

# The Circular Economy Mechanism for the Recycling of Agricultural Waste

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**Abstract:** The research paper explains that the linear economy based on the depletion of natural resources and their use as requirements to produce fossil fuels as fuel, is one of the largest sources of environmental pollution associated with a high carbon footprint of economic activities. Where it differs greatly from the circular economy, which works on the gradual transformation from depleting industrial activities to sustainable industrial activities, conserving natural resources, increasing the economic value of agricultural residues, and transforming them into production requirements. As well as the economic return resulting from the application of these modern technologies, the concept of circular economy, and then preserving the ecosystem through the sound and safe management of waste, to achieve a high economic return that works to improve the Egyptian national product. The article sheds light on the role of the circular economy in the recycling of agricultural waste. It is defined as an economic model that aims to reduce waste and pollution and sustainable use of resources to create new products that benefit society and the environment, and to keep raw materials for a longer period in production cycles and can be reused repeatedly, thus producing It has much less waste, and the essence of this model is to keep resources in the economy for as long as possible, and the waste that is produced can be used as raw materials for other industries.

**Keywords:** Circular Economy, Agricultural Waste, Recycling Agricultural, Egypt

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## 1. Introduction

**Research Targets:** The circular economy aims to achieve a model of sustainable management and efficient use of natural resources. It also benefits the local economy by encouraging production models based on the use of waste as raw materials, and the growth of the workforce. It stimulates the development of a new industrial model that is more innovative and competitive and achieves higher economic growth. And creates more job opportunities. In addition to reducing imports, domestic resources can be reused to less dependence on imported raw materials. **Project Objective of study:** Achieving the benefit of the components of the accumulated agricultural plant and animal waste instead of leaving or burning it and the consequent pollution to the environment by recycling and reusing it as a vital alternative to chemical compounds. **Research problem:** The problem of the research is that elimination of huge quantities of accumulated agricultural waste in a negative way, such as burning, results in great pollution to the environment, at a

time when these wastes contain a huge of mineral elements that are lost by burning, while the possibility of recycling and benefiting from them.

Agricultural waste recycling projects are among the most important newly developed development projects through which the agricultural sector and the national economy in general can be developed, as agricultural waste represents economic resources and effective alternatives in providing many economic products [1].

Industrial processes are considered technologically advanced methods for benefiting from agricultural waste or recycling it, and it plays a major role in upgrading the national income, in addition to its positive impact on preserving the environment from pollution, especially in developing countries due to the unhealthy methods used to dispose of these wastes.

The term agricultural waste here is not limited to crop residues, but animal waste also enters the recycling system and achieves real added value instead of wasting or disposing of it in ways that harm the elements of the environment,

especially humans, while there are many products that are extracted from the system. Recycling includes fodder, timber, fertilizers, and biofuels. Several experiments carried out by European countries have succeeded in benefiting from these wastes in generating electricity and deriving biofuels, and many other requirements that have witnessed the success of agricultural waste recycling projects.

The assessment of the economic revenue, the social return, and the environmental dimension of the biological systems for recycling agricultural secondary products in terms of linking the inputs and outputs of the technologies used to each other in an integrated system technically, financially, and economically has a clear impact on farmers' acceptance of these systems and their impact on sustainable development in the Egyptian village.

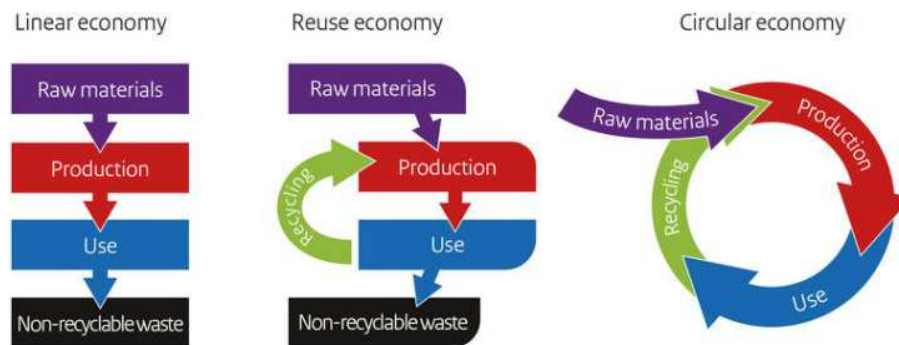
Advances in biotechnology have led to the adaptation of microorganisms to transform organic compounds and waste into economic products while preserving the environment from pollution, as well as exploiting the ability of these microorganisms in the production of food, fodder, bioenergy,

