Annual Emission Reduction Report for Project Activity 2 of CDM Project in Biogas Support Programme of Nepal

CDM Project Reference No: 0139
Monitoring Period: 1st August 2005 to 19th October 2006.

(Biogas to Save This Village in Nepal and the World from Environmental Disaster)

Submitted to:
The World Bank

Through:
Alternative Energy Promotion Centre (AEPC)

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October 31, 2006

Table of Contents

1. Background

All the good work done by the Biogas Support Programme (BSP) of Nepal, particularly in terms of its contribution in helping rural people of Nepal in improving their life in different fronts and in contributing to the protection of the global environment, has been widely recognized in Nepal and abroad. The programme modality developed in BSP has become a model for dissemination of biogas and other similar products to rural areas not only in Nepal but also in other parts of the world. The modality is integrated, effective and efficient as well. It has all the elements for delivery with quality, sustainability, check-and-balance, expanding its outreach to remote areas and reaching to the poorer households.

In this context, an MoU was signed by the Alternative Energy Promotion Centre (AEPC) and the World Bank in 2004 to develop CDM project in the BSP of Nepal, starting from development of a methodology. The MoU included trading of Emission Reduction equivalent to 1 million tons of CO_2. Two small scale CDM Projects with a total of 19,396 biogas plants were registered with the CDM Executive Board in December 2005 and approved.

Consequently, an Emission Reduction Purchase Agreement (ERPA) was signed by the AEPC and the World Bank in May 2006 for trading of the Emission Reductions (ERs) from the two CDM Projects for 7 years. An Implementation Agreement was also signed in May 2006 between AEPC and Biogas Sector Partnership-Nepal (BSP-Nepal).

Though crediting period started from August 1, 2004, this is the first time this reporting is being carried out. There is another report being submitted together for reporting on community benefits, including environmental mitigation.

The reporting should have taken place in August or September 2006. However, it took quite some time as reporting is being done for the first time and BSP-Nepal took longer time than expected to complete activities that were necessary to effectively report.

2. Description of the Small Scale Project Activity in General

The project activity reduces Green House Gas (GHG) emissions by displacing conventionally used fuel sources for cooking, such as fuel wood, kerosene, dung cakes and agricultural residues. The proposed project activity is a sub-project of the national biogas programme called Biogas Support Programme (BSP), which currently is in its Phase IV (2003-2009). Since it is the sub-activity of the umbrella biogas program, the sub-project is named as BSP-Nepal Activity-2.

Table 1: Summary of Plants with Different Sizes and Constructed in Different District Categories in the CDM Project.

Total Plants Registered Under CDM					
Project Activity 2 (16-Jun-2004 to 6-Apr-2005)					
Location	**4 m3**	**6 m3**	**8 m3**	**10 m3**	**Total**
Hill	1168	2961	134	9	**4272**
Remote	42	41	1		**84**
Terai	216	4178	847	91	**5332**
Total	**1426**	**7180**	**982**	**100**	**9688**

2.1. Types of the Project Activities

Type I: Renewable Energy Projects
Category I. C. Thermal Energy for the User

2.2. Technology of the Project Activity

The household biogas digester plants constructed under this project activity provide biogas for the thermal energy needs of households with 2 heads of cattle (cow or buffalo) and displace fossil fuel and/or non-renewable biomass products (firewood). Farming households living in villages in remote areas are the primary buyers of biogas plants. The biogas plants are based on a uniform technical design and are manufactured and installed following established technical standards in Nepal. The households feed dung of cattle (cows or buffaloes) mixed with water into the biogas plant, which through anaerobic digestion produce biogas.

2.3. Biogas Support Program-Nepal (BSP-Nepal) Activity 2

As part of contributing to the overall goals of the umbrella program, the proposed project activity has installed a total of 9,688 small biogas digesters from June 16, 2004 to April 6, 2005 in a number of districts of Nepal as shown below in Table A.2. The total installed equivalent generation capacity of the proposed project activity totals 14.66 MW.

