Executive Summary of Feasibility Study on CDM/JI 2008

Title

Feasibility study on Biogas Support Progmme Activity in Nepal

Studying organization

NTT GP-ECO communication, Inc.

1. General Description of the project

(1) Host country, Region

Federal Democratic Republic of Nepal (Some mountainous region might be excluded)

(2) General description of the project

This is the CDM project which is designed to reduce the consumed amount of firewood as non-renewable biomass and avoid emission of methane gas which is released from the open dumped livestock dung by installing biogas plants at each household and using the generated methane gas as cooking fuel.

In other words, the project is also the programme activity which boundary is in the whole of Nepal (some mountainous region is excluded) and is aimed at setting a village as a CPA site, under Biogas Support Programme (BSP). In the programme activity, Coordinating or Managing entity of CPA which has been founded per villages controls the PoA.

The size of the plants are $4m^3$,$6m^3$,$8m^3$ and $10m^3$. Although the capacity depends on such conditions as types and head number of livestock which household have, and biogas plant, almost household with a few cows has installed $6m^3$ type.

In the project, the amount of emission reduction is expected to be 3.1t-CO_2/y per one plant. And therefore, if one hundred households install biogas plant with $6m^3$ per a CPA, and if 10 CPAs are registered to PoA, the number of plants totals 1,000 plants. And the amount of GHG emission reduction is expected to be 3,100 t-CO_2/y.

On managing, coordinating and monitoring of PoA, IT tool is used because villages as CPA sites are scattered in the whole of Nepal. In particular, tele-center (=the base where IT coordinator is stationed in order to disseminate information from internet terminals among people of communities) is established at each CPA sites, and the information on monitoring during project period, operation and management situations of plants are shared with Coordinating or Managing entity.

The project is the CDM project which is designed to avoid deforestation by controlling the consumed amount of firewood as non-renewable biomass. And it could be established as co-benefit CDM project which solve ground water contamination issues that concentration of Nitrite Nitrogen and Nitrate

Nitrogen in the groundwater reaches higher level by open dumping of livestock dung.

CDM registration and biogas plant construction is expected to be in 2009, and start of the project might be in 2010.

2. Content of the study

(1) Target of the study

The target of the study is described as the followings.

a) Framework for project development of PoA

Framework for the project implementation, field survey shall be conducted on the understanding of program of the host country, selection of candidates Coordinating or Managing entity and CPA sites, and establishment of communication method between Coordinating Managing entity and CPA sites.

b) Transaction of government approval

Literature and field survey on the framework for CDM approval in Nepal shall be conducted.

c) Applicable technology

Literature and field survey shall be conducted on installation of biogas plants (constructing period, quality control on construction technology, construction cost and so on), the generated biogas, methane gas content, Operating & Managing (QC on operation, possibility of livestock dung leakage and durability) and disposal waste.

d) Applicability of the approved methodologies

Literature and field survey shall be conducted on the applicability of the approved methodology of AMS-I.E. (Switch from Non-renewable Biomass for Thermal Applications) and AMS- III.D (Methane recovery in animal dung management systems).

e) Additionality

The applying methodology is for small scale. And additionality shall be certified according to the General Guidance of methodology for small scale CDM projects.

f) Survey on the baseline scenario

Besides analysis of baseline scenario, actual situation of the proposed CPA sites are surveyed by literature and field survey.

g) Calculation of GHG emission reduction

According to small scale methodologies AMS-I.E. and AMS-III.D., the emission reduction is calculated with the default value of IPCC, statistics by the host country, and / or actually measured data at survey sites.

h) Monitoring plan

Literature and field survey shall be conducted on the adoptability of the monitoring requirements for small scale methodology AMS-I.E. and AMS-III.D. after the actual situation of the proposed CPA sites and monitoring plan on the similar projects are investigated.

i) Project / Crediting period

The field survey is conducted on project and crediting period. And project is planed.

j) Environmental Impact Assessment

Literature and field survey is conducted on applicability of Environmental Impact Assessment act for installation and operation of the biogas plant in Nepal.

k) Indirect impact

Literature survey is conducted on Social, Cultural and Economical impact by installation of biogas plants project in Nepal.

l) Stakeholders' comment

Stakeholders' meeting would be held in order to collect and respond to comments on PoA. And they are analyzed.

m) Financing scheme

In order to implement biogas plant installing PoA, financing as well as investment scheme are scheduled. And feasibility of the project is assessed by P/L, C/ F and IRR.

n) Drafting of PDD

PoA-DD and CPA-DD shall be drafted according to the survey results of above a) to m).

o) Pre-Validation

Pre-Validation on the PDD drafted at n) is implemented by DOE. However, this is informal one, which is different from the validation for CDM registration.

p) Making of co-benefit index for climate change

Considering the needs of climate change mitigation in the host country, co-benefit index of the efforts on climate change is discussed and attempted.

(2) The framework for survey conduction

(i) NIPPON TELEGRAPH AND TELEPHONE WEST CORPORATION (NTT West)

NTT West takes care of discussion on establishment of tele-center as managing tool of PoA, and supports field survey on environmental as well as other relevant impacts (including environmental pollution). Among their works, coordination between the central and local governments, and hearing survey on stakeholders are also included.

(ii) Love Green Nepal (LGN)

LGN is a local NGO in Nepal, which supports collection of related matter as well as information and other surveys.

(3) Contents of survey

(i) Field survey

Hearing survey at project sites has been conducted to governmental organization (DNA, AEPC), BSP-N, Association of Biogas Companies, Micro Financial Organization and 10 proposed CPA Sites (household, V.D.C office, Schools and etc).

(ii) Others

Besides field survey, literature and hearing methods have been conducted. And comments have been collected at sites, on internet, or by e-mail.

They are:

- Collection of information on AMS-I.E., AMS-III.D., PoA, similar projects and others at the website of UNFCCC
- Survey on several statistics which have been collected at sites and on the biogas plants installation.
- Survey on feasibility of biogas plants projects and investment barrier.
- Survey on particular cases of estimation of non-renewable biomass.

(iii) The result of the study

The result of the above mentioned (l) is described as the followings.

a) Framework for project implementation

BSP (Biogas Support Program) has been founded and managed by funding support from the government of Netherland since 1996. And in later year, the governments of Germany and Nepal have participated in BSP. During July 2003 and June 2009, BSP has been implemented as the CDM project

Coordinating or Managing entity remains to be decided. However, Alternative Energy Promotion Center (AEPC) and Biogas Sector Partnership-Nepal (BSP-N) have been nominated.

