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FINANCING DOMESTIC BIOGAS PLANTS IN NEPAL

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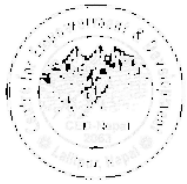

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EXECUTIVE SUMMARY

This paper reviews the state of the art on financing domestic biogas plants in Nepal. Officially there are two instruments namely biogas subsidy and biogas credit fund applied for financing domestic biogas plants in Nepal. CDM fund is emerging as one of the potential source for financing biogas and there are also cases where I/NGOs and local government are supporting directly or indirectly in promoting biogas through toping up subsidy/grants.

The current subsidy structure is same in case of 4 m^3 and 6 m^3 bio-gas plants, slightly lower for 8 m^3 plants and there is no subsidy for 10 m^3 bio-gas plants. Current cost of installing domestic biogas plants ranges between US$ 438 for 4 m^3 plants in Tarai and US$ 810 for 10 m^3 plants in remote hills. Considering the number of biogas plants installed, BSP has categorised a total of 18 districts as Low Penetration Districts (LPDs) for 2007/08 which receive additional subsidy of US$ 7.7 per plant. Further, in order to reach the poor, BSP has piloted an additional subsidy scheme for plant sizes of 4 m^3 and 6 m^3 amounting US$ 23.1, US$ 38.5 and US$ 53.8 respectively for Tarai, Hills and Remote Hills in collaboration with Grameen Bikas Banks (GBBs) assuming that GBBs have a standard criteria and modality to identify poor and have service delivery outlets in more than 40 districts. The effectiveness of this scheme is however questionable and it has created discrimination in the society.

Agriculture Development Bank Limited (ADBL), earlier Agriculture Development Bank Nepal, Nepal Bank Limited (NBL), Rastriya Banijya Bank (RBB) and Microfinance Institutions (MFIs) provide access to finance for farmers interested to install domestic biogas plants. With the decreasing share of ADBL, NBL and RBB on financing biogas, in early 2002, Alternative Energy Promotion Centre (AEPC) established Biogas Credit Unit (BCU) as a wholesale lending facility for MFIs to enable them on-lend to farmers for installing biogas plants. BCU has been working with 177 MFIs and provided wholesale loans over 150 millions, however it is poorly managed and has an overdue build-up of 11% and PAR one day past due of 22%. BCU lacks operational autonomy and its decision is governed by AEPC, a semi-autonomous government organisation and hence it is not operating as a professional organisation for financing biogas promotion.

Topping up of grants/subsidy by different I/NGOs, CBOs and local government (DDCs, VDCs, Municipalities) is quite common due to weak mechanism for enforcing and unifying subsidy on promoting biogas plants. This has distorted market by providing extra subsidy/grant while contributing on boosting number of biogas plants installed in some cases. Issue of double counting, misuse of fund and social discrimination is gradually emerging. All the support coming at district level should be streamlined to create healthy market for biogas promotion.

The nature of investment for biogas plant may differ among people particularly due to their economic condition. Some may borrow money from local money lenders and others from bank. About 31% of the total biogas plants installed are credit financed. Financial and economic cost benefit analysis of the biogas plants provided that investment in biogas is financially viable, economically attractive, socially acceptable, technically sound and environment friendly. Besides biogas plants have contributed positively in the lives of farmers and especially of women and children in rural areas. Biogas has generated a number of economic benefits making it an interesting example of conservation of public goods through a commercial and market approach. MFIs also benefit involving themselves on biogas financing.

There has been significant increase on price (close to 20%) on construction materials, unskilled labour and skilled labour in the FY 2007/08. This warrants the need to revise quotation for biogas construction and revisit the subsidy rate. The initiative undertaken by Biogas Sector Partnership Nepal (BSP/N) to categorize 18 districts as LPDs for

2007/08 with provision of incentive mechanism is noteworthy and this mechanism should be continued in the coming years in order to further expand biogas promotion to low penetration VDCs.

Effectiveness of additional subsidy of US$ 23.1 and US$ 53.8 piloted through GBBs to provide to their clients is questionable. Initiatives already started by the BSP to expand this strategy to all the farmers borrowing from poverty focussed MFIs (MDBs, FI-NGOs and some larger SCCs) is quite innovative. This initiative should come into operation without further delay.

The 177 partner MFIs of the BCU are at diverse capacity. Capacity of most of these MFIs should be enhanced on new credit product (biogas) design and development and promoting bio-gas plus initiatives such as income generating activities to increase repayment capacity of the clients. Capacity building of the partner MFIs need to be integral package in biogas development programme.

Appropriateness of BCU to provide wholesale lending facility for MFI for on-lending to farmers for installing biogas plants need to be reviewed in terms of their overall operation and portfolio management. BCU need to start preparing financial statement and prepare key financial ratios of their operation at least every six months. Further, BSP/N should expedite the process to register more CDM Projects and generate additional funding on implementing more biogas plants and create environment for promoting self-sustaining financing mechanism for biogas promotion in future.

In view of limited capacity, BCU should collaborate with few but large MFIs rather than more number of small MFIs to enable more farmers for installing biogas plant. Considering the huge economic benefits of biogas installation, special focus must be given to increase awareness on biogas plants and promote biogas in low penetration areas in southern part of the Tarai belts inhabited by people of Tarai origin and inaccessible hills and mountains. Hence, promotion is also key in some parts of the country.

Topping up of grants/subsidy by INGOs, NGOs, CBOs and local government (DDCs, VDCs, Municipalities) has more adverse effect than creating favourable environment for promoting domestic biogas as an commercial initiative. This system should be streamlined as one window system at DDC level to avoid duplication, mis-use of fund and reduce social discrimination that could likely be a source of conflict in the society. This could be possible by promoting decentralised planning and financing at district level and devolving DDC with a responsibility to devise district specific subsidy policy along with monitoring, evaluation and quality assurance system.

There is a need to devise the strategy to provide continuity to strengths, minimize weaknesses, use the opportunities and face the treats/challenges related to the use of existing financial instruments in order to expand the outreach of biogas promotion in different parts of rural Nepal.

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ABBREVIATIONS

ADBL	Agriculture Development Bank Limited
AEPC	Alternative Energy Promotion Centre
BCR	Benefit Cost Ratio
BCs	Biogas Companies
BCU	Biogas Credit Unit
BOK	Bank of Kathmandu
BSP	Biogas Support Programme
BSP/N	Biogas Sector Partnership Nepal
CBOs	Community Based Organization
CDM	Clean Development Mechanism
CEAMP	Community Environment Awareness and Management Project
CEDB	Clean Energy Development Bank
CFUG	Community Forestry User Groups
CSD	Centre for Self-help Development
DDC	District Development Committee
EIRR	Economic Internal Rate of Return
ERPA	Emission Reduction Purchase Agreement
FECOFUN	Federation of Community Forestry Users' Group in Nepal
FIRR	Financial Internal Rate of Return
FI-NGOs	Financial Intermediary NGOs
FY	Fiscal Year
GBBs	Grameen Bikas Bank
GGC	Gobar Gas Company
GI	Galvanised Iron
GSP	Gold Standard Project
HDP	High Density Polythene
LPD	Low Penetration District
MDB	Microfinance Development Bank
MFIs	Microfinance Institutions
NBL	Nepal Bank Limited
NBPA	Nepal Biogas Promotion Association
NEFSCUN	Nepal Federation for Savings and Credit Cooperatives Union
NPV	Net Present Value
RBB	Rastriya Banijya Bank
REDP	Rural Energy Development Programme
RET	Renewal Energy Technology
RMDC	Rural Microfinance Development Centre
SCCs	Savings and Credit Cooperatives
SFCLs	Small Farmers' Cooperatives Limited
SNV	Netherlands Development Agency
SWOT	Strengths, Weakness, Opportunities and Threats
VDC	Village Development Committee
WHO	World Health Organization
WI	Winrock International
WWF	World Wildlife Fund

1. INTRODUCTION AND BACKGROUND

1.1 Biogas programme

History of biogas promotion in Nepal is relatively long but eventful marked by series of research and development which dates back to 1955 when late Rev. B. R. Saubolle, S. J. introduced biogas system at St. Xavier's School in Godawari. Observation of Saubolle's on system's performance and people's reaction to technology was indeed noteworthy. After the pioneering venture attempted by Father B. R. Saubolle, it took almost 20 years to draw the attention of Nepalese government towards biogas technology. On the auspicious occasion of the "Agriculture Year", a biogas[1] programme was launched by the government as a special programme in 1975/76. The occasion also marked the disbursement of interest-free-loan for bio-digester construction wherein a total of 199 units of biogas systems were established. Further momentum in biogas sector took place in 1977 with the establishment of the Gobar Gas Tatha Krishi Yentra Bikas Company, now simply called as Gobar Gas Company (GGC), a pioneering and leading biogas construction company. The sector grew at slow pace until the launching of Biogas Support Programme (BSP), under the support from the Netherlands Development Organisation (SNV) in 1992 that made necessary fund and infrastructure available to implement national biogas programme smoothly. Since then BSP has been the only national level programme and major driving force for Nepalese biogas sector. Later, in 1996 Alternative Energy Promotion Center (AEPC) was established as a semi-autonomous government organisation principally with the objective of disseminating and promoting Renewable Energy Technologies (RETs) like Micro Hydropower (MHP), Improved Water Mill (IWM), Biogas, Solar Photovoltaic, Improved Cook Stoves (ICS) and Wind Turbine. Among all these forms of renewable energy, biogas has proven to be most successful in improving the livelihood of rural people by providing clean energy, uplifting their socio-economic status and minimizing destruction of natural resource like forest that leads to environmental hazards. With the establishment of AEPC, Biogas Support Program (BSP) was brought under its umbrella and since 2003 the fourth phase of the program is being implemented by Biogas Sector Partnership Nepal (BSP/N). Various GO/NGOs, namely Government of Nepal, KfW and SNV/N have put concerted efforts in promoting biogas in Nepal.

Nepalese bio-gas sector has undergone into four major stages of development as under.

- Pre-BSP stage (1955-1992): pioneering and research stage marked by (i) technology introduction (1955-1975) and (ii) internalisation and expansion (1975-1992).
- BSP I and II (1992-1997): market development and regulation.
- BSP III (1997-2003): market expansion and
- BSP IV (2003 - to date): consolidation and commercialisation.

Nepal has a huge potential of biogas plants installation[2] due to remoteness, high cost of fossil fuel and livestock raising as an integral part of Nepalese farming system. Technically it is 1.9 million plants but the total economic potential is 1 million plants. However, there is still a long way to achieve the desired goal as less than 10% and 19% of technical and economic potentiality respectively has been exploited so far. Currently, BSP is at the advance stage of the fourth phase (July 2003-June 2009) which has been implemented by Biogas Sector Partnership Nepal (BSP/N) in collaboration with AEPC, SNV and KfW as well as private sector represented by Nepal Biogas Promotion Association (NBPA)[3]. It is targeted to install originally 200,000 biogas plants which were later revised to 135,000 biogas plants.

[1]Biogas production can be extremely effective that offers a source of clean fuel in addition to numerous environmental benefits, such as reducing fuelwood consumption, making valuable nutrients available to the soil, and benefits in health and hygiene.
[2]Updated information as per BSP-Nepal
[3] BSP 2006, May 2006

There has been significant progress on biogas sector over the decades. Some of the notable progress includes the following.

- There are around 72 Biogas Companies (BCs) recognised by BSP for construction and after-sale services of biogas plants. BCs have over 200 main and branch offices all over Nepal. Most of these companies are established by rural entrepreneurs and there are just a few companies with more than US$ 7,692 as capital investment.
- Registration of Biogas Program under Clean Development Mechanism (CDM) has been emerging as one of the significant sources under Carbon Emission Trade for financing promotion of the bio-gas plants thereby providing opportunities for further promotion of this technology and posing new challenges to BSP to maintain stringent quality assurance and monitoring.
- BSP/N has adopted suitable promotion strategy for sustainable expansion of bio-gas.
- There is still investment subsidy available for biogas that has positively contributed for promoting biogas plants.
- Availability of micro credit to farmers from microfinance institutions (MFI) such as Grameen Bikas Banks (GBBs), Microfinance Development Banks (MDBs), Financial Intermediary NGOs (FI-NGOs), Savings and Credit Cooperatives (SCCs) and Small Farmers' Cooperative Limited (SFCLs) out of the Biogas Credit Unit (BCU) established under AEPC. AEPC established BCU using the financial support of KfW amounting 2.5 million Euro and this facility has contributed to increase farmer's affordability to install biogas plants and increase its market size while reaching relatively poor households.

1.2 Objective of the Assignment

This assignment is aimed at documenting evolution of instruments for financing of biogas plants in Nepal. The specific objectives of this study are to:

- describe the trend and pattern of domestic biogas programme in Nepal including an overview of the number of plants installed in the past, with possible targets for the future;
- estimate the breakdown of the current costs of domestic biogas plants;
- provide an overview of the financial instruments applied in the programme in the past and today;
- estimate the breakdown of the current financing of domestic biogas plants;
- analyse the issue of topping up subsidy/grants,
- undertake financial and economic analysis of the biogas plants from users' and financial institutions' perspective,
- undertake an evaluation of the strengths, weaknesses, opportunities and threats (SWOT) of the financial instruments applied in Nepal so far; and
- provide conclusions on the use of financial instruments so far and recommendations on its improved use in future;

1.3 Methodology

Various aspects of methodology adopted in this study are discussed hereunder.

1.3.1. Data Sources

The data required for preparing this report was obtained both from secondary and primary sources. The secondary sources include the review of relevant documents, project document, progress reports and other published and unpublished documents related to the BSP available in BSP/N, AEPC, NBPA and SNV. The primary information was gathered by conducting field studies, observation of biogas plants installed and consultation with relevant key stakeholders.

1.3.2. Data Collection Methods

Review of relevant documents: Key documents related to BSP and various progress reports were reviewed that supported the further investigation process and to obtain answers to the objectives of this assessment.

Focus group discussions: Most of the information required for the evaluation was gathered through focus group discussion with key stakeholders, representatives of BCs and appliance manufacturers and some selected MFIs.

Performance Review: The periodic progress report of BSP/N as well as the progress of BCs was reviewed to assess the performance of the programme on installing the number of biogas plants in different parts of the country.

Individual interviews: Individual interview of about 40 biogas plant owners and their family members were done to ascertain efficiency, effectiveness and impact of the biogas plants on their livelihood, especially savings of time for firewood collection and use of firewood.

Key informant interviews: Interviews with key staff in SNV, BSP/N, NBPA, AEPC, MFI executives and Managing Director of the BCs who are directly or indirectly associated with the project implementation helped to gather information on different aspects of bio-gas financing in Nepal.

Organisational assessment: Operational and financial performance of BCU within AEPC was assessed to ascertain its sustainability and potential to operate in future independent of external support.

Field studies: Field visits were made to gather first hand information on bio-gas installation and their operation in four districts (Banke, Lalitpur, Kavre and Jhapa) as well as observe progress of the programme and verify these progresses with the concerned people and the stakeholders. About 40 biogas plants from Jhapa and Banke districts were selected for in-depth assessment on their overall status and their effect on fuelwood cost and collection time savings. Operation, management and support for after sale services were analyzed in order to assess their operational performance and support to the owner. Field studies were conducted in August 2008.

1.3.3. Information Processing and Analysis

The information collected from different sources were compiled, consolidated and analyzed. Analysis was done under quantitative and qualitative assessment framework.

1.4 Limitations of the Assignment

This report could not adequately analyse the issues of subsidy to come-up with a final conclusion on adjusting subsidy upwards owing to the inflation of construction materials and labour inputs due to time and resource constraints. Adjusting subsidy upwards is against conventional notion that direct subsidy need to be phased-out gradually overtime.