Table 2: District Wise Distribution of Biogas Plants in Project Activity 2

Districts	Number of Plants	Districts	Number of Plants	Districts	Number of Plants
Arghakhachi	27	Kailali	550	Rasuwa	1
Baglung	9	Kanchanpur	531	Rautahat	74
Banke	125	Kapilbastu	172	Rupandehi	288
Bara	159	Kaski	562	Sankhuwasabha	78
Bardiya	233	Kathmandu	68	Saptari	11
Bhaktapur	44	Lalitpur	59	Sarlahi	170
Chitawan	717	Lamjung	292	Sindhuli	188
Dadeldhura	4	Mahottari	55	Sindhupalchowk	13
Dang	259	Makawanpur	414	Siraha	32
Darchula	6	Morang	466	Sunsari	213
Dhading	149	Myagdi	33	Surkhet	61
Dhankuta	206	Nawalparasi	395	Syangja	298
Dhanusa	11	Nuwakot	83	Tanahu	598
Dolakha	63	Okhaldhunga	1	Terathum	19
Doti	3	Palpa	204	Udayapur	123
Gorkha	141	Panchther	32		
Gulmi	31	Parbat	21		
Ilam	140	Parsa	22		
Jhapa	849	Pyuthan	44	**Total**	**9,688**
Kabrepalanchowk	278	Ramechhap	63		

2.4. Project Commissioning

Biogas plants are constructed and commissioned immediately after construction with initial feeding of the plants with a large amount of cattle dung mixed with water. Feeding at specified quantity is done every day for regular gas generation to make gas available for cooking and lighting daily.

3. Monitoring Period

Quality Control & Monitoring of newly constructed plants and that of After Sales Service (ASS) of one or two years old plants, including use of bio-slurry, toilet connection, etc. is the regular and main activity in BSP even before becoming a CDM Project. However, as some of the things, including the Monitoring Plan were still being developed, the monitoring period that covered all parameters has been from 1st of January, 2006 to 19th of October, 2006.

4. Parameters & Process Used for Emission Reduction Calculation

4.1. Emission Reduction Calculation

The systematic surveillance of the project's performance is done by measuring and recording performance-related indicators relevant to the project or activity. This methodology contains the Emission Reduction Calculation process for the two registered sub-projects, Project Activity 1 and 2. A process consisting of five steps is followed to determine the net emission reduction.

4.2. ER Calculation Process

Step 1: Identification of baseline and project emission sources;
Step 2: Identification of emission factors;
Step 3: Identification of activity volumes;
Step 4: Calculations of emissions per source;
Step 5: Calculation of emission reduction factors per plant per region.

Step 1: Identification of baseline and project emission sources:
In this project, the baseline is GHG emission from burning of fuel wood and kerosene. The GHG emissions are CO_2 emissions from burning of kerosene and unsustainable fuel wood and CH_4 emission from burning of fuel wood. For the project emission there is no direct GHG emission from the biogas plant. The only emission that needs to be looked at is the fugitive emission when methane leaks from the digester.

Step 2, Step 3, Step 4: Identification of emission factors, Identification of activity volumes and Calculation of emission per source.

Fuel baseline

1. CO_2 emissions from kerosene burning
2. CO_2 emissions from fuel wood burning
3. CH_4 emissions from fuel wood burning

Step 5: Aggregation of emissions per source into standardized emission reduction factor

Emission reduction factor for a biogas plant of a particular size in a particular region =
+ CO_2 emission reduction from kerosene savings in t-CO_2 equivalent (I)
+ CO_2 emission reduction from fuel wood savings in t-CO_2 equivalent (II)
+ CH_4 emissions reduction from fuel wood savings in t- CO_2 equivalent (III)
- CH_4 emissions from biogas leakage from the digester in t-CO_2 equivalent (IV)

4.3. Total Emission Reduction Calculation

The approach to the baseline is based on the calculation of a standardized net emission reduction factor per biogas plant per region. The following are the steps to calculate the emission reductions due to the project activity during a given period.

