CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02

Biogas Support Program - Nepal (BSP-Nepal) Activity 1

CONTENTS

SECTION A. General description of the small-scale project activity

A.1. Title of the small-scale project activity:

Biogas Support Program - Nepal (BSP-Nepal)[1] Activity-1 [Version 2, 14-11-2005]

A.2. Description of the small-scale project activity:

Under the proposed project activity, the Alternative Energy Promotion Center aims to sell biogas digesters (biogas plants) to households located primarily in the rural areas of Nepal. The project activity will reduce greenhouse gas (GHG) emissions by displacing conventionally used fuel sources for cooking, such as fuel wood and kerosene. Although the proposed activity additionally reduce CH_4 and N_2O emission reductions by introducing a proper disposal of animal waste and by producing a bio-slurry for replacing the household consumption of chemical fertilizers, these emission reductions are not counted for credits.

The proposed project activity is a sub-project of the BSP-Nepal umbrella biogas program that aims to install a total of 200,000 small biogas digesters all over Nepal. Since it is the first sub-activity of the umbrella biogas program, the sub-project is named BSP-Nepal Activity-1. The umbrella biogas program is the fourth phase of the Nepali government's biogas program at the national level. Under the first three phases, a total of 111,395 biogas plants have been disseminated all over Nepal.

Despite the government's past efforts to develop the biogas market with the support from international donors, namely the German Development Bank (KfW) and the Netherlands Development Agency (SNV), the investment in the biogas sector is a non-commercial activity in Nepal. With the phasing out of international public support for the sector, the present umbrella program came into being as a CDM program. The key objective of the umbrella program is to develop the donor-supported biogas program as a commercial activity with the integration of carbon revenues to serve a large rural population.

The key elements of the BSP-Nepal umbrella program's approach are:

- Financial support for end-users through Micro Finance Institutions and Cooperatives;
- Uniform technical design of biogas plants;
- Thorough quality control and monitoring of the production, installation and after-sales services of the participating biogas companies;
- Continuous research & development efforts to optimise plant operation and to tailor the biogas plants to the needs of the end-users;
- Social marketing through outreach, awareness, and training programs;
- Implementation of a fertilizer extension program to maximize the benefits of bio-slurry, a by-product of the biogas;
- Support to institutions servicing various functions of the biogas sector such as financing, construction, maintenances, manufacturing, training, and marketing, and

[1] Biogas Support Program – Nepal (BSP-Nepal) refers to the name of the proposed project activity and Biogas Sector Partnership-Nepal (again BSP-Nepal) refers to the Implementing Agency that works under the coordination of Alternative Energy Promotion Center (the project sponsor) and has the status of NGO.

- Installation of biogas plants on a scale that demonstrates CDM application in the commercialisation of the biogas sector.

As part of contributing to the overall goals of the umbrella program, the proposed project activity has installed a total of 9,708 small biogas digesters from November 1, 2003 to June 15, 2004 in a number of districts of Nepal as shown below in Table A.2.

Table A.2: Distribution of Biogas Plants

Districts	Number of Plants	Districts	Number of Plants	Districts	Number of Plants
Arghakhachi	21	Kabrepalanchowk	190	Rasuwa	23
Baglung	11	Kailali	571	Rautahat	70
Baitadi	1	Kanchanpur	469	Rupandehi	279
Banke	148	Kapilbastu	220	Sankhuwasabha	31
Bara	124	Kaski	573	Saptari	8
Bardiya	264	Kathmandu	70	Sarlahi	181
Bhaktapur	60	Lalitpur	101	Sindhuli	200
Chitawan	575	Lamjung	249	Sindhupalchowk	29
Dadeldhura	10	Mahottari	45	Siraha	11
Dang	352	Makawanpur	612	Solukhumbu	10
Darchula	29	Morang	398	Sunsari	226
Dhading	54	Myagdi	26	Surkhet	81
Dhankuta	135	Nawalparasi	423	Syangja	273
Dhanusa	13	Nuwakot	103	Tanahu	694
Dolakha	112	Palpa	215	Taplejung	9
Doti	5	Panchther	41	Terathum	3
Gorkha	171	Parbat	74	Udayapur	91
Gulmi	74	Parsa	21		
Ilam	107	Pyuthan	19	**Total**	**9708**
Jhapa	707	Ramechhap	96		

A biogas plant produces biogas, thermal energy for cooking. The power equivalent of the installed biogas plants ranges from 1.16 KW to 2.32 KW and the total installed equivalent generation capacity of the proposed project activity totals 14.73 MW.

Contribution to Sustainable Development

At the local level, the BSP-Nepal program has multiple social benefits. A major household benefit is the reduction in time and energy spent by women and children in collecting firewood for cooking. The project will attach latrines to biogas plants providing better sanitation to rural households. Potential employment will add more than 15,000 people-years for skilled people in the construction, maintenance, marketing, and financing of biogas plants. The use of biogas means negligible smoke, hence better family health. Moreover, the residual biological slurry from the biogas plants can be used as superior organic fertilizers to enhance agricultural yields.

At the national level, the proposed umbrella program supports the Nepali Government's sustainable energy goals as laid out in 10th Five Year Plan to improve energy access for rural poor and to reduce rural poverty by providing high quality biogas plants to poor households at an affordable price.

Additionally, the project will support forest conservation goals by substituting the traditionally cooking fuel, i.e., firewood, with biogas fuel.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of Nepal (Host)	Alternative Energy Promotion Centre, Nepal (AEPC) Household Maiya Gautam Household Suk Man Tamang	No
Government of The Netherlands	The Community Development Carbon Fund (CDCF)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Each **biogas household** is the participant of the project who decides to invest in a biogas plant and owns emissions reductions generated thereafter. All but two households as listed above agree by contract to transfer the CO_2 credit and all other rights associated with the transaction and administration of these ERs to the Alternative Energy Promotion Centre.

AEPC, the project sponsor**,** is a government body under the Ministry of Environment, Science and Technology and oversees the policy design and promotion of the national renewable energy sector, of which biogas is a part.

The **CDCF** is a trust fund maintained and operated by the World Bank in its capacity as trustee of the CDCF on behalf of the public and private participants of the CDCF.

Official contact for the CDM project activity:
The Community Development Carbon Fund (CDCF) of The World Bank.

A.4. Technical description of the small-scale project activity:

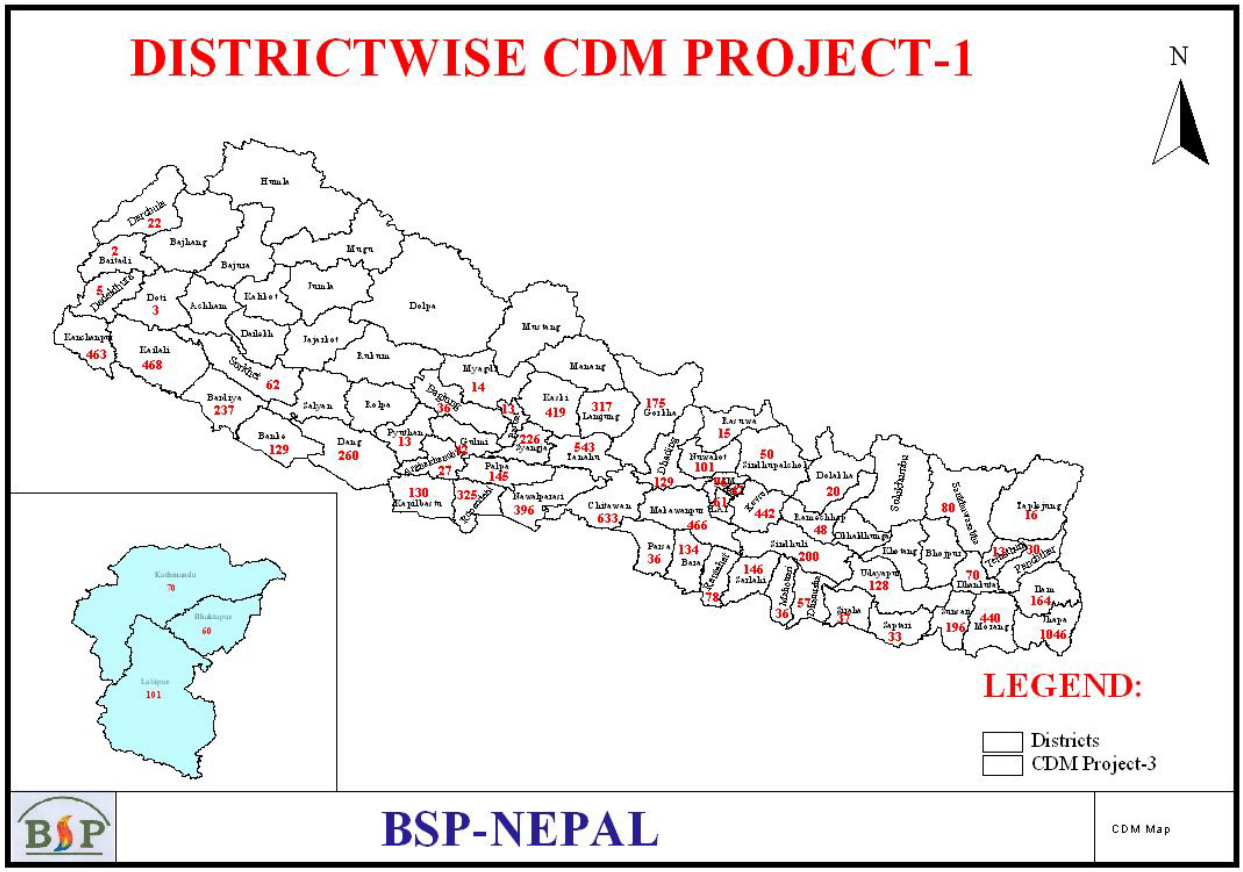
A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

The Kingdom of Nepal.

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

The biogas plants sold under the proposed program have been installed in 57 of 75 districts of Nepal. The geographic location details are given in the map below.



A.4.1.3. City/Town/Community etc:

The biogas plants sold under the proposed project will be installed in various locations in 57 out of 75 districts of Nepal.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):

The biogas plants under the proposed project will be sold across various locations in 57 districts of Nepal. The technology is best suited to the warmer districts existing below 2,000 m altitude; hence these districts are located mostly in the Terai and the Hills.[2] BSP-Nepal will rely on around 60 companies to sell plants through their 200 branches located in different parts of the country.

BSP-Nepal keeps record of the addresses of each household buying biogas plants under its program to allow for field surveys and for monitoring over the lifetime of the project. The plant record includes

[2] The regions located at the elevation from 100 to 500 above sea level are the Terai; the regions located at elevations ranging from 500 to 3,000 m above sea level are the Hills; and the regions located at elevation ranging from 3,000m up are the Mountain.

exact unique plant identification code, physical location, name of biogas household, size of plant, date of construction, and name of the construction company. The database is available upon request.