intermediate compounds, and wastewater purification, in addition to impact resistance. The negative effects of these microbes to maintain human health and sources of wealth [2].

## 2. A Circular Economy

(Often referred to as a "circular" is an economic system that aims to eliminate waste and continuous use of resources. Circular systems use reuse, share, repair, refurbish, remanufacture, and recycle to create a closed loop system, which minimizes the use of resource inputs and lowers waste emissions, pollution, and carbon emissions.

The circular economy aims to maintain the use of products, equipment, and infrastructure for a longer period, thus improving the productivity of these resources. All "waste" must become "food" for another process: either as a by-product or as a resource recovered for another industrial process, or as a renewable resource for nature. This innovative approach contrasts with traditional linear economics, which has a "take, make, throw" model of production.

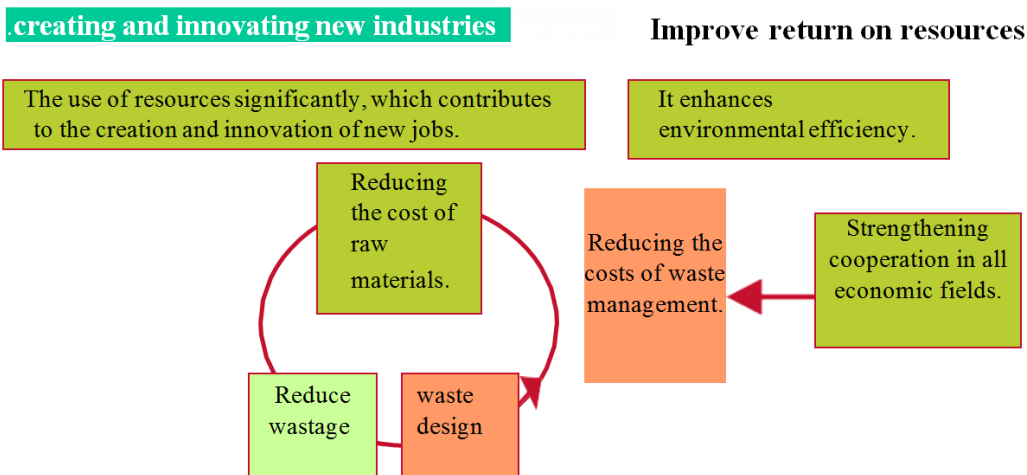


Source: data collected by the researchers.

**Figure 1.** From a linear to a circular economy.

The circular economy also contributes to maximizing the utilization of all raw materials, minerals, energy, and resources in its various forms, as well as recycling, use, re-manufacturing, and development processes, instead of waste

and dumping, as well as introducing the value of things and the importance of effective use and reducing the negative effects of traditional economic patterns [3].



Source: Barbat, J. D., & Liberge, R. (2013). Nuclear Fuel Cycle: Which strategy to support a sustainable growth for nuclear energy? Energy Procedia, 69.