Problems related to operational and financial performance of BCU could not be analysed adequately due to lack of basic information explaining their operation. This has made difficult to make any policy perspective as to the viability of the BCU. BCU has partners with many tiny cooperatives for ensuring access to financial services to farmers willing to install biogas plants. Due to limited scale of operation of these cooperatives, microfinance services could not be extended to a desired level as less than 30% of the plants installed are financed through credit. Factors affecting BCU's inability in the past

to partner with larger MFIs (FI-NGOs and MDBs) could not be adequately analysed. Further, extent to which the "additional subsidy for the poor" initiated from FY 2006/07 in collaboration with GBB to their clients is pro-poor compared to credit financing from other partners (SCCs and FI-NGOs) could not be assessed. As a matter of fact, from equity perspective (i.e. social justice), such an additional subsidy should be provided to the clients of all MFIs providing biogas loan without collateral.

In the context of Nepal, since 1990, the continuous feeding type digester, GGC 2047 model has been recognised as a standard biogas model and this model is commonly promoted in Nepal. The BSP established under the SNV in 1992 also gave approval to the GGC 2047 as the only standard model for promotion in Nepal. In view of this, in this study most of the analysis is based on GGC 2047 model.

2. TREND AND PATTERN OF DOMESTIC BIOGAS PROGRAMME IN NEPAL

2.1 Number of Biogas Plants Installed in the Past

Available information indicates that there are 198,971 biogas installed between 1974/75 - 2007/08 (Table 1 in Annex 1)[4]. Available classification by plant size installed illustrates that the majority (61%) of these plants are of 6 M^3 size followed by 8 M^3, 4 M^3 and 10 M^3 size. Installation of bio-gas plants with larger size i.e. 15 M^3 and 20 M^3 is quite uncommon in Nepal. Analysis of the distribution of bio-gas plants constructed across ecological belts and development region indicates that the proportion of biogas plants constructed is more in Hill (50.1%), followed by Tarai (49.4%) and the least in remote hills (0.5%). The programme has been able to install only 9.01% of the total potential plants: highest in Hills (12.1%), followed by Tarai (7.92%) and remote hills (0.64%). This analysis indicates that biogas programme in Nepal should provide additional efforts to expand the construction of biogas plants in Tarai and remote hills in addition to hill regions. Total biogas plants installed as a percentage of the total potential is high in western hill, followed by central hill and far-western Tarai. In remaining 12 ecological belts and development regions (refer Annex 1) total biogas plants installed as a percentage of the total potential is below 10% and it is less than 1.25% in all the remote hill districts[5].

2.2 Targets of Number of Plants to be installed in Future

Nepal's biogas sector has been governed by the Biogas Support Programme (BSP) Phase IV (July 2003 - June 2009). The BSP/N has a target to install additional 32,000 plants in 2008 and 26,346 plants till June 2009[6].

3. CURRENT COSTS OF DOMESTIC BIOGAS PLANTS

Current cost of domestic biogas plants region and size upto 10 m^3 based on approved quotation of 2007/08 is provided in Table 1 with further details in Annex 3.

Table 1: Cost of Domestic Biogas Plants (In US$) for FY 2007/08

Ecological Belts	4 m^3 (US$.)		6 m^3 (US$)		8 m^3 (US$)		10 m^3 (US$)	
	GI Pipe	HDP pipe	GI Pipe	HDP pipe	GI Pipe	HDP pipe	GI Pipe	HDP pipe
Tarai	425	410	497	482	576	561	637	621
Hills	463	447	541	524	632	616	700	681
Remote hills	520	502	609	591	713	696	791	772

Source: BSP/N, 2008

[4]Information on number of biogas plants installed by year, by size and region/district is provided in Annex 1.
[5]Geographically Nepal is divided into three regions: plain areas in the south (Tarai), mid hills and high/remote hills. High/remote hills are areas will difficult access compared to hills and Tarai.
[6]The current trend shows that over 70% of plant construction takes place during January-June period.

The cost of bio-gas system depends upon its size and location. The trend indicates the cost to be highest in remote Hills followed by Hilly regions and Tarai regions. Further, the cost of domestic biogas plants varies based on materials used (GI pipe versus HDP pipe). With the increase in the price of construction materials, pipes and fittings, appliances and skilled/unskilled labor, cost for domestic biogas construction is likely to increase significantly in the current FY. BSP/N, AEPC and SNV have started some process to revise the quotation of biogas plants and level of biogas subsidy upwards.

4. INSTRUMENTS FOR FINANCING DOMESTIC BIOGAS PLANTS

There are two main instruments namely subsidy and biogas credit facility applied for financing domestic biogas plants in Nepal[7]. In what follows, a description of various instruments used for financing domestic bio-gas plants in Nepal has been provided.

4.1 Biogas Subsidy

The government subsidy for biogas plants was reviewed a year ago and that revised subsidy rates are applicable for all household biogas plants. The current subsidy structure is provided in Table 6.

Table 2: Subsidy Structure for Household Bio-gas Plants for 2007/08

S.N.	Ecological belts	Subsidy Structure by Capacity (m^3) in US$				Subsidy Structure by Capacity (m^3) in Rs.				Per capita income in 2007
		4	6	8	10	4	6	8	10	
1	Tarai	100	100	92	-	6,500	6,500	6,000	-	370 $
2	Hills	146	146	138	-	9,500	9,500	9,000	-	
3	Mountains	192	192	185	-	12,500	12,500	12,000	-	

Source: BSP/N
Note: 1 US$ = Rs. 65

The current subsidy structure is same in case of 4 m^3 and 6 m^3 bio-gas plants, slightly lower for 8 m^3 plants and there is no subsidy for 10 m^3 bio-gas plants. Considering the number of biogas plants installed, BSP has categorised a total of 18 districts[8] as Low Penetration Districts (LPDs) for 2007/08 and these districts receive additional US$ 7.7 subsidy per plant as an incentive mechanism. Effectiveness of this scheme to increase the number of biogas plants in those remote districts is yet to seen.

As an incentive to poorer households to install biogas plants, BSP has initiated piloting of "additional subsidy for the poor[9]" scheme for plant sizes of 4 m^3 and 6 m^3 from FY 2006/07 in collaboration with GBBs on the assumption that GBBs have a standard criteria and modality to identify the poor and have service delivery outlets in more than 40 districts. The effectiveness of this scheme is not encouraging except in case of Western GBB. During field studies, it was revealed that that due to plurality on the existence of microfinance service providers in the same villages or settlements, this scheme has promoted discrimination in the society, meaning that households with similar socio-economic status can get additional subsidy if they are GBB clients and are devoid of such opportunity if they are clients of other MFIs. BSP/N, AEPC and SNV have already made critical assessment of the scheme and decided to extend this scheme

[7]Carbon credit/CDM has been emerging as one of the effective sources for financing domestic biogas plants. Related details on CDM fund is provided in Annex 5.
[8]The districts are: Achham, Dailekh, Okhaldhunge, Rukum, Baglung, Baitadi, Dadeldhura, Doti, Panchthar, Rolpa, Salyan, Taplejung, Dhanusha, Mahottari, Parsa, Rautahat, Sapteri and Siraha.
[9]For piloting, the additional subsidy rates are US$ 23.1, US$ 38.5 and US$ 53.8 respectively for Tarai, hills and remote hill districts.

among those MFIs that provide credit facilities to poor household under group approaches and without collateral[10].

4.2 Biogas Credit Facility

Traditionally, credit for biogas plant construction was provided by Agriculture Development Bank Limited (ADBL), Rastriya Banijya Bank (RBB) and Nepal Bank Limited (NBL). Owing to financial sector reforms and relocation of branch offices or squeezing their areas of operation due to conflict, there has been tremendous decrease in trend of biogas financing from these banks since late 1990s. Despite continued expectation of the sector with these banks to expand their portfolio on biogas sector, the situation did not improve rather there was a decreasing trend on their portfolio on biogas sector. As an alternative arrangement, AEPC (a semi-autonomous government organisation) has set-up the BCU in early 2002 to provide wholesale lending facility with funding support from KfW to the MFIs (SCCs, SFCLs, GBBs, MDBs and FI-NGOs) working in the rural areas. The BCU is currently managed by four staff comprising of Credit Officer, Account Assistant, Credit Assistant and Office Helper. As of July 2008, BCU has qualified a total of 177 MFIs from 38 districts and provided wholesale loans for retail lending to farmers willing to install biogas plants. See Annex 4 for distribution of type and number of MFIs receiving financial support from BCU. The key information is summarised in Table 3.

Table 3: Type and Number of MFIs along with Number of Accounts as of July 2008

S.N.	Type of MFIs	Number of			
		Districts*	MFIs	Accounts	Average account per MFI
1	Cooperatives	37	162	244	1.5
2	FI-NGOs	6	9	10	1.1
3	GBBs	4	4	4	1.0
4	MDBs	2	2	3	1.5
	Total	38	177	261	1.5

Source: Biogas Credit Unit, AEPC and * = overlapping

There are a total of 261 accounts of the MFIs under the BCU of the AEPC and as of July 2008, total loan disbursement was 2.31 millions. Average loan size per plant ranges between US$ 174 and US$ 271 with an average of US$ 218. Thus, over the last seven years, the bio-gas credit unit has supported financing of 10,612 bio-gas plants.

Table 4: Loan disbursed for Biogas and No. of Plants constructed

Fiscal Year	Loan amount (US$)	No. of Plants	Average loan size per plants (US$)
2001/02	53,077	196	271
2002/03	127,027	631	201
2003/04	85,208	459	186
2004/05	249,385	1,435	174
2005/06	438,049	1,790	245
2006/07	492,527	2,723	181
2007/08	869,458	3,378	257
Total	2,314,731	10,612	218

Source: Biogas Credit Unit, AEPC
Note: Exchange rate: 1 $ = Rs. 65 as of July 16, 2008

The six MFIs consulted while preparing this report started providing biogas loan as an activity in addition to their regular business. They have mobilised their own resources and wholesale loan borrowed from BCU for financing biogas plants. The size of wholesale loan varied between US$ 9,692 and US$ 461,539. Some MFIs have taken wholesale loans more than once. On an average a typical MFI has taken wholesale loans 1.5 times

[10]In general partner MFIs provide loans under two scenarios. First, without collateral to group members using peer pressure and group guarantee as collateral and second, with collateral to individual members who can pledge land and/or building as collateral for loan. The additional subsidy is being applicable in the former scenario.

from AEPC. The interest cost for wholesale borrowing is 6% per annum. These MFIs have mostly provided loans with and without collateral. The size of the loan provided for construction of biogas systems ranged between US$ 76.9 and US$ 507.7 depending on cash deficit with the owner. Likewise, loan term ranged between 12-36 months with repayment to be made either on monthly or quarterly instalments. On-lending interest rate to users ranges between 12% and 18% with 15% in most MFIs. Field observation revealed that these MFIs require intensive orientation and training on designing biogas loan products. For instance, for on-time loan recovery loan for biogas plants should be designed considering household cash flow than standard monthly/quarterly installment. Further, MFI must provide loans for starting income generating/microenterprises to biogas clients to increase their loan repayment capacity.

Box A: MFI requires Intensive Training on Managing Biogas Financing

Ms. Devaki Maya Shrestha, is a permanent resident of Rajaina-5 in Banke district. She has installed biogas plant in May 2008 with credit support amounting US$ 353.8 from Mahila Samaj SCC based in Kohalpur of Banke district. Loan term is for two years and loan should be repaid in eight equal installments. She lacks other sources of income and her only source of income is her husband's pension that can be withdrawn twice a year. As of the survey time, her loan was overdue and she expressed that she can't repay the loan until early October 2008. This situation illustrate that MFI should analyse the household cash flow situation and set the repayment rate accordingly in order to enable clients for on-time loan repayment.

Ms. Kali Maya Biswakarma, is a permanent resident of Ghailadubba-4 Champapur in Jhapa district. She installed biogas plant in November 2007 receiving financial support from Karnali SCCs located in Birtamod Bazar of Jhapa district. Loan term is for two years and loan should be repaid in eight equal installments. Her family is very poor and lacks other sources of income to repay the loan on time. On the absence of sources of other sources of income, she repaid her first installment of loan borrowing from moneylenders and second installment by pledging her ornament in the commercial banks. So far she is managing to repay the loan on-time. However, she has no idea on how to manage money for paying the third installment. While dealing with such clients MFI should critically analysis income sources of their biogas clients and provide them biogas plus loan to enable clients to start income generating activities of their own so that on-time loan repayment could be ensured.

Ms. Udin Birja is a permanent resident of Duwagadi-1 of Jhapa district. She is landless. They organized into women groups promoted by SAHARA Nepal, one of the partner SCCs of BCU and obtain loan amounting US$ 307.7 for biogas installation in February 2008. Her biogas plant is operating perfectly and now she has saved the time for firewood collection. She utilized the time saved due to biogas on vegetable marketing as well as managing a small grocery store in her house. She is also leasing 3 bigha of land for agricultural farming. She grew the vegetable like pumpkin in her kitchan garden and sold the harvest in the market and also sold slurry @ US$ 10.8 per bullock cart. She has a family of five members and all of them are self-employed in different activities and repaying the loan on-time to SAHARA Nepal without difficulty. Supplementary income sources have been instrumental to Ms Birja for on-time loan repayment.

BCU has prepared the portfolio report for the first time in June 2008 and second portfolio report was prepared as of July 15, 2008 and third in August 15, 2008. Summary of these portfolio reports is provided in Annex 6. Both overdue and Portfolio at Risk (PAR) one day past due has been improved significantly between June and August (Table 5).

Table 5: Portfolio Quality of BCU Loan Operation

S.N.	Time	Overdue (%)	Portfolio at Risk (%) one day past due
1	June 15, 2008	25.4	39.2
2	July 15, 2008	17.9	36.0
3	August 15, 2008	11.2	22.3

Source: Table A6.1, A6.2 and A6.3 in Annex 6

As of August 15, 2008, total loan disbursement of US$ 2.38 million, US$ 1.19 million is recovered and there is outstanding loan balance of US$ 1.19 million. Of the total outstanding loan balance, US$ 0.13 million (11.2%) is overdue and PAR one day past due is calculated at 22.3%. This improvement is partly attributable to capacity building support from SNV and initiating a system of preparing portfolio report and commissioning intensive follow-up to MFI with bad-debt. More efforts are still required to correct the overdue problems.

The repayment rate from MFIs to BCU is about 90%. There are over 50 partner MFIs with overdue loan with BCU. PAR has crossed overall acceptable range on best practice microfinance operation. Considering existing progresses, there is a need to expedite approval and disbursement process of biogas credit. This in turn may demand reviewing existing criteria and mechanism and addressing other administrative matters, including increasing the capacity of BCU and MFIs. Management of credit fund is much more complicated and requires high level of professionalism within BCU to ensure proper and timely disbursement and recovery. In view of this requirement and existing situation, there is a need to explore alternative wholesale lending mechanism for biogas in a long run or make drastic improvement on BCU operation. Further, there is a need to identify potential MFIs in additional 37 districts such that biogas financing will be available in all the 75 districts of the country. Hence, credit financing is still a problem for promoting biogas plants in Nepal as the partner MFIs are operating in only 38 districts. There is still a need to expand the frontier of biogas financing in 37 inaccessible hills and mountains as well as intensify access to financial services for biogas financing in existing 38 districts.

5. TOPPING UP SUBSIDY/GRANT FOR BIOGAS PROMOTION

Several INGOs, NGOs and local government (DDCs, VDCs, Municipalities) are involved in promoting biogas in Nepal. Some of the NGOs are fully involved in RET sector alone primarily focusing on RETs promotion including biogas while others have integrated RETs in community development projects. The RETs and other projects are run independent of each other. There are also INGOs which consider RET as a supplementary activity and contribute to achieve other major community development goals such as those related to health, environment, income generation, etc.

