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Waste Recycling Strategy and its Role in Enhancing the Dimensions of Sustainable Development in Iraq

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Abstract:

Purpose: The aim of this study was to determine the importance of waste recycling in addressing economic, social and environmental problems facing most countries of the world, especially developing countries, including Iraq, Where Iraq has not developed a recycling strategy for waste considering the economic and climatic changes that the world is witnessing with the increase in population growth rates and the expansion of cities.

Theoretical Framework: Many economists, such as (Kirrchher J., & et al., 2017; Murray, A., & et al., 2015; Prieto-Sandoval V. & et al., 2018; Williams, 2013) have also highlighted the importance of practices in production and waste management, to provide a new business model and a new economic system, by linking economic activity to the extraction of natural resources and starting to introduce a way of thinking that uses waste efficiently and achieves economic optimization.

Design/Methodology/Approach: We have clarified the recycling strategy for waste in Iraq based on the deductive and inductive approach, using descriptive analysis in order to study the recycling process of waste, and its relationship in promoting sustainable development in Iraq.

Findings: Iraq is facing the problem of waste accumulation and worsening environmental pollution. The government should keep pace with the global development in the exploitation of waste as an economic resource and exploit it in the field of energy generation through the establishment of governmental and non-governmental projects specialized in the process of recycling waste, to achieve economic, social and environmental benefits, to achieve the dimensions of sustainable development in Iraq.

Research, Practical & Social Implications: The practical implications include recommendations for economic policy makers to promote sustainable development by adopting measures that support waste recycling in Iraq, and encouraging investments in this process that enhances the environment and economic development. The study's insights can help formulate economic policies that increase the sustainable development rates of bilateral resources and address environmental and economic challenges. **Originality/Value:** The originality and

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scientific value of the study lie in the comprehensive analysis of the role of waste recycling and its relationship to sustainable development in Iraq. It explores the areas of potential application of recycling and its levels in Iraq and provides practical recommendations to promote sustainable development. The study's approach ensures a deductive analysis of the relationship between waste recycling and sustainable development.
Keywords: Waste; Recycling; Waste Recycling Strategy; Sustainable Development; and Clean Energy.
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Authors Declaration:
Conflicts of Interest: None
• **We hereby confirm** that all figures and tables in the manuscript are our property. In addition, official data from the Observatory of Economic in Iraq (IRQ) were used.
• **Ethical approval:** The research was approved by the Ethical Committee of the College of Administration and Economics, University of Baghdad.

1. Introduction:

Considering the rapid pace of building economies and industrial development, the developed and developing world faces many negative impacts on the economy and the environment due to the unjust exploitation of natural resources, their depletion, and infringement on the rights of future generations. On the other hand, this industrial development has led to a large accumulation of various types of waste (solid, gaseous, liquid), which is no less dangerous than internal and external conflicts, wars, and biological weapons, exacerbating environmental pollution. Economic problems, scarcity of resources and environmental pollution have become major challenges for the countries of the world, especially developing countries, including Iraq, and foremost among them is the problem of waste accumulation considering population growth and various industrial activities aimed at profitability, without any consideration of the economic, social and ecological aspects. The process of waste disposal by unsustainable waste management in Iraq is done traditionally, including burning and landfilling in sites that have obtained environmental and non-environmental approval, with waste being disposed of by random throwing in empty yards; it costs Iraq economic waste of resources and environmental pollution. The accumulation of waste without recycling has become a problem due to the depletion of natural resources, its impact on the health of the individual and society, and the distortion of the natural and urban landscape. Iraq produces large quantities of waste daily through population growth and economic activities, with its lack of qualified infrastructure to deal with waste by the public sector and great negligence in supporting and enhancing opportunities for the private sector in recycling waste. The government in Iraq must keep pace with global development in waste recycling by establishing sustainable development projects specialized in recycling waste and exploiting it economically, socially and environmentally, and adopting a waste recycling strategy that contributes to enhancing the dimensions of sustainable development.

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2. Literature Review:

Recent literature has reported new results that, together, recycling waste is an important economic resource, as the process of recycling waste contributes to the advancement of the economic reality of the state (Williams, 2013). Therefore, it is important to study this process and clarify the strategy that achieves benefits that contribute to the advancement and growth of the Iraqi economy positively.

(Zhang, 2010) made a comparison between municipal solid waste management in Berlin and Singapore. Studying waste management's legal, technical, and administrative aspects has a positive economic impact on the conditions in Berlin and Singapore. Therefore, the researchers aimed to conduct a comparative analysis of municipal solid waste management in each of the two cities to identify the current situation and shed light on the prevailing conditions in the municipal solid waste management process. The city of Berlin has achieved clear progress in solid waste management, as the solid waste recycling rate reached 40% in 2007, with a decrease in the quantities of this type of waste because of the increased recycling process directed towards the industrial sector. The process of recycling solid waste in Singapore has increased, as the percentage of waste recycling reached (56%) in the year (2008), which reflects positively on economic and population growth and the change in consumption patterns in this city. However, the production of solid waste quantities in the city has not Decreased due to a lack of municipal legislation supporting recycling in Singapore and its need to pay more attention to how to deal with the environment.

(Breman, 2012) proposed how to implement the waste recycling process to achieve sustainable development. This is done by combining new organizational thinking based on the perception of resource recycling as waste resulting from productive activities with theoretical views on what affects whether it is possible to promote sustainable development and achieve its goals.

The European Union has embraced the circular economy. In the EU Action Plan for the Circular Economy, "Closing the Loop", the circular economy is described as "a fundamental contribution to the EU's efforts to develop a sustainable, low-carbon, resource-efficient and competitive economy. Such a transition is an opportunity to transform our economy and generate new and sustainable competitive advantages for Europe" (European Union, 2015).

In 2016, (Christian Hagelüken, 2016) demonstrated the role of the circular economy in the European Union and its relationship to metal recycling. The environmentally sound processing and recycling of metals and electronics has an efficient role and positive effects on the European economy. The European economic policy measures to improve the recycling of metal materials through the closed cycle of the circular economy and prevent the burial of metals or the burning of electronic waste or its exports have addressed the challenges faced by the waste recycling process. Dealing with metal materials in the European Union must be done systematically. Ensures that Europe maintains its leading position in recycling metal and electronic waste and continues to develop the recycling process in different quantities within complex production processes while ensuring that the products obtained from these processes are of high quality.

