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Economic and Environmental Impact of Production of Compost from Secondary Plant Products in Fayoum Governorate

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Abstract: Many Egyptian farmers usually get rid of secondary plant products (SPP) as waste. So, the study is assessing the economic and environmental impact of using the SPP, particularly wood fuel sorghum, in the production of organic fertilizers (compost) in the Saliheya village, Fayoum governorate. Both descriptive and quantitative statistical analysis methods were used. Also, the financial feasibility of one of the governorate projects was estimated. Data from the Ministry of Agriculture and Land Reclamation and the Public Authority for Environmental Affairs, both published and unpublished, were used. In addition, a questionnaire addressed to the selected project was used to obtain specific technical aspects and data on prices and costs to determine its financial feasibility. The present results showed that the total production of the wood fuel sorghum SPP of the crops studied in the Fayoum Governorate for 2020 represents 17.35% of the total Arab Republic of Egypt (ARE) sorghum SPP. The current study concluded that the governorate's level of benefiting from the SPP, and its financial feasibility was approximately 38%, with a 6-year recovery period. This paper recommends the expansion of the compost projects by establishing about three hundred projects all over the governorate due to their profitability and their ecological effect on the environment. It also recommends scattering the projects all over the governorate in between the agricultural lands where every project will serve about a million square meters (250 Fadden).
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List of abbreviations:
Secondary plant products (SPP), Arab Republic of Egypt (ARE), Internal return rate (IRR), Carbon (C), Nitrogen (N), Egyptian Pound (EL), Kilogram (kg), Benefit / Costs (B/C), Central Bank of Egypt (CBE)

1. Introduction

Egypt's economy suffers from an imbalance between human resources and other economic resources. The increasing interest in recycling the SPP and methods of their use is one of the ways of improving environmental development. Recycling has become a priority of sustainable agricultural development because of climate change issues (1).

Compost is an organic fertilizer that is composed of plant material that has decayed in a process described as composting. The outcome of composting is an accretion of an incompletely decayed natural material called humus [(2)]. Compost fertilizer is a natural matter comprising sensible nutrients and acts as a mulch for plants [(3)]. Through improving soil quality, compost can enhance the extent of living organisms in the soil, soil composition, water content, ion exchange power, soil accumulated constancy, and soil penetration of water [(3, 4)]. Other researchers showed that the C/N proportion of compost fertilizer composition is 15-20 %, organic material is 8-10%, while nitrogen components are 0.3-0.6%, phosphorus is 0.1-0.4%, and potassium is 0.3-1.00% [(5)]. Briefly, compost fertilizer can enhance soil characteristics and crop production [(6,7)]. Utilization of compost in the agriculture sector also reduces the use of chemical fertilizers, which pollute both the soil and the production. The compost type and structure vary according to the plant material and the decomposing conditions. All the types improve the soil. In a previous review, Biochar compost's distinctive physical and chemical characteristics presented a considerable ability for improving the soil. By inserting biochar into the soil, it can reduce soil mass density, improve soil permeability, penetration, and hydraulic properties, blacken soil color, and raise soil temperature.It improves the common soil's physical nature. The application of compost can enhance the water-retention ability and plant-available water constantly [(8)].

The quantity of the agricultural SPP in the present research, namely (rice straw, wood of cotton, wood fuel of maize, wood fuel of sorghum, green plant wastes of sugar beets "Thrones of sugar beets"), in the Fayoum governorate, was about 260.4 million Kg. representing about 3% of the total production at the level of the ARE for the year 2020[(9)]. Therefore,

recycling and reusing the SPP of agricultural crops increases the economic efficiency of the production of these crops, as it contributes to increasing the income of agricultural producers [10-12].

Improved methods for the use of the SPP have been utilized, depending on industrial invention and superior machinery. These methods assure resource efficiency, sustainable production and consumption, and the reduction of harmful ecological effects [13]. The SPP is used in different ways as food for animals or in industries like wood production. While wood fuel sorghum in the Fayoum Governorate is employed as a burned material only, which pollutes the air and increases the temperature. Thus, using wood fuel sorghum in biogas production or compost formation will reduce pollution, improve soil, and increase agricultural production profits (14).

Agricultural Residues:

Published by the Agricultural Research Center [14], the definition of plant agricultural waste and animal waste (animal faces) as secondary products within the agricultural production system. That needs to be maximized by converting them into organic fertilizers, fodder, human food, clean energy, or manufacturing them. That contributes to achieving clean agriculture and protecting the environment from pollution, improving agricultural products; and providing employment opportunities in the countryside. Therefore, they improve the economic and environmental situation and raise the health and social level in the Egyptian countryside.