A.4.2. Type and category(ies) and technology of the small-scale project activity:

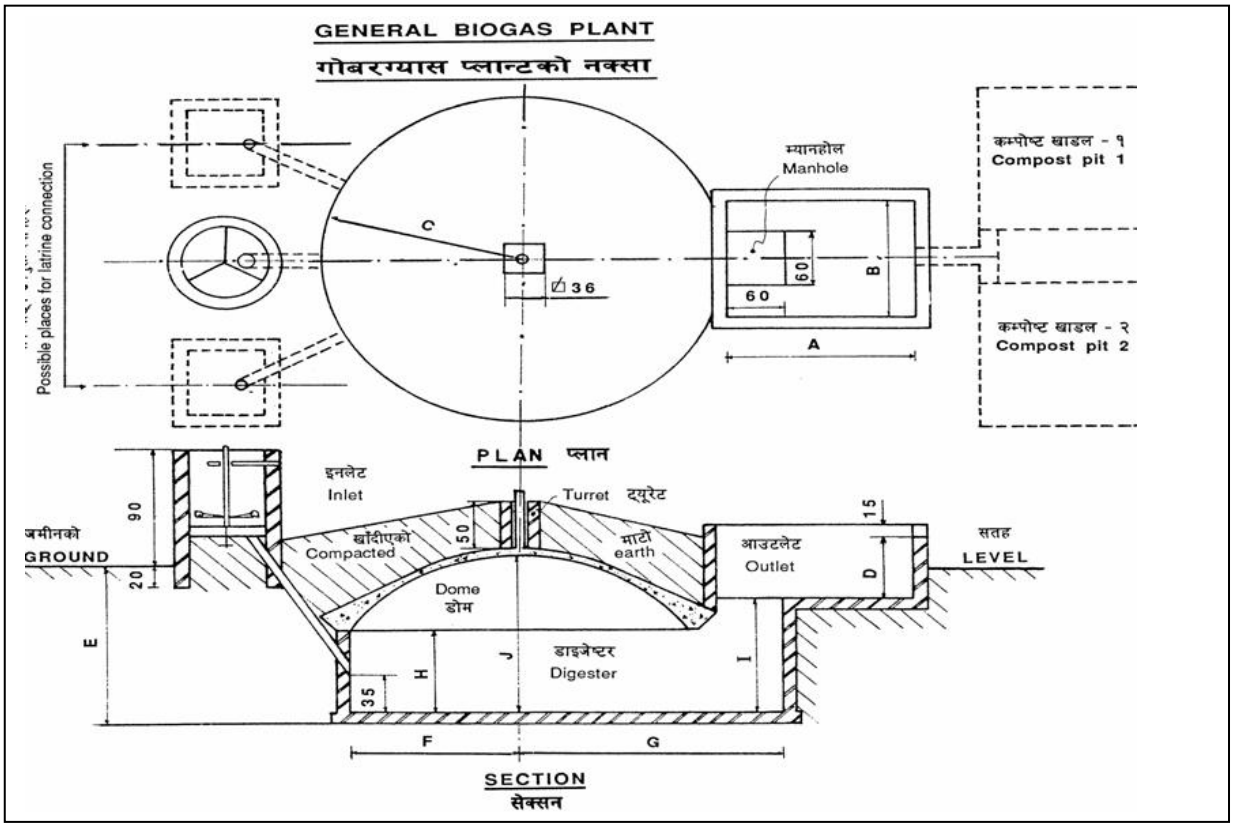
Types of the Project Activities:

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

Technology of the Project Activity:
The household biogas digester plants to be sold under this project activity will provide biogas for the thermal energy needs of households with at least 2 heads of cattle (cow or buffalo) and will 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 will feed dung of cattle (cows or buffaloes) mixed with water into the biogas plant, which through anaerobic digestion will produce biogas. The retention time of the slurry inside the tank is around 3 months. The figure below shows the technical design of the biogas plant.

Biogas household digester plants have been developed and produced in Nepal since 1977. Currently 60 private companies produce biogas plants. All biogas appliances except the main valve are produced locally, and are of good quality. Regarding the main valve, the limited biogas market does not justify the necessary investment for local production as yet; therefore the valves are imported from the Netherlands, Italy and/or Thailand. BSP-Nepal also provides R&D support and technical assistance to the individual companies. Over the last 10 years technology transfer has been facilitated, most notably through a long-term technical assistance program of the SNV (Netherlands Development Organization). The activities supported through this technical assistance have developed a large domestic knowledge base on construction, operation, and maintenance of high quality biogas plants.

Figure A.4.2



A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

- The project activity will reduce greenhouse gas emissions because biogas used for cooking will displace fuel wood and kerosene

Hence, the net annual emission reductions of one biogas digester averages 7.00 tCO2/year which aggregates 0.07 t CO_2e from kerosene displaced, 7.52 tCO_2e from firewood displaced and deduct 0.58. tCO_2e from methane leakage in the project and fugitive emissions due to incomplete combustion. This ER factor has been adjusted to reflect the geographic and size distribution of the installed biogas plants (Refer to Section B.5).

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

It is estimated that the proposed project activity will result in approximately 329,000 tons of net emission reductions over a crediting life of 7 years (2004-2011). This figure includes only those ERs that will be generated during the operation life of the biogas plants and will be further verified during the project operation. More detailed information on how anthropogenic GHG emission reductions will be achieved and the calculation of emission reductions are provided in Section B and Section E, respectively.

Please indicate the chosen crediting period and provide the total estimation of emission reductions as well as annual estimates for the chosen crediting period. Information on the emission reductions shall be indicated using the following tabular format

For type (iii) small-scale project the estimation of project emission is also required

Years	Annual estimation of emission reductions in tones of CO2 (tCO2e)
1 Aug 2004- 31 July 2005	46,990
1 Aug 2005- 31 July 2006	46,990
1 Aug 2006- 31 July 2007	46,990
1 Aug 2007- 31 July 2008	46,990
1 Aug 2008- 31 July 2009	46,990
1 Aug 2009- 31 July 2010	46,990
1 Aug 2010- 31 July 2011	46,990
Total estimated reductions (tonnes of CO_2e)	328,900
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tones of $CO2_e$)_	46,990

A.4.4. Public funding of the small-scale project activity:

The proposed project is a sub-project of the BSP-Nepal umbrella biogas program that received public funding from Parties included in Annex I, namely the German Development Bank (KfW) and the Directorate General for International Cooperation of the Government of the Netherlands (DGIS) through SNV as well as funding from His Majesty Government of Nepal (HMG/N) through the Alternative Energy Promotion Center (AEPC).[3] The providers of the public funding will not purchase any emission reductions generated by the proposed project and affirms that the funding of the project activities for the biogas program has not resulted in the diversion of ODA and that this funding is not counted towards the financial obligation of the concerned Parties. Additionally AEPC has also affirmed the same understanding regarding this funding.

The details of the committed amounts of public funding are given in Annex II.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:

The proposed project is not a debundled component of the BSP-Nepal umbrella biogas program according to the "debundling" rules specified in Appendix C of the simplified M&P for small-scale CDM project activities.

According to the rules, a small-scale project is a debundled component of a larger project if there is a registered small-scale activity or an application to register another small-scale activity:

- With the same participants;

[3] The Directorate General for International Cooperation of the Government of the Netherlands (DGIS) is the key funding source representing the Government of Netherlands.

- In the same project category and technology/measure;
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

The project participants of the proposed project are different from the project participants of another similar sub-project under the BSP-Nepal umbrella that has an application to be registered as a small-activity, thereby clearly demonstrating that the project is not a debundled component.

SECTION B. Application of a baseline methodology:

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

The baseline approach adopted for the BSP-Nepal is based on the small-scale CDM project activity categories contained in appendix B of the simplified M&P for small-scale CDM project activities.

The baseline for the category I. C. Thermal Energy for the User under Type I, Renewable Energy Projects, is defined as follows:

> "For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity times an emission coefficient for the fossil fuel displaced. IPCC default values for emission coefficient may be used."
>
> "For renewable energy technologies that displace non-renewable sources of biomass, the simplified baseline is the non-renewable sources of biomass consumption of the technologies times an emission coefficient for the non-renewable sources of biomass displaced. IPCC default values for emission coefficient may be used."

The biogas digester systems proposed in this PDD generate heat for their owners (households) and displace fossil fuels and/or non-renewable sources of biomass (kerosene and fuelwood).[4] As such this project qualifies under Section I-C of Appendix B of the small-scale guidelines.

B.2 Project category applicable to the small-scale project activity:

Household biogas digester plants provide biogas for the thermal energy needs of households with at least 2 heads of cattle (cow or buffalo). Biogas plants are generally held by farming households living in villages. The biogas digesters are based on a uniform technology manufactured and installed following BSP-Nepal's technical standards. All biogas digesters sold will be registered under BSP-Nepal and their performance monitored through field surveys of a random sample of the installed households. The biogas production of biogas plants will not be metered.

The key features are:

[4] 'Fuelwood' and 'Firewood' are used interchangeably through out the PDD.

1. The baseline and project emissions are based on the emission patterns of a number of randomly selected households. In a field survey, data are collected on both baseline and project emissions by interviewing households.
2. The emission reduction factor is expressed as the net emission reductions of a biogas plant i.e., baseline emissions minus project emissions. The standardized Emission Reduction Factors are determined for different biogas plants based on their geographic location and size. These factors are applied to all biogas plants sold under BSP-Nepal that meet the same specification

With reference to the modalities and procedures for small-scale projects, the above approach based on emission reduction calculation will cover the impact of use of biogas on conventional fuel reduction (such as fuel wood and kerosene).

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 small-scale CDM project activity:

A small-scale CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would occur in the absence of the registered CDM project activity and the project activity is facing one or more barriers as defined in Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities. Several barriers related to investment and technology are described below and hinder the development of the proposed bundle of small-scale CDM activities.

The additionality of the proposed project below is demonstrated in two steps. Since the proposed project activity is a sub-activity of the BSP-Nepal Umbrella Biogas Program, the first step examines the issue of additionality at the level of the umbrella program aiming to install all 200,000 new biogas plants. The second examines the additionality issue at the level of the households to be enrolled in the project.

Investment barrier at the level of the national program

The umbrella biogas program is the fourth phase of BSP Nepal's national biogas program. The CDM consideration has been built into the fourth-phase designed to install additional 200,000 small biogas digesters between Jan 2004-July 2010 and to make the biogas sector a commercially viable and market oriented sector. The timeline of the fourth phase design and preparation as well as acquiring funding from the international donors to provide upfront capital is as follows:[5]

Table B.3.1: Timeline of the fourth-phase biogas program development

Key Event	Date
1) Fourth–phase conceptualisation with the consideration of CDM	Feb. 2001
2) Baseline Study and Project Design Document Preparation:	Dec. 2002 – Sep. 2003
• Contract for PDD was signed with Eco Securities	Dec. 2002
3) Agreement with Donor to cover upfront subsidy investment	

[5] The documentary evidence to support the above timeline will be made available to the Validator upon request.

With SNV:	
Agreement between SNV and HMG/N for IV phase	Jun. 2003
With KFW:	
Preliminary MOU between KfW and HMG/AEPC for IV phase	Nov. 2003
Final agreement between KfW and HMG/AEPC for IV phase	Jan. 2005

With the full support of international donor funding by KFW and DGIS (through SNV), the first phase of the BSP program constructed 6,824 biogas plants during 1992-1994, the second phase constructed 13,375 plants during 1994-1996, and the third phase completed 91,196 plants during March 1997–June 2003. However, despite these past achievements, investing in a biogas plant remains a non-commercial activity in Nepal, as demonstrated in the next section. Furthermore, by the end of the third phase, KFW and DGIS decided to gradually phase out their support to the biogas program by 2009. Therefore, under this scenario, the fourth phase came into existence as a CDM project activity with the aim of making the biogas sector a commercially sustainable sector through integrating carbon revenues benefiting a large rural population.

The following are the unique approaches of the fourth phase:

- Financial support for end-users through micro-finance institutions and cooperatives;
- Uniform technical design of biogas plants;
- Thorough quality control and monitoring of the production, installation and after-sales services of the participating biogas companies;
- Continuous research & development efforts to optimise plant operation and to tailor the biogas plants to the needs of the end-users;
- Social marketing through outreach, awareness, and training programs;
- Implementation of fertilizer extension program to maximize the benefits of bio-slurry, a by-product of the biogas;
- Support to institutions servicing various functions of the biogas sector such as financing, construction, maintenances, manufacturing, training, and marketing, and
- Installation of biogas plants on a scale that demonstrates CDM application in the commercialisation of the biogas sector.