Some of the INGOs have been working with AEPC on project basis. For instance, Winrock International Nepal has established collaborative relationship with AEPC and BSP to bring MFIs into biogas sector. Winrock also worked with AEPC and BSP for developing the first biogas CDM project in Nepal. Currently, Winrock is working in partnership with Community Forest User Groups (CFUGs) to promote biogas plants in six districts under the financial support of the Ford Foundation. The concerned CFUGs provide incentive to their users on biogas installation on top of regular subsidy from government.

Other INGOs such as World Wildlife Fund Nepal, World Vision International Nepal, Plan International Nepal, GTZ, Community Forestry Chitwan, CARE Nepal, IUCN and Practical Action Nepal are working independent of AEPC to promote RETs. They are involved in promoting biogas along with other RETs in their project areas with their financing support packages (training, capacity building and incentives ranging between US$ 30.8 and US$ 107.7). These INGOs also support for toilet construction. Some of them have even provided bulk loan to farmers for constructing biogas systems. Practical Action Nepal has supported construction of biogas system in some district hospitals. Besides, performance/study reports of a number of NGOs mention that they have provided financial and material support (ranging between US$ 30.8 and US$ 107.7) to construct toilet attached biogas system. CBOs such as CFUGs and dairy cooperatives and their association have actively promoted biogas system with an ultimate goal to reduce pressure for forest resources in their community forest. They have provided financial

support ranging between US$ 30.8 and US$ 107.7 to members to install toilet attached or non-attached biogas systems. In some cases, they have also provided soft loans.

Box 2: Cases of Topping Up Subsidy/Grants

In Lalitpur district, DDC provides additional subsidy of US$ 46.15 per biogas plant for a maximum of 100 plants on first come first serve basis. Of the total 100 plants receiving subsidy, four plants were from peri-urban and accessible VDCs (one each from Lamatar, Chapagoun, Thecho and Lubhu) and remaining 96 plants were from inaccessible and remote Village Development Committees (VDCs) namely Gimdi and Ashrang of the districts.

Market for biogas installation is quite complicated in Kavre district. There are as many as nine agencies providing topping-up as subsidy for promoting biogas plant installation. For instance, Rural Energy Development Programme (REDP) has provided subsidy to biogas plants attached to toilet initially @ US$ 38.5 per plant which later increased to Rs. 53.8 per plant. Community Environment Awareness and Management Project (CEAMP) have subsidized for the installation of the 800-900 biogas plants in five VDCs in the west namely Sangha, Mahendra Jyoti, Baluwapati Deupur, Jaisi Thok and Jyamdi. District Women Development Section (DWDS) has subsidized to construct toilet attached biogas plants by providing roofing materials, pan, bricks, etc. mainly in Naya Goun VDC. The whole idea of DWDS has been to avoid duplication but some level of duplication was evident in some VDC. There is a Nepal School Project implemented in remote areas of Kavre district that support eligible farmers to establish biogas plants linking with government subsidy programme and providing differences as a grant. "SHYAM Project" has been implemented in four VDCs (Jaisithok, Jyamdi, Janagal and Baluwa) that provide additional subsidy for installing biogas in these VDCs. Some INGOs have also provided additional subsidy installing biogas in their working VDCs. However, District Development Committee has not been directly involved to provide additional subsidy to bio-gas plants installed in the district.

In Jhapa, Community Forest Users' Groups (CFUGs) are actively involved on promoting bio-gas plants by linking biogas owner with government subsidy in addition to supporting CFUGs to (i) use their own resources as a revolving loan fund, (ii) link its members with existing MFI for access to finance, (iii) work as a credit agent of commercial banks and (iv) involve as a partner for borrowing from BCU of AEPC. Their role in promoting biogas plants among their users is quite substantial.

WWF Nepal programme has developed a Gold Standard Biogas CDM project (GSP) with a target of constructing 7,500 biogas plants in their programme areas in different wildlife conservation area buffer zone in 10 districts[11] and 41 VDCs. The project is using its own fund for subsidy and technical assistance. The time frame is 2007 to 2011.

It is evident that topping up of subsidy/grants has both positive and negative implications in biogas sector. There exist instances where it has boosted number of biogas plants while at the same time distorted market by providing extra subsidy/grant (see Box 2 for details).

6. FINANCING OF DOMESTIC BIOGAS PLANTS

As mentioned earlier, the continuous feeding type biogas digester (GGC 2047 model) is the officially recognised and commonly promoted biogas plant in Nepal. Financing of the domestic biogas plants has been analysed for this model of bio-gas plants only. Affordable financing was a key element in promoting biogas plants. The breakdown for financing of domestic biogas plants in Nepal by plant size (4 m^3, 6 m^3, 8 m^3 and 10 m^3) and materials used (GI pipe versus HDP pipe) is provided in Table 6.

[11]The ten districts are: Bara, Parsa, Makawanpur, Chitwan, Palpa, Dang, Banke, Bardia, Kailali and Kanchanpur.

Table 6: Financing of Domestic Biogas Plants in Nepal (In US$)

Ecological Belts	4 m^3		6 m^3		8 m^3		10 m^3	
	GI Pipe	HDP pipe	GI Pipe	HDP pipe	GI Pipe	HDP pipe	GI Pipe	HDP pipe
Tarai	425	410	497	482	576	561	637	621
Hills	463	447	541	524	632	616	700	681
Remote hills	520	502	609	591	713	696	791	772
Average	444	429	520	504	605	589	669	652
Subsidy	124	124	124	124	116	116	0	0
Farmers' contribution	321	305	396	380	489	473	669	652
Non-cash (Maximum)	162	162	196	196	230	230	265	265
Cash	159	143	200	185	259	244	404	386

Source: BSP/N, August 2008
Note: 1 US$ = Rs. 65

The average cost of a biogas plant ranges between US$ 410 and US$ 791 depending on remoteness, plant size and materials used. It is more expensive to install biogas plant using GI pipe compared to HDP pipe. On the other hand, average subsidy provided is US$ 124 for 4 m^3 and 6 m^3 bio-gas plants and US$ 116 for 8 m^3 plants and there is no subsidy for 10 m^3 sized plants. The balance that ranges between US$ 305 and US$ 652 has been the responsibility of the farmer.

Table 7: Financing (Credit and Cash) of Domestic Biogas Plants in Nepal

Fiscal year	Credit Financing by Different Financial Institutions						Cash	Grand Total	Credit financed biogas as a percent of total
	ADBL	NBL	MFI	PPP	RBB	Total			
1994/95	3913	1	-	-	-	3914	1203	5117	76.5
1995/96	4935	47	-	-	33	5015	2142	7157	70.1
1996/97	4820	91	-	-	78	4989	3398	8387	59.5
1997/98	5261	159	-	-	315	5735	4134	9869	58.1
1998/99	4652	520	-	399	728	6299	4753	11052	57.0
1999/00	3904	512	-	144	423	4983	8282	13265	37.6
2000/01	4230	284	13	-	407	4934	12923	17857	27.6
2001/02	3050	2	196	-	478	3726	11801	15527	24.0
2002/03	2197	-	631	-	359	3187	13153	16340	19.5
2003/04	1138	-	459	-	183	1780	9479	11259	15.8
2004/05	1150	-	1436	-	211	2797	15006	17803	15.7
2005/06	566	-	1789	-	14	2369	13749	16118	14.7
2006/07	294	-	2456	-	1	2751	13178	15929	17.3
2007/08	187	-	3880	-	-	4067	9712	13779	29.5
Total	40297	1616	10860	543	3230	56546	122913	179459	31.5

Source: BSP/N, September 2008
Note: ADBL = Agriculture Development Bank Limited, NBL = Nepal Bank Limited, MFI = Microfinance Institutions, PPP = Park and People Programme, RBB = Rastriya Banijya Bank

In the past ADBL was involved to provide affordable financing to farmers to install biogas plants. During BSP II, other development banks were encouraged to provide access to financial services and NBL and RBB also started lending to farmers for biogas plants. But NBL technically stopped financing on biogas since 2002/03 and role of both ADBL and RBB on biogas financing gradually declined. In contrast, MFIs are gradually increasing their share on biogas financing borrowing wholesale loans from BCU. Owing to declining share of ADBL, NBL and RBB, BCU is motivating major MFIs (GBBs, SFCLs, Chhimek Bikash Bank Ltd., DEPROSC Bikash Bank Ltd., Nirdhan Utthan Bank Ltd., NEFSCUN, CSD, FECOFUN) to expand their portfolios to biogas, sometimes with additional subsidy for the poor to make biogas technology affordable to them. Lately Clean Energy Development Bank (CEDB) has recently been established as a development bank for

wholesale lending for promoting clean energy sector. There are cases of many other development projects, NGOs/CBOs providing loan to biogas users. BCU experienced a lot of problems such as high overdue, follow-up, monitoring, etc. to work with small MFIs, hence, proportion of biogas plants established under credit financing decreased.

Topping-up Subsidy / Grant has some role to motivate farmers to install biogas through cash financing. Sources of cash financing for farmers installing biogas includes: sale of live animals, savings from agriculture income, remittances, salary/services, mobilising family members to manage locally available construction materials and unskilled labour. Thus amounts of investment on biogas plant may differ across farmers due to their economic condition because they may not be able to install plant investing all cash from their saving. Some may borrow from local moneylenders and others from bank.

Strict enforcement of carefully determined quality and design standards are instrumental in achieving relatively high operational success on biogas installation. Private companies were invited to participate on the basis of several terms and conditions aimed at maintaining minimum quality and standards set by BSP[12]. Penalties were imposed for noncompliance when found through random inspection. This along with after-sale services has built confidence of farmers on biogas plants and motivates them to install it even under cash financing.

7. RETURN FROM BIO-GAS PLANTS TO HOUSEHOLDS, SOCIETY AND MICROFINANCE INSTITUTIONS

7.1 Return to Households and Society

World Health Organisation (WHO) has recently prepared guidelines for assessing the return of the household energy technologies (Hutton G. et al, 2006), and within this framework, Winrock International (WI) Nepal had undertaken a cost benefit analysis of household biogas plants following WHO guidelines in September 2006[13]. Detail related to this study is provided in Annex 7.

7.1.1. Basic Consideration

Cost benefit analysis is carried out both at household and society level. In order to be consistent to WI study, various costs and benefits were considered to differentiate between household and societal level analyses (See Table 8).

Table 8: Cost and Benefits Considered for Household Level and Societal Level Analysis

Level of Analysis	Costs	Benefits
Household	▪ Cost of biogas plant at the subsidised rate ▪ Repair and maintenance cost ▪ Cost of extra time consumed due to biogas installation	▪ Savings in medicine ▪ Firewood saving ▪ Kerosene saving ▪ Chemical fertiliser saving ▪ Time saving due to biogas
Society	▪ Full cost of biogas plants ▪ Repair and maintenance cost ▪ Cost of extra time due to biogas ▪ Technical assistance	▪ Savings in medicine ▪ Firewood saving ▪ Kerosene saving ▪ Chemical fertiliser saving ▪ Time saving ▪ GHG reduction

Source: WI, September 2006

[12]There are 73 standards relating to design, size, construction materials, construction of inlet, digester, dome, turret, outlet and compost pits, toilet attachment, appliances and fittings, fitting and layout of the gas pipes, training of masons, and after-sales service.

[13]Winrock International Nepal, "*Cost Benefit Analysis of Biogas Interventions to Reduce Exposure to Indoor Air Pollution in Nepal*" September 2006. Refer Annex 7 for details on cost benefit analysis of the biogas plants.

Consistent to WI study, in this study a comparision scenario has been developed and used to compute incremental benefits and costs of biogas use. The main comparison was done with traditional (wood burning) stoves assuming that in the absence of using biogas, population would continue to use these traditional stoves. An "*incremental cost-benefit analysis*" was done to compare change in benefits and costs from status quo (traditional stoves) to new technology (i.e. biogas) as the biogas plant has replaced existing traditional stoves. Information required for cost benefit analysis was obtained from Biogas Users' survey 2007. The 2008 has been used as the base year and the life of the plants was assumed to be 20 years and a 12% discount factor[14] was used to compute present value of future cost and benefits. The costs and benefits are modeled with respect to one biogas plant unit of different size.

7.1.2.Return to Households

The financial analysis was done to compute the return to households. Three financial ratios: Net Present Value at 12% discount rate, Benefit Cost Ratio at 12% discount rate and Financial Internal Rate of Return (FIRR) were computed (see Table 9).

Table 9: Financial Ratios of Investment on Biogas at HHs Level

Plant Size	Tarai			Hills		
	NPV	BCR	FIRR	NPV	BCR	FIRR
4 m^3	$1,011	2.37	45%	$1,293	2.77	55%
6 m^3	$1,482	2.71	49%	$1,482	2.86	52%
8 m^3	$1,547	2.76	47%	$1,637	2.85	49%
10 m^3	$1,302	2.28	36%	$1,278	2.19	34%

Sources: Table A7.9 to A7.16 in Annex 7

Clearly, benefits of the intervention outweigh costs at HH level, thus giving a net benefit in monetary term. The benefit to the cost ratio ranges from 2.19 and 2.86 and FIRR 34% for households that collect fuelwood. This clearly indicates that biogas plants are beneficial to all households.

7.1.3.Return to Society

The economic analysis was done to compute return to the society. Three economic ratios: Net Present Value at 12% discount rate, Benefit Cost Ratio at 12% discount rate and Economic Internal Rate of Return (EIRR) were computed (Table 10).

Table 10: Economic Ratios of Investment on Biogas at Society Level

Plant Size	Tarai			Hills		
	NPV	BCR	EIRR	NPV	BCR	EIRR
4 m^3	$806	1.71	25%	$1,211	2.03	30%
6 m^3	$1,419	2.18	32%	$1,541	2.24	33%
8 m^3	$1,738	2.36	34%	$1,839	2.40	35%
10 m^3	$1,456	2.10	30%	$1,460	2.05	29%

Sources: Table A7.17 to A7.24 in Annex 7

Clearly, benefits of the intervention outweigh costs at society level, thus giving a net benefit in monetary term. The benefit to cost ratio ranges from 2.05 and 2.40 and EIRR exceed 29% for the society even where fuelwood are collected indicating the beneficial effect of biogas plants to the society. These figures also point out that there is a strong justification for policy makers to support biogas initiative. Biogas provides both environmental and health benefits, which are not well perceived by users and policy makers when making decisions on whether to promote switchover to biogas from

[14]It is the opportunity cost of the capital commonly assumed by many project appraisal documents in Nepal.

traditional stoves and to encourage further investments in biogas. Further, in addition to monetary benefits of biogas intervention gained by individual households and society, economic benefits such as GHG emission reduction promote a cleaner environment and reinforce positive impact. Even when indirect benefits such as forest conservation, employment generation etc. have not been considered, the findings indicate that the investment on biogas promotion is positive.

7.2 Return to Microfinance Institutions

There has been significant paradigm shift on financing biogas plants from financial institutions. The share of ADBL, NBL and RBB on financing has decreased while that of the share of MFIs has increased overtime. There are mainly four types of MFIs (SCCs, FI-NGOs, MDBs and GBBs) currently engaged on providing access to financial services for the domestic biogas plants. There exist differences on service delivery mechanism and operational modality across these MFIs. In most cases (except SAHARA and Karnali) SCCs operate from head office itself while other MFIs operate from branch offices. Interest rate charged by SCCs is low in comparision to interest rate charged by FI-NGOs and GBBs. MDBs charge relatively high interest rate. In this study, amount of loan to be disbursed by different types of MFIs and number of biogas plants installed in order to cover cost of fund, likely loan loss provision, and operating cost while using one full time loan officers are computed and the results are presented in Table 11.