Organic fertilizer (compost)[15]:

It is an improved type of fertilizer or supportive material. It results from the aerobic decomposition of plants or animal wastes, or a mix of both, with specific additives like mineral fertilizers and microbial organisms. It is extremely useful for agriculture. The organic fertilizer (compost) is prepared by determining the area of the heap and digging a channel with appropriate dimensions, then preparing the ground well and placing a layer of the SPP waste inside it, then placing a layer of the animal waste (fermented animal feces) on it, keeping the contents wet and at a suitable temperature with cyclical flipping, and leaving the heap for 5 months. Then it is used for soil fertilization.

Research problem

The problem represents the inefficient use of SPP wastes by the farmers. The SPP wastes accumulated on farms and on the edges of canals in the wrong way. The farmers used to burn it, which threatens the environment by increasing emissions and the earth's temperature. Besides, it contains several mineral elements that are lost. On the other hand, there are many factors that hinder the economic use of the agricultural SPP in Fayoum Governorate, like small areas of the agriculture farms, farmers' experience, and the low income of the farmers. Therefore, the research attempts to identify how to make full use of these SPP, economically and environmentally.

Research objective

The research aims to estimate the economic and environmental impact of using the SPP in the production of organic Fertilizers(compost) in the Saliheya village, the Fayoum Governorate Center. because wood fuel sorghum accounts for approximately 17.35% of total ARE production of wood fuel sorghum. Whereas the cultivated area of sorghum in the Fayoum Governorate represents 33.65% of the total production in the ARE in 2020. Also, the wood fuel sorghum is not used in feeding animals like in other SPP. To achieve this goal, the researchers reported the value of the SPP at the current farm prices. The wastage in the content of the agricultural SPP is from energy. The impact of organic fertilizer (compost) uses on irrigation water and soil properties. Evaluation of the organic fertilizer production project from the SPP of the wood fuel sorghum in the Saliheya village.

Data sources

The research relied on published secondary data and not published data from the Ministry of Agriculture and Land Reclamation and the Public Authority for Environmental Affairs. In addition to a questionnaire addressed to one of the projects related to converting secondary products into organic fertilizers (compost) to obtain some technical aspects and data on prices and costs and know its financial feasibility in line with the conditions of the Saliheya village, the Fayoum governorate during the month of September 2021.

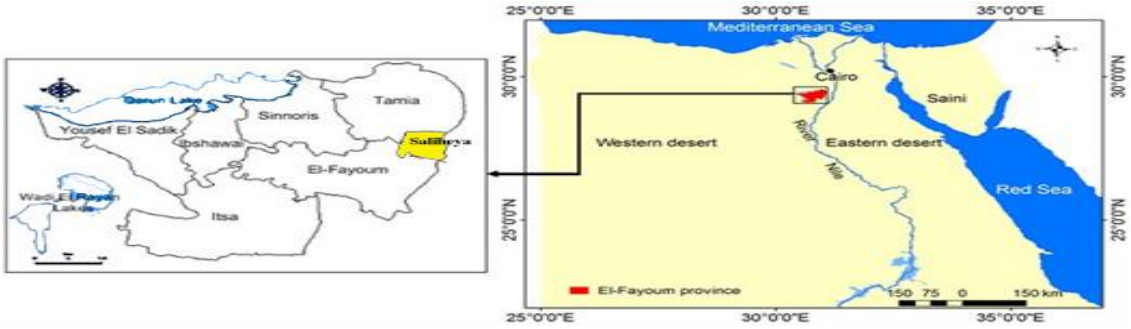

Figure (1) showed the Saliheya village, the Fayoum Governorate Center, El-Fayoum province, taken from Abd-Elmabod *et al.*[17] with modification.

2. Research method

The research relied on the method of descriptive analysis of certain variables represented in the averages and percentages. Also, quantitative statistical analysis methods were used foridentifying conversion factors.The project's financial feasibility was calculated using discount rate-based criteria, including net present value, return to costs ratio, internal rate of return, and capital payback period[16].

3. Results and Discussion

The secondary product value at farm prices

The data presented in table (1) showed the importance of each secondary product in the Fayoum Governorate. At the level of the Republic, it was found that the wood fuel of Maize came in first place, as its monetary value amounted to about 107 million dollars, and Rice straw came in second place in terms of production value and first place in terms of monetary value. This is due to the high price of the wood fuel of the maize because it is used as food for animals. Also, the Thrones of sugar beets come in second place for the same reasons. At the level of the Fayoum Governorate, it was found that the Thrones of sugar beets ranked first in production and monetary value due to their complete use in animal feeding. The wood fuel of sorghum comes in second place, although it contributes 17.35% of all the ARE production, which equals 312.7 million kg.

