Innovations in Organic Waste Management

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Waste Concern

Workshop on Innovations for Scaling Up Organic Waste Management in South Asia
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Hotel Himalaya, Lalitpur

web: www.wasteconcern.org

Contents

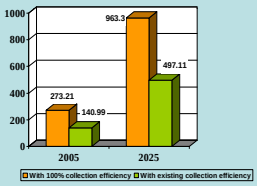
Waste Challenge in Developing Countries

Waste management is mainly focused with end-of-pipe solution which is based on collection, transportation and disposal

Waste Challenge in Asia?

*•Collection service level remain low with only **50%-70%** of resident receiving service.*

• Land is scarce and expensive for many cities in South Asia



Projection of Future Landfill Requirement for Bangladesh Acre Per Year (4 m deep landfill area)

Relationship with Waste Generation Rate with Economic Growth

Waste generations rates of some Asian Countries, sorted by ascending Gross National Income (GNI)

Country	GNI	Waste generations (kg/capita day)	Reference
Nepal	240	0.2-0.5	(UNEP, 2001)
Cambodia	260	1.0	(Yem, 2001)
Lao PDR	290	0.7	(Hoornweg, 1999)
Bangladesh	370	0.5	(Hoornweg, 1999)
Vietnam	390	0.55	(Hoornweg, 1999)
Pakistan	440	0.6-0.8	(World Wildlife Fund, 2001)
India	450	0.3 -0.6	(Ahmed, 2000; Akolkar, 2001)
Indonesia	570	0.8- 1.0	(Mukawi, 2001)
China	840	0.8	(Hoornweg, 1999)
Sri Lanka	850	0.2-0.9	(Jayatilake, 2001; Hoornweg, 1999)
Philippines	1040	0.3 -0.7	(World Bank, 2001)
Thailand	2000	1.1	(Hoornweg, 1999)

GNI 2000 per capita in $, based on Atlas Method, see http://www.worldbank.org/data/databytopic/class.htm

There is a link between growth in wealth and increase in waste — the more affluent a society becomes, the more waste it generates.

Relationship of GDP & Population with Waste Generation

GENERATION OF WASTE IS RAPIDLY INCREASING

Bangladesh Example

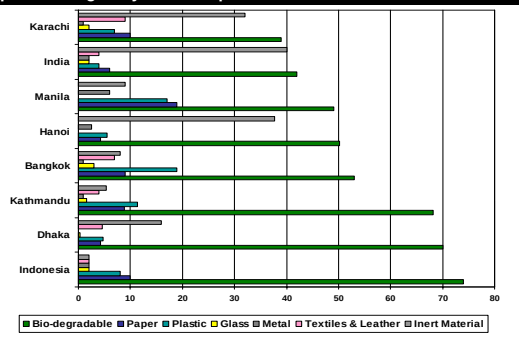
Year	Urban Population	Total Urban Waste Generation (Ton/day)	Per Capita Waste Generation Rate in urban areas Kg/cap/day	Per Capita GDP
1991	20.8 million	6493	0.31*	US $ 220
2005	32.76 million	13,330	0.41**	US $ 482****
2025	78.44 million	47,000	0.60***	>US $ 1000

* World Bank, 1998, *** Waste Concern, 2005, *** UMP, 1999, **** GOB, 2006

GLOBAL PERSPECTIVE ON URBAN SOLID WASTE CHARACTERISTICS

COMPOSITION OF RAW WASTE (by wet weight):	LOW INCOME COUNTRY	MIDDLE INCOME COUNTRY	HIGH INCOME COUNTRY
VEGETABLE/PUTRESCIBLE %	40 to 85	20 to 65	7 to 55
PAPER AND CARTON %	1 to 10	15 to 40	15 to 50
PLASTIC %	1 to 11	2 to 13	2 to 20
METAL %	1 to 5	1 to 5	3 to 13
GLASS %	1 to 10	1 to 10	4 to 10
RUBBER,MISC.%	1 to 3	1 to 5	2 to 12
FINES % (sand, ash, broken glass)	15 to 50	15 to 40	5 to 20
OTHER CHARACTERISTICS:			
MOISTURE %	40 to 80	40 to 60	20 to 35
DENSITY IN TRUCKS, KG/C.M.	250 to 500	170 to 330	120 to 200
LOWER HEATING, KCAL/KG	800 to 1100	1000 to 1500	1500 to 2700

Typical Average Physical Composition of Waste in Urban Areas



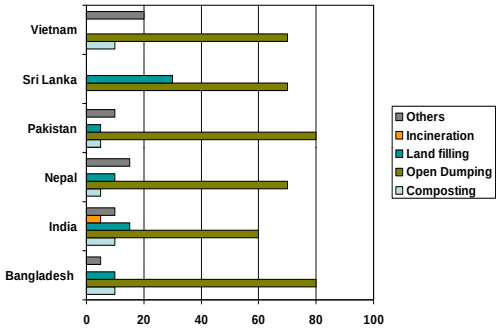
Source: Zurbrugg, 2002

Waste Characteristic of Dhaka, Bangladesh

High organic matter >>(more than 70%)
High moisture content >>(more than 50%)
Low calorific value >>(less than 1000 Kcal/Kg)

