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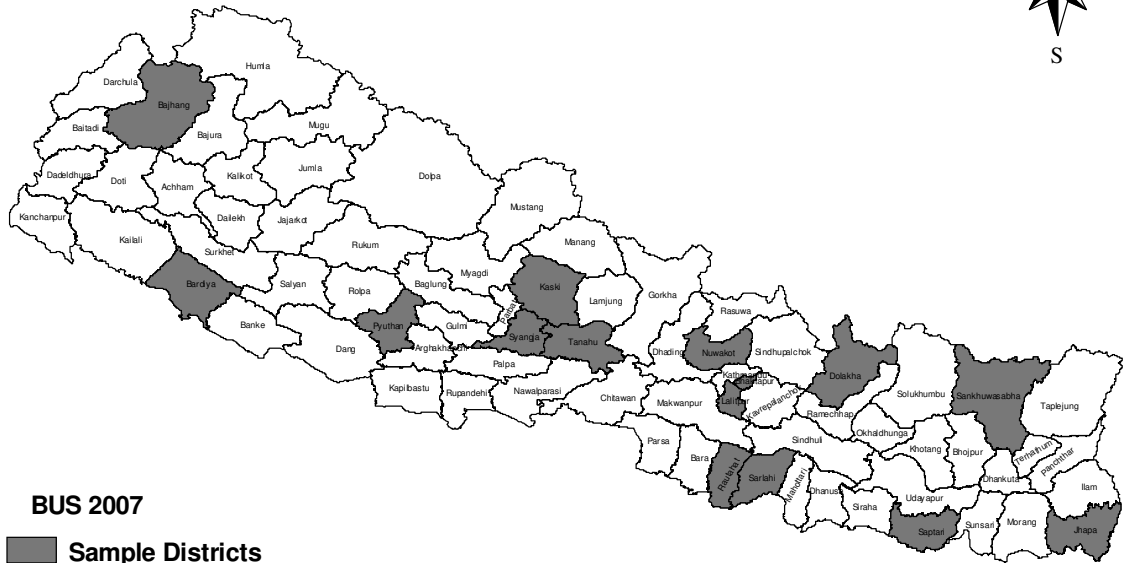
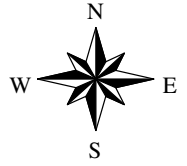
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Abbreviations

ACAP	Annapurna Conservation Area Programme
ADB	Asian Development Bank of Manila
ADB/N	Agricultural Development Bank of Nepal
AEPC	Alternative Energy Promotion Center
AFP	Agence France Presse
ARI	Acute Respiratory Infection
Bari	Cultivated Upland
BG	Biogas
BGL	Biogas Lamp
BGP	Biogas Plant
BGS	Biogas Stove
BSP	Biogas Support Programme
BSP-N	Biogas Sector Partnership-Nepal
BUC	Biogas Users' Committee
BUS	Biogas Users' Survey
CBBC	Central Biogas Coordination Committee
CBOs	Community Based Organizations
CDM	Clean Development Mechanism
CDR	Central Development Region
CES	Centre for Energy Studies
CMED	Central Monitoring and Evaluation Division (NPC)
CMS	Consolidated Management Services Nepal (P) Ltd.
CO ₂	Carbon dioxide
DANIDA	Danish International Development Assistance
DAP	Di-ammonium Phosphate
DDC	District Development Committee
DFID	Department for International Development
DFDP	District Forest Development Programme
DOA	Department of Agriculture
EDR	Eastern Development Region
FAO	Food and Agriculture Organization
FWDR	Far-Western Development Region
FY	Fiscal Year
FYM	Farmyard Manure
GDP	Gross Domestic Production
GGC	Gobar Gas Tatha Krishi Yantra Bikash (P) Ltd
GHC	Green House Commitment
GHG	Green House Gas
GO	Government Organization
GON	Government of Nepal
GWC	Global Warming Commitment
GWP	Greenhouse Warming Potential
Ha	Hectare
HH	Household
HDI	Human Development Index
HMG	His Majesty's Government of Nepal
H ₂ S	Hydrogen Sulphide
ICIMOD	International Centre for Integrated Mountain Development
ICS	Improved Cooking Stove
IEIA	Integrated Environmental Impact Assessment
IFAD	International Fund for Agriculture Development
INGO	International Non-government Organization

IOE	Institute of Engineering
IUCN	International Union for Conservation of Natural Resources
JICA	Japan International Cooperation Agency
KfW	Kreditansalt fur Wiederaufbau
Khet	Low Land under Paddy Cultivation
KRI	Krishi Bikash Gobargas Company (P) Ltd
K ₂ O	Potassium Dioxide
LFP	Livelihood Forestry Project
LPD	Low Penetration District
LPG	Liquefied Petroleum Gas
MGC	Munal Gobargas Company (P) Ltd
MFI	Micro Finance Institute
MOEST	Ministry of Environment, Science and Technology
MOPE	Ministry of Population and Environment
N	Nitrogen
NBL	Nepal Bank Limited
NBPG	Nepal Biogas Promotion Group
NGO	Non Government Organization
NPC	National Planning Commission
NTFP	Non Timber Forest Product
O&M	Operation and Maintenance
OPEC	Organization of Petroleum Exporting Countries
P ₂ O ₅	Phosphorous Pentoxide
PIC	Products of Incomplete Combustion
PED	Public Urja Bikask Company (P) Ltd
R&D	Research and Development
R&M	Repair and Maintenance
RBB	Rastriya Banijya Bank
RBC	Reinforce Brick Concrete
RBCC	Regional Biogas Coordination Committee
RCC	Reinforce Cement Concrete
RET	Renewable Energy Technology
REDP	Rural Energy Development Program
RTC	Regional Training Centre
SCO	Saving and Credit Organization
SEP	Slurry Extension Programme
SLC	School Leaving Certificate
SNV	Netherlands Development Organization
SSMP	Sustainable Soil Management Project
TOR	Terms of Reference
TRPAP	Tourism for Rural Poverty Alleviation Program
TSP	Total Suspended Particulates
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Program
UNHCR	United Nations High Commission for Refugee
UNICEF	United Nations Children Educational Fund
USAID	US Agency for International Development
UV	Ultra Violet
VDC	Village Development Committee
WECS	Water and Energy Commission Secretariat
YSD	Yashoda Sustainable Development (P) Ltd.

BUS 2007 Sample Districts



BUS 2007

 **Sample Districts**

 **Other Districts**

EXECUTIVE SUMMARY

1.0 INTRODUCTION

The Biogas Users' Survey 2006/07 is intended to provide birds' eye view into the program implementation and measure its success in terms of both qualitative and quantitative achievements thus providing a significant input for improvising the program in future, as required. In this context, Consolidated Management Services (P) Ltd. (hereinafter called Consultant) was entrusted to undertake the "Biogas Users' Survey 2006/07 by the AEPC.

2.0 OBJECTIVES

In general, the objective of the Biogas Users' Survey 2006/07 is to make a comprehensive assessment of the impacts of the installed biogas plants on energy, health & sanitation, agricultural systems, socio-economic condition, environment and gender. Besides, the local impact of biogas, this survey is also expected to provide information to evaluate the global environmental impacts of biogas plants in the context of CDM.

3.0 APPROACHES AND METHODOLOGY

With a clear understanding of the objective of this survey, an intensive literature review of previous studies and surveys conducted by different organizations and researches on the use and impacts of biogas was carried out. Based on this, the questionnaire for the household survey and checklist for key informant interviews were formulated in consultation with the AEPC and BSP-N officials. The enumerators were given rigorous training and pre-testing was also carried out. The survey team was mobilized in 15 districts comprising five development regions and from hill and *Terai* ecological belts. The districts selected were: Jhapa, Sankhuwasabha and Saptari from Eastern Development Region; Sarlahi, Rautahat, Dolakha, Lalitpur, Bhaktapur and Nuwakot from Central Development Region; Syangja, Tanahun and Kaski from Western Development Region; Bardiya and Pyuthan from Mid-western Development Region; and Bajhang from Far-western Development Region.

Samples for the survey were given by BSP-Nepal on the basis of Alternative Random Sampling Method prepared by BSP-N itself. As stipulated in the TOR, data from a total of 510 households were analyzed and interpreted.

4.0 MAIN FINDINGS OF THE STUDY

The summary of the main findings of Biogas Users' Survey 2006/2007 is presented in following sections.

4.1 IMPACT ON SOCIO-ECONOMIC CONDITIONS

- **Ethnic Distribution:** The major caste groups are Brahmin/Chettri (67.5%) followed by Dalits and other castes (6.7%) hence indicating the program to be inclusive.
- **Average Family Size:** The average size of the family is 6.7members/hh and the variation in in the hill and *Terai* is insignificant.

- **Literacy and Educational Status:** Increased literacy status was observed with only 14.8% illiterate households in hill and 14.3% in *Terai* and less female literacy than male as a whole. 32.5% household members have attained SLC in total. High percentage of school drop out among females after primary and secondary education is observed in both hill and *Terai*.
- **Occupational Distribution of Households:** The major occupation is agriculture with 78.6% involved in it primarily.
- **Types of Houses and Access to Electricity:** Regarding the types of houses 41.2% have corrugated sheets and only 6.2% have thatched roof (8% in hill and 3.3% in *Terai*). Of the total users, 84.7% households (92.7% in *Terai* and 80.4% in hill) have access to electricity.
- **Availability of Means of Transportation and Communication:** 78.3% households in hill have no means of transportation but in *Terai* 92.1% households have cycle. Regarding means of communication, 96.1% households possess some or the other means of communication like radio (90.2%), television (69.6%) and mobile phones (25.1%). More mobile phones owned by hill households.
- **Land Holding, Cattle Holding, Family Members and Biogas Plant Size:** The capacity of the plant is found to increase proportionately with the increase in number of family members, number of cattle and landholding. However, average land holding in case of >8 m³ plants is less than 8 m³ plant, probably due to disintegration of joint families into nuclear ones subsequently leading to the division of land after biogas installation.
- **Time Allocation, Time Saving and Utilization of Saved Time:** On an average, a household saves 220 minutes/day (3hr 40 mins.) due to biogas installation which is utilized in various activities. 30.8% user households found involved in income generating activities.
- **Investment for Biogas Plant and Status of Loan Repayment:** 62.7% users (62.3% in hill and 63.5% in *Terai*) installed plant from their own savings and only 23.9% took loan from bank. Trend of taking loan from bank is more common in *Terai* (28.7%) than in hill (21.4%). It is found that 63.2% users in hill and 75.8% in *Terai* installment have paid all installments, 21.4% (hill) and 12.9% (*Terai*) have paid some installment. It can be noted that only 12.8% (14.5% from hill and 9.7% *Terai*) have not paid any of the installments.
- **Labor Used during Plant Construction:** 52.3% male labors and 47.7% female labors were used in hill and *Terai*, respectively during plant construction contributing on an average 3.2 days in hill and 2.0 days in *Terai*. The difference in the number of days contributed by labor in hill and in *Terai* indicates economic disparity among users in hill and *Terai*, the latter being economically better-off.
- **Expenditure on Plant Maintenance:** 23.7% households spend on an average of Rs. 630 on instruments and only 3.1% households spend Rs. 707 on structure annually. The durability of plant once installed is proved while the authenticity of instrument used needs to be ensured.
- **Impact on Agriculture Production:** It is observed that on average 39.2% households have reported increased production in Khet, 43% in Bari and 51.6% in kitchen garden. Only 5.7% have said that production has decreased in Khet, 4.9% in Bari and 3.1% in Kitchen garden while 55%% reported no change in Khet, 52% in Bari and 45.3% in kitchen garden.
- **Expenditure on Fuel Purchase:** The installation of biogas plant has overwhelmingly reduced the expenditure of the user households on fuel purchase thereby saving monthly Rs. 2125. This makes their annual saving of Rs. 25,499 thus contributing to a large extent to uplifting their economic status.

4.2 IMPACT ON AGRICULTURE AND LAND USE

- **Average Land Holding by Size and Type:** It is found that the overall average land holding per household is 0.91 ha. *Terai* households have more *khet* compared to hill because of the topography while *bari* and kitchen garden are more in hill than in *Terai* households because they keep less area for kitchen garden.
- **Application of Manures and Fertilizers:** The use of FYM has substantially reduced in both lowland and upland in *Terai* and hill while it has increased in kitchen garden in hill after installation of biogas plant. *Terai* biogas users apply slurry-compost in all the land type indicating that slurry compost is replacing the FYM. Despite increased use of slurry compost, the use of fertilizers still continues among farmers in all land types. The reasons for continued use of chemical fertilizers are a) visibility of crop growth within a very short time period; b) notion among farmers that the productivity would be decreased if chemical fertilizers is not applied; c) easy to handle eg. Store, transport and spread in the field; d) Government policy also encourages continued use of fertilizers; and e) subsidy on transport cost of chemical fertilizers for remote hill districts.

The *Terai* users benefited Rs 2010.00 from DAP only while hill users have saved Rs 1560.00 from DAP and Rs 286.00 from urea per hectare.

- **Changes in Crop Productivity After Installation of Biogas Plant:** Majority of biogas users (55% in *khet*, 52% in *bari* and 45% in kitchen garden) found that the productivity of all land type has remained more or less same even after installation of biogas plant, increased use of slurry compost and continued use of chemical fertilizer. This could be due to lack of proper management and use of compost. On the other hand, 39 % reported increased productivity in *khet*, 43 % in *bari* and 52 % in kitchen garden. More biogas users realize increased productivity in kitchen garden which could be due to more use of slurry there and being at the vicinity the slurry is transported and applied just before planting without losing any nutrients.
- **Livestock Holding Pattern:** On an average, the livestock holding is 1.6 cattle (cow/ox), 1.5 buffalo, 0.2 pig, 2.9 sheep and 14.6 poultry.
- **Animal Husbandry Practices After Biogas Installation:** Substantial percent of households (80.6%) both in hill (78.3 %) and in *Terai* (84.8 %) have adopted stall feeding practice together with forage production (45.9%), shed construction (28.6%), fodder tree production (20.6%) and collection and utilization of dung and urine for biogas production (15.7%).
- **Livestock Shed Management:** The earthen floor can be said to be replaced by concrete floor with 0.5% decrease in the former and increase in the latter by 18% after installation of the biogas plant. Also the provision of urine collection pit (from 4.9% to 19.6 %) in the shed has significantly increased.
- **Fodder Collection and Production Practices:** The average fodder collection by the user households from their own production has increased by 7 kg/day in *Terai* whereas in hill it has increased by 4.4 kg/day. Majority of the households (67.5 % hill and 69.7 % *Terai*) are involved in fodder cultivation after installation of biogas plant.
- **Dung Availability and Production:** Average daily dung availability is 24.9 kg (23.4 kg. in hill and 27.5 kg. in *Terai*). A total of 96.9% households (95.8% in hill and 98.9% in *Terai*) reported using dung as feeding material for bio-digester. Majority of the households (52.8 %) did not realize any change while 30.6 % observed increase in dung production after installing biogas.
- **Use of Organic Residue:** 66.5% households use the organic residue for making compost. The use of residue as fuel for cooking has reduced by 3.1% after biogas, preparing feed for

cattle has increased by 0.6% and composting has increased remarkably by 41.2% after biogas.

- **Bio-slurry Use:** 75.3 % households use different forms of bio-slurry with 52.2 % using slurry compost, 24.9% using dried slurry and only 14.3% using slurry as such. 24.7% were found not using slurry in any form, the major reason, as cited by 27.8 % of the households, being difficulty in carrying slurry in liquid form.
- **Bio-slurry Composting:** 24.3 % households have one pit for composting, 23.9% have two pits, 5.9 % have 3 pits and 24.9 % have no pits at all. Pit method (69.6 %) of composting outnumbered the heap method (10.2 %) which is more common in *Terai* (15.7%) than in hill (7.2%).
- **Storage of Compost Manure and its Application:** 23.5% households said that they transported the slurry to field and spread during slack season and applied to soil only at the time of land preparation followed by 16.3% who kept in heap uncovered and 10% who transported to the field, spread and applied immediately. This indicates that majority of the users do not follow proper storage and application method of compost manure.
- **Impact of Bio- slurry on the Incidence of Diseases and Pests:** Majority of respondents (25.3%) have expressed that they have no idea about the impact of use of slurry on diseases and pests while 18.2 % households observed decreased incidence and 13.9 % observed no change in diseases and pests incidence.
- **Use of Slurry as Fish Feed:** Fish farming is not a common practice among the user households. Only three households were found adopting fish farming.

1 4.3 IMPACTS ON ENERGY, ENVIRONMENT AND EMISSION REDUCTION RELATED ISSUES

- **Types and Numbers of Stoves Used for Cooking:** The use of kerosene stove and traditional stove has reduced significantly by 10% in hill and by 24% in *Terai* after biogas installation implicating significant reduction in use of fuel wood. On an average, about 83% households have one stove and the remaining 17% have two stoves.
- **Sources of Energy for Cooking and Energy Use Pattern:** Fuel wood use which is still the major source of energy followed by biomass (agriculture residue, dung cake) and fossil fuels (kerosene, LPG). Fuel wood use has reduced by 162 kg/month/hh which accounts to the saving of nearly 2 tons/year/hh. Both before and after biogas installation, the use of kerosene for cooking is negligible.
- **Energy for Lighting:** Kerosene is predominant source of energy for lighting in the user households. The decrease in kerosene use for lighting purpose after biogas is not because of the use of biogas lamp but because of the increased consumption of electricity and candles. Solar energy as fuel for lighting is increasing in a steady pace (increase from 0.1% to 0.4%).
- **Construction Materials used:** 98% households in *Terai* have constructed plant using brick and cement and 82% have also used stone for base construction. 93% households in hill have used stone and 11% mud for plant construction. Brick and cement use is more in *Terai* than hill due to difficulty in transporting in hill.
- **Reduction in Indoor Air Pollution:** Out of 92% of the sampled households reporting reduction in kitchen smoke after biogas use, 65% reported a drastic reduction and 28%

reported reduction to some extent. Only 8% reported that there is no reduction in kitchen smoke at all which can be attributed to simultaneous use of traditional stoves. Similarly, the reason behind 89% reporting drastic reduction of smoke in hill as compared to only 52% in *Terai* could also be due to more use of improved cooking stove in hill which also improves the indoor kitchen environment.

- **Sources of Fuel Wood and Status of Forests:** 63% households use fuel wood from private lands followed by 29% from government forest and 26% from community forest. 81% reported forest degradation before biogas while only 7% said that use of fuel wood did not degrade the forest at all.
- **Reduction in Green House Gas Emission:** On an average, reduction in GHG emission per year from fuel wood is 812592 g-C, from kerosene is 12139 g-C, from dung cake is 9218 g-C and from agriculture residue is 2286 g-C.

2 4.4 IMPACT ON HEALTH AND SANITATION SITUATION

- **Status of Latrine:** The construction of latrine before biogas installation was 58% while which has increased to 97% after biogas. 81% are self-motivated for constructing latrine in their house. 69.2% households have latrine connected to the biogas plant.
- **Status of Incidence of Diseases Before and After Biogas Installation:** Majority of the female members (25% to 63% depending upon the disease type) of user households did not have incidence of the diseases whether before or after biogas installation. Among those who reported to have been suffering, it is found that there has been drastic reduction in eye infection and headache (>40%) followed by remarkable reduction in cough (34%) and respiratory diseases (23%). The comparative analysis between data on diseases among male and female reveals that reduction in respiratory and water borne diseases is more in female. 24% decreased case of eye infection followed by 20% cough, 13% respiratory infections and 5% round worm/parasitic infestations is found in children and infants.

4.5 IMPACT ON GENDER AND RELATED CONCERN

- **Ownership of Resources:** Majority of the ownership of property and resources lie with male members of biogas user households except that of cattle/animals which is under joint ownership in both the regions.
- **Decision-Making in the Households:** In majority of the households, both in hill and *Terai*, male members are the main decision-makers regarding biogas plant installation, selecting Biogas Company, selection of location for plant construction, construction of improved cattle shed and in financial dealings/bank loan.
- **Female Labor Input in Biogas Plant Installation:** Majority of the women (55.3%) in both hill and *Terai* work as unskilled laborer during construction contributing on an average 10.8 days. However, 8.4% female in hill and only 2.2% in *Terai* worked as skilled laborers.
- **Time Devoted by Women Before and After Biogas Installation:** Substantial amount of time after installing and using biogas is saved in various activities that include livestock caring, firewood collection/dung cake preparation, cooking food and cleaning utensils indicating that the technology has benefited the users. However, additional time is required

for plant feeding, water fetching and fodder collection. In spite of this, on an average, in a day 220 minutes is saved after using biogas.

- **Utilization of Saved Time:** Majority of female members of the households (46.1%) utilize their saved time in recreation like watching TV, listening to radio, reading newspaper, books and magazines. Followed by this 28.6% get involved in income generating activities, 24.1% in social works and 23.1% in other activities like farm works and attending to their children.
- **Changes in Time Utilization Pattern After Biogas Plant Installation:** Women are able to give more time for child care, cleaning household surroundings, taking care of patient/elderly members after installing biogas. But water fetching, mixing dung with water for biogas plant and fodder collection require more time and hence the time allocation for this has increased. While time allocation for some of the household activities; such as; forage collection, cooking, cleaning dish and others has decreased after biogas plant installation.
- **Status of Women's Participation in Local Social Organizations and CBO/NGOs:** 30.8% women (33.1% in hill and 26.4% in *Teraí*) are involved in Mother's Group, followed by 29.2% (26.2% in hill and 34.8% in *Teraí*) in Cooperatives, 26.1% in Forest Users Group and 8% in others.
- **Women's Perception on Social Status Changes:** 66.1% women felt that they received increased cooperation and cohesion from family members after biogas plant installation. Similarly, 66.2% expressed the view that participation in various social activities in neighborhood has increased followed by 44.3% who said that the time to visit Family Planning Center and Health Center has remained same even after biogas plant installation.
- **Suggestions for the Improvement of Life of Rural Women and Children:** It is suggested that there is a need for training programmes to enhance their skill and knowledge on agriculture, health & sanitation, kitchen management, technical aspects of biogas plant like operation, repair and maintenance to ease their understanding of the technology and help them use biogas efficiently.

4.6 CONSTRUCTION, OPERATION AND MAINTENANCE OF BIODIGESTER

- **Reasons for Installing Biogas Plant:** Shortage of firewood (92.1%) in *Teraí* and easy cooking (88.9%) in hill are the major reasons for the installation of plant. Other reasons are smokeless kitchen (81%), time saving (77%) and provision of subsidy (22%).
- **Gas Production:** 96.2% plants were found producing gas. Of the total respondents, 86% reported that their plants have not failed to produce gas in the past. Of these 65% reported halt in gas production up to 7 days only. However, those reporting gas failure cited that failure of appliances in kitchen (59%) followed by civil structure damage (14%) and no feeding (8%) are the major reasons. 48 % of the sample households felt that increased feeding is the only way to increase gas production in case of insufficiency while 23% said it could be done by connecting latrines to the plant.
- **Plant Feeding:** In both the ecological belts daily feeding is the most popular practice. However, daily feeding is more popular among *Teraí* households (88.6%) than hill households (61.3%) where substantial percentage of households (18.7%) follow alternate day feeding practice. 56.1% users feed all the available dung into plant. 59% in hill and 97% in *Teraí* stated gas sufficiency as major reason for not feeding all available dung to the plant. Besides cow dung, about 45% of the sampled households use human excreta by connecting latrine to biogas plant.

- **Water Requirement:** About 62 liters of water is additionally required per household after the installation of biogas plant with additional 46 litres in *Terai* than in hill. Out of this, 50 % is used for plant feeding while 37 % is used for livestock and rest is used for other household purposes.
- **Level of Satisfaction with Biogas Plant:** Among 3 years old plant in the hill about 52 % reported to be fully satisfied while about 44% reported as satisfied, while in *Terai* 54 % were fully satisfied and about 42 % were satisfied. In hill in case of 3-6 yrs and more than 6 yrs plants, more than 58% of the respondents reported full satisfaction and only 3.6% households on an average expressed dissatisfaction. In *Terai* about 70 % of the respondents among 3-6 years old plants and 48% of the respondents among more than 6 years old plants reported full satisfaction. The reasons for satisfaction were stated as smokeless cooking (86%), and easy and fast dish washing (84.7%) followed by fast cooking (82.5%). While for dissatisfaction, the major reasons cited were gas insufficiency followed by less tasty food and frequent failure of appliances. Regarding other reasons for dissatisfaction 82.7% said difficulty in company dealings.
- **Level of Satisfaction with Biogas Lamp:** No household in *Terai* and only 8 households in hill out of total 56 respondents expressed satisfaction with biogas lamp use. The reasons for prevailing dissatisfactions are the frequent breakage of glass and mantle.
- **Failure of Biogas Appliances:** Households reporting failure of appliances in kitchen are higher in hill than in *Terai*. Breakdown of gas tap has been reported by maximum responding households followed by the breakdown of main valve and gas pipe. In both the ecological belts repairing appliances is done mostly by female members.
- **Gas Leakage:** 77 % of the responding households in hill and 73 % in *Terai* reported no gas leakage. Out of those reporting leakage, 63% reported leakage duration of more than 4 weeks while about 20 % reported 1-4 week and 17 % reported of less than a week. Of these in hill 30 % reported to the biogas companies and 63% got the leakage repaired by themselves. In *Terai* 66% had got the leakage repaired by company and no one took initiative to self repair the leakage.
- **Repair and Maintenance:** About 55 % of the responding households (41% in *Terai* and 64% in hill) reported repair and maintenance services not being provided by biogas companies on time while only about 17% in the hill and 41 % in *Terai* reported timely services being provided. Of those receiving timely services, 96.4 % reported receiving the service within one day. The high percentage of households complaining of not receiving R&M services is due to 62% plants already crossing the guarantee period.
- **Training Provided:** About 75 % of the respondents have reported that they have not received any training from the biogas companies as yet possibly due to following reasons: a) The companies provide training to the users during the slack season of construction (Ashad-Kartik) while enumerators visited during Jestha and it is found that 25% the sampled plants are less than a year old; b) Around 20% of the sampled plants are more than 6yrs old which is a long time with possibility of trained person getting old or married and the new member in the family may not have received training; c) splitting of the family and separation/migration of the trained member; d) the respondent may have replied in negative with the anticipation of getting training; and e) The respondent may not have knowledge about the training.

