CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

Organic Waste Composting at Sylhet, Dhaka, Bangladesh

Submitted by World Wide Recycling B.V. the Netherlands and Waste Concern Bangladesh

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CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

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Organic Waste Composting at Sylhet, Dhaka, Bangladesh

A.2. Description of the project activity:

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The project objective is the realisation of a composting plant for organic wastes on a site in the capital Dhaka of the Peoples Republic of Bangladesh.

The project comprises the design and building of a composting plant for wastes from Dhaka city, with a maximum daily input capacity of 700 tonnes, according to proven standards. Apart from compost the project will realise methane reduction by diverting high organic waste from dumping at a landfill (where anaerobic process occurs) to a composting plant (aerobic process).
All landfills in Bangladesh are poorly controlled sites with no coverage or landfill gas extraction. Hence, the baseline is crude waste disposal without any precautions to avoid the emission of methane.

Based on investigations and calculations the project will realise some 619,000 tCO_2 equivalents over the 7-years period 2006 – 2012 (first crediting period). The investments will be realised during the period 2005 till 2007. Delivery of CERs will start from 2006 onwards.

Like other low-income cities of developing countries, waste generated in Dhaka is mostly organic in nature. Over 80% of the solid wastes consist of organic substances, which have a very high potential for bio-fertiliser (compost) production. The waste has high moisture content and density, making it heavy and unsuitable for incineration or long-distance transport, and it also contains substantial amount of dust and dirt, giving relatively small particle sizes. The material is suitable for aerobic composting. As such composting of this waste is an attractive option for resource recovery and environmental improvement. Uncontrolled dumping is prevented and highly demanded compost is generated that combats soil degradation that is a severe problem in Bangladesh. The project therefore contributes to a sustainable development. The plant will be semi-mechanised and will create jobs, in particular for less educated women.

The project will be the first larger scale composting site in Bangladesh on a commercial basis. As a pioneering effort by the project proponent, the project will contribute to the sustainable development of Bangladesh. The following environmental, economic and social benefits are achieved by executing the project:

1. Environmental benefits – assist in preventing uncontrolled GHG generation and emission from waste that would have been disposed at the landfill; production of soil improver (compost) to battle soil degradation[1];
2. Economical benefits – commercial composting on this scale is a new industrial activity for Bangladesh; foreign expertise and training (consultants and staff from a.o. the Netherlands for the initial stages of the project) to facilitate smooth technology transfer; foreign capital inflow for investment by the project proponent, World Wide Recycling from the Netherlands; (partial) replacement of imported chemical fertilizer by locally produced compost;
3. Social benefits –jobs for locals and staff training to improve skills of locals.

[1] Summary version of the final Hunger report: http://www.unmillenniumproject.org/documents/HTF-SumVers_FINAL.pdf; page 13 box 2.

A.3. Project participants:

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Project proponent/ Sponsor	**World Wide Recycling b.v.** (**WWR**) a Dutch private company and **Waste Concern** (**WC**) a Bangladeshi independent non-governmental organisation (NGO). They have formed a Special Purpose Company (SPC): World Wide Recycling Bio Fertilizer Bangladesh Ltd.
DNA	Government of the People's Republic of Bangladesh Department of Environment

Annex 1 provides more information on the project participants.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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Dhaka, Bangladesh

A.4.1.1. Host Party(ies):

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Peoples Republic of Bangladesh

A.4.1.2. Region/State/Province etc.:

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Dhaka greater area

A.4.1.3. City/Town/Community etc:

>>

Dhaka

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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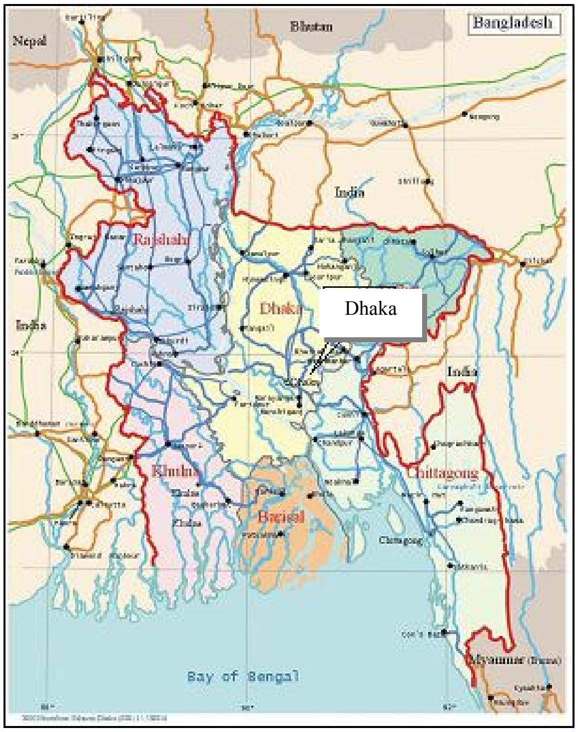
The composting plant for organic wastes will be erected at a site near Dhaka (see map in figures A-1 on next page).



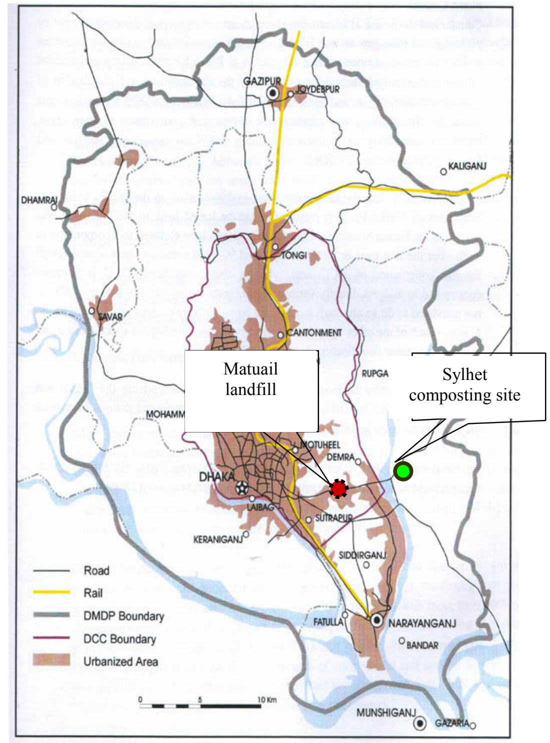


Figure A-1: Map of Bangladesh with location of the capital Dhaka
Figure A-2: Map of Dhaka with location of current landfill (Matuail) and composting site at Sylhet

A.4.2. Category(ies) of project activity:

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Project activity: 13 - Waste handling and disposal

A.4.3. Technology to be employed by the project activity:

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The technology proposed for the composting plant can be regarded as proven technology but new to Bangladesh. Technological or technical constraints are not expected. The chosen process can be characterized as follows:

- the first phase of the composting plant is designed for a processing capacity of 100 tons of organic waste input per day (2006), yearly scaled up to its final capacity of 700 tons of organic waste per day input (from 2009 onwards)[2];
- composting process in two stages: composting followed by maturing ;
- the pretreatment area and the composting area will be roofed, but the sides of the roofs will be open. The maturing area will be open;
- use of static pile system, with extended piles;
- type of aeration: forced blowing (overpressure) during composting process, natural aeration at the maturing area;
- centrally established aerators with piping under the composting piles
- regulation air flow by means of valves;

WWR has extensive knowledge of composting. It is related to the VAR through its shareholder. The VAR operates a 200.000 t/y composting site.
Waste Concern operates several small-scale composting plants that have been designed by Waste Concern and in use since 1995 in Bangladesh. It has extensive knowledge in managing waste project in Bangladesh. Details regarding experiences from Waste Concern with composting can be found at the website www.wasteconcern.org

Royal Haskoning (www.royalhaskoning.com), the engineering consultant of the project proponent, has designed several composting sites. Project references can be found at the Royal Haskoning website[3].

The know-how related to the applied technology and to the operation of the plant will be transferred to the host party since, in the future by far, the majority of the employees will be residents of the host-country.

Process steps
An overall scheme of the process is presented in the figure on the next page.

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[2] One ton of net input will result in approximately 300 kg of compost. The planned total gross input of 700 tons per day (200.000 tons per year) results in approximately 160 tons of compost per day(50.000 ton per year) plus 140 tons of non-organic per day. These figures are continuously monitored (see monitoring plan).
[3] Under the webpage of the Royal Haskoning website:
http://www.royalhaskoning.nl/?strMode=content&strUrl=/content/searchproject.aspx%3Frelated%3Dprojectlinks

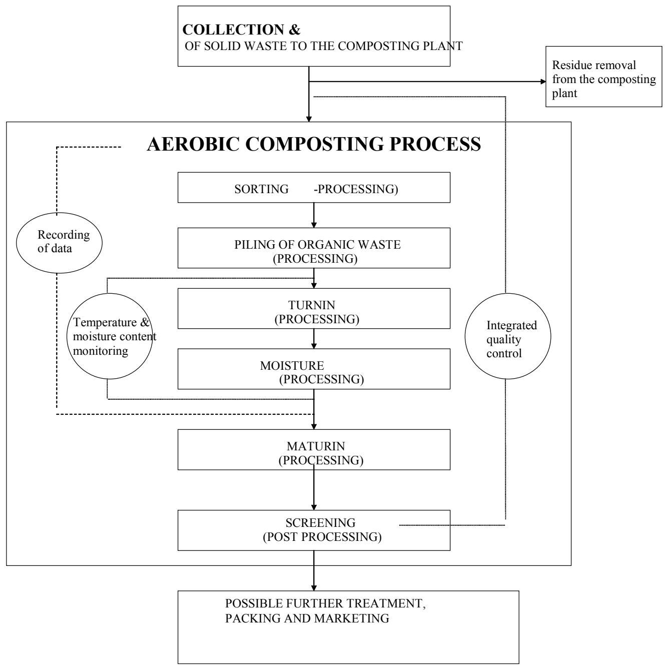

Figure A.3: Different steps in the composting process

Main part of the composting plant will be constructed and operated by Bangladesh parties. Training is foreseen in all stages of the implementation.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

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The project will divert organic waste from landfilling towards a composting plant. Instead of anaerobic conversion, resulting in – amongst others – methane production, the organic waste is aerobically degraded, producing only non-fossil CO_2, into a reusable product (compost). Landfilling results in landfill gas production that emits to the atmosphere in case the landfill is not covered, which in Bangladesh is the case.

By converting organic waste from land filling towards composting, landfill gas methane emissions are for 100% prevented. The prevented methane emission from the landfill that otherwise would occur is claimed as emission reductions (ER's).

Positive Leakage – The produced compost is used in the agriculture (where it is needed to combat soil erosion that is a severe problem in Bangladesh), reducing the need for (fossil) fertilisers. The emission reduction from displacing fertilisers and the emissions in the fertiliser production process are not claimed. The CERs related to the increased crop production (CO_2 fixing) thanks to the use of compost are note claimed either.

In Bangladesh there is no legislation enforcing the composting of organic waste. Since it is not obligated to collect the waste for composting or to collect/combust the landfill gas, the approach is to continue disposal of waste and as a consequence landfill gas will be generated and emitted directly into the atmosphere. Commercial large scale composting projects have not been implemented to date, because the initial barriers are to hard to overcome and there are not sufficient incentives to justify the risk involved in building composting plants in Bangladesh. The project will not be viable unless CDM assistance is acquired. The Project is additional in that emission reductions would not occur in the absence of the proposed CDM activity.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

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619,000 CER's over the period 2006 – 2012 (first crediting period).

A.4.5. Public funding of the project activity:

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The project proponents obtained a commitment for a grant from the Netherlands Development Finance Company (FMO), a special bank for developing countries set-up in 1970 by the government. This grant will come from the LDC Infrastructure Fund[4], a fund that is available for infrastructure projects that contribute to the development and/or improvement of social-economic infrastructure. In order to be eligible for funding, a project must meet FMO's standard criteria, outlined in Criteria & Procedures[5].

Via the LDC Infrastructure Fund, FMO supports the development and improvement of social-economic infrastructure in Least Developed Countries (LDCs). FMO aims to stimulate private investors to invest in private or public-private infrastructure projects in these countries.

Besides financial-economic performance, the projects are carefully scrutinized in terms of corporate governance, environmental and social policies and practices to ensure the sustainability of the investment.

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[4] http://www.fmo.nl/en/products/lcd.php

[5] http://www.fmo.nl/en/aboutfmo/criteria.php

In evaluating proposals, FMO considers the investment plan, a market analysis, a due diligence study, the expected returns and the commitment of management and co-financiers.
The LFC fund will grant a maximum of 45% of the project investments. These may be used for elements of a project that usually fall to a government (which fails to provide for it), or for covering one-time investments integral to the realization of the project but not contributing to its profitability.

The Dutch government does not claim or require any compensation for the provision of the grant in the form of Certified Emission Reductions. The LDC grant does not constitute a diversion of official assistance and is not counted towards any financial obligation from The Netherlands. The grant has been taken into account in the financial analyses under chapter B.2.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

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The approved methodology AM0025 for "avoided emissions from organic waste composting at landfill sites" is applied. Article 48b of the Marrakech agreement states: "Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment". Therefore it applies to this project as significant investments are involved that would not be made without CER revenue.

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

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The methodology AM0025 "avoided emissions from organic waste composting" will be applicable for this project.

The project meets all the applicability criteria as set out in the methodology, see B.2 below.

This methodology "avoided emissions from organic waste composting" is applicable to the following situations in regards to composting activities:

- the project activity involves a composting process in aerobic conditions.
- The proportions and characteristics of different types of organic waste can be determined in order to apply a multiphase landfill gas generation model in estimating the quantity of landfill gas that would have been generated in the absence of the project activity.

The project activity meets the criteria set out above and is therefore applicable. Since there are no regulatory requirements in the Bangladesh at present, the baseline scenario is that the waste will be disposed at the landfill and will generate landfill-gas that will be released to the atmosphere due to the lack of a landfill-gas capture system at landfills in Bangladesh.

B.2. Description of how the methodology is applied in the context of the project activity:

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To apply the methodology to this CDM project activity, the below steps are followed.

Step 1: Application criteria
The project activity involves waste originally intended for land filling will be composted hence the project activity avoids methane emissions by diverting organic waste from dumping at a landfill, that would have cause methane emissions by anaerobic processes,

The following conditions apply:

- the project activity involves a composting process in aerobic conditions
- The proportions and characteristics of different types of organic waste can be determined in order to apply a multiphase landfill gas generation model in estimating the quantity of landfill gas that would have been generated in the absence of the project activity.

The monitoring methodology for Avoided emissions from organic waste composting is used to monitor the emission reductions.

As stipulated by NM0090, the "tool for the demonstration and assessment of additionality" is applied in a conservative and transparent manner to show that CDM assistance is required for the project activity to be successfully implemented. Following the preliminary screening process, a convincing justification is provided to demonstrate that there is no plausible baseline scenario except the project activity and the continuation of key present policies and practices. An investment analysis is then presented to demonstrate that the project activity is additional. Next, a common practice analysis will be conducted to double-check the credibility of the investment/barrier analysis. Lastly, an explanation is offered as to how the impact of CDM registration will enable the Project to be successfully implemented.

The following steps from the "tool for the demonstration and assessment of additionality" will be completed below in section B.3.

Step 0 – Preliminary screening based on the starting date of the project activity
Step 1 – Identification of alternatives to the project activity consistent with current laws and regulations
Step 2 – Investment Analysis
Step 4 – Common Practice Analysis
Step 5 – Impact of CDM Registration

Step 2: Selection of baseline scenario
The appropriate baseline scenario shall be determined using Steps 1, 2 and 3 of the latest version of the "*Tool for the demonstration and assessment of additionality*" agreed by the Executive Board.[6]. See also D.1 of the New Baseline Methodology.