PRESENT PRACTICE

Solid Waste Disposal Methods Practiced in Some Asian Countries



Source: UN 2000, Waste Concern 2009

PROBLEMS FROM PRESENT PRACTICE

Solid Waste Management is based on end-of-pipe solution which is only focused on collection, transportation and final disposal…

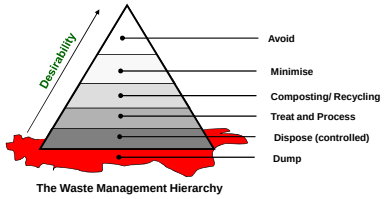
VERMINS
Spreading more than 40 Diseases

METHANE GAS
Bad Odor & Green House gas

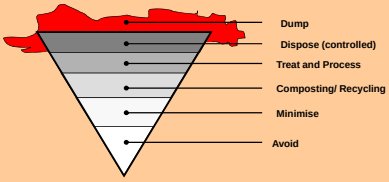
LEACHATE
Polluting Ground & Surface Water

Open dumping practiced in most of the cities and towns, which is the cheapest and easiest solution for them...

Strategy for Improvement (3R)



The Waste Management Hierarchy



The Waste Management Hierarchy (Present Situation)

City of San Francisco, USA: Target of Zero Waste

- City of San Francisco has now a **target of zero waste.**
- They have launched **household**, **community** and **city level composting**
- Today, San Francisco **recovers 72 percent** of the materials it discards,
- City has **twin goals of 75 percent landfill diversion by 2010**, and bringing the city to **zero waste by 2020.**
- This includes passing legislation to increase producer and consumer responsibility. In other words, manufacturers, businesses and individuals will need to be accountable for the environmental impact of the products they produce and use.

- San Francisco has created the first large scale urban collection of food scraps for composting in the country. Today, hundreds of thousands of residents and over 3,000 restaurants and other businesses send over 400 tons of food scraps and other compostable material each day to Recology's Jepson-Prairie composting facility, shown above. Food scraps, plant trimmings, soiled paper, and other compostables are turned into a nutrient-rich soil amendment, or compost, that is used to produce the organic food and wine that San Francisco is famous for serving.
-
- We know that compostable food and paper products still make up more than 36 percent of the material that San Francisco sends to landfill. Our goal is to divert even more compostable material from landfill. Follow the links below to find out how you can participate at home and at work.

- For more information visit COOL 2012, a project dedicated to documenting the benefits of municipal compost programs. Or download Stop Trashing the Climate, a report detailing the climate change impacts of recycling and composting.

EU Landfill Directive

The EU Landfill Directive sets targets for the reduction of biodegradable waste sent to landfill

- As 75% of the 1995 level by 2010
- As 50% of the 1995 level by 2013
- As 35% of the 1995 level by 2020

•ISWA is also promoting organic waste recycling through composting/anaerobic digestion to reduce GHG emissions

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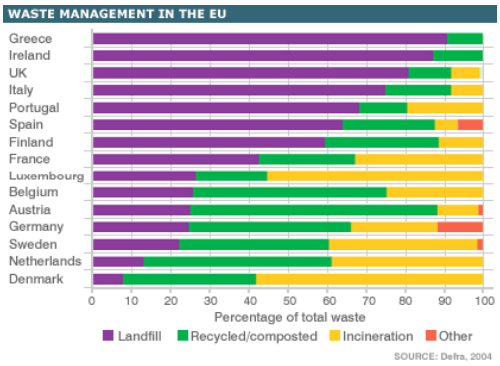

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Ministry of Environment and Forests Notification

New Delhi,
the 25th September, 2000

Segregation of municipal solid wastes

In order to encourage the citizens, municipal authority shall organize awareness programs for segregation of wastes and shall promote recycling or reuse of segregated materials. The municipal authority shall undertake phased program to ensure community participation in waste segregation. For this purpose, regular meetings at quarterly intervals shall be arranged by the municipal authorities with representatives of local resident welfare associations and non-governmental organizations.

Processing of municipal solid wastes

Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill. Following criteria shall be adopted, namely:-

(i) The biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes.

(ii) It shall be ensured that compost or any other end product shall comply with standards as specified in Schedule-IV;

Disposal of municipal solid wastes

Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities.

Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing

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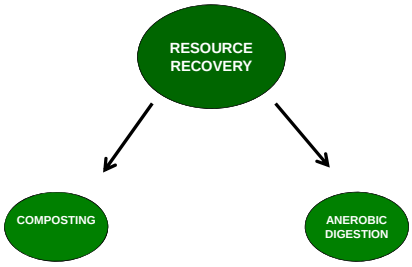
RESOURCE RECOVERY OPTIONS



EXAMPLES OF ORGANIC WASTE COMPOSTING PROJECTS FROM BANGLADESH

Present Scenario of SWM of Dhaka

- Per Capita Waste Generation : 0.56 Kg/cap/day
- Total Waste Generation DCC Area : 3800 tonnes/day
- 70% - 80% of the solid waste is organic