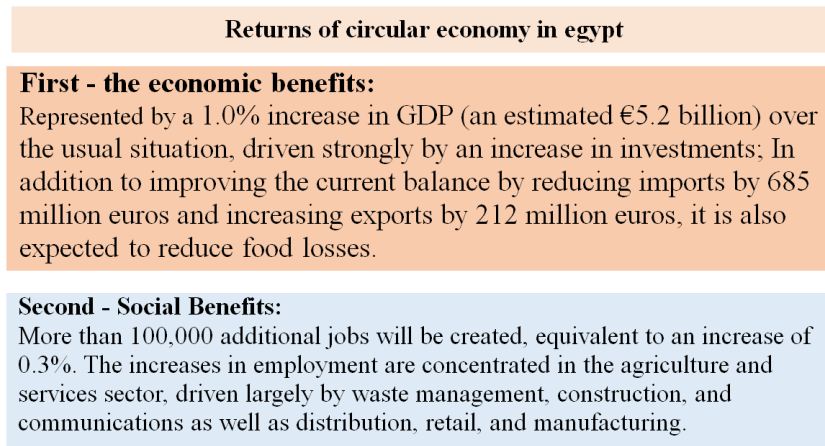
**Figure 2.** The circular economy OF resources.

Circular systems help reuse and recycle to conserve resources, conserve raw materials, protect nature, and thus achieve sustainability. The circular economy approach depends on reducing society's dependence on scarce natural resources by making the most of the available resources, reusing them, and reducing waste [4].

Sally Ashour "Circular Economy": The economic and social returns of its application in Egypt <https://ecss.com.eg/17091/>.

The circular economy is one of the mechanisms for achieving sustainable development in Egypt, with its

various opportunities to transcend development stages and apply advanced technologies, such as encouraging innovation, creating new markets, creating job opportunities, and contributing to poverty reduction and the effects of climate change. The efficiency of resource management is one of the most important applications of the circular economy. Rethinking to adopt an economy that eliminates waste and pollution and maintains the security of natural resources, setting enabling policies and infrastructure, and investing in mechanisms and solutions that support the circular economy.



*Figure 3. Effects and benefits of the circular economy in Egypt.*

### 3. Agricultural Waste in Egypt

Agricultural residues are by-products within the agricultural production system that must be maximized by converting them into organic fertilizers, fodder, human food or clean energy and manufacturing them to achieve maximum benefit, protect the environment from pollution, improve the agricultural system and provide job opportunities in the agricultural sector, which will result in improving the economic and environmental situation and

raising The health and social level in the Egyptian countryside [5].

The burning of agricultural residues not only represents an economic loss, but also has significant adverse effects on the environment, as the emission of toxic gases into the air reduces microbial activity in the soil. In addition, storing waste in the field or dumping it on the roads may make it a suitable environment for the breeding and growth of pests and pathogens that will attack new crops. Therefore, the use of agricultural waste in any other environmentally friendly way is extremely important.



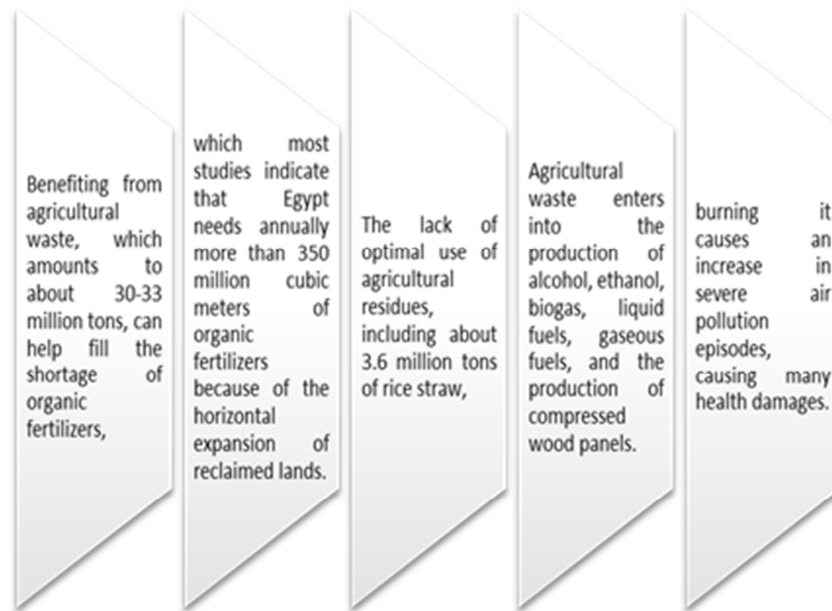
Source: data collected by the researchers.