Step 3: Demonstrate and assess additionality
To demonstrate that the project activity is additional the latest version of the "*Tool for the demonstration and assessment of additionality*" agreed by the Executive Board is used. See also B-3.

Step 4: Calculation of emission reductions
The emission reductions are calculated using the following formula:

$$ER_y = BE_y – PE_y – L_y$$

Where:
ER_y : Emissions Reductions (t CO_2e) in year y
BE_y : Emissions in the baseline scenario (t CO_2e) in year y
PE_y : Emissions in the project scenario (t CO_2e) in year y
L_y : Leakage (t CO_2e) in year y

Step 4a: Emissions in the baseline scenario (BE_y)
To calculate BE_y the formulas as elaborated in the methodology "avoided emissions from organic waste composting" section regarding baseline emissions are used:

$$BE_y = (MB_y - MD_{reg,y}) * GWP_{CH4}$$

Where:
$BE_{,y}$: the baseline emission in year y (tCO_2e)
$MB_{,y}$: methane produced in the landfill in the absence of the project activity in year y (tCH_4)
$MD_{reg,y}$: methane that would be destroyed in the absence of the project activity in year y (tCH_4)
GWP_{CH4} : Global Warming Potential of methane (tCO_2e/ tCH_4)

Determination of MB_y

6 The latest version of the "Tool for the demonstration and assessment of additionality" is available on the UNFCCC CDM web site: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html> .

The amount of methane that is generated each year (MB_y) is calculated for each year with the multiphase model, according to the AM0025 methodology for "Avoided emissions from organic waste composting" The model calculates the methane generation based on the actual waste streams $A_{j,x}$ disposed in the most recent year (y) and all previous years since the project started (x=1 to x=y). The amount of methane produced in the year y (MB_y) is calculated as follows

$$MB_y = \varphi * 16/12 * F * DOC_f * MCF * \sum_{x=1}^{y} * \sum_{j=A}^{D} A_{j,x} * DOC_j * (1-e^{-k_j}) * e^{-k_j*(y-x)}$$

Where

MB_y	:	methane produced in the landfill in the absence of the project activity in year y (tCH_4),
φ	:	model correction factor (default 0.9) to correct for the model-uncertainties
F	:	is fraction of methane in the landfill gas
DOC_j	:	is percentage of degradable organic carbon (by weight) in the waste type j
DOC_f	:	is fraction *DOC* dissimilated to landfill gas
MCF	:	Methane Correction Factor (fraction).
$A_{j,x}$	:	amount of organic waste type j prevented from disposal in the year x (tonnes/year).
k_j	:	decay rates for waste stream type j
j	:	waste type distinguished into the waste categories (from A to D), as illustrated in table E7
x	:	is year during the crediting period; x runs from the first year of the first crediting period (x=1) to the year for which emissions are calculated (x=y)
y	:	is year for which LFG emissions are calculated

Calculation of φ (model correction factor)

Accordance to the AM0025, method for 'avoided emissions from organic waste composting', the value for the model correction factor *φ will be 0.9*

Calculation of F

F will be calculated with the following preferences:

1 measure F on annual basis as a monitoring parameter, at a landfill in the proximity o the composting plant, receiving comparable waste as the composting plant receives.

2 measure F once prior to the start of the project activity at a landfill in the proximity of the composting plant, receiving comparable waste as the composting plant will receive.

3 In case there is no access to the landfill the project proponent should apply the conservative default value of 0.5 (the lower end of IPCC range of 0.5 – 0.6.

Step 1 and Step 2 are not applicable to the baseline, hence *ex ante* the IPCC default value (0.5) of step 3 will be used. The value F is part of the monitoring plan (see annex 4), hence *ex post* step 1 will be used (measuring of F).

Determination of $MD_{reg,y}$

$MD_{reg,y} = MB_y * AF$

Where:

AF = Adjustment Factor in % of MB_y

The Adjustment Factor consists of two element that acknowledge that methane might be captured in the specific situation: (1) to address safety and odour concerns (2) to comply with regulations or contractual requirements:

Re 1: In the Matuail landfill situation currently no measures are in place to capture or destroy methane produced.

Re 2: In Bangladesh no policies or regulations what so ever are in place that oblige landfill operators to capture or destroy methane (REF)

Hence the AF factor will be 0% for the first crediting period. In accordance with the New Monitoring Methodology the $MD_{reg,y}$ and therefore the AF will be evaluated at the beginning of each crediting period.

Step4b: Emissions in the project scenario
To calculate project emissions PE_y the section "project emissions" of baseline methodology is used:

$$PE_y = PE_{elec,y} + PE_{fuel,\ on\text{-}site,y} + PE_{c,\ N2O,y} + PE_{c,\ CH4,y}$$

Where

PE_y	:	project emissions during the year y (tCO_2e)
$PE_{elec,y}$	:	emissions off-site from electricity consumption on-site in year y (tCO_2e)
$PE_{fuel,\ on\text{-}site,y}$	:	emissions on-site due to fuel consumption on-site in year y (tCO_2e)
$PE_{c,\ N2O,\ yy}$	:	emissions during the composting process due to N_2O production in year y (tCO_2e)
$PE_{c,\ CH4,y}$	:	emissions during the composting process due to methane production through anaerobic conditions in year y (tCO_2e)

$PE_{elec,y}$
The project activity will consume electricity. This electricity is taken from the grid. The GHG emission of electricity generation is therefore relevant.

$$PE_{elec} = kWh_e * CEF_{grid}$$

For $CEF_{grid:}$ To account for emissions of electricity generation the CEF of a diesel generator (0,8 tCO_2e/MWh) shall be used or the EF of the grid calculated according to Methodology ACM0002; "Consolidated baseline methodology for grid connected electricity generation from renewable sources",

For determination of Emission Factor (of the grid) the Approved Consolidated Baseline Methodology ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", which was approved on 3 September 2004, shall be applied.

See for the calculated values chapter E.1 and Annex 3.

$PE_{fuel,\ on\text{-}site}$
The emissions within the project boundary are related to vehicles used on-site. The (GHG) emission is calculated from the quantity of fuel used and the specific CO_2-emisison factor of the fuel. As follows:

$$PE_{fuel,\ on\text{-}site} = F_{cons,y}\ x\ \ NCV_{fuel}\ x\ EF_{fuel}$$

$PE_{fuel,\ on\text{-}site}$	:	CO_2 emissions due to on-site fule combustion in year y (tCO_2)

$F_{cons,y}$	:	fuel consumption on site in year y (l or kg)
CV_{fuel}	:	caloric value of fuel (MJ/l.)
D_{fuel}	:	density of fuel (kg//l.) according to IPCC
GWP_{fuel}	:	Global Warming Potential of fuel (tCO_2e/MJ) according to IPCC

See for the calculated values chapter E.1

N_2O emissions ($PE_{c,\ N2O}$)

N_2O emissions might be released during the composting process.
In accordance with AM0025, project participant applies a default emission factor of 0.086 kg N_2O per ton of compost and calculates the total N_2O emissions as follows:

$$PE_{c,\ N2O} = M_{compost} * EF_{c,N2O} * GWP_{N2O}$$

Where

$PEc,_{N2O}$	:	*is N_2O emissions from composting in year y (tCO_2e)*
$M_{compost}$	:	*is total quantity of compost produced in year y (tonnes/a)*
$EFc,_{N2O}$	:	*is emission factor for N_2O emissions from the composting process (t N_2O/t compost)*
GWP_{N2O}	:	*is Global Warming Potential of nitrous oxide (tCO_2/tN_2O)*

CH4 emissions ($PE_{c,\ CH4,y}$)

During composting process, aerobic conditions might not be completely reached in all areas and at all times. Pockets of anaerobic conditions may occur. The emission behaviour of these pockets is comparable with anaerobic situation in the landfill, Through sampling the percentage of waste that degrades under anaerobic circumstances will be determined and calculated in accordance with AM0025 as follows:

$$PE_{c,\ CH4,y} = MB_y * GWP_{CH4} * S_a$$

Where

$PE_{c,\ CH4,y}$	:	project methane emissions due to anaerobic circumstances in the composting process in year y (tCO_2e)
$S_{a,y}$	:	is share of the waste that degrades under anaerobic circumstances in the composting plant during year y (%)
MB_y	:	is quantity of methane that would be produced in the landfill in the absence of the project activity in year y (tCH_4)
GWP_{CH4}	:	is Global Warming Potential of methane (tCO_2e/tCH_4)

Calculation of $S_{a,y}$

To determine oxygen-content during the process, project participant will measure the oxygen content according to a predetermined sampling scheme and frequency. These measurements will be undertaken throughout the crediting period and recorded each year. The percentage of the measurements that show an oxygen content below 10% is presumed to be equal to the share of waste that degrades under anaerobic circumstances, hence the emissions caused by this share are calculated as project emissions ex-post on an annual basis:

$$S_a = S_{OD}/S_{total}$$

Where

S_{OD}	:	Number of samples per year with an Oxygen Deficiency (Oxygen below 10%)
S_{total}	:	Total number of samples taken per year, where S_{total} should be chosen in a manner that

ensures estimation of S_a with 20% uncertainty at 95% confidence level

See chapter E1 for the calculated values.

Step4c: Leakage (L_y)

The only source of leakage to be considered is the CO_2 emission form off-site transportation of waste materials due to a change in transport emissions. This would occur when it is likely that the transport emissions will increase significantly. Project participant will document the following:

- Overview of collection points from were waste will be collected,
- Approximate distance (in km) to the composting facility and existing landfills
- Approximate distance to the nearest end-user

The composting facility will be located at a site close to Dhaka. Currently waste is to be collected at Dhaka greater area and transported to Matuail, the official disposal site of the Dhaka City Corporation. Figure A2 shows the location for a composting site and the Matuail landfill. To transport waste to the composting site, compared to the landfill, an average additional distance should be considered and additional CO_2 emission is to be expected.

For transport of the compost to the end-user, additional CO2 emission is to be expected. Hence the following formula is applied:

$$L_y = \sum_{i}^{n} NO_{vehicles,i,y} * km_{i,y} * VF_{cons,\,i} * CV_{fuel} * D_{fuel} * EF_{fuel}$$

Where

L_y	:	CO_2 emission of vehicles (tCO_2e) in year y
$NO_{vehicles,i,y}$	:	number of vehicles type i for transport in year y
$km_{i,y}$	:	average additional distance travelled by vehicle type I compared to baseline in year y
$VF_{cons,i}$	:	Vehicle fuel consumption per kilometre of vehicle (l/km)
CV_{fuel}	:	caloric value of fuel (MJ/kg)
D_{fuel}	:	density of fuel (kg//l)
EF_{fuel}	:	Emission Factor of fuel (tCO_2e/MJ)

See for the calculated values chapter E.2

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

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The determination of project scenario additionality is done using the CDM consolidated tool for demonstration of additionality, which follows the following steps:

Step 0. Preliminary screening based on the starting date of the project activity

The project is only expected to start operation after registration with the UNFCCC. In any case, as it will be demonstrated in the following steps, CDM revenue has been considered from the early stages of development of the project, and it is an integral part of the financial package of the project.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

Alternative 1: The proposed CDM project activity: "Organic Waste Composting", not undertaken as a CDM project activity.Methane production would be avoided by breaking down organic matter through aerobic processes.

Alternative 2: Incineration of municipal solid waste (MSW). The high moisture content and low calorific content of waste in cities like Dhaka, means that at present incineration is not an efficient process for waste disposal[7]. Only in markets with low organic content (read: developed countries) or in specific situations (e.g. Island states) is incineration a real option, as in those situations the high investment and operational costs are not forming barriers anymore.

Alternative3: Disposal of the waste on a landfill with electricity generation using the landfill gas captured from the landfill site. In Bangladesh there is no legislation enforcing landfill gas extraction with or without utilisation or what-so-ever. Since no obligation exists to collect/combust LFG, collecting/combusting LFG will not be viable without CDM-assistance. In case of landfilling the approach is that the emission of LFG directly into the atmosphere will continue. See also the PDD "Landfill Gas Extraction and Utilisation at Matuail Landfill, Dhaka, Bangladesh"[8]

Alternative 4: Disposal of the waste on a landfill with delivery of gas captured from the landfill stie to nearby industry for heat supply. In Bangladesh there is no legislation enforcing landfill gas extraction with or without utilisation or what-so-ever. Bangladesh has relatively large natural gas reserves, which make it a relatively cheap fuel (8.5Taka per liter vs. 26 Taka per liter of Diesel – which enjoys approximately 50% subsidy on its own[9]!). Hence the investments in collection, cleaning and delivery systems pose large barriers for setting up such activities. Therefore the alternative – without CDM support is seen as not feasible.

Alternative 5: Disposal of the waste on a landfill with flaring of gas captured from the landfill. In Bangladesh there is no legislation enforcing landfill gas extraction with or without utilisation or what-so-

[7] UNEP - http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/index.asp chapter 1.5.1 and chapter 2.2. Topic d. Incineration – 6th paragraph.

[8] http://cdm.unfccc.int/Projects/Validation/view.html?ProjectId=926537053691881523&OE=SGS-UKL

[9] http://www.planetark.com/dailynewsstory.cfm/newsid/31116/newsDate/6-Jun-2005/story.htm "Bangladesh to use Natural Gas in Public Vehicles by the end of 2005" Mustak Hossain Reuters news service, Bangladesh: June 6, 2005

ever. Bangladesh has relatively large natural gas reserves, which make it a relatively cheap fuel (8.5Taka per liter vs. 26 Taka per liter of Diesel – which enjoys approximately 50% subsidy on its own[10]!). Hence the investments in collection and flaring pose large barriers for setting up such activities. Therefore this alternative – without CDM support is seen as not feasible.

Alternative 6: Continuation of the current situation.
Currently waste is dumped on the landfill, where organic matter is broken down through uncontrolled anaerobic processes, releasing all produced methane into the atmosphere.

Sub-step 1b. Enforcement of applicable laws and regulations:

All the alternatives comply with the laws and regulatory requirements for the project location.

Step 2. Investment Analysis

Sub-step 2a: Determine appropriate analysis method

According to the methodology for determination of additionality, if the alternative to the CDM project activity does not include investments of comparable scale to the project, then Option III (of the methodology tool) must be used. As this is the case for the project, Option III is applied here.

Sub-step 2b: Option III - Application of benchmark analysis

The likelihood of development of this project, as opposed to the continuation of its baseline will be determined by comparing its NPV with the benchmark of interest rates available to a local investor, i.e., those provided by local banks in the Host Country, which averages 12% (source: economic trends on www.bangladesh-bank.org[11])

Sub-step 2c: Calculation and comparison of financial indicators

The Tables below show the financial analysis for the project activity. As shown, the project NPV (without carbon) is negative, i.e. the project is unattractive compared to the interest rates provided by local banks in the Host Country.

Table B.1: Cashflow (€) of the project without carbon finance

2004	2005	2006	2007	2008	2009	2010	2011	2012
0	-1,296,493	-718,670	-876,810	-944,901	318,059	310,986	336,948	362,476

2013	2014	2015	2016	2017	2018	2019	2020	
387,547	367,299	381,750	211,637	165,301	394,005	439,839	524,505	

[10] http://www.planetark.com/dailynewsstory.cfm/newsid/31116/newsDate/6-Jun-2005/story.htm “Bangladesh to use Natural Gas in Public Vehicles by the end of 2005” Mustak Hossain Reuters news service, Bangladesh: June 6, 2005

[11] http://www.bangladesh-bank.org/pub/monthly/econtrds/econtrdsxv.html

Table B.2: Financial results of the project (Alternative 1) without carbon finance. NPV uses 14.5% discount rate.

	without CER
Net Present Value (US$)	-1,439,067
IRR	1.1%
Discount rate	12%

Summary of results of project analysis. Details made available to validator.