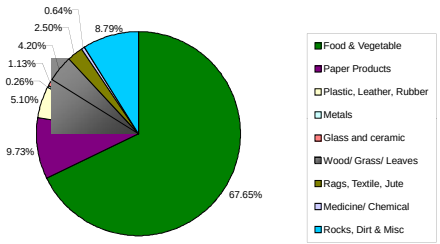
URBAN WASTE GENERATION (Tons/ day) IN BANGLADESH

- **1991: 6493 tonnes/day**
- **2005 :13,300 tonnes/day**
- **2025: 47,064 tonnes/day (estimated)**

Present Scenario of SWM of Dhaka

Present Scenario of SWM of Dhaka

Average Physical Composition of Urban Solid Waste



15 % recyclable waste are collected by the informal sector

MAJOR PORTION OF WASTE IS ORGANIC

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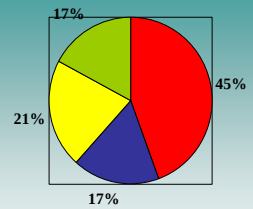
SOIL CONDITION OF BANGLADESH



83% of cultivable land in Bangladesh has less than 3.5% organic matter (more than 3.5% is considered to be good soil)

Pie Diagram Showing Depletion of Organic Matter From the Soil of Bangladesh

ENVIRONMENTAL AND HEALTH PROBLEMS IN URBAN AREAS DUE TO UNMANAGED WASTE

ADDRESSING TWO MAJOR PROBLEMS

ORGANIC MATTER DEPLETION IN THE SOIL OF RURAL AREAS

83% of the soil has less than 3.5% organic matter

WASTE CONCERN'S SOLUTION

- ❑ **Converting Organic Waste Into Compost Using Decentralized Network of Compost Plants**
- ❑ **Use of Compost/Enriched Compost in Agriculture**
- ❑ **Use of carbon credit using CDM under the Kyoto Protocol**

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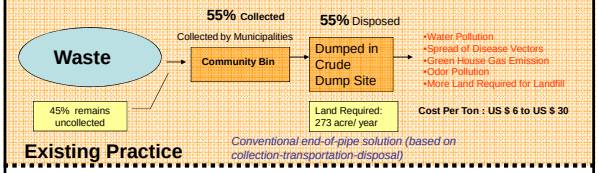
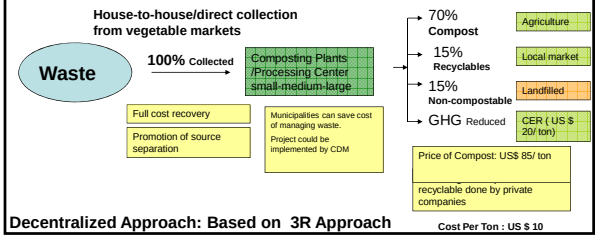
PROBLEMS (overall Bangladesh)



Existing Practice

Conventional end-of-pipe solution (based on collection-transportation-disposal)



Decentralized Approach: Based on 3R Approach

Why Composting?

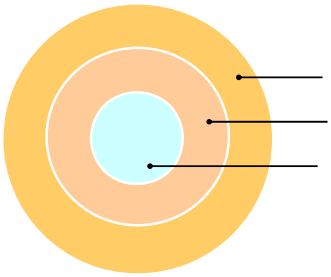
High organic matter >>(more than 70%)
High moisture content >>(more than 50%)
Low calorific value >>(less than 1000 Kcal/Kg)
Lack of space for disposal of solid waste

Why Decentralized Composting?

The exiting physical plan and socio-economic situation of Dhaka strongly suggests decentralization of the composting system. Some of the reasons are:

- Decentralized composting system is labor intensive and less costly compared to the centralized one.
- It is well suited for our waste stream, climate, social and economic conditions.
- Low cost and easily available local materials along with labor intensive technology can be used in this method of composting.
- Improves community participation in source-separation and reduces the volume of solid waste at the source more effectively.
- Significant improvement can be achieved at the collection points of solid waste
- It reduces the costs incurred for collection, transportation and disposal of waste by municipal authorities
- Quality of compost can be maintained

Different Scale of Waste Concern's Composting Model



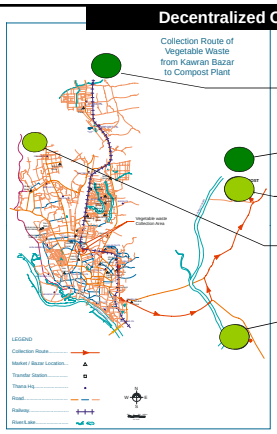
Large Scale
More than 11 ton/day upto 250

Medium Scale
3 to 10 tons/day

Small Scale
Upto 3 tons/day

The flexibility of Waste Concern's composting model is such that it can be adapted to any situation both in urban and rural areas. Moreover, it can be implemented in slum areas. It can be implemented on a small scale, medium scale, or large scale. The small scale model allows for 3 tons of organic waste to be processed daily, while the medium scale model permits processing 3 to 10 tons of organic waste per day. More than 11 tons of organic waste can be processed daily using the large scale model. Besides reducing green house gas emissions, each of these models also generate valuable carbon credits on the international market.