In line with the present results, previous work [21] revealed that summer maize produced about 5500 million kg of woodland (in 2013). The majority were burned and not used to their full benefit. Another study [1] showed that the annual agricultural waste volume was about 35 kg $x10^9$, of which, about 23 kg $x10^9$ of the SPP (used by about 7 kg $x10^9$ fodder, 4 kg $x10^9$ organic fertilizer, and about 12 kg $x10^9$ were leftover without benefit). Moreover, the animal wastes were about 12 kg $x10^9$ annually (employed by about 3 kg $x10^9$ as organic fertilizer, and about 9 kg $x10^9$, annually, were leftover without benefit). These results indicate that about 21 kg $x10^9$ of annual agricultural waste (plant and animal) was leftover without benefit and induced contamination of the agricultural ecosystem. It was essential to trigger an interest in reusing the SPP that comprised a substantial quantity of waste.

Table (1): The quantity and value of the secondary plant product (SPP)in Fayoum Governorate and the total of the Republic for the year 2020

	Type of SPP	Quantity of SPP (Thousand Kg)	monetary value Million Egyptian pounds (EL)	(Million US Dollar)	Arrangemonetary value
Fayoum Governorate	Rice straw	6220	0.95	0.060	5
	wood of cotton	34800	4.18	0.264	3
	wood fuel of Maize	4320	3.46	0.218	4
	wood fuel of sorghum	54250	32.5	2.049	2
	Thrones of sugarbeets	160800	48.25	3.042	1
	total Fayoum	**260390**	**89.3**	**5.633**	**-**
Republic	Rice straw	3052000	451.7	28.480	3
	wood of cotton	468100	56.16	3.541	5
	wood fuel of Maize	2245000	1697	106.999	1
	wood fuel of sorghum	312700	212.7	13.411	4
	Thrones of sugarbeets	2598000	769.1	48.493	2
	Total Republic	**8675800**	**3187**	200.923	**-**
Fayoum ratio to the Republic %		**3**	**2.8**	**2.8**	**-**

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economy, Bulletin of Agricultural Statistics, 2020.
Average Exchange rate 2020. 1 US dollar = 15.86 Egyptian Pound(Central Bank of Egypt, CBE

The wastage in the content of theSPP from energy

Table (2) reveals that the thrones of sugar beets come in the first place, as the equivalent quantity of it wasted was about 42 million kg of equivalent oil, and in the second place comes wood fuel from sorghum with about 14150 thousand kg of equivalent oil, followed by wood from cotton and rice straw. Regarding the total SPP under study at the Fayoum governorate level, the total losses in the content of plant products equivalent energy reached about 67.9 million kg of equivalent oil, and it represents about 3% of the total of the ARE Republic, which is about 2263 million kg of oil equivalent.

As for the level of the ARE, the rice straw and thorns of sugar beets come in first and second place, with the equivalent quantity wasted from them

quantitating to about 796.2 and 677.8 million kg of oil equivalent, respectively. The wood fuel of maize, cotton of wood, and wood fuel of sorghum come in the following arrangement, with about 585.6, 122.1, and 81.6 million kg of oil equivalent, respectively.

Agricultural products are one of the most important unconventional energy sources in the Egyptian countryside, as they are burned in primitive furnaces to generate energy, and the quantity of the agricultural SPP consumed to produce unconventional energy is equivalent to about 60% of the annual production total of these secondary products in the Egyptian countryside. The element of conversion which can be used in this regard is the content of these secondary products of energy and the equivalent of oil equivalent annually, where a thousand kg of petroleum equivalent can be obtained from the quantity of the SPP equal to about 2.3 thousand kg of waste [18].

Table (2): The quantity of fuel losses and its equivalent oil in the secondary plants products producesat the Governorate level and the Republic for the year 2020.

	Type of SPP	Quantity of SPP (Thousand Kg)	* Equivalent consumed fuel (Thousand Kg)	**Equivalent consumed oil quantity (Thousand Kg)	Arrange according to the quantity of equivalent oil
Fayoum Governorate	Rice straw	6220	3730	1620	4
	wood of cotton	34800	20880	9080	3
	wood fuel of Maize	4320	2590	1130	5
	wood fuel of sorghum	54250	32550	14150	2
	Thrones of sugarbeets	160800	96500	42000	1
	total Fayoum	**260390**	**156250**	**67980**	**-**
Republic	Rice straw	3052000	1831000	796200	1
	wood of cotton	468100	280860	122100	4
	wood fuel of Maize	2245000	1347000	585600	3
	wood fuel of sorghum	312700	187620	81600	5
	Thrones of sugarbeets	2598000	1559000	677800	2
	Total Republic	**8675800**	**5205480**	**2263300**	**-**
Fayoum ratio to the Republic %		**3**	**3**	**3**	**-**

* The percentage consumed as a traditional fuel 60%.
** Calculated according to the conversion factor used 2.3 thousand kg.
Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economy, Agricultural Statistics Bulletin, 2020.