Assumptions:

- Discount rate: related to historical commercial lending fees (source: economic trends on www.bangladesh-bank.org[1]), assumed to be approx 12%.
- Inflation: based on historical data (Source: World Economic Outlook (WEO) -- September 2004 -- Statistical Appendix[12]) an average inflation rate of 5% has been assumed. For foreign currency an average inflation rate of 2% has been assumed.
- Currency devaluation rate: Local currency to hard currency devaluation has been assumed to be 4.5% (source: International Monetary Fund – country report No. 04/27 February 2004, page 18, Figure 2, top left graph).

Sub-step 2d: Sensitivity analysis

A sensitivity analysis was conducted by altering the following parameters:

- Increase in project revenue
- Reduction in project capital (CAPEX) and running costs (Operational and Maintenance costs).

Those parameters were selected as being the most likely to fluctuate over time. Financial analyses were performed altering each of these parameters by 10%, and assessing what the impact on the project IRR would be (see Table below). As it can be seen, the project IRR remains lower than its alternative even in the case where these parameters change in favour of the project.

Table B.3: Sensitivity analysis

Scenario	**Discount Rate (%)**	**IRR (%)**	**NPV (€) (optional)**
Original	12%	1.1%	-1,439,067
Increase in project revenue by 10%	12%	6.6%	-756,948
Reduction in project costs by 10%	12%	4.4%	-1,016,422
Original under different discount rate	10%	1.1%	-1,348,540
	14%	1.1%	-1,492,407

Note: NPV uses 12% discount rate.

Step 3. Barrier Analysis

Hereafter the relevant key factors are discussed. Each of the factors described below indicates how it influences the baseline development for the Bangladesh composting project and the GHG emissions at project activity level.

[12] http://www.imf.org/external/pubs/ft/weo/2004/02/pdf/statappx.pdf , table 11, page 216.

Key factor 1 – the likely development or adaptation of the Bangladesh legislation regarding landfill management

Legal framework

The most relevant parts of the legal framework for disposal of waste in Bangladesh are:

- Law on Reduction of the harmful impact of waste upon the environment. In this law, there are no requirements for landfill gas recovery nor for reduction of organic content in waste.
- Environmental Conservation Act 1995 (ECA '95) and the Environmental Conservation Rules 1997 (ECR '97) of the Government of Bangladesh. The ECA '95 and ECR '97 give definitions, instructions how to handle wastes, emission limits and guidelines regarding the (screening for the need of a detailed) Environment Impact Assessment. In none of these documents landfill gas extraction is mentioned.

Envisaged implementation framework

The implementation of the legal framework is determined by three factors: (1) availability of securing necessary financial resources, (2) the adoption and implementation legislation and (3) the resolving of existing market barriers for large–scale composting in Bangladesh.

(1) Availability of securing necessary financial resources.
The Bangladesh waste sector is fully municipality driven. There are no private entrepreneurs involved. Although the need for privatisation is recognised, it is not likely that this process will take place soon. Composting without additional revenues (for instance from selling emission reductions) can be made feasible as was proven by Waste Concern with financial support of UNDP and service clubs, though this need skills. Municipalities do not have sufficient knowledge and financial resources to provide the necessary investments into separate collection and subsequent processing (composting) and marketing. The main reasons for this are waste taxes that are still too low and do not generate sufficient income to the municipalities. (Besides, the Bangladesh Government will need additional financial resources for the set up of proper waste management systems and a/o remediation and/or closure of existing and partly illegal landfills).

Given the current state of Government (incl. the municipalities) finances it is unlikely that the Government of Bangladesh will be able to provide considerable subsidies for the implementation of separate collection systems for (green) organic wastes and composting.

(2) Legislation
Although there is a general policy to simulate re-use of wastes in Bangladesh there is no legislation enforcing landfill covering, landfill gas extraction, organic waste composting or what-so-ever.

(3) Market barriers.
Since this is the first large -scale composting project in Bangladesh, it faces a number of market barriers. Economic unattractiveness, lack of technical know-how and lack of availability of equipment are the most important. The implementation of this project will assist Bangladesh in demonstrating the practice of large scale composting that could assist the country in meeting the objectives regarding re-use of waste.

Key factor 2 – economic developments

Due to population growth and expected economic growth in the coming years, the production of wastes will increase and directly result into higher amounts of waste to be disposed. The result will be an increasing pressure on scarce land for landfilling. In 1995 the waste generation in all the urban areas of Bangladesh was 10,700 Mton/day and is projected to reach 47,000 Mton/day in 2025. It is estimated that the present waste generation in all the urban areas of Bangladesh is 17,000 Mton/day.

The businesses of the project partners and financial strength of the project are described extensively by the Business Plan and do not represent a factor of relevance that might influence the baseline and the project.

Step 4. Common Practice Analysis

Sub-step 4a. Analyse other activities similar to the proposed activity

To date there has been limited development of composting projects in the Host Country. Waste Concern, one of the project participants, is also founder of the "Community based composting" projects. These small scale composting projects have been set-up at different locations in greater Dhaka area. Total volume is 500 ton/ year of compost (compared to the 50.000 ton/ year this CDM proposed project will produce. No other composting activities are known.

Sub-step 4b Discuss any similar options that are occurring

There are no similar options. The current 'community based composting' projects (see above) are strongly financially supported by UNDP and service clubs, and are very small scale. The 35+ operations involve approximately 100 people and produce 500 ton/year. The Sylhet Composting project will provide work for over 400 people and produce 50.000 ton/ year.

Step 5. Impact of CDM registration

As shown in Step 2 above, the project is unlikely to move forward without the additional financial support of the CDM. If the developer was able to sell emission reduction credits from the project activity at an assumed price of U$ 3.00 dollars per ton of CO_2e, the additional revenue generated by carbon sales would be sufficient to make the project go ahead (see Table in Step 2c above).

Table B.4: Impact on CDM registration (entire project duration).

	with CER
Net Present Value (US$)	-187,750
IRR	10.5%
Discount rate	12%

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

>>

The project boundary is the composting-site where waste will be brought in and treated

The flow chart in figure B.1 shows the main components and connections including system boundaries of the project. The flowchart excludes processes beyond control or influence of the project, but includes the relevant beyond control processes to generate secondary energy carriers.

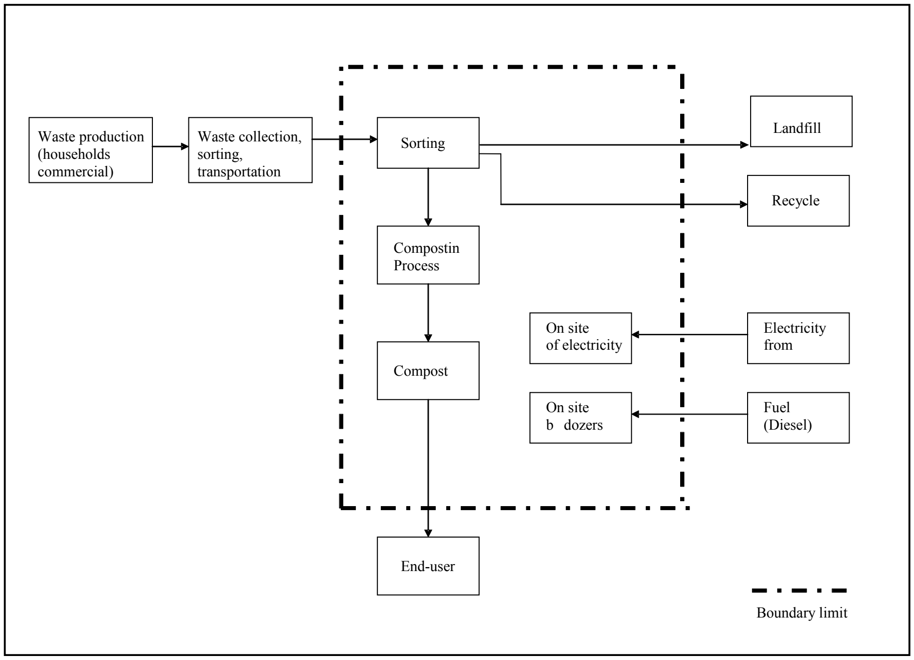


Figure B.1: System boundaries of composting project

Table B.5: Overview of emissions sources included or excluded from project boundary and baseline

	Source	*Gas*		*Justification/Explanation*
Baseline	*Emissions from decomposition of waste at the landfill site*	*CH4*	*Included*	*The major source of emissions in the baseline*
		N2O	*Excluded*	*N2O emissions are small compared to CH4 emissions from landfills. Exclusion of this gas is conservative*
		CO2	*excluded*	*CO2 emissions from the decomposition of organic waste are not accounted*
Project-activity	*On-site fossil fuel consumption due to the project activity*	*CO2*	*Included*	*May be an important emission source*
		CH4	*Excluded*	*Excluded for simplification. This emission source is assumed to be very small*
		N2O	*Excluded*	*Excluded for simplification. This emission source is assumed to be very small*
	Emissions from on site electricity use	*CO2*	*Included*	*May be an important emission source*
		CH4	*Excluded*	*Excluded for simplification. This emission source is assumed to be very small*
		N2O	*Excluded*	*Excluded for simplification. This emission source is assumed to be very small*
	Direct emissions from the composting process	*CO2*	*Excluded*	*CO2 emissions from the decomposition of organic waste are not accounted*
		CH4	*Included*	*The composting process may not be completely aerobic and result in anaerobic decay*
		N2O	*Included*	*May be an important emission source*

NOTE:CO_2 *emissions from the combustion or decomposition of biomass are not accounted as GHG emissions. Where this under a CDM project activity results in a decrease of carbon pools, such stock changes should be considered in the calculation of emission reductions. This is not the case for waste treatment projects.*

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

>>

The baseline study was concluded in September 2005 by the project participants World Wide Recycling, and Waste Concern. They were supported by Royal Haskoning.

The person and entity are listed in Annex 1.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The time line of the project is as follows:

- Project starting date : November 1st 2005
- Construction starting date : May 1st 2006
- Construction finishing date : Nov 1st 2006 (first phase), end of 2008 (last phase)
- Start operating of equipment : December 1st 2006 (starting with 100 tonnes input per day (2006), up scaling to 200 t/d (2007) and 400 t/d (2008) and 700 t/d by 2009 (and onwards)

C.1.2. Expected operational lifetime of the project activity:

>>

The composting plant will continue to operate up to at least 2027.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>

01/11/2006

C.2.1.2. Length of the first crediting period:

>>

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

Not applicable

C.2.2.2. Length:

>>

Not applicable

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>>

Methodology AM0025, dated 14 September 2005, "Avoided emissions from organic waste composting at landfill sites'

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

This methodology "avoided emissions from organic waste composting" is applicable to the following situations in regards to composting activities:

- the project activity involves a composting process in aerobic conditions.
- The proportions and characteristics of different types of organic waste can be determined in order to apply a multiphase landfill gas generation model in estimating the quantity of landfill gas that would have been generated in the absence of the project activity.

The project activity meets the criteria set out above and is therefore applicable. Since there are no regulatory requirements in the Bangladesh at present, the baseline scenario is that the waste will be disposed at the landfill and will generate landfill-gas that will be released to the atmosphere due to the lack of a landfill-gas capture system at landfills in Bangladesh.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. kWh_e	Electricity consumptio n	KWh meter	kWh	M	continuous	100%	Electronic during the crediting period and two years after	Data will be aggregated monthly and yearly
2 CEF_{elec}	Electricity emission factor	Published data of authorities	tCO2e/Mw h	C	Annually		Electronic	Calculated according to ACM0002 or as diesel default factor
3 F_{cons}	Fuel consumptio n	Invoices for fuel purchase	liters	C	continuous	100%	Electronic during the crediting period and two years after	Data will be aggregated monthly and yearly
4 $M_{compost,y}$	Compost produced	Plant records	tonnes	M	Discontinou s	100%	Electronic during the crediting period and two years after	The produced compost will be trucked off from site. All trucks leaving site will be weighed. Possible temporary storage of compost will be weighed as well or not taken in to account for calculated carbon credits.
5 S_a	Share of samples anearobic		%	C	Weekly	See S_{total}	Electronic	Used to determine percentage of material that degrades anaerobically
6 S_{OD}	Number of samples	Oxygen measurement	number	M	Weekly	See S_{total}	Electronic	Samples with oxygen content <10%. Weekly measurements throughout the year, but

	with oxygen deficeincy	device						accumulated once per year only.
7 S_{total}	Number of samples		number	M	Weekly	Statistically significant	Electronic during the crediting period and two years after	Total number of samples taken per year, where S_{total} should be chosen in a manner that ensures estimation of S_a with 20% uncertainty at 95% confidence level

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

All formulas applied in this PDD are described and explained in Baseline Methodology AM0025 “Avoided emissions from organic waste composting at landfill sites” Therefore reference is made to this Methodology.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
8 MD_{reg} or AF	Methane destroyed due to regulatory or other requirements	Local and/or national authorities	% or tonnes	E	Annually	100%	Electronic, during the crediting period and two years after	Changes in regulatory requirements, relating to the baseline landfill(s) need to be monitored in order to update the adjustment factor (AF), or directly MD_{reg} . This is done at the beginning of each crediting period.
9 A_x	Total quantity of waste supplied to compost plant in the year x	Weighbridge	tonnes	M	Discontinuous	100%	Electronic, during the crediting period and two years after	Determine fraction of each waste stream of total waste input to the composting plant

10. $P_{j,x}$	Share of different types of organic waste	Sampling, sorting, weighing	% of A_x	M	Quartely	See note below	Electronic, during the crediting period and two years after	Determine fraction of each waste stream of total waste input to the composting facility
11 F	Methane fraction of landfill gas	Calculated	% methane (CH_4) by weight	M	Annually, or at the start of the project	1 measurement per year	Electronic, during the crediting period and two years after	Monitoring depends of the accessibility of this data coming from landfill in proximity of the composting plant. If no suitable landfill data is available, then a default value of 0.5 will be applied

P_j: To adequately determine the share of each fraction of waste, the project proponent should start with 4 samples per year (once every quarter). The size and frequency of sampling should result in a statistically significant mean with a maximum uncertainty range of 20% at a 95% confidence level.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

All formulas applied in this PDD are described and explained in Baseline Methodology AM0025 “Avoided emissions from organic waste composting at landfill sites” Therefore reference is made to this Methodology.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Not applicable.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

Not applicable.

D.2.3. Treatment of leakage in the monitoring plan

In the table below, the leakage variables are described. Only the variable related to the number of vehicles needs to be recorded continuously. To ensure that the recorded number is correct, it will be verified that the number of vehicles matches with the amount of sold compost. The other two variables are annually estimated and verified by the validator.

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
12 $NO_{vehicles}$	Vehicles per carrying capacity per year	Counting	number	M	discontinuous	100%	Electronic, during the crediting period and two years after	Counter should accumulate the number of trucks per carrying capacity
13 KM_y	Additional distance travelled	Expert estimate	km	E	annually	100%	Electronic, during the crediting period and two years after	

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

All formulas applied in this PDD are described and explained in Baseline Methodology AM0025 “Avoided emissions from organic waste composting at landfill sites” Therefore reference is made to this Methodology.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

The emission reductions can be calculated using the following formula:

$ER_y = BE_y – PE_y – L_y$

Where:

ER_y: Emissions Reductions in year y (t CO_2e)
BE_y: Emissions in the baseline scenario in year y (t CO_2e)
PE_y: Emissions in the project scenario in year y (t CO_2e)
L_y: Leakage in year y (t CO_2e)

If the sum of PE_y and L_y is smaller than 1% of BE_y in the first full operation year of a crediting period, the project participant is obliged to apply a fixed percentage of 1% for PE_y and L_y combined for the remaining years of the crediting period.