AEPC, which has been established in 1996, is the supporting organization of Ministry of Environment, Science and Technology. Besides biogas plant, AEPC supports such policy making as alternative energy and its management.

BSP-N is NGO which installs biogas plants under BSP with AEPC. BSP-N has registered two CDM projects so far and has sufficient performance on installation as well as management of biogas plants.

As for the proposed CPA sites, two V.D.C in each districts have been selected from five regions, which totals 10 V.D.Cs. They are Eastern, Central, Western, Mid -Western and Far-Western regions,

where field survey has been conducted. The content was on the situation of non-renewable biomass use, needs of biogas plants, environmental pollution awareness and etc. And survey has been conducted on possibility of PoA at V.D.C. office and school, and on communication methods (including tele-center) between Managing or Coordinating entity of PoA and CPA management entity.

b) Transaction of government approval, and framework for PoA implementation in the host country

Information on the transaction of government approval for CDM in Nepal has been collected by hearing survey to DNA and literature survey. However, the government of Nepal has experienced political turmoil due to a change of administration in Aug 2008, if the approval system remains the same as usual has yet to be confirmed.

c) Applicable technology

Hearing survey on the R&D background of biogas plant, construction and operation / maintenance has been conducted to AEPC, BSP-N, biogas companies, Association of biogas companies and etc.

The R&D background of biogas plant is that floating drum type from steel has been firstly imported from India in 1975. However, corrosion of the steel parts have been revealed. And just 894 plants have been installed. And therefore, fixed dome from concrete has been imported from China in 1980. On the base of this plant, it has been improved several times from the point of views of simplicity on construction and operation / maintenance. And in 1990's, it has developed as general design of GGC-2047 type. On trial manufacture, although PVC (Polyvinyl Chloride) plastic package type has been developed by assistance of UNICEF in 1986, it has not put to practical use due to problems on the strength.

Construction cost is about 60 thousand yen (depends on the size of biogas plants and introducing sites). On installing skills, certain standard of level is assured according to technical training by BSP and installation manual. And the construction completes within 2 weeks per a biogas plant.

Operation / maintenance (quality control on operation / maintenance and, leakage possibility of livestock dung from dome and durability) is described as the followings.

- Free assurance of biogas plant by biogas companies within three years after installation (after sales service)
- Proper operating rate of biogas plants after installation is 93.8 % (according to the survey by BSP-N, Aug 2007)
- Major reasons of trouble (not fed livestock dung : 31%, cooking stove : 17%, choked pipe : 17%, others : 35%)
- No potential of leakage has been known in the present GGC-2047type (rarely caused by land slide and other reasons)

d) Applicability of the approved methodology

The project is designed to replace cooking fuel by biogas generated from biogas plant and promote appropriate treatment of livestock dung by installing biogas plants at households where firewood is

used as cooking fuel and livestock is kept.

And applicability of small scale methodologies as AMS-I.E. as well as AMS-III.D. has been investigated. As the result, they turned out to be applicable.

e) Additionality

In the project, additionality are proved on investment, technical and others barriers.

Investment barrier at PoA level shows that BSP can be operated only after CER revenue is obtained. And investment barrier at CPA level shows that required fund for household can be financed only after subsidies from BSP, which leads to install biogas plant at households.

Technical barrier shows that the quality of construction on biogas plant is assured above certain standard only with BSP.

Other barriers show that installation of biogas plant can be introduced only with BSP in the rural area which access is geographically difficult.

f) Survey on the baseline

Analysis of baseline scenario has been conducted on project activities as thermal energy use of biogas and feeding livestock dung. As the result, BaU scenario has been set as baseline scenarios respectively.

In other words, the use of firewood as non-renewable biomass and released methane by open dumped livestock dung are the baseline scenario.

g) Calculation of the amount of GHG emission reduction

In AMS-I.E., the amount of emission reduction equal baseline minus leakage. In the project, leakage would be zero. However, ex-pose survey on the potential leakage is required.

In AMS-III.D., ex-ante amount of emission reduction equal baseline minus project emission. Leakage is not needed to calculate. And project emission is methane leakage from biogas plant, and the amount of Methane as well as Nitrous Oxide emission by combustion of biogas. In case of the ex-ante, emission reduction equal the lesser, comparing ex-ante and ex-post of the emission reduction, where ex-post is estimated from monitoring data.

h) Monitoring plan

In AMS-I.E., as baseline monitoring, the amount of consumed biogas is measured by gas flow meter, and methane ratio is measured by methane analyzer. Temperature is measured for the temperature correction of methane gas. In addition, confirmation of proper operation on biogas plant as well as cooking stove is implemented. Potential leakage is monitored by the survey after the fact.

In AMS-III.D., as baseline monitoring, the number of livestock by types, the amount of live stock dung, the amount of consumed methane gas are measured, and proper operation on biogas plant and cooking stove, and slurry use has to be confirmed. For project monitoring, the amount of consumed biogas is measured in order to estimate the emission amount of methane as well as Nitrous Oxide. This is common in baseline monitoring.

i) Duration / Crediting period

Duration of PoA is 28 years, and project and crediting period of CPA are 7 years. The project would be started in 2010.

j) Environmental Impact Assessment

The construction / operation of biogas plants is exempted from Environmental Impact Assessment Act in Nepal. And, the assessment is not needed.

k) Other indirect impact

It has turned out that there are indirect impacts (positive environmental, social, gender, health, economical, agricultural impact) after biogas plant installation in Nepal.

l) Stakeholders' comment

By visiting stakeholders individually, comments on PoA has been collected. They are reflected to the survey result and shall be issues to negotiate in the future, according to the comments

m) Financing scheme

The feasibility of the project is assessed by P/L, F/S and management index after financing and investment scheme are established.

n) Drafting of PDD and relevant documents

PoA-DD, Completed-CPA-DD and PoA-Specific-CPA-DD are drafted according to the result of a) to m)

o) Pre-Validation

Pre-Validation has been conducted on PDD drafted at n) by DOE. And recommendations as the followings have been received.

- Education program should be carried out to the project participants
- f_{NRB} shall be also assessed separately from the method which is described in the PDD
- Skills and description of training programs for monitoring staffs should be attached to PDD
- Potential leakage of non-renewable biomass should be monitored.

p) Making of co-benefit index about climate change and implementing approach

Considering the environmental pollution awareness in the host country, Making of co-benefit index about climate change and implementing approach is attempted.

