

Potential of solid waste composting in the Gaza Strip- Palestine

Abstract

The paper discussed the potential of solid waste composting in the Gaza Strip. More than 60% of Gaza solid waste is organic as 360,000 tons of domestic organic waste is generated yearly in addition to 440,000 tons of organic agriculture waste. In Gaza the compost is sold for 3 USD /20 kg bag. Composting municipal and agriculture waste in the Gaza Strip will produce around 900,000 ton/year and the agriculture demand is only 160,000 ton/year (18%). To be able to make a higher percentage possible it would be required to also look at the potential of compost markets in the West Bank and Egypt in the future, when the political situation in the region is more stable. The main barriers for market development for organic “waste”-derived compost in Gaza are the low availability of high quality compost, limited information on compost usage and its benefits and finally lack of incentive to separate waste at source.

Key words: Compost, market, Quality, Solid waste, Gaza Strip

Introduction

Waste management services in Gaza are currently under great stress, as most other public services, due to the closure and economic restrictions currently imposed on Gaza. With donors support solid waste collectors are assigned on a temporary basis, using mainly donkey carts and push carts to collect the waste. For instance, the Municipal Council of Gaza City operates around 150 donkey carts for collection and transfer of municipal waste (Al-Najar, 2007; ARIJ, 2007; MoP, 2010). An open dump site area in the city is used as transfer station, from which about 20 vehicles transport the waste to the Johr aldeek central dump site. The Rafah municipality operates similar means to collect and transport waste to the central dumpsite at Al Fukhari (Nassar and Jaber, 2007; El-Hawi et.al, 2007)

The currently applied central dump sites are Jahr El Deek landfill (3 million tons of waste so far), located southeast of Gaza municipality, the Deir El Balah dump site (1.6 million tons of waste), located east of Deir Al Balah

municipality and the Al Fukhari landfill (300.000 tons of waste) located east of Rafah municipality (Morris-Iveson, 2009). These sites are currently exceeding their maximum capacity, while the Johr El Deek and Deir El Balah dumpsites face difficulties with the Israeli border military due to their location within the buffer zone next to Israel. The John El Deek dumpsite and the Al Fukhari Dumpsite have not been equipped with soil protection measures, while the Deir El Balah dumpsite has been constructed in a sanitary fashion. This poses a direct threat to the soil quality, especially for the Gaza City central dump site, since northern Gaza is the only area where fresh water has still an acceptable quality (Abdelqader, 2011). Due to the limited access to the three overloaded central dump sites a substantial part of the waste is dumped temporary at transfer sites throughout Gaza without further control or protection, or at new locations, such as Sheikh Ajleen near Gaza City (CMWU, 2010).

Primary collection of waste is done through containers located along the streets, most of which have been constructed locally in Gaza. If collection is coming late, it is noticed that people tend to burn the waste in the containers to make room for more space (UNRWA, 2000). One of the related problems is that most of the vehicles and equipments used for primary and secondary collection have reached the end of their life cycle. This leads to high maintenance costs, and reliance on donkey carts for primary waste collection (Al-Hmaid, 2002; El-Hawi, et. al. 2007). In Gaza a few composting initiatives have been identified. Some are currently in operation others are planned for the near future; until now less than 1% of the total solid waste flow is actually being composted in Gaza.

Discussion

Quantities and types of organic waste

The total population in Gaza is approximately 1.7 million people of a yearly domestic waste amount of 600,000 tons. With an organic waste percentage of approximately 60 % this corresponds to 360,000 tons of organic waste in the domestic waste. In 2040 the population figures are estimated to grow to 3.2 million (PCBS, 2013), resulting in 1.3 million tons of waste and thus approximately 800,000 tons of organic waste. A 50 % separation percentage of the organic waste (= 30 % of the total waste) is assumed possible for the long term. Based on the domestic waste amount calculated for 2040 this results in a total required composting capacity of 400,000 tons of organic waste/year and a potential total compost production of 200,000 tons/year in Gaza in the future.

Furthermore based on information of the Ministry of Agriculture an additional 440,000 tons of organic agricultural waste is produced in Gaza each year. The major part of this (appr. 90 %) is burned at the farms (and partly transported to landfills without being registered). Approximately 10 % is collected by the Ministry and used as fuel or as fodder for animals. Only a small amount (appr. 2 %) is currently being composted in de pilot composting plants in Rafah and Deir El Balah. This currently results in 5,000 tons of compost produced. If half of this agricultural waste would be kept separate and composted this however would result in an additional 110,000 tons of compost/year.

Compost market potential

The potential market for compost application in Gaza is relatively small due to the high population density resulting in a high waste production and therefore high potential compost production per surface area. About 29 % of the Gaza surface area consists of arable land (crops replanted after each harvest) and another 21 % is cultivated for permanent crops (D'Haeyer, 2000; PWA, 2013). With a total surface area of Gaza of approximately 36,000 ha (Khalaf et.al, 2006). This results in a total surface area for the potential compost market of 18,000 ha. The ministry of agriculture has indicated that the total surface area, which is really used as agricultural land is approximately 16,000 ha. On average about 10 tons of compost can be applied on each ha of agricultural land per year. This results in a potential maximum compost application of 160,000 tons of compost per year. This can be filled when a maximum separation and composting percentage of 18 % for both household and agricultural waste is taken into account.