*Figure 4. Modelling of economic agricultural waste.*

The use of agricultural waste can be achieved through 4 main ways, the first of which is the production of fertilizer through recycling, which contributes to organically re-fertilizing the soil and reducing the cost of production. Its

nitrogen content and hence its nutritional value. Recycling will not only increase agricultural production, but also improve its quality [6].

### 3.1. Policy Agricultural Waste in Egypt



Source: data collected by the researchers.

**Figure 5.** Benefits of Agricultural waste in Egypt.

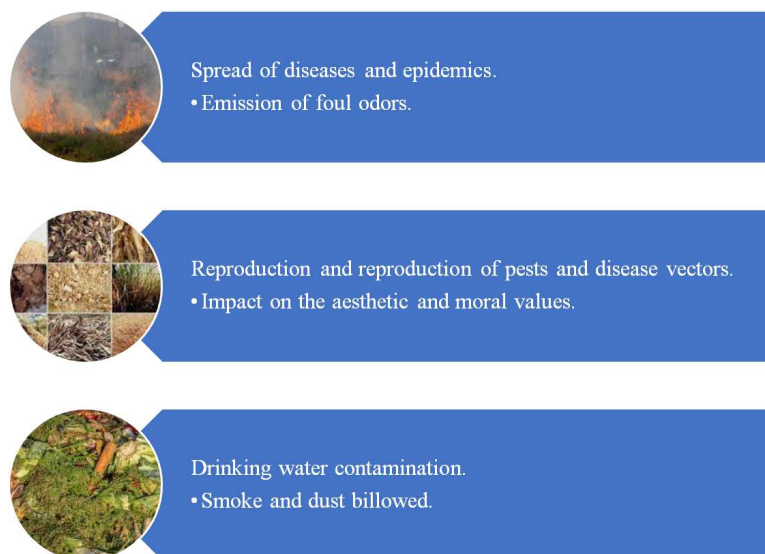
The general policy of the Egyptian state aims to preserve the environment and make optimal use of its resources to achieve sustainable development and preserve the rights of future generations to benefit from those resources.

One of the objectives of the state's public policy in Egypt is to preserve the environment and the optimal economic use of agricultural residues, especially rice straw, instead of burning it, which leads to an increase in environmental pollution as one of the causes of the emergence of clouds.

Agricultural plant and animal wastes are by-products within the agricultural production system that must be

maximized by converting them into organic fertilizers, fodder, clean energy, or re-manufacturing them using nano technologies, which contributes to achieving clean agriculture and protecting the environment from pollution and thus improving the economic and environmental situation and raising the health and social level in the Egyptian countryside [7].

Agricultural waste represents a great burden on the environment, and there is a problem for developing countries to dispose of it, and these countries dream of benefiting from it because it has several dangers, which are: -



Source: data collected by the researchers.

**Figure 6.** Disadvantages of burning agricultural waste.



### 3.2. Biological and Organic Components of Agricultural Waste

Agricultural waste is considered a wealth that must be preserved. This is since Egypt is considered one of the poor countries in what is known as the biomass energy, which is trees, forests, and plant waste.

As the cultivated area of Egypt represents only 4% of the value of the total area of Egypt, and therefore burning This waste is considered a waste of renewable energy.

Each ton of crop yields from 5 to 6 tons of waste, and it is basically a mine of organic materials, as 50% of them are organic components and huge amounts of chemical fertilizers, water and human effort have been used to produce them.

Source: data collected by the researchers.

**Figure 7. Components of Agricultural Waste.**

**Agricultural waste is an untapped environmental treasure:**

Egypt produces more than 35 million tons of agricultural waste annually, and only 12% of this amount is recycled, while millions of other tons are disposed of either by burning or dumping them in canals and drains. Rice straw represents approximately 3.6 million tons of total agricultural waste.

