
This item was submitted to [Loughborough's Research Repository](#) by the author.
Items in Figshare are protected by copyright, with all rights reserved, unless otherwise indicated.

Lessons from a pilot co-composting plant in Kumasi, Ghana

PLEASE CITE THE PUBLISHED VERSION

PUBLISHER

© WEDC, Loughborough University

VERSION

VoR (Version of Record)

PUBLISHER STATEMENT

This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) licence. Full details of this licence are available at: <https://creativecommons.org/licenses/by-nc-nd/4.0/>

LICENCE

CC BY-NC-ND 4.0

REPOSITORY RECORD

Mensah, Anthony, Olufunke Cofie, and Agnes Montangero. 2019. "Lessons from a Pilot Co-composting Plant in Kumasi, Ghana". figshare. <https://hdl.handle.net/2134/31616>.



Lessons from a pilot co-composting plant in Kumasi, Ghana

Anthony Mensah, Olufunke Cofie and Agnes Montangero, Ghana

URBAN ENVIRONMENTAL SANITATION is considered to be one of the most immediate and serious problems confronting urban governments in most developing countries. In Kumasi, Ghana, waste management is simply inadequate. The city has 1 million inhabitants who daily generate 860 tonnes of solid waste (SW) and 500m³ of faecal sludge (FS) collected from on-site sanitation systems. In 1999, the Ghana cabinet approved an Environmental Sanitation Policy (ESP) which tasks the municipal assemblies to take action and promulgate by-laws to regulate environmental sanitation and prevent pollution within their areas of jurisdiction. Section 1.4.2 of Annex 2, Technology states that 'composting shall be carried out using simple methods and on decentralized basis, as near as possible to the point of waste generation. It shall be carried out if it results in the net savings to the Assembly in terms of reduced transport and landfill requirements and possible revenue (estimated with due regard to the limited market for compost)'. Twenty years earlier in 1979, the first large scale centralized composting facility in Ghana was commissioned in Accra but it failed due to technical problems and has gradually become a near total disposal site. Hence, the need for a more appropriate technological option.

Why Co-composting?

Co-composting means composting of two or more raw materials together – in this case, FS and SW. Co-composting FS and SW is advantageous because the two materials complement each other. The human waste is relatively high in N content and moisture and the SW is relatively high in organic carbon (OC) content and has good bulking quality. High temperatures attained in the composting process are effective in inactivating excreted pathogens contained in the FS and will convert both wastes into a hygienically safe soil conditioner-cum-fertilizer. Scott (1952) reports extensively about the combined composting of faecal matter with a variety of other organic materials as practiced in China over centuries. They found that pathogen, notably *Ascaris* egg destruction was 95% complete after 22 days and 100% complete after 36 days in a stack whose contents were turned every 5-14 days and reached 60 °C after each turning. Shuval et al. (1981) and Obeng and Wright (1987) collated information on historical and actual practices of co-composting "nightsoil" and (sewage) sludge. They also reported on economic, agronomic and marketing aspects of co-composting and its respective product. There are, doubtlessly, numerous co-composting activities and schemes

in operation in developing countries but information on such is lacking in Ghana.

Context of the pilot study

Over the years, the Kumasi Metropolitan Assembly (KMA) has had composting as part of its strategic planning for integrated waste management in the city. Under the World Bank financed Urban Environmental Sanitation Project (Urban IV), a Sanitary Landfill facility together with a FS Treatment Plant is being installed at Dompooase. Both facilities have 15-year design life to cater for the current daily generations rates of 860 tons (SW) and 500 cubic metres (FS) including the projected future increases after which new facilities would be required. Among other benefits, an effective co-composting programme would help prolong the lives of both facilities significantly. In view of this, a pilot co-composting study was carried out to provide the vital information for the planning and implementation of the large-scale project at the new landfill site. The study was jointly carried out by KMA, the Urban Agriculture Programme of International Water Management Institute (IWMI), Ghana; the Department of Water & Sanitation in Developing Countries (SANDEC) of the Swiss Federal Institute for Environmental Science and Technology (EAWAG), and the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi

Description of pilot plant

A pilot plant was established in 2002 at Buobai, about 15km eastward from the city centre of Kumasi. It is located on a faecal sludge treatment plant site (FSTP) of KMA. The pilot plant covers a total area of about 500m². It has three main components as described below:

- **Dewatering Area;** which consists of: Access Ramp, Stopping Blocks, Sludge Storage Tank, Drying Beds, Inlet and Outlet Drains, Splitting and Collection Chambers and Percolate Storage Tank. The purpose of the FS dewatering is to produce biosolid, which will be mixed with SW during composting.
- **Composting Area;** which consists of Solid Waste Handling section, Dewatered Sludge Storage section, Composting section, Maturation section, Screening and Bagging section
Office, for a plant manager and **Storeroom,** for bagged compost, tools and other supplies.



Figure 1a. Dewatering Section



Figure 1b. Composting Section

Various operations at the plant are presented in a flow chart in Figure 2. Collection and transportation of FS and SW to the plant were carried out by the Waste Management Department (WMD) of KMA while scientific investigations were done by the Research Partners.

Preliminary lessons

Results so far obtained from the pilot project indicate that the sludge drying beds constitute a good option for obtaining dewatered biosolids. However, the dewatering process lacks continuity of performance of the drying beds because of several factors which include: heavy rainfall in the early stages of dewatering cycles, sludge depth layer, structure and grain size of filter layer, as well as age and biochemical stability of delivered faecal sludge. Some cycles required a prolonged dewatering process. Hence, further improvements of the process and tests are necessary. Particular care need to be given to sand quality. Sand particles should have a diameter of 0.2-06 mm and should not crumble. Crumbling of the sand particles would lead to a rapid clogging of the filter, making sludge dewatering ineffective.

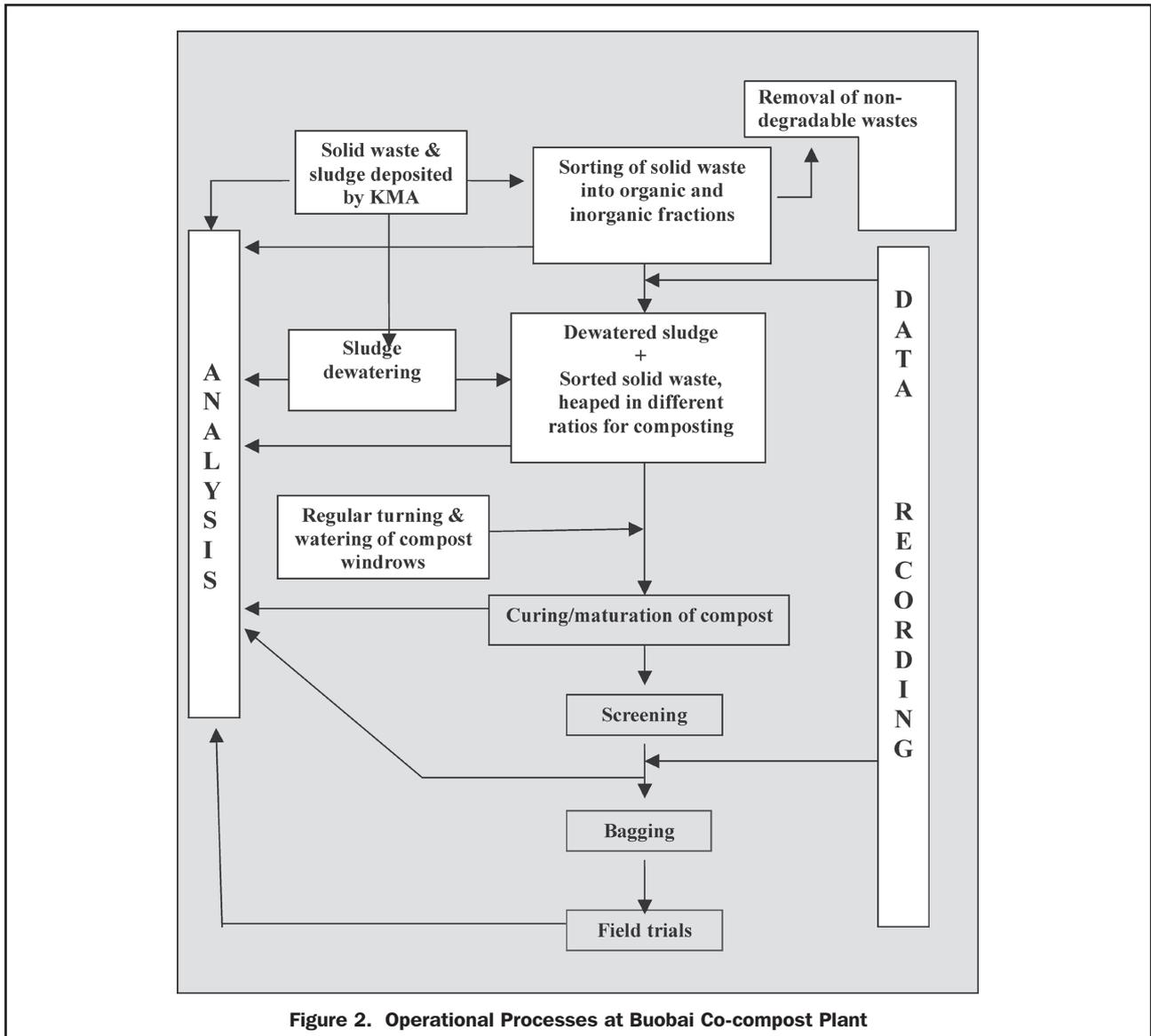
The duration of composting faecal sludge and organic solid waste was between 10-12 weeks. The duration of the thermophilic phase (3 weeks) was sufficient to influence the degree of compost hygienisation. The mature compost was tested for its nutrient content and hygienic properties. The final products show an impressive inactivation of pathogens such as coliforms and helminth eggs. The few experiments monitored to date reveal that its nitrogen content is low (1%). This is not surprising as nitrogen losses are likely to be substantial due to the long retention time of the FS in the drying beds and as a result of the composting process itself (duration, high temperatures). Further studies will be conducted on improvement of nutrient contents.