The formulae used to calculate emission reductions are provided in baseline methodology.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1 kWh_e	Low	kWh-meter will be subject to regular maintenance and testing to ensure accuracy (in accordance with instructions of the meter supplier). The readings will be double checked by the electricity distribution company
2 CEF_{elec}	Low	Calculated as per ACM0002 at start of crediting period (or take default value for diesel generator)
3 F_{cons}	Low	The amount of fuel will be derived from the paid fuel invoices (administrative obligation)
4 $M_{compost,y}$	Medium	Weighed on calibrated scale; also cross check with sales of compost
5 S_a	Medium	O_2 measurement-instrument will be subject to periodic calibration (in accordance with instructions of instrument supplier). Measurement itself to be done by a standardised mobile gas detection instrument. A statistically
6 S_{OD}	Medium	

7 S_{total}	Medium	significant sampling procedure will be set up that consists of multiple measurements throughout the different stages of the composting process according to a predetermined pattern (depths and scatter) on a daily basis
8 MD_{reg}	Medium	Data are derived from or based upon local or national guidelines, so QA/QC-procedures for these data are not applicable.
9 A_y	Low	Weighbridge will be subject to periodically calibration (in accordance with instructions of the weighbridge supplier)
10 P_{jx}	Low	Regular sorting & weighing of waste (initially quarterly) by project proponent will be carried out. Procedures will be checked regularly by a certified institute/DOE
11 F	Low	Analyser will be calibrated regularly by a certified institute (in accordance with instructions of the meter supplier)
12 $NO_{verhicles}$	Medium	Number of vehicles must match with total amount of sold compost. Procedures will be checked regularly by DOE
13 KM	Medium	Assumption to be approved by DOE

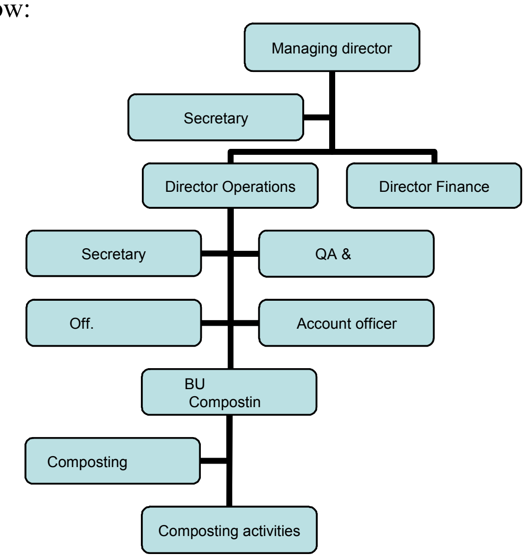
In addition to secure aerobic conditions of the composting process parameters (temperature, oxygen, pH) are monitored. The DOE assess the validity of this procedure.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

The Project Proponents will erect a Special Purpose Company (SPC) for the project and will be shareholders of the company and will seat in the board of directors.

The SPC structure will be as follow:



The Business Unit Manager Composting is responsible for the activities related to implementation of the procedures as described in the monitoring plan (see annex 4). The QA & QC officer will report directly to the Director Operations. He will carry out the internal audits and the quality control and quality assures procedures as described in the monitoring plan.

D.5 Name of person/entity determining the monitoring methodology:

>>

The baseline study was concluded in September 2005 by the project participants World Wide Recycling, and Waste Concern. They were supported by Royal Haskoning.

The person and entity are listed in Annex 1.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>

Reference is made to table B.5 “overview of emissions sources included in or excluded from the project boundary and baseline”

$$PE_y = PE_{elec,y} + PE_{fuel,\ on\text{-}site,y} + PE_{c,\ N2O,y} + PE_{c,\ CH4,y}$$

Where

PE_y	:	project emissions during the year y (tCO_2e)
$PE_{elec,y}$	:	emissions off-site from electricity consumption on-site in year y (tCO_2e)
$PE_{fuel, on-site,y}$	:	emissions on-site due to fuel consumption on-site in year y (tCO_2e)
$PE_{c, N2O, yy}$	:	emissions during the composting process due to N_2O production in year y (tCO_2e)
$PE_{c, CH4,y}$	:	emissions during the composting process due to methane production through anaerobic conditions in year y (tCO_2e)

In the following paragraphs these parameters will be calculated:

$PE_{elec,y}$ Project emissions off site from electricity consumption on site

The project activity will consume electricity. This electricity is taken from the grid. The GHG emission of electricity generation is therefore relevant.

$PE_{elec} = kWh_e * CEF_{grid}$

For $CEF_{grid:}$ To account for emissions of electricity generation the CEF of a diesel generator (0,8 tCO_2e/MWh) shall be used or the EF of the grid calculated according to Methodology ACM 0002; “Consolidated baseline methodology for grid connected electricity generation from renewable sources”,

For determination of Emission Factor (of the grid) the Approved Consolidated Baseline Methodology ACM0002: ”Consolidated baseline methodology for grid-connected electricity generation from renewable sources”, which was approved on 3 September 2004, shall be applied.

In Annex 3, the emission factor has been calculated for Bangladesh. The calculated emission factor (EF) is 0.63173, Therefore this value is applied as CEF_{grid}.

The on site installed electrical capacities are indicated in table E.1 and these values are used to calculate ex ante the project-emissions. These values will be replaced by the ex-post values from the kWh-measurements.

Table E.1: Electricity consumption on-site

Machine	Number of machines	Installed electrical capacity [kW]	Load factor	Operating [hours/ year]	Electricity consumption [kWh/year]
Sieve	2	15	75%	4,000	90,000
Blowers	4	20	75%	8,000	480,000
Other waste-treatment facilities	1	5	75%	4,000	15,000
Lighting etc.		2	100%	4,000	8,000
				Total	593,000

$PE_{elec} = kwh_e * CEF_{grid} = 593{,}000\ kWh * 0.00063\ tCO_2e/kWh = 373.6\ tCO_2$

Hence $PE_{elec,y} = 374\ tCO_2/y$

***$PE_{fuel, on-site}$* Project emission from fuel use on site**

The emissions within the project boundary are related to any on-site fuel combustion. The emission is calculated from the quantity of fuel used and the specific CO_2-emisison factor of the fuel. Below the *ex ante* calculations:

$PE_{fuel,\ on\text{-}site} = F_{cons,y} * NCV_{fuel} * EF_{fuell}$

Table E.2: Used values for emissions calculation related to vehicles used on-site

Parameter	**Description**	**Value**
$F_{cons,y}$	Fuel (diesel) consumption (l.) on site in year y	2006: 131,400 l (3 wheel loaders) 2007: 131,400 l (3 wheel loaders) 2008: 175,200 l (4 wheel loaders) 2009 onwards: 262,800 l (6 wheel loaders)
NCV_{fuel}	Caloric value of fuel (MJ/l.)	36.295 MJ/l (42.7 MJ/kg with 1 l = 0.85 kg),
EF_{fuel}	Global Warming Potential of fuel (diesel) (tCO_2e/MJ) according IPCC	0.0000741 tCO_2 /MJ

Note: estimated fuel consumption per wheel loader will be around 120 l/day, 365 days/year = 43,800 l/wheel loader/yr

For the full scale situation:
$PE_{fuel,\ on\text{-}site} = F_{cons,y} * NCV_{fuel} * EF_{fuel}$ *= 262,800 l * 36,295 MJ/l * 0.0000741 kg/MJ = 707 tonnes per year*

The CO_2 emissions of the project activity on-site are calculated to be 589 tonnes per year for the full scale situation, which is 700 t waste input per day. This figure will be used in this PDD, for actual project emissions, the actual fuel consumptions will be monitored for *ex post* CER calculations.

***$PE_{c,\ N2O}$* Project emission from composting**

Emissions of N_2O during the composting process

$PE_{c,\ N2O} = M_{compost} * EF_{c,N2O} * GWP_{N2O}$

Table E.3: Used values for N_2O emissions from composting

Parameter	**Description**	**Value**
$M_{compost,}$	Total quantity of compost produced in year y (tonnes/a)	2006: 12700 t/y (100 t/d input) 2007: 25400 t/y (200 t/d input) 2008: 50800 t/y (400 t/d input) 2009 onwards: 88900 t/y (700 t/d input)
$EF_{c,\ N20l}$	Emission factor for N2O emissions from composting process	0.000086 t N_2O/tcompost
GWP_{N2O}	Global Warming Potential of nitrous oxide (tCO_2e/tN_2O	310 tCO_2/tN_2O
$PE_{c,N2O}$		2006: 339 tCO_2e 2007: 677 tCO_2e 2008: 1354 tCO_2e

		2009 onwards: 2370 tCO_2e

Note: From 1 ton of waste normally 300-350 kg of compost can be made. In this table project proponent calculates with 350 kg of compost made from 1 ton of waste

$PE_{c, CH4}$ Project emission from composting

The project methane emissions due to anaerobic circumstances in the composting process in year y are to be calculated with the formula below ($PE_{c, CH4}$ in tCO_2e):
$PE_{c,CH4} = MB_y * GWP_{CH4} * S_a$

Where

$PE_{c, CH4,y}$: project methane emissions due to anaerobic circumstances in the composting process in year y (tCO_2e)

Currently no data is available. Ex ante a S_a 2% will be applied in this PDD. Ex post this value will be replaced by the result of actual measurements on site (see instructions in chapter B.2 under calculation of MD_{reg} of this PDD).

Table E.4: Used values for N_2O emissions from composting

Parameter	**Description**	**Value**
MB_y	Quantity of methane that would be produced in the landfill in the absence of the project activity in year y (tCH_4)	Calculated with the multiphase model for each year y
$S_{a,y}$	Share of the waste that degrades under anaerobic circumstances in the composting plant during year y (%)	2% (see note)
GWP_{CH4}	Global warming Potential of methane (tCO_2e/tCH_4)	21

Note: From 1 ton of waste normally 300-350 kg of compost can be made. In this table project proponent calculates with 350 kg of compost made from 1 ton of waste

E.2. Estimated leakage:

The only source of leakage to be considered is the CO_2 emission form off-site transportation of waste materials due to a change in transport emissions. This would occur when it is likely that the transport emissions will increase significantly. Project participant will document the following:

- Overview of collection points from were waste will be collected,
- Approximate distance (in km) to the composting facility and existing landfills
- Approximate distance to the nearest end-user

The composting facility will be located at the Sylhet site, close to Dhaka. Currently waste is to be collected at Dhaka greater area and transported to Matuail, the official disposal site of the Dhaka City Corporation. Figure A2 shows the location of the Sylhet composting site and the Matuail landfill. To transport waste to the composting site, compared to the landfill, an average additional distance should be considered and additional CO_2 emission is to be expected.

For transport of the compost to the end-user, additional CO_2 emission is to be expected. Hence the following formula is applied:

$$L_y = \sum_{i}^{n} NO_{vehicles,i,y} * km_{i,y} * VF_{cons,i} * CV_{fuel} * D_{fuel} * EF_{fuel}$$

Where

L_y	:	CO_2 emission of vehicles (tCO_2e) in year y
$NO_{vehicles,i,y}$	:	number of vehicles type i for transport in year y
$km_{i,y}$	:	average additional distance travelled by vehicle type I compared to baseline in year y
$VF_{cons,i}$	:	Vehicle fuel consumption per kilometre of vehicle (l/km)
CV_{fuel}	:	caloric value of fuel (MJ/kg)
D_{fuel}	:	density of fuel (kg//l)
EF_{fuel}	:	Emission Factor of fuel (tCO_2e/MJ)

The values used are shown in table E.4.

Table E.4: Used values for leakage emissions calculation related to additional transport of waste and to transport of compost

Parameter	Description	Value
	For compost	
$NO_{vehicles}$	number of vehicles used for transport of compost	2006: 12,700 t/y = 1,270 vehicles 2007: 25,400 t/y = 2,540 vehicles 2008: 50,800 t/y = 5,080 vehicles 2009 onwards: 88,900 t/y = 8,890 vehicles Based on 10 ton/vehicle
KM_{av}	average distance to transport compost (in kilometres to end-user(s))	50 km + 50 km return The assumed average distance is 50 km from the project activity site. This value will be monitored.
	Additional transport of waste	
$NO_{vehicles}$	number of vehicles used for transport of raw waste to composting plant	2006: 36,500 t/y = 3,650 vehicles 2007: 73,000 t/y = 7,300 vehicles 2008: 146,000 t/y = 14,600 vehicles 2009 onwards: 255,500 t/y = 25,500 vehicles Based upon 10 ton/truck
KM_{av}	average additional distance from centre Dhaka to Sylhet composting plant compared to Matuail landfill-site (see figure A.3)	15 km + 15 km return The assumed average distance of 20 km is a fixed value during the run-time of the project (unless final location of composting site differs from the currently proposed site)
	Data applicable for both types of transport; compost and waste	
VF_{cons}	fuel consumption (l.) per kilometre of vehicle	15 l./100 km
D_{fuel}	Density of fuel (kg//l.)	0.85 kg/l

CV_{fuel}	Caloric value of fuel (MJ/kg)	42.7 MJ/kg
EF_{fuel}	Emission Factor of fuel (kg CO_2e/GJ) according IPCC	74.1 kg CO_2e/GJ = 74.1 * 10^{-6} tCO_2/MJ

Application of above parameters in the appropriate formula gives the results from table E.5

Table E.5: Leakages in the project:

Transport	**Trucks with compost**	**Trucks with waste**	**Total**
2006	51.2 tCO_2	44.2 tCO_2	95.4 tCO_2
2007	102.5 tCO_2	88.3 tCO_2	190.8 tCO_2
2008	204.9 tCO_2	176.7 tCO_2	381.6 tCO_2
2009 onwards	358.6 tCO_2	309.2 tCO_2	667.8 tCO_2

E.3. The sum of E.1 and E.2 representing the project activity emissions:

Sum of project-emissions, calculated under E1 and project leakages, calculated under E2 are indicated in table E.6The emissions due to anaerobic situation are not included in this list.

Table E.6: Resulting project emissions and leakages in first crediting period tCO_2e (excl $PE_{c, CH4}$)

Year	**Project emissions**				**Leakages**	**Total**
	PE_{electr}	PE_{fuel}	$PE_{c, N2O}$	$PE_{c, CH4}$	L_y	
2006	374	353	339	PM	95	1161
2007	374	353	697	PM	191	1615
2008	374	471	1354	PM	382	2581
2009	374	707	2370	PM	668	4119
2010	374	707	2370	PM	668	4119
2011	374	707	2370	PM	668	4119
2012	374	707	2370	PM	668	4119
Total 2006-2012						**21833**

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

To calculate the emissions in the baseline scenario BE_y the formulas as elaborated in baseline methodology are used:

$$BE_y = (MB_y - MD_{reg,y}) * GWP_{CH4}$$

Where:
Where:
$BE_{,y}$: the baseline emission in year y (tCO_2e)
$MB_{,y}$: methane produced in the landfill in the absence of the project
activity in year y (tCH_4)
$MD_{reg,y}$: methane that would be destroyed in the absence of the project activity in year y (tCH_4)

GWP_{CH4} : Global Warming Potential of methane (tCO_2e/ tCH_4)

Determination of MB_y

The amount of methane, expressed in tCH_4, that is generated each year (MB_y) is calculated for each year with the multiphase model, according to the AM0025 methodology for "Avoided emissions from organic waste composting" The model calculates the methane generation based on the actual waste streams $A_{j,x}$ disposed in the most recent year (y) and all previous years since the project started (x=1 to x=y). The amount of methane produced in the year y (MB_y) is calculated as follows

$$MB_y = \varphi * 16/12 * F * DOC_f * MCF * \sum_{x=1}^{y} * \sum_{j=A}^{D} A_{j,x} * DOC_j * (1 - e^{-k_j}) * e^{-k_j * (y-x)}$$

Where:

Parameter	Description	Value
Φ	model correction factor (default 0.9) to correct for the model-uncertainties	0.9
F	is fraction of methane in the landfill gas	0.5 (most conservative value, might be replaced by site values from the Matuail landfill, the value F is part of the monitoring plan)
DOC_j	Percentage of degradable organic carbon (by weight) in the waste type j	See table E.7.
DOC_f	fraction *DOC* dissimilated to landfill gas. See sub section E.1 from New Baseline Methodology	0.77 (IPCC default value)
MCF	Methane Correction Factor (fraction) see table E.1 from New Baseline Methodology	0.8 (unmanaged site, deeper than 5 meters) See Annex 3 for further background information.
$A_{j,x}$	amount of waste (ton/year) prevented from disposal.	See table E.7
K	Decay rates for waste type j	See table E.7
X	Year during the crediting period; x runs from first year of first crediting period (x=1) to year for which emissions are calculated (x=y).	x =1 to y
Y	Is year for which LFG emissions are calculated	
J	Waste type distinguished into the waste categories from A to D	See table E.7 below.