**Recycling waste and converting it into investment items for marketing:**

Waste recycling is defined as the processes that allow the extraction or reuse of materials such as use as fuel, extraction of minerals and organic matter, soil treatment or oil re-refining.

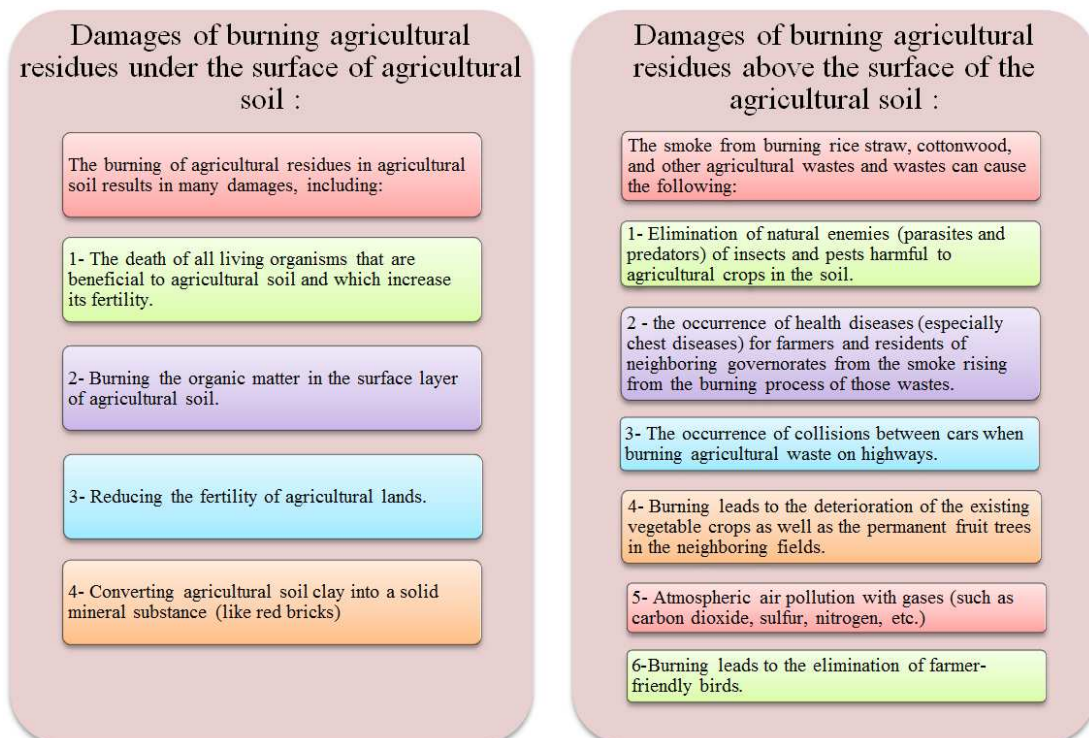
That there is an integrated strategy within the framework of cooperation between the Ministry of Agriculture, the Ministry of Environment and the relevant institutions, to maximize the use of all agricultural, plant, animal and fish waste or agricultural industrial waste at the village level, and to recycle them, to create an added value, increase the return for farmers and breeders, and improve their incomes, as well as contributing In preserving the environment and achieving sustainable development.

Source: data collected by the researchers.