Table 11: Return to MFIs and Sustainable Operation

S.N.	Particulars	Unit	Information by MFI type			
			SCCs	FI-NGOs	MDBs	GBBs
1	Loan disbursement	No of plants	33	41	63	83
2	Loan disbursement	US$/yr	10154	12615	19385	25538
3	Operating cost	US$/yr				
	Salary of a loan officer	US$/yr	1625	2398	4255	5028
	Indirect cost including transaction cost	US$/yr	600	1000	1800	2000
	Utilities, house rent and other cost	US$/yr	120	250	720	800
	Loan loss provision	US$/yr	92	138	185	185
	Cost of capital	US$/yr	203	252	388	511
4	Operating income	US$/yr	1625	2398	4255	5028
	Interest income	US$/yr	1523	2271	4071	4852
	Other income	US$/yr	102	127	185	175
5	Net income	US$/yr	0	0	0	0

Source: Field survey 2008 and author's estimation

This analysis indicates that, in order to operate at break even level, typical SCCs should finance 33 biogas plants, FI-NGOs 41 biogas plants, MDBs 63 biogas plants and GBBs 83 biogas plants. This is the minimum incremental scale of operation for MFI not to loose money by being part of biogas lending. Above analysis indicates minimum scale of operation required for different types of MFI to break-even out of introducing biogas loan product in their business volume.

8. STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS OF THE APPLIED FINANCIAL INSTRUMENTS

Promotion of biogas plants is one of the successful interventions in Nepal. A number of factors unique to Nepal such as biogas plants fit very well into Nepalese integrated farming system that combines crop production and animal husbandry; most rural households rear some cattle to have dung that can be collected to feed biogas plants; handling cattle dung is not a taboo in the context of the Hindu culture; and increasing

difficulty of obtaining fuelwood provides a strong incentive to look for alternative cooking fuels, such as biogas; has contributed to the success on promoting biogas plants. A SWOT analysis of currently applied financial instruments has been done and the results are presented in Table 12 and 13.

Providing uniform, transparent and direct financial incentives for rural farmer to finance a biogas plant have been an important factor in the success of the BSP. At present, a uniform (independent of capacity) subsidy (varying according to district) is applied. This subsidy ranges between 16 and 33% of the total cost of constructing a biogas plant depending on size and geographical location.

Table 12: Evaluation of Financial Instruments: Subsidy Scheme

SWOT	Positive	Negative
Internal	Strengths: ▪ Transparent subsidy policy, ▪ Expansion of networks of BCs, ▪ Provision of additional subsidy for the poor and low penetration districts, ▪ Differential subsidy policy across remoteness.	Weaknesses: ▪ Low penetration in southern parts of Tarai districts bordering to India. ▪ Low awareness in LPD and low penetration VDCs. ▪ Inadequate coordination across partners, ▪ Lack of effective monitoring.
External / Context	Opportunities: ▪ Huge potential, ▪ Future funding through funds generated through VER and CER carbon credits, ▪ Transparent subsidy policy.	Threats: ▪ Political instability and lack of clear-cut subsidy policy, ▪ High inflation of construction materials, ▪ Subsidy adjustment consistent to the inflation rate.

Source: Compilation of discussions with various stakeholders, August 2008

Table 13: Evaluation of Financial Instruments: Credit Scheme

SWOT	Positive	Negative
Internal	Strengths: ▪ Greater efforts to increase access of credit facility to farmers, ▪ Expansion of networks of MFIs.	Weaknesses: ▪ Inadequate credit facility especially in remote hills due to lack of presence of capable MFIs, ▪ Credit facility is collateral oriented, ▪ Differential loan terms for lending across MFIs, ▪ SCCs focusing to on-lend to men clients leading to overdue built-up.
External / Context	Opportunities: ▪ Increased interest of the commercial banks and development banks besides MFIs to expand microfinance on biogas sector, ▪ Huge demand for biogas plants due to increase price and unavailability of fossil fuels.	Threats: ▪ Government's attitude towards MFIs, ▪ Government's controversial policy to write-off loan provided on priority sector.

Source: Compilation of discussions with various stakeholders, August 2008

The uniform, transparent and careful administration of this subsidy that is available only to plants built by certified companies has been an important factor in convincing farmers to purchase biogas plants while ensuring that plants are produced according to strict quality and design standards established by the BSP. Other factors affecting the success of biogas in Nepal includes the long-term support of ADBL for credits to biogas system and supplementary credit facilities provided through BCU.

9. LESSONS LEARNED

There are a number of lessons learned on the Nepal's experiences on financing domestic biogas plants. Some of these lessons are presented hereunder.

- LPD is an effective concept to promote biogas in remote areas and this concept should be expanded to low penetration VDCs.
- Provision of financial services from an entity under government control is ineffective. Thus the future of BCU vis-a-vis its sustainable operation is questionable as it is operating without clear vision and business plan.
- Topping up of grants/subsidy by INGOs, NGOs, CBOs and local government (DDCs, VDCs, Municipalities) has distorted the entire efforts to commercialise biogas market.
- Access to financial services on appropriate terms to farmers contributes on biogas promotion. MFIs providing financial services to women clients are experiencing higher repayment rate than MFIs (cooperatives) extending financial support to men clients.
- Farmers should feel that their biogas plant is subsidised.
- For on-time loan recovery biogas loan should be designed considering household cash flow than standard monthly installment.
- Working with more number of small MFIs is tedious to achieve operational and financial performance.
- MFIs can also benefit by introducing biogas loan product.
- MFI should link biogas owner on some income generating/ microenterprises to increase their loan repayment capacity.

10. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

There are mainly two instruments: biogas subsidy and biogas credit facility that is applied for financing domestic biogas plants in Nepal. The current subsidy structure is same in case of 4 m^3 and 6 m^3 bio-gas plants, slightly lower for 8 m^3 plants and there is no subsidy for 10 m^3 bio-gas plants. There is also special incentive to enable the poor to install biogas plants. ADBL and MFIs provide access to finance for farmers interested to install domestic biogas plants. Over the last 4-5 years, share of ADBL, NBL and RBB has been decreasing while that of MFI is gradually increasing. MFI usually borrow from BCU established by AEPC which has been working with 177 MFIs as of July 2008. Portfolio quality of BCU demands more effort for improvement through especially designed technical packages. Topping of grants/subsidy by INGOs, NGOs, CBOs and local government (DDCs, VDCs, Municipalities) has distorted market for biogas and generating the issue of double counting, cases of misuse of fund, and promoting social discrimination. This needs to be systematised in order to create healthy market and enabling environment for biogas promotion.

In 2007/08, about 30% of the biogas plants were credit financed. MFIs involved on biogas financing lack capacity for design of biogas loan products and analyzing repayment capacity of the biogas clients. Financial and economic cost benefit analysis of the biogas plants provided that investment in biogas is financially viable, economically attractive, socially acceptable, technically sound and environment friendly. Besides biogas plants have contributed positively on the lives of farmers including women and children in rural areas. There exist prospects that MFIs can also benefit involving themselves on biogas financing.

Recommendations

In view of significant increase in price (close to 20%) of the construction materials, unskilled labour and skilled labour in FY 2007/08, there is a need to revise quotation for biogas construction as well as revisit the subsidy rate.

The initiative undertaken by BSP/N in 2007/08 to categorize 18 districts as LPDs with incentive mechanism is noteworthy and this initiative should be continued further deep to promote biogas into low penetration VDCs. Based on findings of critical review on the effectiveness of additional subsidy for the poor of US$ 23.1 to US$ 53.8 piloted to

farmers borrowing from GBBs, the scheme should be replicated among all the farmers borrowing from MFIs involved on poverty focused microfinance operation.

Appropriateness of BCU to provide wholesale lending facility for MFI for on-lending to farmers for installing biogas plants need to be reviewed in term of their overall operation and portfolio management. BCU need to start preparing financial statement and prepare key financial ratios of their operation at least every six months.

Considering existing capacity of the BCU, collaborate with few but large MFIs rather than more number of small MFIs to enable more number of farmers unable to invest on biogas plant due to their poor economic condition and devoid of accumulated savings. Considering the huge economic benefits of biogas installation, special focus must be given to increase awareness on biogas plants and promote biogas in low penetration areas in southern part of the Tarai belts inhabited by people of Tarai origin and inaccessible hills and mountains.

Topping of grants/subsidy by INGOs, NGOs, CBOs and local government (DDCs, VDCs, Municipalities) should be mainstreamed to bring them into one window system at DDC level. It has been recommended to promote decentralised planning and financing at district level and devolve responsibility of devising district specific subsidy policy along with monitoring, evaluation and quality assurance system.

Undertake the intensive orientation and training to partner MFIs on designing biogas loan products. MFIs should set loan repayment schedule considering household cash flow for on-time loan recovery of loan for biogas plants and they should explore the possibilities of biogas plus loans to biogas clients to enable them start income generating / microenterprises. This will eventually provide direct income sources to these clients for loan repayment and act as an incentive to install biogas while improving repayment performance.

MFIs should be encouraged to provide loan to women who are the direct beneficiaries of the biogas plants. Such a focus should be there among SCCs involved on financing biogas plants.

Devise the strategy to provide continuity to the strengths, minimize weaknesses, use the opportunities and face the treats related to the use of existing financial instruments in order to expand the outreach of biogas promotion in different parts of rural Nepal.

11. REFERENCES

AEPC (2000), "*Subsidy for Renewable Energy 2000***",** Lalitpur: AEPC.

AEPC (2006), "*Subsidy for Renewable (Rural) Energy 2006***",** Lalitpur: AEPC.

CMS (2007), "*Biogas Users' Survey 2006/07"*

BSP Nepal (2008), "*BSP 2008"*

Karki A.B., Shrestha, J.N. and Bajgain, S., (2005), "*Biogas as Renewable Source of Energy in Nepal Theory and Development***"** BSP/N, Kathmandu.

MoEST, (2006), "*Rural Energy Policy, 2006*", Kathmandu. Ministry of Environment, Science and Technology/GoN.

NPC, (2002), "*The Tenth Plan (2002-2007)***",** Kathmandu: National Planning Commission.

NBPC (2007), "*Biogas Sector in Nepal: Highlighting Historical Heights and Present Status*".

Silwal, B.B. (1995), "*A Review of the Biogas Program in Nepal*", Winrock International.
Winrock International Nepal (2006), "*Cost-benefit Analysis of Biogas Interventions to Reduce Exposure to Indoor Air Pollution in Nepal*"

Winrock International (2007), "*Biogas for Better Life: An African Initiative*" Draft Discussion Paper.

Annex 1: Information on Construction of Biogas Plants

Table A1.1: Number of Biogas Plants Constructed (1974/75 to 2007/08)

Fiscal Year	Number of Bio-gas Plants Installed						Total
	4 M^3	6 M^3	8 M^3	10 M^3	15 M^3	20 M^3	
Upto 1993/94	-	-	-	-	-	-	11,835
1992/93	-	-	-	-	-	-	3318
1993/94	-	-	-	-	-	-	3506
1994/95	62	652	1,451	2,633	279	38	5,115
1995/96	123	1,190	2,460	3,097	249	38	7,157
1996/97	304	2,004	3,201	2,686	175	17	8,387
1997/98	265	2,861	4,234	2,303	180	26	9,869
1998/99	494	4,268	4,717	1,451	109	13	11,052
1999/00	1,771	7,850	3,001	643	-	-	13,265
2000/01	3,225	11,629	2,616	387	-	-	17,857
2001/02	2,779	10,597	1,864	287	-	-	15,527
2002/03	3,391	11,105	1,622	222	-	-	16,340
2003/04	1,859	8,072	1,191	137	-	-	11,259
2004/05	2,467	13,352	1,804	180	-	-	17,803
2005/06	2,058	12,184	1,686	190	-	-	16,118
2006/07	2,272	12,327	1,249	81	-	-	15,929
2007/08	2,165	10,678	888	3	-	-	13,734
Total	-	-	-	-	-	-	198,071
Total (1994/95 - 2007/08)	23,235	108,769	31,984	14,300	992	132	179,459
% of Total	13.0	60.6	17.8	8.0	0.6	0.1	100.0

Source: Database of BSP/N, August 2008

Table A1.2: Distribution of Biogas Plants Constructed Across Ecological Belts and Development Regions (1992/93 to 2007/08)

Ecological belt	Development Region	Districts (No)	HHs with Animals	Potential Biogas HHs	Total Biogas Plants as of 2007/08	% of Total Potentials
Remote hills	Eastern	3	95986	47993	559	1.16
Remote hills	Central	0	0	0	0	0.00
Remote hills	Western	2	1920	960	0	0.00
Remote hills	Mid Western	7	87972	43984	11	0.03
Remote hills	Far Western	3	62050	31025	228	0.73
	Sub-total	15	247928	123962	798	0.64
Hill	Eastern	7	213160	106579	9168	8.60
Hill	Central	12	455345	227670	30041	13.19
Hill	Western	11	437581	218789	45459	20.78
Hill	Mid Western	5	179063	89531	2615	2.92
Hill	Far Western	5	162061	81030	250	0.31
	Sub-total	40	1447210	723599	87533	12.10
Tarai	Eastern	5	305165	305165	25710	8.42
Tarai	Central	7	354114	354114	20321	5.74
Tarai	Western	3	182294	182294	14891	8.17
Tarai	Mid Western	3	136503	136503	11376	8.33
Tarai	Far Western	2	111369	111369	13962	12.54
	Sub-total	20	1089445	1089445	86260	7.92
	Grand-total	75	2784583	1937006	174591	9.01

Source: Database of BSP/N, August 2008
Note: There is some discrepancy on aggregate figure on installation of biogas plants and their district-wise breakdown.

Annex 2: District Wise Annual Construction of Biogas Plant

In Number

District	HHs with Animals	Potential Biogas HHs	49/50	50/51	51/52	52/53	53/54	54/55	55/56	56/57	57/58	58/59	59/60	60/61	61/62	62/63	63/64	64/65 07/08		64/65 07/08	
			92/93	93/94	94/95	95/96	96/67	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	BSP	GSP	BSP	TOTAL
Remote Hill	26,378	13,189																			
Bajhang	16,424	8,212	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	15	-	-	27
Bajura	34,850	17,425	16	9	6	7	36	26	-	5	43	53	2	-	-	-	-	-	-	-	203
Darchula	19,248	9,624	-	-	-	-	2	-	-	-	-	-	12	43	28	74	42	-	-	-	201
Dolpa	3,579	1,789	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humla	6,193	3,096	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jajarkot	22,366	11,183	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Jumla	10,170	5,085	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kalikot	1,468	734	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Khotang	39,409	19,704	-	-	-	-	1	-	-	-	7	1	-	-	-	-	-	-	-	-	9
Manang	856	428	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mugu	4,787	2,393	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mustang	1,064	532	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sankhuwasabha	25,674	12,837	10	13		8	2	4	6		13	7	19	40	149	40	15	-	-	2	328
Solukhumbu	35,462	17,731	-	-	-	-	-	-	-	-	-	-	-	10	-	-	18	-	-	-	28
Total Remote Hill	247,928	123,962	26	24	6	15	41	30	6	5	63	61	33	93	177	114	87	15	-	2	798
Hill																					
Acham	38,246	19,123	-	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-	-	-	9
Arghakachi	36,778	18,389	46	36	23	21	38	34	48	34	51	72	60	24	51	44	34	-	-	-	616
Baglung	44,822	22,411	-	47	43	18	13	8	17	43	71	50	22	12	44	102	43	-	-	1	534
Baitadi	37,635	18,817	-	3	-	10	-	3	-	7	1	-	-	1	2			-	-	-	27
Bhakatpur	13,625	6,812	5	4	2	8	6	3	4	3	43	33	70	68	85	99	92	-	-	1	526
Dadeldhura	19,333	9,666	-	-	-	-	-	-	-	18	28	1		13	6	10	15	-	-	-	91
Dailekh	36,212	18,107	17	27	-	3	10	5	3	8	2		1	-	-	-	8	-	-	-	84
Dhading	55,468	27,735	32	49	105	119	91	113	187	167	250	198	197	66	266	256	234	-	-	16	2,346
Dhankuta	26,256	13,128	33	25	77	63	61	101	113	211	606	173	253	208	211	64	22	-	-	-	2,221
Dolkha	30,956	15,478	1	-	8	30	17	29	6	24	23	102	118	131	67	40	30	-	-	-	626
Doti	30,635	15,317	-	6	-	3	1	1	2	4				6	5		11	-	-	-	39
Gorkha	50,068	25,034	56	40	106	202	173	204	256	197	331	231	231	187	301	372	297	-	-	10	3,194
Gulmi	51,108	25,554	29	31	14	27	74	116	121	158	187	135	109	79	68	77	92	-	-	1	1,318

