic model is based mainly on the triple "extract, manufacture, throw," which depends on huge amounts of resources and energies behind the depletion of the natural resource base and contributes to the deterioration of environmental systems. Its negative effects became known to researchers and specialists, which prompted them to seek alternative economic models that are environmentally friendly, more compatible with nature, and thus more sustainable. As an alternative solution and a product of this pursuit, the circular economy model has emerged, which is mainly based on creating positive value at the social, economic, and environmental levels. More importantly, this alternative economic model, which is concerned with changing all methods of production and unsustainable consumption patterns through the rational use of resources, recycling and manufacturing of materials and products, environmental design, and industrial ecology, has become a means of sustainable development that will guide countries to optimize the exploitation of limited resources and conserve energy.

V.1- Study Results:

Through the course of this study and the attempt to answer the problem, we have reached a number of results, as follows:

- A sustainable circular economy represents a new economic paradigm where the goal shifts from narrow GDP growth to multidimensional progress that includes broader strengthening of environmental quality, human well-being, and economic prosperity for present and future generations;
- The circular economy model presents itself in global, regional, and local realities as a new economic revolution in the world on the path of keeping raw materials and products in production loops for as long as possible, as it eliminates waste in industrial systems, reduces costs, and reduces the environmental impact of production and consumption;
- Adopting the foundations and principles of the circular economy and embodying the mechanisms and methods on which it is based and the innovations supporting it contribute significantly to reducing the level of waste in all its forms, controlling its volume, and reducing its risks and threats;
- There is an membership relationship between the idea of sustainability and the circular economy, as the latter is considered one of the results of sustainability and its secretions, and at the same time it works to embody its principles and achieve its dimensions, as the circular economy contributes to the preservation of the environment in all its elements, whether in direct or indirect ways, and aims to achieve environmental sustainability as a dimension of sustainable development;
- The nature and philosophy of the circular economy, as well as its principles and foundations. It reflects its relationship with the global goals for sustainable development known as "Our Common World"—the 2030 Agenda especially the goals directly related to the environment and its elements, which directly and explicitly stipulate this within the framework of achieving environmental sustainability.

V.2- Recommandations and suggestions:

We have noted the following comments and recommendations based on the study's findings and recommendations:

- All data and indicators suggest the need to accelerate the transition from the traditional linear economy to the circular economy by separating economic growth from the use of natural resources and ecosystems through the more effective use of those resources at both the economic and environmental levels;

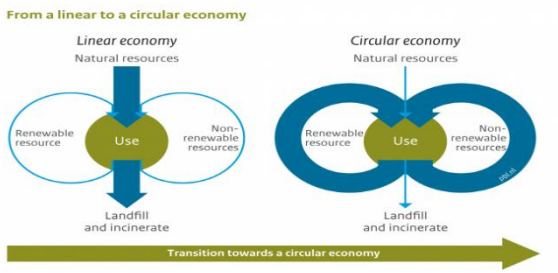
- Achieving a successful transition towards a circular economy model, ensuring the latest balance and harmony between the economy, environment, and society, requires joint measures based on strategies that include various legislative, legal, productivity, financing, etc.;
- Activating the circular economy model, which is keen on the ecosystem, requires the concerted efforts of all parties and actors: governments, international organizations, local groups, public and private sector companies, civil society, and consumers;
- The transition to a circular economy requires that consumers have access to products that are safe, robust, and designed to have the lowest possible negative environmental impact. This focus on the environmental design of products represents an environmental goal and a competitive means for the industry. The standards and procedures that achieve optimal consumption are represented.

- Appendices:

Figure (1): The three dimensions of sustainable development

The source : (Payermoinscherlenergie, 2019); (EL HAOUAS & KHELAF, 2024)

Figure (2): The shift from a linear economy to a circular economy



The source: (NADHMI, 2020)

Figure 03: circular economy

The source: (NADHMI, 2020); (JRC, 2017)

Figure (4): What a Waste 2.0, a look at global solid waste management until 2050

The source: (The World Bank, 2020)

Figure (5) : The 4R Plan

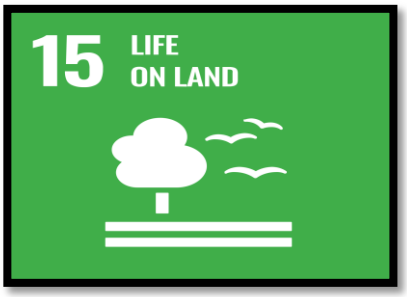
The source: (SAMWORTH2, 2024)

Figure (6): Sustainable Development Goals (2015-2030) SDGs

The source: (United Nations, 2022)

Figure (7): The contribution of the circular economy to the achievement of sustainable development goals related to the environment

The Sustainable Development Goals related to the environment	The contribution of the circular economy to achieving the goal
	**The circular economy works to:** - Promote water efficiency use; - Separate drinking water from wastewater; - Access to and treatment of drinking water for the removal of chemical and biological pollutants; - Protect and restore freshwater ecosystems; - Ensure access to water and water rights.
	**The circular economy contributed to:** - Strong urban-rural linkages for infrastructure, ecosystem services, smart low-carbon cities, and balanced regional development; - Addressing the rural-urban continuum for balanced urban development. Integrated solutions include sustainable rural development, resource-efficient land use, and minimising sprawl; - Land tenure and enhance the rights and livelihoods of tenants in both rural and urban areas; promote national policies that support the balanced development of territories.
	**The circular economy stimulates:** - Phasing out residual ozone-depleting substances, technology options deemed climate-friendly, and sound management of existing ozone-depleting substances held in buildings and equipment; - Decarbonising the economy around the world and achieving a level of climate neutrality and carbon neutrality, or net zero balance; - Restoring the planet's balance, in terms of emissions in and emissions out, to its previous normal state; - Significantly increasing the use of clean and renewable energies.
	**One of the goals of the circular economy is:** - Improving water quality by reducing pollution, stopping the dumping of waste, chemicals, and hazardous substances, and minimising their leakage; - Reducing the proportion of untreated sewage; - Increasing the efficiency of water use; - Ensuring the sustainable withdrawal and supply of freshwater; - Preserving and sustainably using oceans, seas, and marine resources to achieve sustainable development; - Preventing and reducing marine pollution; and supporting the sustainable management and protection of marine and coastal ecosystems.

	**Adopting a circular economy contributes to:** - Reverse and restore degraded land to its natural potential and recognise the value of ecosystem services and natural capital; - Address inequalities in access and right to natural resources for food security and agro-biodiversity protection; - Protect, restore, and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss; track pollutants and halt damage to the environment.

The Source: Prepared by the researcher based on various references

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