Explained (Klitkou, 2019) that organic waste has paths that make it valuable in circular bio-economies, as transforming this waste from worthless to economic value products enhances the shift towards a sustainable and circular bio-economy. Organic waste generated from homes and industries has become a valuable economic resource; this type of waste was a cost and burden on the private sector and society to be transformed into assets used in real production. The process of converting waste products, such as food scraps and forest residues, into products of economic value is involved in various industries, such as manufacturing biomaterials, biochemicals, and biopharmaceuticals.

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At the local level, the researchers (Ali & Imran, 2020) tried to identify the reality of the development strategy in solid waste recycling management in the Iraqi city of Baqubah and the extent to which this strategy is applied to sustain resources in the city's economic units through the management of solid waste by the municipality's directorates. The study was conducted using statistical analysis of the opinions of (55) people based on a questionnaire and following the descriptive method of analysis using statistical tools such as the arithmetic mean and the relative importance of the answers. The study concluded that the Baqubah City Municipality Directorate failed to implement the development strategy for treating and recycling solid waste to achieve sustainability for economic resources in the city, and the lack of awareness of officials in the directorate of the importance of the solid waste recycling process in promoting sustainable development.

2. Material and Methods:

The research is based on a deductive and inductive approach, using descriptive analysis to clarify waste recycling and its relationship with promoting sustainable development in Iraq. The study also uses quantitative research using statistical data from official sources to test the research hypothesis and describe and explain the variables.

2. 1. Hypothesis of the Research: The hypothesis is formulated as follows: "The strategy of waste recycling has a positive impact in enhancing the dimensions of sustainable development in Iraq, by reducing the depletion of resources, enhancing efficiency in their exploitation and protecting the rights of future generations, as well as in their use as an energy source, while reducing the impact of environmental pollution resulting from the accumulation of waste.

2. 2. Import of the Research: Waste Recycling has economic and environmental importance in the Iraqi economy, as it reduces the depletion of natural and economic resources and converts waste into energy sources. Waste recycling is a sustainable ecosystem to reduce the risk of waste and its economic and it is effects on the Iraqi economy and environmental. In addition, waste recycling contributes to reducing pressure on traditional methods of waste treatment and enhancing the dimensions of sustainable development in Iraq.

2. 3. Objectives: The research seeks to clarify the theoretical aspect of the concept of waste and its economic effects. As well as diagnosing the role of waste recycling in enhancing the dimensions of sustainable development in the Iraqi economy.

2. 4. Waste Concept:

The word waste is used without making a precise distinction between three terms that are not completely synonymous (waste, garbage). They can be distinguished as follows: (Merlin, 1988)

Garbage: “Disgusting, disgusting-looking trash.”

Waste: It is "the residue of materials due to the interference of several factors during the manufacturing or conversion process, whether natural or abnormal."

Whereas, waste is generated from different sources and its composition varies according to its sources, and it varies from one person to another according to their activities. Waste is also produced from every human activity, as these various activities are reflected in the properties and composition of waste. Waste is also generated from different sources from one country to another, depending on economic and social conditions. Where waste has been defined as "materials of no economic value from the point of view of their owner or producer, or as movable and neglected things whose owner wants to dispose of them properly and legally to protect public health" (Badr Al-Din, 2000).

Many writers and researchers in the field of economics have also defined waste as "materials that have been neglected, whether they are in a solid or semi-solid state" (Hamash, 2011).

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The expert at the United Nations, (Rober Gillat), also defined waste as (a group of residues of different sizes produced by houses such as food waste, newspapers, etc., as well as waste from markets, companies and factories (Nimr, 2009). The World Health Organization defines waste as "some things that the owner no longer wants in a specific place and time, in the sense that they have no importance or value" (Abdul Wahab, 1997).

In addition, waste is defined by (Sondhi) as "all waste generated from various human activities, which is disposed of as undesirable" (Rahman Nobinur, 2013). There are also those who consider waste "as everything that used to be placed in an individual or collective container to be collected by the municipal worker" (Chanbolle, 1981).

From the above definitions of the concept of waste can be defined as "materials resulting from increased human activities and the absence of environmental awareness in light of the population explosion and the depletion of natural resources, and not investing in recycling projects for recyclable and desirable materials, which achieve an economic, social and environmental benefit."

2. 5. Concept of sustainable development and the relationship of waste recycling to its dimensions:

At its root, development is the result of man's work transforming elements of sale in the environment into wealth, which are goods and services that meet human needs. This transformation depends on the effort of man, the scientific knowledge he employs, and the tools and technical means he uses. Thus, the definitions of sustainable development have been multiplied by scientists and researchers in the economy and the environment.

Waste recycling has a close relationship in promoting the dimensions of sustainable development emphasized by the United Nations by converting waste from worthless and environmentally harmful materials into useful economic materials. The above will be explained as follows:

2. 5. 1. Environmental dimension:

The environmental problems that the world is witnessing, such as global warming, global climate change and the deterioration of the ozone layer, and land degradation, have made most countries in the world need scientific knowledge to manage natural resources for many years to come and preserve the rights of future generations. The economic development and population growth led to an increase in production capacity and an increase in human consumption of resources, which resulted in an increase in waste and pollution. To obtain methodological methods that are encouraging and interrelated with ecosystem management to prevent increasing pressure on it, and the rational use of resources (Abu Ein, 2006).