District	HHs with Animals	Potential Biogas HHs	49/50	50/51	51/52	52/53	53/54	54/55	55/56	56/57	57/58	58/59	59/60	60/61	61/62	62/63	63/64	64/65 07/08		64/65 07/08	
			92/93	93/94	94/95	95/96	96/67	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	BSP	GSP	BSP	TOTAL
Ilam	44,674	22,337	71	80	33	10	27	35	73	70	72	77	141	140	273	166	230	-	-	-	1,498
Kaski	39,032	19,516	483	324	610	698	1,077	1,076	842	841	969	835	878	678	894	770	788	-	-	30	11,793
Kathmandu	48,402	24,201	19	46	86	110	35	27	20	42	47	64	113	82	152	137	134	-	-	2	1,116
kavrepalanchowk	58,563	29,281	-	12	82	94	97	160	209	411	867	1,199	913	287	624	427	586	-	-	35	6,003
Lalitpur	16,506	8,253	3	1	2	5	3	16	7	4	36	62	218	116	105	82	167	-	-	-	827
Lamjung	28,492	14,246	192	71	374	277	294	312	361	656	739	606	559	323	537	346	362	-	-	3	6,012
Makawanpur	51,741	25,870	74	175	126	342	691	755	662	1,155	1,527	1,329	1,306	720	790	962	727	-	207	12	11,560
Myagdi	18,770	9,385	-	-	4	4	-	-	8	83	120	118	153	27	46	53	61	-	-	-	677
Nuwakot	46,667	23,333	26	31	70	133	147	171	155	157	242	144	158	115	170	90	103	-	-	-	1,912
Okhaldunga	27,642	13,821	-	-	-	2	1	-	4	40	23	21	3	1	-	-	1	-	-	-	96
Palpa	41,599	20,799	142	158	131	234	241	288	247	300	418	442	389	267	297	351	329	-	6	11	4,251
Panchther	35,461	17,730	3	14	5	10	4	5	15	33	29	51	35	54	51	19	65	-	-	12	405
Parbat	25,673	12,836		3	26	40	40	48	87	55	40	84	108	71	23	77	48	-	-	-	750
Pyuthan	35,849	17,924	24	90	83	105	45	48	47	30	56	39	50	20	56	31	38	-	-	-	762
Ramechhap	36,513	18,256	-	-	-	11	53	41	114	44	37	98	93	104	103	28	48	-	-	-	774
Raswa	6,583	3,291	-	-	-	1		1	1	1	13	11	6	25	16	12	56	-	-	-	143
Rolpa	35,156	17,578	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Rukum	30,158	15,079	2	18	10	1	5	4	-	-	-	-	-	-	-	-	-	-	-	-	40
Salyan	38,950	19,475	-	-	6	9	3	13	-	11	-	-	-	-	-	-	23	-	-	-	65
Sindguli	41,110	20,555	118	190	133	124	95	91	155	301	508	311	431	252	339	217	298	-	-	2	3,565
Sindhupalchowk	49,211	24,605	61	58	40	19	20	16	21	12	35	29	93	29	63	77	70	-	-	-	643
Surket	38,950	19,475	45	58	79	155	105	83	113	152	259	169	130	95	109	97	98	-	-	-	1,747
Syangja	52,342	26,171	143	156	171	261	258	270	334	394	467	356	397	324	485	423	421	-	-	27	4,887
tanahu	48,897	24,448	212	268	441	805	726	700	668	777	1,132	964	1,284	837	1,005	714	883	-	-	11	11,427
Taplejung	20,922	10,461	-	-	-	-	-	-	1	3	1	9	3	9	16	6	25	-	-	2	75
Terathum	18,314	9,157	2	11	3	2	57	170	330	318	291	154	85	7	28	38	53	-	-	2	1,551
Udayapur	39,891	19,945	17	22	30	129	337	272	208	472	521	253	348	105	239	155	214	-	-	-	3,322
Totall Hill	1,447,210	723,599	1,856	2,054	2,924	4,085	4,845	5,219	5,442	7,236	10,044	8,422	8,957	5,483	7,527	6,342	6,706	-	213	178	87,533
Terai																					
Banke	35,761	35,761	31	20	17	41	63	77	98	127	208	172	173	179	226	227	223	-	43	-	1,925
Bara																					

District	HHs with Animals	Potential Biogas HHs	49/50	50/51	51/52	52/53	53/54	54/55	55/56	56/57	57/58	58/59	59/60	60/61	61/62	62/63	63/64	64/65 07/08		64/65 07/08	
			92/93	93/94	94/95	95/96	96/67	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	BSP	GSP	BSP	TOTAL
	46,724	46,724	75	58	43	34	76	113	131	228	255	189	145	155	264	343	381	-	-	40	2,530
Bardiya	40,066	40,066	58	99	98	143	157	191	310	418	339	352	374	281	452	584	451	-	130	-	4,437
Chitwan	57,115	57,115	349	147	258	451	639	946	1,056	917	1,198	771	842	677	1,254	1,078	870	-	138	1	11,592
Dang	60,676	60,676	97	94	109	299	308	295	276	367	435	422	461	394	481	383	274	-	306	13	5,014
Dhanusa	61,147	61,147	7	11	4	6	6	11	34	22	42	69	56	20	64	76	40	-	-	16	484
Jhapa	68,638	68,638	125	140	318	392	321	634	729	651	933	804	980	782	1,829	1,826	2,302	-	-	44	12,810
Kailai	64,612	64,612	76	122	109	166	169	264	400	432	699	932	936	629	963	913	629	-	584	-	8,023
Kanchanpur	46,757	46,757	41	78	83	77	89	127	283	360	539	544	534	523	945	832	568	-	316	-	5,939
Kapilbastu	48,860	48,860	1	2	57	77	92	113	170	213	219	330	310	234	290	282	279	-	-	-	2,669
Mohattari	48,332	48,332	28	26	26	42	137	75	17	37	56	127	53	52	84	39	106	-	-	14	919
Morang	75,080	75,080	119	158	334	359	304	383	558	887	833	643	664	406	904	875	898	-	-	11	8,336
Nawalparasai	66,579	66,579	28	29	142	251	330	507	564	389	690	638	684	489	742	727	715	-	-	10	6,935
Parsa	33,545	33,545	21	14	2	2	11	16	43	25	29	33	37	27	53	49	87	-	-	3	452
Rautahat	47,839	47,839	7	48	43	37	78	63	66	71	120	76	98	81	142	135	128	-	-	20	1,213
Rupendehi	66,855	66,855	122	128	302	364	394	400	299	281	395	297	359	312	580	594	457	-	-	3	5,287
Saptrai	54,843	54,843	6	16	6	7	3	24	21	73	95	46	21	8	44	13	19	-	-	-	402
Sarlahi	59,412	59,412	45	82	116	161	145	137	219	298	324	256	271	200	300	249	326	-	-	2	3,131
Siraha	58,582	58,582	117	42	23	9	4	9	30	14	43	17	25	9	71	53	34	-	-	-	500
Sunsari	48,022	48,022	83	114	97	139	175	235	300	214	298	326	327	225	411	372	346	-	-	-	3,662
Total Terai	1,089,445	1,089,445	1,436	1,428	2,187	3,057	3,501	4,620	5,604	6,024	7,750	7,044	7,350	5,683	10,099	9,650	9,133	-	1,517	177	86,260
Grand Total	2,784,583	1,937,006	3,318	3,506	5,117	7,157	8,387	9,869	11,052	13,265	17,857	15,527	16,340	11,259	17,803	16,106	15,926	15	1,730	357	174,591

Annex 3: Approved Quotation of Biogas Support Programme for FY 2064/65

In Rs.

S.N.	Cost Item	Unit	Quantity by Capacity (m^3)				Approved price for 2064/65			4 m^3			6 m^3			8 m^3			10 m^3		
			4	6	8	10	Tarai	Hills	Mount.	Tarai	Hills	Mount.	Tarai	Hills	Mount.	Tarai	Hills	Mount.	Tarai	Hills	Mount.
A	**Arranged by Farmers**																				
1.1	Construction Materials																				
	Bricks/Stone	Piece	1200	1400	1700	2000	3.8	3.8	3.9	4573	4573	4690	5335	5335	5472	6478	6478	6644	7622	7622	7817
	Sand	Bags	60	70	80	90	26.8	32.2	36.5	1608	1930	2187	1876	2252	2552	2144	2573	2916	2412	2895	3281
	Gravel	Bags	30	35	40	50	44.7	51.0	63.8	1340	1531	1914	1563	1786	2233	1787	2041	2552	2233	2552	3190
	Iron rod for slab	Kg	15	15	16	16	65.7	71.6	77.6	985	1074	1164	985	1074	1164	1051	1146	1242	1051	1146	1242
	Cement (Tarai)	Bags	11	13	16	19	476.9	0.0	0.0	5246	0	0	6200	0	0	7631	0	0	9061	0	0
	Cement (Hills)	Bags	12	14	18	21	0.0	524.1	681.3	0	6289	8176	0	7337	9539	0	9434	12264	0	11006	14308
										13752	15397	18131	15959	17784	20959	19090	21672	25618	22379	25220	29837
1.2	Labor																				
	Unskilled labor	Days	15	20	23	25	165.0	165.0	165.0	2475	2475	2475	3300	3300	3300	3795	3795	3795	4125	4125	4125
	Total									2475	2475	2475	3300	3300	3300	3795	3795	3795	4125	4125	4125
1.3	Pipe and fittings																				
	GI pipe (0.5'')	Meter	12	12	12	12	141.8	158.8	176.3	1702	1906	2116	1702	1906	2116	1702	1906	2116	1702	1906	2116
	Socket (0.5'')	Piece	2	2	2	2	24.0	25.0	26.0	48	50	52	48	50	52	48	50	52	48	50	52
	GI elbow (0.5")	Piece	5	5	5	5	35.0	36.0	37.0	175	180	185	175	180	185	175	180	185	175	180	185
	Nipple (0.5" * 6")	Piece	2	2	2	2	35.5	36.5	37.5	71	73	75	71	73	75	71	73	75	71	73	75
	GI T (0.5")	Piece	1	2	2	2	38.0	39.0	40.0	38	39	40	76	78	80	76	78	80	76	78	80
	Teflon Tape	Piece	3	3	3	3	9.3	10.3	11.0	28	31	33	28	31	33	28	31	33	28	31	33
	Total									2062	2279	2501	2100	2318	2541	2100	2318	2541	2100	2318	2541
B	**Arranged by Company**																				
	Stove angle	Set	1	1	2	2	756.0	780.0	818.0	756	780	818	756	780	818	1512	1560	1636	1512	1560	1636
	Mixture	Set	0	1	1	1	842.0	929.0	985.0	0	0	0	842	929	985	842	929	985	842	929	985
	Emulsion paints	Litre	1	1	1	2	227.0	249.0	274.0	227	249	274	227	249	274	227	249	274	454	498	548
	Inlet pipe	Meter	4	4	4	4	109.5	119.5	137.3	438	478	549	438	478	549	438	478	549	438	478	549
	DOME gas pipe	Piece	1	1	1	1	541.0	587.0	610.0	541	587	610	541	587	610	541	587	610	541	587	610
	Main Gas Valve Sanwa	Piece	1	1	1	1	517.0	527.0	543.0	517	527	543	517	527	543	517	527	543	517	527	543
	Water drain	Piece	1	1	1	1	162.0	194.0	258.0	162	194	258	162	194	258	162	194	258	162	194	258
	Gas Tap	Piece	1	1	2	2	315.0	327.0	373.0	315	327	373	315	327	373	630	654	746	630	654	746
	Nylon hose pipe	Meter	1	3	3	3	55.0	60.0	65.0	55	60	65	165	180	195	165	180	195	165	180	195
	Pressure meter pipe, etc.	Set	1	1	1	1	445.0	456.0	480.0	445	456	480	445	456	480	445	456	480	445	456	480
	Total									3456	3658	3970	4408	4707	5085	5479	5814	6276	5706	6063	6550

S.N.	Cost Item	Unit	Quantity by Capacity (m^3)				Approved price for 2064/65			4 m^3			6 m^3			8 m^3			10 m^3		
			4	6	8	10	Tarai	Hills	Mount.	Tarai	Hills	Mount.	Tarai	Hills	Mount.	Tarai	Hills	Mount.	Tarai	Hills	Mount.
C	**Construction cost (skilled labor for construction and inspection)**									2574	2808	3042	2808	3101	3393	2925	3218	3510	3042	3346	3650
D	**After sales services**									600	600	600	600	600	600	600	600	600	600	600	600
E	**Promotion and training**									100	100	100	100	100	100	100	100	100	100	100	100
F	**Company service charge (administrative cost)**									2576	2800	2968	3024	3248	3584	3360	3584	3920	3360	3696	4032
	Total									5850	6308	6710	6532	7049	7677	6985	7502	8130	7102	7742	8382
	Grand Total (for GI pipe)									27595	30117	33787	32299	35158	39562	37449	41101	46360	41412	45468	51435
	For HDP Pipe																				
1	HDP pipe	Meter	12	12	12	12	35.5	39.0	47.5	426	468	570	426	468	570	426	468	570	426	468	570
2	GI pipe (0.5")	Meter	3	3	3	2	108.0	121.0	134.3	324	363	403	324	363	403	324	363	403	216	242	269
	Grand total for HDP pipe									26643	29042	32644	31347	34083	38419	36497	40026	45217	40352	44272	50157
	Subsidy for Bio-gas plant owner									6500	9500	12500	6500	9500	12500	6500	9500	12500	0	0	0
	Net cash cost for farmers									20143	19542	20144	24847	24583	25919	29997	30526	32717	40352	44272	50157

Annex 4: Type and number of MFIs along with Number of Accounts as of July 2008

S.N.	District	Type and number of MFIs					Number of Accounts				
		Cooperatives	FI-NGOs	GBBs	MDBs	Total	Cooperatives	FI-NGOs	GBBs	MDBs	Total
1	Argahkhanchi	1	0	0	0	1	1	0	0	0	1
2	Banke	4	1	1	0	6	7	1	1	0	9
3	Bara	1	0	0	1	2	1	0	0	2	3
4	Bardia	5	1	0	0	6	7	1	0	0	8
5	Bhaktapur	1	0	0	0	1	2	0	0	0	2
6	Chitwan	18	1	0	0	19	28	1	0	0	29
7	Dailekh	1	0	0	0	1	1	0	0	0	1
8	Dhading	1	0	0	0	1	1	0	0	0	1
9	Dhankuta	0	1	0	0	1	0	1	0	0	1
10	Dhanusha	1	0	1	0	2	1	0	1	0	2
11	Dolakha	3	0	0	0	3	3	0	0	0	3
12	Gorkha	4	0	0	0	4	9	0	0	0	9
13	Ilam	8	0	0	0	8	11	0	0	0	11
14	Jhapa	15	0	0	0	15	33	0	0	0	33
15	Kailali	2	0	0	0	2	3	0	0	0	3
16	Kanchanpur	4	0	0	0	4	5	0	0	0	5
17	Kapilvastu	6	0	0	0	6	6	0	0	0	6
18	Kathmandu	1	3	0	0	4	1	4	0	0	5
19	Kavre	18	0	0	0	18	25	0	0	0	25
20	Lalitpur	1	0	0	0	1	2	0	0	0	2
21	Mahottari	1	0	0	0	1	1	0	0	0	1
22	Makawanpur	3	0	0	0	3	3	0	0	0	3
23	Morang	18	2	1	0	20	32	2	1	0	35
24	Nawalparasi	12	0	0	0	11	13	0	0	0	13
25	Palpa	1	0	0	0	1	1	0	0	0	1
26	Panchthar	5	0	0	0	5	8	0	0	0	8
27	Pyuthan	1	0	0	0	1	1	0	0	0	1
29	Ramechap	1	0	0	0	1	1	0	0	0	1
30	Rupandehi	5	0	1	1	7	12	0	1	1	14
31	Sankhuwasabha	1	0	0	0	1	1	0	0	0	1
32	Sarlahi	1	0	0	0	1	1	0	0	0	1
33	Sindhuli	1	0	0	0	1	1	0	0	0	1
34	Sindhupalchok	2	0	0	0	2	2	0	0	0	2
35	Sunsari	7	0	0	0	7	9	0	0	0	9
36	Surkhet	2	0	0	0	2	2	0	0	0	2
37	Tanahu	3	0	0	0	3	5	0	0	0	5
38	Udayapur	3	0	0	0	3	4	0	0	0	4
	Total	162	9	4	2	177	244	10	4	3	261

Source: BCU, AEPC, August 2008

Annex 5: Clean Development Mechanism Fund

BSP has been the first CDM Project in Nepal with registration of two CDM Projects in December 2005 of 19,396 plants constructed under BSP Phase-IV, have been registered with and approved by the CDM Executive Board. An Emission Reduction Purchase Agreement (ERPA) for the 2 projects has been signed with the World Bank for trading of the Emission Reductions from the two Projects for first seven years starting 2004/05 as the first crediting year. Annual reporting and verification for the two Projects for crediting years 2004/05 and 2005/06 have been completed and payment has been made too. From these two Projects, the annual carbon revenue (net of Project development and verification expenses) is around US$600,000.

