Co-composting of Municipal Solid Waste and Faecal Sludge in Kushtia Bangladesh

Iftekhar Enayetullah
Co-founder & Director
Waste Concern, Bangladesh
www.wasteconcern.org

ESCAP Session: Designing Effective Partnership for Waste to Resource Initiative

ISWA Congress 2015
Antwerp, September 8, 2015
Total Area: 27.75 sq.m
Estimated Population: 102,988
Total Number of Holdings: 12,907
Total Number of Household: 23,037
Faecal Sludge Generated by the City: 180 M3/ month (estimated)
(equivalent to faecal sludge collected from 90 holdings)
Solid Waste Collected by the City: 20-25 ton/ day (out of this 80% is organic)
Absence of Faecal Sludge Management

• Emphasis should therefore be placed on establishing and operating a sustainable faecal sludge management system that also promotes resource recovery, in order to attain 100% urban sanitation coverage as per set national goal, Promoting private sector participation in faecal sludge collection and treatment as well as NGOs participation in awareness raising is clearly a way forward.

• National Sanitation Strategy 2005, prepared by the Local Government Division of the Ministry of Local Government, Rural Development & Cooperatives has set-up national sanitation goal to achieve 100% sanitation coverage by 2013.
Faecal Sludge is a rich source of nutrients such as nitrogen, phosphorus and potassium. In human excreta, most of the organic matter is contained in faeces, while most of the nitrogen (70-80%) and potassium are contained in urine.

Before using faecal sludge as a fertilizer, it must be made safe. Co-composting is the controlled aerobic degradation of the organics using more than one material (faecal sludge and organic municipal solid waste). Faecal sludge has a high moisture and nitrogen content while bio-degradable solid waste is high in organic carbon and has good bulking properties (i.e. it allows air to flow and air to circulate).

By combining the two, the benefits of each can be used to optimize the process and the output product. Co-composting is a natural process allowing good hygienisation of sludge in a relatively short time. This is due to high temperature of 50 to 70ºC, which is reached during thermophilic degradation process. Co-composting of pre-treated and thickened faecal sludge with solid waste might be a good solution, even for large sludge volumes.

Combining the two

Faecal Sludge + Organic Waste
## Survival Time (in days) of Pathogen by Different Treatment Method

<table>
<thead>
<tr>
<th>Types of Treatment</th>
<th>Bacteria</th>
<th>Virus</th>
<th>Protozoa</th>
<th>Helminths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night soil, faeces at 20-30 C</td>
<td>90 days</td>
<td>175 days</td>
<td>10 days</td>
<td>Many months</td>
</tr>
<tr>
<td>Composting (anaerobic) septic tank/ pit latrine</td>
<td>60 days</td>
<td>60 days</td>
<td>30 days</td>
<td>Many months</td>
</tr>
<tr>
<td>Thermophilic Composting 50-60°C</td>
<td>7 days</td>
<td>7 days</td>
<td>7 days</td>
<td>7 days</td>
</tr>
<tr>
<td>Waste Stabilization Pond</td>
<td>20 days</td>
<td>20 days</td>
<td>20 days</td>
<td>20 days</td>
</tr>
</tbody>
</table>

Source: IDA (1990)
In order to assess sanitation condition of Kushtia Municipality, a sample survey was conducted amongst high, middle, lower-middle and low-income groups. Fig shows 96.67% (290 households out of 300) of the sample households of Kushtia Pourashava have hygienic toilets. However, 55 of them (18.33% of the total) have been found having connection with drains.
Collection and Disposal of Faecal Sludge

From the field survey, it was revealed that 50.33% households have septic tank toilets and 48.67% have ring slab or single pit or twin pit toilets. Although vacuum tug has been used for collection of faecal sludge from the filled up septic tanks or pits of Kushtia Town since a long time, there was no formal or environmentally sound faecal sludge disposal system. Figure shows the frequency of pit/septic tank cleaning in the Municipality.

Faecal sludge of less than three years is not fully decomposed and contains high pollution load, and hence, needs to be treated properly.
Pilot Intervention on Faecal Sludge Management in Kushtia

The main aim of the project is to develop a sustainable faecal sludge management system having full cost recovery and which can be replicated in secondary towns.