However, of those having received trainings 90.3% reported to have received it on operation of biogas plant, 57.4 % on R&M and about 40 % on health and sanitation.
- **Supervision by Biogas Companies:** The ratio of households reporting provision of the supervision service by biogas companies to those saying no provision of such services is

almost 40:60. Regarding the frequency of visit, 66% reported it done once year with only about 9% reporting two visits a year. Households reporting more frequent visits are very few. Again this is due to majority of plants having crossed the guarantee period.

- **Commitments Made by Companies:** About 18% of the sampled households stated that their biogas companies have made some commitments while constructing plant. 11.8% reported that they were committed of providing technical services as and when required, 1.4% said it was financial commitment and remaining 1% told that they committed to providing materials for construction.
- **Subsidy:** 80 % of the responding households have received subsidy while 12.9 % have not received any subsidy. In the hills 95 % of the respondents have received subsidy while only 52% in Terai reported to have received subsidy. The high number of households in *Terai* complaining of not receiving subsidy are particularly women headed and so-called low caste groups' households from Saptari and Sarlahi. This is largely due to their ignorance and unawareness about the subsidy provided.

4.7 BIOGAS COMPANY'S VIEWPOINTS ABOUT BIOGAS USERS

- **Biogas Companies Interviewed:** A total of 30 Biogas Companies located in the 14 districts were interviewed. Rastriya Gobar Gas Company, Kathmandu branch and another Company in Ramechhap district are looking after the biogas installation and promotional activities in Dolakha districts, where none of the companies were found to have office.
- **Criteria for Choosing the Working Areas:** Number of cattle/livestock in the households, road and transportation facility, local availability of construction materials and area of potential biogas users seemed to be the major criteria for selecting the working areas.
- **Other Organizations Involved In Biogas Programme at Local Level:** In most of the surveyed districts local branch offices of Biogas Companies were found to be operating. Amazingly, the remotest district like Bajhang has a Biogas Company, which has signed agreement with District Cooperative Office to work together in the field of biogas. Many districts except Syangja and Pyuthan are reported to have a number of other organizations involved in biogas promotion activities.
- **Types of Services Provided by Companies:** Based on the agreement with BSP-Nepal, the biogas companies provide following services within three years of plant installation to the users. The types of services provided include: counseling the potential users; R&M services and free of cost replacement of spare parts; annual supervision; training to users on the operation, R&M of biogas plants; training to user farmers on slurry management; after sales services to the clients; and facilitating the loan process for biogas plant for farmers.
- **Routine and Request Visit of Company to Supervise Installed Plants:** 37 % of the companies interviewed said that they make routine visits more than three times a year, followed by 23% visiting thrice annually, 23% mostly in the Eastern and Central Development Regions twice a year and the remaining 13% visit only once a year.
- **Major Technical Problems Encountered:** Leakage of gas from tap and pipe, blockage of gas, problem in gas tap, problem in gas burner, leakage in pipe, blockage in pipe due to slurry, damage in water drain washer, low gas production in winter, problem in slurry mixer, blockage in toilet, blockage in inlet pipe, breakage in rubber hose pipe and breakage in lamp glass and mantle are some of the major technical problems encountered by the companies.

- **Suggestions to Improving Performance of Plant** : When asked for suggestions to improve the performance of biogas plant, they said that there should be provision of skilled technicians, regular monitoring and spot checking, location specific plant size and model; refresher trainings to company staff at all level and users training to both old and new users. Also they opined that BSP-N should check that companies follow code of conducts. Besides, it is essential to create awareness among users and make them understand and encourage on the use of urine, need to cover dome with mulch/composting, oiling gas tap fortnightly, daily feeding plant as per requirement.
- **Status of Institutional Capacity of Companies:** 50% companies stated that their capacity has increased, 27% stated their decreased capacity and 23% said that it remained same.
- **Companies' Viewpoint About Subsidy:** According to them subsidy is very essential to promote biogas among the people from lower socio-economic strata and hence it should continue, in fact even be increased according to market price and its disbursement process be made easy and timely.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusion

- From socio-economic point of view biogas program is found to be inclusive, time saving, cost intensive, reachable to poor due to provision of additional subsidy for these sections and helpful in upgrading the overall socio-economic status of the users by increasing their literacy status, information and knowledge base and revenue through involvement in income generating activities utilizing the time saved thereafter.
- From agricultural perspective, slurry compost which is very rich in nutrient content, is slowly replacing FYM and hence use of organic manures is in increasing trend among the biogas users. This trend is positive for the sustainable agriculture. Also the installation of biogas plant has positive impact on animal husbandry as evidenced by majority of users adopting stall feeding practices and managing the shed very well by improving the shed floors and constructing concrete floors for the cattle shed.
- Biogas is an environmentally sustainable technology which uses locally available resources for the production of renewable form of energy. It has significantly helped reduce fuel wood and kerosene consumption thereby reducing the indoor air pollution and GHGs emission. Besides, biogas has also benefited the country through carbon trade in international market by contributing in global carbon emission reduction.
- The level of awareness among people regarding the significance of health, hygiene and sanitation in and around their household has increased remarkably. Biogas has had a positive impact especially on the health of women, who are the prime beneficiaries and children by providing them with clean fuel, thus indirectly contributing to upgrading their socio-economic status.
- The biogas technology has benefited rural women, especially in reducing their work burden of household chores, improving their health and saving their time. Women are able to utilize this saved time in information collection, income generation, social work and other community related activities after the use of biogas. However, the scenario of women's equity and empowerment is bleak with no sole ownership over property and resources and no role to play in household decision-making.

- From the findings, it can be concluded that the shortage of firewood seems to be the main reason for installing biogas. Users of biogas plants are satisfied with the plant operation. The reasons for the satisfaction are smokeless kitchen, efficiency in cooking and washing utensils, saving fuel wood and tasty food. Biogas for lighting is not very popular among the users and those using it are less satisfied. Appliances failure in the kitchen seems to be major technical problem faced by the users and needs to be paid attention to.

Recommendations

In addition to the previous year's recommendations, some of which are yet to be implemented, the Consultant has made following additional recommendations based on this year's findings and experience:

- 1) BSP-N should make an annual agreement on the quality of the appliances with the companies on a mandatory basis.
- 2) BSP-N should conduct information dissemination programs about subsidy to the farmers so that they become aware of this provision.
- 3) It is found that farmers are still unaware of impact of slurry on the incidence of pest and crop diseases, hence an assessment and demonstration on the above should be conducted.
- 4) Cattle urine utilization in gas production should be included in the biogas users training as it increases the gas production as well as the nutrient content of bio-slurry.
- 5) The selection of biogas companies by AEPC/BSP-N should follow a strict procedure to avoid/minimize the entry of fraudulent companies to the extent possible.
- 6) While making supervision visits and visits upon request, the checking of kitchen appliances particularly, the rubber hose, burner and stop cork by the company personnel must be made compulsory.
- 7) The masons and technicians of the companies should be given refresher trainings.
- 8) A separate R&D on the assessment of plant life and its performance is deemed essential.
- 9) The findings show that the companies are lagging behind a little bit in terms of supervision of the installed plants even during the guarantee period. Hence, timely supervision and follow up of the installed biogas plants during and after guarantee period should be encouraged.
- 10) A focused technical study is warranted after the interaction with the users in order to calculate the accurate efficiency of the biogas and other technical aspects of it.
- 11) For effective promotion and sustainable use and management of slurry, BSP-N should collaborate with the Directorate of Soil Management of the Department of Agriculture (DOA) and its Sustainable Soil Management Project (SSMP).
- 12) This study is conducted each year and recommendations are made. Hence, AEPC should document the recommendations that are implemented and also mention it in the TOR so as to ease the job of the consultants.

1.1 INTRODUCTION

With the vision of preventing serious threats to human and social capital like health hazards, depletion of forest resources, environmental degradation and reduced agricultural productivity, biogas technology was introduced in the year 1955. This initiative however got impetus only after 1975 declared as 'Agriculture Year' by the then His Majesty's Government. The Biogas Support Program (BSP) was then established in 1992 with the assistance from the Government of the Netherlands and this further geared up the momentum. Later, in 1996 Alternative Energy Promotion Center (AEPC) was established principally with the objective of disseminating and promoting Renewable Energy Technology (RET) like Micro Hydropower (MH), 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 the 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 BSP-Nepal. Various government and non-government organizations (GO/NGOs), namely GON, KfW and SNV/N have put concerted efforts in the establishment and promotion of biogas in the country and from the latest data (as of December 2006) it is recorded a total of 157,675 biogas plants have been installed in 67 districts & around 2,665 Village Development Committees (VDC) out of 3,913 VDCs of the country.

Nepal has a huge potential of biogas plants installation¹. 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 only about 8.06 percent of the potential have been exploited so far². Currently, the fourth phase (July 2003-June 2009) of Biogas Support Program (BSP) which is almost half way is being implemented by Biogas Sector Partnership Nepal (BSP-N) in partnership with AEPC, SNV and KfW as well as private sector represented by Nepal Biogas Promotion Group (NBPG)³. It is targeted to install 200,000 biogas plants during this phase as also targeted by the GoN's Tenth Plan.

The registration of Biogas Program under Clean Development Mechanism (CDM) has been looked upon as a significant source of revenue generation for Nepal under Carbon Emission Trade. Besides this, materialization of CDM projects for biogas provides opportunities for further promotion of this technology and poses new challenges to BSP to maintain stringent quality assurance and monitoring.

The benefits of Biogas Program can be broadly divided into the five major categories:

- Agricultural benefit
- Gender benefit
- Environmental benefit
- Health benefit
- Socio-economic benefit

A successful biogas program ensures all the above mentioned benefits to its users thus helping considerably in their socio-economic upliftment. However, for measuring the success of a program, besides the quantitative indicator like the number of biogas plants installed, it is also essential to evaluate the qualitative achievements. The real indicators for the latter are the efficiency of operation of the installed

¹ Updated information as per BSP-Nepal

² BSP 2006, May 2006

³ BSP 2006, May 2006

plants, the direct and indirect benefits enjoyed by the users and the extent to which these benefits are derived by the beneficiaries. It is therefore very important to monitor the program on a regular basis in order to assess the functioning of installed plants; achievement of the expected benefits by the users; satisfaction level of the users with the program; the kinds of problems and constraints faced by the users; and the possible mitigating options.

Hence, the Biogas Users' Survey 2006/07 is intended to provide birds' eye view into the program implementation and measure its success in terms of both qualitative and quantitative achievements thus providing a significant input for improvising the program in future, as required.

1.2 SURVEY LOCATION

The location for the survey comprised of fifteen districts distributed in different ecological regions (*Terai*, hills and remote hills). The sample districts randomly selected for the survey are from five development regions –three districts from Eastern Region, six districts from Central Region, three districts from Western Region, two districts from Mid Western Region and one district from Far Western Region. Of these districts, 10 districts are from hill and remaining 5 from *Terai*. It is understood that the sample districts were finalized in consultation with AEPC and BSP-N officials.

1.3 OBJECTIVES

General Objective

In general, the objective of the Biogas Users' Survey is to make a comprehensive assessment of the impacts of the installed biogas plants on energy, health & sanitation and agricultural systems as well as socio-economic, environmental and gender concerns. Besides the local impacts of biogas, this survey is also expected to provide information to evaluate the global environmental impacts of biogas plants in the context of CDM.

Specific Objectives

The specific objectives include the assessment and analysis of the impacts of biogas on the following aspects:

Impact on health and sanitation:

Indoor air pollution and smoke exposure are the two major problems of the rural Nepalese people, especially women and children, as they are the major causative factors of Acute Respiratory Infections (ARI) and other physiological disorders. Since biogas reduces exposure to smoke and significantly improves air quality inside kitchen it will definitely bring about positive health impacts. Also owing to the fact that biogas plant owners usually choose to construct toilets, the sanitation in and around the household will improve. This survey focused on the following health related issues:

- status of toilets, toilets used and toilet attached biogas plant
- exposure to indoor air pollution and reduction of smoke in the kitchen after biogas installation
- incidence of respiratory and eye infection
- incidence of gastro-intestinal diseases
- mosquito induced diseases and nuisance
- accidents due to fire/burning, general physical condition (stress, free time, time for feeding etc) among women, men and children

Impact on socio-economic conditions:

As biogas reduces fuel expenses for cooking and lighting and also saves significant time spent in collecting fuel wood (which is getting even scarcer these days), this has economic and social implications. Following issues having socio-economic implications are focused in the survey:

- Time and money saved after biogas installation on different household activities
- Use of the saved time in different income generating activities
- Changes in income and access to the natural resources and basic utility services
- Changes in agriculture production
- Use of modern facilities like electricity, transportation, communication etc.
- Employment generation
- Assessment of economic status of biogas plant owners
- Assessment of social inclusion in the context of access to biogas by Dalits and disadvantaged people.
- Financing source for biogas plants installation
- Expenditure on fuel wood purchase and repair and maintenance of biogas plant
- Educational status of the biogas user households.

Information on biogas plants:

Following biogas plant related information was assessed:

- Instruction on operation as provided by the biogas company
- Operation and maintenance of the biogas plant including trainings
- After-sale-services provided by the companies
- Plant operation rate, problem and maintenance cost
- Major problems faced by the farmers
- Dung availability per day and burning hours of biogas stove
- Functioning biogas plant with respect to their age
- Plants financed by banks or cash
- Constraints and comforts in dealing with banks or financial institutions
- Other organizations supporting biogas (through toilet construction or other means)

Users' satisfaction and perception:

Perceptions of the biogas users with regards to the following relevant issues were assessed:

- Awareness level, requirements and suggestions for possible improvement
- Operation and Maintenance training received by them
- Means of communication on biogas
- Satisfaction/ dissatisfaction level with biogas and the company
- Sources of information
- Repair and maintenance
- Family member responsible for contacting the construction company
- Time and types of services provided by the company

Impact on gender:

Since biogas provides direct benefit to rural women especially, as a result of the reduction of workload, following gender related issues were assessed:

- Access to and ownership of resources like land, cattle etc
- Women's participation in decision making process
- Construction, operation, maintenance and management of biogas plant
- Ability of women to contact the construction company for services/repairs
- Technical know-how of either men or women
- Benefits derived by women and children from the installation of biogas plant
- Health and workload change before and after biogas installation
- Changes in time for study
- Income generation and productive work
- Women's involvement in social works
- Time involvement of women vis-à-vis men in household chores like cooking, feeding, fuel wood collection and operation of biogas plant

Impact on agriculture:

Livestock is one of the major and inherent components of Nepalese farming system because besides being a major source of income, it also provides manure for agricultural land to enhance and sustain crop productivity. Livestock being the prime source of raw material for biogas and since the digested slurry is considered a high quality manure, impacts of biogas on two major components of the Nepalese farming systems, viz. livestock and crop, were assessed with due focus given on the following major issues:

- Cattle (livestock) population, grazing method (openly grazed /stall fed), shed management, animal health, fodder management etc
- Changes in the above practices after the installation of biogas
- Quantity of dung produced each day and its utilization in the biogas (loading rate), dung patties for burning purposes and manure for composting purpose
- Changes in the composting practices such as piling up the manure, turning for aeration, pit depth and duration of storage in the pit
- Slurry use pattern and their effectiveness on crop growth, soil fertility and crop productivity and ultimately the farm income

Impact on energy, emission reduction and environment:

Biogas reduces the pressure on forests and alleviates deforestation as biogas plant is considered to save more than two tons of fuel wood per annum. The digested slurry is an excellent source of bio- fertilizer that can significantly improve soil fertility and crop productivity. Besides, biogas can significantly reduce the level of Green House Gases (GHGs) emission in the environment. While assessing the energy and environmental benefit, following issues were given primary attention:

- Household daily utilization of fire wood (quantity saving of firewood), agriculture residues, animal dung, kerosene, LPG for cooking and type of stoves
- Changes in the above practices after the installation of biogas
- Construction materials (stones/bricks) used for biogas plant
- Daily gas production and consumption
- Local (household) environmental condition before and after the installation of biogas and its impact on global environment

1.4 EXPECTED OUTPUT

The primary output from the survey of user households is to provide comprehensive information on the following:

- Information on environment impact like change in the use pattern of energy sources for cooking and lighting; types of stoves used; state of use of firewood and smoke in the kitchen, etc.
- Impacts on gender like ownership of land and other resources; women's participation in decision making; women's role in biogas plant operation, repair & maintenance and its overall management; slurry use and composting, use of women labor in construction work; benefit derived by women and children from biogas establishment as a result of saved time; change in health status; work load; their involvement in income generating activities, productive works and in social/community organizations/activities; change in cooking behavior; easiness and difficulties faced by female members in the users HH after biogas installation; and overall change observed by women in their own social status; and their satisfaction level with the biogas plant and the derived benefits, etc.
- Impact on the status of health of the biogas user household members like respiratory and eye infection; gastro-intestinal disease; mosquito induced disease; general physical condition; fire-related accidents; headache resulting from hydrogen sulphide gas, etc.
- Impact on sanitation such as status of toilet, its attachment with the biogas plant; reasons for not constructing/attaching toilet, etc.
- Impact due to the use of biogas on socio-economic conditions like time and money saving; change in social status; rise in income level; use of saved time in income generating/productive activities; change in control and access to the natural resources; use of modern technologies; change in educational status of household members, etc.
- Information on biogas plant like investment; subsidy; state of gas production; plant feeding; amount of gas used for cooking and lighting; its adequacy; satisfaction with the gas production and benefits derived; operation instruction provided by company; operation and maintenance including training; after-sales service provided; plant operation rate; problem with plant, etc.
- Information on user's perception like awareness; operation and maintenance training received; user's satisfaction/dissatisfaction; user's requirement and possible suggestions for improvements; repair services sought; availability of services on time, etc.
- Change in agriculture input like slurry use pattern and its effect in crop production; soil fertility; water retention capacity; incident of pest/disease in crops due to slurry use; cattle shed improvement; cattle population; feeding; dung availability; manure handling; manure and fertilizer use practice, etc.

1.5 METHODOLOGY

It is very well understood by the CT that for successful implementation and delivery of realistic output from the proposed survey, a rigorous review of literature is mandatory, which has also been pointed out by the TOR. Hence, clearly understanding the objective of this study, an intensive literature review of previous studies and surveys conducted by different organizations and researches on the use and impacts of biogas was carried out. The outcome of the desk study was formulation of strategic tools/methods for the entire study.

Following activities besides literature review were undertaken during the desk study phase:

- Preparation of draft questionnaire for household survey and checklists for key informant interview and observation sheets.

- Consultations and discussions with the concerned AEPC and BSP-N personnel regarding improvisations on the draft questionnaires, checklists and finalization of the survey districts.
- Planning for questionnaire and checklists, conduction of training to the field staff, pre-testing and subsequent field work.

During the preparation of the data collection tools it was ensured by the CT that the questionnaires, checklists and observation sheets incorporated all possible socio-cultural-economic and technological aspects pertaining to the use of biogas. While designing the questionnaire and checklist, the recommendations made in the previous year's survey were also taken into consideration.

1.5.1 Selection of Survey Samples

Samples for the survey were given by BSP-Nepal on the basis of Alternative Random Sampling method prepared by BSP-N itself. Completely randomized samples were selected using the ORACLE software with the existing database in BSP-N. A four tier system was followed in which cluster-wise distribution, district-wise distribution, list of sampled VDC with no. of plants and detail list of sample plants were generated in four steps. First of all, Nepal as a whole was divided into 15 clusters on the basis of three Ecological Regions and five Development Regions. Cluster-wise distribution of plant was then generated by defining plant construction period.

As a result of this sampling method, the following districts were selected from the five Development Regions.

Table 1-1: List of Sample Districts and Plants for Biogas Users' Survey 2006/2007

Development Region	Sample Districts	Sample Plants
Eastern Development Region - Terai	Jhapa and Saptari	62
Eastern Development Region – Remote Hill	Sankhuwasabha	65
Central Development Region - Terai	Sarlahi and Rautahat	73
Central Development Region - Hill	Dolakha, Lalitpur, Bhaktapur, Nuwakot	124
Western Development Region- Hill	Syangja, Tanahun, Kaski	100
Mid-western Development Region - Terai	Bardia	50
Mid-western Development Region- Hill	Pyuthan	50
Far western Development Region – Remote Hill	Bajhang	13
Total		537

The samples given also include considerable numbers of plants that have already crossed the guarantee period of three years. The age of the plants is given in **Table 1-2** hereunder:

Table 1-2: Year of Biogas Installation by District

District	Before 2055		2055-2057		2057-2060		2060-2062		After 2062		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Dolakha	2	13.3	1	6.7	11	73.3	1	6.7	0	0	15	100
Bajhang	1	8.3	0	0	0	0	0	0	11	91.7	12	100
Syangja	1	7.1	6	42.9	4	28.6	3	21.4	0	0	14	100
Bhaktpur	0	0	0	0	2	22.2	5	55.6	2	22.2	9	100
Lalitpur	0	0	0	0	13	44.8	6	20.7	10	34.5	29	100

Tanahu	1	2.4	9	22	11	26.8	14	34.1	6	14.6	41	100
Sankhuwasabha	0	0	1	1.7	7	11.7	18	30	34	56.7	60	100
Nuwakot	1	1.5	14	20.9	32	47.8	10	14.9	10	14.9	67	100
Kaski	3	8.1	9	24.3	9	24.3	9	24.3	7	18.9	37	100
Pyuthan	2	4.2	13	27.1	17	35.4	10	20.8	6	12.5	48	100
Hill	11	3.31	53	15.96	106	31.93	76	22.89	86	25.9	332	100
Jhapa	4	8.5	9	19.1	9	19.1	9	19.1	16	34	47	100
Bardiya	0	0	11	23.4	8	17	16	34	12	25.5	47	100
Saptari	1	6.7	5	33.3	8	53.3	1	6.7	0	0	15	100
Sarlahi	1	1.4	8	11.6	27	39.1	21	30.4	12	17.4	69	100
Tarai	6	3.37	33	18.54	52	29.21	47	26.4	40	22.47	178	100
Total	17	3.3	86	16.9	158	31	123	24.1	126	24.7	510	100

1.5.2 Pre-testing of Questionnaire/Checklists and Field Training

Before the finalization of the data collection tools, an intensive three days training program was organized for the field survey team from 6-8 May '07. During this exercise, on the first day, orientation to the enumerators regarding the survey objectives and methodology and the questions regarding each sections was given. Each section of the questionnaire and the checklist were discussed thoroughly ensuring that the enumerators understood them clearly and administered them in the field efficiently and effectively to meet with the objectives of the survey. As a part of training, on the second day, the questionnaire was pre-tested in Ramkot VDC by the field survey team under the supervision of CT. Also Deurali Biogas Company was contacted for the Key Informant Interview. Based on the experience and feedback from this pre-testing, on the last day of the training, necessary amendments were made in the questionnaire and checklist which were then finalized in agreement with AEPC/BSP-N.

1.5.3 Team Allocation and Mobilization to the Field

The field survey team which had a total of 12 enumerators was allocated for 15 sampled districts to undertake field survey. The team was provided with itineraries which included detailed information about their destination, contact person/address and assigned work, etc. The CT visited Kaski district as a part of field supervision of the survey team.

The itinerary of the field survey team is given in **Annex I**.

1.5.4 Primary Data Collection

Besides secondary information, the primary data required for this survey was collected from the field by administering the structured and pre-coded questionnaires among the biogas user households from the samples. The perceptions of the Biogas companies were sought through the Key Informants' Interview using the checklist.

a. Household Survey with Structured Questionnaire

As guided by the TOR, household level information was collected from the 510 biogas user households by administering structured and pre-coded questionnaire. Besides general information, the questionnaire sought information on socio-economic aspects, land and livestock holdings, farming systems, production and productivity of each of the components, information on the functioning, efficiency and gas output of the biogas plant, gas utilization pattern, construction, repair and maintenance, users' perception about the biogas plant and gas utilization, general health and sanitation aspects, impact on environment, use of manures and fertilizers, use of organic residues, slurry and compost manure, investment on plant, functioning of plant, plant feeding and different questions pertaining to the gender aspects. The household

questionnaire also sought and recorded information on the pre and post installation situation regarding each of the above mentioned aspects. The information thus collected facilitated to give a clear picture of the impact of the biogas installation on major components of households and livelihood. The language of the questionnaire was in simple Nepali.

b. Key Informant Interview

The checklist developed during the desk study was used to interview key informants from the biogas companies. From this exercise, information regarding the criteria for choosing the working areas, types of services provided by the companies, no. and types of trainings provided, supervision role and frequency, common problems faced by the users, their own perception on the capabilities of the company, suggestions for improving the performances of the plant, the problems and constraints faced by them and the steps taken to solve those problems were sought.

The CT put special effort during the field work to ensure the quality of data collected.

The questionnaires and checklists are given in **Annex II**.

1.5.5 Data Analysis and Interpretation and Report Preparation

Data obtained from the field were scrutinized thoroughly, processed and tabulated using Access software. The data were analyzed using the Fox-pro software after which they were interpreted by the respective team members of the Consulting Team. These data and their interpretations were then compiled and draft final report was prepared.

It should be noted that a list of 561 households were given to the field survey team. However, due to several reasons data from only 510 (1 household from Rautahat) households were analyzed and interpreted. To elaborate on this, of the 50 samples not included in this process, 25 were from Bhojpur, which is the sixteenth district (for which a separate report shall be submitted), 5 plants could not be found in the specified VDCs⁴, 2 houses were found locked and the remaining 20 plants had closed down due to several reasons some of which include:

- People from the company did not come for repair and maintenance despite several notifications.
- Incomplete construction of plant
- Migration of household members
- Company did not give instructions on plant operation after installation
- Opened hotel and hence gas not in use.

The draft final report was presented among the stakeholders in a consultative workshop organized at the BSP-N hall on 2nd August, 2007 and the comments and suggestions thus obtained were incorporated to the extent possible in the final report. The list of participants in the consultative workshop is given in **Annex III**.

⁴ These plants have been located and verified by the BSP-N field officials. The evidence documents provided is attached in **Annex IV**.

1.6 ORGANIZATION OF THE REPORT

The findings of the survey have been organized into nine Chapters altogether. The first chapter gives the introduction of the survey and its objectives and discusses the methodology adopted for this survey. The socio-economic impact of biogas is given in the second chapter. The third chapter deals with the findings on the agriculture and land use pattern and the fourth chapter with the issues relating to environment and energy. In the fifth and sixth chapters, impact of biogas on health & sanitation and gender related issues are discussed, respectively. Chapter seven assesses the construction, operation and maintenance aspects while also measuring the satisfaction level of the beneficiaries. In chapter eight, the perception of the Biogas companies is presented. The ninth and the last chapter discuss the conclusion and possible recommendations as derived from the survey findings.