Some 60,000 plants have been constructed after construction of the plants already registered as mentioned above. The process had been halted due to problem with the earlier methodology and it took quite an effort and time to develop a new one. There have been serious debates over development and approval of the new methodology for biogas and other projects that replace use of non-renewable biomass. Compared to the earlier methodology, which used to give 4.99 tons of CO_2 equivalent of Green House Gas (GHG) Emission Reduction, the new methodology gives only around 2.5 tons. As the market price is gradually rising, biogas CDM projects are still feasible. It is expected that the annual CDM revenue could reach as high as US $ 3.5 million mark within a year or so. This amount actually meets the current annual expenditure of BSP, including subsidy.

A MoU was signed around 2 years ago with KfW to develop biogas CDM projects and trade the Emission Reduction. After approval of the new methodology in January this year, AEPC, KfW and BSP-Nepal have been working together to develop new biogas CDM projects and a consultant (Climate Focus B.V. of the Netherlands) has recently been hired to develop Projects with use of all the possible options namely, Programmatic of Activity (PoA), Small Scale Bundling and even the Verified Emission Reduction (VER) approach. KfW has provided financial support for the same.

There are two other methodologies approved for CDM Project on biogas but they are not appropriate for the baseline case of Nepal.

On one hand, materialization of CDM projects for biogas opens up a new venue of opportunity for further promotion of the technology in Nepal. On the other hand, it adds new challenges to BSP in terms of more stringent quality assurance and monitoring that are in line with the CDM requirements. Furthermore, there are other requirements on community development and environmental mitigations for the CDM Projects done with the Community development Carbon Fund (CDCF) of the World Bank mentioned above.

The expected revenues from CDM Projects has been planned to be utilized to fill the fund gap in the Phase IV, resulting from the additional activities planned due to revised programme objective as well as due to the additional requirements of CDM. The surplus revenue, from the Phase IV period, will be used for extension of BSP beyond Phase IV.

Another development – a separate project of 7,500 biogas plants in 41 VDCs of 10 districts (in buffer zone of conservation areas) is being implemented from 2007 for 4 years following the same modality as that of BSP. There is a tripartite agreement between AEPC, BSP-Nepal and WWF Nepal for the project implementation and total funding for it comes from WWF. This project is termed as "Gold Standard Biogas VER Project (GSP). WWF is thus developing a Gold Standard Biogas VER Project for carbon trading and use of the revenue to finance the project, at least, partially with the 7,500 plants being constructed under GSP.

Annex 6: Portfolio Report of Biogas Credit Unit

Table A6.1: Portfolio Report of the Biogas Credit Unit as of June 15, 2008

Portfolio type	Outstanding loan balance (Rs.)	Overdue amount (Rs.)	Overdue rate (%)	Portfolio at Risk (%)
Non-due	41,407,119	-	0	0.0
0-3 months	9,289,754	2,822,558	4.1	13.6
3-6 months	8,200,422	6,085,581	8.9	12.0
6-12 months	1,803,222	1,084,254	1.6	2.6
> 12 months	7,446,683	7,292,308	10.7	10.9
Total	68,147,200	17,284,701	25.4	39.2

Source: Biogas Credit Unit, AEPC

Table A6.2: Portfolio Report of the Biogas Credit Unit as of July 15, 2008

Portfolio type	Outstanding loan balance (Rs.)	Overdue amount (Rs)	Overdue rate (%)	Portfolio at Risk (%)
Non-due loan	43,605,049	-	-	-
01-90 days due	14,196,979	3,400,230	5.0	20.8
91-180 days due	802,969	447,969	0.7	1.2
181-365 days due	1,665,631	808,831	1.2	2.4
> 365 days due	7,897,126	7,574,001	11.1	11.6
Total	68,167,754	12,231,031	17.9	36.0

Source: Biogas Credit Unit, AEPC

Table A6.3: Portfolio Report of the Biogas Credit Unit as of August 15, 2008

Portfolio type	Outstanding loan balance (Rs)	Overdue amount (Rs)	Overdue rate (%)	Portfolio at Risk (%)
Non-due	60,014,580	0	0.0	0
0-3 months	9,240,547	1,179,673	1.5	12.0
3-6 months	227,915	152,915	0.2	0.3
6-12 months	725,585	448,133	0.6	0.9
> 12 months	7,060,946	6,900,946	8.9	9.1
Total	77,269,573	8,681,667	11.2	22.3

Source: Biogas Credit Unit, AEPC

Annex 7: Cost Benefit Analysis of Bio-gas Plants

WHO has recently prepared guidelines on conducing cost benefit analysis of household energy technologies (Hutton G. et al, 2006) and a cost benefit analysis of the domestic biogas technologies has been conducted by WI in September 2006.

A comparison scenario was developed and used to compute incremental benefits and costs of biogas use. The main comparison is with traditional (wood burning) stoves assuming that in the absence of using biogas, population would continue to use these traditional stoves. An "incremental cost-benefit analysis" has therefore been performed to compare change in benefits and costs from traditional stoves to new technology. The basis for the analysis in this study is the replacement of existing traditional stoves with biogas plants. The cost and benefits considered for household level and societal level analysis is presented in Table A7.1.

Table A7.1: Cost and Benefits Considered for Household Level and Societal Level Analysis

Level of Analysis	Costs	Benefits
Household	▪ Cost of biogas plant at the subsidised rate ▪ Repair and maintenance cost ▪ Cost of extra time consumed due to biogas installation	▪ Savings in medicine ▪ Firewood saving ▪ Kerosene saving ▪ Chemical fertiliser saving ▪ Time saving due to biogas
Society	▪ Full cost of biogas plants ▪ Repair and maintenance cost ▪ Cost of extra time due to biogas ▪ Technical assistance	▪ Savings in medicine ▪ Firewood saving ▪ Kerosene saving ▪ Chemical fertiliser saving ▪ Time saving ▪ GHG reduction

Source: WI, 2006

In order to compare benefits and costs, conventionally used indicators such as Benefit Cost Ratio, Net Present Value and Internal Rate of Return have been computed. The information for this study is primarily based on findings of "Biogas Users' Survey 2006/07", BSP/N, other sources and field survey findings. The base year and year of intervention is taken as 2008. Costs and benefits are estimated on an annual basis; net present values with 12% discount factor have been adopted. Life of the biogas plant has been taken to be 20 years and costs and benefits have been calculated based on this assumption. The costs and benefits are modeled with respect to one biogas plant unit of 4 m^3, 6 m^3, 8 m^3 and 10 m^3.

Household Level Analysis

In this assignment, advisability for households to shift from a traditional stove to a biogas plant and stove has been explored through identification, quantification and valuation of all costs and benefits.

Cost Estimation

Identification of costs

A shift of HH from traditional stove to a new biogas stove involves substantial incremental expenses compared to the status quo; the computed incremental cost in the analysis, therefore, will be equal to the cost of the biogas plant and stove itself. In addition to plant construction and R&M costs, biogas intervention comprises cost for stove replacement, opportunity costs like time loss for biogas related activities which would otherwise have been used for income generating activities. The plant construction costs for a household depends on the subsidy provided by the government.

Quantification of costs
Quantifying the cost of biogas use comprises three types of costs: plant construction cost, repair and maintenance cost and cost of loss of time due to biogas related activities.

Valuation of costs

Installation/Construction cost of biogas plant: The construction cost of biogas plants varies with the size of plant and location. The government provides subsidy for biogas plants installed by certified companies which have agreed with BSP/N to participate in biogas sector. Total construction cost with and without government subsidies are presented in table A7.2.

Table A7.2: Biogas Plant and Stove Construction Cost with and Without Subsidy (US$) in 2007/08

Ecological Belts	4 m^3		6 m^3		8 m^3		10 m^3	
	GI Pipe	HDP pipe	GI Pipe	HDP pipe	GI Pipe	HDP pipe	GI Pipe	HDP pipe
Total cost without subsidy								
Tarai	425	410	497	482	576	561	637	621
Hills	463	447	541	524	632	616	700	681
Subsidy								
Tarai	100	100	100	100	92	92	0	0
Hills	146	146	146	146	138	138	0	0
Total cost with subsidy								
Tarai	325	310	397	382	484	469	637	621
Hills	317	301	395	378	494	477	700	681

Source: BSP/N, 2008

ii. Repair and maintenance costs: R&M costs are needed only if problems arise, and may differ from one plant to the next. R&M for a biogas plant and stove is estimated to be US$ 2.73 per year.

iv. Cost of time spent for biogas related activities: Using biogas to meet household energy needs results in time spent on biogas-related activities such as water collection and mixing of cow dung and water; this may be interpreted as use of time that could otherwise be used for income generating activities. The present rate for unskilled labor is US$ 1.36/day i.e. US$ 0.17/hour assuming 8 working hours per day. Total cost of time spent for biogas related activities is estimated at US$ 40.3 per year.

Table A7.3: Cost of Time Consumed for Biogas Activities

S.N.	Activity	Time consumed hrs/day	Rate of Unskilled Labor (US$/hrs)	Amount (US$/Year
1	Collection of water	0.4	0.17	24.8
2	Mixing of water and dung	0.25	0.17	15.5
	Total	0.65		40.3

Uncertainties in costs

There are various uncertainties in cost quantification, which may affect the result. Some probable uncertainties in costs analysis may arise due to:

- Exclusion of cost required for rearing and maintenance of animals that produce dung. Since there is not much difference in the livestock holding size among biogas using and non-using households, this cost is not included in the analysis. Average livestock

holding per household is only 1.76% higher in biogas-using households as compared to non users.
- Difference in transportation cost of raw materials for plant installation at different locations.
- Difference in time required collecting water that varies depending on availability of water in the area.

Since the range of values these uncertainties can take is not available, and the costs considered represent averages under BSP programme, no further analysis was done to explore the impacts of these uncertainties.

Benefit Estimation

Identification of benefits

The benefits are categorized into two types – General benefits and health benefits. The beneficial environmental impacts are not limited to the household level alone; hence this is discussed in the next section in societal level analysis. However, increase in agricultural production due to increased soil fertility benefits individual households directly.

i .General Impacts: General impacts include reduction in expenditure for traditional fuels, which would otherwise be incurred in absence of biogas; reduction in time spent for fuel wood collection for those households which collect fuel wood instead of buying; and reduction in time spent cooking due to increased efficiency of biogas stove. All these impacts have direct relationship with financial saving of the farmers. While in practice all the time saved may not be used for income generating activities, theoretical monetization of the time saved illustrates potential beneficial impacts clearly in financial terms.

- **Reduced expenditure on traditionally used fuels (wood, kerosene):** Shifting from traditional energy use to biogas reduces expenses to buy fuel wood/kerosene. Once a biogas plant and stove are installed, biogas is readily available free of charge from household waste products without any investment in raw material. It is estimated that there is an average saving of 3,966 kg of fuel wood and 48.26 liters of kerosene per year in a biogas using household, compared to that in a biogas non-using household (BSP Nepal, 2002)[15]. This is based on the assumption that all users buy fuel wood, the time consumed to collect fuel wood by those who don't buy has been set to zero so as to avoid overlapped benefits. At the prevailing rate of US$ 0.22/kg (Rs 1.61/kg) of fuel wood (BSP-Nepal, 2002) and US$ 0.9/L (Rs 60/L) of kerosene (current market price), there will be cash savings at HH level.

- **Reduced time spent on fuel collection (wood, agricultural residues, straw, and dung):** Biogas related studies in the past have reported substantial time saving after biogas use due to the reduction in burden of fuel wood collection. According to BSP/N data pertaining to time savings, the time spent on fuel wood collection has been saved by 84 minutes per day after biogas use, which means savings of 511 hours a year. It must be noted here that the time saved in fuel wood collection is considered here only for households which actually collect it, and not for those that buy fuel wood. This time saved can be used by household members for income generating activities as far as practically feasible. However, utilization of the time saved for recreational activities like adult literacy, skill development training, family care etc also enhances the overall development of individual households.

[15]These are average figures from the survey of 600 biogas users and 600 non-biogas users during EIA study conducted by BSP-Nepal in 2002.

- **Reduced time spent cooking and for cleaning utensils:** Biogas stoves have higher combustion efficiency compared to traditional biomass and fossil fuel stoves. A biogas stove is 1.07 times more efficient than an LPG stove, 1.22 times more efficient than a kerosene stove, 4.63 times more efficient than agricultural residue burning traditional stove and 6.52 times more efficient than dung burning traditional stoves in terms of heat output (Smith K.R et al, 2000 quoted in WI 2006). This increased efficiency leads to substantial time savings for rural women. The study suggests that biogas users save an average of 96 minutes a day for cooking compared to traditional stove users. Furthermore, biogas being a clean fuel, time save in washing cooking utensils is also estimated to decrease by 39 minutes per day on average. The time saved can be used in productive work, making it a beneficial to them. The time saved due to reduction in workload can be utilized for income generation. However, not all the saved time will be utilized for productive activities, especially in rural areas where biogas will be predominantly installed. According to BSP Nepal, only approximately 50% of the saved time is used for productive work.

- **Reduced expenditure on commercial fertilizers:** Biogas slurry, a by-product of biogas, is a very good organic fertilizer and conditioner for the soil. Its use as organic fertilizer instead of imported expensive chemical fertilizers in fields saves substantial money at the household level.

- **Reduction in workload for women:** Reduction in time spent cooking and for cleaning utensils has increased female participation in Biogas User's Community. The Biogas Users' Survey 2007 concludes that the participation of rural women in social events and organizations has increased by 31% in Hills and by 48% in Tarai. This social mobilization has motivated rural women to overcome household barriers through improved access to information. However, such indirect benefits are very difficult to value in monetary terms, and are therefore not quantified in this analysis.

ii. Health Impacts

Health benefits include reduced fatalities and illness from lower indoor air pollution levels, reduced death and illness from improved sanitary facilities, reduced death and illness from fewer unintentional injuries and a reduced need for health care and medication. Fewer deaths and less disease also translate into time savings that can potentially be used productively for income generation.