Without the CDM, the biogas sector in Nepal would diminish as the donors' support shrinks. For the application of the CDM to making the biogas sector economically viable, installation of at least 200,000 biogas plants is necessary. By implementing the above approaches, all 200,000 biogas plants can gradually penetrate into rural households over a period of several years, creating "a learning by doing" opportunity to utilize the CDM funding mechanism to commercialise the biogas sector in Nepal. Making biogas plants financially accessible on a large scale while promoting and maximizing their socio-economic and carbon value would create an economic basis for future biogas sector investments. The optimisation of the technological performance through R&D and rigorous quality control would build a sound technological base. In addition, the institutional development to facilitate various functions of the biogas sector, such as financing, construction, maintenances, manufacturing, training, and marketing, would further establish the sustainability of the biogas sector.

The implementation of the fourth-phase umbrella requires a total finance of US$ 25.3[6] million. The cost of subsidies totals US$ 20.5 million, and the operations and maintenance cost is US$ 4.8 million.

[6] An exchange rate of 1US$=73NRs is used in throughout the PDD.

The government of Nepal (through AEPC) along with the German Development Bank (KfW) and the Directorate General for International Cooperation of the Government of the Netherlands (DGIS) provide total funding of US$ 19.7 million for upfront capital for program implementation. This funding constitutes a US$ 9.15 million contribution from KfW, US$ 4.92 million from DGIS/The Government of the Netherlands, and US$ 5.61 million from HMG/Nepal. Even with these funding contributions, the project proponent still faces a shortfall of US$ 5.6 million that the Nepali government is unable to cover. Thus, the carbon finance will fill the financing gap due to a reduction in and phase-out of donor support.

By combining carbon revenues earned from selling the generated ERs with the remaining public donor support it will be possible to build upon the previous efforts to develop the biogas sector and transform it into a commercially viable sector. At the time of reaching the agreement to provide funding support to the fourth-phase (refer to Table 3.1), both KFW and DGIS/SNV fully recognized that biogas plants have a GHG mitigation potential that has a financial benefit that is achievable under the CDM, and the income from the sales of GHG emission reductions will help achieve the fourth-phase target of installing 200,000 biogas plants and making the biogas program a commercially sustainable activity.

Investment barrier at the level of households

The high up-front investment cost of a biogas plant is a barrier for poor cash-strapped farmers in Nepal. Depending on size and location, a biogas plant costs between US $251 and $393 (Table B.3.1). For a Nepali farmer, the conventional and least cost cooking technology is the traditional or improved stove burning a combination of firewood, agricultural residue, and animal manure. The conventional lighting fuel is kerosene used in small wick lamps. Tea shops and a few families living in towns or next to motorable roads where firewood is likely to be scarce use kerosene in pressure stoves for cooking in market areas. Both the traditional stove and the improved cooking stove are low-cost devices constructed from local materials. The total cost of an improved stove can range from US$3-6 and the cost of a kerosene stove ranges from US$6-8.[7]

The high up-front investment cost of a biogas plant inhibits a poor farmer from adopting the technology, making the subsidy provided under the proposed project an essential economic incentive for farmers deciding to purchase a biogas plant. The subsidies range from $73 in the Terai to $113 in the Hills (Table B.3.1). The higher levels of subsidy in the Hills and mountain areas are intended to compensate for higher costs of construction, relatively lower gas production, and less likelihood of fuelwood purchase in those locations. The subsidies are greater for 4m^3 and 6m^3 plants than for 8m^3 and 10m^3 plants. This is to encourage poorer farmers who have fewer cattle and are less likely to pay for firewood to purchase plants.

Table B.3.2: Cost of biogas plants in Nepal (US$).

Size (m^3)	Location	Average Cost	Subsidy	Net Cost
4	Terai	251	73	178
4	Hill	261	113	148
6	Terai	284	73	211
6	Hill	295	113	182
8	Terai	335	67	268

[7] The cost of constructing an improved cook stove depends on the design used. $1-2 of steel ‘reinforcement’ is often used. Other construction materials, such as stone and clay, are locally available. A trained stove builder will charge between $2-4 to construct the stove..

8	Hill	350	107	243
10	Terai	376	67	309
10	Hill	393	107	286

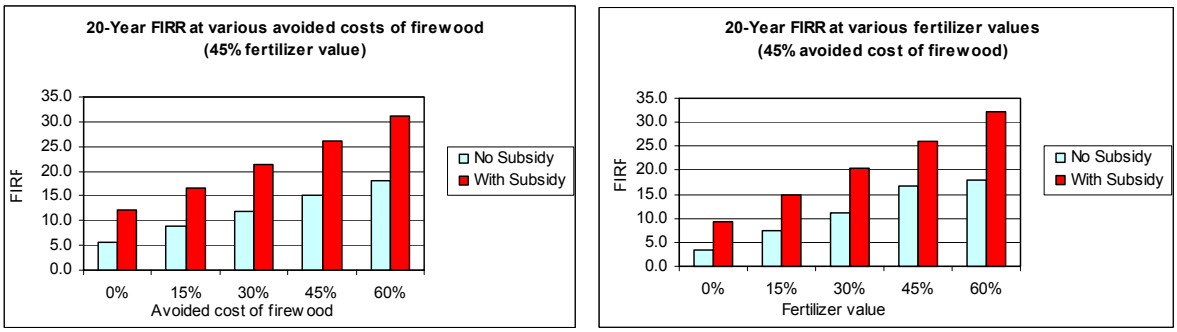
Source: Winrock International 2004.

The earlier phases of the BSP-Nepal program targeted more accessible areas where a higher percentage of households purchase cooking fuel. The proposed project aims to introduce new plants in more remote communities where the majority of households would not purchase firewood in the absence of the project activity. Although the percentage is not precisely known, existing studies and consulted experts are in agreement that the large majority of farmers acquire firewood at no monetary expense.

Only a minority of rural Nepali households – primarily those living in market towns or next to motorable roads – purchase firewood in the market or cook with kerosene or LPG. The majority collects fuel from the closest forest. Firewood can be costly if purchased at the official government price of about US$0.02/kg of wood and a liter of kerosene costs US$ 0.46, whereas biogas has no running costs except the cost of labor to feed manure into the plant and to maintain the plant. The average annual maintenance cost of the biogas plant is about US$2.

The analysis below shows that the 20-year Financial Internal Rate of Return (FIRR) of an average 6 m^3 plant is sensitive to two kinds of annual cost savings that a participating farmer would achieve by investing in a biogas digester. These savings are the avoided cost of firewood and the avoided purchase of inorganic fertilizer as a result of the use of biogas slurry (bio-slurry).

Figure B.3.1: Sensitivity Analysis[8]



In this analysis, a biogas digester investment is considered financially attractive if the FIRR (20-year) is higher than the interest rate (cost of capital) for plant installation, i.e. 15%. Without the subsidy, the FIRR values indicate that the investment is only profitable under one of the following scenarios:[9]

a) the household would purchase none of its firewood consumption but would realize 85% of the fertilizer benefits from bio-slurry;
b) the household would purchase 45% of the firewood consumption and realize 45% of the fertilizer benefits; or
c) the household would purchase 100% of the consumed firewood but would realize no fertilizer benefits

[8] For detail analysis, refer to (BSP) Plant Level Financial Sensitivity Analysis Spreadsheet in Annex IV.
[9] For details, use the financial analysis model presented in (BSP) Plant Level Financial Sensitivity Analysis Spreadsheet in Annex IV .

A recent BSP-Survey reports that the Hill household using a biogas plant would purchase on average 11.5% less firewood annually compared to the amount that it would have purchased without a biogas plant and would achieve little or no benefits in terms of bio-slurry value (the remaining firewood collected at no expense).[10] Since the bio-slurry use is a new practice in Nepal, this study also indicates that the sampled households did not have confidence in this new source of fertilizer to reduce purchase of commercial inorganic fertilizers; consequently, the households realized little financial value from the bio-slurry use. Although no survey is available for the Terai, the Terai households are expected to purchase a greater percentage of firewood, thereby potentially achieving greater savings from avoiding the firewood purchase by using a biogas plant than the households in the hills (due to the scarcity of available forest firewood).[11] Nevertheless, given the minimal fertilizer benefits that the biogas households are realizing from the bio-slurry, it is extremely unlikely that the Terai household would realize at least 47% of fertilizer value from the bio-slurry, which is required for a profitable investment. A household that would achieve no financial value from bio-slurry use would only regard the biogas investment as profitable if it had purchased at least 95% of the amount of annually consumed firewood (which would be substituted with a biogas digester). However, this scenario, too, is unlikely since the targeted households in the project are located in remote areas and most probably will acquire firewood at no cost. This strongly indicates that the targeted farmers in both Terai and Hill would not invest in the biogas digester unless they would receive a subsidy that fills their cost gap.

With the subsidy provided in the project case, even if no value from fertilizer displacement is achieved, 15% avoided cost of firewood would result in a break-even, and a 30% avoided cost of firewood would result in a FIRR of about 7%. Conversely, for households that would have purchased no firewood, 15% of the fertilizer benefits would almost result in break-even and 20% of fertilizer in a FIRR of 1.3%. The project is expected to increase fertilizer benefits of the bio-slurry for the participating households through a planned fertilizer extension program. The project through social marketing activities will further enable these households to incorporate not-yet monetized benefits of the biogas use, such as time savings and improved health through reduced indoor smoke and improved sanitation, in their investment decision. Thus, the subsidy provision along with social marketing and fertilizer extension activities under the project would provide socio-economic incentive for a farmer to buy into the biogas program.

Technology barrier: A well-known barrier for the dissemination of biogas digesters worldwide is the poor quality of biogas systems. In the absence of a proper quality control program, suppliers of biogas plants would compete solely on price. Users cannot determine the quality of biogas plants. Thus, without the proposed CDM project activity, biogas companies would have an incentive to save on costs and provide poor quality systems. The dissemination of low-quality biogas plants would lead to lack of trust in the technology, resulting in a vicious circle with less demand, fewer margins on biogas digesters sales, and more cost savings. This vicious cycle is a barrier to the successful adoption of the biogas digester technology in Nepal. Currently, in addition to the subsidy that it administers, BSP-Nepal provides quality control on all plants constructed by participating companies. In fact, it is this “carrot” and “stick” approach that results in high quality plants, which is at the heart of the success of BSP-Nepal. BSP-Nepal has built up its comprehensive system of quality control in order to make sure that high quality biogas plants are consistently produced. CDM revenues can support this quality control and assurance function of BSP-Nepal necessary to maintain the construction standard and, subsequently, the performance of the technology.

[10] The study report is available for the validator upon request.
[11] Refer to Unsustainable Fuel wood Calculation Spreadsheet in Annex V.

In essence, without carbon revenues, the Nepali government's program to make the biogas sector a commercially viable and market-oriented sector would be in jeopardy and would most likely not achieve its program objectives. Moreover, it is evident that the most likely development in the absence of the proposed project activity is that the households to be enrolled in the project would continue to use conventional fuels to meet their cooking energy needs. Additionally, it is most likely that they would continue disposing the manure of their cattle according to their conventional practices.

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

At the unit level, the project boundary is defined by the individual sites and refers to the operation of the biogas digester at the household level. Table B.4.1 shows the emission sources that are under the control of the project participants, significant and attributable to biogas digesters. Figure B.4.1 and B.4.2 show the physical relation between the emission sources and the project boundary.