Chapter 2

SOCIO-ECONOMIC IMPACT

The installation and use of biogas plant can be correlated with various socio-economic impacts because it has various beneficial aspects to it. Firstly, biogas cuts off expenditure on fuel purchase; secondly, it protects the family members from several health hazards associated with the use of other fossil fuels thereby reducing the expenses on medicine and treatments; thirdly, it enhances the productivity of agriculture produce; and last but not the least, it saves significant time of women and other family members thereby providing time for various other self-developmental activities including income generating activities. Due to these beneficial consequences biogas installation is expected to give an economic boost to the user family thereby upgrading their social status as well.

Hence, this chapter attempts to analyze the socio-economic status of the biogas users in order to assess the affordability and access to biogas, simultaneously analyzing the impact of biogas on their socio-economic conditions. The socio-economic impacts of biogas both at local and national context can be assessed through the analysis of manifold variables which comprise of information on the economic condition and social status of the users. Different indicators and parameters developed for this purpose during the desk study phase and administered during the field study phase have come up with some useful data which can be interpreted to define the socio-economic impact of the use of biogas on these households. The parameters selected for this purpose include: ethnic distribution, family size, level of education, occupation, size of land holding and number of cattle owned, type of house, access to electricity, possession of means of transportation and communication, time saving and its utilization, saving in fuel purchase, impact in agriculture production, investment on biogas plant, loan repayment, subsidy, etc.

2.1 ETHNIC DISTRIBUTION

2.1.1 Ethnic Distribution of Households Surveyed

Inclusion of people from different caste and ethnicity into development mainstream, especially the ones from the disadvantaged groups has been one of the prime objectives of the Tenth Plan as well as Millennium Development Goal (MDG). The caste of the households surveyed gives a glimpse of ethnic distribution of the biogas user households. In this regard, it is attempted to assess the affordability of biogas by the Dalits/disadvantaged and the marginalized households in order to evaluate the social inclusiveness of this technology.

Table 2-1: Ethnic Distribution

Unit: HHs

Ethnicity	No.
Brahmin/ Chhetri	344 (67.5)
Newar	30 (5.9)
Tharu	18 (3.5)
Rai	12 (2.4)
Magar	15 (2.9)
Kumal	12 (2.4)
Gurung	17 (3.3)

Tamang	28 (5.5)
<i>Dalit and others</i>	34 (6.7)
Total	510 (100.0)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 2-1 shows the ethnic distribution of households using biogas as an alternative source of energy. It is found that Brahmin/Chettri are the major caste groups (67.5%) followed by *Dalits and others* (6.7%), Newar (5.9%), Tamang (5.5%), Tharu (3.5%), Gurung (3.3%), Magar (2.9%), Kumal and Rai 2.4%. With 6.7% Dalits and other marginalized groups using this technology, it can be asserted that biogas program is slowly becoming inclusive. As compared to the last year's finding, there is marginal increase in the number of users from other castes including *Dalits*.

2.2 FAMILY SIZE DISTRIBUTION OF HOUSEHOLDS

2.2.1 Average Family Size of Households

The socio-economic status of a family is directly proportional to the size of the family and number of dependents in the household. This is because with more dependent members in family and less income, the economy of a household is imbalanced as consumption exceeds production and there will be no surplus to raise the economic standard of the household.

Table 2-2: Average Family Size of Households

Unit: Number

Ecological Belt	Household Number	Family Members	Average Family Size
Hill	332	2249	6.77
<i>Terai</i>	178	1194	6.71
Total/ Overall	510	3443	6.75

Table 2-2 illustrates the average family size of the biogas user households which is 6.75. On an average the size of the family in *Terai* is 6.77 and in hill is 6.71. Though the average family size in *Terai* is higher than in the hill, the difference is insignificant.

2.3 LITERACY AND EDUCATIONAL STATUS

2.3.1 Educational Level of Household Members

The educational status of the family members in a household is an important indicator for determining high or low socio-economic status. The level of education has more or less direct impact on the social status and economic well-being of a family. If socio-economic status is good, access to education is easy and vice-versa. With education, people gain knowledge and information and can generate revenue. An educated household has more chances of seeking information on biogas and thinking on using this technology. While on the other hand use of biogas is also expected to make the households economically better-off thereby easing the access to education for their family members.

Table 2-3: Education Level of Household Members

Unit: HHs

Education level	Hill			Terai			Both		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Illiterate	52 (3.2)	186 (11.6)	238 (14.8)	20 (2.5)	93 (11.8)	113 (14.3)	72 (3.0)	279 (11.6)	351 (14.6)
Literate (Class 1-5)	88 (5.5)	153 (9.5)	241 (15.0)	50 (6.3)	89 (11.3)	139 (17.6)	138 (5.8)	242 (10.1)	380 (15.9)
Class 6 – 10	181 (11.3)	177 (11.0)	358 (22.3)	72 (9.1)	78 (9.9)	150 (19.0)	253 (10.6)	255 (10.6)	508 (21.2)
SLC	320 (19.9)	224 (14.0)	544 (33.9)	127 (16.1)	108 (13.7)	235 (29.7)	447 (18.7)	332 (13.9)	779 (32.5)
Above SLC	144 (9.0)	80 (5.0)	224 (14.0)	81 (10.2)	73 (9.2)	154 (19.5)	225 (9.4)	153 (6.4)	378 (15.8)
Total	785 (48.9)	820 (51.1)	1605 (100.0)	350 (44.2)	441 (55.8)	791 (100.0)	1135 (47.4)	1261 (52.6)	2396 (100.0)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 2-3 illustrates the educational status of the biogas user household members. Going through the ecological belts, only a minor difference is observed in the hill and *Terai* with 14.8% illiterate households in hill and 14.3% in *Terai* which concurs with the BUS 2006 findings. Gender-wise female illiteracy is much higher compared to male in both the ecological belts. The table also shows that the percentage of primary and secondary level education is high among female than male with 20.5% female in hill and 21.2% in *Terai* compared to that of male which is 16.8% and 15.4% in hill and *Terai*, respectively. Again contrary to this, the percentage of females in grade 6-10 shows decreasing trend than the males in hill while its more in case of *Terai* thus forming the basis to infer that there is significant school drop out among females in hill which could probably be due to high work load and low economic status of people in hill than in *Terai*. With the highest percentage (32.5%) of household members having done SLC, it can be deduced that biogas must have enhanced the socio-economic status of the user household enabling them to afford fees for higher education after the primary level which is free of costs.

2.4 OCCUPATIONAL DISTRIBUTION OF HOUSEHOLDS

2.4.1 Major Occupation of Household Head

Nepal being predominantly an agrarian country, it is obvious that agriculture is the primary occupation of people, especially in the rural context. The data on the major occupation of the household head as obtained from the survey is given in **Table 2-4** hereunder.

Table 2-4: Major Occupation of Household Head

Unit: HHs

Occupation	Ecological Belts		
	Hill	Terai	Total
Agriculture	239 (72.0)	162 (91.0)	401 (78.6)
Business	15 (4.5)	3 (1.7)	18 (3.5)
Service	72 (21.7)	10 (5.6)	82 (16.1)
Industry	2 (0.6)	0 (0.0)	2 (0.4)
Others	4 (1.2)	3 (1.7)	7 (1.4)
Total	332 (100.0)	178 (100.0)	510 (100.0)

The above figures without and within the parenthesis show the number of respondents and percentage

The majority of households (78.6%) are involved in agriculture with still more percentage from *Terai* (91%) than from hill (72%) due to the hill topography and soil condition. Besides agriculture, 16.1% are involved

in service again more from the hill (21.7%) than from *Terai* (5.6%). This is followed by business (3.5%), others mostly overseas employment (1.4%) and industry (0.4%). However, comparing with the BUS 2006 findings, where the major occupations were only concentrated on agriculture and service, this year it has diversified to others like business, service, industry and foreign employment as well.

2.5 TYPES OF HOUSE AND ACCESS TO ELECTRIC GRID

2.5.1 Types of House

Although, types of houses differ across the ecological belts, it can be taken as a significant variable that hints on the economic status of a household. **Table 2-5** illustrates types of houses in the sample households taken as an indicator of their socio-economic status.

Table 2-5: Types of House

Unit: HHs

Types of House	Ecological Belt		
	Hill	<i>Terai</i>	Total
Thatched Roof	30 (8.0)	6 (3.3)	36 (6.2)
Corrugated Sheets	188 (50.1)	50 (27.5)	238 (41.2)
Tile/Slated Roof	82 (21.9)	68 (37.4)	150 (26.0)
Mixed	10 (2.7)	4 (2.2)	14 (2.4)
Other including RCC/RBC Roof	34 (9.1)	51 (28.0)	85 (14.7)
Total	344 (91.7)	179 (98.4)	523 (90.6)

The above figures without and within the parenthesis show the number of respondents and percentage

It is observed that a large percentage (41.2%) of sample households have corrugated sheets, 26% have tile/slatted roof, 14.7% have RCC/RBC roof, 6.2% have thatched roof and 2.4% have mixed. More households in hill (50.1%) have corrugated sheets compared to *Terai* (27.5%) while more *Terai* households have tile/slatted roof (37.4%) than hill households (21.9%) which can be attributed to the adaptation to different climatic conditions in these two ecological belts. Houses with thatched roof are more in hill (8%) than in *Terai* (3.3%) indicating more poverty in hill than in *Terai*. However, with very less houses having thatched roof in total, it can be inferred that either the program is yet to reach out to the economically weaker section of the communities or the use of biogas has uplifted the poor from their lower economic status. Compared to the last year with 9.1% houses with thatched roof, this year there is slight decrease in the number.

2.5.2 Access to Electricity

Access of households to basic amenities is a positive sign of economic development and their affordability reflects upon their upgraded socio-economic status. Access to electricity directly or indirectly enhances the socio-economic status of a household because it has value added on education, health, enterprise development, micro-industry set up, use of biogas and extended working hours in the rural areas.

Table 2-6: Access to Electricity

Unit: HHs

Access to Electricity	Ecological Belts		
	Hill	<i>Terai</i>	Total
Yes	267 (80.4)	165 (92.7)	432 (84.7)

No	65 (19.6)	13 (7.3)	78 (15.3)
Total	332 (100.0)	178 (100.0)	510 (100.0)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 2-6 demonstrates the access of electricity in the sampled households. It is encouraging to find that of the total user households, 84.7% have access to electricity with *Terai* households having greater access (92.7%) than hill households (80.4%). From this difference it can be deduced that *Terai* households have better access and affordability and hence enhanced socio-economic status than hill households. Besides, due to the topographical constraints, it is difficult to make on-grid connections to the hill and hence the lower accessibility of people to electricity. While making comparison with the previous year's data, this year the number of households having electricity is more and those not having is less.

2.6 AVAILABILITY OF MEANS OF TRANSPORTATION AND COMMUNICATION

2.6.1 Possession of Means of Transportation

The possession of transportation means by the user households is also taken as a parameter for assessing the socio-economic status. Owning a means of transportation means better mobility of the family members and consequently their better economic status. However, the possession of transportation means also depends on the access of the area to road. The possession of means of transportation among the sampled households is given in **Table 2-7**.

Table 2-7: Possession of Means of Transportation

Unit: HHs

Transportation Means	Ecological Belts		
	Hill	<i>Terai</i>	Total
None	260 (78.3)	8 (4.5)	268 (52.5)
Cycle	33 (9.9)	164 (92.1)	197 (38.6)
Motorcycle/scooter	27 (8.1)	24 (13.5)	51 (10.0)
Wheel cart	7 (2.1)	28 (15.7)	35 (6.9)
Other (Specify)	5 (1.5)	1 (0.6)	6 (1.2)
Total	332	225	557

The above figures without and within the parenthesis show the number of respondents and percentage

Majority of the biogas users in hill (78.3%) do not possess any means of transportation which can be attributed basically to less facility of road infrastructures in the hill as compared to *Terai*. This finding is concurrent with the finding of the previous year. Of those who have some means of transportation, 9.9% have cycle, 8.1% motorcycle, 2.1% wheel cart and 1.5% others. While in case of *Terai*, cycle is predominantly the most popular as well as affordable means of transportation possessed by 92.1% households followed by wheel cart (15.7%), motorcycle/scooter (13.5%) and others (0.6%). It can be inferred from this data that due to access to road and greater affordability, *Terai* households usually have some means of transportation than those in the hill.

2.6.2 Possession of Means of Communication

Possession of means of communication can be used to assess the socio-economic status of a household. These technological devices are effective and essential sources of information dissemination and communication.

Table 2-8: Possession of Means of Communication

Unit: HHs

Media	Ecological Belts		
	Hill	Terai	Total
None	17 (4.8)	4 (2.2)	21 (3.9)
Radio	311 (88.6)	170 (93.4)	481 (90.2)
Television	211 (60.1)	160 (87.9)	371 (69.6)
Mobile phone	98 (27.9)	36 (19.8)	134 (25.1)
Other	2 (0.6)	0 (0.0)	2 (0.4)
Total/Overall	639	370	1009

The above figures without and within the parenthesis show the number of respondents and percentage

Table 2-8 depicts the possession of means of communication among the sampled households. Amazingly, 96.1% households possess some or the other means of communication from which it can also be inferred that possibly the economic status of family enhanced after biogas installation, enabling them to possess such gadgets like television and mobile phones.

The majority of the households (90.2%) have radio, followed by television (69.6%), mobile phones (25.1%) and others (0.4%). It should be noted that compared to BUS 2006 findings, where 8.3% households in hill had no means of communication, this year it has reduced to 4.8%. Also the number of households owning television has increased from 47.9% in the previous year's finding to 69.6% this year. Regarding the possession of every means of communication except mobile phones, the *Terai* households are ahead of the hill indicating better economic position of *Terai* households compared to hill. Surprisingly, more households in hill (27.9%) possess mobile phones than *Terai* (19.8%) from which it can be inferred that due to weak transportation facility, communication facility in hill have been made more convenient and also the people in these regions find it very handy in their everyday life.

2.7 LAND HOLDING, CATTLE HOLDING, FAMILY MEMBERS AND BIOGAS PLANT SIZE

The size of land holding and the number of cattle owned are one of the prime indicators of socio-economic status of a family. More land holding and number of cattle owned indicates better socio-economic condition of a household. However, this can also be linked with the number of family members in the house. Households with significant land holding are usually found to possess more number of cattle. Also the installation and the capacity of biogas plant largely depend on the number of cattle owned because more the number of cattle greater will be the availability of feeding material for the plant.

Table 2-9: Biogas Plant, Family Member, Cattle Holding and Land Holding

Biogas Plant Size(m ³)	Family Members			Cattle Holding (Cow/Ox+Buffalo)			Land holding (Ha/hh)		
	Hill	Terai	Average	Hill	Terai	Average	Hill	Terai	Average
4	5.8	4.9	5.6	2.7	1.6	2.5	0.7	0.8	0.7
6	6.9	6.6	6.8	3.2	3.4	3.3	0.7	1.1	0.9
8	6.8	7.4	7.2	2.8	3.9	3.4	0.8	1.6	1.3
>8	15	8.5	12	3.9	4	3.9	1	1.2	1.1

Total/ Overall	6.8	6.7	6.8	3.1	3.4	3.2	0.8	1.2	0.9
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Going through the capacity of installed plant, number of family members, number of cattle and landholding, Table 2-9 demonstrates the interrelationship between the three variables. All these three variables show increasing trend with the increase in the size of the biogas plant. Households having 4m³ biogas plant have average family size of 5.6 members, 2.5 numbers of livestock and 0.7 ha land ownership. Similarly, households with 6m³, 8m³ and larger than 8m³ plant have 6.8, 7.2 and 12.0 family members, 3.3, 3.4 and 3.9 number of livestock, and 0.9, 1.3 and 1.1 ha of land, respectively. It should be noticed that the average cattle holding and land holding is less compared to the previous year's data. Also the average land holding in case of >8 m³ sized plants is less than 8 m³. From this finding it can be inferred that the prevalent trend of disintegration of joint families into nuclear ones subsequently leading to the division of land could have given rise to this situation. This is supported by the fact that the current demand is towards small sized biogas plants and hence the current subsidy policy in favour of plant sized 4 cu.m and 6 cu.m shall increase the number of biogas users while also including the ones from the lower socio-economic status.

2.8 TIME ALLOCATION

2.8.1 Time Allocation Before and After Biogas Plant Installation

One of the primary objectives of this survey is also to assess the time saved after the use of biogas. The installation of biogas is expected to save time on different activities like collecting firewood, making dung cakes, cooking and cleaning utensils, etc thereby sparing them surplus time for other activities like income generation which can make substantial contribution to their socio-economic upliftment. Table 2-10 attempts to demonstrate the difference in time allocation for different activities before and after biogas installation.

Table 2-10: Time Allocation Before and After Biogas Plant Installation

Unit: Minutes/Day

Activities	Time spent before Biogas Plant Installation			Time spent after Biogas Plant			Time Saved after Biogas Plant
	<i>Terai</i>	Hill	Both	<i>Terai</i>	Hill	Both	
Livestock Caring	150	140	146	137	115	129	17
Fetching Water	55	66	59	61	76	66	-7
Plant Feeding	0	1	0	25	28	26	-26
Firewood Collection/Dung Cake Preparation	262	324	284	169	50	127	157
Fodder Collection	84	53	73	92	49	77	-4
Cooking	143	163	150	95	81	90	60
Cleaning Utensils	55	63	58	37	31	35	23
Total							220

By calculating the difference in time allocation on varied activities of household before and after biogas installation, the total time saved by a household in a day can be estimated. It is found from the above table that substantial amount of time after installing and using biogas is saved in various activities that include livestock caring, collecting firewood/ preparing dung cake, cooking food and cleaning utensils indicating that the technology has benefited them. 17 minutes/day is saved in livestock caring, 157 minutes/day in collecting firewood/preparing dung cake, 60 mins./day in cooking and 23 min./day in cleaning utensils. Time saved in livestock caring is basically due to the practice of stall feeding. Huge amount of time is saved in firewood collection and dung cake preparation and this finding is concurrent with the saving of firewood after biogas. Also time saved in fodder collection can be attributed to the practice of growing fodder trees by users. However, there is additional time required for feeding plant, fetching water and collecting fodder. In spite of this, on an average, a household saves 220 minutes/day (3hr 40 mins.) due to biogas installation. This survey shows more time saving in comparison to the last year's survey, in which only 68 mins./day was found to be saved. Such a vast difference in time saving from previous year's finding can be attributed to better formulation and administration of questionnaire that helped to

calculate the time more accurately. Also this finding is in line with the baseline value of CDM project which is 3 hrs.

2.8.2 Use of Saved Time in Income Generating Activities after Biogas Plant Installation

The positive impact of biogas on the socio-economic status of the user households can be derived from their involvement in income generating activities utilizing the time saved thereafter. **Table 2-11** illustrates the involvement of the users in activities that earn them revenue.

Table 2-11: Use of Saved Time in Income Generating Activities after Biogas Plant Installation

Unit: Respondents in %

Income Generating Activities	Production		
	Hill	<i>Terai</i>	Total
Yes	80 (24.1)	77 (43.3)	157 (30.8)
No	252 (75.9)	101 (56.7)	353 (69.2)
Total	332 (100)	178 (100)	510 (100)

The above figures without and within the parenthesis show the number of respondents and percentage

Regarding the utilization of the time saved after the biogas installation in income generating activities, from Table 2-11 it is found that 30.8% respondents (24.1% from hill and 43.3% from *Terai*) are involved in income generating activities thus earning revenue to upgrade their living standard. The data showing less households in hill involved in income generating activities can be interpreted as less market opportunity in hill than in *Terai*.

2.9 INVESTMENT FOR BIOGAS PLANT

2.9.1 Investment for Biogas Plant

The nature of investment for the biogas plant may differ among people particularly due to their economic condition because they may not be able to install the plant investing all the cash from

their saving. Some may borrow money from local money lenders and others from bank. The trend of investment is illustrated in Table 2-12 below:

Table 2-12: Investment for Biogas Plant

Unit: HHs

Investment	Hill	Terai	Total
Own Cash Saving	207(62.3)	113(63.5)	320(62.7)
Loan from Money Lender	33(9.9)	6(3.4)	39(7.6)
Bank Loan	71(21.4)	51(28.7)	122(23.9)
Cooperative Loan	13(3.9)	5(2.8)	18(3.5)
Do Not Know	8(2.4)	3(1.7)	11(2.2)
Total/ Overall	332(100.0)	178(100.0)	510(100.0)

The above figures without and within the parenthesis show the number of respondents and percentage

The table above depicts that 62.7% users (62.3% in hill and 63.5% in Terai) installed plant from their own savings followed by 23.9% taking loan from bank, 7.6% from money lenders, 3.5% from cooperative loan. It can be seen that the trend of taking loan from money lender is more in hill (9.9%) as compared to Terai (3.4%) while taking loan from bank is more in Terai (28.7%) than in hill (21.4%) reflecting relatively low economic status of users in hilly region and hence low access to bank loan which requires some collateral before giving loan. Also as reported by the companies, this could be due to the difficult and tedious loan sanctioning process. However, when compared to the BUS 2006 findings, the trend of investing from own cash has decreased by 16.5% while that by taking loan from bank and cooperatives has increased by 3.1% and 0.7%, respectively.

2.9.2 Loan Repayment Status

The status of loan repayment can also be taken as an indicator for assessing the socio-economic condition of a household. Generally households having fairly good income tend to pay their loan installments without keeping an overdue.

Table 2-13: Households Reporting Loan Payment Borrowed for Biogas Installation

Unit: HHs

Ecological Location	Paid All Installments	Paid Some Installments	Paid No Installments	Other	Total
Hill	74(63.2)	25(21.4)	17(14.5)	1(0.9)	117(100)
Terai	47(75.8)	8(12.9)	6(9.7)	1(1.6)	62(100)
Total/Overall	121(67.6)	33(18.4)	23(12.8)	2(1.1)	179(100)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 2-13 demonstrates the status of loan payment by the households. It is shown that 63.2% users in hill and 75.8% in Terai who borrowed money for the plant installment have paid all installments, 21.4% (hill) and 12.9% (Terai) have paid some installment. It can be noted that only 12.8% (14.5% from hill and 9.7% Terai) have not paid any of the installments. The fact that more borrowers from Terai than hill have paid all their installments while comparatively less have not paid any installment indicates that users in Terai are economically strong than those in the hill. However, it can be inferred that the economic condition of those 12.8% not paying any installment has not become better after using biogas which could be due to several reasons including the splitting of family and subsequent reduction in household income.

2.10 LABOR USED DURING PLANT CONSTRUCTION

Contribution of labor from the user households during construction means saving of expenditure which would be otherwise paid to the masons hired. This variable can also be used as an indicator of the socio-economic status of the user household.

Table 2-14: Labor Used During Plant Construction

Ecological Belt	Male		Female		Total	
	No.	%	No.	%	No.	%
Hill	560	(52.1)	514	(47.9)	1074	(100.0)
Terai	190	(52.8)	170	(47.2)	360	(100.0)
Overall	750	(52.3)	684	(47.7)	1434	(100.0)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 2-14 illustrates that 52.1% and 52.8% male labors and 47.9% and 47.2% female labors were used in hill and *Terai* households, respectively. As evident from the data, the number of female labor (47.7%) used is less than the male labor (52.3%) in both the ecological belts, possibly due to requirement of physical labor for construction and also due to the indulgence of women in agriculture and other household activities.

Table 2-15: Average No. Of Days Labor Contributed During Plant Construction

Unit: Days

Ecological Belt	Male		Female		Total	
	No.	Average	No.	Average	No.	Average
	Hill	560	1.7	514	1.5	1074	3.2
Terai	190	1.1	170	1.0	360	2.0
Overall	750	1.5	684	1.3	1434	2.8

Table 2-15 depicts that the average number of days contributed as labor during plant construction by the male members is 1.7 and 1.1 and that of female members is 1.5 and 1.0, in hill and *Terai*, respectively. While going by the total average, contribution in hill (3.2) is more than that in *Terai* (2.0), suggesting the economic disparity among users in hill and in *Terai*, the latter being economically better-off.

2.11 EXPENDITURE ON PLANT MAINTENANCE

Biogas plant has quite long durability. It is estimated that the plant operates for about 20 years or more, once installed. During this tenure, no large additional investment is needed except for some expenditure for time to time repair and maintenance in case of any malfunctioning of the plant. **Table 2-16** depicts the expenditure on plant R&M annually.

Table 2-16: Annual Expenditure on Plant Repair and Maintenance

Unit: Expenditure/HH/Year

Ecological Zone	Instrument		Structure	
	HH Reporting	Rs/ HH	HH Reporting	Rs/ HH
Hill	80(24.1)	576	12(3.6)	868
Terai	41(23.0)	734	4(2.2)	226
Total/ Overall	121(23.7)	630	16(3.1)	707

The above figures without and within the parenthesis show the number of respondents and percentage

As responded by 23.7% households, on an average they spend Rs. 630 on instruments annually and 3.1% households said that they spend Rs. 707 on structure annually. With only 3.1% households reporting the expense in structure, the durability of the plant structure once installed is proven. However, with substantial number of households reporting expenditure on instruments, there is a need to authenticate the quality of the equipment used in order to reduce cost burden of R&M to the users. When compared with the last year's finding, the amount spent on instrument this year is more by Rs.226 while on structure it is less by Rs. 68. Also the no. of HHs reporting expenditure on structure has slightly increased in both the ecological belts than in the previous survey probably due to rise in price of commodities. Also another significant reason for this is that there are more than 60% plants having crossed the guarantee period, the frequency of failure of appliances may be more.

2.12 IMPACT ON AGRICULTURE PRODUCTION

The use of biogas has direct implication on the agriculture production because the slurry produced during its operation is a high quality fertilizer. The slurry which may be used as it is or composted after mixing with other biodegradable materials can enhance agriculture production which in turn can be linked with increase in socio-economic status of a household.