Quantification of benefits

Information on quantification of benefits of biogas plants are provided in Table A7.4 in terms of time savings, fertilizer savings, fuel wood savings and kerosene savings as identified in WI 2006 study.

Table A7.4: Quantification of Benefits of Biogas

S.N.	Particulars	Quantity/HHs/Year	Remarks
1	Health benefit (saved medicine and life savings)	Not available	Data on quantity saved is not available but overall savings in health care in monetary term is available (see Table …..)
2a	Time savings of HHs which buy the fuelwood (cooking 96 min/day, cleaning of cooking utensils 39 min/day)	821.25 hrs	135 minutes or 2.25 hrs/HH/day. Time saved on collection of fuel wood is excluded here. This time savings is used for HHs buying fuel wood

S.N.	Particulars	Quantity/HHs/Year				Remarks
2b	Time savings of HHs which collect fuelwood (cooking 96 min/day, cleaning of cooking utensils 39 min/day and collecting of fuelwood - 84 min/day)	1332.25 hrs (821.25 hrs + 511 hrs)				Additional savings of 1.4 hrs/HH/day as compared to section 2a in this table. Time saved on fuelwood is included here. This time saved is used for HHs collecting fuelwood
3	Time gained due to avoideness of illness	Not available				
4	Fertilizer savings	4 m^3	6 m^3	8 m^3	10 m^3	No separate data available for Tarai and Hills
	Nitrogen (N)	26	29	52	65	
	Phosphorus (P)	13	19	26	32	
	Potassium (K)	26	39	52	65	
5	Fuel wood savings (kg) - Tarai	708	1640	2041	1683	
	Fuel wood savings (kg) - Hills	1295	1825	2260	1775	
6	Kerosene savings (litre) - Tarai	413	246	265	253	Savings is mostly from Kerosene used for cooking and very little for lighting
	Kerosene savings (litre) - Hills	497	311	273	238	

Source: Biogas User's Survey, AEPC/HMG, 2004/05

Valuation of Benefits

Valuing the probable impacts in monetary terms indicates direct financial benefits from biogas program. In WI 2006 study, certain impacts are valued as the money saved per household per year. This annual saving has been forecasted for 20 year time period, with discount rate of 12% per annum.

Table A7.5: Valuation of Biogas Impact

S.N.	Particulars	Amount Saved/HH (US$/year)			
1	Health benefit (saved medicine and life savings)	7.0			
2a	Time savings of HHs which buy the fuelwood (cooking 96 min/day, cleaning of cooking utensils 39 min/day)	70.0			
2b	Time savings of HHs which collect fuelwood (cooking 96 min/day, cleaning of cooking utensils 39 min/day and collecting of fuelwood - 84 min/day)	114.0			
3	Time gained due to avidness of illness	Not available			
		4 m^3	6 m^3	8 m^3	10 m^3
4	Fertilizer savings	15.0	22.0	29.0	36.0
5	Fuel wood savings - Tarai	36.5	84.5	105.0	86.7
	Fuel wood savings - Hills	66.7	94.0	116.4	91.4
6	Kerosene savings - Tarai	21.3	12.7	13.7	13.0
	Kerosene savings - Hills	21.6	16.0	14.1	12.2

Source: Biogas User's Survey, AEPC/HMG, 2004/05

It is estimated that only 50% of the time saved is used in income generating activities in one year period. The current rate of unskilled labor as fixed by the government is US$ 17/hr. Source: Biogas User's Survey 2004/05

Uncertainties in Benefits

Certain uncertainties in benefits may arise due to:

- Impracticality of utilization of the time saved for income generating activities due to lack of work opportunities in actual rural scenarios. In other words, there is no certainty that the valuation of the time saved is practical because in reality, the time saved is more often utilized in activities like family health care, adult literacy etc.

- Exclusion of the fact that reduction in number of animals producing dung may occur at any time of the plant operation. This may lead to additional burden of cost required if one has to increase the number of livestock head.
- Only savings in the cost of medicine reported by biogas users has been considered in this analysis. This could vary from year to year.
- Biogas will not replace 100% of the fuelwood use in households. Fuelwood would still be used mainly for cooking food for cattle and for heating purposes. This would have some impacts on the health benefits. Moreover because of this, the total time saved could also be less than assumed as households would still have to spend time going to the forest etc to gather fuel wood. So while there would be significant reduction in time spent in the forest, the travel time would not be reduced considerably.

Again, due to lack of range of uncertainties in impacts, further calculation has not been done to study these impacts.

Results of Financial Analysis

The financial analysis has been done computing three financial ratios: Net Present Value at 12% discount rate, Benefit Cost Ratio at 12% discount rate and Financial Internal Rate of Return (FIRR). The result has been presented in Table A7.6.

Table A7.6: Financial Ratios of Investment on Biogas at HHs Level

Plant Size	Tarai			Hills		
	NPV	BCR	FIRR	NPV	BCR	FIRR
4 m^3	$1,011	2.37	45%	$1,293	2.77	55%
6 m^3	$1,482	2.71	49%	$1,482	2.86	52%
8 m^3	$1,547	2.76	47%	$1,637	2.85	49%
10 m^3	$1,302	2.28	36%	$1,278	2.19	34%

Clearly, benefits of the intervention outweigh costs at HH level, thus giving a net benefit in monetary term. The benefit to the cost ratio ranges from 2.19 and 2.86 for households that collect fuelwood. This clearly indicates that the biogas plants are more beneficial to all households.

Economic Analysis

This chapter provides an analysis of costs and benefits of the proposed intervention from society's perspective. In an economic study, society refers to the overall population including producers, consumers and the government. In household level analysis, financial analysis took into consideration the cost and benefits incurred upon individual households alone. The societal level economic analysis takes into consideration all costs and benefits incurred by society as a whole. This chapter is organized into separate sections to identify, quantify and value the economical costs and benefits per plant from society's perspective.

Cost Estimation

Identification of costs

Cost in CBA from a societal perspective includes most of the costs per plant identified in household level analysis. The basic costs include plant construction, R&M costs and cost due to loss of time. In addition, however, there are program costs referred to as Technical Assistance (TA) costs. These include cost for promotion and marketing, administration, quality control, R&D/standardization, training, monitoring and evaluation, institutional support, program management and external evaluation. Finally, the subsidy provided by the government represents an additional cost to society.

Quantification of costs
Cost of plant construction, R&M and time losses have already been quantified as part of the household-level analysis. Government subsidies with respect to different biogas plant sizes are presented in the Table below.

Valuation of costs
The subsidy provided to households, and the technical assistance cost is additional for the societal level analysis. The technical assistance cost of US$ 15 per plant has been considered in this analysis[16].

Benefit Estimation

Identification of impacts
Apart from impacts identified in the HH level analysis; there are certain other impacts which are borne by the society as a whole following biogas intervention.

i .General Benefits

- **Subsidy savings as a result of reduced expenditure on traditionally used fuels (wood, kerosene):** Since the government provides subsidy to construct biogas plants at the household level, it is evident that switching to biogas reduces societal cost going into the subsidy scheme, in addition to reducing household costs. The country will also share a direct economic benefit by reducing fuel wood use and kerosene imports. If calculated at the national level by multiplying with the total number of households with biogas plants, this is clearly a significant figure that will impact Nepal's economy considerably. Allowing higher prices of fuel wood in benefit calculation will further increase the economic returns.

ii. Health Benefits

- **Increased risk of fire due to methane leakage:** One limitation of biogas use in terms of safety is that there is a chance of methane leakage from the stove and the plant itself, which can cause accidental deaths due to fire from gas stoves, and cause major economic losses to concerned households. Given the rarity of such events, this adverse impact was not quantified in this analysis.

iii. Environmental Benefit

- **Reduced deforestation pressures:** Biogas intervention also has a direct impact on the environment, which is of concern to society as a whole. Bajgain S. et al, 2005 reveal in their report that according to IUCN, 1995, 32.7 metric tons of fuel wood is harvested per hectare land per annum in Nepal. Even though it is not clear what percentage of this deforestation is due to fuel needs rather than for commercial logging, the replacement of fuel wood by biogas could contribute to protecting 6,790 ha of land and around 9 million trees per year. However, a study from Brazil estimated the cost to reforest one tree at US$0.25, including seedling, technical assistance, fertilizer, wire, pesticide and administration (The Global CBA Report; Carneiro de Miranda, 1997). As there is no such data available in context of Nepal, this impact was not quantified in the analysis.
- **Reduced greenhouse gas emissions:** Besides the direct impact of environmental welfare, reduction in carbon emission is a good source of income for the country. The Community Development Carbon Fund (CDCF) is offering $7 per ton reduction in CO_2

[16]The technical assistance cost for the year 2003 has come out to be US$34 per plant *(Bajgain S. and Shakya I., 2005)*. However according to the *BSP Nepal*, the average TA cost for 200,000 biogas plants planned for the forth phase of BSP is US$ 15 per plant. So in this analysis, TA cost is taken as US$15 per plant.

emissions at present. Hence as a technology, biogas plants can bring additional revenue for Nepal by reducing GHG emissions. However, total GHG reduction will be reduced to some extent by methane leakage from biogas plants and the net reduction has to be adjusted accordingly.

Quantification of Benefits

- **Subsidy savings as a result of reduced expenditure on traditionally used fuels (wood, kerosene):** The government is currently providing subsidy of US$0.095/L in kerosene at the national level. Fuel wood is also provided by the government (Timber Corporation of Nepal) at subsidized rates of US$ 0.021/kg, in both Tarai and hill, which is actually US$ 0.03/kg in terrain and US$ 0.04/kg in hills without subsidy. Biogas intervention which can replace fuel wood and kerosene consumption has positive effect on economic saving of the country.
- **Reduced greenhouse gas emissions:** The global environmental value of greenhouse gas emissions reduction by a biogas plant is calculated as the product of the total emissions reduction and the market price of carbon reduction. The quantity of greenhouse gas reduced through the use of biogas is presented in Table 5.7 for each plant size and location:

Table A7.7: GHG Reduction from Using a Biogas Plant (tons of CO_2 eq. per year)

Plant Size (m^3)	Tarai	Hill	Average of Tarai and Hills
4	3.2	5.8	4.46
6	7.3	8.0	7.69
8	9.3	9.9	9.63
10	7.4	7.9	7.65

Source: Winrock International and EcoSecurities, 2004

It is evident from Table A7.7 that there is a substantial reduction in GHG emissions due to biogas use. Carbon can be traded internationally and this reduction in carbon emission is a steady source of income for the nation. The above Table shows that carbon-dioxide emission reduction is increases in ratio with increase in size of plant, except for 10 cu.m plant. This can be attributed to the fact that fuel wood replacement is less by the gas produced from 10 cu. m. plant as compared to others. This is because at the household level, the quantity of raw material/cattle dung fed into the plant is almost equal (studies like annual biogas users' survey have reported similar cattle holding size by rural households) despite the larger plant size. This creates technically incompatible situation for biogas production process, leading to decrease in gas production rather than increase.

Valuation of Benefits

Reduced greenhouse gas emissions: The impacts of biogas in reducing carbon emissions can be estimated by the values associated with emission reduction in the international market. The price currently varies from US$ 4 to $ 20 depending upon the nature and risks of the project. The impacts of biogas due to savings in carbon emissions with US$ 7 per ton of CO_2 savings[17]:

Results of Economic Analysis

The economic analysis has been done three economic ratios: Net Present Value at 12% discount rate, Benefit Cost Ratio at 12% discount rate and Economic Internal Rate of Return (EIRR). The result has been presented in Table A7.8.

[17]The Community Development Carbon Fund of the World Bank has negotiated at US$ 7 per ton CO2 savings from biogas in Nepal

Table A7.8: Economic Ratios of Investment on Biogas at Society Level

Plant Size	Tarai			Hills		
	NPV	BCR	EIRR	NPV	BCR	EIRR
4 m^3	$806	1.71	25%	$1,211	2.03	30%
6 m^3	$1,419	2.18	32%	$1,541	2.24	33%
8 m^3	$1,738	2.36	34%	$1,839	2.40	35%
10 m^3	$1,456	2.10	30%	$1,460	2.05	29%

Clearly, benefits of the intervention outweigh costs at society level, thus giving a net benefit in monetary term. The benefit to the cost ratio ranges from 2.05 and 2.40 for the society even fuelwood has been collected. This clearly indicates that the biogas plants are more beneficial to all society. These figures also point out that there is a strong justification for policy makers to support biogas initiative in the country.

Table A7.9: Financial Cost Benefit Analysis of the 4 m^3 Sized Biogas Plant in Tarai

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	325	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
3	Total investment and operating cost	US$	368	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	194	203	214	224	236	247	260	273	286	301	316	331	348	365	384	403	423	444	466
	Fuel wood savings	US$	0	37	38	40	42	44	47	49	51	54	57	59	62	66	69	72	76	80	84	88
	Kerosene savings	US$	0	21	22	23	25	26	27	29	30	31	33	35	36	38	40	42	44	46	49	51
	Fertilizer savings	US$	0	15	16	17	17	18	19	20	21	22	23	24	26	27	28	30	31	33	34	36
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
5	Net income	US$	-368	149	156	164	172	181	190	199	209	220	231	242	254	267	280	294	309	324	341	358
6	Financial ratios																					
	NPV		$1,011																			
	BCR		2.37																			
	IRR		45%																			

Table A7.10: Financial Cost Benefit Analysis of the 4 m^3 Sized Biogas Plant in Hill

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	317	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
3	Total investment and operating cost	US$	360	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	224	236	247	260	273	286	301	316	331	348	365	384	403	423	444	466	490	514	540
	Fuel wood savings	US$	0	67	70	74	77	81	85	89	94	99	103	109	114	120	126	132	139	146	153	161
	Kerosene savings	US$	0	22	23	24	25	26	28	29	30	32	34	35	37	39	41	43	45	47	50	52
	Fertilizer savings	US$	0	15	16	17	17	18	19	20	21	22	23	24	26	27	28	30	31	33	34	36
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
5	Net income	US$	-360	179	188	197	207	218	229	240	252	265	278	292	306	322	338	355	372	391	411	431
6	Financial ratios																					
	NPV		$1,293																			
	BCR		2.77																			
	IRR		55%																			

Table A7.11: Financial Cost Benefit Analysis of the 6 m^3 Sized Biogas Plant in Tarai

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	397	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
3	Total investment and operating cost	US$	440	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	240	252	265	278	292	307	322	338	355	373	391	411	431	453	476	499	524	551	578
	Fuel wood savings	US$	0	85	89	93	98	103	108	113	119	125	131	138	145	152	159	167	176	184	194	203
	Kerosene savings	US$	0	13	13	14	15	15	16	17	18	19	20	21	22	23	24	25	26	28	29	31
	Fertilizer savings	US$	0	22	23	24	25	27	28	29	31	33	34	36	38	40	41	44	46	48	50	53
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
5	Net income	US$	-440	195	205	215	226	237	249	261	274	288	303	318	334	350	368	386	405	426	447	469
6	Financial ratios																					
	NPV		$1,365																			
	BCR		2.71																			
	IRR		49%																			

Table A7.12: Financial Cost Benefit Analysis of the 6 m^3 Sized Biogas Plant in Hill

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	395	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
3	Total investment and operating cost	US$	438	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	253	266	279	293	308	323	339	356	374	392	412	433	454	477	501	526	552	580	609
	Fuel wood savings	US$	0	94	99	104	109	114	120	126	132	139	146	153	161	169	177	186	195	205	215	226
	Kerosene savings	US$	0	16	17	18	19	19	20	21	23	24	25	26	27	29	30	32	33	35	37	39
	Fertilizer savings	US$	0	22	23	24	25	27	28	29	31	33	34	36	38	40	41	44	46	48	50	53
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
5	Net income	US$	-438	208	218	229	241	253	265	278	292	307	322	339	355	373	392	411	432	454	476	500
6	Financial ratios																					
	NPV		$1,482																			
	BCR		2.86																			
	IRR		52%																			