Decentralized Compost Plants in Dhaka



250 tons/day plant to be operational by September 2011 in Gazipur

250 tons/day plant to be operational by December 2010 in Bulta

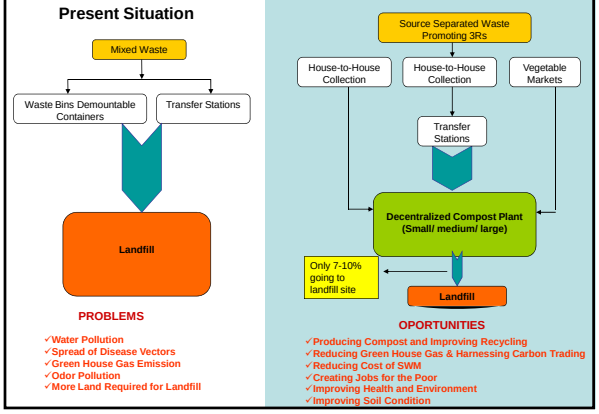
130 tons/day plant operational since 2008 in Bulta

25 tons/day Barrel Type Composting operational in Slums since 1998 in Mirpur

10 tons/day plant operational since November 2008 in Katchpur

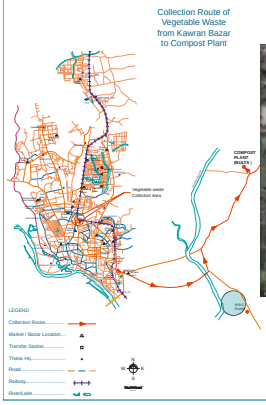
DCC generates **3800 tons/ Day**
70% organic waste
Organic Waste **2660 tons/ Day**

Approach of Waste Concern



Compost Plants for Urban & Rural Areas (Small Scale)

Medium Scale Compost Plant Located in Katchpur, Narayanganj



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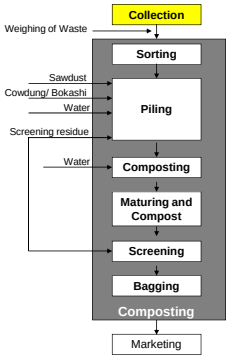
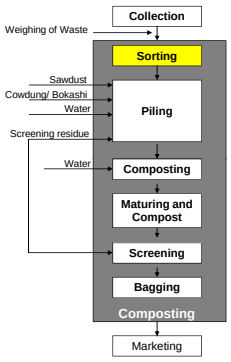
Different Steps of Composting Process



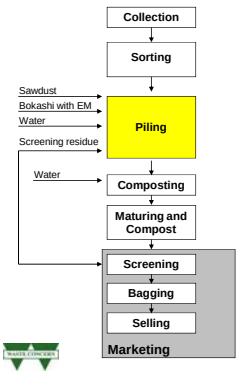
Collection



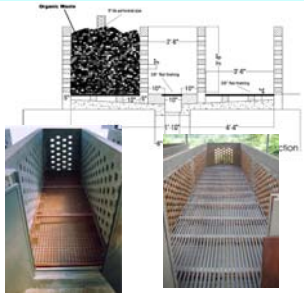
Parameters to be Monitored During Implementation

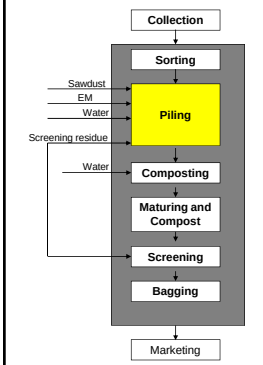
Weighing of Waste Input

Box Method Composting

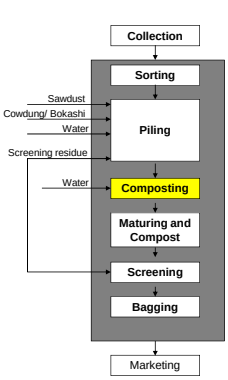


- Use of additives for optimizing Process
- Roof Covered
- Perforated Base
- Low cost technique
- Labor intensive





Different Steps of Composting Process



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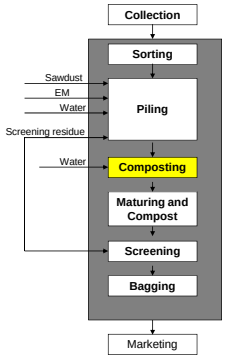


TEMPARATURE CONTROL

Thermophilic Phase (40-70° C) Takes 27 days

Mesophilic Phase & Maturation (20-40° C) 11 + 15 days -

Temperature is monitored and records are kept to assess the trends

Composting

Survival Time (in days) of Pathogen by Different Treatment Method

Types of Treatment	Bacteria	Virus	Protozoa	Helminths
Night soil, faeces at 20-30 C	90 days	175 days	10 days	Many months
Composting (anaerobic) septic tank/ pit latrine	60 days	60 days	30 days	Many months
Thermophilic Composting 50-60^{0}C	7 days	7 days	7 days	7 days
Waste Stabilization Pond Retention time >20days	20 days	20 days	20 days	20 days