3. Project Feasibility

(1) Establishment of project boundary and baseline

(i) Applicability of the approved methodologies

As the result of discussion on applicability of small scale methodologies of AMS-I.E. and AMS-III.D., they are applicable. Details are described as the followings.

Technology / Measure conditions	Propriety
This category comprises small thermal appliances that displace the use of non-renewable biomass by introducing new renewable energy end-user technologies. Examples of these end user technologies include biogas stoves and solar cookers.	Applicable because biogas stove is used.
If any similar registered small-scale CDM project activities exist in the same region as the proposed project activity then it must be ensured that the proposed project activity is not saving the nonrenewable biomass accounted for by the other registered project activities.	Applicable to non-renewable biomass which is not considered as the baseline in the 2 registered small scale CDM.
Project participants are able to show that non-renewable biomass has been used since 31 December 1989, using survey methods.	Applicable

Figure_Table 1 AMS-I.E. Switch from Non-renewable Biomass for Thermal Applications

Technology / Measure conditions	Propriety
This methodology covers project activities involving the replacement or modification of existing anaerobic dung management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. This methodology is only applicable under the following conditions: ・The livestock population in the farm is managed under confined conditions; ・Dung or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries) ・The annual average temperature of baseline site where anaerobic dung treatment facility is located is higher than 5°C ・In the baseline scenario the retention time of dung waste in the anaerobic treatment system is greater than 1 month, and in case of anaerobic lagoons in the baseline, their depths are at least 1 m; ・No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.	・The head number of live stock which households have is monitored in the project. ・The slurry obtained from biogas plant is expected to be used as fertilizer. ・The geographical boundary in the project is in the whole of Nepal, however, some mountainous regions with annual average temperature is below 5°C are excluded. ・ Although it is confirmed that open dumped period of livestock dung is longer than 1 month, it is monitored during the project period. ・Methane is not combusted because it is released from the open dumping sites in the baseline.
The project activity shall satisfy the following conditions: ・The final sludge must be handled aerobically. ・In case of soil application of the final sludge the proper conditions and procedures (not resulting in methane emissions) must be ensured. ・Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared.	・Slurry is treated aerobically. ・Project participants are instructed to treat slurry appropriately. ・No methane leakage from biogas plant.
The recovered methane from the above measures may also be utilised for the following applications instead of flaring or combustion: (a) Thermal or electrical energy generation directly; or (b) Thermal or electrical energy generation after bottling of upgraded biogas; or (c) Thermal or electrical energy generation after upgrading and distribution: (d) Upgrading and injection of biogas into a natural gas distribution grid with no significant transmission constraints; or (e) Upgrading and transportation of biogas via a dedicated piped network to a group of end users.	・The project is applicable to thermal energy use(a).
If the recovered methane is used for project activities covered under paragraph 4 (a), that component of the project activity shall use a corresponding category under type I.	・AMS-I.E. is applied to the project.
Emission reductions under this category are estimated *ex ante* (ERex-ante)(the balance of the amount of emission reduction in the baseline and project) shall be under 60 kt CO2, annually	・Annual reduction amount of AMS-III.D. is50t-CO_2 per 1CPA, which is applicable.

Figure_Table 2 AMS-III.D. Methane recovery in animal dung management systems

(ii) Project boundary

The project boundary of BSP is set in the whole of Nepal, and therefore PoA is also included the boundary. However, some mountainous region where annual average temperature is above 5°C is exempted from the applying conditions of AMS- III D.

And boundary of CPA shall be within the households where biogas plant is installed. In this case, household includes kitchen, open dumping sites of live stock dung and biogas plants.

(iii) Establishment of baseline scenario and its approach

The baseline scenario of AMS-IE and AMS- III D is identified as BaU. And therefore, it is described as the table and figure below.

Methodologies	Baseline Scenario
AMS-I.E.	Kitchen at households where firewood as non-renewable biomass is combusted, and its combusting activities.
AMS-III.D.	Biogas plant installed at households, kitchen where methane gas is combusted and its combusting activities.
Total baseline scenario	Within the households and areas including biogas plant and kitchen, where the above mentioned activities are implemented.

Figure_Table 3 Baseline Scenario

Figure_Table 4 articular cases of baseline scenario

(iv) Emission sources of GHG / Emission activities

The emission sources of GHG in the baseline scenario of the project and project activities are described as the table below.

Scenario	Methodology	Emission source / activity	GHG	Included?	Reasons
Baseline emission	AMS-I.E.	Combustion of non-renewable biomass	CO_2	Yes	Major emission source
			CH_4	No	Emission factor of CH_4 is sufficiently smaller than that of CO_2
			N_2O	No	Emission factor of N_2O is sufficiently smaller than that of CO_2
	AMS-III.D.	Open dumped of livestock dung	CH_4	Yes	Major emission source
Project emission	AMS-III.D.	Leakage of CH_4 from biogas plant	CH_4	Yes	Not a major emission source, but calculation is considered
		Combustion of biogas	CO_2	No	Carbon neutral
			CH_4	Yes	Not a major emission source, but calculated
			N_2O	Yes	Not a major emission source, but calculated
		Power and thermal energy source for plant	CO_2	No	Not used as power and thermal energy
Leakage	AMS-I.E.	Leakage in production of renewable biomass	CO_2	No	Not included in applying conditions
		Potential source of leakage	CO_2	No	Not calculated, but ex-post survey is conducted
		Leakage on transfer	CO_2	No	Calculated only when transferred

Figure_Table 5 Emission sources of GHG / Emission activities

(v) Calculation of baseline emission

The amount of baseline emission by combustion of non-renewable biomass is calculated, according to AMS-I.E.

$$BE_y = \frac{HG_{p,y}}{\eta_{old}} \cdot f_{NRB,y} \cdot EF_{projected\_fossilfuel} \quad (A)$$

Where,

BE_y : Emission reductions during the year in t-CO_2

$HG_{p,y}$: Quantity of thermal energy generated by the new renewable energy technology in the project in year y (TJ)

η_{old} : Efficiency of the system being replaced, measured using representative sampling methods or based on referenced literature values

$f_{NRB,y}$: Fraction of biomass used in the absence of the project activity in year y that can be established as non renewable biomass using survey methods

$EF_{projected\_fossil\,fuel}$: Emission factor for the projected fossil fuel consumption in the baseline.The fossil fuel likely to be used by similar consumers is taken: 71.5 tCO2/TJ for Kerosene, 63.0 tCO2/TJ for Liquefied Petroleum Gas (LPG) or the IPCC default value of other relevant fossil fuel.