The impact of organic fertilizer (compost) on the irrigation water and soil properties

Several studies have shown the importance of organic fertilization in increasing and improving the properties of agricultural soils of different types. Accordingly, by increasing the ability to retain water, it is possible to save about 25% of the total consumed water when planting any agricultural crop, while also increasing crop productivity. Whereas organic soil fertilization helps to form and increase the organic matter in the soil[5]. The property of water preservation has significant importance in soil water retention during drought. Therefore, the ratio can be considered (25% saving in irrigation water) is the conversion factor that is used to determine the economic return (total savings in irrigation water for the crops under study for Fayoum Governorate and the total of the ARE) resulting from the use of organic fertilizers (compost) in Egyptian agriculture [19].

Table (3) demonstrated that the lost quantity of irrigation water resulting from not using organic fertilizers (compost) in Egyptian agriculture for all studied crops in the Fayoum Governorate, where the summer sorghum crop comes in the first place, which amounted to about 139.2 thousand cubic meters, followed by the summer maize, sugar beet, cottonwood, and summer rice, respectively. Furthermore, the total loss at the governorate level was about 317.9 thousand cubic meters, which represents about 5.8% of the total ARE, which is about 5521 thousand cubic meters. Moreover, at the level of the ARE, the quantity of water lost for summer maize comes in the first place, reaching about 2374 thousand cubic meters, followed by summer rice, sugar beet throne, sorghum, and cottonwood, respectively.

Recycling SPPas a source of (biogas) production

It is possible to take advantage of the locally available agricultural waste, which is quite large, as a safe, healthy, and environmentally friendly source to produce clean energy, which is called biogas. Using moderntechnologiesused globally in the field of agricultural waste treatment. In this direction, the conversion factor can be used, which shows that each of about 6.84 kg of plant residue is equivalent to one cubic meter of biogas (5513 kilocalories), and by using this coefficient, it is possible to identify the

equivalent quantity of biogas for each secondary product under study. It is also possible to identify the equivalent quantity of kerosene in liters, given that each cubic meter of biogas is equivalent to about 0.6 liters of kerosene, and therefore, the corresponding value of the equivalent quantity of kerosene for each waste shows its economic impact. In addition to the resulting organic fertilizers, this is a secondary economic revenue stream of the biogas resulting from this technology[18]. In an earlier work), they showed that the 4 m^3 biogas production unit encounters 100% of the domestic requirements from gas and offers 13 labor chances for periodic labor, which provides around 35% of the energy requirements of the farmhouses and offers a revenue valued at around 4760 Egyptian pounds (EL) yearly. The 6 m^3 biogas production unit provides 15 labor chances for periodic labor, which accounts for nearly 50% of the farmer's energy consumption and offers a revenue valued at around 7040 EL yearly[20].

Table (3): The quantity of irrigation water lost, which can be saved in the case of using industrial organic fertilization for the areas planted with the study crops for the year 2020

	the crop	Total area (Thousand square meters)	Total consuming water (Thousand cubic meters)	* Quantity is missing from water (Thousand cubic meters)	Arrange according to the quantity of water lost
Fayoum Governorate	summer rice	11172	15.5	3.9	5
	cotton	78120	109.6	27.4	4
	summer maize	447300	470.8	117.7	2
	summer sorghum	544320	557	139.2	1
	Sugar beet	148260	118.7	29.7	3
	total Fayoum	1229172	**1272**	**317.9**	**-**
Republic	summer rice	5476800	7602	1900	2
	cotton	1005060	1410	352.5	5
	summer maize	9021600	9496	2374	1
	summer sorghum	1505280	1540	385	4
	Sugar beet	2541840	2036	509	3
	Total Republic	19550580	**22084**	**5521**	**-**
Fayoum ratio to the Republic%		6.3	**5.8**	**5.8**	**-**

***** Calculated according to the conversion factor used (Quantity of water loss is 25%).
Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economy, Agricultural Statistics Bulletin, 2020.

It is clear from table (4) that the equivalent quantities of biogas and kerosene in relation to the Thrones of sugar beets in the Fayoum governorate come in the first place, as the equivalent quantity of biogas reached about 23.5 thousand cubic meters, and kerosene is about 14.1 thousand liters, and wood fuel of sorghum comes in second place, with about 7.93 thousand cubic meters for biogas, and about 4.76 thousand liters for kerosene, and the total equivalent quantity of biogas in Fayoum governorate is about 38.1 thousand cubic meters, and kerosene is about 22.9 thousand liters. They represent about 3% and 3% for biogas and kerosene, respectively, of the ARE republic's total of about 1268 thousand cubic meters for biogas and about 761 thousand liters for kerosene**.**

On the level of the ARE, the equivalent quantity of biogas and kerosene for rice straw comes in the first place. The equivalent quantity of biogasreaches about 446.2 thousand cubic meters, and the equivalent quantity of kerosene is about 267.7 thousand liters. While wood fuel sorghum comes in last with about 45.7 thousand cubic meters of biogas and 27.4 thousand liters of kerosene.