- In order to tackle **solid waste management** as well as **faecal sludge management** problems, a pilot project has been initiated in Kushtia Municipality, a secondary town in Bangladesh.
- **Project Initiated:** November 2012
- The pilot project has the following Features:
  1. **Compost plant Capacity** = 4 tons/day
  2. **Faecal sludge drying bed** (with a coco peat filter) to treat = 9 M3/day
  3. **Land Area:** 668 M2 (dedicated by the Kushtia Municipality)
The liquid sludge (faecal sludge) is poured into the sludge tank, from where it is passed into the sludge drying bed by natural gravity. When the drying bed becomes filled up, it is kept there for few days so that sludge gets dried and the percolate is transferred into the connected percolate tank.

The percolate is pumped into the coco peat filtration unit for further treatment. The filtered water coming out from the coco peat has high nutrient, and can be safely released into agricultural land for irrigation purpose.

On the other hand, dried layer of the fecal sludge is collected up from the drying bed and is mixed with the municipal organic solid waste in 1:3 ratios, and compost is produced in the co-composting plant using aerobic theomorphic composting method to be used as organic fertilizer.
Site Plan of the Co-composting Facility, Kushtia
Co-composting of Faecal Sludge with Organic Waste at Baradi, Kushtia City

Faecal Sludge Collected by Vaccu-Tug and Discharged in the Drying Bed and later Co-composted with Organic Waste to Produce Compost
Provided land
operation of the project,
collection of faecal sludge and
collection of fee for the service

UNESCAP provided grant for construction of the coco peat filter.

Cost for construction of the compost plant and faecal sludge drying bed along with the cost for the vacuum tugs

UNESCAP

Kushtia Municipality

Waste Concern

LGED

 Technology Provider.
 Design of the co-composting facility
 Construction supervision.
 Monitoring & Evaluation of the facility of the plant.
 Preparation of Business Plan.
 Training of municipal staffs
### Test Results of the Co-Compost and Treated Waste Water

#### Physical Properties

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Parameters</th>
<th>Actual Concentration</th>
<th>Standard * Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pH</td>
<td>7.8</td>
<td>6.0 – 8.5</td>
</tr>
<tr>
<td>2</td>
<td>Organic Carbon</td>
<td>11.97%</td>
<td>10 – 25 %</td>
</tr>
<tr>
<td>3</td>
<td>Nitrogen (N)</td>
<td>3.08</td>
<td>0.5 – 4.0 %</td>
</tr>
<tr>
<td>4</td>
<td>Phosphorus (P)</td>
<td>0.97</td>
<td>0.5 – 1.5 %</td>
</tr>
<tr>
<td>5</td>
<td>Potassium (K)</td>
<td>1.08</td>
<td>1.0 – 3.0 %</td>
</tr>
<tr>
<td>6</td>
<td>Sulfur (S)</td>
<td>--</td>
<td>0.1 – 0.5 %</td>
</tr>
<tr>
<td>7</td>
<td>Zinc (Zn)</td>
<td></td>
<td>Maximum 0.1 %</td>
</tr>
<tr>
<td>8</td>
<td>Copper (Cu)</td>
<td>0.0064%</td>
<td>Maximum 0.05 %</td>
</tr>
<tr>
<td>9</td>
<td>Chromium (Cr)</td>
<td>27.6054 ppm</td>
<td>Maximum 50 ppm</td>
</tr>
<tr>
<td>10</td>
<td>Cadmium (Cd)</td>
<td>0.00 ppm</td>
<td>Maximum 5 ppm</td>
</tr>
<tr>
<td>11</td>
<td>Lead (Pb)</td>
<td>26.1172 ppm</td>
<td>Maximum 30 ppm</td>
</tr>
<tr>
<td>12</td>
<td>Nickel (Ni)</td>
<td>0.00 ppm</td>
<td>Maximum 30 ppm</td>
</tr>
</tbody>
</table>

* Compost Standards of Ministry of Agriculture, Government of Bangladesh for use in the agricultural purposes.