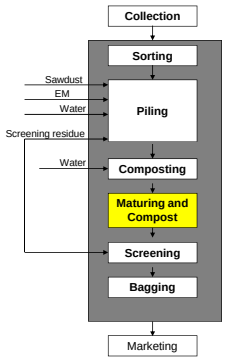
Source: IDA (1990)

Parameters to be Monitored During Implementation

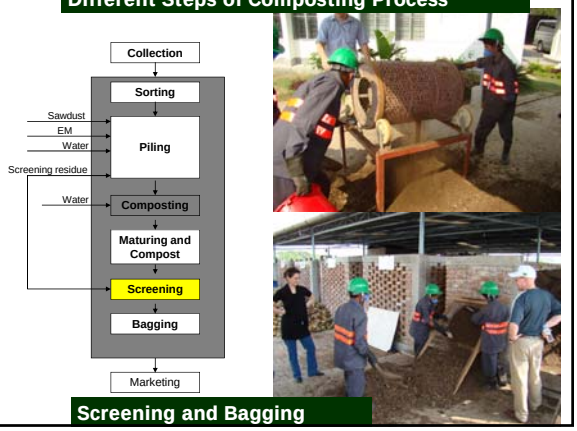
Regular Oxygen Monitoring

Process Quality Control

Regular Oxygen Monitoring

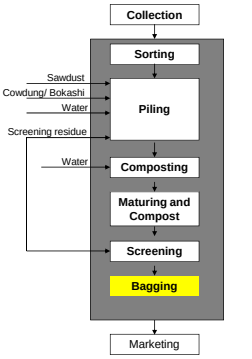


Different Steps of Composting Process



Screening and Bagging

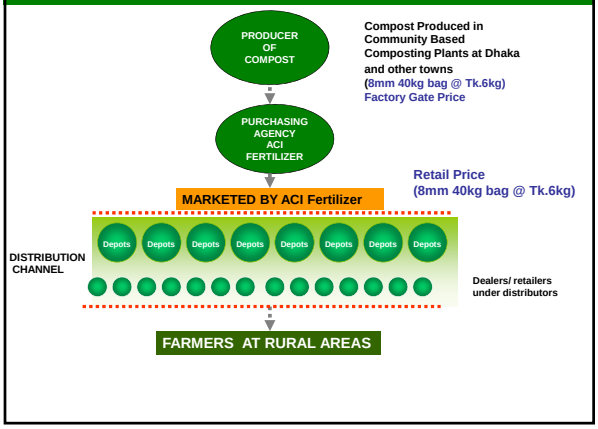
Different Steps of Composting Process



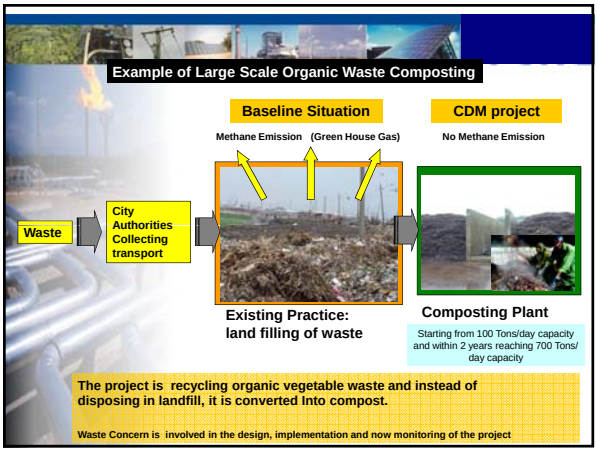
BAGGING

- 40 kg bags

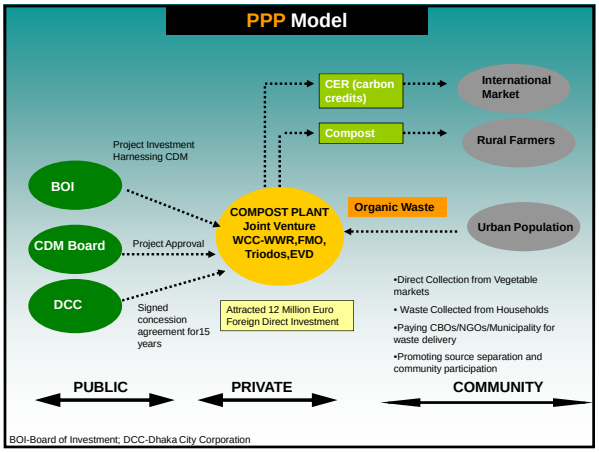
MARKETING OF COMPOST



Example of Large Scale Organic Waste Composting

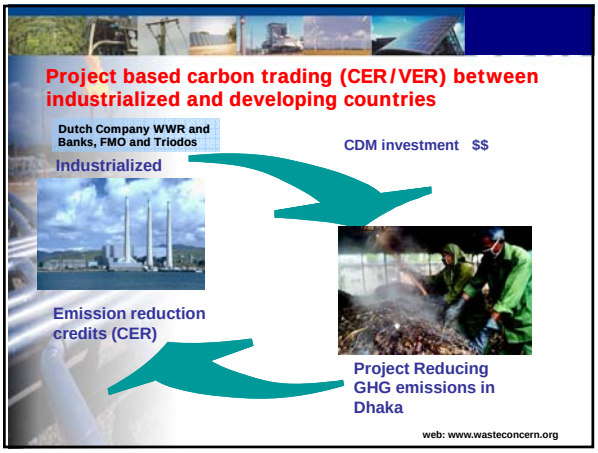


PPP Model



BOI-Board of Investment; DCC-Dhaka City Corporation

Project based carbon trading (CER/VER) between industrialized and developing countries