Table 2-17: Change in Agriculture Production

Unit: Respondents in %

Agricultural Land	Production		
	Increased	Decreased	No Change
<i>Khet</i>	200 (39.2)	29 (5.7)	281 (55.1)
<i>Bari</i>	219 (42.9)	25 (4.9)	266 (52.0)
Kitchen Garden	263 (51.6)	16 (3.1)	231 (45.3)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 2-17 illustrates the impact of biogas use on the agriculture production of households. It is observed that on average 39.2% households have reported increased production in Khet, 43% in Bari and 51.6% in kitchen garden. Only 5.7% have said that production has decreased in Khet, 4.9% in Bari and 3.1% in Kitchen garden while 55% reported no change in Khet, 52% in Bari and 45.3% in Kitchen garden. Compared to BUS 2006 result, this year, the reporting of increase in production has decreased by 5.2% in Khet and by 2.2 in Kitchen garden while those observing no change have decreased by 7.6% in Khet, by 4.6% in Bari and increased by 3.5% in Kitchen garden. Similarly, those reporting decreased production has drastically reduced by 41.2% in Kitchen garden, 5% in Khet and 4.2% in Bari. From this it can be deduced that the use of slurry in kitchen garden has resulted in increased agricultural production helping to a certain extent to enhance their socio-economic status.

2.13 EXPENDITURE ON FUEL PURCHASE

The use of biogas is expected to decrease/replace the use of traditional stoves requiring firewood as well as other fossil fuel like LPG, kerosene, etc hence saving the cost for purchasing these fuels. **Table 2-18** demonstrates the change in expenditure after biogas installation and use that would otherwise incur on fuel purchase.

Table 2-18: Change in Expenditure on Fuel Purchase

Unit: Rupees/Year

Fuel Type	Expenditure		Total Monthly Saving	Annual Saving
	Before biogas	After biogas		
Fuel wood	4046	2386	1660	19924
Kerosene	709	244	465	5575
Total	4755	2630	2125	25499

The installation of biogas plant has overwhelmingly reduced the expenditure of the user households on fuel purchase thereby saving substantial amount annually. It is found that Rs.1660 on fuel wood and Rs. 465 on kerosene is saved monthly by the user households. With total monthly discount of Rs. 2125 on fuel purchase, they are actually saving Rs. 25,499 annually. This clearly indicates that the use of biogas has had a substantial contribution towards making the lives of the users economically better as they save handsome amount of money curtailed from the fuel purchase to be utilized in other needful activities. This year's data show remarkable saving in the fuel purchase than the previous year which was only Rs.611 monthly and Rs. 7331 annually.

IMPACTS ON AGRICULTURE AND RELATED ISSUES

In agrarian country like Nepal, agriculture is the main occupation of people, especially in the rural context. This has also been proved by the Biogas Users' Survey, which comes out with the same finding among the users of biogas each year. It is found that people at rural level are fully dependent on agriculture as a prime source for earning income and hence sustaining their livelihood. The type of farming, however, differs in different ecological belt and depends on the size of land holding. Most of the biogas users carry out mixed cropping of cereal crops, cash crops and animal rearing. Animal rearing is the pre-requisite for biogas plant installation since animal dung is the main component for feeding biogas digester. Therefore, this chapter deals with the impact indicators such as landholding area and type, productivity of major crops cereals, cash crops cultivated, quantity and types of manures (including bio-slurry) and fertilizers applied in different crops. The chapter also deals with number and type of animal holding; shed management practice, fodder collection practice, quantity of dung production, compost preparation method, use of bio-slurry in fisheries etc, in order to analyze the impact of biogas on these aspects.

3.1 IMPACTS ON AGRICULTURE

3.1.1 Average Land Holding by Size and Type

The average land holding of a household and the types of land owned is the determinant not only of the socio-economic status of a household but also of the types of crops grown, cropping pattern, crop yield and the productivity as a whole. **Table 3-1** depicts the type and size of land owned by the biogas user households.

Table 3-1: Average Land Holding by Size and Type of Land among Beneficiaries

Land Type	Unit Ha/HHs		
	Hill	Terai	Total
<i>Khet</i>	0.37	1.02	0.6
<i>Bari</i>	0.34	0.13	0.27
Kitchen Garden	0.05	0.04	0.05
Total/ Overall	0.75	1.2	0.91

It is found that the overall average land holding per household is 0.91 ha. Across the ecological belts, in hill it is 0.75ha and in *Terai* it is 1.2 ha. However, in case of average land holding by type, *Terai* households have more *khet* compared to hill because of the topography while *bari* and kitchen garden are more in hill than in *Terai* households who keep less area for kitchen garden.

3.1.2 Application of Manures and Fertilizers by Land Type

For enhancing the productivity, manures and fertilizers are applied to the land by the farmers. However, the nutrient content in each type of manure and fertilizer varies and the farmers should be well aware of this fact so that they apply right type and amount of manure and fertilizer to their crop to get maximum yield. It is very essential to choose correct type of fertilizer/manure depending upon the need of the types of nutrients to the plants because otherwise the excess or deficiency of some nutrient may damage the crop and soil. Studies have found that FYM is low in

organic carbon, nitrogen content, potassium, ammoniac N, etc which are required for the highest crop yield. Since the slurry and the slurry compost is rich in these nutrients, its use in the field is highly recommended. And one of the important objectives of biogas program is to reduce the use of chemical fertilizers which is harmful to the ecosystem thereby promoting the use of slurry and slurry compost which is eco-friendly and at the same time cost efficient to the users.

Table 3-2: Manures and Fertilizers Use by Land Type in Terai

Unit: Kg/Ha

Type	Lowland		Upland		Kitchen Garden		Overall	
	Before Biogas	After Biogas	Before Biogas	After Biogas	Before Biogas	After Biogas	Before Biogas	After Biogas
Organic manures								
FYM	2667	474	4315	1621	10128	3086	3131	700
Slurry	0	24	0	134	0	1321	0	85
Slurry compost	0	2312	0	4068	0	11421	0	2850
Total	2667	2810	4315	5822	10128	15827	3131	3634
Chemical fertilizers								
Urea	52	52	104	103	16	16	57	57
DAP	43	44	102	101	14	13	49	49
Potash	9	10	9	8	4	4	9	9
Others	0	0	0	0	0	0	0	0
Total	104	106	215	212	34	33	115	115

Table 3-3: Manures and Fertilizers Use by Land Type in Hill

Unit: Kg/Ha

Type	Lowland		Upland		Kitchen Garden		Overall	
	Before Biogas	After Biogas	Before Biogas	After Biogas	Before Biogas	After Biogas	Before Biogas	After Biogas
Organic manures								
FYM	7628	5954	8565	6156	7435	11024	8036	6369
Slurry	0	11	0	30	0	840	0	73
Slurry compost	0	2445	0	3130	0	7535	0	3078
Total	7628	8410	8565	9316	7435	19398	8036	9519
Chemical fertilizers								
Urea	91	86	50	48	19	13	68	64
DAP	40	43	17	18	8	8	28	30
Potash	6	6	1	1	1	2	3	4
Others	0	0	0	0	0	0	0	0
Total	13	135	68	67	28	23	99	98

Table 3-2 and 3-3 indicate the use of manures and fertilizers in different land types before and after installation of the biogas plant in both the ecological regions (*Terai* and hill) among the biogas users. The use of FYM is substantially reduced in both lowland and upland in *Terai* and hill while it has increased in kitchen garden in hill after installation of biogas plant. *Terai* biogas users apply slurry-compost in all the land type. This indicates that slurry compost is replacing the FYM. Both hill and *Terai* biogas users apply

more slurry to the kitchen garden than other land types. The reason for this may be the proximity of kitchen garden and hence easy in carrying the slurry from the plant and applying to the land. The overall use of slurry compost is found to have increased in all land types.

It is also found that though there is increased use of slurry compost, the use of fertilizers still continues among farmers in all land types. However, compared to the BUS 2006 findings, where there was increased use of chemical fertilizer even after biogas, with few exceptions, this year it is found that use of few types of fertilizer has increased by a very nominal degree in both hill and *Terai*, but overall use has remained same before and after the biogas installation and not increased.

The reasons for continued use of chemical fertilizers are:

- The growth of the crops after fertilizer application is seen immediately within few days. Farmers are of the opinion that the productivity would be decreased if they don't apply chemical fertilizers.
- It is easy to handle eg. Store, transport and spread in the field.
- Government policy also encourages continued use of fertilizers. Though the subsidy is removed now, there is subsidy on transport cost of chemical fertilizers for remote hill districts.

3.1.3 Nutrients Contributed by Slurry after Biogas Plant Installation

Table 3-4 Nutrients contribution of Slurry after Biogas Installation

Unit: Kg/ha

Nutrients	Terai			Hills		
	Slurry	FYM	Balance	Slurry	FYM	Balance
N	46	36	10	56	22	34
P ₂ O ₅	60	28	32	40	15	25
K ₂ O	38	33	5	28	35	(7)

From **Table 3-4**, it is calculated that liquid slurry and slurry compost contributed 46 kg N, 60 kg P₂O₅ and 38 kg K₂O in *Terai* while the quantity of decreased nutrients from the decreased FYM application amounts to 36 kg N, 28 kg P₂O₅ and 33 kg K₂O per hectare. Similarly, slurry manure liquid and compost contributed 56 kg N, 40 kg P₂O₅ and 28 kg K₂O per hectare of land in hill and decrease in nutrients with decreased use of FYM amounts 22 kg N, 15 kg P₂O₅ and 35 kg K₂O in hill. Slurry manure contributed additional nutrients 10 kg of N, 32 kg of P₂O₅ and 5 kg of K₂O per ha in *Terai* and 34 kg of N, 25 kg of P₂O₅ per ha in hill. But in case of K₂O there is decrease by 7 kg after installation of biogas plant in hill the reason being slurry compost contains less K₂O than FYM.

The Biogas users are able to save 67 kg DAP and 13 kg of urea in hill. The *Terai* users are able to save only 52 kg DAP. Since potash content on the slurry compost is low, users of both the regions are not able to get benefit from potash. The *Terai* users benefited Rs 2010.00 from DAP only while hill users have saved Rs 1560.00 from DAP and Rs 286.00 from urea per hectare.

3.1.4 Changes in Crop Productivity after the Installation of Biogas Plant

Table 3-5: Changes Observed by the Biogas Users in Productivity after Installation of Biogas Plant

Unit: HHs

Land Type	Hill			Terai			Total		
	Increased	Decreased	Same	Increased	Decreased	Same	Increased	Decreased	Same
<i>Khet</i>	112 (34)	17 (5)	203 (61)	88 (49)	12 (7)	78 (44)	200 (39)	29 (6)	281 (55)
<i>Bari</i>	148 (45)	17 (5)	166 (50)	71 (40)	8 (5)	99 (56)	219 (43)	25 (5)	265 (52)

Kitchen Garden	158 (48)	12 (4)	162 (49)	105 (59)	4 (2)	69 (39)	263 (52)	16 (3)	231 (45)
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The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-5 illustrates the change in productivity after the installation of biogas plant. It is observed that majority of biogas users (55% in *khet*, 52% in *bari* and 45% in kitchen garden) found that the productivity of all land type has remained more or less same even after installation of biogas plant. On the other hand, 39 % reported increased productivity in *khet*, 43 % in *bari* and 52 % in kitchen garden. More biogas users realize increased productivity in kitchen garden which could be due to more use of slurry there. More of the *Terai* households observed increased productivity in *khet* and kitchen garden while majority of the hill households observed same yield in all three land types.

Despite the increased use of slurry compost and continued use of chemical fertilizers more of the hill and *Terai* farmers found same productivity as before in *khet* and *bari* and couldn't receive any benefit from increased application of compost and fertilizers. The reason is correlated with the **Table 3-20**. It is because of the lack of proper management and use of compost. Since many farmers transported compost during slack period and left in the field uncovered, most of the nutrients of the compost are lost. It could be illustrated from the reality that more users of both ecological regions realized increase in productivity in kitchen garden than in *khet* and *bari* since the kitchen garden is at the vicinity of the house and the slurry is transported and applied just before planting without losing any nutrients.

It is found that 6 % farmers realized decrease in productivity in *khet*, 5 % in *bari* and 3 % in kitchen garden. The reason may be the continuous imbalanced use of chemical fertilizers without use of any type of compost. The continuous use of urea leads to the soil degradation and depletes soil fertility.

3.1.5 Change in Productivity of Different Crops by Land Type after Installation of Biogas Plant

Table 3-6: Changes in Crop Productivity after the Installation of Biogas Plant in Lowlands

Unit: HHs

Crop	Number of Growers			Increased In Percentage			Decreased In Percentage			No Change In Percentage		
	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total
Paddy	259 (78)	157 (88.2)	416 (81.6)	119 (45.9)	25 (15.9)	144 (34.6)	23 (8.9)	9 (5.7)	32 (7.7)	117 (45.2)	123 (78.3)	240 (57.7)
Maize	124 (37.3)	113 (63.5)	237 (46.5)	52 (41.9)	15 (13.3)	67 (28.3)	8 (6.5)	6 (5.3)	14 (5.9)	64 (51.6)	92 (81.4)	156 (65.8)
Wheat	155 (46.7)	115 (64.6)	270 (52.9)	67 (43.2)	23 (20)	90 (33.3)	14 (9)	8 (7)	22 (8.1)	74 (47.7)	84 (73)	158 (58.5)
pulses	28 (8.4)	104 (58.4)	132 (25.9)	18 (64.3)	14 (13.5)	32 (24.2)	1 (3.6)	13 (12.5)	14 (10.6)	9 (32.1)	77 (74)	86 (65.2)
Potato	104 (31.3)	82 (46.1)	186 (36.5)	55 (52.9)	15 (18.3)	70 (37.6)	10 (9.6)	8 (9.8)	18 (9.7)	39 (37.5)	59 (72)	98 (52.7)
Vegetable	29 (8.7)	10 (5.6)	39 (7.6)	7 (24.1)	1 (10)	8 (20.5)	0 (0)	0 (0)	0 (0)	22 (75.9)	9 (90)	31 (79.5)
Oilseed	25 (7.5)	76 (42.7)	101 (19.8)	11 (44)	7 (9.2)	18 (17.8)	1 (4)	11 (14.5)	12 (11.9)	13 (52)	58 (76.3)	71 (70.3)
Cash Crops	3 (0.9)	21 (11.8)	24 (4.7)	1 (33.3)	0 (0)	1 (4.2)	0 (0)	2 (9.5)	2 (8.3)	2 (66.7)	19 (90.5)	21 (87.5)
Others	0 (0)	1 (0.6)	1 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	1 (100)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-7: Changes in Crop Productivity after the Installation of Biogas Plant in Uplands

Unit: HHs

Crop	Number of Growers			Increased In Percentage			Decreased In Percentage			No Change In Percentage		
	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total
Paddy	280 (84.3)	90 (50.6)	370 (72.5)	144 (51.4)	10 (11.1)	154 (41.6)	16 (5.7)	7 (7.8)	23 (6.2)	120 (42.9)	73 (81.1)	193 (52.2)

Maize	140 (42.2)	7 (3.9)	147 (28.8)	53 (37.9)	3 (42.9)	56 (38.1)	17 (12.0)	2 (28.6)	19(13)	70 (50)	2 (28.6)	72 (49)
Wheat	64 (19.3)	44 (24.7)	108 (21.2)	37 (57.8)	1 (2.3)	38 (35.2)	3(4.7)	0 (0.0)	3 (2.8)	24 (37.5)	43 (97.7)	67 (62)
pulses	68 (20.5)	57 (32.0)	125 (24.5)	38 (55.9)	5 (8.8)	43 (34.4)	2 (2.9)	1 (1.8)	3 (2.4)	28 (41.2)	51 (89.5)	79 (63.2)
Potato	110 (33.1)	68 (38.2)	178 (34.9)	71 (64.5)	12 (17.6)	83 (46.6)	7 (6.4)	6 (8.8)	13 (7.3)	32 (29.1)	50 (73.5)	82 (46.1)
Vegetable	57 (17.2)	20 (11.2)	77 (15.1)	30 (52.6)	1 (5.0)	31 (40.3)	2 (3.5)	0 (0.0)	2 (2.6)	25 (43.9)	19 (95)	44 (57.1)
Oilseed	56 (16.9)	65 (36.5)	121 (23.7)	25 (44.6)	10 (15.4)	35 (28.9)	3 (5.4)	5 (7.7)	8 (6.6)	28 (50)	50 (76.9)	78 (64.5)
Cash Crops	6 (1.8)	30 (16.9)	36 (7.1)	4 (66.7)	0 (0.0)	4 (11.1)	1 (17.0)	1 (3.3)	2 (5.6)	1 (16.7)	29 (96.7)	30 (83.3)
Others	7 (2.1)	15 (8.4)	22 (4.3)	4 (57.1)	0 (0.0)	4 (18.2)	2 (29.0)	1 (6.7)	3 (14)	1(14.3)	14 (93.3)	15 (68.2)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-8: Changes in Crop Productivity after the Installation of Biogas Plant in Kitchen Garden

Unit: HHs

Crop	Number of Growers			Increased In Percentage			Decreased In Percentage			No Change In Percentage		
	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total
Broad Leaf	247 (74.0)	165 (93.0)	412 (81.0)	18 (7.3)	1 (0.6)	19 (4.6)	2 (0.8)	2 (1.2)	4 (1.0)	227 (92.0)	162 (98.0)	389 (94.0)
Cabbage	172 (52.0)	160 (90.0)	332 (65.0)	34 (20.0)	4 (2.5)	38 (11.0)	1 (0.6)	2 (1.3)	3 (0.9)	137 (80.0)	154 (96.0)	291 (88.0)
Brinjal	162 (49.0)	162 (91.0)	324 (64.0)	36 (22.0)	3 (1.9)	39 (12.0)	3 (1.9)	2 (1.2)	5 (1.5)	123 (76.0)	157 (97.0)	280 (86.0)
Pumpkin	235 (71.0)	165 (93.0)	400 (78.0)	16 (6.8)	3 (1.8)	19 (4.8)	1 (0.4)	1 (0.6)	2 (0.5)	218 (93.0)	161 (98.0)	379 (95.0)
Cucumber	232 (70.0)	161 (90.0)	393 (77.0)	22 (9.5)	3 (1.9)	25 (6.4)	2 (0.9)	1 (0.6)	3 (0.8)	208 (90.0)	157 (98.0)	365 (93.0)
Cauliflower	147 (44.0)	139 (78.0)	286 (56.0)	23 (16.0)	3 (2.2)	26 (9.1)	2 (1.4)	0 (0.0)	2 (0.7)	122 (83.0)	136 (98.0)	258 (90.0)
Bean	222 (67.0)	159 (89.0)	381 (75.0)	24 (11.0)	3 (1.9)	27 (7.1)	1 (0.5)	0 (0.0)	1 (0.3)	197 (89.0)	156 (98.0)	353 (93.0)
Tomato	172 (52.0)	164 (92.0)	336 (66.0)	33 (19.0)	1 (0.6)	34 (10.0)	3 (1.7)	0 (0.0)	3 (0.9)	136 (79.0)	163 (99.0)	299 (89.0)
Onion	211 (64.0)	162 (91.0)	373 (73.0)	20 (9.5)	1 (0.6)	21 (5.6)	3 (1.4)	0 (0.0)	3 (0.8)	188 (89.0)	161 (99.0)	349 (94.0)
Other Veg.	9 (2.7)	1 (0.6)	10 (2.0)	3 (33.0)	0 (0.0)	3 (30.0)	0 (0.0)	0 (0.0)	0 (0.0)	6 (67.0)	1 (100.0)	7 (70.0)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-6, 3-7 and 3-8 show the change in productivity of various crops cultivated in *khet*, *bari* and kitchen garden. Majority of the biogas users realized no change in productivity of the crops they cultivated in all the land types. The percent of biogas users who realized no change in productivity ranged from 52 % (Paddy) to 95 % (Pumpkin). Biogas users who observed increased productivity ranged from maximum of 46.6 % in potato (**Table 3-7**) to minimum of 4.2 % in cash crop (**Table 3-6**). Among the land types more biogas users observed no change in productivity in kitchen garden and realized increased productivity in upland condition than other land types.

More biogas users of hill realized increased productivity than *Terai* users. On the other hand more *Terai* users observed no change in productivity than hill users in all land types.

Among the cereal crops more biogas users cultivate paddy (82 % and 73 %) in lowland as well as upland followed by wheat (53 %) in lowland (**Table 3-6**) and potato (35 %) in upland which is given in (**Table 3-7**). Among vegetables, broad leaf mustard tops (81 %) in cultivation followed by pumpkin (78 %).

The reason for no change in productivity may be due to lack of proper management and use of compost. The results regarding productivity are similar to the BUS 2006 findings.

3.2 IMPACTS ON LIVESTOCK

Animal husbandry is the part and parcel of the farming community of Nepal. Without any animal a farmer may not be a real farmer in Nepal. Since animals are the main source of dung which is the main feeding

material and the amount of gas produced by the biogas plant depends on the amount of dung fed into it, the number of livestock and cattle holding of a household is a significant parameter. Hence, issues relating to livestock like average livestock holding, husbandry practice, shed management, etc shall be discussed in this section hereunder.

3.2.1 Livestock Holding Pattern

Table 3-9: Average Livestock Holding

Unit: No/HHs

Livestock Type	Biogas Users		Total
	Hill	Terai	
Cattle (Cow/Ox)	1.5	1.9	1.6
Buffalo	1.6	1.5	1.5
Pig	0.2	0.1	0.2
Sheep	2.8	2.9	2.9
Poultry/ Birds	20.3	3.9	14.6

Table 3-9 demonstrates that the major livestock raised by the biogas user household are cattle, buffalo, pig, goat/sheep and poultry. On an average, the livestock holding is 1.6 cattle (cow/ox), 1.5 buffalo, 0.2 pig, 2.9 sheep and 14.6 poultry. The cattle and buffalo are the important biomass (dung) producer which is pre-requisite to the biogas plant. It is found that pig husbandry is the lowest which is due to the fact that majority of the owners are Brahmin/Chettris. Also poultry farming is more in hill with average holding of 20.3 compared to 3.9 in *Terai*.

3.2.2 Animal Husbandry Practices after Biogas Plant Installation

It is assumed that after the installation of biogas plant, the practices of livestock rearing will be changed because the main source of feeding material is the livestock animals. Hence, the practice adopted should be such that maximum feeding material is obtained from the animals to get as much dung and consequently increased gas production. **Table 3-10** hereunder depicts the types of improved practices of animal husbandry adopted by the household after biogas plant installation.

Table 3-10: Increase in Animal Husbandry Practices after Biogas Plant Installation

Unit: HHs

Increased in Animal husbandry Practice	Hill	Terai	Total
Stall Feeding	260 (78.3)	151 (84.8)	411 (80.6)
Forage Production	158 (47.6)	76 (42.7)	234 (45.9)
Cattle shed construction	107 (32.2)	39 (21.9)	146 (28.6)
Fodder Tree Production	38 (11.4)	67 (37.6)	105 (20.6)
Collection and utilization of Dung and Urine for Biogas Production	57 (17.2)	23 (12.9)	80 (15.7)

The above figures without and within the parenthesis show the number of respondents and percentage

The above table indicates that substantial percent of households (80.6%) both in hill (78.3 %) and *Terai* (84.8 %) have adopted stall feeding practice. Together with this, the users have also adopted the practice of forage production (45.9%), constructed shed (28.6%), fodder tree production (20.6%) and collection and

utilization of dung and urine for biogas production (15.7%) suggesting that there is a very little awareness regarding the utilization of urine along with dung as a feeding material for the plant. Comparing hill and Terai households, the practice of stall feeding (84.8%) and fodder tree production (37.6%) is more in Terai households while forage production (47.6%), cattle shed construction (32.2%) and collection and utilization of dung and urine (17.2%) is more in hill households. However, comparing with the BUS 2006 data, the practice of stall feeding and forage production among households has increased by 9.3% and 18.5%, respectively while the other three variables has decreased by 2.3%, 3.1%, 16.4%, respectively.

3.2.3 Livestock Shed Management

With the changed animal husbandry practices it is also expected that the households manage better shed for their livestock and cattle. This is important not only from the dung and urine collection point of view but also from the sanitation perspective. Table 3-11 below demonstrates the changes brought about by biogas plant installation in the shed management.

Table 3-11: Changes Brought about by Biogas Plant in Shed Management

Unit: HHs

Cattle Shed Condition	Before			Now		
	Hill	Terai	Total	Hill	Terai	Total
Smooth, Earthen Floor	131 (40.0)	91 (51.0)	222 (44.0)	117 (35.0)	105 (59.0)	222 (43.5)
Smooth, Concrete Floor	121 (36.0)	13 (7.3)	134 (26.0)	182 (55.0)	43 (24.0)	225 (44.1)
Urine Collection Pit	16 (4.8)	9 (5.1)	25 (4.9)	57 (17.0)	43 (24.0)	100 (19.6)

The above figures without and within the parenthesis show the number of respondents and percentage

From the above table it can be seen that there is decrease in smooth earthen floor after installation of plant by 0.5% but the percent of smooth concrete floor has increased substantially from 26% before plant to 44% after installation of the biogas plant. The earthen floor is hence replaced by concrete floor. Also the provision of urine collection pit (from 4.9% to 19.6%) in the shed has significantly increased due to awareness among people about the use of urine in biogas as feeding material.

3.3 FODDER, DUNG COLLECTION AND CROP RESIDUE USE

3.3.1 Fodder Collection Practices

Table 3-12: Fodder Collection Practices among Biogas Users

Unit: HHs

Fodder Collection Practices	Hill				Terai			
	Before		After		Before		After	
	HH %	Kg	HH %	Kg	HH %	Kg	HH %	Kg
Forest	15.7	8.5	13.9	9.8	26.4	13.1	27	14.3
Own Production	66.3	42.2	67.5	46.6	64	44.7	69.7	51.7
Both	23.8	18.9	23.8	21.4	5.6	3.9	6.2	4.9
Total/Overall		69.6		77.8		61.7		70.9

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-12 shows that the average fodder collection of the biogas users before and after the installation of biogas plant. The average fodder collection of per day from their own production increased by 7 kg per day in *Terai* whereas in hill it increased by 4.4 kg in a day. Majority of the households (67.5 % hill and 69.7 % *Terai*) are involved in fodder cultivation after installation of biogas plant. Collection of fodder from forest has remarkably decreased as compared to previous year which was 57.7%.

3.3.2 Practices of Fodder Grass Production

Table 3-13: Practice of Fodder Grass Production

Unit: HHs

	Hill		<i>Terai</i>		Overall	
	Before	After	Before	After	Before	After
Growing grass on the bund	190 (57.0)	215 (65.0)	122 (69.0)	123 (69.0)	312 (61.0)	338 (66.0)
Planting Fodder trees	152 (46.0)	190 (57.0)	50 (28.0)	57 (32.0)	202 (40.0)	247 (48.0)
Others	18 (5.4)	17 (5.1)	2 (1.1)	2 (1.1)	20 (3.9)	19 (3.7)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-13 depicts the percent of biogas users household practicing fodder cultivation before and after the installation of biogas plant in ecological regions. Majority of biogas users (66 %) cultivate fodder grass on the bunds while 48 % grow fodder trees after installation of plant. There is marginal increase in the percent of biogas users practicing fodder grass cultivation.