**Figure 8. Recycling waste in Egypt.**

## 4. Disadvantages of Burning Agricultural Waste

The burning of agricultural residues has helped to cause various problems specific to agricultural soil, and the most important of these problems are:

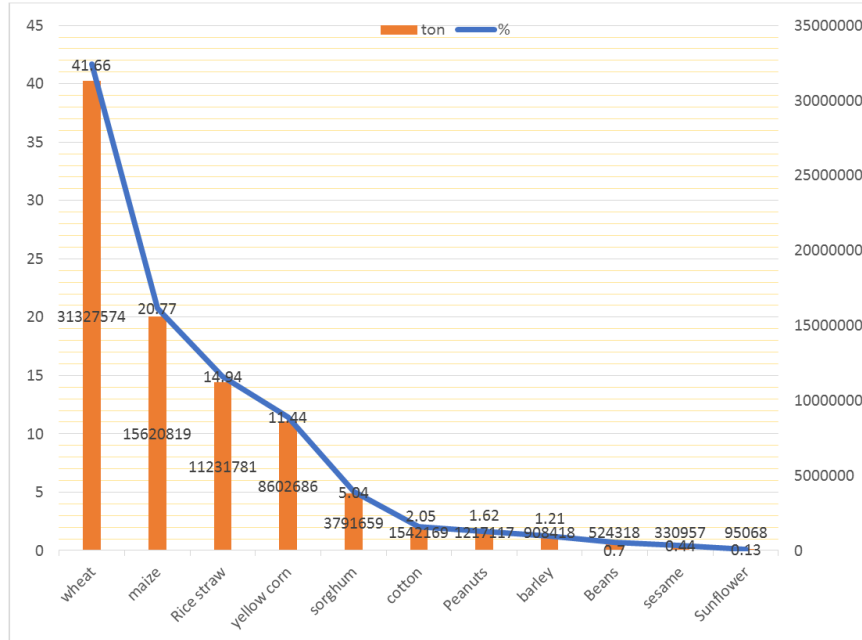


Source: data collected by the researchers.

**Figure 9. Disadvantages of burning agricultural waste.**

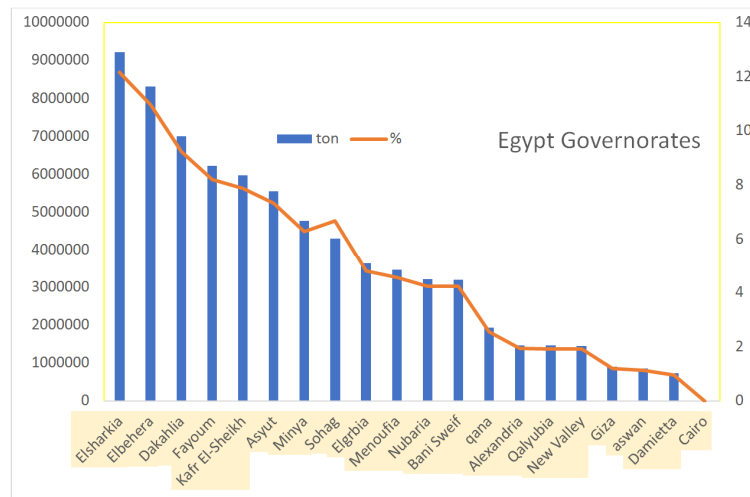
The entry of carbon dioxide from the atmosphere into the agricultural soil, at the expense of the oxygen necessary for the respiration of the roots of plants and microorganisms in the soil, which impedes their spread and reproduction, thus reducing the fertility of the agricultural soil completely.

The method of utilizing the waste by converting it into organic fertilizers is one of the methods that suit the Egyptian conditions due to the low percentage of organic matter in the Egyptian lands, especially in the new lands, which represent a large percentage of the cultivated area.



Source: data collected by the researchers.

**Figure 10.** Agricultural waste by crop in Egypt.



Source: data collected by the researchers.

**Figure 11.** Agricultural residues in the governorates of Egypt 2022.

The statistics showed that the wheat crop contributes as a source of waste with a value of 41.66%, while the maize crop contributes with a value of 20.77%, while the value of the rice straw crop is 14.94%, and for yellow maize its value is 11.44%, and sorghum ranked fifth with a value of 5.04% years 2022.

These data show the extent of the volume of waste that can be a blessing that contributes to the sustainability of the use of natural resources if it is used well, rather than being a

curse and a source of pollution and waste of resources if left without integrated management [8].