Evaluation of the organic fertilizer production project (compost) from the SPPof agricultural sorghum in the village of Al-Saliheya:

The project [4] is an integrated system that eliminates the problem of the agricultural SPP and maximizes the economic return. In addition to eliminating the problem of pollution resulting from burning and the excessive use of pesticides and chemicals. It also works to change the behavior of farmers and turn them into the use the organic agriculture method after providing this type of production that achieves them for export opportunities, which leads to increasing the returns of the agricultural process as well as preserving the environment.

Technical study for the organic fertilizers (composts)project:

The project is established in the village of Saliheya, the center of the Fayoum Governorate, on a land area of about 4,200 square meters, with a rental

value of about 40,000 EL annually. The land (non-agricultural) is divided into a barn for storing raw materials of 900 square meters, a barn for storing the final product of 850 square meters, an area of awnings of 1,800 square meters, and an administrative building of 200 square meters. It produces about 188 thousand kg of organic fertilizer (compost) of sorghum waste residues per cycle. The cycle duration is three months in four cycles, with a total of 750 thousand kg annually, and the number of workers in the project is estimated to be six workers (project manager, tractor driver, and four ordinary workers), and diesel is the source of fuel needed to operate tractors and motors. Gasoline is also being used as fuel for the final product's transport vehicles.

Table (4): The quantity of energy losses (biogas) and the equivalent quantity from kerosene in the content of secondary plant products (SPP)at the Governorate level and the Republic for the year 2022.

	Type of SPP	Quantity of SPP (Thousand Kg)	* Equivalent quantity of biogas (Thousand cubic meters)	** Equivalent quantity of kerosene (Thousand liters)	Arrange according to the quantity of biogas and kerosene
Fayoum Governorate	Rice straw	6220	0.91	0.55	4
	wood of cotton	34800	5.09	3.05	3
	wood fuel of Maize	4320	0.63	0.38	5
	wood fuel of sorghum	54250	7.93	4.76	2
	Thrones of sugarbeets	160800	23.5	14.1	1
	total Fayoum	**260390**	**38.1**	**22.8**	**-**
Republic	Rice straw	3052000	446.2	267.7	1
	wood of cotton	468100	68.4	41	4
	wood fuel of Maize	2245000	328.2	196.9	3
	wood fuel of sorghum	312700	45.7	27.4	5
	Thrones of sugarbeets	2598000	379.8	227.9	2
	Total Republic	**8675800**	**1268**	**761**	**-**
The ratio of Fayoum % to the Republic		**3**	**3**	**3**	**-**

* Calculated according to the conversion factor used (6.84 kg of residue is equivalent to m^3 of biogas).
** Calculated according to the conversion factor used (m^3 of biogas is equivalent to 0.6 liters of kerosene).
Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economy, Agricultural Statistics Bulletin 2020.

Table (5) illustrated the fixed costs that have been paid once during the life of the project, which amounted to about 338000 EL, which represents about 45.5% of the total costs, which amounted to about 743700 EL. The value of machines and equipment comes in first place, which is (the stirring machine, agricultural tractor, and mixing) by about 66%, buildings with a rate of 17.8%, the value of the land rental by about 15.2%, and finally the preparation of the land (concrete layer) and the work of umbrellas with a rate of 4.4% of fixed cost value.

The data from the same table showed that the variable costs during the study period, which are the costs that are paid annually, amounted to about 405700 EL and represented about 54.5% of the total costs, with an average value of 743700 EL, and human labor wages come at the forefront of the variable costs, with an average value of about 270000 EL and the rate of 66% of the total variable costs, then the costs of purchasing waste (45000 EL, at 11%, then the costs of plastic bags, packaging, and packaging operations, which amounted to about 22000 EL, representing about 5.4% of the variable costs, Then the prices of other additions needed for the conversion process, whose average value is about 18200 EL, at a rate of about 4.5% of the total variable costs, and finally, the costs of electricity and water consumption, and the price of fuel, and the agricultural silt, and transportation represent about 4.2%, 3.6 %, 3%, and 1.7%, respectively, of the total variable costs.The table also revealed the size of the project's revenues in the Fayoum Governorate, which was about 600,000 EL annually.

The financial feasibility of the project [23]

- Average variable costs per thousand kg = total variable costs / total production per kg x10^3.