Examples of 3R practice: Dhaka experience CDM

UNFCCC/CCNUCC

CDM – Executive Board

AM0025 / Version
Sectoral Scope
EB

NOTE: The following project activities are required to make the PDD publicly available as per the guidance in paragraph 29 of the report of twenty seventh meeting of the Board:
1. those that use mechanical process to produce refuse-derived fuel (RDF) from waste and its use for energy generation.

Revision to the approved baseline methodology AM0025

"Avoided emissions from organic waste through alternative waste treatment processes"

Source

This baseline methodology is based on the proposed methodologies submitted for the project "Organic waste composting at the Matuail landfill site Dhaka, Bangladesh," whose baseline study, monitoring and verification plan and project design document were prepared by prepared by World Wide Recycling B.V. and Waste Concern. It has been revised to include elements from the methodology for the "PT Navigat

Obtained UNFCCC approval on Sept 2005

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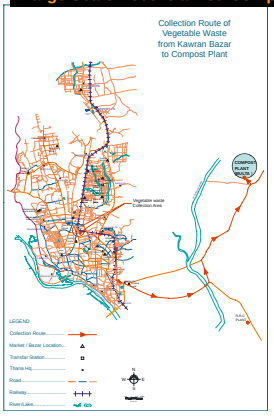
Large Scale Decentralized Compost Plant at Bulta, Dhaka

130 Tons/day Capacity Compost Plant (first phase) at Dhaka of Waste Concern established in 2008

Large Scale Decentralized Compost Plant Located in Bulta, Dhaka



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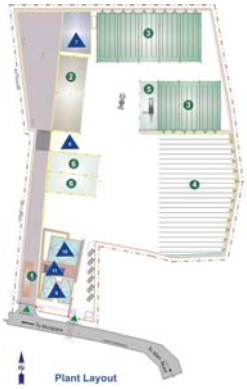
Plant layout



LEGEND

1. Weigh Bridge
2. Reception, Sorting & Pre-treatment Area
3. Pre-Composting Area
4. Maturing Area
5. Screening Area
6. Compost Storage

- Leachate Water Storage Pond
- Structural Material Storage
- Building 01: Administration & conference
- Building 02: Cafeteria, Day care & washing facilities
- Harvested Rain Water Reservoir

Basic Information of the Plant

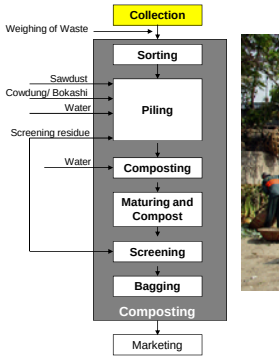
Basic information:

- Total plant area: 14744 sq. M.(1.47 ha)
- Employment creation: 90 persons
- Organic waste recycled: 130 tons/day
- Production capacity: 30-40 tons/day
- GHG emission reduction: 12,000-14,000 $t_2$ons CO/yr.
- Land filling avoided: 52195 m^3/yr.

Special Features:

- 100% on-site waste water recycling
- Rain water harvesting from total roof and hard surface area
- Day care center for female staff
- Free meal for the workers
- Health insurance for the workers

Different Steps of Composting Process



Collection

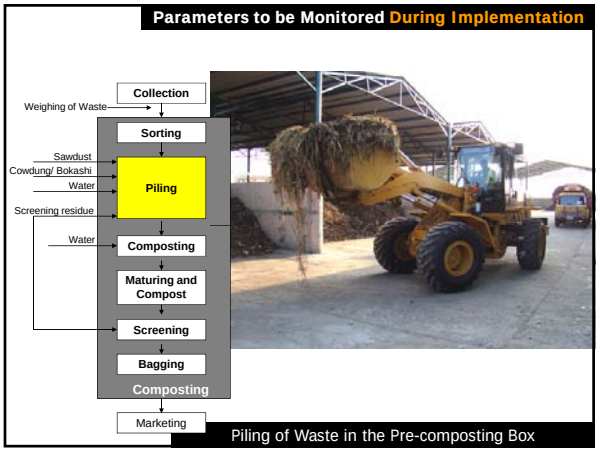
Parameters to be Monitored During Implementation

Weighing of Waste Input

Parameters to be Monitored During Implementation

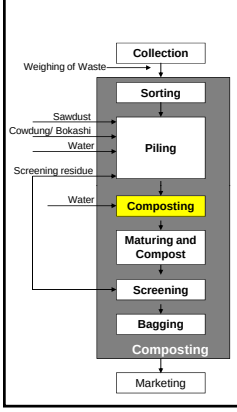
Unloading of Incoming Waste and Preliminary Sorting