It is also expected that the achievement of these goals will result in the creation of cadres of rural youth who are qualified in the field of safe technical handling with agricultural waste, and who are trained and able to innovate to benefit economically from these wastes by working on small and medium projects at the level of villages and centers, in addition to providing units to

produce organic fertilizers. Decomposition and useful agricultural soil to expand into dense and clean plantings [9].

Studies in Egypt revealed in 2020; And continuing so far, the figures for the percentages of agricultural waste wasted in the governorates are inflated, and not exploited, as the percentages of waste in Sharkia governorate amounted to about 9.2 million tons, or 12%, while the waste in Beheira governorate amounted to 8.3 million tons, or 11%, and its percentage in Dakahlia governorate reached about 11%. More than 7 million tons by 9%, followed by Fayoum governorate with a volume of 6.2 million tons by 8%, while Kafr El-Sheikh ranked fifth with 6 million tons or 7.8% [10].

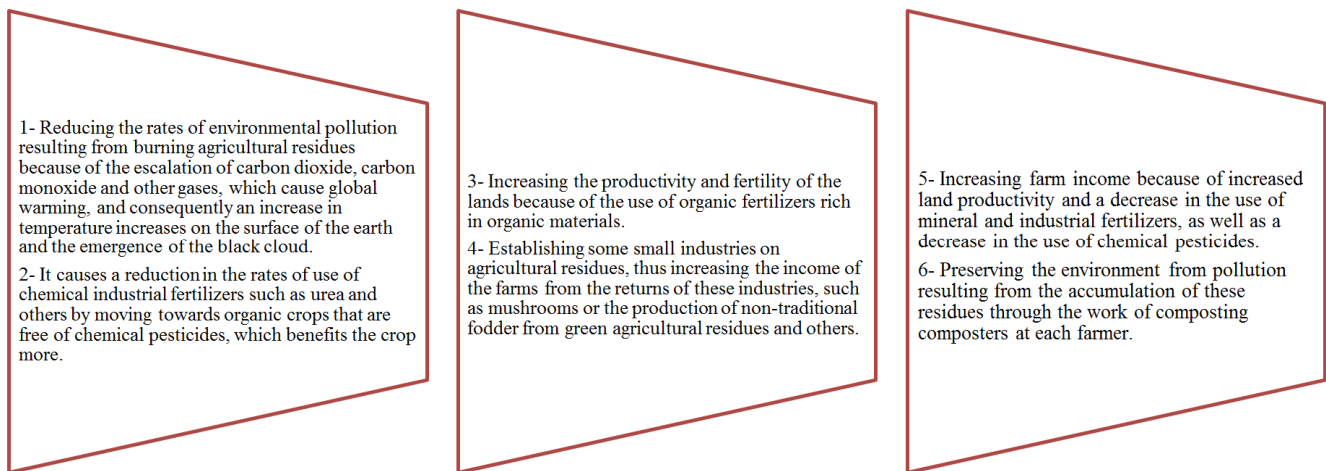
## 5. The Importance of Recycling Agricultural

waste There is a close and permanent relationship between agricultural waste and the environment. Based on the Kyoto

Agreement, many countries are trying to find solutions to reduce pressure on the global ecosystem, which is currently considered a single, inseparable system, as the global ecosystem has become a small village, so what happens in any country affects other countries Whether it is far or near this country.