Average variable costs per thousand kg = 405700 / 750 = 540.9 EL / thousand kg.

- Unit profit margin (thousand kg) = price per thousand kg - the cost of production per thousand kg.
- Unit profit margin (thousand kg) = 800 – 541 = 259 EL / thousand kg
- Annual profit margin = revenue - variable costs

Annual profit margin = 600000 - 405700 = 194300 EL.

- Annual net profit = revenue - annual production costs

Annual net profit = 600000 – (405700 + 40000 + 1500 + 6000 + 22300) = 124500 EL.

The simple (undiscounted) criteria

1- Payback period: It is a measure that expresses the time period during which the project can recover its initial investment cost through its net returns. The project payback period is calculated from the following law:

Payback period = Investment costs / net profit = 743700 / 124500 = 6 years.

2- The return on investment: an indicator of the project's ability to make a profit.

The return on investment = (net profit/investment costs) x100

= (124500/743700) x 100 = 16.7%.

Table (5): Averages of variable and capital costs and their respective ratios for the organic fertilizer production project in Fayoum Governorate for the year 2021.

Statement	Item	value in Egyptian pounds (EL)	value in US Dollar	%
Total fixed costs	The rent value of the non-agricultural land	40000	2522.07	11.8
	Buildings	60000	3783.10	17.8
	The value of the equipment and machinery used with an annual depreciation 10%	223000	14060.53	66.0
	Preparing the ground (concrete layer) and making umbrellas	15000	945.78	4.4
	Total fixed costs	**338000**	21311.48	**100.0**
Total variable costs	Human labor	270000	17023.96	66.6
	Agricultural waste price	45000	2837.33	11.1
	packaging and packaging costs (50 kg)	22000	1387.14	5.4
	Electricity and water consumption costs	17000	1071.88	4.2
	Fuel price	14500	914.25	3.6
	Transfer	7000	441.36	1.7
	Agricultural silt	12000	756.62	3.0
	Other additives for the conversion process (nitrogen fertilizer, phosphorous and bacterial activator)	18200	1147.54	4.5
	Variable costs	405700	25580.08	100
	Total (investment) costs	743700	46891.55	
	Total production (thousand kg)	750	47.29	
	price per thousand kg	800	50.44	
	Total revenue	600000	37831.02	

Source: compiled and calculated from the research sample questionnaire form.

Average Exchange rate 2020. 1 U.S dollar = 15.86 Egyptian Pound(Central Bank of Egypt, CBE)

3- Break-evenproduction: It is one of the important methods used in determining the volume of production or the volume of sales.

- Break-even production = investment costs/profit margin

Break-even production = 743700 / 194300 = 3830 thousand kg.

It is the lowest quantity that the project can produce in 6 years without any loss. It is clear from this that the project is profitable, but this is not enough to accurately judge the feasibility of the project. To accurately judge this project, the discounted criteria should be evaluated in this project.

The discounted criteria

First, the discount rate should be obtained from the Central Bank of Egypt. In this project, it is equal to 9%.

1- The current benefit rate for the current costs:

Current benefit ratio to cost = the present value of benefits / the present value of costs.

At a discount rate price of 9% = 2333.8 / 1916 = 1.22%.

2- Net present value:

- Net present value = the present value of benefits - the present value of costs.

At a discount rate price of 9% = 2333791-1916032 = 417760 EL.

3- The ratio of current benefits to current costs (B/C) at a discount factor of 9% equals about 1.22%.

The data represented in table (6) shows that when a discount factor is 9%, the project will be profitable, as each monetary unit invested in the project is given a net benefit of 0.22. The greater this percentage, the more profitable the project. The value of the internal rate of return (IRR) is estimated at about 38%. This means the project is feasible if the discount factor, which represents the opportunity cost of investing capital in the community, is less than 38%. The project's cost recovery period is estimated at about 6 years.

The production of wood fuel sorghum in the Fayoum governorate is three thousand kilograms per 4200 square meters[22]. The studied compost project uses 750 x10^3 kg of wood fuel sorghum. This weight of sorghum waste is produced from 250 Fadden (about one million square meters). While the Fayoum governorate cultivated lands equal to 125.63 Thousand Fadden (about 527.7 million square meters) of sorghum[22]. The burned quantity of sorghum waste was about 60%. So, the number of projects needed in the Fayoum governorate can be calculated from this data and estimated by about three hundred projects. Moreover, scattering the projects between the cultivated lands will decrease the transportation value. In the examined project, the transportation value represents 1.7 % of the variable cost. This small value is since the project collects sorghum waste from the farmers near the project position. If the distance between the farm's increases, the transportation value will increase, and the profit will decline.