Table E.7: Amount of waste, composition (waste type), decay rates and DOC_j -values

		WASTE STREAMS				
Year	**Mixed A-E**	**A; Paper & textiles**	**B :Garden & park waste a.o.**	**C: Food waste**	**D: Wood and straw waste**	**E: Inert**
DOC_j values		40%	17%	15%	30%	0%
Decay rates		0.023	0.023	0.231	0.023	0

(k-values)						
	t/yr	**t/yr**	**t/yr**	**t/yr**	**t/yr**	**t/yr**
2006	36,500	0	3.650	32.850	0	0
2007	73,000	0	7.300	65.700	0	0
2008	146,000	0	14.600	131.400	0	0
2009	255,500	0	25.550	229.950	0	0
2010	255,500	0	25.550	229.950	0	0
2011	255,500	0	25.550	229.950	0	0
2012	255,500	0	25.550	229.950	0	0

The main parts of the calculations with the multiphase model, using the above setpoints are shown in annex 3. The results are summarized in the table below. The net prevented CO2 emissions do take into account a fraction of 2% of the incoming waste that degrades anaerobic (S_a = 2%).

Table E.8: results of the calculations

Year		$BE_y - PE_{c,CH4}$ (t CO2e)	Project -emissions (PE_y) and –leakages (L_y) in t CO2e, except $PE_{c,CH4}$		$ER_y = BE_y - PE_y - L_y$ (tCO2e)
			emissions	**leakages**	
2006		7,840	1,066	95	6,679
2007		21,922	1,404	191	20,327
2008		48,818	2,199	382	46,237
2009		93,762	3,451	668	89,643
2010		129,570	3,451	668	125,451
2011		158,123	3,451	668	154,004
2012		180,914	3,451	668	176,795
2006-2012					**619,136**
2013		199,130	3,451	668	195,011
2014		213,712	3,451	668	209,593
2015		225,406	3,451	668	221,287
2016		234,805	3,451	668	230,686
2017		242,380	3,451	668	238,261
2018		248,505	3,451	668	244,386
2013-2018					**1,339,224**
2019		253,476	3,451	668	249,357
2020		257,529	3,451	668	253,410
2021		260,851	3,451	668	256,732
2022		263,590	3,451	668	259,471
2023		265,865	3,451	668	261,746
2024		267,768	3,451	668	263,649
2019-2024					**1,544,365**
2025		269,374	3,451	668	265,255

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

See section E.4

E.6. Table providing values obtained when applying formulae above:

See section E.4

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The project involves the implementation and operation of a composting plant in Dhaka. It does not use any scarce resources (like water); it doesn't produce any solid waste nor emissions to water and soil. The (limited number of) vehicles (one or two dozers) do produce local combustion gases. The main environmental negative component can be NOx that is an acidifying gas. The engines of the vehicles however, will comply with US and Western European emission standards; therefore the amount emitted is very limited. The electricity used on-site causes elsewhere off-site pollution connected to electricity generation in inefficient power stations. The amount of electricity used is, however, relatively little and therefore the off-site emissions.

Composting can have some local environmental impact, mainly odour emissions. Odour reduction techniques are applied. The composting plant is envisaged to be located near an existing landfill site. At an existing landfill site, the odour emissions will not contribute significantly.

Soil erosion in Bangladesh is a severe problem. Compost can improve the soil condition and will improve crop production. Compost is therefore in great demand and contributes to a better environment.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

In brief, the project might have a slight negative environmental impact during the operational phase: being odour emission. However this emission is compensated by prevented emissions from the landfill.

No impacts during the construction phase are expected

Environmental legislation

The legislation in force are the Environmental Conservation Act 1995 (ECA '95) and the Environmental Conservation Rules 1997 (ECR '97) of the Government of Bangladesh.

The Department of the Environment (DOE) of the Ministry of Environment and Forests (MOEF), headed by the Director General, is the Regulatory Body responsible for enforcing the ECA '95 and ECR '97.

There is a three-tier approach to be followed regarding the Environmental Impact Assessment (EIA).

1. *Screening*
   As per ECR '97, a normative screening procedure is to be followed according to which industries/activities/projects have been divided into four categories viz. Green, Orange A, Orange B and Red;
2. *Initial Environment Examination (IEE)*
   All industries/activities and projects in Orange B and Red categories have to conduct an IEE which helps in understanding the potential extent of environment changes and in finding ways to mitigate by considering the available information, or past experience or standard operating practices. The steps for conducting IEE are:
   - collection of baseline information in respect of the project and the environmental setting of the project and its site;
   - setting of boundaries of an IEE by identifying the significant issues;

- impact assessment, suggestion of mitigation measures, Environment management plan (EMP) or alternative or other project modifications;
- in the event that the IEE of the project reveals that further investigation is to be carried out then the developer will have to carry out a detailed EIA;

3. *Detailed EIA*
   The detailed EIA should be focused on addressing the issues, which remains unresolved in the IEE.
   The steps involved in conducting an EIA are as follows:
   a. Baseline studies – this is usually divided into two sections:
      1: studies related to the project (site selection, mass and energy balances, product storage and transport, list of machinery and equipment emission and ways of treatment etc.);
      2: impact identification (list of key sources on environment, detailed impacts, etc);
   b. Evaluation to determine whether mitigation of pollution or the proposed project will be required;
   c. Mitigating measures (changing of site, process, operation, disposal routes etc).

Screening

The screening of the Composting project reveals that this type of project in not mentioned in one of the lists. Mentioned are however, in the Red list, “domestic/commercial wastes” elements of the project. No specification is given about the size or whatsoever. The size of the plant is however such that one might expect that it falls in category “Red”.

Initial Environment Examination (IEE)

In section E the project boundaries, the environmental setting of the project and its site are given.

The environmental impact is given above in chapter 1. Apart from some local combustion emissions of vehicles, the impact might only be odour. This might result in the need for a detailed EIA.

Environmental impact assessment

As mentioned before, for composting there is might be a requirement of a detailed EIA report. The site is not yet exact known; therefore the actual need cannot be addressed. This will be done as soon as this is known.

In case a detailed EIA is required this will be done during the design phase. Any recommendation from the EIA will be implemented in the design.
The screening and the Initial Environment Examination reveal that there might be a need for a detailed Environmental Impact Assessment.

References

(1) Environmental Conservation ACT, Government of Bangladesh, 1995
(2) Environmental Conservation Rules, Government of Bangladesh,1997
(3) National Policy for Safe Water & Sanitation. Local Government Division, Ministry of Local Government Rural Development & Co-operatives, Dhaka, 1998

SECTION G. Stakeholders’ comments

The project is planned at the site in Sylhet in Dhaka. The site is situated some 20 km east from the city centre. In the project area the major stakeholders are:

a. Local population - they comprise of the local people around the project area. The role of the local people is as a beneficiary of the project because a large number of (low-qualified) jobs will be created for them. On the other hand they might experience some odour emissions from the compost plant;

b. Citizens of Dhaka – as they experience large amounts of wastes being dumped in the streets of Dhaka that will be addressed by the separate collection of (some) Wastes;

c. Dhaka City Corporation (DCC) (a self government institution) - as they are the owner of the site and might also participate in the operation of the plant – however they are also project proponent. Thereby their stakes will be represented through separate agreements (Contract);

d. Map Agro Ltd. – they are the buyer of the compost. There is a written formal agreement between Map Agro and WWR/WC to market the compost produced.

Stakeholders of the c and d categories will see their stakes secured through bilateral contracts with the project participants. For the stakeholders from the a and b categories a local stakeholder consultation process has been held.
The entire process of carrying out the local stakeholder consultation has been done in a participatory manner. The project developer has used consultative techniques such as Participatory Rural approach to assess the views and needs of the local stakeholders. The project, during its operation will try to adhere, as far as possible and relevant, to the requirements of the local stakeholders from the project.

G.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

Through advertisements (see Appendix 1) stakeholders were invited to come to an information meeting at the BRAC Center in Dhaka on February 12, 2005

45 participants from government offices, academics, non-governmental organizations, media groups, local residents, development partners and private sector were present in the meeting.

Minutes of Meeting (MoM) was prepared in which all questions, remarks etc. were recorded. Appendix 1 contains the Minutes of Meeting.

G.2. Summary of the comments received:

>>

Questions were related to the technology applied, the role of DCC, the CDM procedures etc. No questions were raised on environmental topics.

Mr. Khursheedul Islam, a consultant working for Energy Project in Bangladesh, suggested to form a group or forum who will actively involve to encourage this type investment and for initiation of more this type projects and also to look after on going projects and the progress work in this regard. Overall there was agreement that the proposed project was a beneficial project from sustainability view point.

Pictures G.1 to G.4: Photo's made during the Stakeholder assessment

G.3. Report on how due account was taken of any comments received:

>>

The project proponents will take the suggestion up and will inform the stakeholders regularly on the progress of the projects at Matuail landfill site.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Represented by:	
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First Name:	Mohammed
Department:	Environment
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Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The Netherlands Development Finance Company (FMO) is a special bank for developing countries, and was set-up in 1970 by the Dutch government. For this project, FMO released a preliminary funding proposal consisting of a grant element and a long term loan element, both from the so-called LDC Fund[13]. Both facilities would be bound by ODA-requirements. The grant element is being contemplated for two reasons: 1) making an non-economic sustainable project economic sustainable, and 2) providing back-up funding in case not enough commercial banks would be interested in financing the project after it has been made economic viable. Apart from fulfilling ODA-requirements as regulated by the OECD in Paris, allowing the Netherlands to register outgoing funds from the LDC Fund as official development aid, the LDC Fund has no further requirements from any state entity. It operates independently under a contract between the state and FMO. In the analysis of the underlying credit, however, FMO will not make differences between income sources. The more income the project generates the higher the likelihood commercial banks will be interested to participate and therefore the grant might be lowered.

In order to be eligible for funding, a project must meet FMO's standard criteria, outlined in Criteria & Procedures[14]. Via the LDC Infrastructure Fund, FMO supports the development and improvement of social-economic infrastructure in Least Developed Countries (LDCs). FMO aims to stimulate private investors to invest in private or public-private infrastructure projects in these countries. Besides financial-economic performance, the projects are carefully scrutinized in terms of corporate governance, environmental and social policies and practices to ensure the sustainability of the investment. In evaluating proposals, FMO considers the investment plan, a market analysis, a due diligence study, the expected returns and the commitment of management and co-financiers. The LDC Fund might grant a maximum of 45% of the project investments with a maximum of project cost of Euro 45 million. These may be used for elements of a project that usually fall to a government (which fails to provide for it), or for covering one-time investments integral to the realization of the project but not contributing to its profitability.

The Dutch government does not claim or require any compensation for the provision of the grant in the form of Certified Emission Reductions. In fact, it isn't determined yet who will be the buyer of the CERs. Therefore, at forehand, the LDC grant does not result in a diversion of official development assistance and is separate from and is not counted towards any financial obligation from The Netherlands. The grant has been taken into account in the financial analyses under chapter B.2.

The contact person for the LDC fund at the FMO is Mr. Marc Buiting, m.buiting@fmo.nl.

[13] http://www.fmo.nl/en/products/lcd.php

[14] http://www.fmo.nl/en/aboutfmo/criteria.php

Annex 3

BASELINE INFORMATION

Methane correction factor (MCF)

The methane correction factor (MCF) accounts for the fact that unmanaged landfills produce less methan from a given amount of waste than managed landfills, because a larger fraction of waste decomposes aerobically in the top-layers of unmanaged landfills. The proposed default values for MCV are listed in table Annex 3.1:

Table Annex 3.1: Solid waste disposal Site (SDWS) Classification and Methane correction Factors

Type of site	MCF default values
managed site	1.0
Unmanaged site – deep (> 5 m waste)	0.8
Unmanaged site – shallow (< 5 m waste)	0.4
Note: Managed SDWS must have controlled placement of waste (i.e. waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include some of the following: cover material, mechanical compacting or levelling of waste	

Source: table 5.1 in the 2000 IPCC Good Practice Guidance

In this particular case, the waste would have been disposed at the landfill of Matuail. The landfill of Matuail can be considered as an unmanaged landfill, since most of the criteria indicated in the note of table Annex 3.1 are lacking. However the landfill of Matuail has a height of more than 10 meter and can thus be considered as a deep landfill, hence the MCF in this case should be 0.8.

Calculation of EF in according to the approved ACM0002 method

PE_{elec} Project emissions of electricity production in the grid

The Approved Consolidated Methodology ACM0002: "Consolidated methodology for grid-connected electricity generation from renewable sources", which was approved on 3 September 2004, is applied for determination of the emission factor (EF) of the grid.

Step 1 of ACM0002 is calculation of the Operating Margin emission factor ($EF_{OM,y}$), based on one of the four following methods:

a. Simple OM, or
b. Simple adjusted OM, or
c. Dispatch data Analyses OM, or
d. Average OM.

The Bangladesh Power Development Board (BPDB) publishes annually about the electricity production in the grid. Relevant copies of the year 2003 FY (2003-2004) are attached in annex 3.

The ACM0002 indicates that method c should be the first methodological choice. However method c is not appropriate for this project for the following reasons:

- No information is available regarding the grid system dispatch order of operation for each power plant of the system
- No information is available regarding the amount of power (MWh) that is dispatched from all plants in the system during each hour that the project activity is operating.

The composition of the electricity generation park in Bangladesh is such that low-cost/must run power plants are not present (see annex). 90% of the electricity generated is based on gas as fuel. Almost 5% is

fuel oil based. The remainder is hydro. Method a or b is therefore not appropriate. Therefore method d is applied (the average OM).
The average OM is calculated as the average emission factor rate of all power plants including low-cost/must run power plants.

The average OM, as the simple OM, can be calculated using either of the two following data vintages:

- a 3-years average, based on the most recent statistics available at the time of PDD submission;
- the year in which project generation occurs, if $EF_{OM,y}$ is updated based on *ex-post*.

The second option, $EF_{OM,y}$ is updated based on ex-post information, is selected.

Step 2: Calculate the Build Margin emission factor ($EF_{BM,y}$) as the generation-weighted average emission factor of a sample of power plants. The sample group consists of either:

- the five power plants that have been built most recently, or
- the power plants capacity additions in the electricity system that comprises 20% of the system generation (in MWh) and that have been built most recently.