**All test performed according to procedure described in "Manual for Fertilizer Analysis", Ministry of Agriculture, Government of the People's Republic of Bangladesh
Laboratory analysis of Compost Produced in the Kushtia Co-Compost Plant Carried Out by The Department of Soil, Water and Environment, University of Dhaka

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faecal Coliform, MPN/g</td>
<td>3.6</td>
</tr>
<tr>
<td>Salmonella spp/ 25g</td>
<td>Absent</td>
</tr>
<tr>
<td>Helminth/ g</td>
<td>Absent</td>
</tr>
</tbody>
</table>

* Compost Standards of Ministry of Agriculture, Government of Bangladesh for use in the agricultural purposes. **All test performed according to procedure described in "Manual for Fertilizer Analysis", Ministry of Agriculture, Government of the People’s Republic of Bangladesh

Results of Waste Water from Sludge Drying Bed Before and After Treatment by Coco Peat Filter

<table>
<thead>
<tr>
<th>Type of Waste Water</th>
<th>pH Standard (6.0-8.5)*</th>
<th>DO (mg/l) Standard (4.5-8)*</th>
<th>COD (mg/l) Standard 400 (mg/l)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Treatment ( First Tank)</td>
<td>7.34</td>
<td>1.3</td>
<td>576</td>
</tr>
<tr>
<td>After Treatment with Peat Filter (First Tank)</td>
<td>7.36</td>
<td>4.9</td>
<td>192</td>
</tr>
<tr>
<td>Before Treatment (Second Tank)</td>
<td>7.70</td>
<td>1.6</td>
<td>484</td>
</tr>
<tr>
<td>After Treatment with Peat Filter (Second Tank)</td>
<td>7.15</td>
<td>5.5</td>
<td>192</td>
</tr>
</tbody>
</table>

* Compost Standards of Ministry of Agriculture, Government of Bangladesh for use in the agricultural purposes. **All test performed according to procedure described in "Manual for Fertilizer Analysis", Ministry of Agriculture, Government of the People’s Republic of Bangladesh
In order to sustain faecal sludge management services, it is essential to recover the operational costs and make profits.

In order to sustain the operation, a profit of 15% to 20% should be charged on top of the expenditure.

### Sanitation Fee or Rate per Household

<table>
<thead>
<tr>
<th>Total O &amp; M including profit</th>
<th>Fee Per Year/HH with holding tax</th>
<th>Fee Per Year/HH with water charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD 53,713, with depreciation and 15% profit</td>
<td>USD 4.13</td>
<td>USD 8.7</td>
</tr>
<tr>
<td>USD 58,161 with depreciation and 20% profit</td>
<td>USD 4.5</td>
<td>USD 9.18</td>
</tr>
</tbody>
</table>

The cost for faecal sludge collection and treatment can be imposed with either conservancy tax or as a separate charge as sanitation fee linked with holding tax, subject to approval by the Ministry of Local Government. The other option is to link it with the water charge.
Different Management Options to Run the Facility

Option 1: Municipally Owned and Operated System
Option 2: Municipally Owned and Privately Operated System
Option 3: Privately Owned and Operated System

Financial Flow for Municipally Owned and Privately Operated Model
Pilot Intervention on Faecal Sludge Management in Kushtia

Recommended Options for Operation and Maintenance of Faecal Sludge Collection and Treatment System in Kushtia

• It is evident that there are three possible options for operation and maintenance (O&M) of the faecal sludge collection and treatment system. However, considering the present condition of Kushtia Pourashava in terms of availability of skilled manpower and experience in operation and maintenance of such project, municipally owned and operated system could not be recommended. Risks are high for lower quality of services.

• Fully privately owned and operated system is also not possible at the moment since there is no regulation or guideline for faecal sludge management currently in place. Since there are no incentives for private sector such as tax holiday for a certain period, nor low interest rates for financing such projects from banks, it is highly unlikely that private sector will be interested to invest capital cost which amounts to USD 135,000 for the Kushtia pourashava. Moreover, private sector would require a concession period of at least 20 years with a provision of land from the pourashava to initiate the project. Since all these issues are not clear at the moment, privately owned and operated system is currently not a viable option.

• Municipally owned and privately operated model seems to be a viable option. In this model, Kushtia municipality will invest and own all the infrastructure and they will lease it to the private sector to operate and manage it. Pourashava will pay the private sector a fee based on the number of pits/tanks cleaned per month.
Thank You