Parameters to be Monitored During Implementation



Piling of Waste in the Pre-composting Box

Parameters to be Monitored During Implementation



Moisture Control
Reuse of leachate water

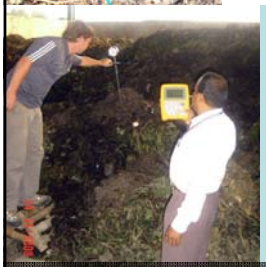
Parameters to be Monitored During Implementation

Temperature Control

Process Quality Control

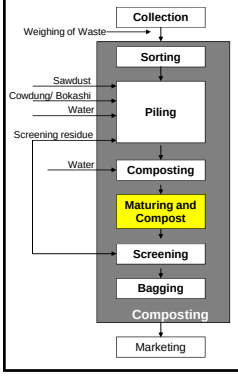
Forced Aeration by Blowers to Provide Oxygen in the Compost Pile

Process Quality Control



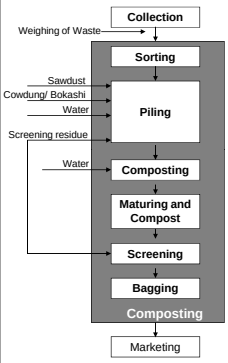
Regular Oxygen Monitoring

Different Steps of Composting Process



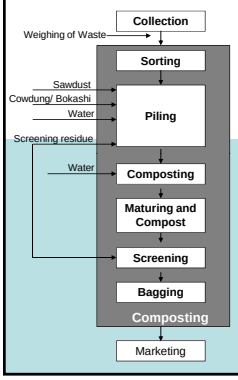
Maturing of Compost

Different Steps of Composting Process



Screening of Compost

Compost Produced from Organic Waste



IMPACT OF THE PROJECT

1 ton Organic Waste

Composting

Produce1/4 ton Compost

1 ton Organic Waste

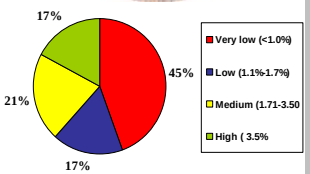
Composting

Reduce 1/2 ton Green House Gas

www.wasteconcern.org

SOIL CONDITION AND IMPACT OF COMPOST

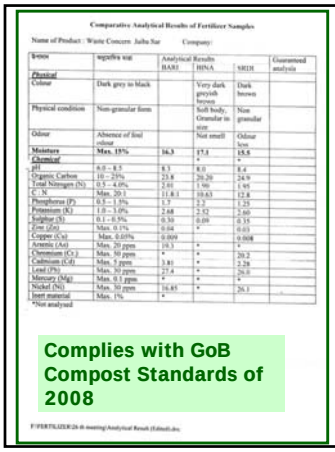
83% of cultivable land in Bangladesh has less than 3.5% organic matter (more than 3.5% is considered to be good soil)



Pie Diagram Showing Depletion of Organic Matter From the Soil of Bangladesh

FIELD TRIAL OF COMPOST PRODUCED BY WWR ON RICE FROM AUGUST TO NOVEMBER, 2008 Reduces the use of chemical fertilizer 25-30 increased yield 30%

Quality Control



Comparative Analytical Results of Fertilizer Samples

Name of Product : Waste Concern Jaiba Sar Company:

Items	Standard	Analytical Results BARI	HINA	SRDI	Guaranteed analysis
Physical					
Colour	Dark grey to black		Very dark greyish brown	Dark brown	
Physical condition	Non-granular form		Soft body, Granular in size	Non granular	
Odour	Absence of foul odour		Not smell	Odour less	
Moisture	**Max. 15%**	**16.3**	**17.1**	**15.5**	
Chemical			*	*	
pH	6.0 – 8.5	8.3	8.0	8.4	
Organic Carbon	10 – 25%	23.8	20.20	24.9	
Total Nitrogen (N)	0.5 – 4.0%	2.01	1.90	1.95	
C : N	Max. 20:1	11.8:1	10.63	12.8	
Phosphorus (P)	0.5 – 1.5%	1.7	2.3	1.25	
Potassium (K)	1.0 – 3.0%	2.68	2.52	2.60	
Sulphur (S)	0.1 – 0.5%	0.30	0.09	0.35	
Zinc (Zn)	Max. 0.1%	0.04	*	0.03	
Copper (Cu)	Max. 0.05%	0.009		0.008	
Arsenic (As)	Max. 20 ppm	10.3	*	*	
Chromium (Cr)	Max. 50 ppm	*	*	20.2	
Cadmium (Cd)	Max. 5 ppm	3.81	*	2.28	
Lead (Pb)	Max. 30 ppm	27.4	*	26.0	
Mercury (Mg)	Max. 0.1 ppm	*	*	*	
Nickel (Ni)	Max. 30 ppm	16.85	*	26.1	
Inert material	Max. 1%	*			

*Not analysed

Complies with GoB Compost Standards of 2008

Quality Control Laboratory

Working Condition

Informal sector working in unsafe working condition

Informal sector working in safe working condition

How Carbon Credit Can Help the Poor?