The sample group that comprises the larger annual generation shall be used.

The first option, the five power plants that have been built most recently, is used (see table annex 3.5 (copy of spreadsheet) in annex 3).

In line with Step 1, an *ex-post* calculation will be applied. The required data will be available as it is an obligation of BPDB to publish the data in their annual report. Normally BPDB publishes its annual report within six month after end of the year.

Step 3: Calculated the baseline emission factor EF_y as the weighted average of the OM emission factor ($EF_{OM,y}$) and the Build Margin factor ($EF_{BM,y}$):

$EF_y = w_{OM}.\ EF_{OM,y} + w_{BM}.\ EF_{BM,y}$
where the weights w_{OM} and w_{BM} by default are 50%.

For the most recent year (2003) the steps 1 to 3 have been applied, according ACM0002, in the table in annex 3 (table Annex 3.5).

In accordance with ACM0002 leakages (like related to construction activities) are not considered. This results in a baseline emission factor of the electricity park in Bangladesh for the year 2003 of 0.63173 tCO_2/MWh (see table Annex 3.5 in Annex 3, which also contains relevant copies of annual report of BPDB FY 2003-2004).

Table Annex 3.5 contains the determination of EF (y = 2003) of the grid in Bangladesh (ref to ACM0002).

Table Annex 3.5: Calculated emission factor of the grid in most recent year (2003, FY 2003-2004) according ACM0002

year 2003 — Power plant data (source BPDB)

No.	Name of plant		fuel source	Commissioning period	Installed capacity (in MW)	Derated capacity (in MW)	Type of plant	(A_1) Fuel consumption Natural gas ($x10^6$ Nm^3)	(A_2) Fuel consumption liquid fuel ($x10^6$ ltr)	(B) Caloric net vaule (MJ/Nm^3 or MJ/ltr) *	(C) CO_2 emissionfactor ($t CO_2/GJ$) **	(D) oxydatiefactor (IPCC %)	AxBxCxD Emission (tCO_2/yr)	Electricity generated (MWh)	average ($t CO_2/MWh$)
1	Karnafuli	2 x 40 + 3 x 50 MW	hydro	1962-1968	230	220	Steam turbine				0.0000		0.00	803,113.00	
2	Ashuganj	2 x 64 MW ST	Gas	1970	128	100	Steam turbine	234.00		35.37	0.0561	99.50%	462,032.72	712,033.00	
	Ashuganj	3 x 150 MW ST	Gas	1986-1988	450	450	Steam turbine	676.91		35.37	0.0561	99.50%	1,336,557.99	2,313,792.00	
	Ashuganj	GT 1	Gas	1982	56	45	Gas turbine	40.43		35.37	0.0561	99.50%	79,828.99	80,440.00	
	Ashuganj	Combined cycle	Gas	1984	34	}				35.37	0.0561	99.50%	0.00	69,958.00	
	Ashuganj	GT 2	Gas	1986	56	67	Gas turbine	106.23		35.37	0.0561	99.50%	209,751.01	211,134.00	
3	Shanhjibazqar	7 x GT	Gas	1968-1969	96	68	Gas turbine	106.89		35.37	0.0561	99.50%	211,054.18	123,701.00	
	Shanhjibazqar	70 MW GT	Gas	2000	70	70	Gas turbine	30.56		35.37	0.0561	99.50%	60,340.68	84,770.00	
4	Sylhet	1 x 20 MW ST	Gas	1986	20	20	Gas turbine	23.31		35.37	0.0561	99.50%	46,025.57	49,807.00	
5	Fenchuganj	ST/CC	Gas	1994-1995	90	90	Gas turbine	147.70		35.37	0.0561	99.50%	291,633.47	450,050.00	
6	Ghorasal	2 x 55 MW ST	Gas	1974-1976	110	80	Steam turbine	85.38		35.37	0.0561	99.50%	168,582.71	211,861.00	
	Ghorasal	2 x 210 MW ST	Gas	1986-1889	420	420	Steam turbine	570.80		35.37	0.0561	99.50%	1,127,043.92	1,868,528.00	
	Ghorasal	2 x 210 MW ST	Gas	1994-1999	210	210	Steam turbine	515.96		35.37	0.0561	99.50%	1,018,762.41	1,699,654.00	
7	Siddhirghanj	1 x 50 MW ST	Gas	1970	50	46	Steam turbine	51.45		35.37	0.0561	99.50%	101,587.96	171,476.00	
8	Haripur	2 x 33 MW ST	Gas	1987	99	96	Gas turbine	201.53		35.37	0.0561	99.50%	397,920.74	446,039.00	
9	Chittagong	1 x 60 MW ST	Gas		60	50	Steam turbine	80.97		35.37	0.0561	99.50%	159,875.17	213,035.00	
	Chittagong	2 x 28 MW ST	Gas		56	52	Gas turbine	0.71		35.37	0.0561	99.50%	1,401.89	2,091.00	
10	Rauzan	1 x 210 MW ST	Gas	1993	210	180	Steam turbine	324.20		35.37	0.0561	99.50%	640,132.51	1,050,800.00	
	Rauzan	1 x 210 MW ST	Gas	1997	210	180	Steam turbine	230.21		35.37	0.0561	99.50%	454,549.37	739,500.00	
11	Khulna	1 x 100 MW ST	FO	1984	110	35	Steam turbine		192.31	39.99	0.0774	99.00%	589,079.87	668,788.00	
	Khulna	1 x 60 MW ST	FO	1973	60	55	Steam turbine		15.85	39.99	0.0774	99.00%	48,551.38	49,196.00	
	Khulna	2x 28 MW ST	SKO	1980	56	21	Steam turbine		12.50	37.28	0.0733	99.00%	33,831.09	32,562.00	
12	Baghabari	GT	Gas	1991	71	71	Gas turbine	146.47		35.37	0.0561	99.50%	289,204.84	407,323.00	
	Baghabari	GT	Gas	2001	100	100	Gas turbine	227.96		35.37	0.0561	99.50%	450,106.75	642,310.00	
13	Bherramara	3 x 20 MW ST	HSD	1976-1980	60	54	Gas turbine		42.52	37.49	0.0741	99.00%	116,886.54	101,455.00	
14	Thakurgaon	7 x 1.5 MW Diesel	LDO	1966	4.5	2.5	Diesel engine		0.43	37.61	0.0741	99.00%	1,185.94	1,666.00	
15	Saidpur	3 x 3.75 MW Diesel	LDO		3.75	0	Diesel engine		0.00	37.61	0.0741	99.00%	0.00	0.00	
	Saidpur	1 x 20 MW ST	HSD	1987	20	18	Gas turbine		13.04	37.49	0.0741	99.00%	35,846.67	31,033.00	
16	Barisal	2 x 20 MW ST	HSD	1984-1987	40	36	Gas turbine		27.65	37.49	0.0741	99.00%	76,009.24	64,601.00	
	Barisal	9 x Diesel units	HSD	1975-1980	2.6	1.5	Diesel engine		5.02	37.49	0.0741	99.00%	13,799.87	5,607.00	
17	Rangpur	1 x 20 MW ST	HSD	1988	20	18	Gas turbine		12.14	37.49	0.0741	99.00%	33,372.59	27,574.00	
18	Bhola	Diesel unit	HSD	1988	1.5	}	Diesel engine		0.88	37.49	0.0741	99.00%	2,419.10	2,702.00	
	Bhola	Diesel unit	FO	1975-1980	6	4	Diesel engine		1.01	39.99	0.0774	99.00%	3,093.81	2,692.00	
	total grid				3210.35	2860		3,801.67	323.35				8,460,469.00	13,339,291.00	0.63425
	5 most recent build power plants				680	650		1152.39	0				2275392.682	3616284	0.62921
															0.63173

* (local) caloric values and density applied as indicated in the BPDB-report

** IPCC values are applied
- HSD, LDO as diesel oil have an emission factor of 20.2 tC/TJ
- FO as fuel oil has an emission factor of 21.1 tC/TJ
- SKO"is considered as 'other oil' with an emission factor of 20.0 tC/TJ
  mass conversion factor 44/12 (tCO_2/tC)

Table with baseline data of Electricity Park in Bangladesh (below follow relevant copies from Bangladesh Power Development Board (BPDB) annual report FY 2003-2004):

BPDB Net generation	12583.3270	MKWh
Total Private Net Generation	7478.1746	"
Total Net generation	20061.5016	"
Total Private Net generation + BPDB Gross Generation	20820.5713	"

POWER PLANT WISE YEARLY SUMMARY STATISTICS (Provisional) FY2003-2004 **Page No. - 3**

Total generation (System) :		Energy:		Per Unit Fuel Cost :		Total Cost :		Fuel Consumption :		Per Unit Fuel Consumption		Heat Rate :		Efficiency (%)
Steam Turbine	(N.Gas/FO)	9698.6645	Gwh	0.891	Taka/kwh	8640.2406	Million Taka					2619.396	Kcal/kwh	32.83
Steam Turbine	(N.Gas)	8980.6803	"	0.762	"	6841.7712	"	97806.859	Million cuft.	10.891	cu.ft/kwh	2607.259	"	32.99
Steam Turbine	(F.Oil)	717.9842	"	2.505	"	1798.4694	"	208.157	Million lit.	0.290	litre/kwh	2771.202	"	31.04
Gas Turbine	(N.Gas/HSD/SKO)	2093.7091	"	1.923	"	4025.9409	"					3601.940	"	23.88
Gas Turbine	(N.Gas)	1836.4844	"	1.046	"	1921.3784	"	27467.154	Million cuft.	14.956	cu.ft/kwh	3580.557	"	24.02
Gas Turbine	(HSD/SKO)	257.2247	"	8.182	"	2104.5625	"	107.8546	Million lit.	0.419	litre/kwh	3754.612	"	22.91
Gas Turbine	(HSD)	224.6625	"	8.428	"	1893.4090	"	95.3542	"	0.424	"	3803.039	"	22.62
Gas Turbine	(SKO)	32.5622	"	6.485	"	211.1535	"	12.5004	"	0.384	"	3420.487	"	25.14
Diesel	(HSD/LDO/FO)	15.7681	"	6.068	"	95.6890	"	7.3374	"	0.465	"	4208.598	"	20.44
Diesel	(HSD)	11.4102	"	6.809	"	77.6964	"	5.8991	"	0.517	"	4632.475	"	18.57
Diesel	(LDO)	1.6659	"	5.138	"	8.5599	"	0.4292	"	0.258	"	2315.847	"	37.14
Diesel	(FO)	2.6920	"	3.504	"	9.4327	"	1.0092	"	0.375	"	3583.258	"	24.00
Combined Cycle	(Gas)	731.1417	"	0.858	"	627.2251	"	8966.526	Million cuft.	12.264	cu.ft/kwh	2935.937	"	29.29
Hydro		803.1133	"											
								134240.538	Million cuft.					
Total (Excluding Hydro)		12539.2835	"	1.068	"	13389.10	" (Total)	323.3492	Million lit.			2803.909	"	30.67

Total Generation (System) : By type of Fuel :		Energy:		Per Unit Cost :		Total Cost :		Fuel Consumption :		Per Unit Fuel Consumption		Heat Rate :		Efficiency (%)
Gas =		11548.3064	Gwh	0.813	Taka/kwh	9390.37	Million Taka	134240.538	Million cuft.	11.624	cu.ft/kwh	2782.848	Kcal/kwh	30.91
FO =		720.6762	"	2.509	"	1807.9021	"	209.166	Million lit.	0.290	litre/kwh	2774.235	"	31.00
HSD =		236.0727	"	8.350	"	1971.1054	"	101.253	"	0.429	"	3843.129	"	22.38
SKO =		32.5622	"	6.485	"	211.1535	"	12.500	"	0.384	"	3420.487	"	25.14
LDO =		1.6659	"	5.138	"	8.5599	"	0.429	"	0.258	"	2315.847	"	37.14
Hydro =		803.1133	"											
Total (Excluding Hydro)		12539.2835	"	1.068	"	13389.10	"					2803.909	"	30.67
Gas =	(86.6)	11548.3064	Gwh	0.813	Taka/kwh	9390.3747	Million Taka	134240.54	Million cuft.	11.624	cu.ft/kwh	2782.848	Kcal/kwh	30.91
Liquid Fuel =	(7.4)	990.9770	"	4.035	"	3998.7209	"	323.3492	Million lit.	0.326	lit./kwh	3049.334	"	28.21
Hydro =	(6.0)	803.1133	"											

POWER PLANT WISE YEARLY SUMMARY STATISTICS (Provisional) FY2003-2004 Page No. - 1

Date : 27-07-04

Sl. No.	Name of power plant	Type of fuel	Installed Capacity (MW)	Generation Derated Capacity (MW)	Gross Energy Generation (GWH)	Fuel consumed (Mill.Cft./ Mill.Litre)	Fuel Cost (Million Taka)	Station use (GWH)	Station use % of gross Generation	Annual Plant factor (%)	Fuel consumed per unit generation. (cu.ft./kwhr litre/kwh)	Per unit Fuel Cost Taka/kwh	Average Heat rate Kcal/kwh	Efficiency (%)
1	Karnafuli Hydro(2x40 MW+3x50 MW)	Hydro	230	220	803.1133			2.7298	0.34	39.86				
	Ashuganj 2x64 MW Steam Turbine	Gas	128	100	712.0331	8262.8578	578.0022	47.3212	6.65	63.50	11.60	0.81	2778	30.96
	Ashuganj 3x150 MW Steam Turbine	Gas	450	450	2313.7921	23902.1619	1672.0006	166.2137	7.18	58.70	10.33	0.72	2473	34.78
2	Ashuganj GT 1	Gas	56	45	80.4440	1427.7836	99.8761	0.2040	0.25	16.40	17.75	1.24	4249	20.24
	Ashuganj Combined Cycle	Gas	34	CC	69.9580			4.6216	1.64	35.65	13.34	0.93	3195	26.92
	Ashuganj GT 2 *	Gas	56	67	211.1337	3751.0910	262.3958	0.2228	0.11	43.04	17.77	1.24	4253	20.22
3	Shahjibazar Gas Turbine(7 units)	Gas	96	68	123.7009	3774.5286	264.0353	1.9788	1.60	14.71	30.51	2.13	7305	11.77
	Shahjibazar 60 MW Gas Turbine	Gas	70	70	84.7700	1079.1468	75.4883	0.4258	0.50	13.82	12.73	0.89	3048	28.22
4	Sylhet 1x20 MW Gas Turbine	Gas	20	20	49.8065	823.0144	57.5714	0.1668	0.33	28.43	16.52	1.16	3956	21.74
5	Fenchuganj C.C.	Gas	90	90	450.0500	5215.4347	364.8293	3.9043	0.87	57.08	11.59	0.81	2774	31.00
	Ghorasal 2x55 MW Steam Turbine	Gas	110	80	211.8614	3014.8642	210.8953	28.2730	13.35	21.99	14.23	1.00	3407	25.25
6	Ghorasal 2x210 MW Steam Turbine	Gas	420	420	1868.5284	20155.3102	1409.9013	144.7575	7.75	50.79	10.79	0.75	2582	33.31
	Ghorasal 2x 210 MW S/T (5+6 th Unit)	Gas	210	210	1699.6540	18218.8121	1274.4397	109.2947	6.43	92.39	10.72	0.75	2566	33.52
7	Siddhirganj 1x50 MW Steam Turbine	Gas	50	46	171.4760	1816.8511	127.0921	7.0016	4.08	39.15	10.60	0.74	2537	33.91
8	Haripur 3x33 MW Gas Turbine	Gas	99	96	446.0393	7116.2562	497.7953	1.8503	0.41	51.43	15.95	1.12	3819	22.52
9	Chittagong 1x60 MW Steam Turbine	Gas	60	50	213.0352	2859.1676	200.0041	21.7880	10.23	40.53	13.42	0.94	3213	26.77
	Chittagong 2x28 MW Barge Mounted GT	Gas	56	52	2.0912	25.1165	1.7569	0.3099	14.82	0.43	12.01	0.84	2875	29.91
10	Rauzan 210 MW S\T (1st)	Gas	210	180	1050.8000	11447.8069	800.7953	81.9071	7.79	57.12	10.89	0.76	2608	32.98
	Rauzan 210 MW S\T (2nd)	Gas	210	180	739.5000	8129.0269	568.6405	73.8158	9.98	40.20	10.99	0.77	2632	32.68
	Khulna 1x110 MW Steam Turbine	F.oil	110	35	668.7882	192.3102	1645.6706	51.7082	7.73	69.41	0.29	2.46	2749	31.29
11	Khulna 1x60 MW Steam Turbine	F.oil	60	55	49.1960	15.8471	152.7988	3.1139	6.33	9.36	0.32	3.11	3079	27.93
	Khulna 2x28 MW BMPP	SKO	56	21	32.5622	12.5004	211.1535	0.3184	0.98	6.64	0.38	6.48	3420	25.14
12	Baghabari 71 MW Gas Turbine	Gas	71	71	407.3230	5171.8353	361.7795	2.3275	0.57	65.49	12.70	0.89	3040	28.29
	Baghabari 100 MW Gas Turbine	Gas	100	100	642.3095	8049.4727	563.0755	1.6340		73.32	12.53	0.88	3000	28.67
13	Bheramara 3x20 MW Gas Turbine	HSD	60	54	101.4547	42.5218	829.8747	0.4508	0.44	19.30	0.42	8.18	3755	22.90
14	Thakurgaon 7x1.5 MW Diesel	LDO	4.5	2.5	1.6659	0.4292	8.5599	0.1520	9.12	4.23	0.26	5.14	2316	37.14