Energy production from waste is a sustainable environmental dimension that preserves the environment from pollution, while reducing the budget of cleaning contracts and creating investment opportunities in recycling. Therefore, the waste recycling strategy is an essential factor in enhancing the dimensions of sustainable development (environmental dimensions) by considering waste as an economic resource that leads to low consumption and energy savings (Clark, 2019). There is a close relationship between waste recycling and the environment in generating electric power and reducing environmental pollution. Developed countries have been interested in investing and recycling waste as a source of energy as it saves time, cost and effort in preparing the materials necessary for the raw production process, but when materials are as an alternative to raw materials, they save and reduce energy. The amount of energy that can be obtained from twenty million tons of waste in the State of Britain is equivalent to the energy of approximately six million tons of coal, and this amount of energy constitutes about (5%) of the consumption of electric power plants in Britain. As for the United States of America, there are (2300) landfills that collect gas in (520) of which are used to produce energy and light about (700) thousand houses. The Waste Department in America also operates five of the largest landfills to generate (500) megawatts of electricity. Which is also used by (93%) of the gas produced from waste to produce (10) thousand gallons of liquid gas used as fuel (Hideki, 2019).

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Waste recycling also plays an economic and environmental role in saving energy through recycled materials as an alternative to raw materials. It is possible to clarify this in the following Table 1:

Table 1: Amount of energy saved (Kj) per ton of solid waste components

Energy Details	Paper & Carton	Glass	Metals	Plastics.
Energy Storage	3.1	0.1	1.9	148.7
Production	15.7	3.1	12.3	26.1
Transportation	0 8	0-2.	4-2	0-2.
Other	0	0.7	86.4	29.3
Gross Total	**18**	**3.9**	**100.6**	**203**

Source: - Department of Environment. (2010). Climate Change and Water NSW, Environmental Benefits of Recycling, Sydney South, P. 9.

From Table (1), recycling solid waste, including paper and cardboard waste, saves an amount of energy (3.1) tons, and re-consuming glass waste saves an amount of energy (0.1) and (1.9) per ton, respectively. Recycling plastic waste is the highest in energy savings. (148.7) tons.

Germany and the Netherlands are among the developed countries in recycling waste through the adoption of the "Zero Waste" project, in addition to importing quantities of more than one million tons of waste annually for use in the power generation process. The Netherlands also seeks to reach sustainable energy in 2050 at reasonable prices, as it reduces the emission of carbon dioxide and other gases by half, and (40%) of electricity was obtained from sustainable sources. The share of renewable energy in the Netherlands (7.4%) in (2018) (Bourouba, 2019). In addition, waste recycling has many environmental benefits, including savings in health costs from the negative effects of waste. Recycling them and using them in industries as inputs instead of raw materials reduces the volume of pollutants emitted from exploration, extraction, transportation and treatment. This reduces the volume of pollutants from other methods used in dealing with waste. According to US studies, we find that the health costs resulting from the emissions of various wastes, including those hazardous to health, from the production of aluminum packaging from raw materials amounted to (298) dollars/ton produced. However, these costs decrease to (86) dollars / ton. If the cans used in production are used, then there is a great environmental benefit in recycling waste (Hawariya, 2020). Recycling waste also prevents the access of pollutants to surface water and groundwater and preserving them and achieving the quality of water, seas and oceans instead of throwing them indiscriminately into the seas and oceans (Nations, Transforming Our World: The 2030 Agenda for Sustainable Development, 2015).

2. 5. 2. Economic dimension:

The economic dimension emphasizes growth, modernization, and industrialization (Quraishi, 2007). The economic dimension is mainly related to sustainable development issues of selecting, financing and improving industrial technologies in various fields of natural resources employment (Salman, 2007). Recycling waste has sustainable economic dimensions, achieving equity among the world's population in the exploitation of resources, reducing their depletion, and ensuring the rights of future generations through the acquisition of competitive advantages by productive institutions by equipping companies and factories with low-cost raw materials, such as steel, plastic and glass. Recycling waste contributes to saving financial resources. Disposing of waste by traditional methods without recycling it economically requires huge financial revenues. Recycling saves financial resources, produces goods at low costs, and sells them at affordable prices in the market (Fahima, 2009).

The consumer also receives financial revenues for selling waste to investors and factories to recycle it. Recycling waste reduces the import of raw materials from abroad, benefits from technology, and develops it in line with local conditions, reducing production costs, taxes, and import and transport fees (Katun, 2009). Recycling waste also enhances state revenues by

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supporting the ability of tourist destinations to conserve resources, reduce their depletion, and promote sustainable development (Suleiman, 2023).

It should also be noted that the recycling and exploitation of waste make the national economy more resilient in the face of external changes represented by the high prices of primary materials. The process of waste recycling contributes to reducing pressure on landfills and traditional methods of waste treatment. It provides large amounts of land to encourage investment in waste recycling and other industries.

2. 5. 3. Social dimensions:

Achieving the social dimension of sustainable development is based on the idea of human development and their awareness of the importance of waste as an economic and environmental resource considering population growth. Waste recycling projects enhance access to employment and reduce unemployment, because waste recycling projects require a lot of labor. Recycling works to raise the spirit of citizenship and social responsibility through the participation of community members in making development decisions that affect their lives. As well as the role of women as the pillar of society from within the home or in the job and work to organize and sort waste for the purpose of recycling (Naji, 2013).

It should also be noted that it is necessary to work to stabilize population growth and the optimal distribution of population within cities, which has become a great pressure on economic and environmental resources, to constitute an obstacle to sustainable development that can be tracked globally in Table 2:

Table 2: Global population growth rates

Year	Population in Mn	Annual growth rate
1965	3326	1.8%
1990	5284	1.6%
2000	6185	-
2030	8869	1.2%

Source: Abboud, Salem Muhammad. (2021). Sustainable Development and Environmental Costs, 3rd Edition, Dr. Dar for Administrative and Economic Sciences, Iraq, p. 193.

It is noted from Table that the population is expected to increase for the period from (1990 - 2030) by about (3585) million people. (90%) of this increase is for developing countries, which leads to increased consumption of resources, increased unemployment and poverty, and hinder economic growth. Therefore, we believe it is necessary to move towards a strategy of recycling waste and exploiting it as a sustainable economic, social and environmental resource with the need to reduce the dependency of developing countries by encouraging various investments, specifically opening new projects specialized in waste recycling.

