

Recycling Agricultural Organic Waste as Reducing Waste and Generating Income in Jericho City, Palestine

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Abstract— Generation of agricultural organic solid waste (green plant waste and animal manure) is rising significantly in Palestine; due to demand on agriculture as a source of income, and the development of the agricultural sector as a national strategy. This paper explains about the experiences of two agricultural organic waste recycling plants belonging to the private sector in recycling of agricultural organic solid waste in Jericho city as a case study of recycling of agricultural waste for not only reducing waste amount but also creating new income source. The various aspects covered in this paper are the introduction, needs, methodology, results, and the recommendations on how to develop this sector, the various issues and obstacles to develop a sustainable agricultural organic waste recycling focusing on the main two challenges: raising farmers awareness and securing legal framework for supporting investments and private sector participation in Palestine. The core issue in this paper is how recycling of agricultural organic waste could be a source of income as conserving the environment. Results of this study showed that; recycling of agricultural organic waste could be one of the income sources if the awareness of farmers is raised, and the legal framework is developed.

Keywords—Agricultural organic wastes, Composting, Recycle, West Bank, Palestine

I. Introduction

Jericho governorate, or Jericho and Jordan River Rift Valley area, is known as major agricultural area in Palestine. Agriculture is considered one of the main sources of income for the population of Jericho governorate. On the other hand, Jericho city is widely known as the oldest city in world; as big numbers of tourists are yearly visiting Jericho from various countries. Such condition made it worth to think about establishing an integrated solid waste management including agricultural organic waste management. Studies made in the past showed that; a huge amount of agricultural waste is produced annually in Jericho and Jordan River Rift Valley area, in addition to the manure of cattle, sheep, and goats, which are disposed to landfills and dumpsites.

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II. Materials and Method

A. Description of the Study Area

Jericho city, the oldest city in the world, is located in the southern part of the Jordan Rift Valley which is extending from Africa in the south to Turkey in the North joining the crossroads of the east-west corridor and north-south corridor.

The city is located about 300 m below the sea level. It is 35 km east of Jerusalem and about 14 km northwest of the Dead Sea and 8 km west of the Jordan River and extends over 37,481 dunums (roughly, 1 dunum = 1,000 m²). The city has been and will continue to be developed as a regional center for trade, tourism, and agriculture as well as environmental management particularly due to its unique historical, religious and cultural characteristics. Today, Jericho City is the only international gateway for Palestinians residing in the West Bank to the outside world. Fig. 1 shows the location of Jericho city.



Figure 1: Location of Jericho city (Source: MoLG database)

B. Need for Agricultural Organic Waste Recycling

Approximately 25,000 ton of agricultural waste (green plant waste and animal manure) is produced annually; this waste is mostly left in land, burned, or just disposed of around agricultural areas. In order to reduce the disposal amount of waste and protect the environment, there is a strong need to proper treatment of agricultural waste [1].

C. Methodology

Study of the existing agricultural organic waste recycling projects in Jericho city with respect to the income generation, here also it represents the typical agricultural organic waste problem, no sufficient recycling, it's not well organized.

There are two recycling facilities for treating and recycling agricultural organic waste in Jericho city. The first step in conducting the study was to review of all previous related studies and reports about agricultural organic waste recycling in West Bank. The available information have been thoroughly checked and analyzed to form a full understanding and assessment of the collected and obtained data.

Meetings and interviews with key persons who are working in these two facilities have been conducted to collect the required information from their acquired experience which is essential of accumulation of required data.

Finally, the financial data about all possible costs and revenues was identified, analyzed and presented.

III. Results

A. General Findings

Experiences of composting and recycling of agricultural organic waste is limited across West Bank, Palestine [1].

There are few agricultural organic waste composting facilities in West Bank, and are mostly managed by agricultural societies, as a part of extended service provided by these societies to their members.

Many composting facilities are constructed by PARC (Palestinian Agricultural Relief Committees) in different locations in Palestine since 2010, some of them are functioning very well where some are out of orders due to different reasons like lack of land availability and water shortage for constructing such facilities, the production capacities of these facilities vary from 40 to 7000 ton yearly. (PARC database).

Agricultural organic waste recycling could be a source of income, this needs rising of farmers awareness, and developing legal framework.

B. Case Studies

(1) Palestinian Fertilizers Company (PFC)

- Description of the Facility:

The company was established in the year 2010, and is located south east Jericho city, the total area of the facility is about 60 dunums (60,000 m²), out of which 2,000 m² for the composting plant.

The company is owned by Palestinian investors and is managed by administrative board. The investment cost was about 1.25 million USD, out of them 400,000 USD for equipment.

The production capacity of the recycling plant is about 12,000 m³ per year, and the main organic waste used is animal and green plant waste (see Fig. 2). Used composting technology was windrow with 1.5 m wide, 1.2 m high, and 50 m long. Open space of a palm plantation is used as windrow yard. Windrow is consisted several layers of green waste and cow dung lifted in this order. The plant is operated 8 hours daily for nearly 150 days per year according to the market demands. The operation area is divided into different components for mixing, compost fermentation, packing, and storage. The company started marketing its products from July 2013.