1) Number of installed biogas plants under the project = N

2) Determine annual performance ratio of the installed biogas plants in year 1 given by
P_1 = Total Number of Biogas Plants that are operational/Total Number of Biogas Plants Sold

Whereby $0 < P_1 < 100\%$

3) Determine Emission Reduction Factor applicable to the installed biogas plants

a) Calculate the net emission reduction factor for a biogas plants of size a in region b in a given period, say year 1, by

$[ERF_{(a,b,1)}]$= CO_2 emissions from kerosene savings in tCO_2eq + CO_2 emissions of fuel wood savings in tCO_2eq (II) + CH_4 emissions from fuel wood savings - CH_4 leakage emissions from biogas digester and incomplete combustion in tCO_2eq (V)

b) Determine the geographic and size distribution (in %) of the installed biogas plants

c) Determine weighted average emission reduction factor of all installed biogas plants in year 1 = $ERF_{(w,1)}$
If the weighted ER factor is > 5 t-CO_2 */bio-digester/year, apply the ER factor of 4.99 t-CO_2/plant/year*
If the weighted ER factor is < 5 t-CO_2 */bio-digester/year, apply that weighted ER factor*

Therefore,

Total emission reductions of the project activity in year 1 = N*P* $ERF_{(w, 1)}$

5. Monitoring Methodology

5.1. Sampling Methods for the Annual Biogas Users' Survey and Regular Quality Control and Monitoring

5.1.1. Random Sampling for Annual Biogas Users' Survey (BUS)

Sampling or the BUS was done by BSP-Nepal with the help of a multi-tiered random sampling. For this, BSP-Nepal added a Random Sampling facility in the existing BSP Database. Completely randomized samples were selected using the software. A four tiered system was followed in which 15 clusters were defined in the basis of 5 Development

Regions and 3 categories of districts (terai, hill and remote hill) in each Development Region.

In each cluster, districts were randomly sampled and in each sampled districts Village Development Committees (VDCs) were again randomly sampled. Samples of households were finally taken from households in sampled VDCs. Cluster wise distribution of plant was then generated by defining plant construction period as follows:

Step 1:

Data input: Define Plant Construction Period.
Report to be generated: Cluster Wise Distribution of Plants.

Period: from --------- to ----------

Cluster Name	No. of Districts	No. of VDC	No. of Plants

In the second step, district wise distribution of plants was generated by defining number of districts to be randomly sampled within a selected cluster.

Step 2:

Data input: Define Plant Construction Period.
Select a Cluster.
Define No. of Districts to be randomly sampled.
Report to be generated: List of Sampled Districts with No. of Plants

Cluster Name: …….. Period: from --------- to ----------

Sampled District Name	No. of VDC	No. of Plants

In the third step, list of sampled VDCs with no. of plants was generated by defining number of VDCs to be randomly sampled from the sampled districts.

Step 3:

Data input: Select the previously sampled districts in Step 2. Define No. or Percentage of VDCs to be randomly sampled from the already sampled district(s) in Step 2.

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Report to be generated: List of Sampled VDC with No. of Plants

Cluster Name: …….. Period: from --------- to ----------

District Name	Name of VDCs	No. of Plants

Finally, detail list of sampled households was generated from the sampled VDCs in step 3.

Step 4:

Data input: Select the previously sampled districts in Step 2
Define the Total No. or Percentage of Plants to be sampled from the sampled VDC(s) in Step 3

Report to be generated: Detail List of Sampled Households

Cluster Name: …….. Period: from --------- to ----------

District Name	VDC /NP Name	Plant Owner Name	Address ….

The actual survey and reporting was done by a consultant hired by AEPC.

5.1.2. Sampling for Regular Quality Control & Monitoring in BSP

The purpose of this regular task is to check the quality of the biogas plants and the after-sales service provided, including training for use and use of bio-slurry. Newly constructed plants are inspected for construction and operation qualities. This is done for 5% randomly sampled households. Another 5% of the randomly sampled households are inspected in the second year for quality of ASS and use of slurry. The same is repeated in the third year. At least 5% of plants are checked with a minimum of two plants per branch per company.

This task is linked to three questionnaires; all are included in the overall performance evaluation of biogas companies termed as Biogas Performance Index (BPI).

The data collected from the Biogas User Survey and from the regular Quality Control & Monitoring of new and ASS plants are entered in the oracle based on BSP Database system. The next step is the data generation for ER calculations in CDM.