Table shows the recycling of waste and its role in enhancing the dimensions of sustainable development:

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Table 3: Role of waste recycling in promoting the dimensions of sustainable development

Dimensions of sustainable development	Fostering sustainable development	Waste Recycling Results
Ecological Dimension	Saving energy consumption and reducing climate change.	Recycling is important in saving energy through recycling materials as an alternative to raw materials. For example, recycling one bottle reduces pollution in water (5%) and in air (20%). Waste recycling also reduces the use of fossil fuels in energy.
	Preserving air, water and land from environmental pollution and its health effects on society.	Recycling prevents waste from emitting toxic gases, as well as reaching surface and groundwater, in addition to treating and reusing healthy water that reduces water waste and environmental pollution.
	Reducing pressure on landfills and providing land for the purpose of investing in waste recycling projects.	Recycling waste reduces the amount of waste in landfills.
Economy	Conserve natural resources;	Producing low-cost recycled goods and selling them at reasonable prices in the market.
	Tourism Sector	The recovery of the tourism sector and attracting tourists from different countries of the world to places that are clean and beautiful through their interest in the field of waste recycling.
Social Dimension	Reduced unemployment, poverty and job creation	Investing in the field of waste recycling and absorbing large numbers of labor.
	Enhancing the role of women	Through waste recycling, enhance the role of women in work and the participation of both genders in the organization and sorting of waste from the waste generation site.
	Reducing population explosion	Reducing the volume of waste through recycling, reducing informal housing and reducing tribal and clan problems that hinder sustainable development.

Source: Author's work based on the dimensions of sustainable development.

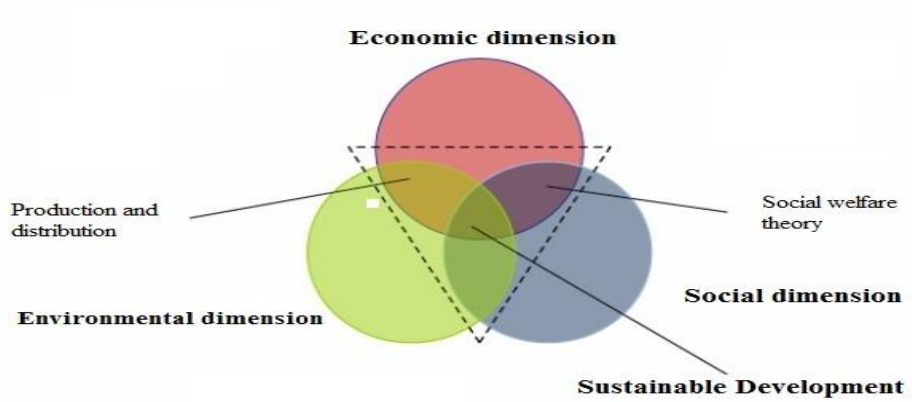

Figure 1: Dimensions of sustainable development

Source: Burgenmeier, Beat. (2008). Economic Policies for Sustainable Development, 1st Edition, Boeck Group, Brussels, P 43.

Figure that the three dimensions of sustainable development are one of the main pillars, so that it is not possible to limit attention to one dimension without all other dimensions, so it is

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always necessary to pay attention to the dimensions of sustainable development to the same extent. On the other hand, there is overlap and interdependence between the dimensions. The environmental aspect related to the protection of the environment and the preservation of natural resources is based on the economic dimension that provides the necessary resources for the purpose of recycling and preserving the environment. Increasing environmental pollution also negatively affects natural resources in their various forms, as this hinders economic exploitation processes. As for the social dimension related to the human aspect, human beings are the goal of sustainable development. Economic activities and the preservation of the environment mainly target the human being and his well-being.

3. Discussion of Results:

3. 1. Real recycling in Iraq:

Exploitation of waste in Iraq as an economic resource in the field of energy generation through waste recycling projects and companies is almost unavailable or very limited, as well as below global economic and environmental standards. Its work is limited to recycling some waste and not others, with poor technology used in recycling waste.

The total number of waste sorting and recycling projects in Iraq reached (4) projects in (2021), and the number of working projects, including (2) and under construction (2), while the amount recycled amounted to (3.35) tons / day, reaching (1045.2) tons/ year. The waste sorting rate was (13.1%) in the outskirts of Baghdad / Mahmoudiyah district / Al-Yousfiyah sub-district. It is possible to clarify the above in Table as follows:

Table 4: Number of waste sorting and recycling projects according to the practical situation, number of working days, recycled quantities, percentages of sorting and their locations in the governorates of Iraq for the year (2021)

Governorate	families.	Parked	Under Construction	Total	Number of working days (year / day)	Recycled Quantity (Ton / Day)	Recycled Quantity (t / yr)	Waste Sorting	Location in Governorate
Baghdad Municipality	0	0	2	2	0	0	0	0	Karkh side and Rusafa side
The outskirts of Baghdad	1	0	0	1	312	3.35	1045	13.1	Mahmoudiyah District/ Al-Yousfiyah sub-district
Dhi Qar	1	0	0	1	-	-	-	-	Nasiriyah District/Judicial Center

Source: Ministry of Planning, Central Bureau of Statistics, Environmental Statistics of Iraq, for the year (2021), separate pages.

Table indicates the limited waste sorting and recycling projects in Iraq and the waste of waste as economic resources, and their use in the field of energy generation compared to the traditional diversified method by municipal institutions, including incineration and landfilling methods for waste disposal. The number of landfill sites that do not have environmental approval reached (221) sites, including (72) sites that have environmental approval, and (149) sites that do not have environmental approval, with continued coordination and directives by the Ministry of Construction and Housing and public municipalities with municipal institutions in the governorates of Iraq to increase the sites that have environmental approval, and to close sites that do not have environmental approval.

In addition, some sites, including some sites that have environmental approval, are in violation of environmental conditions and the impact of the landfill site on society.