Figure 2: Production line, screening and packaging of compost product in PFC plant

- Sources of Raw Materials:

Used raw materials are either purchased or collected from farm yard in Jericho governorate. Green plant waste is collected directly by the company from farms in Jericho city for no price; the company just hires the cost of the collection. For animal organic solid waste (manure), the manure is purchased from animal farms in Jericho governorate, and part is purchased from other areas in west bank. The prices vary from 45 to 55 USD per cubic meter depending on the source. This waste stream is shown in Fig. 3.

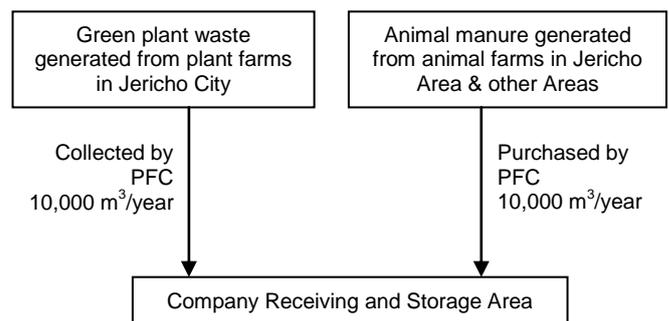


Figure 3: Waste Stream for PFC

- Operational Cost

The total annual operation cost for PFC is about 2,188,200 NIS (approx. 625, 200 USD). The TABLE 1 shows the breakdown of annual total cost for the plant operation:

TABLE 1: Total Annual Operation Cost for PFC (as of 2014)

Item	Cost (NIS) / y	Cost (USD) / y	Remarks
Manpower	126,000	36,000	10 workers (6 months)
Raw Materials (animal waste)	900,000	257,143	10,000 m ³
Raw Materials (plant waste)	0	0	10,000 m ³
Electricity	30,000	8,571	
Water	36,000	10,286	
Raw Materials (Packages)	480,000	137,143	
Maintenance	50,000	14,286	
Transportation Cost	75,000	21,429	
Other Costs	167,300	47,800	
Depreciation Cost	140,000	40,000	
Total Annual Cost	2,004,300	572,657	

- Selling Price

The company produces only one size 25 liter package, each package is sold for 6.5 NIS. The commercial name is “Compost Baladna”. The total annual production is about 480,000 packages.

- Unit price of packaged compost product: 6.5 (NIS)
- Gross sales: 3,120,000 (NIS); 891,429 (USD)
- Profit = 891,429 – 572,657 = 318,772 (USD/year).
- Gross profit margin rate: 35.8 %

(2) Agricultural Engineers Home Society (AEHS)

- Description of the Facility

The society recycling plant is a small scale plant established on 2011 is located east of Jericho city, the total area of the facility is about 5 dunums (5,000 m²), out of which 1,000 m² for the composting plant, the plant is owned by the Arab Development Society with a fund of \$220,000 from the government of Japan in 2011, through its grants assistance for grassroots human security project (GGP). Used technology is windrow method and materials are green waste and livestock excreta. The former is tree trimming and leaves generated at some of the parks and streets in Jericho City which are generated every 40 or 50 days. The later are cow dung generated from about 500 cows at dairy farm of the Arab Development Society located adjacent to the composting plant. The operation area is divided into different components for mixing, compost fermentation yard, packing, and storage.



Figure 4: AEHS compost plant (Upper: Full view, Middle: Compost yard, Lower: Compost products line)

The society was established on 2003, it has 22 member (agricultural engineers), and is managed by administrative board of 5 members. The investment cost of the facility was about 220,000 USD, funded by the Grassroots Human Security Projects.

The production capacity of the recycling plant is about 2,000 m³ per year, and the main organic waste used is animal manure and green plant waste.

- Sources of Raw Materials

Animal manure is purchased from Arab Development Society farms; AEHS is collecting all the generated animal manure for a fixed price (9 USD) per cubic meter. Green plant waste is collected directly by Jericho municipality from Jericho curbside and public spaces, and sent this waste to the AEHS storage area for free of charge. This waste stream is shown in Fig. 5 below:

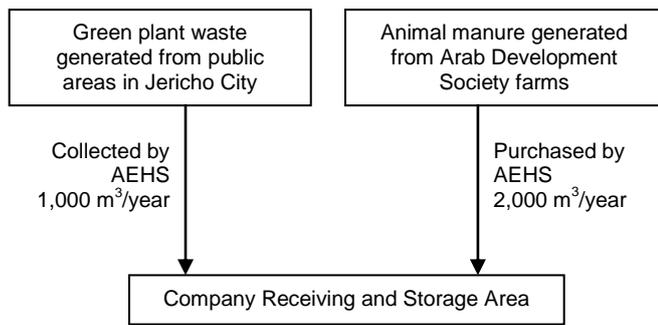


Figure 5: Waste Stream for AEHS

Operational Cost of AEHS:

The total annual cost is about 263,570 NIS (73,850 USD). The Table 3 shows the breakdown of the total annual cost for the operation AEHS:

TABLE 2: Annual operation cost of AEHS (as of 2014)

Item	Cost (NIS) / y	Cost (USD) / y	Remarks
Manpower	80,400	22,971	6 workers/ 4 months per year. 1 driver /12 month per year
Raw Materials (animal waste)	63,000	18,000	2,000 m ³
Raw Materials (plant waste)	0	0	1,000 m ³
Electricity	1,150	329	
Water	6,000	1,714	
Fuel	24,000	6,857	
Raw Materials (Packages)	37,200	10,629	
Maintenance	4,000	1,143	
Land Rent	2,500	714	
Waste Transportation	1,800	514	
Other Costs	2,000	571	
Depreciation Cost	75,000	21,429	
Total Annual Cost	297,050	84,871	

Selling Prices and Revenue:

The society produces only one size 20 kg package, each packaged is sold for 6.0 NIS. The total annual production is about 40,000 packages. Also about 858 m³ of the product is sold without packaging.

- Unit price of packaged compost: 6.0 (NIS/pack)
- Total selling: 240,000 (NIS) (= 68,571 (USD))
- Nonpackaged compost product: 165 (NIS/m³)
- Gross sales: 141,570 (NIS) (= 40,449 (USD))
- Profit = 68,571 + 40,449 – 84,871 = 24,149 (USD/year)
- Gross profit margin rate: 22.2 %

(3) Business prospects

In both PFC and AEHS cases in Jericho city, the compost manufacturing business using agricultural waste

can generate profits. Jericho city and its surroundings is one of the most agriculturally active areas in Palestine, and it can be expected a great demand for these compost products as soil conditioners and fertilizer since they are environmentally friendly and ecological products.

iv. Discussion of Results

The results after analysis of the collected data showed that;

1) The two facilities are getting financial benefits from the recycling of the agricultural organic waste as an organic fertilizer (compost product). The difference in revenues between the two facilities could be justified by the difference of interest. For the Palestinian Fertilizers Company (PFC); the project is an investment project by private sector, while for the Agricultural Engineers Home Society (AEHS) it is a farmers supporting cooperative project.

2) The main reason of the high production cost in the Palestinian Fertilizers Company (PFC) is the high price of the animal waste (manure) in Jericho area. The Agricultural Engineers Home Society (AEHS) purchases the manure from the Arab Development Society where the recycling facility set relatively low price.

3) The PFC business has a higher gross profit margin than the AEHS business, and it seems that this is due to the difference in business scale.

4) The difference in the selling price between the two composting facilities could be justified by; the difference of interest between the two facilities, and the difference of manure prices.

5) However, both facilities share the same marketing problems mainly due to; (i) farmers are not aware enough of using compost instead of chemical fertilizers, (ii) the absence of laws and economic instrument for promoting the usage of compost product, and (iii) the competition of the Israeli compost which is sometime giving to the farmers in very low prices about 3 USD per cubic meter.

6) On the other hand, the Israeli security ban on imported chemical fertilizer has deleterious effects on Palestinian agriculture [2], which indicates a necessity of some self-support of fertilizer, and compost is expected to be one of the measures.

6) Palestinian authorities shall pay efforts toward promoting green waste recycling and compost recycling through providing more incentives at different levels.

v. Conclusions and Recommendations

Recycling of agricultural organic waste could be not only reducing the amount of solid waste disposal but creating a source of income in Palestine. This needs revision of the current legal framework which supports the investments and the private sector participation in this field, which gives some intensives for the use of environmentally friendly compost products by the farmers, and rising of farmers' awareness on the environment and economy.

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It is necessary for decision makers to consider the recycling of agricultural organic waste in the strategic plans, and to allocate sufficient resources to reach this goal as mentioned in the National Strategy [7].

It is also worth to review the current legal framework, and to make required updating and modifications to encourage such type of recycling activities.

It is a recommendation to the Ministry of Agriculture of Palestinian National Authority to promote awareness of the benefits of compost in its awareness and guidance programs [7].

In this study we focused on only agricultural organic waste that is basically contamination free from municipal waste stream. However, it is a future challenge to think about recycling of the biodegradable organic fractions of municipal solid waste, which also had a large effect on the waste reduction flowing into landfills. In the case of municipal solid waste composting, a source separation practice, such as segregation of dry waste and wet waste, is essential for avoiding undesirable contamination to compost products.

Additionally, another trial which worth to mention here about composting is the project initiated by HWE (House of water and environment) in Jericho, which was funded by EU, all requested machines and equipment were installed in the site, but due to many administrative changes in Jericho Municipality (project partner) that negatively affected the project implementation, in addition to weakness or absence of relevant law that enforce waste separation and recycling.

In recent years [3] [4] [5] [6], compost production using biodegradable organic fractions in municipal solid waste has been attempted in several parts of Palestine. It is necessary to properly monitor these activities, promote the effective use and recycling of compost products produced from municipal solid waste, and promote the waste reduction.

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