3.3.3 Dung Availability and Production

Major component for feeding biogas is dung although in case of some exceptions where the plant is run simply from the latrine attachment. The volume of gas produced depends on availability of dung.

Table 3-14: Dung Availability and Production

Unit: HHs

	HH using Dung	Dung Available (Kg/Day)	Decreased	Increased	No Change	Total Reporting
Hill	318 (95.8)	23.4	42 (13.2)	93 (29.2)	183 (57.5)	318
<i>Terai</i>	176 (98.9)	27.5	40 (22.7)	58 (33)	78 (44.3)	176
Total/ Overall	494 (96.9)	24.9	82 (16.6)	151 (30.6)	261 (52.8)	494

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-14 indicates the availability and production of dung. Dung availability in *Terai* is slightly more than in hill. A total of 96.9% households on an average (95.8% in hill and 98.9% in *Terai*) reported using dung as feeding material for bio-digester. Their average daily dung availability is 24.9 kg (23.4 in hill and 27.5 in *Terai*). Compared to BUS 2006 findings on dung availability which was 40 kg/day, in this year's finding, it has decreased substantially.

Regarding the change in dung production before and after biogas installation, majority of the households (52.8 %) did not realize any change while 30.6 % observed increase in dung production which is substantially higher than the previous year's finding that was 17.4%.

3.3.4 Use of Organic Residues

The farming communities in Nepal use the organic residues of crop cultivation for various purposes like using as animal feed, fuel for cooking purpose as well as mulching for crop. **Table 3-15** illustrates the different uses of organic residue before and after the installation of biogas plant.

Table 3-15: Use of Organic Residues

Unit: HHs

Use of Crop Residue	Before			Now		
	Hill	Terai	Total	Hill	Terai	Total
As fuel for cooking	61 (18.4)	6 (3.4)	67 (13.1)	49 (14.8)	2 (1.1)	51 (10.0)
For preparing cattle feed	319 (96.1)	158 (88.8)	477 (93.5)	320 (96.4)	160 (89.9)	480 (94.1)
Composting	58 (17.5)	71 (39.9)	129 (25.3)	179 (53.9)	160 (89.9)	339 (66.5)
Mulching	7 (2.1)	1 (.6)	8 (1.6)	9 (2.7)	160 (89.9)	169 (33.1)
Other	17 (5.1)	1 (.6)	18 (3.5)	19 (5.7)	160 (89.9)	179 (35.1)

The above figures without and within the parenthesis show the number of respondents and percentage

The table above shows that the use of organic residues for composting has increased remarkably from 25.3% before biogas to 66.5% after it. Similarly, its use for mulching has increased substantially from 1.6% to 33.1% households utilizing it that way. Also its use as fuel for cooking has reduced by 3.1%. When compared with before and after plant installation, it is found that the use of residue as fuel for cooking has reduced by 3.1% after biogas while for preparing cattle fodder has increased by 0.6%. The findings are more or less similar to the previous year's findings.

3.4 BIO-SLURRY AND COMPOSTING PRACTICES

One of the major by-products of the biogas is slurry which has high manure value. But it has been found that the biogas users do not give much importance to slurry as is also proved by the previous surveys. However, the slurry extension program launched by the AEPC/BSP-N to sensitize the users on its nutritive value for the crop plant and thereby promote its use has left positive impact on biogas users and increased the use of bio-slurry among them.

3.4.1 Bio-Slurry Application Mode

Table 3-16: Bio-Slurry Application Mode

Unit: HHs

Bio-Slurry Application Mode	Hill	Terai	Total
Slurry as such	33(9.9)	40(22.5)	73(14.3)
Slurry compost	166(50.0)	100(56.2)	266(52.2)
Dried not Composted	82(24.7)	45(25.3)	127(24.9)
Total Reporting Slurry Use	258(77.7)	126(70.8)	384(75.3)
HHs Not Using Slurry	74(22.3)	52(29.2)	126(24.7)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-16 above depicts the bio-slurry application mode among the biogas users. It shows that 75.3 % of the respondents of biogas users use different forms of bio-slurry which is around 3% more than the previous year's finding. Among the bio-slurry users, 52.2 % use slurry compost with slightly more Terai households (56.2%) using it than hill households (50%). 24.9% households use dried slurry and only 14.3% use it as such with more households in Terai (22.5%) using it than hill (9.9%).

24.7% (22.3% in hill and 29.2% in *Terai*) were found not using slurry in any form. The percent of the *Terai* households not using bio-slurry has substantially decreased as compared to the BUS 2006 findings (27.8 %) which indicates that bio-slurry use is getting popularity in *Terai*.

3.4.2 Bio-Slurry Composting

Table 3-17: Number of Slurry Pits

Unit: HHs

Number of Slurry Pits	Hill		Terai		Total	
	No.	%	No.	%	No.	%
None	75	22.6	52	29.2	127	24.9
One	108	32.5	16	9	124	24.3
Two	75	22.6	47	26.4	122	23.9
Three	17	5.1	13	7.3	30	5.9
Four	57	17.2	50	28.1	107	21
Total/ Overall	332	100	178	100	510	100

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-17 shows the number and percent of biogas user households having different number of compost pits. Majority of (32.5 %) households in hill have one pit for composting while in Terai only 9% have one pit. Similarly majority (28.1%) of households in Terai have four pits while in hill only 17.2% have the same. Equal percentage (22.6%) in hill have no pit and two pits for composting, respectively whereas in case of Terai, 29.2% do not have pit and 26.4% have two pits for composting. Only 5.1 % in hill and 7.3% in Terai have 3 pits for composting. Household having no compost pits are 25 % which is significantly higher than survey result of the previous year (1.3 %).

3.4.3 Composting Method

Table 3-18: Composting Method

Unit: HHs

Methods	Hill		Terai		Total	
	No.	%	No.	%	No.	%
Heap	24	7.2	28	15.7	52	10.2
Pit	238	71.7	117	65.7	355	69.6
Other	7	2.1	4	2.2	11	2.2
None	63	19.0	29	16.3	92	18.0
Total/ Overall	332	100	178	100	510	100

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-18 indicates the number and percent of biogas users practicing different composting methods. Among the composting methods the pit method (69.6 %) of composting outnumbered the heap method (10.2 %). However, heap method was more common in *Terai* (15.7%) than in hill (7.2%). The findings of the BUS 2006 also obtained similar results as pit method by 95.3 % and heap method by 4.7 %.

3.4.4 Reason for Not Using the Bio-slurry

Table 3-19: Reason for Not Using the Bio-slurry

Unit: HHs

Reason	Hill	<i>Terai</i>	Total/Overall
Lack of knowledge about manure value	5 (1.5)	4 (2.2)	9 (1.8)
Lack of knowledge about application technique	3 (0.9)	1 (0.6)	4 (0.8)

Difficult to carry because of its wet nature	81 (24.4)	61 (34.3)	142 (27.8)
Hesitation in carrying because of being attached with toilet	40 (12.0)	21 (11.8)	61 (12.0)
Available in very small quantity	28 (8.4)	36 (20.2)	64 (12.5)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-19 illustrates the reason as cited by the respondents for not using the bio-slurry. Majority (27.8 %) of the households cited the difficulty in carrying slurry in liquid form as the main reason for not using it. Other 12% said due to hesitation in carrying as it is attached to latrine, 12.5% due to its availability in very small quantity, 1.8% reported that they lacked knowledge about the manure value and other 0.8% said due to the lack of knowledge about its application technique. This points out to the necessity of conducting the slurry utilization and application demonstrations to the farmers.

3.4.5 Slurry/Compost Storage and Application

Table 3-20: Storage of Compost Manure

Storage	Unit: HHs		
	Hill	Terai	Total
Spread and dried in the ground	26 (7.8)	2 (1.1)	28 (5.5)
Keep in heap uncovered	74 (22.3)	9 (5.1)	83 (16.3)
<i>Keep covered in heap</i>	11 (3.3)	6 (3.4)	17 (3.3)
<i>Piled under a shed</i>	19 (5.7)	1 (0.6)	20 (3.9)
Piled temporarily in the field	15 (4.5)	1 (0.6)	16 (3.1)
Spread in the field into small heaps uncovered	25 (7.5)	6 (3.4)	31 (6.1)
<i>Transported and spread in the field with cover until field application</i>	23 (6.9)	6 (3.4)	29 (5.7)
<i>Transported to the field, spread and applied immediately</i>	34 (10.2)	17 (9.6)	51 (10.0)
Transported to the field and spread during slack season and applied to soil only at time of land preparation	47 (14.2)	73 (41.0)	120 (23.5)
Others	0 (0.0)	0 (0.0)	0 (0.0)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 3-20 reveals the storage process of compost manures. Majority of the households (23.5%) said that they transported the slurry to field and spread during slack season and applied to soil only at time of land preparation followed by 16.3% who kept in heap uncovered and 10% who transported to the field, spread and applied immediately. Only 3.9 % of users pile the compost under the shed and store in heap with cover. The percent of farmers who adopt proper management and use of slurry compost is less they are indicated in the bold italics in **Table 3-20**.

Similar result (10.7 % pile under the shed and 3.5 % covered in heap) was obtained in BUS 2007 too. This indicates that majority of the users don't follow proper management and use of the compost manures in their field. That is why they are not getting benefits which they should have with the increased use of compost manures.

3.5 IMPACT OF BIO-SLURRY ON THE INCIDENCE OF DISEASES AND PESTS

It is generally assumed that the bio-slurry is completely decomposed and therefore the chance of pathogens infestations as compared to other form of dung products and compost is minimal. **Table 3-21** hereunder illustrates the impact of bio-slurry on the incidence of diseases and pests.

Table 3-21: Impact of Bio-slurry on the Incidence of Diseases and Pests

Unit: HHs

	Hill	Terai	Total
Decreased	64 (19.3)	29 (16.3)	93 (18.2)
Increased	30 (9.0)	33 (18.5)	63 (12.4)
No Change	56 (16.9)	15 (8.4)	71 (13.9)
Do Not Know	110 (33.1)	19 (10.7)	129 (25.3)
Total/ Overall	260 (78.3)	96 (53.9)	356 (69.8)

The above figures without and within the parenthesis show the number of respondents and percentage

Majority of respondents (25.3%) have expressed that they have no idea about the impact of use of slurry on diseases and pests while 18.2 % households observed that incidence of diseases and pests has decreased and 13.9 % observed no change in diseases and pests incidence. Minimum of the respondents, around 12.4 % have expressed increase in diseases and pests. Since majority of the respondent have expressed no change and don't know and these are the simple perception of the biogas users, no definite conclusion can be drawn without definite research in this regard.

3.6 USE OF SLURRY AS FISH FEED

Besides the manure value of slurry, the digested slurry is also considered to be a good feed for fish. But due to high cost consequences, fish farming at household level is still not very popular practice. In this year's survey households, out of three users who have adopted fish farming, only one household is found to use slurry for feeding fish.

ENERGY, ENVIRONMENT AND EMISSION REDUCTION

Biogas is gaining popularity among rural household as a clean fuel for cooking. Being a renewable and environmentally sustainable technology, it is highly suitable for agrarian country like Nepal where most of the households have some land and cattle holding. It is quite viable, in the sense that the dung produced from the cattle is the main feeding material for biogas production and the slurry coming out as by-product is a high grade organic fertilizer for increasing the crop yield. Biogas project has been the first project in Nepal to provide economic benefit through carbon trade under Clean Development Mechanism (CDM) of the Kyoto Protocol. The Tenth Five Year Plan has also focused on achieving sustainable development through the participation of all stakeholders in environment and natural resource management. Among various strategies developed under National Environmental Conservation Program like encouraging and developing environmentally friendly scientific technologies; and promoting women participation in environmental management at national and local level, are directly related to renewable technology like biogas. Biogas is that alternative energy resource which plays significant role in reducing dependency on imported energies and mitigating negative environmental effects by proper use of resources available at local level. This renewable energy is extracted from readily available raw materials in rural areas – dung and agricultural residues along with latrine waste in some cases, and hence is highly feasible in rural context. Hence, the direct positive impacts of biogas on environment are that –it replaces the traditional fuel (biomass and fuel wood) and fossil fuel (kerosene, LPG), which would otherwise cause indoor and outdoor air pollution, Green House Gas (GHGs) emission & deforestation; and also improves environmental sanitation. Some of the indirect positive impacts of biogas on environment are – replacement of chemical fertilizer to some extent through the use of bio-slurry, soil and watershed conservation through avoided deforestation, evasion of land degradation through reduced open grazing as stall feeding is getting popular among users to ease the dung collections.

4.1 TYPES AND NUMBER OF STOVES USED FOR HOUSEHOLD COOKING

In a rural set up, generally traditional stove, improved cooking stove (predominantly in hilly regions) and husk stove are used. However, significant number of households with accessibility and affordability to imported fossil fuel also use kerosene stove and LPG stove for cooking purpose. The type of stove used is an indicator of environmental pollution and GHGs emission. For example, use of traditional stove indicates burning of biomass and fuel wood which emit harmful aromatic hydrocarbons causing indoor and outdoor air pollution, while use of ICS causes outdoor air pollution rather than indoor. Moreover, due to increased efficiency of ICS as compared to traditional stove, it would comparatively emit less pollutant.

Table 4-1: Types of Stove Used before and after Biogas Installation

Unit: HHs

Stove Types	Before			After		
	Hill	Terai	Total	Hill	Terai	Total
Biogas Stove				324 (97.6)	177 (99.4)	501 (98.2)
LPG Stove	25 (7.5)	13 (7.3)	38 (7.5)	39 (11.7)	12 (6.7)	51 (10.0)
Kerosene Stove	27 (8.1)	12 (6.7)	39 (7.6)	8 (2.4)	1 (0.6)	9 (1.8)
Improved Cooking Stove	26 (7.8)	2 (1.1)	28 (5.5)	45 (13.6)	2 (1.1)	47 (9.2)
Traditional Stove	314 (94.6)	163 (91.6)	477 (93.5)	282 (84.9)	121 (68.0)	403 (79.0)
Bhuse Chulo (Husk Stove)	13 (3.9)	9 (5.1)	22 (4.3)	7 (2.1)	0 (0.0)	7 (1.4)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 4-1 depicts that biogas has significantly replaced kerosene stove and traditional stove in both the ecological set up. The use of traditional stove has reduced by 10% in hill and by 24% in Terai after biogas installation implicating significant reduction in use of fuel wood. However,

increased use of LPG and ICS in hilly region reveals that households that are habituated to non-smoky kitchen environment after biogas use have adapted to comparatively cleaner fuel during the deficit of biogas to meet all the fuel need. Studies held in past have shown that biogas produced has not been sufficient to meet all energy needs of a household like for boiling water, making animal feed etc. Biogas Users' Survey 2006 had also reported the increased use of ICS stove after biogas installation. It could be observed from **Table 4-1** that husk stove which was used by 5% households in *Terai* is no more into use. Its use has reduced in hill households as well.

Table 4-2: Number of Biogas Stoves

Unit: HHs

Ecological Location	One Stove	Two Stoves	Total Reporting
Hill	294 (88.6)	38 (11.4)	332 (100.0)
<i>Terai</i>	131 (73.6)	47 (26.4)	178 (100.0)
Total/Overall	425 (83.3)	85 (16.7)	510 (100.0)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 4-2 depicts that on an average about 83% households have one stove and rest 17% have two stoves. It is observed that in both hill and *Terai*, more than 70% households have one biogas stove while 11% in hill and 26% in *Terai* have two stoves. From the data showing significant households having two stoves, it can be inferred that either it is for their convenience in cooking or to make optimum utilization of all the gas produced.

4.2 SOURCES OF ENERGY AND ENERGY USE PATTERN

4.2.1 Energy for Cooking

In rural set up, energy is primarily consumed for cooking and lighting purposes than others. Since time unrecorded, the basic source of energy for rural people of Nepal has been fuel wood extracted from variously owned forests including government forest, community forests and private forests. Besides, causing massive deforestation and the resulting land and soil degradation, fuel wood extraction from forest has also caused environmental pollution through increased carbon emission and posed risk to wildlife. Similarly, in fuel wood deficit areas, biomass like agricultural residues and cattle dung cake are used to fulfill the domestic energy needs for cooking and heating. However, biogas which is mainly used for cooking and in some case for lighting purpose has brought along the change in energy use pattern. It has been successful in slowly substituting the fuel wood and biomass and helping to control GHGs emission into the atmosphere mitigating the global climate.

Table 4-3: Energy Used for Cooking before Biogas Plant

Energy Source	Hill			<i>Terai</i>			Both		
	Summer	Winter	Average	Summer	Winter	Average	Summer	Winter	Average
Fire Wood (kg/Month)	249	339	294	255	351	303	252	342	297
Kerosene (Litre/Month)	1.8	2	1.9	1.5	1.7	1.6	1.7	1.9	1.8
Agriculture Residue (Kg/ Month)	0.5	0.7	0.6	1.4	1.4	1.4	0.8	1	0.9
Dung Cake (kg/Month)	1.1	1.1	1.1	1.8	7.6	4.7	1.4	3.4	2.4
LPG (Cylinder/Month)	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4
Coal (Kg/Month)	0	0	0	0	0	0	0	0	0
Saw Dust	0.2	0.2	0.2	0.8	1.1	1	0.4	0.5	0.5

Table 4-4: Energy Use (Except Biogas) for Cooking after Biogas Plant

Energy Source	Hill			<i>Terai</i>			Both		
	Summer	Winte	Averag	Summ	Winte	Averag	Summ	Winte	Average

		r	e	er	r	e	er	r	
Fire Wood (kg/Month)	117	177	147	78	159	117	102	171	135
Kerosene (Litre/Month)	0.7	0.7	0.7	0.5	0.5	0.5	0.6	0.6	0.6
Agriculture Residue (kg/Month)	0.4	0.6	0.5	0.1	0.1	0.1	0.3	0.4	0.4
Dung Cake (kg/Month)	0	0	0	0.3	0.3	0.3	0.1	0.1	0.1
LPG (Cylinder/Month)	0.3	0.3	0.3	0.2	0.3	0.2	0.2	0.3	0.3
Coal (kg/Month)	0.1	0.1	0.1	0	0	0	0.1	0.1	0.1
Saw Dust	0.3	0.3	0.3	0	0	0	0.2	0.2	0.2

Table 4-3 and 4-4 depict that fuel wood is a major source of energy for cooking purpose both before and after biogas use. On an average, fuel wood use has reduced by 162 kg/month/hh which accounts to the saving of nearly 2 tons/year/hh. Nevertheless, fuel wood consumption has reduced drastically after biogas use in both hill (71% in summer and 48% in winter) and in *Terai* (50% in summer and 54% in winter). Past studies also have shown similar results along with the fact that fuel wood consumption is more in winter than in summer which is due to prevailing lower temperature in winter season hence requiring more energy. Tropical forest which is a key role player of carbon assimilation is the major forest of Nepal. Hence, reduction in fuel wood consumption by about 54% on an average at national level has had significant positive impact controlling deforestation as well as carbon emission reduction.

Besides fuel wood, the other sources of energy used for domestic purpose are biomass (agriculture residue, dung cake) and fossil fuels (kerosene, LPG). It is observed that both before and after biogas installation, the use of kerosene is negligible. This is because in rural households, kerosene is mostly used for initiating the fire wood burning and lighting the wick lamps. From the findings, the significant positive change on energy consumption pattern is indicated clearly.

4.2.2 Energy for Lighting

Lack of access to electricity has forced rural people to use wick lamp and candles for lighting purpose. The use of different sources of energy except biogas for lighting purpose by the user households is depicted in **Table 4-5** below.

Table 4-5: Current Source of Energy for Lighting except Biogas

Energy Source	Unit	Before			After		
		Hill	<i>Terai</i>	Total	Hill	<i>Terai</i>	Total
Kerosene	Litre/Month/hh	9	21.1	13.2	5.6	18.8	10.2
Electricity	Unit/Month/H	18	23.7	20.0	19.8	24.8	21.6
Candle	NRs./month/h	21.9	44.9	29.9	46.4	69	54.3
Solar Energy	% of HH Having	0.1	0.1	0.1	0.3	0.5	0.4

With the consumption of 13 litres before biogas and 10 litres after biogas, kerosene is predominant source of energy for lighting in the user households. However, as demonstrated in the above table, the decrease in kerosene use for lighting purpose after biogas is not because of the use of biogas lamp but because of the increased consumption of electricity and candles. Solar energy as a renewable resource is also getting popular for lighting purpose in rural areas. It is reported that solar energy as fuel for lighting is increasing in a steady pace (increase from 0.1% to 0.4%). As compared to last year's survey which showed increase in

solar use from 2% to 14%, this year's data on solar use is negligible. This finding could have been affected by the sample districts selected where program on solar extension might not have reached.

One of the major advantages of biogas plant is that it can be used as source for lighting also. Since majorities of the rural households do not have access to electricity, biogas can be a very good alternative source of illumination. **Table 4-6** depicts the average number of biogas lamps used per household.

Table 4-6: Households Reporting Number of Biogas Lamps

Unit: HHs

Ecological Location	None	One	Two	> Two	Total Reporting
Hill	234 (70.5)	17 (5.1)	1 (0.3)	0 (0.0)	252 (75.9)
Terai	72 (40.4)	0 (0.0)	0 (0.0)	0 (0.0)	72 (40.4)
Total/Overall	306 (60.0)	17 (3.3)	1 (0.2)	0 (0.0)	324 (63.5)

The above figures without and within the parenthesis show the number of respondents and percentage

It is found that the practice of using biogas for lighting purpose has not yet become popular as majority of the respondents both in hill and Terai do not use gas for lighting purpose. Out of 63.5% of total respondents, it is found that 60% do not possess biogas lamps and 3.3% possess one biogas lamp while 0.2% possesses two biogas lamps. This finding is less than the previous year's findings, which revealed that 11% of the sampled households have biogas lamp. The reason for biogas not being used much for lighting could be due to insufficiency of gas even for the cooking. Also with nearly 85% user households having electricity and with the provision of alternative sources of energy for lighting such as electricity (on-grid, off-grid, solar PV, etc) and kerosene, the use of biogas for lighting is curtailed.

4.3 CONSTRUCTION MATERIAL USED

The materials used for construction of biogas plant depend on the local availability of materials and the geographical condition. In remote places without access to transport, it is not feasible to use brick and cement and hence people sometimes also use limestone and mud as construction materials. However, stone is also used for construction as per the convenience and affordability of the households.

Table 4-7: Types of Material Used in the Plant Construction

Unit: HHs

Types of Material	Ecological Belts		
	Hill	Terai	Total
Stone	308(92.8)	145(81.5)	453(88.8)
Brick	62(18.7)	174(97.8)	236(46.3)
Mud	35(10.5)	2(1.1)	37(7.3)
Cement	321(96.7)	175(98.3)	496(97.3)
Lime Stone	-	-	-
Others	47(14.2)	19(10.7)	66(12.9)

The above figures without and within the parenthesis show the number of respondents and percentage.

Table 4-7 depicts that the most of the sample households in Terai have constructed their biogas plants using brick and cement (98%). However, it is found that 82% households in Terai have used stones for base construction. In remote places without access to transport, it is not feasible to use bricks and cement, people have used stone and mud also for plant construction. 93% households in hills have used stone, and 11% have used mud as raw materials. It is also observed that use of bricks and cement is more in Terai as

compared to that in hill, and vice versa incase of stone and mud. This might have been because of the transportation problem in hilly regions and priority given to the locally available materials. This shows possibilities of using locally available construction materials like mud, stones/limestone, etc thus avoiding the land and air pollution which would otherwise be caused due to blasting, mining, excavation and kilning to obtain gravels, cement, sand, and bricks, respectively.

4.4 REDUCTION IN INDOOR AIR POLLUTION

Burning of fossil fuel (kerosene) and biomass including fuel wood, releases harmful pollutants like Hydrocarbons, Carbon-monoxide, SO_x, NO_x, and particulate matters. These products of incomplete combustion (PIC) cause adverse impacts on health and comfort which are injurious to human health. Such harmful pollutants are concentrated in kitchen environment in rural areas where fuel wood is used predominantly as domestic fuel. Studies have shown that indoor air pollution is one of the prime risk factors to human health among rural people, and it specifically affects the vulnerable groups like women, children and elderly. According to MoPE, 2003 the TSP and PM-10 in indoor air of sampled rural area was found to be 3-42 mg/m³ and 1-14 mg/m³, respectively. These values are considerably higher than the WHO standards (TSP-0.12 mg/m³, and PM10-0.07mg/m³).

Replacing traditional fuel by clean and renewable biogas can be a key transformative step in reducing kitchen smoke thus improving the indoor environment.

Table 4-8: Households Reporting Decrease in Smoke in Kitchen

Unit: HHs

Changes Observed	Hill	Terai	Total
Not reduced	37 (11.1)	6 (3.4)	43 (8.4)
Reduced to some extent	122 (36.7)	14 (7.9)	136 (26.7)
Reduced drastically	173 (52.1)	158 (88.8)	331 (64.9)
Total/ Overall	332 (100.0)	178 (100.0)	510 (100.0)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 4-8 depicts that around 92% of the sampled households have reported reduction in kitchen smoke after biogas use. Among them, 65% reported a drastic reduction and 28% to some extent in kitchen smoke. Biogas Users' Survey 2005/06 also had shown similar results (*drastic reduction-64%* and *to some extent – 27%*). However, 8% of the sampled households reported that there is no reduction in kitchen smoke at all. However, the reported cases of less/no reduction of smoke even after biogas use can be attributed to simultaneous use of traditional stoves in the cases of gas deficit for cooking whole day meal or preparing animal feed. Similarly, the reason behind 89% reporting drastic reduction of smoke in hill as compared to only 52% in *Terai* could also be due to more use of improved cooking stove in hill which also improves the indoor kitchen environment.