POWER PLANT WISE YEARLY SUMMARY STATISTICS (Provisional)

FY2003-2004

Page No. - 2

Sl. No.	Name of power plant	Type of fuel	Installed Capacity (MW)	Generation Capability (MW)	Gross Energy Generation (GWH)	Fuel consumed (Mill.Cft./ Mill.Litre)	Fuel Cost (Million Taka)	Station use (GWH)	Station use % of gross Generation	Annual Plant factor (%)	Fuel consumed per unit generation. (cu.ft./kwh or litre/kwh)	Per unit Fuel Cost Taka/kwh	Average Heat rate Kcal/kwh	Efficiency (%)
15	Saidpur 3x3.75 MW Diesel	F.oil	3.75	0	0.0000	0.0000	0.0000	0.0000	#DIV/0!	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
		LDO			0.0000	0.0000	0.0000	0.0000			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Saidpur 20 MW Gas Turbine	HSD	20	18	31.0330	13.0403	253.4495	0.2280	0.73	17.71	0.42	8.17	3765	22.84
16	Barisal 2x20 MW Gas Turbine	HSD	40	36	64.6008	27.6545	574.2509	1.0660	1.65	18.44	0.43	8.89	3836	22.42
	Barisal Diesel(9 units)	HSD	2.6	1.5	5.6070	5.0212	60.6386	0.2842	5.07	24.62	0.90	10.81	8024	10.72
17	Rangpur 20 MW Gas Turbine	HSD	20	18	27.5740	12.1376	235.8339	0.4030	1.46	15.74	0.44	8.55	3944	21.81
18	Bhola Diesel	HSD	1.5	4	2.7020	0.8779	17.0578	0.4676	11.07	41.05	0.32	6.31	2911	29.54
		FO	6		2.6920	1.0092	9.4327	0.1293			0.37	3.50	3583	24.00
	Total(Grid)		3210	2860	13339.2955		13389.0955	759.0697	5.69	47.43		1.00		
19	Isolated East	HSD			1.9309	0.0000	0.0000	0.0000						
	Isolated West	HSD			1.1704	0.0000	0.0000	0.0000						
	TOTAL BPDB		**3210**	**2860**	**13342.3968**		**13389.0955**	**759.0697**	**5.69**	**47.44**		**1.00**		
	Private:													
	KPCL	F.oil	110	110	494.2489									
	WEST MONT	Gas	90	90	472.3434									
	NEPC	Gas	110	110	541.2931									
	RPCL	Gas	140	140	531.5706									
	AES, Haripur	Gas	360	360	2480.4423									
	AES, Meghnaghat	Gas	450	450	3804.6994									
	Total Private (Net Generation)		**1260**	**1260**	**7478.1746**									

1. Total system generation of BPDB 13342.3968 Gwh
2. Total Hydro generation 803.1133 Gwh
3. Total generation (East) 11303.7182 Gwh
4. Total generation (West) 2038.6786 Gwh
5. Total station use 759.0697 Gwh
6. Total station use (East) 696.7868 Gwh
7. Total station use (West) 62.2829 Gwh
8. Energy transfer through EWI from East to West (Ghorasal end) = MKWh
9. Energy transfer through EWI from West to East = 0 Gwh
10. Total Install Capacity as of June '2003=4680MW
11. Total Capability as of June '2003 = MW
12. Fuel Cost (Total) 13389.0955 Million Taka
13. Fuel Cost (East) 8465.5197 Million Taka
14. Fuel Cost (West) 4923.5759 Million Taka
15. Fuel Consumption:
    - -Gas 134240.538 M. Cubic feet
    - -Liquid Fuel 323.3492 Million litre

Generation cost (East) (Fuel Only)	Average	0.806 Taka/kwh	Excluding Hydro	In Steam Turbine	0.762 Taka/kwh
	Average	0.749 Taka/kwh	Including Hydro	In Gas Turbine	1.266 Taka/kwh
	By gas	0.806 Taka/kwh		In Conbined Cycle	0.858 Taka/kwh
				Diesel	0.000 Taka/kwh
Generation cost (West) (Fuel Only)	Average	2.415 Taka/kwh		In Steam Turbine	2.505 Taka/kwh
	By gas	0.881 Taka/kwh		In Gas Turbine	2.318 Taka/kwh
	By F.oil	2.509 Taka/kwh		- Gas	0.881 Taka/kwh
	By SKO/HSD	8.182 Taka/kwh		-Liquid Fuel	8.182 Taka/kwh
	By LDO	5.138 Taka/kwh		Diesel	6.915 Taka/kwh
Generation cost (Total) (Fuel Only)	Average	1.068 Taka/kwh	Excluding Hydro	In Steam Turbine	0.891 Taka/kwh
	Average	1.004 Taka/kwh	Including Hydro	In Gas Turbine	1.923 Taka/kwh
				In Conbined Cycle	0.858 Taka/kwh
				Diesel	6.068 Taka/kwh

Notes:-

1. Fuel	Calorific value	Specific gravity
Natural gas	239.4 Kcal/cubic ft. 950 BTU/CFT	
HSD	10,667 Kcal/Kg	0.84
F.Oil	10,278 Kcal/Kg	0.93
SKO	11,000 Kcal/Kg	0.81
Naptha	10,000 Kcal/Kg	0.71
LDO	10,333 Kcal/Kg	0.87

(B) WEST ZONE (Existing)

SL No	Power Station	Number of Unit(s)	Unit Type	Commissioning date (DD/MM/YY)	Type of Fuel	Installed Capacity (MW)	Derated Capacity (MW)	Generation (MW) on	
								Max. Gen. Day	Min. Gen. Day
1	2	3	4	5	6	7	8	9	10
1	KHULNA	1	ST	25-05-1973	F.Oil	60	55	48	0
		1	ST	07-07-1984	F.Oil	110	95	85	92
		2	CT	07-06-1980	SKO	28	21	16	16
			CT	03-06-1980	SKO	28	21	16	16
2	BHERAMARA	3	CT	28-07-1976	HSD	20	20	0	19
			CT	27-04-1976	HSD	20	20	18	19
			CT	19-01-1980	HSD	20	20	18	19
3	SAIDPUR	1	CT	17-09-1987	HSD	20	20	19	20
4	THAKURGAON	3	D	06-06-1966	LDO	4.5	4	4	2.8
5	BARISAL	2	D	1975-1980	HSD	5.85	3.2	3	2.5
		2	CT	05-08-1984	HSD	20	18	16	16
			CT	04-10-1987	HSD	20	18	15	15
6	RANGPUR	1	CT	16-08-1988	HSD	20	20	18	18
7	BHOLA	2	D	08-10-1988	F.Oil/HSD	6	2.5	2	1.5
		3	D	1975-1980	HSD	1.50	1.2	1	1
8	BAGHABARI	1	CT	04-06-1991	Gas	71	71	70	70
		1	CT	25-11-2001	Gas	100	100	102	0

Private

1	KPCL BMPP	18	D	12-10-1998	F.Oil	110	110	113	113
2	BAGHABARI BMPP	2	CT	26-06-1999	Gas	90	90	87	87
	SUB TOTAL(B) :					**755**	**710**	**650**	**527.3**
	TOTAL(A+B);					**4680**	**4362**	**3536**	**2892.3**

SUMMARY

						Installed Capacity (MW)	Derated Capacity (MW)	Generation (MW) on	
								Max. Gen. Day	Min. Gen. Day
1	2	3	4	5	6	7	8	9	10
	Hydro					230	220	76	65
East	ST (Steam Turbine)					2058	1928	1566	1132
Zone	CC (Combined Cycle)					180	150	90	55
Total	CT (Combustion Turbine)					397	294	181	185
	D (Diesel)					0	0	0	0
	Private					1060	1060	973	928
	ALL					**3925**	**3652**	**2886**	**2365**
West	ST (Steam Turbine)					170	150	133	92
Zone	CT (Combustion Turbine)					367	349	308	228
Total	D (Diesel)					18	11	10	8
	Private					200	200	200	200
	ALL					**755**	**710**	**650**	**527.3**
	Hydro					230	220	76	65
System	ST (Steam Turbine)					2228	2078	1699	1224
Total	CC (Combined Cycle)					180	150	90	55
	CT (Combustion Turbine)					764	643	488	413
	D (Diesel)					18	11	10	8
	Private					1260	1260	1173	1128
	ALL					**4680**	**4362**	**3536**	**2892.3**

Notes :

System Maximum Generation was on 14-06-2004 during peak hours at 19:30 hrs.

System Minimum Generation was on 03-06-2004 during peak hours at 20:00 hrs.

Relevant copies from used multi-phase model (see paragraph E.4)

year	prevented LFG-emission			correction factor (φ) *0.9*	Project -emissions and -leakages (CO2-eq)		Net prevented CO2-emissions (t/y)
	m3/yr	m3/hr	CO2-eq		emissions	leakages	
2006	1,162,184	133	8711	7,840	1,066	95	6,679
2007	3,249,726	371	24358	21,922	1,404	191	20,327
2008	7,236,773	826	54242	48,818	2,199	382	46,237
2009	13,899,373	1,587	104180	93,762	3,451	668	89,643
2010	19,207,542	2,193	143967	129,570	3,451	668	125,451
2011	23,440,239	2,676	175692	158,123	3,451	668	154,004
2012	26,818,886	3,062	201016	180,914	3,451	668	176,795
2013	29,519,236	3,370	221256	199,130	3,451	668	195,011
2014	31,680,794	3,617	237458	213,712	3,451	668	209,593
2015	33,414,294	3,814	250451	225,406	3,451	668	221,287
2016	34,807,636	3,973	260894	234,805	3,451	668	230,686
2017	35,930,596	4,102	269311	242,380	3,451	668	238,261
2018	36,838,564	4,205	276117	248,505	3,451	668	244,386
2019	37,575,511	4,289	281640	253,476	3,451	668	249,357
2020	38,176,348	4,358	286144	257,529	3,451	668	253,410
2021	38,668,790	4,414	289835	260,851	3,451	668	256,732
2022	39,074,843	4,461	292878	263,590	3,451	668	259,471
2023	39,411,982	4,499	295405	265,865	3,451	668	261,746
2024	39,694,085	4,531	297520	267,768	3,451	668	263,649
2025	39,932,174	4,558	299304	269,374	3,451	668	265,255

TOTALS

ETS (2006-2007)	4,411,909	504	33,069	29,762	2,470	286	27,006
Kyoto I period (2008-2012)	90,602,814	10,343	679,097	611,187	16,003	3,054	592,130
Kyoto II period (2013-2015)	94,614,324	10,801	709,164	638,248	10,353	2,004	625,891
ETS + Kyoto I (2006-2012)	95,014,723	10,846	712,165	640,949	18,473	3,340	619,136

YEAR	input composting plant		Amounts degrading non aerobic (Aa) for calc. $Pe_{compost}$		aerobic composted	
year	gross input at composting plant ton/year	gross daily input (ton/day)	% that degrades not aerobic (Aa)	amount in tonnes/yr	aerobic composted/year (ton/year)	net prevented from disposal (ton/year)
2006	36500	100	2.0%	730	35,770	**35,770**
2007	73000	200	2.0%	1,460	71,540	**71,540**
2008	146000	400	2.0%	2,920	143,080	**143,080**
2009	255500	700	2.0%	5,110	250,390	**250,390**
2010	255500	700	2.0%	5,110	250,390	**250,390**
2011	255500	700	2.0%	5,110	250,390	**250,390**
2012	255500	700	2.0%	5,110	250,390	**250,390**
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2021	255500	700	2.0%	5,110	250,390	**250,390**
2022	255500	700	2.0%	5,110	250,390	**250,390**
2023	255500	700	2.0%	5,110	250,390	**250,390**
2024	255500	700	2.0%	5,110	250,390	**250,390**
2025	255500	700	2.0%	5,110	250,390	**250,390**

Table 2; Default DOC (Degradable Organic Carbon) values for major Waste streams

Cat no		initial composition of the offered waste at landfill	DOC (%)	fast degradable	moderate degradable	slow degradable	Total C-content initial offered	Carbon content waste to be composted: fast degradable	moderate degradable	slow degradable
A	paper and textiles	0.0%	40%	0%	0%	100.0%	0.00%	0.00%	0.00%	0.00%
B	garden and park waste and other (non-food) organic putrescibles	10.0%	17%	0%	0%	100.0%	1.70%	0.00%	0.00%	1.70%
C	food waste	90.0%	15%	100%	0%	0.0%	13.50%	13.50%	0.00%	0.00%
D	Wood and straw waste (excl. Lignin)	0.0%	30%	0%	0%	100.0%	0.00%	0.00%	0.00%	0.00%
E	Inert (debris/asbestos/asphalt/soil)	0.0%	0%	0%	0%	0.0%	0.00%	0.00%	0.00%	0.00%
	TOTAL	*total=100%; check*					*15.20%*	*13.50%*	*0.00%*	*1.70%*

Annex 4

MONITORING PLAN

The project developers and operators (SPC formed by World Wide Recycling and Waste Concern) will oversee the development of the project and will periodically carry out internal audits, when required with external assistance, to assure that project activities are in compliance with monitoring and operational requirements.

WWR/WC will adopt the instructions given in the MP and accomplish all activities related to the implementation of the procedures given in the Operational Manual. The main responsibilities of the operator are related to:

- *Data handling*: maintaining an adequate system for collecting, recording and storing data according to the protocols determined in the Monitoring Plan, checking data quality, collection and record keeping procedures regularly;
- *Reporting*: preparing periodic reports that include emission reductions generated, observations regarding Monitoring plan procedures;
- *Training:* assuring personnel training regarding the performance of the project activities and the Monitoring plan;
- *Quality control and quality assurance*: complying with quality control and quality assurance procedures to facilitate periodical audits and verification.