The amount of baseline emission by the open dumped livestock dung is calculated according to AMS-III.D.

$$BE_y = GWP_{CH_4} \cdot D_{CH_4} \cdot UF_b \cdot \sum_{j,LT} MCF_j \cdot B_{0,LT} \cdot N_{LT,y} \cdot VS_{LT,y} \cdot MS\%_{Bl,j} \quad (B)$$

Where,

GWP_{CH4}	:	Global Warming Potential (GWP) of CH4 (21)
D_{CH4}	:	CH4 density (0.00067 t/m3 at room temperature (20 ºC) and 1 atm pressure).
LT	:	Index for all types of livestock
j	:	Index for animal waste management system
MCF_j	:	Annual methane conversion factor (MCF) for the baseline animal waste management system "j"
$B_{O,LT}$	:	Maximum methane producing potential of the volatile solid generated for animal type "LT" (m3 CH4/kg dm)
$N_{L,Ty}$	:	Annual average number of animals of type "LT" in year "y" (numbers)
$VS_{L,Ty}$	:	Volatile solids for livestock "LT" entering the animal manure management system in year "y" (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,j}$	:	Fraction of manure handled in baseline animal manure management system "j"
UF_b	:	Model correction factor to account for model uncertainties (0.94)

(vi) Calculation of the project emission

The emission in Methane recovery in animal manure management systems is calculated according to AMS-III.D.

$$PE_y = PF_{PL,y} + PE_{flare,y} \quad \text{(C)}$$

Where,

PE_y	:	Project emissions in year "y" (tCO2e)
$PE_{PL,y}$	:	Emissions due to physical leakage of biogas in year "y" (tCO2e)
$PE_{flare,y}$	:	Emission from flaring or combustion of the biogas stream in the year "y" (tCO2e)

(vii) Leakage

In AMS-I.E. and AMS-III.D, leakage is not calculated. However, ex-post survey is implemented for potential leakage of non-renewable biomass in AMS-I.E.

(2) Monitoring plan

(i) Major monitored quantity

Major monitored quantity is described as the followings.

Data / Parameter:	$HG_{p,y}$	η_{old}	$f_{NRB,y}$	$EF_{projected\_fossilfuel}$	N_{hh}
Data unit:	TJ	-	-	tCO_2/TJ	-
Description:	The amount of thermal energy which has been generated by renewable energy in the year y	Efficiency of the replaced thermal application (cooking stove)	The non-renewable biomass ratio of the amount of consumed biomass in the absence of the project in the year y	Emission factor of fossil fuel which would have been consumed in the baseline scenario	The number of household where biogas plant and thermal application are appropriately operated
Source of data to be used:	Estimated value from monitoring data	Literature value	Assess from the result of survey on the forests	IPCC Default value	Monitoring data
Value of data applied for the purpose of calculating expected emission reductions	0.0011 (The monitored data by gas meter × reference value)	0.1 (literature value)	1 (Estimated from reference value)	63.1t-CO_2/TJ (2006 IPCC Guideline (LPG)	1,000 (10CPA × 100 household / CPA)
Description of measurement methods and procedures to be applied:	The amount of biogas is monitored with gas flow meter. Methane content is monitored with gas analyzer.	—	Estimated from reference value	2006 IPCC Guidelines	Confirmation by visual inspection
QA/QC procedures to be applied:	Accuracy assurance period of gas flow meter is 10 years, and calibration during the period is not required	—	—	—	Quality of haring data can be assured through training program for staffs who confirm by visual inspection
Any comment:	CH_4 content shall refer to the central value of the following table temporally	This value could be revised by ex-post survey of the non-renewable biomass	—	—	—

Figure_Table 6 AMS-III.D. Monitoring Categories

Data / Parameter:	GWP_{CH4}	D_{CH4}	UF_b	MCF_j	$B_{0,LT}$	$N_{LT,y}$	$VS_{LT,y}$	$MS\%_{Bl,y}$
Data unit:	-	t/m^3	-	-	$m^3CH_4/kg\text{-}dm$	-	Kg-dm/animal/year	-
Description:	Global Warming Potential	Methane density	Correction factor for model	Conversion factor for Methane from livestock dung management methods *j* in baseline	The maximum Methane producing potential from the volatile solid which livestock *LT* has discharged	Average head number of livestock *LT* in the year *y*	The amount of volatile solid of livestock *LT* which is to be fed into the livestock manure management system in the year *y*	Fraction of manure handled in baseline animal manure management system "*j*"
Source of data to be used:	IPCC Default value	Default value	Default value	IPCC Default value	IPCC Default value	Monitoring data	IPCC Default value	IPCC Default value
Value of data applied for the purpose of calculating expected emission reductions	21	0.00067	0.94	0.015	0.1 (buffalo) and etc	3 (buffalo) and etc	1,424 (buffalo) and etc	0.41
Description of measurement methods and procedures to be applied:	-	-	-	-	-	Confirmation by visual inspection	-	-
QA/QC procedures to be applied:	-	-	-	-	-	Quality of haring data can be assured through training program for staffs who confirm by visual inspection	-	-
Any comment:	-	-	-	-	-	-	-	-

Figure_Table 7 AMS-III.D. Monitoring Categories -1

The amount of ex-post emission reduction by methane avoidance is calculated according to AMS-Ⅲ.D.

$$ER_{y,ex-post} = \min\left[\left(BE_{y,ex-post} - PE_{y,ex-post}\right), \left(MD_y - PE_{power,y,ex-post}\right)\right]$$

Where,

$ER_{y,ex-post}$	:	Emission reductions achieved by the project activity based on monitored values for year "y" (tCO2 e)
$BE_{y,ex-post}$	:	Baseline emissions calculated using formula 1 using ex post monitored values of NLT,y and if applicable VSLT,y
$PE_{y,ex-post}$	:	Project emissions calculated using formula 4 using ex post monitored values of NLT,y ,MS% i,y and if applicable VSLT,y
MD_y	:	Methane captured and destroyed or used gainfully by the project activity in year "y" (tCO2e)
$PE_{y,ex-post}$	:	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year "y" (tCO2e)

MD_y is calculated by the following formula referring to the monitoring data.

$$MD_y = BG_{burnt,y} \cdot w_{CH_4,y} \cdot D_{CH_4} \cdot FE \cdot GWP_{CH_4}$$