4.5 GREEN HOUSE GAS EMISSION REDUCTION AND BIOGAS PROGRAM IN NEPAL

Green House Gases (GHG) comprise of gases like carbon monoxide, SO_x, NO_x, methane and other gases, which absorb the solar radiation and trap the heat inside the atmosphere thus causing green house effect. Fossil fuel burning and deforestation may enhance this effect to the extent of becoming harmful to the health and environment. Parameters having direct effect on energy, environment and emission reduction as required by Environmental Management Plan of Clean Development Mechanism (CDM) are dealt with in this section. Kyoto Protocol allows the developed countries to achieve their emission reduction targets by financing CDM projects or by sequestering carbon dioxide from the atmosphere. It is designed to promote sustainable development in developing countries and assist Annex I parties in

meeting their GHG emission reduction commitments. Biogas is a sustainable approach to emission reduction in the context of developing countries like Nepal where more than 80% population depends on agriculture for their livelihood. Biogas project has been the first project in Nepal with significant contribution to the country's economy through carbon trading. Biogas has been the most successful and sustainable project in terms of environmental pollution reduction, basically through energy saving and emission reduction.

4.5.1 Sources of Fuel Wood and Status of Forests

Forests play vital role in regulating climate, controlling water run off, providing wildlife habitat, purifying air, reducing carbon emission, conserving soil and protecting environment. In the context of Nepal, dependency on fuel wood for cooking and heating by about 86% of the population who live in rural areas has caused considerable depletion of forest at local and national level. However, the rural renewable energy like biogas, which has reached to more than 67 districts by now, has played significant role in saving these economically and environmentally valuable natural resources.

Table 4-9: Sources of Fuel Wood Used

Unit: HHs

Sources of Fuel Wood	Terai	Hill	Total
Collected from Forest/Farmland			
Community Forest	100 (30.1)	33 (18.5)	133 (26.1)
Government Forest	73 (22.0)	73 (41.0)	146 (28.6)
Private Forest/ Farmland	226 (68.1)	98 (55.1)	324 (63.5)
Bought	50 (15.1)	65 (36.5)	115 (22.5)
Other			

The above figures without and within the parenthesis show the number of respondents and percentage

Table 4-9 depicts that the sources of fuel wood for its users are basically community forests, government forests, and private forests/upland. It is found that on an average, 63% households use fuel wood from private lands followed by 29% from government forest and 26% from community forest.

Table 4-10: Households Reporting Status of Forest before Biogas Use

Unit: HHs

Extent of Degradation	Hill	Terai	Total
Highly Degraded	88 (26.5)	33 (18.5)	121 (23.7)
Degraded to Some Extent	175 (52.7)	116 (65.2)	291 (57.1)
Not Degraded	25 (7.5)	13 (7.3)	38 (7.5)
Total/Overall	288 (86.7)	162 (91.0)	450 (88.2)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 4-10 shows that 57% of the users reported to some extent of degradation of forests before biogas use, 24% reported high degradation hence totaling to 80.8% saying that forest was degraded. Only 7% said that use of fuel wood did not degrade the forest at all. Along with the significant reduction in fuel wood consumption, it is obvious that the forest degradation has also reduced after biogas installation. Among the total households reporting about the status of forest before biogas use, 91% reported that the degradation had occurred (27% reporting degradation to some extent and 65% reporting high degradation).

4.5.2 Reduction in Green House Gas Emission

Biogas contributes in three different ways to reduce Green House Gas emission, viz, reducing deforestation by saving trees, which would otherwise be used as fuel wood; reducing direct methane emission from the biomass like dung and crop residues; and reducing the GHGs emission by fuel substitution. According to Global Carbon Budget, 25% of annual Carbon Emission is due to deforestation activity.⁵ Smith et. al, 2000 presents the amount of carbon emitted by unit quantity of various traditional energy sources like fuel wood, kerosene, dung and agricultural residues⁶. According to the study, amount of carbon emitted by burning one kilogram of these fuels are: fuel wood - 418 gram Carbon (g-C); kerosene – 843 gram carbon (g-C); dung – 334 gram carbon (g-C); and agriculture residue – 381 gram Carbon (g-C) equivalent of carbon emission. On the basis of this estimation and the findings in **Tables 4-3 and 4-4** it can be concluded that the estimated reduction in carbon emission after biogas use has been as follows:

Table 4-11: Average Reduction in Carbon Emission by Fuel Type

Fuel Type Used before Biogas	Average Reduction in Carbon Emission/Year (g-C)
Fuelwood	812592
Kerosene	12139
Dung cake	9218
Agriculture residue	2286

⁵ www.cdmwatch.org

⁶ IEIA Report, 2002, BSP-N

Chapter 5

IMPACTS ON HEALTH AND SANITATION

This chapter presents the impact of biogas on health and sanitation of the users. For this purpose status of latrine, latrine connection to biogas plants and incidence of respiratory and water borne diseases among the household members both before and after biogas installation are taken as indicators.

Health and sanitation are interrelated issues and indispensable basic human right needed for the sustainability of human life. However, in country like Nepal, where more than 40% of the population live below the poverty line and more than 80% live in rural area, access of a substantial population to health care facilities or even to basic health care services in certain cases may be a luxury . In this context, it is always better to stick to preventive measures than seek curative options to the extent possible so as to avoid several kinds of health malady as well as substantial expenses that may incur in the treatment. Past studies have shown that health care facilities have been made accessible to a substantial rural population through implementation of various development programs including the Biogas Support Program. Communities and individuals not having access to health care services, especially high risk women, children, and people living in remote rural areas have been benefited by biogas programs to a greater extent. With most of their time spent on the claustrophobic kitchen due to use of fuel wood and minimal access to health care services due to poverty, the plight of rural people, especially women and children can only be imagined. But, it has been proven that the use of biogas has been successful in reducing the kitchen smoke and consequently the occurrence of respiratory and other diseases with the use of fuel wood. Biogas has also played a key role in improving sanitation condition in households and surrounding thus decreasing the occurrence of water borne diseases. Thus as a direct implication of improved health and sanitation, the children can have better education and other members can be involved in income generating activities subsequently upgrading the socio-economic status of their family and alleviating poverty.

5.1 STATUS OF LATRINE AND LATRINE ATTACHED BIOGAS PLANTS

5.1.1 Status of Latrine

Latrine is one of the basic amenities from health and sanitation point of view. Proper use and maintenance of latrine helps control water borne diseases. However, in rural communities, improper defecation around the household is a major problem causing various water borne diseases among the members. Considering this scenario, Government in the Tenth Five Year Plan has also focused on implementation of rural sanitation programs in the communities thereby educating people about the importance of sanitation in public health and inspiring people to construct and use private toilets.

Table 5-1: Status of Latrine

Unit: HHs

Presence of Latrine	Before Biogas			After Biogas		
	Hill	Terai	Total (T ₁)	Hill	Terai	Total (T ₂)
Yes	174 (52.4)	122 (68.5)	296 (58.0)	320 (96.4)	175 (98.0)	495 (97.1)
No	158 (47.6)	56 (31.5)	214 (42.0)	12 (3.6)	3 (2.0)	15 (2.9)
	332 (100.0)	178 (100.0)	510 (100.0)	332 (100.0)	178 (100.0)	510 (100.0)

The above figures without and within the parenthesis show the number of respondents and percentage

The studies have shown that the trend of latrine construction at household level has been increasing steadily in past few years along with the increased awareness among people created by development

programs including the biogas program which is also depicted by **Table 5-1** above. The table shows that only 58% of the total sample households had constructed latrines before biogas installation. After biogas installation the percentage has increased to 97%.

5.1.2 Motivation for Latrine Construction

Lack of latrine in rural Nepal is primarily due to people's unawareness about its necessity. Hence in the first place, they need to be made aware of its need and then motivated to construct it. However, sometimes people may get self motivated and construct latrine in their house. Past studies have shown that there are several factors motivating people to construct latrine in their house to keep their surrounding clean and hygienic.

Table 5-2: Motivation for Latrine Construction

Unit: HHs

Motivators	Hill	Terai	Total
Self	258 (77.7)	155 (87.1)	413 (81.0)
Family, Neighbors, Relatives	12 (3.6)	3 (1.7)	15 (2.9)
Biogas Company Staff	39 (11.7)	16 (9.0)	55 (10.8)
NGO Staff	10 (3.0)	0 (0.0)	10 (2.0)
Total/Overall	319 (96.0)	174 (97.8)	493 (96.7)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 5-2 above illustrates that 81% of the households are self-motivated for latrine construction followed by Biogas Company Staff (11%), family, neighbors and relatives (2.9%) and NGO Staff (2%). It is also observed that in hill households 3% are motivated by NGO staff for latrine construction while it is null in *Terai*. This might be due to the intervention of programs like Tourism for Rural Poverty Alleviation Program (TRPAP) which focuses on hilly regions for latrine construction. Compared to last year's data, this year, motivation by Biogas Company Staff for latrine construction has reduced by 9%. However, this might be due to the fact that most of the households became motivated by self to construct the latrine.

5.1.3 Biogas Connected Latrines

The main objective of connecting latrine with the biogas plant is to increase feeding in the plant as well as to resolve the problem of sewerage. Until few years back, people were reluctant to connect latrine to the biogas plants because of various socio-cultural taboos. It was found that some of the elderly people in the family used to have religious constraint and didn't want to have food cooked on gas produced from latrine waste. Similarly, some of the farmers were hesitant to carry the slurry coming out from the latrine attached plants. However, this case is not very common since few years and the trend of connecting latrine to the biogas plant is found to be increasing. This has not only added value to gas production but significantly improved the sanitation condition around the household.

Table 5-3: Biogas Connected Latrines

Unit: HHs

Latrine Connected to Biogas	Hill	Terai	Total
Yes	242 (72.9)	111 (62.4)	353 (69.2)
No	90 (27.1)	67 (37.6)	157 (30.8)
Total	332 (100.0)	178 (100.0)	510 (100.0)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 5-3 demonstrates that 69.2% households have connected their latrine to the biogas plant whereas 31% still have not done so. Looking across the ecological belts, hill households (72.9%) have comparatively higher percentage of latrine connection to plant than *Terai* (62.4%). The reason behind this

can be that in hilly region, the quantity of gas produced is less and hence to increase the quantity of feedstock latrine connection may have been popular. It is noteworthy to find that compared to the previous year's finding, this year the latrine connected biogas plants have increased by 4%.

5.1.4 Reason for Not Connecting the Latrine to the Biogas Plant

Table 5-4: Reason for Not-connecting Latrine to Plant

Unit: HHs

Reasons	Hill	Terai	Total
Company did not suggest	1 (0.3)	0 (0.0)	1 (0.2)
Higher Cost	4 (1.2)	2 (1.1)	6 (1.2)
Social Constraint	0 (0.0)	0 (0.0)	0 (0.0)
New construction Provision	4 (1.2)	1 (0.6)	5 (1.0)
Open space	3 (0.9)	0 (0.0)	3 (0.6)
Total/Overall	12 (3.6)	3 (1.7)	15 (4.8)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 5-4 depicts that only 5% of the total sample households reported the reason for not connecting latrine to the biogas plant, and hence nothing specific could be inferred. However, the available data shows that the reasons behind not connecting the latrine are basically higher cost of construction and lack of open space.

5.2 INCIDENCE OF DISEASES (PRE AND POST INSTALLATION OF BIOGAS)

Incidence of diseases and status of health are important parameters indicating the living standard of people. The incidence of disease pre and post biogas installation can be compared to assess the impact of biogas on the health of its users and the success of the biogas program because biogas is a clean fuel and does not produce smoke and other pollutants harmful to health. Past studies have shown that biogas installation has caused significant reduction in respiratory and water borne diseases which come under the First Priority program of the Tenth Five Year Plan. Among various concerns addressed by the Tenth Plan, self-reliance and gender awareness are also focused for effective health care in its health concerns that will ultimately lead to poverty alleviation. The health status of male, female and children were assessed separately to find out which group has been most benefited by the biogas program from health point of view. Survey data on health status of female, male and children are given in **Table 5-5, 5-6 and 5-7**, respectively.

Table 5-5: Incidence of Diseases and Fire Related Accidents among Biogas User Female

Unit: HHs

Diseases	Increased			Decreased			No Change			No Diseases/ Incidents		
	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total
Eye Infection	6 (1.8)	0 (0.0)	6 (1.2)	189 (56.9)	21 (11.8)	210 (41.2)	24 (7.2)	0 (0.0)	24 (4.7)	75 (22.6)	131 (73.6)	206 (40.4)
Respiratory Disease	5 (1.5)	0 (0.0)	5 (1.0)	108 (32.5)	7 (3.9)	115 (22.5)	33 (9.9)	1 (0.6)	34 (6.7)	118 (35.5)	123 (69.1)	241 (47.3)
Cough	13 (3.9)	0 (0.0)	13 (2.5)	160 (48.2)	12 (6.7)	172 (33.7)	36 (10.8)	0 (0.0)	36 (7.1)	69 (20.8)	116 (65.2)	185 (36.3)
Diarrhea	0 (0.0)	0 (0.0)	0 (0.0)	34 (10.2)	3 (1.7)	37 (7.3)	28 (8.4)	0 (0.0)	28 (5.5)	182 (54.8)	122 (68.5)	304 (59.6)
Dysentery	1 (0.3)	0 (0.0)	1 (0.2)	27 (8.1)	2 (1.1)	29 (5.7)	38 (11.4)	0 (0.0)	38 (7.5)	133 (40.1)	98 (55.1)	231 (45.3)
Round worm/Parasitic Infection	0 (0.0)	0 (0.0)	0 (0.0)	17 (5.1)	3 (1.7)	20 (3.9)	37 (11.1)	0 (0.0)	37 (7.3)	143 (43.1)	95 (53.4)	238 (46.7)
Encephalitis	1 (0.3)	0 (0.0)	1 (0.2)	0 (0.0)	3 (1.7)	3 (0.6)	1 (0.3)	0 (0.0)	1 (0.2)	229 (69.0)	94 (52.8)	323 (63.3)
Malaria	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.6)	4 (2.2)	6 (1.2)	1 (0.3)	0 (0.0)	1 (0.2)	186 (56.0)	94 (52.8)	280 (54.9)
Headache	3 (0.9)	2 (1.1)	5 (1.0)	201 (60.5)	13 (7.3)	214 (42.0)	38 (11.4)	2 (1.1)	40 (7.8)	45 (13.6)	83 (46.6)	128 (25.1)

T.B	0 (0.0)	1 (0.6)	1 (0.2)	0 (0.0)	1 (0.6)	1 (0.2)	1 (0.3)	0 (0.0)	1 (0.2)	183 (55.1)	97 (54.5)	280 (54.9)
Fire and Related Accidents	1 (0.3)	0 (0.0)	1 (0.2)	57 (17.2)	1 (0.6)	58 (11.4)	23 (6.9)	0 (0.0)	23 (4.5)	98 (29.5)	97 (54.5)	195 (38.2)
Others	1 (0.3)	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)	1 (0.2)

The above figures without and within the parenthesis show the number of respondents and percentage

The benefit of the biogas and the success of the program can be directly linked with the improvement in the health of women because they are the ones who spend most of the time in kitchen and hence the prominent users of biogas. As shown in **Table 5-5** majority of the female members (25% to 63% depending upon the disease type) of the sampled households did not have incidence of the diseases whether before or after biogas installation. Among those who reported to have been suffering, it is found that there has been drastic reduction in eye infection and headache (>40%) followed by remarkable reduction in cough (34%) and respiratory diseases (23%). Nearly 6% of the females also mentioned to have reduced cases of diarrhea and dysentery. Those reporting increased frequency of these diseases after biogas installation are negligible being less than 1% in most of the cases. This shows that biogas has played a significant role in improving the health condition of women, who would otherwise be affected by poly-aromatic hydrocarbons present in the smoke coming out of fuel wood. Besides above mentioned diseases, biogas as a clean fuel, also has enormous contribution towards avoiding risk factors for maternal and neonatal health hence assuring safe motherhood.

Table 5-6: Incidence of Diseases and Fire Related Accidents among Biogas User Male

Unit: HHs

Diseases	Increased			Decreased			No Change			No Diseases/ Incidents		
	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total
Eye Infection	1 (0.3)	0 (0.0)	1 (0.2)	143 (43.1)	12 (6.7)	155 (30.4)	40 (12.0)	0 (0.0)	40 (7.8)	88 (26.5)	140 (78.7)	228 (44.7)
Respiratory Disease	1 (0.3)	0 (0.0)	1 (0.2)	83 (25.0)	5 (2.8)	88 (17.3)	36 (10.8)	0 (0.0)	36 (7.1)	137 (41.3)	125 (70.2)	262 (51.4)
Cough	14 (4.2)	0 (0.0)	14 (2.7)	137 (41.3)	8 (4.5)	145 (28.4)	35 (10.5)	0 (0.0)	35 (6.9)	84 (25.3)	120 (67.4)	204 (40.0)
Diarrhea	0 (0.0)	0 (0.0)	0 (0.0)	27 (8.1)	3 (1.7)	30 (5.9)	28 (8.4)	0 (0.0)	28 (5.5)	176 (53.0)	122 (68.5)	298 (58.4)
Dysentery	1 (0.3)	0 (0.0)	1 (0.2)	19 (5.7)	2 (1.1)	21 (4.1)	39 (11.7)	0 (0.0)	39 (7.6)	134 (40.4)	98 (55.1)	232 (45.5)
Round worm/Parasitic Infection	0 (0.0)	0 (0.0)	0 (0.0)	18 (5.4)	2 (1.1)	20 (3.9)	34 (10.2)	0 (0.0)	34 (6.7)	141 (42.5)	96 (53.9)	237 (46.5)
Encephalitis	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.1)	2 (0.4)	1 (0.3)	0 (0.0)	1 (0.2)	188 (56.6)	95 (53.4)	283 (55.5)
Malaria	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)	4 (2.2)	5 (1.0)	2 (0.6)	0 (0.0)	2 (0.4)	184 (55.4)	94 (52.8)	278 (54.5)
Headache	5 (1.5)	0 (0.0)	5 (1.0)	148 (44.6)	8 (4.5)	156 (30.6)	54 (16.3)	1 (0.6)	55 (10.8)	63 (19.0)	89 (50.0)	152 (29.8)
T.B	0 (0.0)	0 (0.0)	0 (0.0)	6 (1.8)	1 (0.6)	7 (1.4)	1 (0.3)	0 (0.0)	1 (0.2)	177 (53.3)	97 (54.5)	274 (53.7)
Fire and Related Accidents	0 (0.0)	0 (0.0)	0 (0.0)	45 (13.6)	0 (0.0)	45 (8.8)	33 (9.9)	0 (0.0)	33 (6.5)	100 (30.1)	98 (55.1)	198 (38.8)
Others	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)	1 (0.2)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 5-6 clearly indicates that biogas use has remarkable positive impact not only on women's health but also on health of the male members of the households. In fact, it can be assumed that biogas also assists in increasing the average life expectancy of elderly people in the family by decreasing their exposure to harmful pollutants and maintaining the sanitation condition around household. Incidents of respiratory and water borne diseases including fire related hazard have fairly decreased after biogas use. Besides, there is also decrease in cases of headache by 31%. This shows that in rural set up where male members also spend substantial time in household activities are also benefited by biogas use.

Table 5-7: Incidence of Diseases and Fire Related Accidents among Biogas User Children

Unit: HHs

Diseases	Increased	Decreased	No Change	No Diseases/ Incidents
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	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total
Eye Infection	10 (3.0)	0 (0.0)	10 (2.0)	103 (31.0)	17 (9.6)	120 (23.5)	11 (3.3)	0 (0.0)	11 (2.2)	62 (18.7)	134 (75.3)	196 (38.4)
Respiratory Disease	0 (0.0)	0 (0.0)	0 (0.0)	61 (18.4)	5 (2.8)	66 (12.9)	8 (2.4)	0 (0.0)	8 (1.6)	102 (30.7)	125 (70.2)	227 (44.5)
Cough	3 (0.9)	0 (0.0)	3 (0.6)	92 (27.7)	11 (6.2)	103 (20.2)	15 (4.5)	0 (0.0)	15 (2.9)	75 (22.6)	117 (65.7)	192 (37.6)
Diarrhea	6 (1.8)	0 (0.0)	6 (1.2)	15 (4.5)	4 (2.2)	19 (3.7)	30 (9.0)	0 (0.0)	30 (5.9)	109 (32.8)	121 (68.0)	230 (45.1)
Dysentery	5 (1.5)	0 (0.0)	5 (1.0)	16 (4.8)	2 (1.1)	18 (3.5)	23 (6.9)	0 (0.0)	23 (4.5)	85 (25.6)	97 (54.5)	182 (35.7)
Round worm/Parasitic Infection	4 (1.2)	0 (0.0)	4 (0.8)	23 (6.9)	2 (1.1)	25 (4.9)	32 (9.6)	0 (0.0)	32 (6.3)	73 (22.0)	96 (53.9)	169 (33.1)
Encephalitis	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.7)	3 (0.6)	1 (0.3)	0 (0.0)	1 (0.2)	125 (37.7)	94 (52.8)	219 (42.9)
Malaria	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	6 (3.4)	6 (1.2)	1 (0.3)	0 (0.0)	1 (0.2)	124 (37.3)	92 (51.7)	216 (42.4)
Headache	0 (0.0)	1 (0.6)	1 (0.2)	83 (25.0)	11 (6.2)	94 (18.4)	15 (4.5)	1 (0.6)	16 (3.1)	84 (25.3)	86 (48.3)	170 (33.3)
T.B	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	124 (37.3)	97 (54.5)	221 (43.3)
Fire and Related Accidents	0 (0.0)	0 (0.0)	0 (0.0)	32 (9.6)	1 (0.6)	33 (6.5)	8 (2.4)	0 (0.0)	8 (1.6)	80 (24.1)	97 (54.5)	177 (34.7)
Others	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)	1 (0.2)

The above figures without and within the parenthesis show the number of respondents and percentage

Children and infants spend most of the time with their mothers and in rural context, women spend significant period of time in kitchen. Hence, installation of biogas has helped improve children's health considerably which is depicted by **Table 5-7** reporting 24% decreased case of eye infection followed by 20% cough, 13% respiratory infections and 5% round worm/parasitic infestations.

It can be found that in all the cases of female, male and children, apart from respiratory and water borne diseases, there has been reduced incidence of other diseases like malaria, encephalitis, TB including fire hazard. This can be attributed to the improved sanitation and reduced exposure to open fire which would be there while using traditional cooking stove.

The comparative analysis between data on diseases among male and female reveals that reduction in respiratory and water borne diseases is more in female. This can be attributed to the fact that women spend most of their time in kitchen, and they are also responsible for maintaining sanitation in and around the household surrounding. However, the status of "No Change" in occurrence of disease among males, females and children indicating same level of infection/infestation, can be due to the use of fuel wood which is commonly still used by the households as a supplementary fuel source for making cattle fodder, boiling milk and water, etc.

Chapter 6

IMPACTS ON GENDER AND RELATED ISSUES

In the Nepalese context, the energy consumption pattern is household oriented. Maximum energy is being consumed by this sector in cooking, heating room, preparing animal fodder and so on. Though both male and female are constantly involved in acquiring energy sources for daily use, females' involvement is found to be much more. Women are the primary users, managers and collectors of traditional energy sources in the rural households. Previous reports on Biogas Users' Survey indicated that biogas technology has brought about substantial improvement in the gender related issues specifically in the livelihood of female using biogas as energy source. Analyzing the impact of biogas on the gender related issues, this chapter deals with various gender concerns including women's involvement in biogas related decision-making, the status of their workload, time saved and its utilization, contribution of women labor in biogas construction, involvement of women in social organizations and so on that have a direct impact on the livelihood of entire family members.

6.1 OWNERSHIP OF PROPERTY AND RESOURCES

Access to resources is a key indicator for analyzing gender and development because the power relation in a family is mostly determined by the ownership of property and resources by male or female of the house. In general, Nepalese women have less access to household property and resources. It has been proved by different studies that women contribute more time and effort than men in household chores as well as agricultural activities, however, due to less access to resources and lack of ownership of household property they are economically weak and always need to depend on their male counterparts. At present, gender equality has been a major concern for the development organizations/institutions from social inclusion point of view. Considering the fact, this survey examined and analyzed the information on ownership of household property and resources by sex. **Table 6-1** presents the male/female ownership status in various property and resources i.e. land cattle, house, vehicle/tractor, cash/bank account and biogas plant.

Table 6-1: Ownership of Property and Resources

Unit: HHs

Property/Resources	Male			Female			Both		
	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total
Land	261 (78.6)	113 (63.5)	374 (73.3)	36 (10.8)	43 (24.2)	79 (15.5)	34 (10.2)	25 (14.0)	59 (11.6)
Cattle/Animals	49 (14.8)	64 (36.0)	113 (22.2)	17 (5.1)	11 (6.2)	28 (5.5)	258 (77.7)	95 (53.4)	353 (69.2)
House	280 (84.3)	130 (73.0)	410 (80.4)	41 (12.3)	40 (22.5)	81 (15.9)	3 (0.9)	6 (3.4)	9 (1.8)
Vehicle/Tractor	45 (13.6)	116 (65.2)	161 (31.6)	5 (1.5)	10 (5.6)	15 (2.9)	6 (1.8)	39 (21.9)	45 (8.8)
Cash/Bank Account	87 (26.2)	95 (53.4)	182 (35.7)	9 (2.7)	21 (11.8)	30 (5.9)	14 (4.2)	7 (3.9)	21 (4.1)
Biogas Plant	230 (69.3)	138 (77.5)	368 (72.2)	81 (24.4)	37 (20.8)	118 (23.1)	0 (0.0)	2 (1.1)	2 (0.4)

The above figures without and within the parenthesis show the number of respondents and percentage

It is found from the above table that in both the cases of *Terai* and hill, majority of the ownership of property and resources lie with male members of biogas user households except that of cattle/animals. With regard to cattle/animal both male and female have a joint ownership in both the regions. Male in *Terai* mostly owned vehicles/tractors, whereas very few male as well as female owned vehicles/tractors in hill showing poverty and unfavorable landscape for using vehicles/tractors in the hill. All in all, it can be inferred that rural women are still lagging far behind in terms of sharing equal power relation with their male counterparts and a very bleak situation of their economic status is reflected.

6.2 GENDER ROLE IN DECISION MAKING PROCESS

In a patriarchal society like ours', involvement of women in decision-making process, more so at the rural level is negligible, widely expressing gender inequality. Female's involvement in household decision-making process shows the active or passive participation in household activities. As obvious, the prime beneficiaries of biogas plant are female who spend most of the time in kitchen and who are primarily responsible for feeding the plant, hence it is very necessary that they are involved in the decision making process in relation to the biogas plant. **Table 6-2** shows the current status of involvement of both male and female in decision-making with regard to biogas plant implementation and other activities related to it.