Although there is high demand for compost in and around Kumasi by different groups of people, predominantly farmers the amount they are willing to pay is low as compared to the production cost. This is because of the availability of cheap alternative soil ameliorant in the form of poultry manure. The economic appraisal of the plant however shows that it could be economically viable, though financially it might not be. The break-even analysis indicates that the ideal range of operation of a co-composting station of the type used for this pilot scheme is from 10-45 tons of compost per annum. The break-even weight is estimated at 45 tons of compost per annum. This will require 225 m³ of municipal solid waste (or 135 m³ of sorted waste) and 430 m³ of raw faecal sludge (or 43 m³ of dewatered faecal sludge) to produce it. At 2002 constant prices, this volume of compost is expected to yield a net economic benefit of US\$ 14,697 to the municipal assembly.

Co-composting could be an effective component of integrated waste management. However a good marketing strategy must be put in place to ensure the sustainability of the system.

References

- Scott, J.C. (1952). *Health and Agriculture in China – A Fundamental Approach to Some of the Problems of World Hunger*. Faber and Faber Ltd., London.
- Shuval, H.I., Gunnerson, C.G., Julius, D.S. (1981). *Night Soil Composting*. The World Bank. Appropriate Technology for Water Supply and Sanitation No. 10.
- Obeng, L.A. and Wright, F.W. (1987). *The Co-composting of Domestic Solid and Human Wastes*. UNDP/World Bank Integrated Resource Recovery Series GLO/80/004, GLO 80/0/007, Report No. 7. World Bank Technical Paper (ISSN 0253-7494) No.57



ANTHONY MENSAH, Waste Management Department, Kumasi Metropolitan Assembly, Ghana.
 OLUFUNKE COFIE, International Water Management Institute, West Africa sub-regional office, Accra, Ghana.
 AGNES MONTANGERO, Department of Water and Sanitation in Developing Countries, Swiss Federal Institute for Environmental Science and Technology, Switzerland