An Operational Manual to be produced by the developer of the project will include procedures for training, capacity building, proper handling and maintenance of equipment, emergency plans, and work conditions and security.

The Monitoring plan and Operational Manual will be validated by the DOE.

Quality control and quality assurance procedures

Regarding quality control and assurance procedures to be undertaken for the monitored data, the practices to be implemented in the context of the Matuail composting plant project are as follows:

Monitoring

Monitoring will be done in accordance with the instructions indicated in section D.2.

Monitoring records:

Daily readings of all field meters will be registered in either electronic form or on paper worksheets. Data collected will be entered in electronic worksheets and stored. Periodic controls of the field monitoring records will be carried out to check any deviation from the estimated CERs and according the Operational Manual for correction or future references.

Recommendations on system and procedures improvements will be presented. Periodic reports to evaluate performance and assist with performance management will be elaborated.

Equipment calibration and maintenance:

All meters and other sensors will be subject to regular maintenance and testing regime according to the technical specifications from the manufacturers to ensure accuracy and good performance.

Calibration of equipment will be performed periodically according to technical specifications and in agreement with recommendations given by suppliers and/or institutes.

Corrective actions:
Actions to handle and correct deviations from the Monitoring Plan and Operational Manual procedures will be implemented as these deviations are observed either by the operator or during internal audits. If necessary, technical meetings between the operator, the developer and the sponsor of the project will be held in order to define the corrective actions to be undertaken.

Site audits:
The authorities will make regular site audits to ensure that monitoring and operational procedures are being observed in accordance with the Monitoring Plan and the Operational Manual.

Training:
The operator personnel will be trained in equipment operation, data recording, reports writing, and operation, maintenance and emergency procedures in compliance with the Operational Manual.

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Appendix 1

Minutes of Meeting Stakeholders Assessment

STAKEHOLDERS' MEETING ON LANDFILL GAS RECOVERY AND UTILIZATION AT MATUAIL, DHAKA AND COMPOSTING OF ORGANIC WASTE IN DHAKA

Local stakeholders' consultation meeting to discuss stakeholder concerns on proposed Clean Development Mechanism (CDM) projects – 1) Landfill Gas Recovery and 2) Utilization at Matuail, Dhaka of capacity 3-6 MW electricity production and Composting of Organic Waste in Dhaka of capacity 700 t/day.

Date and Venue: 12.02.2005, 10.00 AM at BRAC Center, Mohakhali, Dhaka, Bangladesh.

Dr. Mujibur Rahman, Professor, Environmental Engineering Division, Bangladesh University of Engineering and Technology (BUET) and Director International Training Network (ITN) chaired the meeting introducing himself and requested all the participants to introduce themselves accordingly. 45 participants from government offices, academics, non-governmental organizations, media groups, local residents, development partners and private sector were present in the meeting After that Dr. Mujibur Rahman conducted the meeting as Chairman. Then he requested the project proponents to give a brief description of the project.

Mr. Maqsood Sinha, Executive Director of Waste Concern (WC), in his presentation focused on aim of this project, the roles of two project proponents Waste Concern and World Wide recycling, Kyoto Protocol – Clean Development Mechanism (CDM), waste generation and management situation in Dhaka city and impact of this project. He also mentioned about the CDM project approval process in Bangladesh and informed that the aforesaid projects.

Mr. Maarten Van Dijk, Managing Director, World Wide Recycling (WWR), Netherlands, represented Word Wide Recycling in this stakeholders meeting and shared his project and experiences which will be replicated at Matuail, Dhaka after some modification. He explained the technology they use in their project for recycling and reuse of their wastes and also explained the scope of applying this technology in Bangladesh.

Mr. Iftekhar Enayetullah, Director, Waste Concern (WC), in his presentation focused on waste generation scenario of Dhaka City Corporation (DCC) Area , waste quality and its prospect for composting and bio-gas generation and also the scope of the project. He also gave a brief description of different units of the proposed CDM projects, project cost and financial viability, global and local benefits and finally the current status of both of the projects.

Dr. Mujibur Rahman, conducted the open discussion where the stakeholders raise questions, express their concerns and comments. Mr. Sinha, Mr. Iftekhar, Mr. Maarten and Dr. Ijaz answered the queries of the participants. Specific concerns and questions and the answers are delineated in the table below.

Stakeholder Concern / question / comment	Answer / outcome
How will the technology of the pilot project developed in Netherlands be adopted in different climatic condition of Bangladesh? [Mr. Shahjahan,	The pilot project in Netherlands is developed for segregation of mixed wastes (both organic and inorganic), since Bangladesh doesn't has any source separate

BEMP, DoE, GoB]	collection system. However, the waste management and treatment technology used in Netherlands will be implemented in Bangladesh with some modifications, making it suitable for the local circumstances.
Is there any plan for management of the remaining wastes, not collected by DCC? [Dr. Engr. Khurshed-ul-islam UNDP, SEU]	Presently DCC collects 1200 t/d of waste out of total generated waste 3200 t/d. The project will manage only the wastes collected by DCC. However, the savings made by the project for DCC can help them to improve their collection efficiency.
How will the project manage the excess wastes, if the collection efficiency of DCC increases? [Md. Anisul Kabir Research Officer IPSU]	With the current collection efficiency (1200 t/d) the project will sustain up to 2020. If the collection efficiency increases the wastes can be managed up to a certain time limit, but the lifetime of the land fill site will be reduced.
How long it will take to implement the project?	After completion of all types of official formalities, it will take only six (6) months to bring the project in full operation.
How will this project work to reduce the amount of landfill disposals from 35 % to 20%? [Taslima Islam, Senior Staff Lawyer, BELA]	Source segregation of wastes will help to achieve the target of landfill wastes reduction from 35% to 20%.
Does any developing country practice the technology used in this project? [Taslima Islam, Senior Staff Lawyer, BELA]	Yes. For example, in Lakhnow India there is a similar type project.
Who is the owner of this project? And how will the income from the project are distributed? [Shafiul Azam Ahmed, World Bank)	The land for this project belongs to DCC and WC and WWR works in partnership, where WWR is the investor and technology provider. Both WWR and DCC will be benefited from this project. A percent of royalty will go to DCC and DCC has no fixed cost anymore.
What is the Carbon Trading Concept and How does it work? [Dr. Abdus Satta Syed, ACE Data Products]	It's the concept of financing a developing country to reduce GHG emission by any developed country, which will give them the credit of reducing GHG emission for their country.
Are these two projects bundled or separate projects? Mr. Mozaharul Alam, MOEF]	These projects are separate CDM projects and not bundled.
What is the status of validation process of the project technologies? [Mr. Mozaharul Alam, MOEF]]	
Is there any scope for other projects like poultry litter treatment and composting to be included in CDM project? [Gias Uddin Ahmed, Chairman Center for Agro Technology Division]	A research is being carried out to include the poultry litter treatment and composting under CDM projects.

RECOMMENDATIONS OF STAKEHOLDERS' MEETING

The stakeholders thanked WWR and WC for initiating the first CDM project in Bangladesh and suggested to replicate this idea all over the country in different types of projects. Participants insisted to install the same type projects in the dumping sites of other city corporations also on the basis of response from the government authorities.

They also expressed their concern about the immediate implementation of the project with the active participation of all the concerned authorities. Mr. Khursheedul Islam, a consultant working for Energy Project in Bangladesh, suggested to form a group or forum who will actively involve to encourage this type investment and for initiation of more this type projects and also to look after on going projects and the progress work in this regard.

Overall there was agreement that the proposed project was a beneficial project from sustainability view point.

Dr. Mujibur Rahman, concluded the meeting with a short speech mentioning the importance of immediate implementation of the project for the country's interest. And he also emphasized the role of media to highlight the importance of this type of project and to increase public awareness and involvement.

LIST OF PARTICIPANTS STAKEHOLDERS MEETING FEB. 12, 2005

SL	Name & Designation	Telephone	Fax	Email
1	Mr. Md. Obaidur Rahman Managing Director MAP Agro Industries House-40, Road-18, Sector-14 Uttara Model Town Dhaka.	8952342 8921351	8952342	
2	**Krishibid MD. Rafiqul Islam** R&D Manager Alpha Agro Limited Jatiya Scout Bhaban (11th Floor) 70/1 Purana Paltan Line, Kakrail Dhaka 1000	9847967 0171- 539008	8315335	
3	**Dr. Mujibur Rahman** Professor, Civil Engg. ITN-Bangladesh Civil Engineering Building(3rd Floor) Bangladesh University of Engineering & Technology (BUET) Dhaka-1000			
4	**Dr. Ijaz Hossain** Professor & Head Department of Chemical Engineering BUET Dhaka-1000	9665609 8617523 8110189 (R) 011052028		
5	**Engr. Anjan Shaha** Manager Engineering Business Resources Ltd.			
6	**Mr. Titu** Matuail High School Demra, Konapara Matuail, Dhaka			
7	**Saju** Momen Sai Demra, Matuail Dhaka			

8	**Ms. Rina** Momen Sai Demra, Matuail Dhaka			
9	**Ms. Helena Akter** Rose Bird Kindergarten Demra, Matuail Dhaka			
10	**Mr. Harun-ur-Rashid** Rose Bird Kindergarten Demra, Matuail Dhaka			
11	**Mr. A.H.Md. Maqsood Sinha** Executive Director WASTE CONCERN House 21(Side B), Road-7 Block-G, Banani, Dhaka-1213	9884774 9873002		
12	**Mr. Iftekhar Enayetullah** Director WASTE CONCERN House 21(Side B), Road-7 Block-G, Banani, Dhaka-1213	9884774 9873002		
13	**Mr. Maarten Van Dijk** Managing Director World Wide Recycling Netherlands			
14	**Mr. Shah Monirul Kabir** Research Officer WASTE CONCERN House 21(Side B), Road-7 Block-G, Banani, Dhaka-1213	9884774 9873002		
15	**Ms. Laila Arjuman Banu** WASTE CONCERN House 21(Side B), Road-7 Block-G, Banani, Dhaka-1213	9884774 9873002		
16	**Ms. Syeda Shaila Akter Khan** WASTE CONCERN House 21(Side B), Road-7 Block-G, Banani, Dhaka-1213	9884774 9873002		
17	**Mr. Abdur Razzak** WASTE CONCERN House 21(Side B), Road-7 Block-G, Banani, Dhaka-1213	9884774 9873002		
18	**Mr. Wasim Kha** WASTE CONCERN House 21(Side B), Road-7 Block-G, Banani, Dhaka-1213	9884774 9873002		
19	**Dr. M S Islam** **Executive Director** **BARI**	0176585137		
20	**Mr. Suranjit Debnath** Reporter The Daily Star 19 Kawranbazar	8124944-6	8125155	

	Dhaka			
21	**Mr. Shafiul Azam Ahmed** Water & Sanitation Specialist Water & Sanitation Program The World Bank Flat 03-04, Building-A, Priyo Prangan 2, Paribag Dhaka	8159015 extn.-4148	8159029	
22	**Mr. Murad Husain** Manager -COO Affairs Rahimafrooz Batteries Ltd. 705, West Nakhalpara Tejgaon, Dhaka.	9113696 0171- 606707	8115305	
23	**Mr. Mozaharul Alam** Research Fellow BCAS House - 10, Road - 16/A Gulshan - 1 , Dhaka – 1212	8851237 8851986 9113682	8851417	
24	**Taslima Islam** Senior Staff Lawyer BELA House 15A, Road 3 Dhanmondi, Dhaka			
25	**Novera Hossain** Unnayan Samannay 2/F/1 Mymensingh Road , Shahbagh Dhaka	8610332 8622320	8622320	shamannay@sdnbd.org
26	**Begum Ummay Hasan** **Deputy Drector Technical** Department of Environment E-16, Agargaon Dhaka – 1207			
27	**Md. Shahjahan** LPC,BEMP Department of Environment Dhaka – 1207	0189258177		
28	**MD. Shah Alam** National Consultant on Energy, UNDP, SEU UNDP IDB Bhaban E/8-A, Begum Rokeya Sharani Sher-e-Bangla Nagar Dhaka	0171840354		
29	**Dr. Engr. Khurshed-ul-Islam** National Consultant on Energy, UNDP, SEU House 43/A, Road 116, Gulshan, Dhaka-1212			
30	**Dr. Zainal Abedin** Minstry of Agriculture Dhaka			
31	**Gias Uddin Ahmed** Chairman Center for Agro Technology Division			

32	**Md. Anisul Kabir** Research Officer IPSU			
33	**Anisur rahman** **BSS**			
34	**Zakir Hossain** Asst Engineer MSP LGED, Dhaka			
35	**Yasmin Akhter** BILIA Dhanmondi, Dhaka			
36	**Dr. Abdus Satta Syed** Proprietor ACE Data Products BIRS Bhaban Karwan Bazar Dhaka			
37	**Mohosinul Karim** Staff Correspondent BD News 24 10, Jahangir tower 6th Floor, Karwan Bazar Dhaka			
38	**S K Amzad Hossain** Project Director LGED, Dhaka	8119437		
39	**Latiful Alam Khan** Managing Director Center for Environment Studies HEDA, Bangladesh	0176193246		
40	**Masum Ahmed** Bangladesh Betar (Radio Bangladesh) Dhaka	0172981906		
41	**Abul Kalam Azad** S B, Dhaka			
42	**Salahudin Bablu** Senior Reporter Daily Inqilub Dhaka			
43	**Md Shariful Alam Mondal** (Environment Monitoring Officer) Dhanmondi r/A House 49, Road R/A Dhaka			
44	**Fiaz Ullah Bhueyan** Daily Naya Diganto Dhaka			
45	**Shafiul Goni Numan** Daily Sangram			

Figure Appendix 1.1: Advertisement for invitation to participate in the Stakeholders Assessment

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NOTICE FOR STAKEHOLDERS' MEETING

The stakeholders' meeting of the two CDM projects entitled "Landfill Gas Extraction and Utilisation from Matuail Waste Dump Site and Composting of Organic Waste in Dhaka" will be held on Feb 12, 2005 at BRAC Center, 75 Mohakhali, Dhaka from 10 AM to 1 PM. The meeting is organized by World Wide Recycling and Waste Concern. Interested stakeholders are invited to attend the meeting.

Appendix 2

Letter of Approval

একই তারিখ ও স্মারকের স্থলাভিষিক্ত হবে

Government of the People's Republic of Bangladesh
Department of Environment
Paribesh Bhaban, E/16 Agagaon,
Sher-e-Bangla Nagar, Dhaka 1207
www.doe-bd.org

Ref.: Paribesh/Tech. (Int. Con.)/350/2003/2632 **Date:** 16/09/2004.

Sub.: Host Country Approval to two CDM projects (1) "Landfill Gas Extraction and Utilization at Matuail Landfill Site in Dhaka and (2) Composting of Organic Waste in Dhaka" of World Wide Recycling BV of the Netherlands and Waste Concern of Bangladesh.

This is to inform you that the Project Idea/Concept Note and Project Design Document for two CDM projects (1) "Landfill Gas Extraction and Utilization at Matuail Landfill Site in Dhaka and (2) Composting of Organic Waste in Dhaka" of World Wide Recycling BV of the Netherlands and Waste Concern of Bangladesh, was considered by the Designated National Authority (DNA) in its Meeting of 08 August 2004. The DNA approved the above mentioned projects. The DNA confirms that:

i. The projects will contribute to sustainable Development in Bangladesh.
ii. This approval is for the voluntary participation in the proposed CDM project activity.

It may be further noted that the Government of Bangladesh has ratified the Kyoto Protocol on 22 October 2001.

(Mohammad Reazuddin)
Director (Technical 1)
&
Member Secretary
National CDM Committee

Mr. Maarteen (J.M.W.) Van Dijk
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