Table (6): Financial analysis at a rate of 9% discount for the production of organic fertilizer (compost) in Fayoum Governorate for the year 2021

Project age	Costs (USDollar)	Benefits (US Dollar)	Net benefits	The current value for the costs (c)	The current value for the benefits (B)	Net present value at the highest discount rate 9%
0	21311	0	-21311	21311	0	-21311
1	25580	37831	12251	23468	34707	11239
2	25580	37831	12251	21530	31842	10311
3	25580	37831	12251	19753	29212	9460
4	25580	37831	12251	18122	26800	8679
5	25580	37831	12251	16625	24588	7962
Total	149211	189155	39944	120809	147149	26340
(B/C)				1.22		
IRR				%38		

() Between arches indicates the negative signal.
Source: It was collected and calculated from the sample questionnaire.
Average Exchange rate 2020. 1 U.S dollar = 15.86 Egyptian Pound(Central Bank of Egypt, CBE)

Conclusions

Interest in the recycling of agricultural SPP has increased in Egypt recently. The quantity of agricultural SPP in the Fayoum Governorate reached about 260 million kg. It represents about 3% of its equivalent in the ARE Republic. It is about 8676 million kg in 2020. The research estimates the economic and environmental impact of using the SPP to produce organic fertilizers(compost) in the village of Saliheya, the center of the Fayoum Governorate. The research has reached some important results. The total value of the SPP of the study crops at the level of Fayoum Governorate in 2020 is about 89.3 million EL, representing about 2.6% of the ARE republic's total of about 3457 million EL. The quantity of wasted unconventional energy of plant secondary products that are burned, and the equivalent of equivalent oil is about 260800 thousand kg of waste, and this quantity is equivalent to about 67900 thousand kg of equivalent oil, and it represents about 3% and 3%, respectively, of the total ARE, which is about 8676000 thousand kg of waste and about 2263000 thousand kg of equivalent oil. The quantity of lost irrigation water because of the lack of organic fertilizers (compost) in agriculture for all study crops in the governorate represents about 318 thousand cubic meters, which represents about 5.8% of the ARE republic's total of about 5520 thousand cubic meters. The research showed that the equivalent quantity of biogas and kerosene for the SPP represents about 3%, with 3% of the total ARE republic estimated at about 1268 thousand cubic meters of biogas and 761 thousand liters of kerosene. By studying the economic and financial feasibility of the organic fertilizers (compost) production project from wood fuel of sorghum and the extent of its benefit in Fayoum Governorate, it was found that the internal rate of return (IRR) of the project amounted to about 38% with a recovery period of 6 years. These results indicate the extent of the economic and environmental benefits of the project.

Recommendations

1. Increasing awareness of farmers about the importance of recycling agricultural SPP through various media, holding episodes and training courses during the harvest, and emphasizing the possibility of achieving economic returns that the farmer can accomplish.
2. Encouraging small farmers to work collectively in the field of recycling agricultural waste into organic fertilizer to reduce the use of chemical fertilizers in agriculture and in preparation for the shift to organic agriculture.

3. Supporting the governmental and private sectors to conduct technical and economic studies that clarify the expected economic returns when recycling agricultural waste and making these studies available to investors to establish production factories that depend on the recycling process.
4. Promoting the optimum benefit from using these agricultural wastes, which would achieve profit and preserve the environment. As the project of organic fertilizer production (compost) helps to improve the soil properties, it also increases the project's internal rate of return (IRR), which reached about 38%. Additionally, the production of clean energy like biogas. This is instead of just getting rid of this waste in an unhealthy way that harms the environment and humanity.

References:

[1]. Hassan H. B. A., Ahmed E. A. 2019. Economic study of some agricultural wastes in Fayoum Governorate. Middle East Journal of Agriculture Research., Vol 8(4): p 1054-1066. DOI:10.36632/mejar/2019.8.4.8

[2]. Zakarya I. A., Suhaimi N. S., Kamaruddin A. 2020. Comparative Evaluation of Compost Quality, Process and Organic Materials and Adoptability Potential to Complement By Compost Quality Index (CQI). IOP Conference Series Earth and Environmental Science 616(1):012042. Dio: 10.1088/1755-1315/616/1/012042

[3]. Scholl L., Rien N. 2007. Soil Fertility Management. 5th ed (Wageningen: Agromina Foundation). p 83.

[4]. Abdel-Rahman G. 2009. American-Eurasian. J. Agric. & Environ. Sci. 6: 220–226.

[5]. Fernando, 2012. Compost for Coconut Plantations. (Srilanka: Coconut Research Institute).

[6]. HDRA, 1998. Composting in The Tropics I (United Kingdom: Ryton Organic Gardens Coventry CV8 3LG). p19.

[7]. Riwandi, Handajaningsih M., Prasetyo, Hasanudin. 2018. Compost derived from local organic materials as source of plant nutrients. IOP Conf. Series: Earth and Environmental Science 215 (2018) 012030 doi :10.1088/1755-1315/215/1/012030.