Table B.4.1 Overview of emission sources

Emission source	Baseline	Project
Fuel use	CO_2 emissions from kerosene	None
	CO_2 emissions from burning unsustainable fuel wood	None
	CH_4 emissions from burning of fuel wood	None
Fugitive emissions		Biogas (CH4) leaks from digester and incomplete combustion

Notes:
1. The CO_2 emissions from renewable sources, most notably biogas (project) and agricultural residues (baseline) have been excluded from the emission sources, as they do not lead to a net emission reduction.
2. Insignificant emission sources (emissions < 1% of total baseline emissions) are not included in the Table. These emissions are:
- Emissions from construction of biogas digesters;
- CH_4 and N_2O emissions from burning biogas;
- CH_4 and N_2O emissions from burning kerosene;
- CO_2, CH_4 and N_2O emissions from burning LPG.

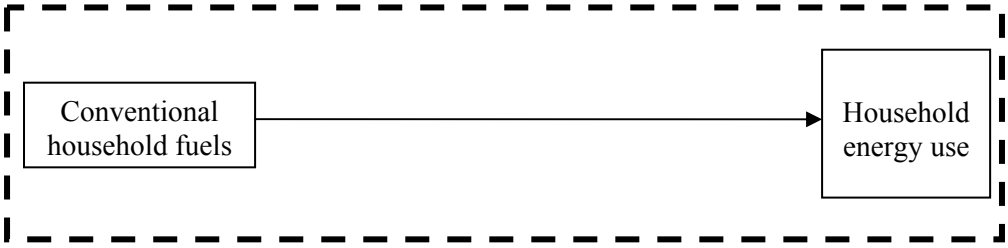


Figure B.4.1: Baseline emissions. Sources of GHG emissions and uses

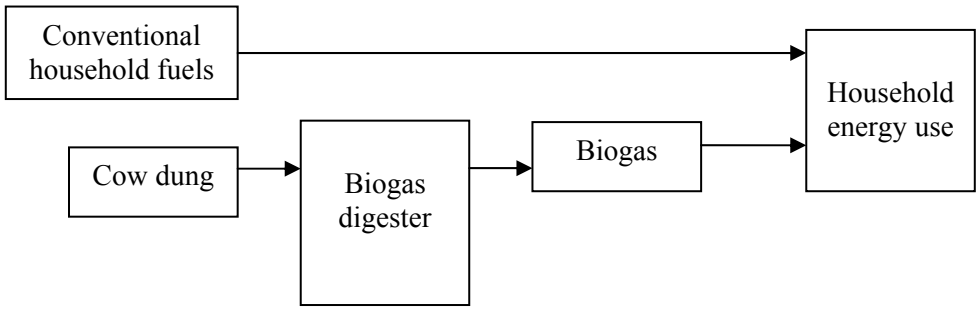


Figure B.4.2: Project emissions. Sources of GHG emissions and uses

B.5. Details of the baseline and its development:

Specification of baseline:

As indicated in B.2, the approach to the baseline is the calculation of the net emission reduction factor per biogas plant. In line with the spirit of the baseline methodology specified in appendix B of the simplified M&P for small-scale CDM project activities, a process consisting of 5 steps is followed to determine the net emission reductions:

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

Step #1: Identification of baseline and project emission sources.

Baseline and project emission sources have been identified as listed in Table B.4.1.

Step #2: Identification of emission factors.
Manure - In accordance with the Nepal national GHG inventories, the emission factors for dairy, non-dairy cattle and for buffaloes are taken from the IPCC Tier 1 approach.[12] IPCC Tier 1 emission

[12] National GHG inventories, 2002.

factors rely on default emission factors drawn from previous studies. The Tier 1 approach is likely to be sufficient for most animal types in most countries. Tier I methodology emission factor for India & subcontinent assumes that half of the dung is used for fuel and the remainder is managed in dry lots. This is in line with the situation in Nepal. Estimated dung use for fuel in Terai is roughly 46% and in Hills around 36%.[13] For chemical fuel/methane leakage the default emission factors have been taken from the IPCC.[14] GWP of methane is 21.

The references for each emission factor are provided in the detailed description of the emission calculation formulas in section E.

Step #3: Identification of activity volumes.

The following activity volumes need to be measured:
- Amount of fuel saved per household
- Amount of methane leakage from biogas digesters into the air.

Data sources used to estimate volumes:
- BSP-Nepal's Environmental Impact Study – This Study includes an extensive household survey among 1,200 households (600 biogas users, 600 non-users) which has been used to assess changed household behavior in relation to consumption of fossil fuels and fuel wood due to the introduction of biogas digesters.
- BSP-Nepal's database on biogas users - This database contains a wealth of information from the BSP-Nepal quality control program on the total population of biogas plants sold so far in Nepal (totaling over 100,000). Information is mostly technical and related to gas production, such as cow dung fed into biogas digesters.

In measuring the emission volumes the following factors have been taken into account:
- Size – emission reductions are likely to be a function of the amount of biogas produced and consumed which in turn is determined by the size of biogas digester. The most common biogas digester plants sold under BSP-Nepal are 4 m^3, 6 m^3, 8 m^3 and 10 m^3. Incidentally, also systems of 15m^3 and 20 m^3 are sold, although these larger plants are no longer recorded by BSP-Nepal. These systems have been included in the category 10 and larger.
- Geographic zone – As previously mentioned, Nepal is characterised by three distinctive geographic zones: Terai, Hills, Mountains. The different environments and possible different habits of people living in these zones may have an impact on the volume of baseline and project emissions. In the case of Nepal, the data have been distinguished between these three regions.

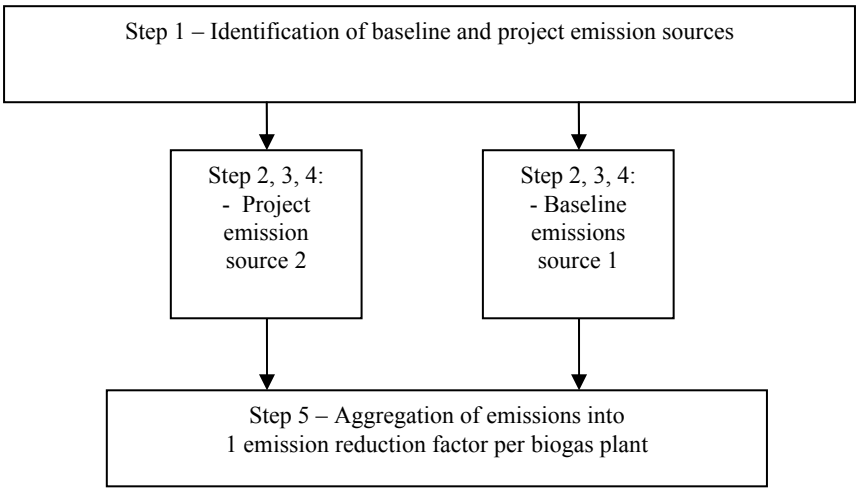
The references for each emission factor are provided in the detailed description of the emission calculation formulas in section E.

Step #4: Calculation of emissions per source.
The emissions per source have been calculated according to a specific calculation formula, which combines the activity volumes per plant per region with the emission factor.

[13] Water and Energy Commission Secretariat, 1995, p.64.
[14] IPCC, 1996.

Step #5: Calculation of emissions reduction factor.
For each plant in each region the emissions for the various sources have been aggregated (baseline emissions minus project emissions) resulting in one emission reduction factor per plant per region.

The figure below shows an overview of the different steps in the project cycle.



Source 1: Fuel Displacement
Source 2: Fugitive emissions from leakage from biogas digester and from incomplete combustions

The aggregate emission reduction factors are shown in table B.5.1.

Table B.5.1: Aggregate emission reductions factors

Size biogas digester	**Terai (tCO2e/year /plant)**	**Hill (tCO2e/year /plant)**	**Mountain (tCO2e/year /plant)**
4 m^3	2.94	5.43	5.43
6 m^3	6.83	7.60	7.60
8 m^3	8.45	9.42	9.42
10m^3	6.61	7.03	7.03

Geographic and size distribution of biogas plants in the proposed project:

Size if plant	Hill	Terai
4m^3	13%	2%
6m^3	33%	39%
8m^3	1%	10%
10m^3	0%	1%

Emission Reduction factor of the biogas plants under the proposed project (weighted according to geographic and size distribution):

7.00 tCO2e/year /plant

For the purpose of conservative estimation and meeting the threshold emission reduction per system for the application of the monitoring methodology defined under the small scale Methodology

applicable under I.C.9(c), each biogas digester under the proposed project will claim emission reductions of only 4.99 tCO_2/plant/year (this ER factor only applies to those plants that generate ERs exceeding 5 tCO_2/plant/year)

Date of completion of the final draft of this baseline section *(DD/MM/YYYY)*:
15/2/2005.

Name of person/entity determining the baseline:

A consortium consisting of EcoSecurities and Winrock International Nepal has developed the baseline. These entities are not project participants. The contact persons are given below.

Jan-Willem Martens EcoSecurities B.V. Mauritskade 25 2514 HD Den Haag The Netherlands Telephone (31) 70 – 365 4749 Fax: (31) 70 365 6495 Jan-willem@ecosecurities.com	Mr. Bikash Pandey Winrock International Nepal. 1103/68 Devkota Marga, Baneshwor, P.O. Box 1312, Kathmandu, Nepal. Tel: 977-1-4467087, Fax: 977-1-4476109 bpandey@winrock.org.np

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

C.1.1. Starting date of the small-scale project activity:

November 1, 2003

C.1.2. Expected operational lifetime of the small-scale project activity:

21y.

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

C.2.1. Renewable crediting period:

Yes.

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

2004/08/01

BIOGAS PLANTS INSTALLED BETWEEN '01-NOV-2003' AND '15-JUN-2004

C.2.1.2. Length of the first crediting period:

7y.

C.2.2. Fixed crediting period:

Not applicable

C.2.2.1. Starting date:

C.2.2.2. Length:

SECTION D. Application of a monitoring methodology and plan:

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

In line with the selected baseline methodology in Section B, the monitoring methodology in Annex B of the simplified M&P for small-scale CDM project activities that applies to this project is:

I.C. Thermal Energy for the User:
"If the emissions reduction per system is less than 5 tons of CO2 a year:

(1) Recording annually the number of systems operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute),
(2) Estimating the annual hours of operation of an average system, if necessary using survey methods. Annual hours of operation can be estimated from total output (e.g. tonnes of grain dried) and output per hour if an accurate value of output per hour is available.

Of important note, in the case of the BSP-Nepal project, condition 2) has been adjusted to estimating directly the reduction in conventional fuel consumption (e.g. fuel wood, kerosene), that is before and after the household installed a biogas digester, through a household survey.[15] In the context of household biogas digesters this is a more accurate method for estimating emission reductions per system than the estimation of annual hours of operation of the biogas digester for the following reasons: 1) intensity of biogas use (high flame/low flame) can vary resulting in an unstable relation between operation hours and consumed biogas energy; 2) little is known between the direct link between hours of biogas use and reduction in conventional fuel wood consumption 3) by measuring directly the fuel consumption, the savings are corrected for any direct rebound effects (the increase in consumption of the saved fuel for other purposes).

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

The above choice of the methodology is most suited for the proposed project for the following two reasons:

The tracking system applicable under the above proposed methodology already exists within BSP-Nepal to monitor the number and performance of all installed biogas plants. Therefore, the use of the above methodology will allow accurately monitoring and verifying the generated emission reductions and achieving costs savings necessary for the feasibility of this small-scale CDM activity. The existing monitoring system consists of the following elements:

Sales Registration and Sales Monitoring:

Biogas digesters installed by eligible companies will become eligible as soon as they are registered in the BSP-Nepal database. The eligibility of biogas companies under the CDM project is based on their adherence to BSP-Nepal's quality monitoring program and end-user subsidy program. The criteria for companies to be eligible under this program are:

[15] Based on survey database of "*An Integrated Environment Impact Assessment, Final Report, Biogas Support Programme"* BSP-Nepal 2002.

i. Registered as a company in the Department of Industry of HMG/Nepal[16];
ii. Experience in biogas construction;
iii. With sufficient skilled labour force;
iv. Strong financial position;
v. Good business plan.