Table 6-2: Gender Role in Decision Making Process

Unit: HHs

Property/Resources	Male			Female			Both		
	Hill	Terai	Total	Hill	Terai	Total	Hill	Terai	Total
Plant installation	169 (50.9)	104 (58.4)	273 (53.5)	30 (9.0)	7 (3.9)	37 (7.3)	125 (37.7)	62 (34.8)	187 (36.7)
Selection of biogas company	214 (64.5)	131 (73.6)	345 (67.6)	26 (7.8)	8 (4.5)	34 (6.7)	84 (25.3)	34 (19.1)	118 (23.1)
Connection of toilet to biogas plant	87 (26.2)	72 (40.4)	159 (31.2)	16 (4.8)	8 (4.5)	24 (4.7)	167 (50.3)	57 (32.0)	224 (43.9)
Selection of location for biogas construction	151 (45.5)	116 (65.2)	267 (52.4)	24 (7.2)	8 (4.5)	32 (6.3)	145 (43.7)	48 (27.0)	193 (37.8)
Construction of cattle shed	124 (37.3)	110 (61.8)	234 (45.9)	20 (6.0)	8 (4.5)	28 (5.5)	160 (48.2)	51 (28.7)	211 (41.4)
Bank and financial dealing	144 (43.4)	125 (70.2)	269 (52.7)	14 (4.2)	9 (5.1)	23 (4.5)	89 (26.8)	32 (18.0)	121 (23.7)

The above figures without and within the parenthesis show the number of respondents and percentage

Despite female being the prime beneficiary of the biogas use, ironically, it is found from the survey that they have a very negligible representation in the decision-making related to various process of biogas installation. In majority of the households, both in hill and in *Terai*, male members are the main decision-makers regarding biogas plant installation, selection of Biogas Company, selection of location for plant construction, construction of improved cattle shed and in financial dealings/bank loan.

6.3 WOMEN LABOUR INPUT IN BIOGAS PLANT INSTALLATION

The construction of biogas requires labour, both skilled and unskilled. Generally, Biogas Companies take the responsibility of plant construction but depending upon the socio-economic status of a household and also interest of the members; they contribute their labour and assist the company technicians. In this regard from gender perspective, it is attempted to see the female labour input during plant construction.

Table 6-3: Women Labour Input in Biogas Plant Installation

Unit: HHs

Activities/Labor Input Type	Hill		Terai		Both	
	Number of HHs Responding	Average Days of Labor Contribution	Number of HHs Responding	Average Days of Labor Contribution	Number of HHs Responding	Average Days of Labor Contribution
Skilled	28 (8.4)	19.1	4 (2.2)	6	32 (6.3)	17.5
Unskilled	221 (66.6)	12	61 (34.3)	6.5	282 (55.3)	10.8

The above figures without and within the parenthesis show the number of respondents and percentage

Table 6-3 depicts that majority of the women in both hill and *Terai* (55.3%) work as unskilled laborer during construction (66.6% in hill and 34.3% in *Terai*) contributing on an average 10.8 days. The difference in hill and *Terai* can be interpreted as due to the difference in socio-cultural norms in the two regions as well as high poverty in hill as compared to *Terai*. Also 8.4% households in hill and only 2.2% in *Terai* were found to work as skilled laborers. However, it is more as compared to last year's survey where only 1.9% women were used as skilled labours which in case of *Terai* was nil and also their average days of labor contribution was only 5.

6.4 TIME DEVOTED BY FEMALE BEFORE AND AFTER BIOGAS PLANT INSTALLATION

In rural areas, besides the agricultural activities, most time of women is spent doing household activities such as livestock caring, fetching water, collecting firewood/preparing dung for cooking, collecting fodder for livestock, cooking food for household members, cleaning utensils, etc. Household management including energy management is women's business in most cases. However, the burden of traditional biomass energy has an implication with time, safety and stress to them. In this regard, biogas technology has certainly reduced women's workload in some of the household activities.

Referring from **Table 2-10**, it is found that substantial amount of time after installing and using biogas is saved in various activities that include livestock caring, collecting firewood/ preparing dung cake, cooking food and cleaning utensils indicating that the technology has benefited them. 17 minutes/day is saved in livestock caring, 157 minutes/day in collecting firewood/preparing dung cake, 60 mins./day in cooking and 23 min./day in cleaning utensils. However, there is additional time required for feeding plant, fetching water and collecting fodder. In spite of this, on an average, in a day 220 minutes is saved. Hence, this time can be utilized by women/men in various other activities including their own personality and knowledgebase enhancement.

6.5 UTILIZATION OF SAVED TIME AFTER BIOGAS PLANT

Women/men can use the saved time in various activities including involvement in income generating activities which is quite important for the economic empowerment of the family as a whole and women in specific. Besides, if women save time from household activities, they can get involved in different community based activities which will definitely empower them and involve them in decision-making processes. It has been proved by the previous surveys that time is saved after installation of biogas plants and **Table 6-4** explains how women utilize their saved time after biogas plant installation in the study districts.

Table 6-4: Utilization of Saved Time in Various Activities

Unit: HHs

Activities	Hill	Terai	Total
Adult Education	4 (1.2)	3 (1.7)	7 (1.4)
Recreation (Watching TV, Listening Radio, Reading Newspaper, Books, Magazines etc.)	124 (37.3)	111 (62.4)	235 (46.1)
Social Work	58 (17.5)	65 (36.5)	123 (24.1)
Income Generating Activities	51 (15.4)	95 (53.4)	146 (28.6)
Others	109 (32.8)	9 (5.1)	118 (23.1)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 6-4 depicts the use of saved time in different activities after plant installation by the household members. It is found that most of the time saved is utilized in recreation, watching TV and listening to radio (46.1%) which supports the fact that majority of the households being literate are eager to seek information and entertainment at the same time. This data is followed by 28.6% involved in income generating activities, 24.1% in social works, magazines, etc and 23.1% in household activities and agriculture work. Only 1.4% were found to indulge in adult literacy class. Of these various activities, in majority of the activities except farm works and attending children, more *Terai* households were found to be involved than the hill. With the larger percentage of households utilizing their leisure time in reading and enhancing their knowledge base and information sources as well as in social works the increased awareness among people regarding their self development and the development of their community is greatly reflected. And hence the positive impact of biogas in the socio-economy of the users is unequivocal.

6.6 CHANGES IN THE TIME UTILIZATION PATTERN AFTER BIOGAS PLANT INSTALLATION

Biogas plant provides clean energy for cooking and lighting. Besides this, it also saves considerable time of the users hence providing them with surplus time for other activities, therefore, it is a boon to the rural communities. Time allocation in various activities in a day to day life is very important, especially for rural women. There are infinite ways in which time is used or misused. Managing time is concerned with decisions for action.

Table 6-5: Changes in the Time Utilization Pattern after Biogas Plant Installation

Unit: HHs

Activities	Hill		Terai	
	Increased	Decreased	Increased	Decreased
Child Care	180 (51.3)	88 (25.1)	171 (94.0)	2 (1.1)

Cleaning Household Surroundings	202 (57.5)	129 (36.8)	171 (94.0)	8 (4.4)
Take Care of Patients Elderly Members	112 (31.9)	127 (36.2)	84 (46.2)	56 (30.8)
Water Fetching	283 (80.6)	20 (5.7)	142 (78.0)	32 (17.6)
Mixing Dung with Water	326 (92.9)	3 (0.9)	152 (83.5)	21 (11.5)
Fodder Collection	190 (54.1)	39 (11.1)	77 (42.3)	27 (14.8)
Forage Collection	2 (0.6)	325 (92.6)	12 (6.6)	104 (57.1)
Cooking	2 (0.6)	327 (93.2)	0 (0.0)	175 (96.2)
Cleaning Dish	2 (0.6)	327 (93.2)	0 (0.0)	177 (97.3)
Others	1 (0.3)	2 (0.6)	0 (0.0)	3 (1.6)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 6-5 illustrates that majority of female members of biogas user households are benefited by biogas plants because it has given them adequate time to get involved in various other activities that are equally important. Of the total respondents, 94% in *Terai* and 51.3% in hill reported that they can give more time for child care. Again 57.5% in hill and 94% in *Terai* said they get more time to tend their home and keep surroundings clean. Similarly, 92.6% in hill and 57.1% in *Terai* reported that they require less time for forage collection, 93.2% in hill and 96.2% in *Terai* asserted that time for cooking has decreased and also less time required for cleaning as reported by another 93.2% in hill and 97.3% in *Terai*. However, 80.6% in hill and 78% in *Terai* said that they required more time for fetching water, 92.2% in hill and 83.5% in *Terai* said the time required for mixing dung with water has increased. Also 54.1% in hill and 42.3% in *Terai* asserted to increased time requirement for fodder collection which is due to stall feeding practice. All in all women have found that their time allocation in various activities has reduced which can be utilized for taking care of children, elderly and keeping their house and surrounding clean.

6.7 IMPACT OF BIOGAS ON COMMUNITY DEVELOPMENT

With so much time saved after biogas installation and increased participation of female in social works, their involvement in community-based organizations, NGOs and other civil society organizations needs to be assessed which is equally necessary for community development. The members of those organizations in a society work for common interest - community as well as individual development, and hence female's participation in such organizations is important. This kind of involvement not only helps to empower them but also instigate a sense of community development. **Table 6-6** shows the status of women's participation in various civil society organizations utilizing the time saved after the installation of biogas plants.

Table 6-6: Status of Female Participation in Various Civil Society Organizations after Biogas Plant Installation

Organizations	Unit: HHs		
	Hill	<i>Terai</i>	Total
Mothers Group	110 (33.1)	47 (26.4)	157 (30.8)
Cooperatives	87 (26.2)	62 (34.8)	149 (29.2)
Forest Users' Group	78 (23.5)	55 (30.9)	133 (26.1)
Others	32 (9.6)	9 (5.1)	41(8)

The above figures without and within the parenthesis show the number of respondents and percentage

It is found from the above table that out of total 30.8% women involved in Mother's Group, 33.1% are from hill and 26.4% from *Terai*. Compared to the previous year's finding which had shown only 17.1% women involvement, this year it has raised remarkably. This is followed by 29.2% women (26.2% in hill and 34.8% in *Terai*) involved in Cooperatives, 26.1% (23.5% in

hill and 30.9% in *Terai*) in Forest Users' Group, and remaining 8% in others. Compared to the BUS 2006 data, this year women's involvement in each of these organizations has increased.

6.8 WOMEN'S PERCEPTION ON SOCIAL STATUS AFTER BIOGAS PLANT INSTALLATION

Women's development requires not only access to resources and increase in household income but also increase in their social status. In present study questions were asked with regard to women's perception on increase or decrease in their social status after installation of biogas plants in their households. **Table 6-7** presents their perception in this regard in the study areas.

Table 6-7: Women's Perception on Social Status after Biogas Plant Installation

Unit: HHs

Activities	Increased			Decreased			Same		
	Hill	Teraí	Total	Hill	Teraí	Total	Hill	Teraí	Total
Cohesion/co-operation among family members	192 (57.8)	145 (81.5)	337 (66.1)	0 (0.0)	0 (0.0)	0 (0.0)	125 (37.0)	28 (15.4)	153 (29.6)
Participation in the Social Activities Neighborhood	176 (53.0)	141 (79.2)	317 (62.2)	0 (0.0)	0 (0.0)	0 (0.0)	137 (40.5)	32 (17.6)	169 (32.6)
Visit to Family Planning Center and Health Center	109 (32.8)	107 (60.1)	216 (42.4)	3 (0.9)	0 (0.0)	3 (0.6)	165 (48.7)	64 (35.7)	229 (44.3)
Others	0 (0.0)	3 (1.7)	3 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

The above figures without and within the parenthesis show the number of respondents and percentage

It was found that in majority of sample households, women received cohesion cooperation from the family members (58% in hill and 81.5% in Teraí) after biogas plant installation. Similarly, majority of women expressed the view that participation in various social activities in neighborhood has increased after biogas plant installation. Likewise significant proportion of women (33% in hill and 60% in Teraí) could visit Family Planning Center and Health Center after biogas plant installation. They got more time for participation in various social activities and visiting Health Center and Family Planning Center, which is a positive sign of improvement in their quality of life. However, 44.3% women said that the status of their visit to family planning center and health centers has remained same.

6.9 SUGGESTIONS FOR THE IMPROVEMENT OF LIFE OF RURAL WOMEN AND CHILDREN

In the context of biogas program, where women are the prime beneficiaries, they are the better advisors for improving the program. Due to their direct involvement with the technology, they are the ones who can identify the problems and thereby suggest possible non-technical solutions. The suggestions thus provided by them can be of immense significance for improving their livelihood and enhancing their social status. Despite the fact that one of the major reasons for introducing the biogas technology at rural level is to relieve women of their workload and make their life better from health, hygiene and their own social development point of view, there might be some gaps which need to be fulfilled to actually make this program successful and guarantee a complete satisfaction to its users. With this mindset, during the field visit the women members of the households were made to give their opinion regarding the improvements needed in the program which will directly or indirectly have a positive impact on their life. Some of the significant suggestions made were:

- Need for training programmes to enhance their skill and knowledge on agriculture, health & sanitation, kitchen management and other aspects.
- Need for training to women on technical aspects of biogas plant like operation, repair and maintenance.

CONSTRUCTION, OPERATION AND MAINTENANCE OF BIODIGESTOR

This chapter deals with the state of operation, repair and maintenance of the installed biogas plants. The durability of plant, its proper functioning and smooth flow of gas all depends upon its construction, operation and maintenance. Hence, after the installation of plant, it is vital to ensure its smooth functioning by carefully operating the plant and undertaking the timely maintenance and repair services, as and when required. In this context, for getting information on the construction, O&M status of bio-digester the different parameters like amount, type and quantity of materials being fed into the digester, the state of gas production, their uses for different purposes, perceptions of the users, state and type of maintenance services, types of training provided to the beneficiaries, problems encountered both in appliances and civil structures, mitigation measures being followed etc. are discussed. These kinds of information are significant not only for ensuring timely and quality services to the biogas users and hence giving them satisfaction with the technology but equally important for identifying the shortcomings of the technology and improvising the on-going program accordingly to ensure better planning and implementation of future projects.

7.1 REASONS FOR INSTALLING BIOGAS PLANT

Though there are many advantages of the installation of biogas plant, individual households might have different specific reasons for biogas installation. The sampled households were asked to state the major reasons for installing the biogas plant. Table 7-1 below gives the picture of the reasons for which the households have installed biogas plants and they have been expressed by ecological locations in terms of households and percentage.

Table 7-1: Reasons for Installing Biogas Plant

Unit: HHs

Reasons	Hill	Terai	Total
Shortage of Firewood	278(83.7)	164(92.1)	442(87)
Easy Cooking	295(88.9)	156(87.6)	451(88)
Smokeless Kitchen	272(81.)	143(80.3)	415(81)
Improved Sanitation by Attaching Toilet	177(53.3)	88(49.4)	265(52)
Time Saving	254(76.5)	137(77)	391(77)
Slurry can be used as Manure	69(20.8)	77(43.3)	146(29)
Energy Source for Lightning	35(10.5)	5(2.8)	40(8)
Subsidy Provision	90(27.1)	24(13.5)	114(22)
Others	36(10.8)	2(1.1)	38(7)

The above figures without and within the parenthesis show the number of respondents and percentage.

The table above reveals mixed view points with regards to the reasons for biogas installation both in hill and Terai. However, shortage of firewood (92.1%) in Terai and easy cooking (88.9%) in hill are the major reasons for the installation of plant. Other reason scoring more than 80% is the smokeless kitchen. Time saving is another factor scoring more than 75% both in hill and Terai. Farmers do not seem to take biogas as a major energy for lighting purpose as this is reported by least in both in hill and Terai. It is strange to note that quite a good percentage (22%) of households surveyed (27.1% in hills and 13.5% in Terai) have stated provision of subsidy as the reason for biogas installation. However, the percentages of households stating the subsidy as the reason for biogas installation is just about half than that of the BUS 2006 findings. In the previous year's findings there was quite significant difference of opinions among the two ecological locations with regards to improved sanitation by attaching toilet (71% hill & 13.8% Terai). But this year no such differences were observed. However, like last year, this year also shortage of firewood, smokeless

kitchen, easy cooking and time saving have remained the four major reasons for biogas plant installation in both the ecological belts.

7.2 GAS PRODUCTION

7.2.1 Biogas Plants Producing Gas

Biogas plants are basically installed to produce gas and the sampled households were asked to state whether their plants are currently (at the time of survey) producing gas or not. **Table 7-2** below depicts the current state of gas production.

Table 7-2: Biogas Plants Producing Gas

Unit: HHs

Ecological Belts	Producing Gas		
	Yes	No	Total
Hill	336(94.9)	18(5.08)	354
Terai	179(98.8)	2(1.1)	181
Total/Overall	515(96.2)	20(3.7)	535

The above figures without and within the parenthesis show the number of respondents and percentage.

The table above reveals that out of the total sampled biogas plants, 96.2 % were found producing gas. Compared to the last year's survey finding, which was 98.7%, this year there is a slight dip in gas producing biogas plants.

The 5 plants that could not be located during the survey have been also included as operating plants after being provided with the proof by BSP-N. However, these plants are not included in other interpretations due to unavailability of data.

7.2.2 Failure in Gas Production in the Past

Smooth and constant production of gas determines success of biogas plant. The table below illustrates the households reporting gas stoppage and also the duration of gas stoppage from the biogas plant in the past.

Table 7-3: Biogas Plants Stopped Producing Gas in the Past

Unit: HHs

Ecological Belts	HH Reporting Halt			Duration of Halt in Days			
	Yes	No	Total	Up to 7 Days	8 - 15 Days	More than 15 days	Total
Hill	41(12.3)	291(87.7)	332	27(65.8)	5(12.2)	9(21.9)	41
Terai	28(15.7)	150(84.3)	178	18(64.3)	3(10.7)	7(25.0)	28
Total/Overall	69(13.5)	441(86.5)	510	45(65.2)	8(11.6)	16(23.2)	69

The above figures without and within the parenthesis show the number of respondents and percentage

Table 7-3 depicts that on an average, about 86% of the respondents (84% in Terai and 88% in hill) reported that their plants have not failed to produce gas in the past. These figures are marginally low compared to the last years findings (2005/06) in which the figures were 90% in Terai and 94% in hill. Out of about 14% plants

reporting halt in gas production for sometime in the past, about 65% said that it stopped up to 7 days only while 11% and 23 % reported the halt for 8- 15days and more than 15 days, respectively.

7.2.3 Reasons for Failure in Gas Production (Past and Current)

There are many reasons for gas production failures. However, no feeding, appliances failures and damaged civil structures are considered the major reasons for production failure. The sampled households were asked to state the reasons for gas production failure. Table 7-4 below depicts the reasons for the failure in gas production in the past and also in the present, as perceived by the sampled households.

Table 7-4: Reasons for Failure in Gas Production (Past and Current)

Unit: HHs

Ecological Location	No Feeding	Failure of Appliances	Civil Structure Damaged	Do Not Know	Total
Hill	6(13.0)	28(61.0)	6(13.0)	6(13.0)	46(100)
Terai	0	15(55.5)	4(14.8)	8(29.7)	27(100)
Total/Overall	6(8.2)	43(58.9)	10(13.7)	14(19.27)	73(100)

The above figures without and within the parenthesis show the number of respondents and percentage

The above table shows that among the respondents, who lodged complaint of no gas production from the plant, about 59% reported the failure of appliances followed by about 14% civil structure damage and about 8% (only in hills) stating no feeding as the major reasons for gas production failure. About 19% of the respondents did not seem to know the reasons for the gas production failure. Compared to the findings of BUS 2006 the households reporting production failures is a little higher and with regards to the reasons for gas production failure as in the previous year failure of appliances has remained the major reason.

7.3 PLANT FEEDING

7.3.1 Plant Feeding Practices

Quantity of feed and frequency of feeding are very important factors for successful operation of biogas plant. Table 7-5 below illustrates the frequency and quantity of feeding in the plant among the sample households.

Table 7- 5: Information on Plant Feeding

Unit: HHs

Feeding	Average Quantity Fed (kg)			HH Reporting (No)		
	Hill	Terai	Total	Hill	Terai	Total
Once a Day	20.9	26.8	23.5	200(61.3)	156(88.6)	356(70.9)
Twice a Day	30	37.1	31.5	16(4.9)	6(3.4)	22(4.4)
Every Alternate Day	20.7	37.6	27.8	61(18.7)	7(3.8)	69(13.7)
Twice a Week	40.9	36.8	40.6	23(7.1)	4(2.3)	27(5.4)
Once a Week	22.2	43.3	24.5	25(7.7)	3(1.7)	28(5.6)
Total/Overall	24	28.1	25.4	326	176	502

The above figures without and within the parenthesis show the number of respondents and percentage.

The table above reveals that both in hill and in Terai daily feeding is the most popular practice. However, daily feeding is more popular among Terai households (88.6%) than hill households (61.3%). In hill substantial percentage of households (18.7%) follow alternate day feeding practice with about 7% each following twice a week and once a week feeding practices, whereas in Terai the number of households following practices other than daily feeding are negligible. The previous year survey had shown alternate

day feeding equally popular as the daily feeding practice in *Terai*. The finding of wide range in the feeding practices in the hills concurs with that of the findings of the 2005/06 survey.

7.3.2 Dung Feeding Status and the Reason for Not Feeding All Dung in Biogas Plant

While dung is the main feeding material for household biogas plants, major constituent of Farm Yard Manure (FYM) of the rural households is also dung. Since most Nepalese Farming Systems are still FYM based, all the dung available with the households is not fed into the plant. Table 7-6 and Table 7-7 below points out status of dung feeding into the plant and the reasons for not feeding all the available dung in the plant by the users.

Table 7-6: Households Feeding/Not Feeding all Available Dung

Unit: HHs

Dung Feeding Status	Hill	<i>Terai</i>	Total
HH Feeding all Dung	133(43.6)	130(79.3)	263(56.1)
HH Not Feeding all Dung	172(56.4)	34(20.7)	206(43.9)
Total/Overall	305	164	469

Table 7-7: Reasons for Not Feeding all Available Dung

Unit: HHs

Reasons	Hill	<i>Terai</i>	Total
Sufficient Gas	101(58.7)	33(97.0)	134(65.0)
Fear of Nutritional Quality of FYM	21(12.2)	0	21(10.2)
Lack of Time	24 (13.9)	1(3.06)	25(12.2)
Other Reasons	26(15.1)	0	26(12.6)
Total	172(100)	34(100)	206

The above figures without and within the parenthesis show the number of respondents and percentage

Table 7-6 reveals that about 56.1% of the respondents feed all the available dung in plant while 43.9% do not feed all the available dung into the plant. Majority of *Terai* users (79.3%) feed all available dung while majority of hill users (56.4%) do not feed all the available dung.

With regards to the reasons for not feeding all dung, Table 7-7 shows that out of the 172 responding households in hill about 59% and out of 34 respondents in *Terai* 97% stated gas sufficiency to be the major reason for not feeding all the available dung to the plant. The rest 41% hill respondents seem to be almost equally divided among the reasons other than the sufficient gas. In case of *Terai* sufficiency is almost the sole reason for not feeding all dung to the plant. The findings of this year are to a great extent similar to the findings of BUS 2006 survey.

7.3.3 Type of Feeding Material

Though dung is the major feeding material, now-a-days other materials like use of human faeces by connecting latrines to the biogas plant, pig dung, poultry droppings, etc are also getting popular.

Table 7-8: Type of Feeding Material for Biogas Plant Other than Cow Dung

Unit: HHs

Type of Feeding Material	Hill	Terai	Total
Night Soil (Human Excreta)	185(55.7)	46(25.8)	231
Pig Dung	2(0.6)	0	2
Poultry Droppings	3(0.9)	0	3
Other	9(2.7)	8(4.5)	17

The above figures without and within the parenthesis show the number of respondents and percentage

Table 7-8 depicts different types of feeding practiced by the sample households. It is found that besides cow dung, about 45% of the sampled households use human excreta by connecting latrine with biogas plant followed by few households using pig dung and poultry droppings. The table also reveals that practice of latrine connection is comparably very popular in hill than in Terai. The practice of using pig dung and poultry droppings is very negligible perhaps due to low volume of availability and less number of households having pigs in their households. The findings are in concurrence with the previous year's result.

7.4 WATER REQUIREMENT

With the installation of biogas plant household requirement of water is expected to increase naturally. The Table 7-9 hereunder depicts additional water requirement for different purposes after the installation of biogas plant.

Table 7-9: Additional Water Required After the Installation of Biogas Plant

Unit: Litre/day

Ecological Location	Total Additional Requirement	Needed for Plant Feeding	Needed for Livestock	Needed for Other Purposes
Hill	46	24	11	11
Terai	92	45	45	2
Total/Overall	62	31	23	8

The above figures without and within the parenthesis show the number of respondents and percentage

The table above reveals that on an average about 62 liters of water is additionally required per household after the installation of biogas plant. Out of this, 50 % is used for plant feeding while 37 % is used for livestock and rest is used for other household purposes. Ecological location wise, additional water requirement in Terai is 46 liters more than in hills. Unlike hill, in Terai the additional water is equally distributed between plant feeding and livestock purposes. Compared to previous year's finding, additional water requirement after plant installation is more by about 50% in the hill while in case of Terai not much difference was observed.

7.5 MEASURES TO INCREASE GAS PRODUCTION

Biogas owner generally measures the success or failure of the biogas plant by the sufficiency or insufficiency of the gas for domestic use. In the situation of gas insufficiency biogas users generally take different measures to increase their gas production. The table below states the measures being taken by the respondents.

Table 7-10: Measures Taken to Increase Gas Production

Unit: HHs

Measures Taken	Hill	Terai	Total
Increase Feeding	145(43.7)	99(55.6)	244(47.8)
Feed after Heating in the Sun	19(5.7)	12(6.7)	31(6.1)
Cover the Dome with Mud/ Straw	9(2.7)	6(3.4)	15(2.9)
Feed other Material in the Plant	5(1.5)	1(0.6)	6(1.2)
Attach Toilet with the Plant	58(17.5)	60(33.7)	118(23.1)
Do Nothing	118(35.5)	54(30.3)	172(33.7)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 7-10 reveals that increased feeding is the most popular practice being followed to increase gas production. On an average about 48 % (55% in Terai & 44% in hill) of the sample households follow this practice and around 23 % (34% in Terai & 17% in hill) of the respondents were found connecting latrines to increase gas production. Attaching latrines, in fact, is another form of increased feeding. Hence, on an average it can safely be said that 71 % of the sample households feel that increased feeding is a prime measure for increasing gas production. It is quite strange to note that despite feeling gas insufficiency about 34% were found making no effort to increase gas production. The reason for this may be their ignorance. The findings are in concurrence with that of the previous survey except for the fact that this year more percentage of sampled households were found taking measures of connecting latrines to the plants while percentage of households taking no measures to increase production increased by about 10 % as compared to 2005/06 survey.