[8]. Ahmad Bhat, S.; Kuriqi, A.; Dar, M.U.D.; Bhat, O.; Sammen, S.S.; Towfiqul Islam, A.R.M.; Elbeltagi, A.; Shah, O.; AI-Ansari, N.; Ali, R.; et al. 2022. Application of Biochar for Improving Physical, Chemical, and Hydrological Soil Properties: A Systematic Review. Sustainability, 14, 11104. https://doi.org/10.3390/su141711104

[9]. Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economy, "Agricultural Statistics Bulletin", 2020. https://www.agri.gov.eg/library/25.

[10]. Mustafa R, H. 2015. Economic Return For Waste Recycling In Egypt (A Case Study Of Recycling Agricultural Waste). Journal of Agriculture Sciences., Vol 23(2): p 303-316. DOI: 10.21608/AJS.2015.14578

[11]. Elbadrashini N, K. A., El-Eraky M.B., Abd Elmoneim S. M., El-sawy M.A. 2019. Possibility Of Using Agricultural Waste In Egypt "A Case Study In Gharbia Governorate". Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, Egypt Vol 27(3), p 1739-1759. DOI: 10.21608/ajs.2019.73975

[12]. Hassan H. B. A., El Gebaly M. R., Abdul Ghani S. S., Hussein Y. M. M. 2014. An Economic Study of Recycling Agricultural Wastes in Egypt. Middle East Journal of Agriculture Research, Vol 3(3): p 592-608. https://curresweb.com/mejar/mejar/2014/592-608.pdf

[13]. Duque-Acevedo M., Belmonte-Urena L. J., Cortes- García F. J., Camacho-Ferre F. 2020. Agricultural waste: Review of the evolution, approaches and perspectives on alternative uses. Global Ecology and Conservation, Vol 22: e00902. https://doi.org/10.1016/j.gecco.2020.e00902 2

[14]. Ministry of Agriculture and Land Reclamation, 2001. "Recycling of agricultural waste to produce compost", Central Administration for Agricultural Guidance, Agricultural Research Center, Bulletin No. 396.

[15]. https://www.eeaa.gov.eg/portals/0/eeaaReports/AgrWasteRecycleGuide/A.W.R.G%202010.pdf

[16]. Basyouny S. G. A. 2021. An Economic Feasibility for Honey Bee Production Projects Financed from The Small Enterprise Development Agency in Dakahlia Governorate. Egyptian Journal of Agriculture Economy. Vol 4: p 1391-1430.https://meae.journals.ekb.eg/article_223841_6eb23c5fbf7018500a64d35e81476296.pdf

[17]. Abd-Elmabod S. K., Ali R. R., Anaya-Romero M., Jordan A., Muñoz-Rojas M., Abdelmageed T. A, Zavala L.Mde la Rosa D. 2012. Evaluating Soil Degradation under Different Scenarios of Agricultural Land Management in Mediterranean Region. Nature and Science; Vol 10(10): p 103-105. https://www.researchgate.net/publication/230718542

[18]. El-Shimy, S. A. 1996. The Economic and Environmental impact of the Use of Agricultural Wastes, the First Scientific Symposium, the Economic and Environmental Return of the Uses of Rural and Urban Waste, Egyptian Association for Research and environmental Services.

[19]. El-Mallah G. 2005. “Introducing the Water Resource in Economic Calculations when Comparing New Farming Areas”, Thirteenth Conference of Agricultural Economists, Contemporary Issues in Egyptian Agriculture, Egyptian Association of Agricultural Economics, p 28-29.

[20]. Talaat S. 2021. The Economic and Environmental Impact of Using Agricultural Waste in Biogas Production. Journal of Sustainable Agriculture Sciences., Vol 47(2): p 233-247.
Dio: 10.21608/JSAS.2020.44007.1237

[21]. Elbadrashini N. K.A., El-Eraky M.B., Abd Elmoneim S. M., El-sawy M.A. 2019. Possibility of using agricultural waste in Egypt "a case study in gharbia governorate". Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, Egypt. 27(3), 1739-1759. Website: http://ajs.journals.ekb.eg.

[22]. Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economy, Agricultural Cost Statistics and Net return, 2nd vol. 2020.http://www. agri.gov.eg/liberary/25). Last accessed 9-2022.

[23]. Kheder S. A., El-Sayed E. R. 2017. An Economic Study of some Agricultural Waste Recycling Projects in El-Gharbia Governorate. Egyptian Journal of Agriculture Economic. 27(2), 591-602. https://meae.journals.ekb.eg/article_111607_f1fb3ace1878d48ebff5a389666d9fc8.pdf

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