BSP-Nepal has registered all eligible biogas plants in an annual system installation report. The annual system installation report has been issued per biogas company. It provides the information necessary to determine how many biogas plants have actually been sold and constructed. Biogas Sector Partnership-Nepal has extensive experience in verifying the sales records of participating biogas companies.

ISO Certification & Quality Control and Assurance Monitoring
Biogas Sector Partnership-Nepal has been ISO-9001/2000 certified by JAS-ANZ/ICL Certifications Limited. Under this certification, BSP-Nepal is mandated to carry out quality control (QC) and quality assurance (QA) procedure as described in Section D.4.

Under quality control and quality assurance obligation, BSP-Nepal though biogas companies verifies at least 15% of all installed biogas plants over a period of three years: 5% of newly installed plants, 5% of plants installed during the previous year, and 5% of plants installed two years ago.

For emission reduction calculation and verification, BSP-Nepal has included additional indicators in its standard QA/QC monitoring.[17]

Biogas User's Survey
Additionally, a Biogas User's Survey is annually undertaken through an independent third party consultant for evaluating the impacts of biogas installed. The survey is part of monitoring and evaluation activities of AEPC in coordination with BSP-Nepal and has included additional monitoring parameters necessary for the purpose of monitoring emission reductions.

Performance Monitoring – Under the CDM, only emission reductions that are monitored and verified can be claimed. Only those biogas households that are operating is counted toward emission reduction calculation by using the performance rate of the installed biogas plants. Through a sample survey, the number of systems out of order are determined and the performance ratio is calculated by taking the percentage of the sold biogas digesters under BSP-Nepal that are still operating.

BSP-Nepal itself or through an independent third party also occasionally verify the performance of the installed plants whenever it feels necessary for cross-checking purpose. The past performance monitoring data shows 97% performance ratio.

[16] His Majesty Government of Nepal

[17] The monitoring of additional indicators will start from 2006.

Section E for a detailed description of how ERs are calculated based on monitored biogas plants.

D.3 Data to be monitored:									
ID	**Data type**	**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)**	**For how long is archived data to be kept?**	**Comment**	**Responsible Authority**
1	Sales registration	Registration of sales	M	continuous	100%	Electronic	Until 2 years after the last issuance of ERs for this project activity	Data is annually reported in the annual installation report	BSP-Nepal in coordination with Biogas Companies
2	Sales monitoring	Verification of installation	M on basis of a sample	Annually	15% (5% of each generation for 3 years)	Electronic	Until 2 years after the last issuance of ERs for this project activity	Data will be aggregated monthly and yearly as part of ISO Verification for quality control and assurance	BSP-Nepal in coordination with Biogas Companies
3	Performance monitoring	Performanc e ratio	(m) + (c) + (e)	Annually	Statistically significant sample will be chosen and adopted	Electronic and paper	Until 2 years after the last issuance of ERs for this project activity	For first 3-years of the installation, data is collected as part of ISO Monitoring and Verification for quality control and assurance and beyond 3-years, as part of the Annual Users' Survey	BSP-Nepal
5	Reduction in kerosene used for cooking	Litre	(m) + (c) + (e)	Annually	Statistically significant sample will be chosen and adopted	Electronic and paper	Until 2 years after the last issuance of ERs for this project activity	Same as before	BSP-Nepal
6	Reduction in firewood used for cooking	Kg	(m) + (c) + (e)	Annually	Statistically significant sample will be chosen and adopted	Electronic and paper	Until 2 years after the last issuance of ERs for this project activity	Same as before	BSP-Nepal
5	Accessibility to sustainable biomass.**		(m) + (c) + (e)	Annually	Same as before	Electronic and paper	Until 2 years after the last issuance of ERs for this project activity	Same as before	BSP-Nepal

**This parameter will check whether the biogas households under the proposed project will continue over time to be substituting for non-renewable biomass, by means of questionnaire. Based on the perceptions of the sampled user and non-user households in terms of positive or negative trends in accessibility to firewood, sources of firewood and forest re-growth around the household vicinity, the percentage of substituted biomass that can be considered non-renewable will be computed and revised each year.

D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

BSP-Nepal has prepared BSP-Nepal Quality Control Quality Manual that describes the process and the ISO clauses for the core business Quality Control. The core business quality control mechanism involves AEPC, BSP-Nepal, NBPG, recognized workshops, recognized biogas companies and biogas owners. Main tasks of these participants are summarized below:

Biogas Owner: Biogas owner receives controller (either from BSP-Nepal, biogas company or NBPG) who checks the status of the plant, carries out final audit for after sales service. Biogas owner also receives on the spot advice if necessary.

Recognized Biogas Company: The company representative must accompany BSP-Nepal staff and NBPG staff on final product audit and receive any advice from BSP-Nepal about the function and maintenance issue. The company receives early warning every month and gets status according to the performance rating system based on the ISO-9001/2000 at the end of the construction period which is also linked to incentives.

Recognized Workshop: BSP-Nepal has an agreement with recognized biogas appliances manufacturing companies. These companies are mandated to use workshop manual that has the BSP-Nepal agreement, drawings and standards for biogas appliances. Quality control staff from BSP-Nepal go to the workshop to check if the standards are met.

AEPC and NBPG: Both of these organizations execute quality control of companies as per agreement with BSP-Nepal.

BSP-Nepal: BSP-Nepal carries out thorough quality control activities to ensure that the biogas plants are built with quality standards. This includes setting up random sampling, field visits, on the spot advice to biogas companies and biogas owners, collecting and analyzing data obtained through questionnaire during visits, sending warning reports to biogas companies every month, organizing and attending national quality review meeting, adopting “rewards or punishment” system to biogas companies etc. At least 5% of the constructed plants in any year are visited by BSP-Nepal staff for quality control. BSP-Nepal also calculates a Biogas Performance Index (BPI) (which is a composite of allocated points for Production, Average Default, Average Penalty, Average Feeding %, Accuracy, Maintenance, After Sales Service Progress) to show the status of each participating biogas company.

BSP-Nepal is ISO-9001/2000 certified by JAS-ANZ/ICL Certifications Limited. The ICL Certification Limited carries out annual surveillance audit to verify that the standards and procedures mentioned in the BSP-Nepal Quality Control Quality Manual are still maintained in accordance with ISO 9001:2000. The key elements of ISO verification include management commitment for customer and quality policy; review of management focusing on planning, responsibility, authority & communication; provision for resources; human resources; infrastructure; work environment; planning of product realization; purchasing; production and service provision; monitoring and measurement; data collection and analysis etc. One main component of this audit is to confirm if review, verification and validation of design and development have been performed and if any changes in design and development are controlled. The audit also focuses on monitoring and measurement of customer satisfaction, internal audit, monitoring and measurements of processes and products, control of nonconforming product, actions for preventive as well as corrective measures. This thorough process already encompasses required activities for CDM monitoring and thus no separate monitoring would be required.

The BSP-Nepal Quality Control Quality Manual and details of ISO-9001/2000 verification can be obtained from BSP-Nepal.

D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:

Project Implementation:
AEPC is responsible for ensuring the overall implementation of the proposed project activity. Under the supervision of AEPC, BSP-Nepal acts as an intermediary agency to ensure the management and operation of the proposed project activity.

Execution of Monitoring Plan
BSP-Nepal as an intermediary will manage the implementation of the Monitoring Plan including Quality Control and Assurance meeting the CDM requirements for the collection, processing, and auditing/verification of data.

Technical Capacity and Training
BSP-Nepal is responsible to ensure that the required capacity and internal training is provided to its operational staff to implement the Monitoring Plan.

D.6. Name of person/entity determining the monitoring methodology:

The monitoring plan has been developed by a consortium consisting of EcoSecurities and Winrock International Nepal. Contact persons:

Jan-Willem Martens EcoSecurities B.V. Mauritskade 25 2514 HD Den Haag The Netherlands Telephone (31) 70 – 365 4749 Fax: (31) 70 365 6495 Jan-willem@ecosecurities.com	Mr. Bikash Pandey Winrock International Nepal. 1103/68 Devkota Marga, Baneshwor, P.O. Box 1312, Kathmandu, Nepal. Tel: 977-1-4467087, Fax: 977-1-4476109 bpandey@winrock.org.np

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

E.1.1 Selected formulae as provided in appendix B:

Since appendix B does not indicate a specific formula to calculate the GHG emission reductions by sources, description of formulae is given in E.1.2

E.1.2 Description of formulae when not provided in appendix B:

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

As mentioned in Section B.2, the approach to the baseline of the proposed project is based on the calculation of a standardized emission reduction factor per biogas plant taking into account both baseline emissions and project emissions. For clarity and flow of presentation, all emission sources and their calculations are therefore discussed under E.1.2.4**.**

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

There is no leakage due to the project activity. In the project baseline, the supply and demand of the cattle manure is confined within the project boundary of an individual household. The wet manure is used as compost for the household's own use and the dry manure as dung-cake for cooking. Since the biogas plant will generate more efficient and clean fuel to substitute for the previously used cow dung, the net effect on the cow dung availability will be zero. Similarly, the biogas plant produces residual bio-slurry that has superior fertilizer value than the compost fertilizer.

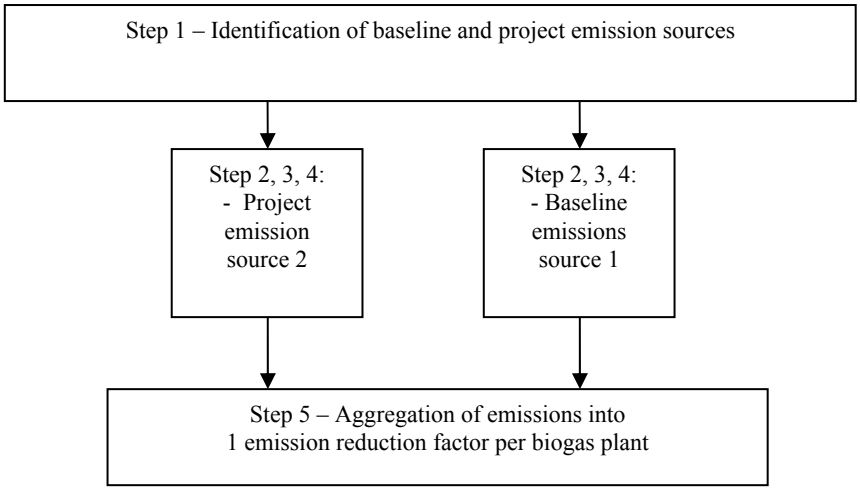
Any other potential emission sources and possible leaks within the project boundary were identified and incorporated in the formulae to calculate the standardized emission reduction as indicated in Section E.1.2.1. The details are explained in Section E.1.2.4.

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

Not applicable.

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

The baseline methodology steps outlined in B.5.1 have been followed to calculate the standardized emission reduction factor (see figure below).



Source 1: Fuel Displacement
Source: Fugitive emissions from leakage in biogas digester and incomplete combustion

Step 1: Identification of emission sources

Table E.4-1 Overview of emission sources

Emission source	Baseline	Project
Fuel use	CO_2 emissions from kerosene	None
	CO_2 emissions from burning unsustainable fuel wood	None
	CH_4 emissions from burning of fuel wood	None
Fugitive		Biogas (CH4) leaks from digester and incomplete combustion

Step 2, 3 and 4 per emission source

Below for each source, step 2, 3 and 4 are outlined.