6. ER Calculation Process in BSP Database System

1. The BSP Database has the facility to record both the Summary Tabular data and detail Individual Plant Survey Data received from the User Survey.
2. The system has the facility for ER calculation from data received from Quality Control & Monitoring System.
3. Format of data received from the Summary Data form of the User Survey and the Quality Control & Monitoring is as follows:

a. Average Firewood Consumption

Region		Terai / Hills							
Plant Size	Avg. Family Size	Average Firewood Consumption per HH (Kgs/day)						Avg. Firewood Saving kg / Day	Firewood Saving/ Year
		Summer			Winter				
		Before	After	Saving	Before	After	Saving		

b. Average Kerosene Consumption

Region		Terai / Hills							
Plant Size	Avg. Family Size	Average Firewood Consumption per HH (Liters/day)						Avg. Kerosene Saving Litres / Day	Kerosene Saving/ Year
		Summer			Winter				
		Before	After	Saving	Before	After	Saving		

c. Methane Leakage

Methane Leakage						
GWP						
Methane Density						
% Methane in Biogas						
Size	M3 Biogas / Day	M3/Yr	M3-ch4/year	leakage	tCh4/plant/year	tCO2eq/plant /year

4. Data Received For Individual Plant from Annual User Survey is as follows:

Plant Code				
Owner Name				
Survey Date				
Family Size				
1 Bhari = ……. Kg				
Firewood Consumption (Bhari/Month)	Before Biogas		After Biogas	
	Summer	Winter	Summer	Winter
Kerosene Consumption (Litre	Before Biogas		After Biogas	
	Summer	Winter	Summer	Winter

/Month)				
Firewood Cost (NRS Per Bhari)				
Fuelwood Cost (NRS Per Litre)				

3.1 Based on the individual data the system generates a table similar to the tables mentioned in point 2.

3.2 For converting month to day. 1 month = 30 days should be assumed.

5. The system has the option for defining the following parameters for each ER Calculation period.

- Methane Leakage (in %)
- GWP
- Methane Density
- % Methane in Biogas
- MW Capacity for Size 4, 6, 8 or 10 M^3

6. Based upon the above system, the following reports are generated.

6.1 Net CO_2 Emission Saving from kerosene for cooking

	Terai	**Hill**	**Mountain**	**Average (Terai and hills)**	**Weighted Average**
4M3					
6M3					
8M3					
10M3					

6.2 Net CO_2 Emission Saving from Firewood for cooking

	Terai	**Hill**	**Mountain**	**Average (Terai and hills)**	**Weighted Average**
4M3					
6M3					
8M3					
10M3					

6.3 Net CH_4 Emission Saving from Firewood

	Terai	**Hill**	**Mountain**	**Average (Terai and hills)**	**Weighted Average**
4M3					
6M3					
8M3					
10M3					

6.4 Net Emission Reduction from Fuel Saving

	Terai	Hill	Mountain	Average (Terai and hills)	Weighted Average
4M3					
6M3					
8M3					
10M3					

6.5 Methane Emission

	Terai	Hill	Mountain	Average (Terai and hills)	Weighted Average
4M3					
6M3					
8M3					
10M3					

6.6 Net GHG savings per digester (t-CO_2 e/plant/year)

	Terai	Hill	Mountain	Average (Terai and hills)	Weighted Average
4M3					
6M3					
8M3					
10M3					

6.7 Annual t-CO_2 eq Emission Reduction

	Terai	Hill	Mountain	Average (Terai and hills)
4M3				
6M3				
8M3				
10M3				

7. The system has the facility to calculate ER for any period as defined.

7. Summary Report on Emission Reduction

7.1. Details of Emission Reduction Calculation

The following chart is directly generated from the BSP Database, which shows details of the Emission Reduction calculation For the Project Activity 2, the calculation is done for the first crediting period of August 1, 2005 to July 31, 2006.

Table 3: Details of Emission Reduction Calculation for Project Activity 2

Emission Reduction Calculation for Project Activity 2				
A.	**Annual Performance Rate**			
	Crediting Period			1
	Fiscal Years			August 1, 05 to July 31, 06
	Total Number of Existing Plants			9688
	Annual Performance Rate			98.70%
B.	**Annual Emission Reduction Factor**			
	Annual Weighted ER Factor			8.9975
	Applied ER Factor			4.99
C.	**Emission Reductions from Aug 1, 2005**			
	Size/Region	Unit	Total	1 Aug 2005-
	(Terai/Hills)			31-Jul-06
				ER1
	4m3 Hill	TCO2 e		5842.25
	4m3 Terai	TCO2 e		1044.64
	4m3 Total	TCO2 e	Total	6886.89
	6m3 Hill	TCO2 e		14528.25
	6m3 Terai	TCO2 e		20206.06
	6m3 Total	TCO2 e	Total	34734.31
	8m3 Hill	TCO2 e		652.90
	8m3 Terai	TCO2 e		4096.35
	8m3 Total	TCO2 e	Total	4749.25
	10m3 Hill	TCO2 e		43.53
	10m3 Terai	TCO2 e		440.10
	10m3 Total	TCO2 e	Total	483.63
	Annual ER	**TCO2 e**	**Total**	46854.07

7.2. Total Emission Reduction Claimed for Project Activity 2

The overall Emission Reduction from the Project is calculated and presented below.