Table A7.13: Financial Cost Benefit Analysis of the 8 m^3 Sized Biogas Plant in Tarai

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	484	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
3	Total investment and operating cost	US$	527	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	269	282	297	311	327	343	360	379	397	417	438	460	483	507	533	559	587	617	647
	Fuel wood savings	US$	0	105	110	116	122	128	134	141	148	155	163	171	180	189	198	208	218	229	241	253
	Kerosene savings	US$	0	14	15	15	16	17	18	19	20	21	22	23	24	25	26	28	29	31	32	34
	Fertilizer savings	US$	0	29	30	32	34	35	37	39	41	43	45	47	50	52	55	57	60	63	66	70
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
5	Net income	US$	-527	224	235	247	259	272	286	300	315	331	347	365	383	402	422	443	465	489	513	539
6	Financial ratios																					
	NPV		$1,547																			
	BCR		2.76																			
	IRR		47%																			

Table A7.14: Financial Cost Benefit Analysis of the 8 m^3 Sized Biogas Plant in Hill

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	494	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
3	Total investment and operating cost	US$	537	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	280	294	309	324	340	357	375	394	414	434	456	479	503	528	554	582	611	642	674
	Fuel wood savings	US$	0	116	122	128	134	141	148	155	163	171	180	189	198	208	219	230	241	253	266	279
	Kerosene savings	US$	0	14	15	15	16	17	18	19	20	21	22	23	24	25	26	28	29	31	32	34
	Fertilizer savings	US$	0	29	30	32	34	35	37	39	41	43	45	47	50	52	55	57	60	63	66	70
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
5	Net income	US$	-537	235	247	259	272	285	300	315	330	347	364	382	402	422	443	465	488	513	538	565
6	Financial ratios																					
	NPV		$1,637																			
	BCR		2.85																			
	IRR		49%																			

Table A7.15: Financial Cost Benefit Analysis of the 10 m^3 Sized Biogas Plant in Tarai

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	637	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
3	Total investment and operating cost	US$	680	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	257	270	283	298	312	328	344	362	380	399	419	440	462	485	509	534	561	589	619
	Fuel wood savings	US$	0	87	91	96	101	106	111	117	122	129	135	142	149	156	164	172	181	190	199	209
	Kerosene savings	US$	0	13	14	14	15	16	17	17	18	19	20	21	22	23	25	26	27	28	30	31
	Fertilizer savings	US$	0	36	38	40	42	44	46	48	51	53	56	59	62	65	68	71	75	79	83	87
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
5	Net income	US$	-680	212	222	234	245	257	270	284	298	313	329	345	362	380	399	419	440	462	485	510
6	Financial ratios																					
	NPV		$1,302																			
	BCR		2.28																			
	IRR		36%																			

Table A7.16: Financial Cost Benefit Analysis of the 10 m^3 Sized Biogas Plant in Hill

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
3	Total investment and operating cost	US$	743	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	261	274	287	302	317	333	349	367	385	404	424	446	468	491	516	542	569	597	627
	Fuel wood savings	US$	0	91	96	101	106	111	117	122	129	135	142	149	156	164	172	181	190	200	209	220
	Kerosene savings	US$	0	12	13	13	14	15	16	16	17	18	19	20	21	22	23	24	25	27	28	29
	Fertilizer savings	US$	0	36	38	40	42	44	46	48	51	53	56	59	62	65	68	71	75	79	83	87
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
5	Net income	US$	-743	215	226	237	249	262	275	289	303	318	334	351	368	387	406	427	448	470	494	518
6	Financial ratios																					
	NPV		$1,278																			
	BCR		2.19																			
	IRR		34%																			

Table A7.17: Economic Cost Benefit Analysis of the 4 m^3 Sized Biogas Plant in Tarai

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	763	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
	TA Cost	US$	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Total investment and operating cost	US$	821	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	216	227	238	250	263	276	289	304	319	335	352	369	388	407	428	449	472	495	520
	Fuel wood savings	US$	0	37	38	40	42	44	47	49	51	54	57	59	62	66	69	72	76	80	84	88
	Kerosene savings	US$	0	21	22	23	25	26	27	29	30	31	33	35	36	38	40	42	44	46	49	51
	Fertiliser savings	US$	0	15	16	17	17	18	19	20	21	22	23	24	26	27	28	30	31	33	34	36
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
	GHG reduction	US$	0	22	23	24	26	27	28	30	31	33	34	36	38	40	42	44	46	48	51	53
5	Net income	US$	-821	171	179	188	198	208	218	229	240	252	265	278	292	307	322	338	355	373	392	411
6	Economic ratios																					
	NPV		$806																			
	BCR		1.71																			
	IRR		25%																			

Table A7.18: Economic Cost Benefit Analysis of the 4 m^3 Sized Biogas Plant in Hill

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	801	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
	TA Cost	US$	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Total investment and operating cost	US$	859	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	265	278	292	306	322	338	355	372	391	410	431	453	475	499	524	550	578	606	637
	Fuel wood savings	US$	0	67	70	74	77	81	85	89	94	99	103	109	114	120	126	132	139	146	153	161
	Kerosene savings	US$	0	22	23	24	25	26	28	29	30	32	34	35	37	39	41	43	45	47	50	52
	Fertiliser savings	US$	0	15	16	17	17	18	19	20	21	22	23	24	26	27	28	30	31	33	34	36
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
	GHG reduction	US$	0	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97
5	Net income	US$	-859	219	230	242	254	267	280	294	309	324	340	357	375	394	414	434	456	479	503	528
6	Economic ratios																					
	NPV		$1,211																			
	BCR		2.03																			
	IRR		30%																			

Table A7.19: Economic Cost Benefit Analysis of the 6 m^3 Sized Biogas Plant in Tarai

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	835	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
	TA Cost	US$	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Total investment and operating cost	US$	893	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	291	306	321	337	354	372	390	410	430	452	474	498	523	549	576	605	635	667	701
	Fuel wood savings	US$	0	85	89	93	98	103	108	113	119	125	131	138	145	152	159	167	176	184	194	203
	Kerosene savings	US$	0	13	13	14	15	15	16	17	18	19	20	21	22	23	24	25	26	28	29	31
	Fertiliser savings	US$	0	22	23	24	25	27	28	29	31	33	34	36	38	40	41	44	46	48	50	53
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
	GHG reduction	US$	0	51	53	56	59	62	65	68	72	75	79	83	87	91	96	101	106	111	117	122
5	Net income	US$	-893	246	258	271	285	299	314	330	346	363	382	401	421	442	464	487	511	537	564	592
6	Economic ratios																					
	NPV		$1,419																			
	BCR		2.18																			
	IRR		32%																			

Table A7.20: Economic Cost Benefit Analysis of the 6 m^3 Sized Biogas Plant in Hill

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	879	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
	TA Cost	US$	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Total investment and operating cost	US$	937	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	309	324	341	358	376	394	414	435	457	479	503	528	555	583	612	642	675	708	744
	Fuel wood savings	US$	0	94	99	104	109	114	120	126	132	139	146	153	161	169	177	186	195	205	215	226
	Kerosene savings	US$	0	16	17	18	19	19	20	21	23	24	25	26	27	29	30	32	33	35	37	39
	Fertiliser savings	US$	0	22	23	24	25	27	28	29	31	33	34	36	38	40	41	44	46	48	50	53
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
	GHG reduction	US$	0	56	59	62	65	68	71	75	79	83	87	91	96	101	106	111	116	122	128	135
5	Net income	US$	-937	264	277	291	305	321	337	354	371	390	409	430	451	474	497	522	548	576	605	635
6	Economic ratios																					
	NPV		$1,541																			
	BCR		2.24																			
	IRR		33%																			

Table A7.21: Economic Cost Benefit Analysis of the 8 m^3 Sized Biogas Plant in Tarai

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	914	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
	TA Cost	US$	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Total investment and operating cost	US$	972	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	334	351	369	387	406	427	448	470	494	519	545	572	600	630	662	695	730	766	805
	Fuel wood savings	US$	0	105	110	116	122	128	134	141	148	155	163	171	180	189	198	208	218	229	241	253
	Kerosene savings	US$	0	14	15	15	16	17	18	19	20	21	22	23	24	25	26	28	29	31	32	34
	Fertiliser savings	US$	0	29	30	32	34	35	37	39	41	43	45	47	50	52	55	57	60	63	66	70
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
	GHG reduction	US$	0	65	69	72	76	79	83	88	92	96	101	106	112	117	123	129	136	143	150	157
5	Net income	US$	-972	289	304	319	335	351	369	387	407	427	449	471	494	519	545	572	601	631	663	696
6	Economic ratios																					
	NPV		$1,738																			
	BCR		2.36																			
	IRR		34%																			

Table A7.22: Economic Cost Benefit Analysis of the 8 m^3 Sized Biogas Plant in Hill

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
	TA Cost	US$	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Total investment and operating cost	US$	1013	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	350	367	385	405	425	446	468	492	517	542	569	598	628	659	692	727	763	801	841
	Fuel wood savings	US$	0	116	122	128	134	141	148	155	163	171	180	189	198	208	219	230	241	253	266	279
	Kerosene savings	US$	0	14	15	15	16	17	18	19	20	21	22	23	24	25	26	28	29	31	32	34
	Fertiliser savings	US$	0	29	30	32	34	35	37	39	41	43	45	47	50	52	55	57	60	63	66	70
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
	GHG reduction	US$	0	70	73	77	81	85	89	93	98	103	108	113	119	125	131	138	145	152	160	168
5	Net income	US$	-1013	304	320	336	352	370	389	408	428	450	472	496	521	547	574	603	633	665	698	733
6	Economic ratios																					
	NPV		$1,839																			
	BCR		2.40																			
	IRR		35%																			

Table A7.23: Economic Cost Benefit Analysis of the 10 m^3 Sized Biogas Plant in Tarai

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
	TA Cost	US$	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Total investment and operating cost	US$	1033	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	309	325	341	358	376	394	414	435	457	480	503	529	555	583	612	643	675	708	744
	Fuel wood savings	US$	0	87	91	96	101	106	111	117	122	129	135	142	149	156	164	172	181	190	199	209
	Kerosene savings	US$	0	13	14	14	15	16	17	17	18	19	20	21	22	23	25	26	27	28	30	31
	Fertiliser savings	US$	0	36	38	40	42	44	46	48	51	53	56	59	62	65	68	71	75	79	83	87
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
	GHG reduction	US$	0	52	55	57	60	63	66	70	73	77	81	85	89	94	98	103	108	114	119	125
5	Net income	US$	-1033	264	277	291	306	321	337	354	371	390	409	430	451	474	498	523	549	576	605	635
6	Economic ratios																					
	NPV		$1,456																			
	BCR		2.10																			
	IRR		30%																			

Table A7.24: Economic Cost Benefit Analysis of the 10 m^3 Sized Biogas Plant in Hill

S.N.	Particulars	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	Construction cost	US$	1038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Operating cost																					
	Time lost cost	US$	40	42	44	47	49	51	54	57	60	63	66	69	72	76	80	84	88	92	97	102
	R&M cost	US$	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7
	TA Cost	US$	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Total investment and operating cost	US$	1096	45	47	50	52	55	58	61	64	67	70	74	77	81	85	89	94	99	104	109
4	Pertaining income savings	US$	0	316	331	348	365	384	403	423	444	466	490	514	540	567	595	625	656	689	724	760
	Fuel wood savings	US$	0	91	96	101	106	111	117	122	129	135	142	149	156	164	172	181	190	200	209	220
	Kerosene savings	US$	0	12	13	13	14	15	16	16	17	18	19	20	21	22	23	24	25	27	28	29
	Fertiliser savings	US$	0	36	38	40	42	44	46	48	51	53	56	59	62	65	68	71	75	79	83	87
	Medication cost savings	US$	0	7	7	8	8	9	9	9	10	10	11	11	12	13	13	14	15	15	16	17
	Time cost savings for fuelwood collectors	US$	0	114	120	126	132	139	145	153	160	168	177	186	195	205	215	226	237	249	261	274
	GHG reduction	US$	0	55	58	61	64	67	70	74	78	81	85	90	94	99	104	109	115	120	126	133
5	Net income	US$	-1096	271	284	298	313	329	345	363	381	400	420	441	463	486	510	536	562	591	620	651
6	Economic ratios																					
	NPV		$1,460																			
	BCR		2.05																			
	IRR		29%																			

Annex 8: List of Persons Met

1. Mr. Soroj Rai, Executive Director, BSP,
2. Mr. Ramesh K. Gautam, Microfinance Advisor, SNV,
3. Ms. Subarna Rai, Programme Monitoring Team Manager, SNV
4. Mr. Uttam P. Jha, OSID Advisor and Sector Leader Renewable Energy, SNV
5. Mr. Krishna Chandra Subedi, Chairperson, Nepal Biogas Promotion Association,
6. Mr. Mohan Raj Sharma, Executive Director, Nepal Biogas Promotion Association,
7. Mr. Bala Ram Shrestha, BSP, Nepal
8. Ms. Meena Sigdel, Mahila Samaj SCCs, Kohalpur
9. Mr. Kamal Bhandari and Mr. Dila Ram Adhikari, Lekh Beshi Solar Energy and Biogas Service Company, Kohalpur, Branch
10. Mr. Bhola Kafle and Mr. Rishi Adhikari, Paschimanchal Dhaulagiri Gobargas Company (P) Ltd. Kohalpur, Branch
11. Mr. Prabhakar Mishra, Chief Executive Officer, Madhaya Paschimanchal GBB, Nepalgunj
12. Mr. Suresh Chaudary, Rastriya Gobar Gas Company (P) Ltd., Kohalpur Branch
13. Mr. Sunil K. Karna, Krishi Yantra Tatha Gobar gas Company (p) Ltd. Nepalgunj Branch,
14. Mr. Krishna Prasad Adhikari, Baikalpith Urja Tahta Gobar Gas Company (P) Ltd. Kohalpur Branch,
15. Mr. Arjun Pant, Tribeni Gobargas Company, Kohalpur Branch,
16. Mr. Mukunda K. C., Planning Assistant, DDC Lalitpur,
17. Mr. Durga P. Timilsina, Rapti Gobargas Company (p) Ltd. Chapagoun Branch,
18. Mr. Binod Prakash Singh, Local Development Officer, DDC Kavre.
19. Mr. Rishi Kanta Ghimire, Programme Officer, DDC Kavre,
20. Mr. Rabindra Bista, Technical Officer, REDP, Kavre,
21. Mr. Mukti Nath Taujale, Busienss and Mobilisation Officer, REMREC, Kavre,
22. Mr. Dilip Sharma, Social Mobilisation Coordinator, REMREC, Kavre,
23. Mr. Dhurba Chaulagain and Ms. Shanti Sapkota, All Nepal Biogas Company, Banepa,
24. Mr. Padam Dulal and Rabeti K. Dulal, Deureli Gobargas Company, Banepa.
25. Mr. Sameer Thapa, AEPC
26. Mr. Shusil Acharya, Credit Officer, BCU/AEPC,
27. Mr. Raju Ghimire, Account Assistant, BCU/AEPC,
28. Mr. Lab K. Thapa, Assistant, BCU/AEPC,
29. Mr. Dharma Dulal, Credit Assistant, BCU/AEPC,
30. Mr. Mahendra Giri, Chief Manager, SAHARA, Nepal, Charpane, Jhapa
31. Mr. Kamal Bahadur Basnet, Chairperson, Karnali SCC, Birtamod
32. Mr. Dilli Basnet, Marketing Manager, Karnali SCC, Birtamod,
33. Mr. Netra P. Neupane, General Manager, Sana Krishak Samudaik Gobargas Company (P) Ltd. Birtamod,
34. Mr. Shyam Ghimire, General Manager, Shiva Shakti Gobargas (p) Ltd. Birtamod, Jhapa
35. Mr. Acharya, Branch Manager, GBB Branch Office, Birtamod.