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Table (5) shows the number of municipal institutions, and the number of landfill sites for the disposal of waste obtained and not obtained environmental approval in the governorates of Iraq for the period (2013-2021):

Table 5: Number of municipal institutions, and the number of landfill sites for the disposal of waste obtained and not obtained environmental approval in the governorates of Iraq for the period (2013 - 2021)

Year	(a) Municipal associations	Number of landfill sites with and without environmental approval
2013	257	138
2014	257	144
2015	369	236
2016	204	156
2017	251	205
2018	261	213
2019	265	224
2020	265	220
2021	265	221

Source: The Ministry of Construction, Housing and Public Municipalities, the Directorate of Public Municipalities, the Environment Department, the Directorate of Municipality of the Governorates Center and the Directorates of Municipalities of the Governorates.
- Baghdad Municipality, Department of Solid Waste and Environment, Iraq.
- Data for the year (2013) include all Iraqi governorates except the Kurdistan region.
- Data for (2014) include all Iraqi governorates except (Nineveh, Anbar, Salah al-Din).
- Data for the year (2016) include all Iraqi governorates except for the governorates of (Nineveh and Anbar) due to the security situation, except for the Kurdistan region.
- Data for the years (2017, 2018, 2019, 2020, 2021) include all Iraqi governorates except the Kurdistan region.

Therefore, the establishment of waste recycling projects in Iraq by the public sector, as well as encouraging the private sector to recycle, is a necessary priority that must be considered to promote sustainable development in Iraq. It contributes to the conservation of resources, the generation of energy from waste and the reduction of emissions of various toxic gases and their serious effects on society.

3. 2. Waste generation in Iraq:

Iraq faces the problem of waste generation by about (30) thousand tons per day by the population and various economic activities without processing and recycling, and to keep pace with the development of most countries of the world in the recycling of waste in order to preserve the forces of nature from continuous losses, as the forces are one of the necessities of the population's ability to continue to live on this planet (Barles, 2018). The continuous population growth in Iraq has led to an increase in the amount of waste with the weakness of integrated waste management and limited to the transport and disposal of waste in the traditional way through burning or landfilling and other various methods and the occurrence of environmental pollution (Dianda, 2019). The increase in the population in Iraq began in the 1970s.

In 1947, the population reached (5) million people. In 1957, the population reached (6) million people. In 1967, the population reached (8) million people. In 1979, the population was (12) million. The increase in population has been accompanied by an increase in the revenues of oil wealth, an increase in the income of the Iraqi individual, and an increase in consumption and the amount of waste, especially in the main urban areas, as everyone generates a daily amount of waste estimated at (0.8) kilograms, and (0.25) kilograms of the population of villages and countryside.

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After (2003), there was a change in the waste phenomenon based on the political, economic and social changes that took place in Iraq with the change in consumption patterns and the opening of the Iraqi market to all types of goods, with the increase in the population in Iraq from (27) million people in (2003) to (46) million people in (2024), which led to an increase in the amount of waste. It should also be noted that there are other reasons besides the increase in the population that led to an increase in the amount of waste in Iraq after (2003), including (Hideki, 2019).

Show Table (6) the average amount of waste generated per person (kg/ day) in the governorates of Iraq except for the Kurdistan Region of Iraq for the period (2011-2020):

Table 6: Average amount of waste generated per capita (kg / day) in the governorates of Iraq except for the Kurdistan Region of Iraq for the period (2011-2020)

Governorate	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average Total (kg / day)
Basra	2.0	1.3	1.1	1.3	1.7	1.3	1.1	0.9	1.0	1.1	0.8
Maysan	2.1	0.3	0.8	1.2	1.7	1.1	1.1	1.0	1.2	0.9	1.1
Dhi Qar	1.4	0.8	1.1	1.3	1.3	1.6	1.7	1.8	2.5	2.6	1.6
Muthanna	1.3	1.6	1.3	1.4	1.2	1.4	1.2	1.4	1.1	0.9	1.3
Al-Qadisiyah	0.6	0.8	1.3	1.4	1.3	1.8	1.4	1.3	1.2	1.3	1.2
Nineveh	0.7	0.5	0.9	0.7	0.8	0.9	0.9	1.0	0.9	0.8	0.8
Kirkuk	1.0	0.5	0.8	1.1	1.0	0.7	0.8	0.6	0.8	0.7	0.8
Al-Anbar	1.7	0.7	1.2	0.9	1.5	2.0	2.8	2.5	2.1	2.1	1.8
Baghdad	1.1	0.9	1.4	1.2	1.4	1.7	1.2	1.3	1.1	1.4	1.3
Wasit	1.1	0.7	1.4	1.3	1.1	1.7	1.1	1.1	1.9	1.4	1.3
Babylon	1.5	1.1	1.2	1.2	1.3	1.4	1.3	1.4	1.2	1.3	1.3
Diyala	0.9	0.5	1.2	1.3	1.4	1.2	1.3	1.2	1.2	2.2	1.2
Karbala	1.4	1.3	1.5	2.1	1.2	1.6	1.6	1.6	1.9	1.6	1.6
Ṣalaḥ Al-Dīn	1.7	0.3	1.2	1.2	1.3	1.2	2.2	3.1	4.0	3.3	2.0
Najaf	1.0	0.5	1.4	1.2	1.6	1.4	1.7	1.5	1.7	1.4	1.3
Annual average	1.3	0.8	1.2	1.3	1.3	1.4	1.4	1.4	1.6	1.5	1.2

Source: Ministry of Planning, Central Bureau of Statistics, Department of Environmental Statistics for Iraq, for the period (2011-2020), various pages.

- Ministry of Construction, Housing and Public Municipalities, Directorate of Public Municipalities - Environment Department/ Directorate of Municipality of the Center of Governorates and Directorates of Municipalities of Governorates.
- Baghdad Municipality. (2021). Department of Solid Waste and Environment, Iraq, p. 16.

Table (6) shows that Salah al-Din Governorate ranked first in waste generation at a rate of (2.0) kg/ day per person, and then Anbar Governorate ranked second at a rate of (1.8) kg / day per person. Then (Dhi Qar and Karbala governorates) each governorate had a rate of (1.6) kg/ day per person. It was followed by the governorates (Baghdad, Wasit, Babil, Muthanna and Najaf) with an average of (1.3) kg / day per person. Then (Diyala and Qadisiyah governorates) each governorate has a rate of (1.2) kg / day for everyone.