Input	Process	Output
➢**Collection** (Organic Waste From Markets and Residential Areas Free of Cost)	➢**Aerobic Composting**	➢**Compost** (50,000 tons/year)
➢**Saving** Municipal cost	➢**Saving** Landfill Area	➢**Carbon Credits** (89,000 ton Co2e/ year)
		➢**Producing** environment friendly product
Pro-poor element	**Pro-poor element**	**Pro-poor element**
➢**700 tons/ day** of waste collection Starting from 100 tons/day	➢**Creating 800 new jobs**	➢**Cheaper**
➢**Job Creation** 400 new jobs	➢**Focusing on Waste Pickers**	➢**Less Irrigation**
	➢**Health Insurance**	➢**Soil Quality Improved**
	➢**Daycare Center**	➢**Higher Crop Yield**
	➢**Free Meal**	➢**Leads to higher income**

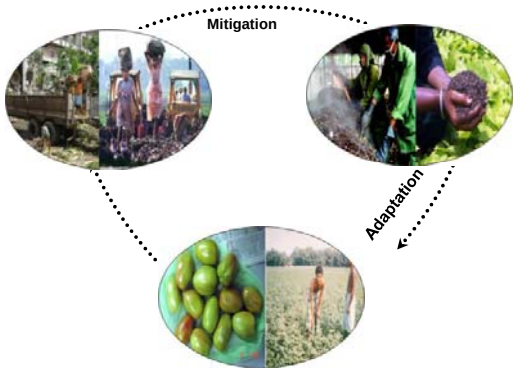
ACI Fertilizer: Largest Agro Product Marketing Company Marketing the Compost in Bangladesh

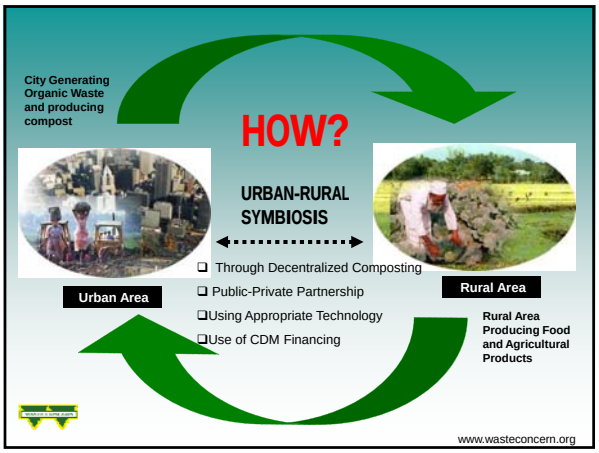
Decentralized Large Scale Compost Plant

Financial Aspect

- **130 tons/day capacity compost plant at Bulta**
- **Investment=** 2.5 million euro (land, construction, machinery and upfront investment for PDD preparation and validation and registration)
- **Operation cost =** 0.325 million euro/year
- **Compost production capacity =** 9000-10,000 tons/year
- **Selling Price of Compost** = 6000 taka/per or 60 euro per/ton
- **Income from sale of compost**= 0.54 million euro- 0.6 million euro
- **CERs**= 14000 tons/year
- **Income from sale of CERs** 14000 * 13 euro/ton = 0.18 million euro
- **Total income=** 0.72 million euro/year
- **Carbon credits=** 30% of the total income

Mitigation-Adaptation Loop





Key Lessons in Organic Waste Management in Bangladesh

Methodology for UNFCCC	For the first time methodology for composting organic waste developed by Waste Concern and its Dutch partner World Wide Recycling B.V which was approved by UNFCCC (AM 0025)
Clear Guideline on PPP	Clear Guideline on PPP (with roles and responsibilities). PPP should be win-win situation for each partners.
Income from Carbon Trading	Income from Carbon Trading (CER/VER) is an important incentive to promote waste related projects cost recovery. It can increase the revenue by 30%
Standard for Compost	Government Standard for Compost and Endorsement by Agriculture Department/Ministry is important for marketing of compost. Role of Ministry of Agriculture is very crucial.
Quality Control	Quality of Compost is very important for marketing.
Compost Testing Protocol	Role of the Ministry of Agriculture/Ministry of Environment in developing Field Application/test protocol for compost is necessary
Specialized Marketing Company	Involvement of private sector specialized in agro business in marketing of compost is needed
Source Segregation of Waste	Source Separation as well as proper sorting of waste is very important and it plays an important role in compost quality control.
Inclusion of Informal Sector	Inclusion of informal sector in waste related projects is important

Lessons Learnt

- ✓ **Clear-cut policy package, incentives, guidelines** needs to be promoted for 3R in most of the developing countries. (53 permissions were required to implement this project)
- ✓ **Appropriate Technology** are expensive, which should be subsidized by rich developed countries (for example technology transfer in CDM projects).
- ✓ **Easy financial support** should be promoted by bank/ financial organizations and incentives should be extended to 3R projects.
- ✓ **Capacity building training programs and research** on 3R required for both public and private sector
- ✓ **Public-Private-Community Partnership** needs to be promoted to bring in investment in 3R projects.
- ✓ **Informal sector** should to be given special attention in 3R initiatives.
- ✓ **Role of Media** needs be promoted to inform people and raise mass awareness on 3R.

Thank You