Current market conditions

In general the best market conditions are in the spring or autumn. Currently approximately 5,000 tons of compost is produced in Gaza. The compost is sold to some international financiers, who further distribute the waste to farmers. Currently the compost is often given to the farmers for free. Attempts to have farmers directly pay for the compost have failed so far, due to questions about the compost quality and the poor economic circumstances under which the farmers operate.

In Gaza the compost is sold for 10 NIS/20 kg bag (about 3 USD/20 kg bag). This corresponds to 500 NIS/tons (about 150 USD/tons). In the West Bank about 50 USD/ton is being paid (Mahamid and Thawaba, 2010). At this moment it is difficult to get people to pay for the compost partly as a result of

the poor economical situation. However, compost in bags is imported from Israel with a current price of 250 USD/ton. The costs for compost production in Gaza are calculated on approximately 68 USD/ton of compost. It should therefore be possible to create a sustainable compost market if good quality compost can be produced in Gaza and if the farmers can be convinced of the quality of the compost produced. An overview of this comparison between costs and profits is given in the table 1.

Table 1: Costs of compost production compared with the price currently paid for compost

Compost Prices	USD/ton compost
Price paid in Gaza for locally produced compost	150
Price paid in West Bank for locally produced compost	50
Price paid for Israeli produced compost	250
Costs for compost production	68

The low willingness to pay may also be influenced by a low level of acceptance of compost made from “waste” in Gaza. In general farmers are well informed on the benefits of compost application for soil improvement and the positive influence it will have on crop growth (UNEP, 2003). However the compost produced at this moment has a low organic matter (8 to 10 %) and nutrient content. Farmers now rather use chicken and cow manure and artificial fertilizers to increase the fertility of their land. They don't see the advantages of compost application to the full extent. Some awareness should be created and the level of education should be improved to popularize the use of compost in agriculture and increase the acceptance of compost made from “waste”. This should include information about the use of artificial fertilizer vs. compost, the problems of eutrofication as a result of artificial fertilizer usage, benefits of compost application (improvement of organic matter content, water holding capacity of the soil, soil aeration, microflora). The lack of knowledge might prevent further opening of the compost market. The Ministry of Agriculture has indicated that farmers will accept compost as soil improver and will accept the idea that compost application is better than using artificial fertilizers if they are informed on this topic. This will also require an increase of the quality of the compost. This can partly be done by carefully selecting the base material for the compost, increasing the organic matter content. By mixing the compost with manure the organic matter content can be increased further and the compost can be enriched with nitrogen and phosphorus (Hargreaves, et. al 2008). The marketing potential may be enlarged by this because a farmer then only has to use one soil improver for both organic matter and nutrients.

Compost markets are very sensitive for the quality of the compost. Bad experiences with and the presence of macro pollutants like plastics and glass

or micro pollutants like heavy metals in the compost could ruin the market for compost for many years require a great deal of marketing effort to repair the damage done. Also compost with low organic matter content will cause farmers to stop using compost, because they don't see results of the compost application on their crop growth. The quality of the compost is therefore of the utmost importance to create market potential for compost application. Separation at source of the organic waste is therefore essential for development of the good compost market. Compost production from the mechanical separated organic fraction from household waste should only be taken in to. To increase the availability of information regarding compost usage and its benefits and to open the compost markets an information campaign by the Palestinian government is recommended both for the waste producers (citizens, municipalities) as for the compost users (agriculture and other markets). Such an information campaign is important to make the separate collection and composting of the organic fraction of municipal waste a success. Without compost market stocks of compost will grow rapidly if composting facilities are realized. This will result in high costs and lack of interest by citizens who see these stocks growing. This could then cause great problems with the separate collection. This means that starting up separate collection should be combined with a marketing and information campaign for compost application. For the information campaign two different groups to be addressed, can be distinguished:

- Citizens and organizations producing waste, who should be encouraged to keep the organic fraction of the waste separate and to separately give this to or bring this to the waste collection organizations.
- The various composting markets and especially agriculture, which should be encouraged to use the compost produced from these organic waste fractions

For each of these groups an information campaign should focus on different topics, resulting in the need for different promotional documents and or brochures.