Where,

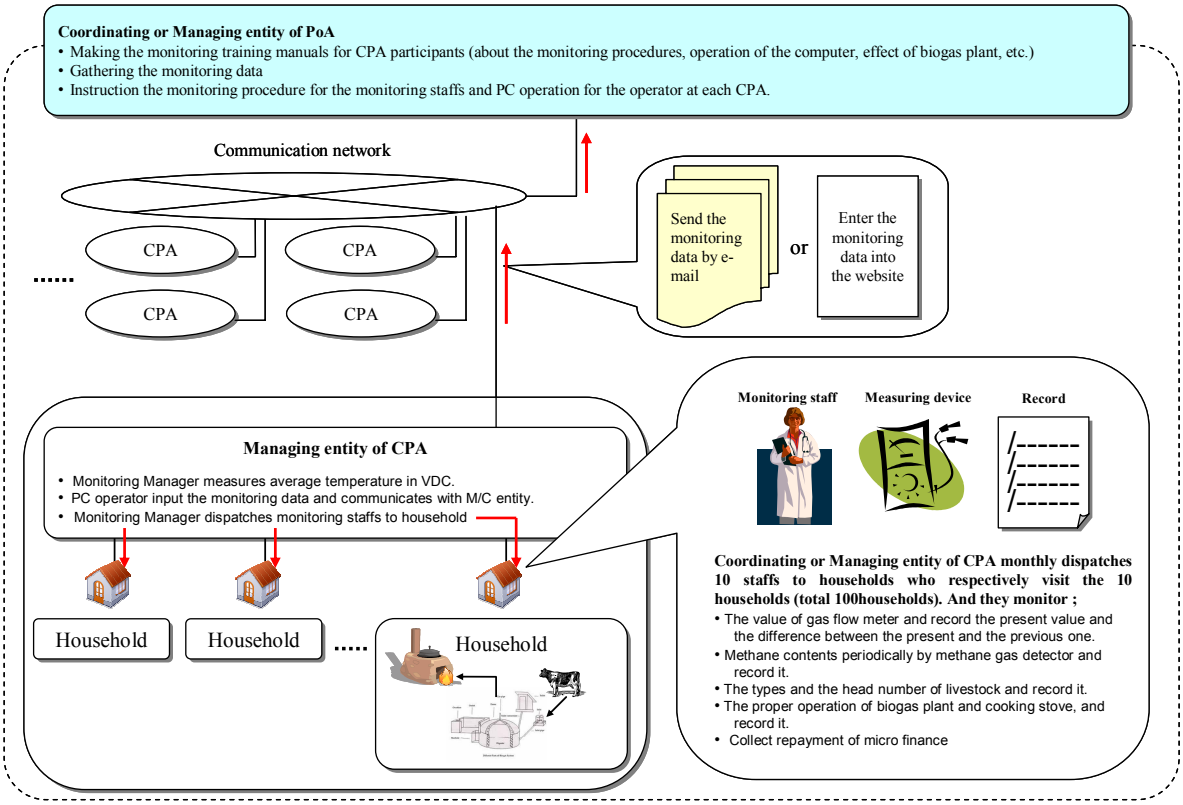
$BG_{burnt,y}$	:	Biogas3 flared or combusted in year "y" (m3)
$w_{CH4,y}$	:	Methane content3 in biogas in the year "y" (mass fraction)
FE	:	Flare efficiency in the year "y" (fraction)

Data / Parameter:	$BG_{burnt,y}$	$w_{CH4,y}$	EF
Data unit:	m^3/year	%-mass	%
Description:	The amount of biogas	The Methane content in biogas	Combustion efficiency
Source of data to be used:	Monitoring data	Monitoring data	Reference value
Value of data applied for the purpose of calculating expected emission reductions	0.0019 (Monitoring data by gas meter)	0.6 (Referred to literature value)	0.99
Description of measurement methods and procedures to be applied:	Measuring the amount of biogas by gas flow meter , and recording	Measuring by methane gas analyzer	-
QA/QC procedures to be applied:	Accuracy assurance period of gas flow meter is 10 years, and calibration during the period is not required	Regular calibration is implemented	-
Any comment:	-	-	-

Figure_Table 8 AMS-III.D. Monitoring Categories -2

(ii) Monitoring procedures

Monitoring procedures are described as the followings.



Figure_Table 9 Monitoring flow

Managing entity of CPA is established at each site, where a PC operator, a monitoring manager and 10 monitoring staffs are stationed. The entity dispatches them to each household monthly. A staff takes care of 10 households, and conduct monitoring.

Monitoring staffs are trained in advance on the method of measuring gas meter, recording and using monitoring devices. They take care of Methane gas analyzing periodically. In addition, they measure the amount of biogas by the gas meter which are installed at household, and also conduct hearing survey on the monitoring quantity above Figure_Table 6, 7 and 8.

Besides monitoring, the staffs conduct the following works.

- Collection of repayment for microfinance (repayment to micro finance organization)
- Checking the conditions of biogas plant (outputs of biogas, the amount of water to be fed into biogas plant) (inform to biogas companies or Association of Biogas Companies, if any)
- Collection of comments from households (inform to Coordinating or Managing entity through Managing entity of CPA)

Data recording staff at Management entity of CPA sends monitoring data monthly to Coordinating or Managing entity through communication tool after hearing data and record of gas meter value are checked.

Coordinating or Managing entity drafts monitoring report after they accumulate the received data.

(3) The amount of GHG emission reduction

The amount of GHG emission reduction in entire PoAs is described as the table below.

unit：thousand t-CO_2

Scenario	Emission source / Emission activities	2010	2011	2012	2013	2014	2015	2016
Baseline	Combustion of non-renewable biomass	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	Methane emission from livestock dung	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Project	Methane leakage from biogas plants	0	0	0	0	0	0	0
	Combustion of renewable biomass	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Power and thermal energy use source for biogas plants	0	0	0	0	0	0	0
Total amount		3.1	3.1	3.1	3.1	3.1	3.1	3.1

Figure_Table 10 The amount of GHG emission reduction

(4) Duration / Crediting Period

Duration and Crediting period is scheduled as the table below.

Activities	2009	2010	2011	2012	2013	…	2027	2028	2029
Drafting of PoA-DD･CPA-DD									
Validation									
Application for CDM registration									
CDM registration		★							
Construction of bigas plant									
Project period						…			
Verification of GHG emission reduction			★	★	★		★	★	
Application for the issuance of CER						…			
Issuance of CER				★	★		★	★	★
End of the project									

Figure_Table 11 Project Schedule

(5) Environmental Impact Assessment and other indirect impact

(i) System for Environmental Impact Assessment

Although Environmental Impact Assessment act has been enforced in Nepal, construction and operation of biogas plants are exempted from the act. And therefore, the assessment is not carried out.