Fuel baseline

I. CO2 emissions from kerosene:

Emission factors (step 2):

2.41 $kgCO_2$/liter kerosene.[18]

Volume estimation (step 3):

- Consumption of kerosene per day before installation (in litres/day);[19]

[18] IPCC, 1996.

- Consumption of kerosene per day after installation (in litres/day).[20]

Calculation of emissions (Step 4):
Calculation formula for each plant size per region in tCO_2eq/year:
- Kerosene savings in litres per day* 365 * 2.41 $kgCO_2$/liter/1000.

II. CO_2 emissions from fuel wood:
Emission factors (step 2):
1.83 $kgCO_2$/kg of fuel wood.[21]

Volume estimation (step 3):

- Average consumption of fuel wood per day before installation (in kg/day);[22]
- Average consumption of fuel wood per day after installation (in kg/day);[23]
- Share of unsustainable fuel wood consumption per household.[24]

Calculation of emissions (Step 4):
Calculation formula for each plant size per region in tCO_2eq/year:
- Fuel wood savings in kg per day * % of unsustainable fuel wood consumption per hh[25] * 365 * 1.83 $kgCO_2$/kg of fuel wood/1000.

The methodology utilized to claim non-renewable biomass as a source of emission reductions shows that all 100% fuelwood consumption in a biogas household should be considered unsustainable. The methodology is described in Annex III.

III. CH_4 emissions from fuel wood burning
Emission factors (step 2):
- 3.0g C methane emissions from burning 1 kg fuel wood[26]
- 1 gC = 1.3 gCH_4
- 21 $tCO2eq/tCH_4$ = GWP of methane

Volume estimation (step 3):
- Average consumption of fuel wood per day before installation (in kg/day);
- Average consumption of fuel wood per day after installation (in kg/day);
- Share of unsustainable fuel wood consumption per household.

Calculation of emissions (Step 4):
Calculation formula for each plant size per region in tCO_2eq/year:
3.0 gC * 1.3 gCH_4/gC /1,000,000 * 21 tCO_2eq/tCH_4 * fuel wood savings in kg per day * 365

IV. CH_4 emissions from biogas leakage from the digester

[19] BSP-Nepal, 2002.
[20] BSP-Nepal, 2002.
[21] IPCC, 1996.
[22] BSP-Nepal, 2002.
[23] BSP-Nepal, 2002.
[24] See Annex V for further explanation.
[25] hh refers to Household
[26] Smith et al, 2000.

Emission factors (step 2):
- GWP(CH_4) = 21tCO_2eq/tCH_4
- 12.5% = Methane leakage per biogas digester[27] (= conservative estimation based on IPCC range of 5-15%)[28]
- 0.71 kg/m^3 = density of methane[29]

Note: Although the IPCC range is between 5-15%, the methane leakage of 12.5 % is assumed taking into account both leakage from biogas digester and CH4 emissions from incomplete combustion.

Volume estimation (step 3):
- Biogas production in m^3 per plant;[30]
- Methane concentration in biogas in percentage;[31]

Calculation of emissions (Step 4):
Calculation formula for project CH_4 emissions per plant size per year =
m^3 biogas production * % methane concentration in biogas * 0.71 kg/m^3 * 12.5% * 21 tCO_2eq/tCH_4

Step 5 – Aggregation of emission per source into standardised emission reduction factor

Emission reduction factor for a biogas plant of size a in region b =
+ CO_2 emissions from kerosene savings in tCO_2eq (I)
+ 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 in tCO_2eq (V)

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

The approach to the baseline is based on the calculation of a standardised net emission reduction factor per biogas plant per region (see E.2). The following describe 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

[27] An experiment was carried out over a sample of plants during the preparation of the PDD to document leakage from the slurry tank. A metal tank was placed into the slurry tank, the captured gas burned and its heat content calculated (water heating method) to determine how much gas was leaking out. The metal tank rises as more gas collects under it. An outlet at the top of the tank can release the collected gas. The experiment showed that over a range of plant sizes in a day 8-9% of total gas produced was found to be leaking from the slurry tank. This is consistent with the default IPCC range of 5-15%. More conservative value of 12.5% has been used for emission reductions calculations to account for possible longer term leakage from the slurry tank or the compost pit, possible leakage from the pipe joints, valves, or stoves, and leakage around the metal tank and emission from incomplete combustion.
[28] IPCC, 1996.
[29] Chawla, 1986.
[30] Chawla, 1986.
[31] Chawla, 1986.

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) The section E.1.2.4 shows steps to 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)

Note: Based on the monitoring results (Section D.3), the ER factor will be adjusted every year to reflect the changes in firewood and kerosene saving for that year.

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 tCO2/biodigester/year, apply the ER factor of 4.99 tCO_2/plant/year
If the weighted ER factor is < 5 tCO2/biodigester/year, apply that weighted ER factor

Therefore,

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

E.2 Table providing values obtained when applying formulae above:

1) Calculation of Standard Emission Reduction Factor per unit biogas plant

Table E.2-1: Emission Reduction Factor Calculation

Emission Reductions
Unit: ton CO2 equiv.per plant

A. Fuel savings

I. Net CO2 Emission Saving from kerosene for cooking

	Terai	Hill	Mountain	Average (Terai and hills)	Weighted Average
4M3	0.19	0.06	0.06	0.12	
6M3	0.09	0.04	0.04	0.06	
8M3	0.09	0.09	0.09	0.09	
10M3	0.06	0.07	0.07	0.06	0.07

II. Net CO2 Emission Saving from firewood for cooking

	Terai	Hill	Mountain	Average (Terai and hills)	
4M3	3.03	5.54	5.54	4.28	
6M3	7.01	7.80	7.80	7.40	
8M3	8.72	9.66	9.66	9.19	
10M3	7.19	7.58	7.58	7.39	7.20

III. Net CH4 Emission Saving from firewood

	Terai	Hill	Mountain	Average (Terai and hills)	
4M3	0.14	0.25	0.25	0.19	
6M3	0.32	0.35	0.35	0.33	
8M3	0.39	0.44	0.44	0.41	
10M3	0.32	0.34	0.34	0.33	0.32

Net Emission Reductions from Fuel Saving

	Terai	Hill	Mountain	Average (Terai and hills)	
4M3	3.35	5.84	5.84	4.60	
6M3	7.41	8.19	8.19	7.80	
8M3	9.20	10.18	10.18	9.69	
10M3	7.57	7.99	7.99	7.78	7.59

B. Project Emissions: Fugitive emissions including leakage from bigoas digister and CH4 emissions from incomplete combustion.

IV. Methane Emission

	Terai	Hill	Mountain	Average (Terai and hills)	
4M3	0.41	0.41	0.41	0.41	
6M3	0.58	0.58	0.58	0.58	
8M3	0.76	0.76	0.76	0.76	
10M3	0.96	0.96	0.96	0.96	0.58

C. Net GHG savings per digester (TCO2e/plant/year)

	Terai	Hill	Mountain	
4M3	2.94	5.43	5.43	
6M3	6.83	7.60	7.60	
8M3	8.45	9.42	9.42	
10M3	6.61	7.03	7.03	7.00

For the purpose of conservative estimation and meeting the threshold emission reduction per system for the application of the monitoring methodology defined under the small scale Methodology applicable under I.C.9(c), each biogas digester under the proposed project will claim emission reductions of only 4.99 tCO_2/plant/year (this figure applies only to those plants that generate ERs exceeding 5 tCO_2/plant/year).

2) Estimation of Total Emission Reductions

Table E.2-2: Estimation of Emission Reductions over 7-Year Period

Crediting Period	Plant Installation #	Annual ERs tCO2e	Cumulative ERs tCO2e
1 Aug 2004- 31 July 2005	9,708	46,990	46,990
1 Aug 2005- 31 July 2006		46,990	93,979
1 Aug 2006- 31 July 2007		46,990	140,969
1 Aug 2007- 31 July 2008		46,990	187,959
1 Aug 2008- 31 July 2009		46,990	234,948
1 Aug 2009- 31 July 2010		46,990	281,938
1 Aug 2010- 31 July 2011		46,990	328,927

SECTION F.: Environnemental impacts:

F.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

An Integrated Environmental Impact Assessment (EIA) of biogas digester has been executed by BSP-Nepal, including health, socio-economic and gender analysis. The study concluded a net positive benefit from the use of biogas digester on socio-economic and health conditions of the biogas households and on local environment. While no adverse environmental impacts were identified, some concerns were raised with relation to the presence of pathogens in the residual bio-slurry and increased incidence of mosquitoes in the biogas households.

Studies were undertaken to address the pathogen and mosquito concerns. The study on the presence of pathogens in the bio-slurry indicates the presence of some forms of pathogens but confirms the absence of any fatal bacteria like Salmonella typhi and Vibrio Cholarate -01 in all the samples of the residual bio-slurry. Similarly, the study on mosquito breeding detected no direct link between the mosquito breeding and the biogas plant operation.

Nevertheless, BSP-Nepal has developed Environmental Mitigation Plan to mitigate any possible impacts from the biogas use.

The Environment Mitigation Plan is attached in Annex IV.

SECTION G. Stakeholders' comments:

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

Stakeholder consultation

Biogas digesters are sold to small-scale farmers (households) throughout Nepal. Stakeholder consultation in the context of a consumer technology like a biogas digester is automatically built into the commercial sales process. Farmer "buy-in" regarding the biogas benefits is the key to selling of a biogas plant. By paying a considerable amount for its biogas digester (in the range of US$ 148 to 309), the household appreciates the value of the biogas plant. Households will also be required to sign a contract in which they transfer their emission reduction rights and all other rights associated with CDM participation to AEPC in exchange for after-sales support, subsidy and quality control. As part of this process, BSP-Nepal will inform households about the CDM and the international climate change process.

Because of the household nature of the biogas installation, no known government regulatory requirement exists concerning the consultation process. Nevertheless, consultations were undertaken with biogas users and non-users in two districts in the Terai (Dhanusha) and Hills (Baglung) regions during 17-20 and 22-25 May, 2005. The consultations process involved detailed household survey of randomly selected both biogas users and non-users of the selected Village Development Committees (VDCs) representing the major ethnic/caste groups of the two sample districts, focus group discussion with potential biogas users, and key informants interviews of knowledgeable persons contacted during the visits.

End-user satisfaction

Since program commencement in 1992-1993 end-user satisfaction has been monitored via an annual household survey executed by independent external researchers. The results of the end-users surveys show a high satisfaction rate. The above findings agree with several studies carried out in the past by BSP-Nepal that revealed the users' satisfaction percentage ranging from 94 to 98%. Among other factors, the users' satisfaction is dependent upon the performance of their plants followed by quality of the after sales-services received by them.

As part of market development, the biogas companies informally contact and consult with local NGOs working in the areas related to biogas to help explain the benefits of the bio-gas plants to the local population and mobilize their participation in the program. One such local NGO, for example, Resource Management & Rural Empowerment Center (REMREC), works in rural water and sanitation, and cooperates with the local company working in the same area to promote biogas plants.

G.2. Summary of the comments received:

The overall perceptions of the majority of the respondents surveyed in the above two mentioned districts about the social, economical, and environmental benefits of the biogas plants was positive and they had not perceived any negative social impacts of the BSP at both household and communities levels in both Hills and Terai regions.

According to the end-users survey, a majority of the biogas households expressed high satisfaction in the performance of the biogas plants. Additionally, oother studies done on the end-user satisfaction have reached similar conclusions. The Environmental Impact Assessment of BSP-Nepal notes:

"Users' satisfaction is the most important factor to judge the successful adoption of the technology. In this regards, the results of the survey revealed that around 95% of the sampled biogas households are satisfied with the performance of their plants. The small percentage of the unsatisfied biogas users argued that in some cases, the plant is either too big or in other cases, it is too small (BSP-Nepal, 2002; p. 3-3)." It is also noted that particularly women appreciate the benefits of a biogas plant in

their house through a smokeless kitchen, reduced drudgery related to fuel wood collection and improved sanitary conditions.