The governorates of Basra, Nineveh and Kirkuk also occupied the last ranks, so each governorate had an average of (0.8) kg / day per person. Likewise, it recorded the highest rate of waste annually in (2019), reaching (1.9) kg / day, while it recorded the lowest rate of (0.8) kg / day in (2012).

In (2021), the total average amount of ordinary waste generated per capita was (kg / day) in the governorates of Iraq at a rate of (1.3) kg/ day except for the Kurdistan region. Waste generated in the governorates of Iraq is an economic wealth that can be used as an economic resource through the process of recycling waste in the field of energy and sustainable

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development, reducing dependence on oil and reducing environmental pollution in Iraq. However, limited projects and weak municipal institutions in Iraq have caused economic waste through various disposal methods of ordinary waste and type of method with environmental pollution. Table (7) shows the percentages of the Iraqi governorates according to the usual waste disposal methods and the type of method for the year (2021), as follows:

Table 7: Percentages of Iraqi governorates according to the usual waste disposal methods and type of method for the year (2021)

Standard waste disposal methods	Number of governorates	(%)	Governorate Names
Landfilling at Environmentally Approved Sites	13	81.3	Except for the outskirts of Baghdad, Karbala, and Salah al-Din.
Landfilling in environmental sites that do not have environmental approval	15	93.8	Except for Babylon.
Throwing in empty squares	6	37.5	Nineveh, Diyala, Anbar, the outskirts of Baghdad, Salah al-Din, and Najaf.
Recycling	2	12.5	The outskirts of Baghdad, Dhi Qar.
Other	1	6.3	Najaf
Waste energy initiatives	0	0	None

Source: - Ministry of Construction, Housing and Public Municipalities, Directorate of Public Municipalities - Environment Department/ Directorate of Municipality of the Center of Governorates and Directorates of Municipalities of Governorates.
- Baghdad Municipality. (2021). Department of Solid Waste and Environment, Iraq, p. 17.

Table (7) show that the non-environmental landfill method occupied (93.8%), and the environmental landfill (81.3%), and ranked second and third, throwing in empty squares by (37.5%) and other methods (such as burning) (6.3%). As for the recycling of waste in the field of energy, the percentage reached (0%), and this is a negative indicator in the waste of resources and the aggravation of the problem of environmental pollution.
As shown in Table (8), the amount of ordinary waste raised (tons / year) in the Iraqi governorates except for the Kurdistan Region of Iraq for the period (2011-2020), as follows:

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Table 8: Amount of ordinary waste raised (tons / year) in the Iraqi governorates except for the Kurdistan Region of Iraq for the period (2011-2020)

Governorate	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average Total (tons / year)
Basra	1316457	1159577	768500	963450	1198697	1124865	963658	802602	945436	1009889	1025313
Maysan	457626	100525	212705	324775	507168	324446	331039	332388	386175	302723	327957
Dhi Qar	481598	423733	378045	465287	555640	537617	605499	654043	1145200	1248156	649482
Muthanna	150107	349920	130911	147492	163739	175879	155570	182972	154197	132170	174296
Al-Qadisiyah	896	301066	288893	321292	299300	387378	307839	274786	262057	282143	302750
Nineveh	529329	592856	612028	586028	598742	655984	688984	776295	634014	618402	629266
Kirkuk	293993	263586	286968	395853	369344	285784	297291	269741	357909	307519	312799
Al-Anbar	452659	358359	328769	354894	425464	468754	472265	726846	628825	633372	485021
Baghdad	1208689	143562	219684	156135	1900938	263062	1300863	1432685	1382114	1923587	993132
Wasit	255651	275075	330604	327131	295796	320967	303330	314183	535270	407217	336522
Babylon	420724	673790	346568	357870	259187	426617	388307	430301	409331	450298	416299
Diyala	21257	231537	255030	280665	322551	315474	335029	345757	409561	622656	313952
Karbala	341654	477122:	397134	565807	344560	428578	455789	505326	645735	555918	471762
Ṣalaḥ al-Dīn	396822	152075	259115	258454	243127	323978	404982	538434	702769	822748	410250
Najaf	339434	215467	460693	421654	615354	552780	675821	606062	612870	591144	509128
Annual average	888800	714781	659456	740848	1012450	824020	960783	1024053	1151433	1238493	837738

Source: Ministry of Planning, Central Bureau of Statistics, Department of Environmental Statistics for Iraq, for the period (2011-2020), various pages.

Table (8) show that Basra Governorate ranked first in the amount of waste raised at a rate of (1025313) tons/ year, and then Baghdad Governorate ranked second at a rate of (993132) tons / year, and Dhi Qar Governorate ranked third at a rate of (649482) tons / year, and ranked fourth in Nineveh Governorate at a rate of (629266), while Muthanna Governorate ranked last at a rate of (174,296) tons / year. The amount of waste removed in (2021) was at a rate of (17368735) tons / year.

3. 3. Low waste recycling and energy generation in Iraq:

Electricity plays an important role in our contemporary world, where electric power has received great importance as a major source of energy that contributes to advancing sustainable development as a result of their association with the economic and environmental sectors. They contribute to the creation of productive activities that rely mainly on electric power for their production, especially if they have appropriate prices and costs for the production market. Electric power is one of the means of protecting the environment. In order to reduce the aggravation of the problem of environmental pollution, there has been a global trend to discover sources of electrical energy production, and the process of producing electrical energy through waste recycling has emerged by most countries of the world.

Iraq was able to achieve progress in the level of population access to electricity by (100%) in (2020), but it faces the challenges of supply hours, which are almost very low and may reach an average of (3-4) hours per day in most cities of Iraq (Nations, Sustainable development report, 2021).

Iraq also suffers from limited waste recycling projects, especially in electricity generation. In addition to the increase in the spread of the installation of private diesel generators (civil generators), which reached (48,533) generators in Iraq (Planning, Statistics for Iraq, 2023). Their continued operation has high costs borne by the Iraqi individual in light of the worsening environmental pollution. It is estimated that the total cost to the Iraqi economy due to the lack of electricity exceeds (40) billion dollars annually. This is a burden on the budget of Iraq and is clearly evident when oil prices fall globally.