(ii) Positive Environmental Impact

The amount of collected firewood decreases by the proposed project, which is consequently expected to lead to avoid deforestation. And the appropriate treatment of livestock dung leads to appropriate treatment of waste materials. Ground water contamination caused by Nitrate Nitrogen and Nitrite Nitrogen produced by open dumping is also expected to be mitigated.

(iii) Social impact

It is reported that the hours spent in collecting firewood is saved by the installation of biogas plant, and the saved hour is 93 minutes on a day average. 228 to 89 minutes in Terai, 187 to 90 minutes in Hill, and the installation of biogas plant leas to save considerable amount of hours.

(iv) Impact on gender

Women are released from the hard work (collection of firewood) by the installation of biogas plant. And 93 minutes of hours can be saved on a day averege. It has also promoted social advancement by women.

(v) Impact on health

There are a lot of households which use firewood as cooking fuel in Nepal. Kitchen is filled with smoke by combustion of firewood, and therefore, there are a lot of women who claim of Offensive health condition. However, cases of eye ache, head ache and sore throat as well as diseases of lung have bee reported to decrease after the installation of biogas plant.

(vi) Economical impact

In BSP, the registered biogas companies are eligible to install biogas plants. So far, some 80 companies have been registered, which helps to expand the employment opportunity. And the yield of crops increase by using the slurry produced from biogas plant.

(vii) Agricultural impact

Generally, farmers use chemical fertilizer, however, it is controlled by installation of biogas plant. This is because the slurry discharged from the plant is used as agricultural fertilizer.

And the yield of crops such as grain also increases.

(6) Stakeholders' comment

Stakeholders' meeting is to be held at PoA level, however, it will be held after Coordinating or Managing entity is assigned. On implementing PoA in advance, as comments at PoA level, meeting has been held individually with DNA, AEPC, BSP-N, Association of Biogas Companies and biogas companies.

DNA approved of PoA which the concept of tele-center is applied, however, they commented that the sustainable operation of tele-center shall be discussed.

AEPC demanded that it shall be appointed to Coordinating or Managing entity.

BSP-N requested it should be discussed that BSP-N shall be involved in PoA, in some way. And BSP-N commented that the organization by itself is preparing for biogas plant introducing PoA which AMS-ⅠE is applied.

Association of Biogas Companies commented that it would participate in monitoring by cooperating with its network and tele-center.

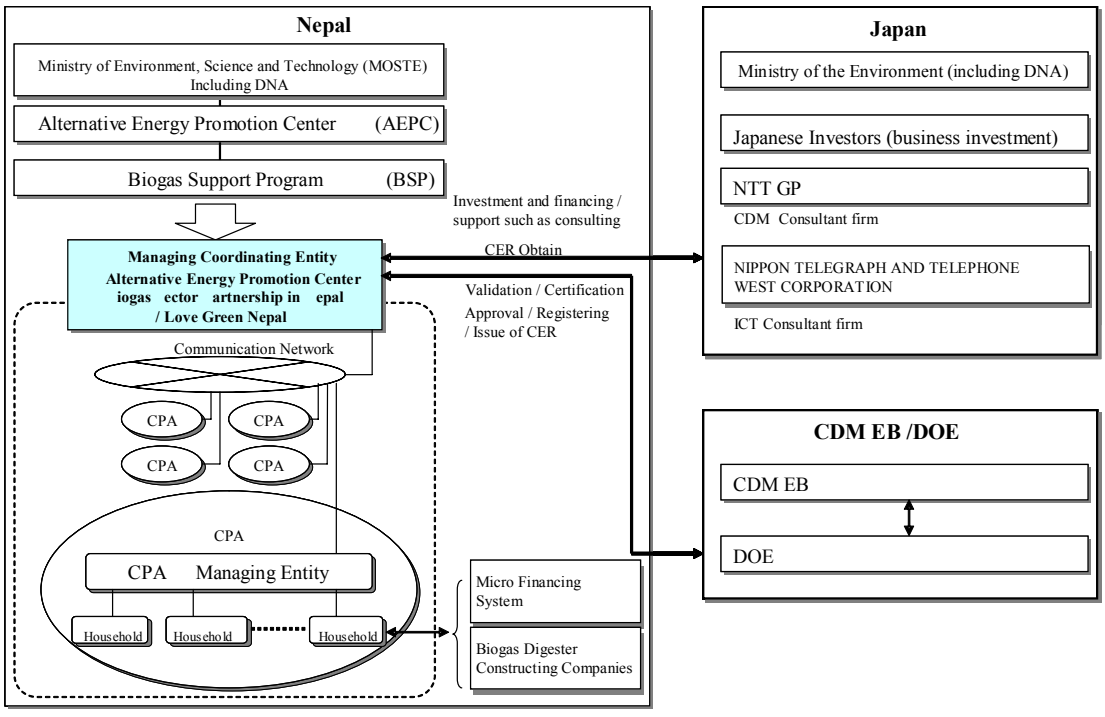
Biogas Companies approved of the project.

(7) Framework for project implementation

Framework for project implementation is described as the figure below. And each entity for implementation is as the followings.

- The project is negotiated to be implemented under BSP. Unique program to the project could be established, according to the negotiation.

- Coordinating or Managing entity remains to be designated, however, AEPC and BSP-N are nominated.
- Managing entity of CPA which is mainly composed of village office is established at CPA, and manages it. And CPA takes responsible for communication between households and Coordinating or Managing entity. For this purpose, communication network is used.
- Households achieve the amount of GHG emission reduction by installing biogas plant, protecting non-renewable biomass (firewood) and prevention of open dumping of livestock dung.
- Micro finance organizations invest to households on installation of biogas plant. As the financial organization, banks, Agricultural Cooperatives, Unions and other organizations can participate.
- In case of installing biogas plant under BSP, biogas companies must be registered to BSP. According to field survey, the number of the registered companies is 72.
- DNA is established at the Ministry of Environment, Science and Technology. As to government approval, Coordinating or Managing entity applies to DNA.
- As Japanese project participants, investors to PoA and CER purchaser are considered. However, BSP is operated by the fund from the government of Netherland and Germany. And therefore, the negotiation with them is necessary for the fund from Japanese organization.