Table 4: Summary of Total Net Emission Reduction Calculation for Project Activity 2

Project Activity 2	
Crediting Period	1
Date	August 1, 05 to July 31, 06
Total Number of Existing Plants	9688
Annual Performance Rate	98.70%
Annual Weighted ER Factor	8.9975
Applied ER Factor	4.99
Total Annual ER claimed from PA2	**46854.07**

Thus, the total Emission Reduction claimed from the Project in the period from August 1, 2005 to July 31, 2006 is 46,854.07.

Annex 1. Summary of Emission Reduction Factors Calculated for Each Plant Size in Each District Category

Summary of Emission Reduction Factor for PA2				
Unit: ton CO2 equivalent per plant				
A. Fuel Savings				
1. Net CO2 Emission Saving from Kerosene for cooking				
Location	**Terai**	**Hill+Remote Hill**	**Average**	**Weightage Average**
Size Code	Total Value	Total Value		
4	0.10995625	0.042290865	0.076124	
6	0.021145433	0.186695241	0.10392	
8	0	0	0	
10	0.17593	0	0.087965	0.0793
2. Net CO2 Emission Saving from firewood for cooking				
Location	**Terai**	**Hill+Remote Hill**	**Average**	**Weightage Average**
Size Code	Total Value	Total Value		
4	7.244688462	8.125779966	7.68523	
6	9.907127032	8.428805888	9.16797	
8	10.61476646	8.68335	9.64906	
10	10.6872	0	5.3436	9.1865
3. Net MH4 Emission Saving from firewood				
Location	**Terai**	**Hill+Remote Hill**	**Average**	**Weightage Average**
Size Code	Total Value	Total Value		
4	0.328584231	0.368546305	0.348565	
6	0.449339641	0.382290103	0.415815	
8	0.481434763	0.399835	0.437635	
10	0.48472	0	0.24236	0.4167
Net Emission Reductions from Fuel Saving				
Location	**Terai**	**Hill+Remote Hill**	**Average**	**Weightage Average**
Size Code	Total Value	Total Value		
4	7.683228942	8.536617136	8.10992	
6	10.37761211	8.997791232	9.6877	
8	11.09620122	9.083185	10.0897	
10	11.34785	0	5.67393	9.5735
B. Project Emissions: Fugitive Emissions including leakage from biogas digester and CH4 emissions from incomplete combustion				
Location	**Terai**	**Hill+Remote Hill**	**Average**	**Weightage Average**
Size Code	Total Value	Total Value		
4	0.41	0.41	0.41	
6	0.59	0.59	0.59	
8	0.76	0.76	0.76	
10	0.96	0.96	0.96	0.5861
C. Net GHG Savings per digester (TCO2e/plant/year)				
Location	**Terai**	**Hill+Remote Hill**	**Average**	**Weightage Average**
Size Code	Total Value	Total Value		
4	7.273228942	8.126617136	7.85192	
6	9.787612106	8.407791232	9.33464	
8	10.33620122	8.323185	9.32969311	
10	10.38785	0	5.19393	8.9975

Annex 2: Summary of Quality Control & Monitoring for FY 2005/06 That Forms the Basis for Emission Reduction Calculation

S. N0.	Particulars	Fiscal Years			Average
		2003/04	2004/05	2005/06	
1	Number of Total Plants Constructed	11,259	17,803	16,118	
2	Number of Plants Which Received After Sales Service (ASS carried out in FY 2005/06 for plants constructed in FY 2003/04 and 2004/05)	10,710	17,060	X	
3	Number of Plants Inspected for Quality of ASS	570	901		
4	ASS Progress Made (%)	95.12	95.83		95.48
5	Number of Newly Constructed Plants Inspected for Quality			855	
6	Total Quality Control & Monitoring Progress (%)	5.32	5.28	5.31	5.30