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

End-user satisfaction is the ultimate goal of the BSP-Nepal to provide sustainability to the biogas sector. Key to achieving this goal is the continuous consultation with all concerned stakeholders to receive feedback that directly feeds into maintaining and improving the quality of the biogas sector.

The quality control program includes a number of mechanisms through which feedback from end-users is sought and fed into the BSP-Nepal to ensure further optimization of the program. They include:

- Quality control monitoring;
- After sales service
- Independent annual end-user survey; and
- Plant verification surveys.

After-sales service
In order to participate in the Program biogas companies are obliged to provide free-after-sales service to the end-users for the first 3 years. This provides end-users with the guarantee that possible construction and material defects in the biogas plant will be repaired. By monitoring the after-sales activities of biogas companies BSP-Nepal gets direct feedback on the quality of systems delivered, which feed into determining the performance of the biogas companies.

Quality control monitoring
BSP-Nepal executes an extensive quality control system of biogas digesters to ensure the interests of households. The result obtained form the quality control monitoring is linked to the payment of bonuses/penalties to the participating biogas companies. Through the system that checks numerous indicators to measure the performance of the company, BSP-Nepal ranks these companies from good to bad. This provides an incentive for these companies to improve the performance of their systems. If a company performs poorly, then the BSP-Nepal provides additional training to aid the company to improve its service quality and strengthen its business operations.

Annual end-user survey
Since 1992-1993 end-user satisfaction has been monitored via an annual household survey executed by independent external researchers. Using the findings and recommendations of the study, BSP-Nepal in conjunction with biogas companies undertake new activities or simply improve the existing ones to strengthen the quality of the biogas sector.

Plant verification studies
Plant verification studies are in-depth studies of a district in which all biogas plants within the district are interviewed to verify their performance, assess user satisfaction and learn from end-use feedback. Local government authorities in collaboration with BSP-Nepal carry out these studies.

ANNEX I

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Alternative Energy Promotion Centre (AEPC)
Street/P.O.Box:	GPO Box 6332
Building:	
City:	Kathmandu
State/Region:	
Postcode/ZIP:	
Country:	Nepal
Telephone:	+977 1 5539390 / 5539391
FAX:	+977 1 5539392
E-Mail:	energy@aepc.wlink.com.np
URL:	www.aepcnepal.org
Represented by:	
Title:	Executive Director
Salutation:	Dr.
Last Name:	Basnyat
Middle Name:	Bahadur
First Name:	Madan
Department:	Alternative Energy Promotion Centre (AEPC)
Mobile:	
Direct FAX:	+977 1 5539392
Direct tel:	+977 1 5539390 / 5539391
Personal E-Mail:	energy@aepc.wlink.com.np

Organization/Individual:	Household Maiya Gautam
Street/P.O.Box:	Karttike Deurali-6
Building:	
City:	Kavre
State/Region:	
Postcode/ZIP:	
Country:	Nepal
Telephone:	
FAX:	Not available
E-Mail:	NA
URL:	http:///
Represented by:	
Title:	Biogas Owner
Salutation:	Ms.
Last Name:	Gautam
Middle Name:	
First Name:	Maiya
Department:	
Mobile:	NA
Direct FAX:	NA
Direct tel:	NA
Personal E-Mail:	NA

Organization/Individual:	Household Suk Man Tamang
Street/P.O.Box:	Nangkhel
Building:	
City:	Bhaktapur
State/Region:	
Postcode/ZIP:	
Country:	Nepal
Telephone:	
FAX:	Not available
E-Mail:	NA
URL:	http:///
Represented by:	
Title:	Biogas Owner
Salutation:	Mr.
Last Name:	Tamang
Middle Name:	Man
First Name:	Suk
Department:	
Mobile:	NA
Direct FAX:	NA
Direct tel:	NA
Personal E-Mail:	NA

Organization:	Community Development Carbon Fund (CDCF), New Carbon Funds Team, The World Bank.
Street/P.O.Box:	1818 H Street, NW
Building:	MC4-414
City:	Washington DC
State/Region:	
Postcode/ZIP:	20433
Country:	USA
Telephone:	202 473 6010
FAX:	
E-Mail:	cfcontacts@worldbank.org
URL:	www.communitycarbonfund.org
Represented by:	
Title:	Senior Manager
Salutation:	Mr.
Last Name:	Knudsen
Middle Name:	
First Name:	Odin K.
Department:	Carbon Finance Unit
Mobile:	
Direct FAX:	
Direct tel:	202 473 6010
Personal E-Mail:	oknudsen@worldbank.org

ANNEX II

INFORMATION REGARDING PUBLIC FUNDING

In addition to the income from carbon finance, the BSP-Nepal will require grant funding to cover the initial investment in the proposed project activity. The cash position of BSP-Nepal indicates a financing gap in the first 10 years of operation. However, BSP-Nepal has secured financial support from KfW (Germany), DGIS (the Netherlands) and AEPC (HMG/N). The sponsors have committed themselves to providing public funding for the proposed project activity for the amounts listed for the 2003-09 period.

KfW:	US$ 9.15 million,
DGIS/The Government of the Netherlands:	US$ 4.92 million,
HMG/Nepal:	US$ 5.61 million.

It should be noted that none of the donors will claim any portion of the emission reductions generated by BSP-Nepal. The AEPC affirms its understanding that the funding for the project activities for the biogas program has not resulted in the diversion of ODA and that this funding is not counted towards the financial obligation of concerned Parties. A letter from Alternative Energy Promotion Center is attached. The confirmation statements by KFW and DGIS on non-diversion of their respective ODAs have been provided.

The CDCF Participants also confirms that any public funding for the purchase of CERS from the Project does not result in a diversion of ODA and is separate from and not counted toward the financial obligation of the concerned Parties.

An Affirmation Letter from AEPC:

14/07 2005 14:46 FAX 00977 1 5542397 AEPC 02

His Majesty's Government of Nepal
Ministry of Environment, Science and Technology
Alternative Energy Promotion Development Board
Alternative Energy Promotion Centre

☎ : (977) 1 5528335, 5539237
Fax : (977) 1 5542397
P.O.Box : 14237, Kathmandu
E-mail: aepc@setl.ntc.net.np
Dhobighat, Lalitpur

Ref. No.

Date:. 15 July 2005

Subject: To whom it may concern

The AEPC affirms its understanding that the funding for the project activities for the biogas program has not resulted in the diversion of ODA and that this funding is not counted towards the financial obligation of concerned parties.

(Dr. Madan Bdr. Basnyat)
Executive Director

ANNEX III

METHODOLOGY TO CLAIM NON-RENEWABLE BIOMASS AS A SOURCE OF EMISSION REDUCTIONS FOLLOWING APPENDIX B OF THE SMALL SCALE CDM GUIDELINES

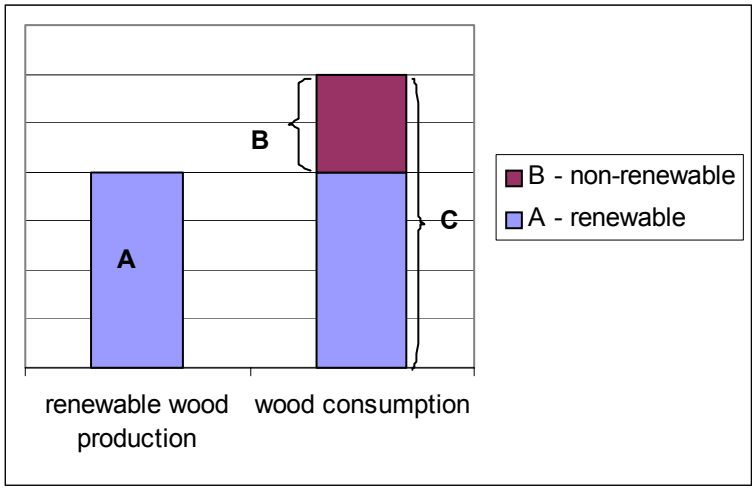
This methodology operationalizes on article 15 of Category I-C "Thermal energy by the user" of Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities. Article 15 states that "*renewable energy technologies that supply individual households or users with thermal energy that displaces .... non-renewable sources of biomass*" can claim emission reductions from such sources. The guideline does not provide further guidance on how a project should demonstrate that the biomass source is non-renewable.

This methodology provides a step-by-step approach on how to operationalise the concept of "non-renewable" in the context of household energy technologies that reduce non-renewable sources of fuel wood. The notion of non-renewable in the context of fuel wood consumption is understood as fuel wood consumption that contributes to deforestation or forest degradation. The critical factor is whether the consumption is greater than the increase in sustainable biomass growth. Biomass would be reduced in absolute terms beginning at the point where the consumption of biomass exceeds the rate of growth, as illustrated by this simple equation:

$$Gb/Db < 1$$

Where
Gb = growth in biomass
Db = use of biomass.

To make this concept operational non-renewable fuel wood consumption (B) is defined as any wood consumption (C) beyond the level of renewable wood production (A). See figure below.



The methodology is defined as three conditions which the project has to meet in order to claim emission reductions from non-renewable sources of wood:

1) In the project area the consumption of wood exceeds the renewable wood production.
2) Fuel wood consumption by households constitutes a significant share of total wood consumption;
3) The emission reductions can only be claimed in proportion to the reduction of non-renewable biomass.

Condition 1: In the project area the amount of sustainable wood that is available is less than the consumption of wood

This condition is an operationalisation of the concept of non-renewable fuel wood. Sustainable forest growth is defined as the annual increment of reachable forest areas. Consumption of wood is defined as the sum of timber and fuel wood consumption. If relevant the project should also try to quantify other sources of wood consumption and adjust for import and export out of the region.

This condition is met if:

Annual increment (A) < Total annual wood consumption (C)

Calculation guidance:

A: Annual increment (tons/year) = reachable forest area (in ha) * mean annual increment/ha (m^3/ha/year) * average density of forests (tons/m^3)

C: Total wood consumption (tons/year) = timber wood consumption (x) + industrial fuel wood consumption (y) + household fuel wood consumption (z)

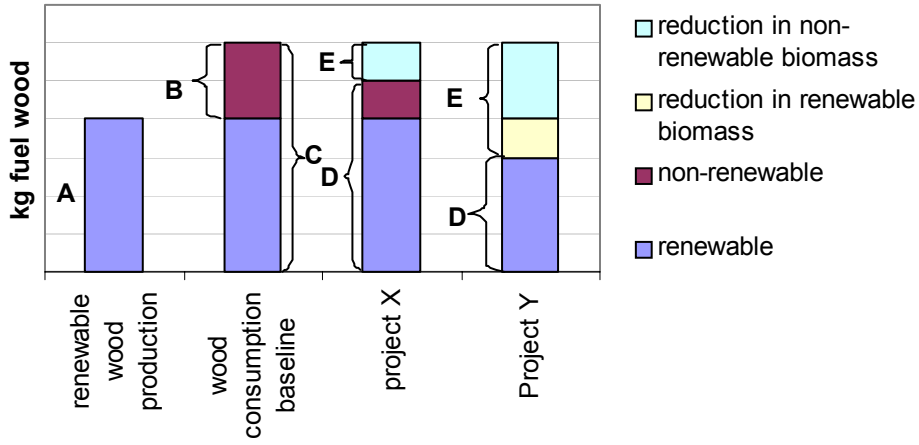
Condition 2: Fuel wood consumption by households has a significant share in total wood consumption

This condition has to be met in order to demonstrate that household consumption is indeed a driver in significant deforestation / forest degradation and there are no other factors causing the degradation. The project can demonstrate that a household has a significant share if it meets one of the following criteria:

- Household fuel wood consumption (c) > Annual Increment (A)
- Household fuel wood consumption (c) is the largest wood consumption sector; (z) > (x) and (c) > (y)
- Share of household fuel wood consumption (c/C) > 35%

Condition 3: The emission reductions can only be claimed in proportion to the reduction of non-renewable biomass but the **maximum emission reductions to be claimed cannot be more than the total emission reductions from non-renewable biomass**

The project can only claim emission reduction insofar it leads to a reduction in the unsustainable use of biomass. This is illustrated in the figure below using two project examples. Project X can claim all emission reductions related to reduction in fuel wood consumption, because all reductions in wood consumption are reductions in non-renewable sources of wood. Project Y, instead, can claim only 67% of its emission reductions, since the total reduction in fuel wood of the Project is larger than the amount of non-renewable fuel wood consumption in the baseline. That means that also a part (33%) of the renewable fuel wood consumption has been reduced. For this latter part it cannot claim emission reductions.