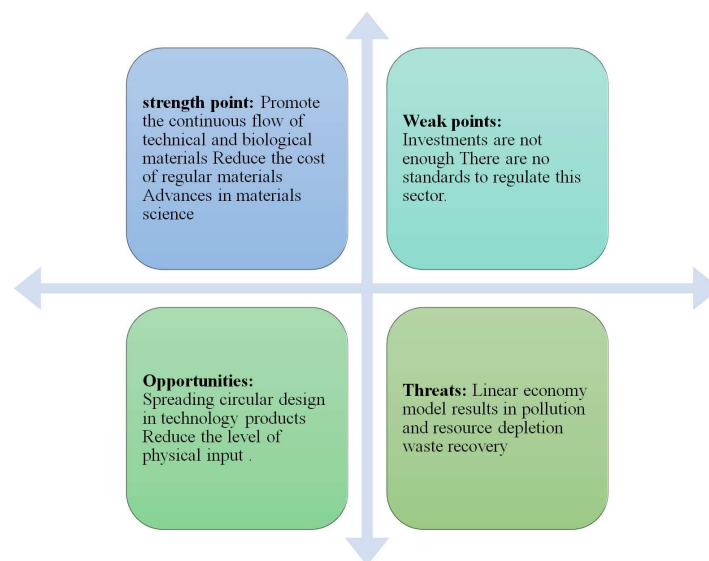
## 6. Benefits of Recycling Agricultural Residues

The transition to a circular economy will contribute to exploiting the large quantities of waste that are found in all societies, and transforming it into a value-added industry, and achieving high profits. It also contributes to maintaining the sustainability of non-renewable resources, as it represents an innovative solution in the field of reusing resources and products and reducing Loss of it in all stages of manufacturing [11].



Source: data collected by the researchers.

**Figure 12.** Recycling Benefits OF Agricultural Residues.



Source: data collected by the researchers.

**Figure 13.** Strategic Diagnosis of the Circular Economy Using the SWOT Matrix.

## 7. Ways to Make Use of Agricultural Waste (Agricultural Waste Management)

The composition of agricultural waste determines the ways to use it. Some of them are used as feed, while others are used to produce fertilizers or in the production of energy and materials. The following is a presentation of the most

important methods used to benefit from agricultural waste.

### 7.1. Animal Feed Production

Such as using hay and sometimes wood, such as corn stover in its fresh state, to produce silage. Rice straw may also be used after chopping [1].



Source: data from site <https://www.agri2day.com/2021/09/24/>.

**Figure 14.** Animal feed production.

### 7.2. Production of Compost or Organic Fertilizer

All agricultural waste may be suitable to produce compost through aerated composting of agricultural waste. Production of organic fertilizers and soil additives from agricultural waste to increase soil fertility and improve its construction [4].



Source: data from site <https://www.agri2day.com/2021/09/24/>.

**Figure 15.** Compost or Organic Fertilizer.

### 7.3. Production of Materials with an Economic Value

Such as the production of paper from rice straw, the production of compressed wood MDF and dyes from agricultural waste.



Source: data from site <https://www.agri2day.com/2021/09/24/>.

**Figure 16.** Materials with an Economic Value.



#### 7.4. Bio-Energy Production

The biomass generated from agricultural waste is considered a renewable source of energy if it is properly managed. Where it is possible to produce biofuels in all forms of gas, liquid and solid from these wastes - biogas technology can be used to produce biogas, as well as the use of pyrolysis to produce gaseous coal and biogas as well. Alcohols are also produced from the fermentation of agricultural wastes such as bagasse and rice straw [12].



Source: data from site <https://www.agri2day.com/2021/09/24/>.

**Figure 17.** Bio-Energy production.

Good management of the agricultural waste file helps to fill the shortage of organic fertilizers, which studies indicate that Egypt needs 350 million cubic meters of organic fertilizers annually because of the horizontal expansion in the cultivation of desert lands and agricultural development projects such as the one and a half million acres project [13].

## 8. Conclusion

The circular economy can effectively contribute to improving the efficiency of resource use by recycling products and paying attention to how they are manufactured and used because of their significant impact on climate change and out of the linear economy pattern that assumes a permanent supply of natural resources with endless human and ecological capabilities to get rid of those wastes Without compromising the environment or climate.

As a result of recycling, agricultural wastes, which are by-products within the agricultural production system, are utilized by converting them into fertilizers, feed, clean energy, or manufacturing them, while ensuring clean agriculture, protecting the environment from pollution, improving the economic and environmental situation, and raising the health, social and rural level. To take advantage of the incentives for supply chains for industrial process inputs [7].

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