Figure_Table 12 Framework for Operating Managing of PoA

(8) Financing Schedule

Financing and Investment schedule is described as the table below.

Financing /Investment schedule		Amount	Implementing year	Prospect for financing
Cash in				
	Subsidy (or investment)	Initial cost 40%	Installing year	Subsidies by BSP to household by biogas plant are considered.
	Micro financial organization	Initial cost 60%	Installing year	Financing by micro financial organization to household by biogas plant is considered, however, financing conditions depend on organizations.
Cash out				
	Investment in plant and equipment	Initial cost 100%	Installing year	Installing period is expected to be 3 months.

Figure_Table 13 Financing and investment schedule

(9) Economical analysis

CER revenue is the only income through the project, however, purchasing cost of firewood and fossil fuel are saved by the use of biogas. And that of chemical fertilizer is also saved by the use of slurry obtained from the biogas plant at household level.

Profits and losses are calculated, considering these saved costs as economical income. The result is described as the table below.

Unit : Million Yen

Calculation of profits and losses	1st	2nd	3rd	4th	5th	6th	7th
Income	27.7	27.7	27.7	27.7	27.7	27.7	27.7
Expenditure	22.7	19.5	16.3	13.5	13.5	13.5	13.5
Revenue	5.0	8.2	11.4	14.1	14.1	14.1	14.1

Figure_Table 14 Calculation of profits and losses

The result of sensitivity analysis on IRR is described as the table below.

("-" means non-profitable) unit: %

Unit price of CER (Yen/t-CO_2) / Compensating rate (%)	0	2,000	3,000	4,000
30 (level at present condition)	-	-	-	2.9
40	-	-	4.0	8.9
50	-	5.6	11.3	16.9

Figure_Table 15 Sensitivity Analysis of IRR

(10) Additionality

According to the Attachment B of General guidance to small scale methodology, one additionality of several barriers shall be proved. And investment, technology and other barriers are described as the following sections.

(a) Investment barrier

i) Investment barrier at PoA level

The table below describes the funding for BSP and its use. Operating capital is made up of

fund by the government of the Netherlands, Germany and Nepal, CER revenue, and registration fee of biogas companies. 77% of the whole capital at the fourth phase is used as subsidies for installation of biogas plant, and the rest is for operating fee of BSP.

Investment on BSP	M€	Purpose of use
SNV/DGIS (the Netherlands)	0.95	Subsidy for biogas plant
	2.78	Operation cost of BSP
KfW (Germany)	7.09	Subsidy for biogas plant
The government of Nepal	2.82	Subsidy for biogas plant
CER	0.22	Operation cost of BSP
Biogas companies registration fee and others	0.25	Operation cost of BSP
Sub total	10.86	Subsidy for biogas plant (77%)
	3.25	Operation cost of BSP (23%)
Ground total (=Cost on implementing BSP)	14.11	(100%)

Figure_Table 16 funding support

Operation of BSP has been funded by the Netherlands and Germany. However, the amount of funding at the fourth phase is reduced from that of the third phase, and therefore the balance is needed to be compensated by CER revenue. In the absence of CER revenue, installation of biogas plant in Nepal will not be implemented due to the shortage of capital. On this point, investment additionality at PoA level is proved.

ii) Investment barrier at CPA level

In case of installing biogas plant at household, subsidies for the project are provided by BSP, however, as shown above i), operation of BSP is available only after CER revenue. In case that households implement installation of biogas plant without CDM, they are forced to install the plants by their own capital or microfinance loan equivalent to the total amount or the part of construction cost. In that case, it would not be obviously implemented, according to the trial calculation below.

The result of hearing survey which has been conducted to financial organizations and biogas companies on microfinance is described as the table below.

Categories	Contents (only valid within the hearing survey, and not applicable to all organizations)
Microfinance organization	180 organizations such as banks and Agricultural Cooperatives in Nepal
Term of repayment	Generally, no longer than 5 years
Interest rate on repayment	Generally, more than 10%
Mortgage	A guarantor, recommendation by biogas companies, land and others
Others	The above contents are on micro financial system exclusively for installation of biogas plants. There is other micro financial system.

Figure_Table 17 General description of microfinance

Financial organizations include banks, Agricultural Cooperatives and others. As shown above, financing conditions are that term of repayment is generally no longer than 5 years, and interest rate on repayment is generally more than 10% and so on. Considering that construction, the cost of biogas plant at household is financed by microfinance organization, trial calculation is as the table below.

Conditions	Contents
Initial cost	60 thousand yen /plant
Average salary	225 thousand yen
Total amount of capital	60 thousand yen
Total amount of capital to average salary	26.7%
Term of repayment	Three years
Interest rate on repayment	15%

Figure_Table 18 General description of loan on microfinance

Repayment schedule is as the following table.

Thousand yen

Repayment schedule	1st	2nd	3rd
Repayment amount of capital	20	20	20
Interest on repayment	9	6	3
Total repayment amount	29	26	23
Total amount of debt to average salary	12.9%	11.6%	10.2%

Figure_Table 19 Repayment schedule

According to the table above, debt to income rate is 10.2% to 12.9%, and mortgage such as land and others are required for loan. However, households could not be financed because they have less mortgage. For a lot of households, the scenario of installation of biogas plant would not be implemented. And therefore, investment additionality is also proved at CPA level.

(b) Technical barrier

In BSP, only registered biogas companies are eligible to install biogas plant. The registered biogas companies are 72, in the whole of Nepal. Those companies are trained on skills of installing biogas plant, maintenance and others. And they are obliged to offer free assurance within 3 weeks after installation, which is a vital role in order to maintain the quality of biogas plant.

In case that households install biogas plant by their own (without CDM), inexpensive commission to biogas companies which have not been registered to BSP is available. After installation, biogas plants are assured of free maintenance and overhaul for three years. Therefore, in case of commission to non registered biogas companies, installation skills and its operation as well as maintenance, which are secured in BSP, are not assured. And consequently, the plants could not be operated appropriately. In that case, even if the biogas plants are installed, some cases do not lead to GHG emission reduction. This is the technical barrier.

(c) Other barrier (Geographical barrier)

In order to support the introduction of biogas plants in the whole of Nepal, cost effect on the plants must be explained to the local household. However, the introduction is difficult for household who live far from the principle roads due to expensive sales cost from the point of commercial view.

(11) Project Feasibility and issues to be solved

The project feasibility does not seem to be difficult because it is backed by powerful local needs and established technologies. However, the following issues such as political and financial have been revealed as the survey advances.