This information will increase awareness and the level of education, but will not guarantee a well operating source separation of the organic waste. An incentive to stimulate separate collection is required to increase the willingness within the public to actively contribute to separation at source. Examples of such incentives are:

- Lower waste collection and treatment fees for areas contributing to source separation (this requires a well operating Solid Waste Management system with a high percentage of fees actually recovered)

- combining separate collection with an increased waste collection frequency, resulting in less nuisance by waste in the houses and streets
- creating jobs for the trimming of trees in the streets resulting in an increase of the separate collection of organic wastes from those trees
- creating parks or other 'green' areas in regions where separate collection is a success
- combining the separate collection of organic waste with lower fees of other public utilities

Developing markets for compost, produced from organic "waste" materials in Gaza will represent a significant challenge for the waste sector. Elaboration of a market development programme should start with engaging stakeholders (local authorities/ potential composters and the waste management sector) to establish a compost production and demand infrastructure for compost. The various governmental organizations can also stimulate biowaste and green waste compost application by e.g. prescribing this for development activities. The Palestinian authority and the municipalities should also try to play a controlling role in prices asked for the compost produced by making centralized agreements with the private sector to on one hand develop a good compost market and on the other hand protect farmers against high prices in these difficult economic conditions.

Proposed composting strategy for Gaza

Optimal composting technology

An open air (with roof) aerated pile composting system is recommended for the composting of organic waste streams in Gaza. This guarantees the best balance between process conditions/regulation and cost effectiveness. Furthermore separate collection of the organic waste streams to be composted is recommended to guarantee the best compost quality and therefore the best marketing potential.

Because of the open-air conditions, recommended for the composting facilities, the capacity of the facility should not be chosen too small. Small capacities will cause problems in the process control during very hot periods in the year. The small heaps with organic matter, that is composting, will be influenced too much during these periods. Larger heaps of organic matter will not be influenced so much. By performing the composting activities in a closed building these influences can be limited but the costs will increase enormously. As a result of the discussion presented above it is not recommended to plan a composting facility for the organic fraction of MSW on

(small) community level. The composting facilities should be planned on a larger governorate level. For green waste composting (organic waste streams from for instance parks) composting on community level with smaller and much simpler technologies is possible and can be stimulated. In this paragraph however the focus is put on larger regional composting facilities.

Total amount of organic material to be composted

The total amount of organic material (separated collected organic fraction of domestic waste and agricultural organic waste) that eventually might be available for composting in Gaza is calculated on a total of 620,000 tons/year, resulting in a compost production of 310,000 tons/year. This production exceeds the potential compost market, calculated for Gaza, with a factor 2. It would therefore be required to also look at the potential of compost markets in the West Bank and Egypt if these compost quantities would be produced. However the penetration of these compost markets outside Gaza is not considered realistic on short notice under the current political situation. Therefore a separation and composting percentage of 18 % for both household and agricultural waste is taken into account for the composting Strategy for Gaza. Based on the domestic waste amount calculated for 2040 this results in a total required composting capacity of 240,000 tons/year of the organic fraction of domestic waste and of 80,000 tons/year of agricultural waste. This results in a potential total compost production of 160,000 tons/year in Gaza in the future, which could just be absorbed by the compost market potential in Gaza.

The remaining part of the organic fraction of domestic waste will not be collected separately and will still be landfilled until penetration of compost markets outside Gaza seems feasible. The amount of domestic waste going to the landfill will however be reduced with 18 % as a result of the introduction of composting in the waste management system.

The major part of agricultural waste is currently burned at the farms (and partly illegally transported to landfills without being registered). Approximately 10 % is collected by the Ministry and used as fuel or as fodder for animals. Only a small part (approximately 2 %) is currently being composted. This part will be increased to 18 % as a result of the introduction of composting in the waste management system. Technically this percentage could be much higher, but the current market potential of compost prevents this. The fraction of the agricultural, which is recycled or used as fuel or fodder, will in this manner be increased from 12 % to 28 %. By further stimulation of the use of agricultural organic waste as fuel and animal fodder or by working this organic

waste in the soil (if suitable) on location the percentage burned on location or land filled illegally can be reduced even further.

Conclusions and Recommendations

Composting municipal and agriculture waste in the Gaza Strip will produce around 900,000 ton/year and the agriculture demand is only 160,000 ton/year (18%). To be able to make a higher percentage possible it would be required to also look at the potential of compost markets in the West Bank and Egypt in the future, when the political situation in the region is more stable.

The production of high quality compost can be increased by expanding the current pilot projects and supporting the larger scale initiatives, which are being started up in Gaza at the moment. An important role can be played by NGO's and private companies who are interested in the compost market. The Palestinian government and local authorities should seek cooperation with these stakeholders. Compost production should be started with materials, which can be source separated easily, like the organic fraction of market waste, agriculture waste and green waste from parks and trees in the roads. Next to this source separation of the organic fraction of household waste should be introduced in some parts of Gaza. The mechanical separated fraction of household waste should only be used as base material for compost if waste and compost analysis results show that this will also result in high quality compost (based on micro and macro contaminants). Otherwise this compost can jeopardize the compost market.

The main barriers for market development for organic "waste"-derived compost in Gaza are the low availability of high quality compost, limited information on compost usage and its benefits and finally lack of incentive to separate waste at source.

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