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Therefore, the government should, in light of the implementation of the renewable energy strategy (2013-2030) and the promotion of sustainable development, and in cooperation with the World Bank, which provided financial and technical support, as it allocated about (7) million dollars to the waste recycling strategy, and open the areas of investment in the public sector and the private sector to successful foreign projects in the field of waste recycling to generate electricity, and reduce the use of oil and the process of burning it in order to generate electricity within the national grids, while limiting it to the production of electricity from solar and hydroelectric energy. Iraq's total production of electrical energy for the period from (2015-2019) reached (540.5) megawatts of solar energy, and (12.226) megawatts of total hydropower for the same period, without paying attention to recycling waste in electricity generation (Electricity, 2019).

3. 4. Sustainable development in Iraq and the implementation mechanism:

The Sustainable Development Agenda (2030) and its 17 goals, which received a UN consensus in (2015), outline a roadmap with a strategic vision for states and actors in order to devote efforts to creating a world in which everyone enjoys equality and sustainable prosperity, while preserving the resources of our planet from inefficient and inequitable depletion for future generations. Although there are many challenges facing the implementation of sustainable development in Iraq, it has sought to follow the policies proposed by international organizations to promote sustainable development. The Iraqi government cooperates with the United Nations through the United Nations Common Country Strategic Framework under the Iraqi Vision 2030. The Iraqi government has also worked to issue voluntary reports on the Sustainable Development Goals (2030), including:

3. 4. 1. The first voluntary report in (2019): whose slogan is (the triumph of the will of a homeland). Voluntary reports are an important tool in monitoring progress towards achieving the national development plan and promoting it locally. The report also seeks to achieve several national goals: (NCSD, 2019)

- The government announces the continuation of the pace towards Iraq's return to the international arena. It also looks forward to achieving development, the fruits of which are distributed fairly among groups and regions without marginalization or exclusion.
- Diagnosing the challenges facing the achievement of sustainable development, especially those related to the sustainable development plan and the potential competition between it and the pressing national spending and reconstruction requirements in an unstable environment.
- Provide a full description of the process of achieving the SDGs and their indicators at the national level, and the steps that the government and its partners will follow in this way.
- Strengthening the policies and institutions of participation and translating international goals into a vision of national goals that help to take measures that can bring about the desired transformation within the framework of the Sustainable Development Goals.
- Promoting the national sustainable development plan with the support of donors and international organizations that can contribute to helping Iraq overcome the difficulties it faces.
- Providing a concise database of the SDGs and diagnosing the data gap to guide the future statistical effort to fill it with appropriate data.
- Provide digital monitoring of progress on the path to national sustainable development.
- Sharing the experience of Iraq with the experiences of other countries to exchange international experiences and expertise.

The vision of Iraq (2030) is based on achieving a possible human being in a country with a unified society, a diversified economy, and a sustainable environment that enjoys justice and good governance. The dimensions of development that respond to our priorities and goals in reaching a human being are possible in a unified country and society based on a right-for-all approach, and an economic system oriented to a diverse social market characterized by a high degree of stability of its macroeconomic indicators. As well as providing a safe and sustainable environment for the current and future generations, to achieve a sustainable improvement in the

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quality of people's lives. To ensure sustainability in production and consumption patterns, reduce the repercussions of environmental pollution and climate change, and enhance the protection of biological diversity, through government institutions that ensure respect for the political, civil and human rights of citizens to reach the required paths to achieve equality for all citizens.
Table (9) shows the Iraq Vision (2030):

Table 9: Iraq's Vision on Sustainable Development Goals (2030)

Iraq Vision (2030) **A human being is possible in a safe country, a unified society, a diversified economy, and a sustainable environment that enjoys justice and good governance**	
(1)The survival of the mind, soul and body for generations of generations capable of innovation, creativity and achievement.	(2)Effective administrative institutions that ensure respect for political, civil and human rights, justice and equality for all citizens before the law.
(3)A diversified social market economy that generates decent job opportunities that provides the level of economic well-being jointly managed by the public and private sectors in a way that enhances the potential of the Iraqi economy.	(4)A safe society whose members enjoy peace and in which the values of citizenship, solidarity and achievement are strengthened.
(5)Providing a clean, safe and sustainable environment for the current and future generations by localizing the environment component in development plans and policies to achieve a sustainable improvement in the quality and quality of life of human beings and ensure sustainability in production and consumption patterns and reduce the repercussions of environmental pollution and climate change.	

Source: National Committee for Sustainable Development. (2019). The first voluntary report on the sustainable development goals, Ministry of Planning, Iraq, p. 16.

Table (9) shows that Iraq's Vision (2030) has defined in its content a new social contract between the state and the citizen that will enhance his confidence in the government, as it provides him with opportunities for self-development, work and earning income. The State is also working to develop economic activities, and to draw up reform paths that address the impact of the challenges of the past while providing strategies and plans that will respond to its objectives and mechanisms to manage the problems of the past and present, and expectations of future risks in the light of national capabilities, while ensuring the strength of the mechanisms of development interactions with a positive impact on the rates of achievement of the Sustainable Development Goals.

In addition, these aspirations in the national vision and priorities with responsive objectives of the international sustainable development agenda (2030), require a continuous national effort to enhance accountability and effectiveness of capacities at all levels of the state and its institutions and in the process of public policymaking and implementation. This was a necessary condition for strengthening citizen confidence in the state, reducing the risks of a renewed cycle of violence, and laying the foundations for a well-functioning democracy and a private sector-led economy. Thus, the moral and solidarity commitment in the implementation of the Sustainable Development Goals (2015-2030) was officially announced. When comparing the SDGs with the vision, we find that (74%) of the 16 goals were covered in the vision, so the starting point was with the third national development plan for the period (2018-2022).