(i) PoA based on BSP (Biogas Support Program)

In Nepal, 17 hundred thousand biogas plants have been installed under BSP. And two projects have been registered as CDM in Dec 2005. In case of implementing the PoA, it is desirable to carry out under BSP.

However, BSP must use the funding from the government of Netherland (SNV/N) and Germany (KfW) with highest priority. If PoA can be implemented by the other funding under BSP depends on further negotiation with both governments.

As the result of the negotiation with those governments, WWF seems to have implemented project activities individually by establishing Gold Standard VER Project (GSP). And therefore unique system could be developed in the project.

(ii) Coordinating or Managing organization of PoA

Framework for implementation of PoA is under discussion, assuming cooperation with AEPC as Operating organization of BSP and BSP-N as PoA implementing organization. AEPC suggested that it take care of coordination and management of PoA, and other organizations including BSP-N for implementation. On the contrary, BSP-N commented that the implementation of PoA under BSP is desirable.

The candidate is discussed mainly among AEPC and BSP-N. However, they seem to have individually discussed the PoA which AMS-I.E. is applied. And therefore, further discussion might be required, considering cooperation with both organizations.

(iii) Financing

For the half of construction cost of biogas plants, financing from the local financial organizations is considered, and for the rest, the subsidy by Japanese private and public sectors are considered. Meantime, PoA has the feature that CPA can be added to the project additionally, and investment on CPA is required on adding. And therefore, flexible system which can be invested on adding CPA is necessary. On this point of view, financing system shall be discussed further.

The scenario for the business plan in the future is discussed as the following, taking the above issues into account.

Biogas plants installing PoA is preferable to be implemented under the existing BSP. As to funding from Japanese public and private sectors, approval is required by Ministry of Environment, Science and Technology of Nepal, AEPC, SNV/DGIS (Netherland) and KfW (Germany) as funding supporters of BSP. And therefore, it is being negotiated on Japanese funding supporters to obtain approval by the party involved. Although it depends on the negotiation, unique program in the project could be established like WWF.

Funding support by Japanese public and private sectors are considered. In case of investment on PoA, flexible financial system, which investment is available on adding CPA, is necessary. At present, the funding support from private sector is discussed.

Coordinating or Managing entity, AEPC or BSP-N are nominated. BSP-N has registered two CDM projects so far. And considering that BSP-N is preparing for other CDM registration, BSP-N seems to be suitable to Coordinating or Managing entity.

Although it is the same with the concept of BSP-N on applying the methodology of AMS-I.E., AMS-III.D. is excluded. Besides monitoring methods, negotiation might be focused on this point.

Start of the program is expected to be after Aug 2009, when present phase Ⅳof BSP ends. It shall be arranged along with financing plan.

4. Pre-Validation

(1) General Description of Pre-Validation

Pre-Validation on PoA-DD and CPA-DD has been conducted by JACO CDM as DOE. And the following comments have been received.

The validation covers screening documents on PoA-DD and CPA-DD. The certified sectoral scope on validation of JACO CDM is 1 to 3, and 14. AMS-Ⅰ.E which is to be applied to the project belongs to 1, while AMS-III.D. 15. In order to implement pre-validation on both methodologies, JACO CDM must be certified as sectoral scope of 15. However the project is an informal validation, and it can be conducted even before certification.

(2) Communication history with DOE

Comments are as the followings, each of them are as available or under consideration.

・Training and education for the people involved・・・Available

・Assessment of f_{NRB}・・・under consideration

・Monitoring・・・Available

・Leakage・・・under consideration

5. Feasibility of co-benefit CDM

(1) Assessment of prevention of environmental pollution in the host country

Efforts on environmental pollution effect are surveyed on the following three categories.

a) Nitrogen content which penetrates into the ground water caused by open dumped livestock dung

b) Offensive odor released from open dumped livestock dung

c) Discharge of livestock dung as waste materials

a) Nitrogen content which penetrates into the ground water from livestock dung

In order to investigate Nitrate Nitrogen and Nitrite Nitrogen content, which penetrate into the ground water from the open dumped livestock dung, water is sampled from the water resource for households and measured.

According to the result, a household in Terai has been reported with the total value of Nitrate Nitrogen and Nitrite Nitrogen of about 8mg/ℓ. However, the household with the content exceeding 10mg/ℓ has not been reported. Average value in Terai is 1.3mg/ℓ, while 0.4mg/ℓ in Hill, which shows that the ground water in Terai could have been contaminated severely by open dumped livestock dung, on simple comparison of average value. However, in case that the household with the value of about 7.9mg/ℓ is excluded, the average value in Terai is 0.5mg/ℓ, which also shows that the average value is a little bit higher than that in Hill. This shows that a lot of households in Hill are seldom suffered from the open dumped livestock dung because those households use spring water and river in remote area as source of drinking water. On the contrary, in Terai, the households use well water as source of drinking water, which might be vulnerable to the open dumped livestock dung.

Given the situation above, effect of co-benefit by installation of biogas plant is considered to be high in Terai where the ground water could be contaminated severely. And measurement of Nitrogen concentration after installation of biogas plant (co-benefit monitoring) is also necessary.

b) Offensive odor released from open dumped livestock dung

Simple ammonia measurement has been conducted at open dumping sites of livestock dung. According to the measurement, a case of 3ppm has been reported, while cases of below 1ppm at many other dumping sites have been reported. Actually, when smelled closely at the dumping sites, a faint of offensive odor has been just felt. It depends on subjective judgment by people, it shall be just as reference.

c) Discharge of livestock dung as waste materials

A lot of cases have been witnessed that livestock dung has been open dumped in front of household. As the result of hearing survey, the dung has been proved to be dumped in order to use it as fertilizer, cooking fuel and construction materials. Referring to the illegal dumping issues which are common in the developing countries, the Nepal case has not infringed on the laws and regulations. And then, there is no awareness of environmental pollution as waste materials treatment issues.

(2) Proposition of co-benefit index (in case that sufficient survey results have been obtained)

On making of co-benefit index at b), LCA unified index data which Japan LCA forum has has been referred. LCA unified index is the factor to assess several environmental impact by the unified index (amount of money), and the amount of GHG emission reduction as well as contamination concentration of the ground water can be assessed comprehensively by the index. As the result, the conversion factor for unifying index of the amount of GHG emission reduction has been formed, while Nitrate Nitrogen and Nitrite Nitrogen not, which has not led to making of co-benefit index.