The project can claim emission reductions if it follows the following criteria:
a) The project can claim all emission reductions from its fuel wood savings if:

- the projected fuel wood consumption after project (D) > Annual Increment (A); or
- the projected fuel wood reduction (E) < non-renewable fuel wood consumption in the baseline (B)

b) The project can claim emission reductions in proportion to the share of reduction in non-renewable fuel wood as part of the total fuel wood reductions (B/E) if:

The projected fuel wood consumption after project (D) < Annual Increment (A) [or E > B].

However, the project can only claim emission reductions related to fuel wood reduction up to the point where total fuel wood reduction of the project (E) is equal to the non-renewable fuel wood in the baseline (B) [E=B]

Application of the above methodology to the proposed project:

		Terai	Hills	Unit	Data Source
	Density of fuel wood	0.87	0.63	kg/liter	Forest Resources of Nepal (1987-1998), Publication No.74, November 1999.

Condition 1

Calculation of Annual Increment (A)

	Reacheable forest area	589,300	1,589,978	ha	Forest Resources of Nepal (1987-1998), Publication No.74, November 1999.
	Mean annual increment	3	5	m3/ha/year	Forest resources of Nepal 1988/1997 and assuming a maturity period of 40 years.
	Annual increment	2,033,085	7,989,639	m3/year	
A	Annual increment (=net sustainable wood production)	1,768,784	5,060,105	tonnes/year	

Calculation of annual wood consumption (C)

	Projected timber consumption	1,066,000	1,082,000	m3/year	Master Plan for the Forestry Sector Nepal, Main Report, 1988, HMG of Nepal, Ministry of Forests and Soil Conservation.
x	Projected timber consumption	927,420	685,267	tonnes/year	
	Projected HH & industrial fuel wood consumption	6,482,000	6,778,000	tonnes/year	Master Plan for the Forestry Sector Nepal, Main Report, 1988, HMG of Nepal, Ministry of Forests and Soil Conservation.
y	Projected industrial fuel wood consumption	118,000	119,600	tonnes/year	master plan, Appendix Table 4.11, page 216
c	Projected household fuel wood consumption	6,364,000	6,658,400	tonnes/year	
C	Projected total wood consumption	7,409,420	7,463,267	tonnes/year	

Conclusion: Condition 1 is met since A < C

Condition 2

This project meets all the criteria set:

c > A	TRUE	TRUE
c > x and c > b	TRUE	TRUE
HH fuelwood share of total wood consumption (c/C)	86%	89%

Conclusion: Condition 2 is met

Condition 3

	Situation before				
A	Total sustainable fuel wood available for households (tons/year)	1,519,220	4,514,404	tonnes/year	
D	Total household fuel wood consumption	6,364,000	6,658,400	tonnes/year	
B	Unsustainable fuel wood consumption	4,844,780	2,143,996	tonnes/year	
	Situation after project				
	Average fuel consumption per hh before biogas installation	10.74	11.74	kg/day	Household survey implemented as part of the EIA of BSP
	Average fuel consumption per hh before biogas installation	3.92	4.29	tonnes/year	
	Average fuel consumption per hh after biogas installation	4.8	5.7	kg/day	Household survey implemented as part of the EIA of BSP
	Average fuel consumption per hh after biogas installation	1.74	2.09	tonnes/year	
	Fuel wood reduction	2.18	2.19	tonnes/year	
	Number of biogas installation sold = 200,000	100,000	100,000		
E	Total fuel wood reduction	217,905	219,183	tonnes/year	

	Unsustainable fuel wood consumption after project	4,626,875	1,924,813	tonnes/year
B > E	The project can claim all emission reductions (B > E)	TRUE	TRUE	

Conclusion: Condition 3 (a) is met

Since all three conditions are met, the proposed project can claim <u>all (100%)</u> emission reductions from the firewood savings.
None of the areas of the proposed project have or will access to sustainable wood. However, the BSP-Nepal as part of monitoring and sampling will check if the above conditions will change in the project areas. If so happens in certain project areas, the emission reductions will be adjusted to account for such change.

ANNEX IV: ENVIRONMENTAL MITIGATION PLAN

ENVIRONMENTAL MANAGEMENT PLAN

1. HEALTH AND SANITATION				
Parameter	Indicators	Method	Schedule	Mitigation Plan
1.1 Latrine Construction	▪ Self-motivated HHs to build latrines ▪ Motivation by Biogas Company	Interview with users and non-users of biogas and construction and maintenance reports.	Biogas Users Survey is conducted every year and finalize by June.	BSP-N will advise the farmers to connect toilets showing the benefits of sanitation improvement.
1.2 Health Aspects of Digested Sludge, with plans to overcome the existence of pathogens in slurry especially from Latrine-attached Plants	▪ Detection of worm, protozoa and pathogenic bacteria such as Salmonellas, E. Coliform, etc	Analyze randomly selected slurry and compost samples (100) for pathogens.	BSP-N has conducted a study on the presence of pathogen in slurry. It has shown presence of some pathogens.	Proper handling of sludge and hand washing will be included in the user's training manual. Research by R&D unit is in the pipeline for the increase in retention time for the full digestion of the dung. Monitoring of diseases to be done through annual Biogas User survey.
1.3 Mosquito control (where required)	Places where mosquitoes occur frequently Causes of mosquito breeding	A device was developed and tested in 40 households. it was discovered that mosquito breeding is not due to the biogas. If farmers feel it is due to the biogas installation of the device is recommended.	Mosquito breeding research report is available and Biogas Users Survey to be conducted every year.	Provide siphon or flip, low cost mosquito control devices, to farmers on request. BSP-N will provide the farmers instructions related to clean environment and mosquito control.
1.4 Possible Gas Leakage	Assess gas leakage from biogas plants (e.g. from dome, pipefitting, burners, lamps, etc).	Random sampling of the plants	During the course of preparing baseline, Winrock has conducted a study on gas leakage. A follow up study will be carried out in 2006.	Proper instruction and training will be provided to company technicians while installing pipes. BSP-N will inform the farmers and apprise them regarding the leakage in the outlet.
2. LAND USE AND LIVESTOCK RELATED ISSUES				
2.1 Water Availability and Consumption	▪ Source of water ▪ Distance traveled to fetch water ▪ Water required to	Interview with users and non-users of biogas	Biogas Users Survey to be conducted every year.	Training manuals with information on proper feeding of dung and water will

	mix with cow dung for feeding the bio-digester ▪ Water required for consumption by cattle			be provided to farmers. Farmers will not be allowed to have standing water to accumulate for more than two days in the digester.
2.2 Bio-slurry as Fish Meal	▪ Use of digested slurry as fish meal (pilots only – increased use subject to more indepth environmnental analysis)	Conduction of Field Experimentation on Fish with bio-slurry	Experimentation Completed. Report available with BSP-N	A follow up study will be done on the quality of water due to residual bio-slurry in the fish pond and the effect on recipients on the d/s.

Annex V: ACRONYMS

AEPC	Alternative Energy Promotion Center
BSP-Nepal	Biogas Support Programme-Nepal
ADBN	Agriculture Development Bank, Nepal
AIC	Agricultural Inputs Corporation
BP	Biogas Plant
BSP	Biogas Support Program
BSP – N	Biogas Sector Partnership Nepal
CDCF	Community Development Carbon Fund
CER	Certified Emission Reduction
CODEX	Consortium of Development Experts
DAP	Dia Ammonium Phosphate
DGIS	Directorate General for International Cooperation of the Government of the Netherlands
EIA	(Integrated) Environmental Impact Assessment (executed by BSP)
ER	Emission Reduction
FIRR	Financial Internal Rate of Return
HMG/N	His Majesty's Government of Nepal
IRR	Internal Rate of Return
KfW	German Development Bank
MoP	Muriate of Potash
NPK	Nitrogen, Phosphorous, Potassium
NPV	Net Present Value
NRs	Nepali Rupees
T/H/R	Terai/Hills/Remote Hills

REFERENCES

BSP-Nepal, 2002: *An Integrated Environment Impact Assessment, Final Report, Biogas Support Programme,* Biogas Support Programme, Kathmandu (quantitative data references to this study have been retrieved from the responses to questionnaires and the survey database)

BSP, 2003a : BSP in-house database of all biogas plants sold under its program

Bulmer, A, Finlay J, Fulford D & Lau-wong, M., 1985: *Biogas: Challenges and experiences from Nepal, Vol 1,* United Mission to Nepal,

Chawla O.P. 1986: Advances in biogas technology. New Delhi: Indian Council of Agricultural Research, 1986

G. P. Devkota, Biogas technology in Nepal, Page 55

IEA/OECD, 2001: "IEA/OECD/UNEP workshop on baselines, May 2001, www.iea.org.

IPCC, 1996: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories,

JT Houghton, LG Meira Filho, B Lim, K Treanton, I Mamaty, Y Bonduki, DJ Griggs and BA Callender (Eds) IPCC/OECD/IEA. UK Meteorological Office, Bracknell

Kanel, 1999: Study on FIRR of biogas plants, BSP, Kathmandu

Martinot, E., R. Ramankutty and F. Rittner, 2000: "*Thematic Review of the GEF Solar PV Portfolio: Emerging experience and lessons*", Global Environment Facility Working Paper, Washington D.C., USA

Ministry of Population and Environment, 2001: *State of the Environment Nepal*, HMG of Nepal

Ministry of Forests and Soil Conservation, 1988: *Master Plan for the Forestry Sector Nepal,* Main Report, HMG of Nepal

Ministry of Forests and Soil Conservation, 1999: *Forest Resources of Nepal (1987-1998)*, Department of Forest Research and Survey, Ministry of Forests and Soil Conservation, Forest Resource Information System Project, The Government of Finland, Publication No. 74, Nov. 1999

Kirk R. Smith, R. Uma, V. V. N. Kishore, Junfeng Zhang, V. Joshi, and M. A. K. Khalil, Annu., 2000: *Greenhouse Implications of Household Stoves: An Analysis for India,* Rev. Energy Environ., no. 25, pp. 741-63, Table 2

SNV-Nepal 2001: Programme Support to Nepal's Renewable Energy Sector – Volume I, introduction and analysis*, Katmandu*

Violette, 2001: Violette, Dan, 2001, *Simplified procedures for the baseline assessment and monitoring of CFL projects*, Section 5.4 in J.W. Martens, S.N.M. van Rooijen., V. Bovee, H.J. Wijnants, 2002, *Standardised baselines for small-scale CDM activities*, ECN-C--01-122, ECN, Petten, the Netherlands

Water and Energy Commission Secretariat, 1995: Energy Technology: An Overview and Assessment", 1994/95.