Also, the decision of the Iraqi Council of Ministers No. 209 in 2016 serves as the general executive framework for the preparation of the National Development Plan (2018-2022). It is also the starting point for achieving the Sustainable Development Goals (2030), which focused on the repercussions of the war with ISIS and the reconstruction of areas affected by military operations, the decline in oil prices and attention to the development aspect by raising

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the slogan "Establishing an effective developmental state with social responsibility." To reduce dependence on the rentier economy through the appropriate use of oil revenues to support sustainable development and rely on balanced growth, with spatial and sectorial guidance for investments through the criterion of comparative advantage, reducing unemployment rates and improving development conditions (Planning, National Development Plan, 2017).

Whereas, the achievement of the(17) sustainable development goals by Iraq is still proceeding at a slow pace, and it also faces a problem in determining the extent of progress achieved for the goals and their indicators of (230) indicators, as data is available on (67) indicators, meaning that the percentage of available data is (29.1%), which constitutes a gap ranging from Goal (13), for which data are not available, to Goal (3), for which data are available.

Iraq has recorded an average performance of almost (50%) for each of the Goals (1, 3, 6, 12, 13, 16), with special reference to Goal (12), which represents the sustainable development model that summarizes sustainable development in its entirety. Iraq is also one of the high consumer countries and did not have medium or good consumption patterns. The prevalence of unsustainable production methods through increased use of oil, toxic emissions and waste production with limited recycling projects, which poses a major challenge in Iraq. The rest of the indicators for the other goals were relatively low, with Iraq ranked (14) in the Arab world, and (127) globally out of (156) countries included in the evaluation, with an index value of (53.7) degrees (Planning, Statistics for Iraq, 2023).

3. 4. 2. The second voluntary report in (2021): its slogan (Iraq and the return to the development path). The report aims to show the verified sustainable development goals, as Iraq faces new challenges represented by the popular demonstrations in (2019), and their peak increased in October of the same year, then the shock of the global Corona crisis and its impact on the Iraqi economy, with the decline in oil prices globally and the decline in oil revenues (OPEC, 2022), which led to Iraq's decline in development indicators.

The objectives of the second voluntary report were to monitor the progress achieved in sustainable development indicators in Iraq and to know the effects of various challenges and crises and the extent to which they undermine sustainable development, while identifying the best ways to ensure the progress of sustainable development in the right direction and work to enhance the opportunities for transformation at the governorate level in the preparation of sustainable development reports by local governments (NCDO, 2021).

In (2020), despite the Corona crisis, the voluntary report included obtaining more data, which increased by (7%), when the available data on sustainable development indicators in (2020) reached (36%). There are data for all the indicators of the (17) goals and in different proportions in Iraq.

It is noteworthy that Iraq ranked (113) globally out of (166) countries covered by the evaluation, with an index value of (63.1) points. It ranked (12) out of (18) Arab countries. The State of Algeria also ranked (56) globally, and (1) in the Arab world with an index value of (72.9) marks. While the State of Somalia ranked (164) in the world, and (18) in the Arab world, with an index value of (46.2) marks. As shown in Table (10) below:

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Table 10: Ranking of Iraq among global and Arab countries in the Sustainable Development Index for the year (2020)

Country	Ranking Globally	Ranking in Arabic	Grade (0-100)
Algeria	56	1	72.9
Tunisia	63	2	71.4
Morocco	64	3	71.3
U. A. E.	71	4	70.3
Oman	76	5	69.7
Bahrain	82	6	68.8
Jordan	89	7	68.1
Lebanon	95	8	66.7
KSA	97	9	65.8
Qatar	103	10	64.7
Kuwait	112	11	63.1
Iraq	113	1.2	63.1
Syria	126	13	59.3
Mauritania	130	14	57.7
Djibouti	138	15	54.7
Yemen	151	16	57.3
Sudan	159	17	49-6
Somalia	164	18	46.2

Source: United Nations. (2020). Sustainable development report, P 36.

4. Conclusions And Recommendations:

4. 1. Conclusions:

1- Waste recycling is the practical tool to enhance the interdependence between the economy and the environment on the one hand, and sustainable development on the other.
2- Recycling waste is of great importance in reducing the economic and environmental impacts of waste on society.
3- Recycling waste contributes to sustainable electricity generation.
4- Waste recycling projects in Iraq are limited, as well as relying on traditional methods that cause waste and environmental pollution and disrupt sustainable development in Iraq.
5- The increase in population and internal and external migration to Iraq, with the spread of slums and the conversion of most agricultural land into residential areas, and the division of its area into (100) m as houses and residential and commercial buildings in the absence of urban planning, led to the accumulation of waste and exacerbation of environmental pollution.
6- Weak management (municipal institutions) in addressing the problem of waste, with the absence of environmental awareness and the imposition of environmental fines in Iraq.
7- The absence of a strategy for waste recycling by the government in the short and long term and not keeping pace with the global development in the field of waste recycling and promoting the dimensions of sustainable development.

4. 2. Recommendations:

1- The need to adopt a waste recycling strategy to preserve the rights of future generations by opening investment to the public and private sectors to embody the basic pillars of waste recycling as an integrated system that enables the promotion of sustainable development in Iraq.
2- Establishing waste recycling projects contributes to conserving resources, providing job opportunities and preserving the environment.
3- The need to exploit waste in the field of electric power generation. Reduce dependence on traditional energy sources that cause environmental pollution.
4- Promoting environmental awareness and imposing environmental fines in Iraqi society.

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5- Enhancing the role of municipal institutions in waste treatment through the process of transportation, sorting and collection to manufacturing through waste recycling projects.
6- Reducing the population increase and the spread of informal housing in Iraq, with the need for an organized economic and environmental mechanism in the construction of houses and residential buildings in accordance with urban planning.
7- Reducing reliance on traditional methods of waste treatment, such as incineration and landfilling, which cause waste of resources and environmental pollution.

Authors Declaration:
Conflicts of Interest: None
-We Hereby Confirm That All The Figures and Tables In The Manuscript Are Mine and Ours. Besides, The Figures and Images, which are Not Mine, Have Been Permitted Republication and Attached to The Manuscript.
- Ethical Clearance: The Research Was Approved by The Local Ethical Committee in The University.

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