7.6 LEVEL OF SATISFACTION WITH BIOGAS PLANT

7.6.1 Level of Satisfaction by Installation period

The level of satisfaction with the biogas plant is directly linked with the smooth functioning of the plant and sufficient production of gas. Table 7-11 below demonstrates level of satisfaction by the installation period of the biogas plants.

Table 7-11: Level of Satisfaction by Installation Period

Unit: HHs

Level of satisfaction	Installation Period						Total	
	Within 3 Years		3-6 years		More than 6 years		Hill	Terai
	Hill	Terai	Hill	Terai	Hill	Terai		
Fully Satisfied	68(51.9)	32(54.2)	61(58.1)	44(69.8)	56(58.9)	27(48.2)	185(55.9)	103(57.9)
Satisfied	58(44.3)	25(42.4)	41(39.0)	16(25.4)	35(36.8)	26(46.4)	134(40.5)	67(37.6)
Not Satisfied	5(3.8)	2(3.4)	3(2.9)	3(4.8)	4(4.2)	3(5.4)	12(3.6)	8(4.5)
	131	59	105	63	95	56	331	178

The above figures without and within the parenthesis show the number of respondents and percentage

The table reveals that among 3 years old plant out of 131 respondents in the hill about 52 % reported to be fully satisfied while about 44% reported as satisfied, while in Terai out of the 59 respondents 54 % were fully satisfied and about 42 % were satisfied. It is quite gratifying to note that more than 58 % of the respondents in hill reported full satisfaction both in cases of 3-6 years and more than 6 years old plants with only a few households expressing dissatisfaction. In Terai about 70 % of the respondents among 3-6 years old plants and 48% of the respondents among more than 6 years old plants reported full satisfaction. In total 96.2% users in hill and 96.6% in Terai are satisfied with the performance of the installed biogas. Only about 3.6% on an average are dissatisfied.

7.6.2 Reasons for Satisfaction with Biogas Use

The Table 7-12 below presents various mixed reasons given by sample households for their satisfaction with the biogas.

Table 7-12: Reasons for Satisfaction with Biogas Installation

Unit: HHs

Reasons	Hill	Terai	Total
Smokeless Cooking	279(84)	160(89.9)	439(86.1)
Fast Cooking	268(80.7)	153(86)	421(82.5)
Tasty Food	87(26.2)	122(68.5)	209(41)
Easy and fast Dish washing	289(87)	143(80.3)	432(84.7)
Constant Watching Not Necessary	235(70.8)	119(66.9)	354(69.4)
Other	9(2.7)	4(2.2)	13(2.5)

The above figures without and within the parenthesis show the number of respondents and percentage

As indicators of satisfactions cannot be quantified, it was measured in terms of the reasons given by them for their satisfaction. The table above reveals that smokeless cooking (86%), and easy and fast dish washing (84.7%) followed by fast cooking (82.5%) are the unanimous reasons for the satisfaction with biogas installation in both the ecological belts. Regarding the good taste of the food cooked in biogas there seemed to be some degree of difference in opinion between hill and Terai users with only 26 % of the respondents stating tasty food in the hill and about 69 % of the Terai respondents expressing the same.

7.6.3 Reasons for Dissatisfaction with Biogas Use

As there are reasons for satisfaction, there must be reasons for dissatisfaction as well. The Table 7-13 below depicts the reasons stated by responding households for their dissatisfaction with biogas use.

Table 7-13: Reasons for Dissatisfaction with Biogas Use

Unit: HHs

Reasons	Hill	Terai	Total
Gas not sufficient	5(1.5)	0	5(1)
Less tasty food	61(18.4)	3(1.7)	64(12.5)
Frequent Repairs	19(5.7)	4(2.2)	23(4.5)
Frequent Failure of Appliances	17(5.1)	1(0.6)	18(3.5)
Toilet Attached	17(5.1)	0	17(3.3)
Other	3(0.9)	0	3(0.6)

The above figures without and within the parenthesis show the number of respondents and percentage

It is quite striking to note from the above table that the major reason for dissatisfaction with biogas use is less tasty food. Equally striking to note is that high number of households has expressed dissatisfaction with biogas in hill as compared to Terai which has only a few households expressing dissatisfaction. This year's survey finding in this aspect is quite in contrast to that of the last year when gas insufficiency was stated as the major reason for dissatisfaction followed by less tasty food and frequent failure of appliances.

7.6.4 Level of Satisfaction with Biogas Lamps

Practice of using biogas as source for lighting has not yet become popular. However, the table below depicts the degree of satisfaction with biogas lamps among the responding sample households.

Table 7-14: Level of Satisfaction with Biogas Lamps

Unit: HHs

Ecological Location	Fully Satisfied	Satisfied	Not Satisfied	Total Reporting
Hill	8(2.4)	3(0.9)	25(7.5)	36(10.8)
Terai	0	0	20(11.2)	20(11.2)
Total/Overall	8(1.6)	3(0.6)	45(8.8)	56(11)

The above figures without and within the parenthesis show the number of respondents and percentage

The Table 7-14 above depicts that of the 56 responding households 8 expressed full satisfaction while 3 were satisfied (only in hill). No household in *Terai* expressed satisfaction with biogas lamp use. Out of 45 households expressing no satisfaction 25 were from hills and 20 from *Terai*. The findings seemed to concur with that of 2005/06 survey.

7.6.5 Reasons for Satisfaction with Biogas Lamp Use

There were few households in hill which expressed satisfaction with biogas lamp use. The table below depicts the reasons for satisfaction with the use of biogas lamps among those sample households who responded.

Table 7-15: Reasons for Satisfaction with Biogas Lamps Use

Unit: HHs

Reasons	Hill	Terai	Total
Bright Light	8(2.4)	0	8(1.6)
Easy to Use	3(0.9)	0	3(0.6)
Can work even During Night	6(1.8)	0	6(1.2)

The above figures without and within the parenthesis show the number of respondents and percentage

Among the biogas lamp users from hill who had expressed satisfaction with lamp, the reasons given were bright light and provision to work even during night.

7.6.6 Reasons for Dissatisfaction with Biogas Lamp Use

Table 7-16: Reasons for Dissatisfaction with Biogas Lamps

Unit: HHs

Reasons	Hill	Terai	Total
Frequent Breakage of Mantle	5(1.5)	0	5(1)
Frequent Breakage of Glass	6(1.8)	0	6(1.2)
Difficult to Light	1(0.3)	0	1(0.2)
Not Movable	1(0.3)	0	1(0.2)
Others	0	0	0

The above figures without and within the parenthesis show the number of respondents and percentage

Though there were 20 households in *Terai* who had expressed dissatisfaction with biogas lamp use, it is astonishing to find that no household could state precise reason for dissatisfaction. However, among 13 responding households in hill, frequent breakage of glass (6 households) and frequent breakage of mantle (5 households) were the major reasons for dissatisfaction with biogas lamp use. Though the responding households were less in 2005/06 survey the findings concur with that of the current survey

7.6.7 Other Reasons for Dissatisfaction with Biogas Installation

Apart from the problems associated with cooking and lighting, there are other institutional reasons as well for the dissatisfaction with biogas. The table below depicts the institution-related reasons expressed by responding households for being dissatisfied with biogas.

Table 7-17: Reasons for Dissatisfaction on Other Aspects of Biogas

Unit: HHs

Ecological Location	Problem with Company Dealings	Problem with Bank Dealings	Other	Total Reporting
Hill	23(56.1)	7(17.1)	11(26.8)	41
Terai	68(98.5)	0	1(1.5)	69
Total/Overall	91(82.7)	7(6.4)	12(10.9)	110

The above figures without and within the parenthesis show the number of respondents and percentage

The Table 7-17 shows that problem with company dealings is the major reason for dissatisfaction both in Terai and hill. In Terai company dealings seemed to be almost the sole problem whereas in hill problems with bank dealing (17%) and others (27%) were also stated as the reasons for dissatisfaction. The findings of the current survey in this aspect seemed a bit different than the survey of 2005/06 in the sense that along with problem in company dealing, problem with bank dealing and others were also stated as the reasons for dissatisfaction whereas in the current year survey problem with company dealings seemed to be the prime reason. A large number of plants having crossed the guarantee period, the regular supervision and R&M services is not provided by the companies hence this complaint from the users.

7.7 FAILURE OF BIOGAS APPLIANCES

7.7.1 Failure of Appliances

Smooth functioning of all the appliances is very important for successful operation of the biogas plant. The table below depicts how frequently appliances fail to function and who repairs them in case of failure.

Table 7-18: Failure of Various Appliances Used in Biogas Plant.

Unit: HHs

Appliances	Frequency of Failure (Nos.)	Repaired by Company	Hill				Terai					
			Self repaired		No Repair	Total Reporting	Average Failure (Nos.)	Repaired by Company	Self Repaired		No Repair	Total Reporting
			F	M					F	M		
Mixer	1.0	26	22	3	0	51	1	13	11	3	0	27
Main Valve	1.2	47	42	13	3	105	1	10	10	4	0	24
Gas Pipe	1.4	42	42	13	6	103	1.5	24	22	9	2	57
Water Drain	1.1	24	21	8	3	56	1.3	4	4	0	0	8
Rubber Hose	1.3	27	26	2	4	59	1.4	11	8	2	1	22
Gas Tap	1.6	53	47	10	4	114	1.5	8	7	3	0	18
Stove	1.2	13	12	1	0	26	1.3	3	3	1	0	7
Biogas Lamp	2	1	1	0	1	3	1	1	1	0	0	2

Table 7-18 illustrates that the households reporting failure of appliances in the kitchen are higher in hill than in Terai. In all the responding households the frequency of appliance failure is high. Among the responding households in hill, breakdown of gas tap has been reported by maximum responding households (114) followed by the breakdown of main valve (105 households) and gas pipe (103 households). On the other hand, breakdown of gas pipe, mixer and main valve are the three major problems. With regards to the repair

of the appliances, the practice of self repair and getting repaired by biogas companies are equally popular. It is quite satisfying to note that female members of the households are far ahead of their male counterparts in attending to the broken appliances both in *Terai* and hill.

7.7.2 Breakdown of Civil Structure (Annual)

Good civil structure is vital for smooth operation of the biogas plant. The table below depicts the frequency of the break downs of different civil structures of biogas plants

Table 7-19: Breakdown of Civil Structure (Annual)

Appliances	Hill						Terai					
	Average Failure (Nos.)	Repaired by Company	Self Repaired		No Repair	Total Reporting	Average Failure (Nos.)	Repaired by Company	Self Repaired		No Repair	Total Reporting
			F	M					F	M		
Inlet Pit	1	2	0	3	1	6	1	1	0	0	0	1
Toilet	1	0	0	1	1	2	1	0	0	1	0	1
Dome	1	2	0	0	0	2	1.3	1	0	0	2	3
Digester	1	0	0	3	0	3	1.5	0	0	1	1	2
Drain pit	1.7	2	1	1	0	4	1	0	0	1	0	1
Drain pit Cover	1	1	1	1	0	3	0	0	0	0	0	0
Outlet	1.2	0	2	6	2	10	1	0	0	0	1	1
Outlet Cover	1	1	2	3	0	6	1	0	0	0	1	1

The above figures without and within the parenthesis show the number of respondents and percentage

Table 7-19 shows the status of civil structure breakdown as reported by the users. The main civil structures damaged frequently are seen to be outlet, outlet cover and inlet pit in hill and toilet and dome in Terai. In hill it is found that such breakdowns are repaired by the users themselves especially the female members.

7.8 GAS LEAKAGE

7.8.1 Gas Leakage

Gas leakage from the plant may occur sometime due to various reasons. The table below depicts the gas leakage situation among the sample households.

Table 7-20: Households Reporting Gas Leakage

Unit: HHs

Ecological Location	Yes	No	Do Not Know	Total Reporting
Hill	46(14.3)	249(77.3)	27(8.4)	322(100)
Terai	6(3.4)	130(73)	42(23.6)	178(100)
Total/Overall	52(10.2)	379(74.3)	79(15.5)	510(100)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 7-21: Gas Leakage Duration

Unit: HHs

Gas Leakage	Duration			Total reporting
	< 1 Week	1-4 Week	>4 Weeks	
Hill	8(17.4)	9(19.5)	29(63.0)	46
Terai	1(16.6)	0	5(83.4)	6
Total/Overall	9(1.8)	9(1.8)	34(6.7)	52(10.2)

The Table 7-20 reveals that 77 % of the responding households in hills and 73 % in *Terai* reported no gas leakage. Percentage of households reporting gas leakage is higher in hill (14.3%) than in *Terai* (3.4%) whereas percentage expressing ignorance is higher in *Terai* (23.6%) than in hill (8.4%). Compared to the 2005/06 survey the households reporting gas leakage in the current year is a little higher both in hill and In *Terai*. With regards to the duration of gas leakage as depicted in Table 7-21 out of 46 households reporting gas leakage in hill, 63% reported leakage duration of more than 4 weeks while about 20 % reported 1-4 week duration and 17 % reported duration of less than a week. In *Terai* only 6 households reported gas leakage out of which 5 households reported leakage duration of more than 4 weeks.

7.8.2 Measures to Prevent Gas Leakage

Since gas leakage is problem that can not remain unattended for longer period, generally beneficiaries take necessary measures to mitigate the leakage problem. The table below depicts the measures being taken by the respondents.

Table 7-22: Households Reporting Measures Taken to Prevent Gas Leakage

Unit: HHs

Ecological Location	Informed the Concerned Authority	Repaired the Leakage Point	Informed BSP-N	Others	Total reporting
Hill	14(30.4)	29(63.0)	0	3(6.5))	46
Terai	4(66.6)	0	0	2(33.4)	6
Total/Overall	18(34.6)	29(55.8)	0	5(9.6)	52

The above figures without and within the parenthesis show the number of respondents and percentage

Table 7-22 reveals that households reporting gas leakage is much higher in hill (46) than in *Terai*(6). Out of the 46 households only about 30 % reported to the biogas companies and 63% got the leakage repaired by themselves. In *Terai* out of 6 households reporting leakage 4 households reported to the companies. This year's survey findings are totally different from those of the 2005/06 survey where there was almost no leakage reporting from hill and only 4 household in *Terai* had reported leakage in *Terai*. Among those reporting leakage about 33% in *Terai* had got the leakage repaired by themselves whereas this year no household took initiative to self repair the leakage.

7.8.3 Gas Shortage Due to Leakage

When there is gas leakage households generally feel the shortage of gas. The table below depicts the magnitude of effect (period of gas use) of gas leakage on the households.

Table 7-23: Households Reporting Gas Use Period Reduced Due to Leakage

Unit: HHs

Ecological Location	Yes	No	Total Reporting
Hill	18(39.1)	28(60.8.)	46
Terai	2(33.4)	4(66.6)	6

Total/Overall	20(38.5)	32(61.5)	52
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The above figures without and within the parenthesis show the number of respondents and percentage

From Table 7-23 it is found that out of 52 responding households about 39% felt that their gas use period has reduced due to leakage while about 60 percent felt that the leakage has no effect on the duration of the gas use. Though the number of responding households were much larger in hill than in *Terai* the effect of leakage on household gas use duration seems almost the same both in *Terai* and hill.

7.8.4 Magnitude of Gas Use Reduction Due to Leakage

The Table 7-24 below depicts the magnitude of reduction in gas use due to leakage.

Table 7-24: Reduced Period of Gas Use Due to Leakage

Unit: HHs

Ecological Location	Period			Total
	<15 min	15-30 min	>30 min	
Hill	1(0.3)	13(72.2)	4(22.2)	18
<i>Terai</i>	0	2(100)	0	2
Total	1(5)	15(75)	4(20)	20

Out of the 18 households in hill (who said that the leakage has reduced gas use duration) about 72% felt that the leakage has reduced the gas use by about 15-30 minutes daily while about 22% felt that it has reduced gas use by more than 30 minutes. In *Terai* only 2 households had reported reduction due to leakage and both of the households felt that it has reduced their gas use by 15-30 minutes daily.

7.8.5 Techniques Used to Check Gas Leakage

There are various techniques of testing gas leakage. The table below demonstrates different techniques applied by the user households for checking the gas leakage.

Table 7-25: Techniques Used to Check Leakage

Unit: HHs

Ecological Location	Technique				Total
	Smell	Soap Solution	Low Flame	Others	
Hill	89(61.4)	33(22.7)	22(15.2)	1(0.7)	145
<i>Terai</i>	3(37.5)	2(25.0)	2(25.0)	1(12.5)	8
Total/Overall	92(60.1)	35(22.9)	24(15.7)	21.3)	153

From Table 7-25 it is found that responding households in hill are much larger than *Terai* and among 145 responding households in hill about 62 % detect gas leakage by smell while about 23 % adopt soap solution technique and 15.7 % detect leakage from low flame. Among 8 responding *Terai* households 3 detect leakage by smell, 25% each by soap solution and low flame, respectively.

7.9 REPAIR AND MAINTENANCE

7.9.1 Repair and Maintenance and other Institutional Services Provided by Biogas Company.

With the popularity of biogas technology, companies have been established in many parts of the country and all the biogas plants included in the survey are associated with a Biogas Company. The table below describes the status of repair and maintenance and other institutional services provided by the associated biogas companies.

Table 7-26: Repair and Maintenance Services Provided by Biogas Company

Unit: HHs

Ecological Location	Yes	Yes but Delayed	No	Total Reporting
Hill	35(16.6)	42(19.3)	134(63.5)	211
Terai	50(41.4)	21(17.3)	50(41.3)	121
Total/Overall	85(25.6)	63(19.0)	184(55.4)	332

The above figures without and within the parenthesis show the number of respondents and percentage

It is found from the Table 7-26 that about 55 % of the responding households (41% in *Terai* and 64% in hill) reported repair and maintenance services not being provided by biogas companies while only about 17% in the hill and 41 % in *Terai* reported timely services being provided by the companies. Percentage of households reporting delayed service is about 19 in hill and 17 in *Terai*. Compared to the survey finding of 2005/06 the percentage households reporting no service by companies this year is larger. However, this could be due to the fact that there is a provision of 3 years guarantee for the structural part and only one year guarantee for appliances and in this case more than 60% of the sampled plants are older than three years and not being covered by the guarantee period anymore.

7.9.2 Time Taken to Provide Repair and Maintenance Service

Biogas companies generally take some time to provide repair and maintenance services after being informed by the beneficiaries. Table 7-27 gives information about the time taken by them to provide the services to the clients as reported by the users.

Table 7-27: Number of Days to Provide Repair and Maintenance Service

Unit: HHs

Ecological Location	One Day	Two Days	Three Days	>3 Days	Total Reporting
Hill	116(95.9)	3(2.5)	0	2(1.7)	121
Terai	45(97.8)	0	1(2.2)	0	46
Total/Overall	161(96.4)	3(1.8)	1(0.6)	2(1.2)	167

The above figures without and within the parenthesis show the number of respondents and percentage

The above table reveals that out of 167 responding households 96.4 % receive repair and maintenance service within one day. In hill out of 121 respondents 96%, receive service within one day while out of 46 respondents in *Terai* about 98 % have stated that they receive service within one day from the biogas company. This is a good sign of prompt service of the biogas companies.

7.10 TRAINING BY BIOGAS COMPANY

7.10.1 Training Provided to the Beneficiaries

Provision of training to the beneficiaries is vital for successful operation of biogas plants. Table 7-28 depicts the status of the training received from biogas companies by biogas user households.

Table 7-28: Biogas Companies Provide Training to Beneficiary Households

Unit: HHs

Ecological Location	Yes	No	Total Reporting
Hill	96(28.9)	236(71.1)	332(100)
<i>Teraī</i>	59(33.1)	119(66.9)	178(100)
Total/Overall	161(25.6)	349(74.4)	510(100)

The above figures without and within the parenthesis show the number of respondents and percentage

The above table shows that about 75 % of the respondents (71 % in hill & 67% in *Teraī*) reported having not received any training from the biogas companies as of yet. This year's finding in this aspect is just the reverse of that of the last year's survey. This high percentage of negative reply may be due to the several reasons cited as under:

1. The companies provide training to the users during the slack season of construction (Ashad-Kartik). Our enumerators made the field visit on Jestha and it is found that 25% the sampled plants are less than a year old.
2. Around 20.2% of the sampled plants are more than 6yrs old. In this case, many of the trained person could be no longer in the kitchen because of old age or gotten married. And the new member in the family may not have received training.
3. Other reasons could be split of the family and separation/migration of the trained member.
4. The respondent may not have received training, though other member of the family might have already received it. Hence with the anticipation of getting training, s/he might have replied negatively.
5. The respondent may not have knowledge about the training.

7.10.2 Types of Training Provided by Biogas Company

Table 7-29 illustrates the types of training provided by the biogas companies to the users.

Table 7-29: Types of Training Provided

Unit: HHs

Ecological Location	Training Type			
	Operation	Repair & Maintenance	Health Sanitation	Total
Hill	95(99.0)	51(53.1)	22(22.9)	96 (100)
<i>Teraī</i>	45(76.3)	38(64.4)	40(67.8)	59(100)
Total/Overall	140(90.3)	89(57.4)	62(40.0)	155(100)

The above figures without and within the parenthesis show the number of respondents and percentage

With regards to the type of trainings provided by biogas companies, out of total households reporting to have received training 90% (99% in hill & 76.3% in *Teraī*) have reported receiving training on operation of biogas plant while about 57.4 % (53.1% in hill & 64.4% in *Teraī*) received training on R&M and about 40 % (22.9% in hill & 67.8 % in *Teraī*) on health and sanitation.

7.10.3 Ability to Carry out Repair and Maintenance

Since biogas plants need frequent repair and maintenance, it is very necessary that biogas owners become able to carry out the activities. The table below depicts the status of the ability of the responding households to carry out repair and maintenance activities.

Table 7-30: Ability to Carry out Repair and Maintenance

Ecological Location	Repairing Ability			
	Able	Not able	Do not know	Total Reporting
Hill	47(25.3)	24(12.9)	115(61.8)	186
Terai	41(23.6)	20(11.5)	113(64.9)	174
Total/overall	88(24.4)	44(12.2)	228(63.3)	360

The above figures without and within the parenthesis show the number of respondents and percentage

Table 7-30 shows that out of the responding households about 25% have ability to carry out repair and maintenance jobs (25.3% in hill & 23.6% in Terai) while about 12 % of the responding households both in hill and Terai stated inability to carry out repair and maintenance jobs. However, more than 60% of the responding households both in Terai and hill stated “Do not know”.

7.11 SUPERVISION VISITS BY BIOGAS COMPANY

7.11.1 Supervision Visits Status

Timely and regular supervision by authorized technical personnel is necessary for smooth and continued operation of biogas plant. Since biogas companies are the recognized institutions to conduct regular supervision, Table 7-31 depicts the status of the provision of this service to the beneficiaries.

Table 7-31: Households Reporting Supervision Visits by Biogas Company

Unit: HHs

Ecological Location	Yes	No	Total Reporting
Hill	141(42.5)	191(57.5)	332(100)
Terai	61(34.3)	117(65.7)	178(100)
Total/Overall	202(39.6)	308(60.4)	510(100)

The above figures without and within the parenthesis show the number of respondents and percentage

The above table shows that the ratio of households reporting provision of the supervision service by biogas companies to those saying no provision of such services is almost 40:60. However percent households reporting supervision visit by company is higher in hill (42.5%) than in Terai (34.3%). This ratio of Yes to No was almost 50:50 in the 2005/06 survey. Such a large percentage of respondents reporting no supervision visits by the companies are again due to fact that for majority of the households the guarantee period has already lapsed.

7.11.2 Frequency of Supervision Visits

Frequent supervision of the biogas plants by the technical hands can ensure the smooth functioning of the plant. Table 7-32 depicts the status of supervision visits made by the concerned biogas companies.

Table 7-32: Number of Regular Supervision Visits Made by Biogas Companies per Year

Unit: HHs

Ecological Location	Once	Twice	Thrice	More than thrice	Total Reporting
Hill	7	1	0	0	8
Terai	19	0	0	0	19
Total/Overall	26	1	0	0	27

The above figures without and within the parenthesis show the number of respondents and percentage

It is observed that among 122 responding households, about 66% reported that supervision by the company is done once in a year with only about 9% reporting two visits a year. Households reporting more frequent visits are very few which is due to older sample plants in majority.

7.12 COMMITMENTS MADE BY COMPANY

7.12.1 Commitments Made by Company

Since almost all the biogas plants are constructed by registered companies, these companies sometimes make certain commitments to their clients. The biogas owners were asked whether their biogas companies had made any commitments to them. The table below depicts the commitments made by the companies.

Table 7-33: Commitment Made by Company

Unit: HHs

Ecological Region	Yes	No	Total
Hill	73(22)	259(78)	332(100)
Terai	20(11.2)	158(88.8)	178(100)
Total/Overall	93(18.2)	417(81.8)	510(100)

The above figures without and within the parenthesis show the number of respondents and percentage

The Table 7-33 reveals that about 18% of the sampled households (22% in hill & 11.2% in Terai) stated that their biogas companies have made such commitments. However larger (78%) respondents reported that companies have made no such commitments. The table also reveals that such commitments are made more in hill than in Terai.

7.12.2 Types of Commitment

Table 7- 34: Type of Commitment

Unit: HHs

Commitment	Hill	Terai	Total
1.Financial	6 (1.8)	1(0.6)	7(1.4)
2.Materials	4(1.2)	1(0.6)	5(1)
3.Technical Service	53(16)	7(3.9)	60(11.8)
Total	63(19)	9(5.1)	72(14.1)

The above figures without and within the parenthesis show the number of respondents and percentage

Table 7-34 depicts the types of commitments made by the biogas companies to the users during the time of installation of biogas. 11.8% reported that they were committed of providing technical services as and when required, 1.4% said it was financial commitment and remaining 1% told that they committed to providing materials for construction.

7.12.3 Equipment for the Removal of Hydrogen Sulphide Gas

Hydrogen Sulphide gas is produced along with the methane gas from the plant. It has some nuisance effect on health like headache. There are equipments available at present to remove this gas. The respondents were asked to state whether they were recommended to use this equipment for the removal of this gas. Table 7-35 below depicts the response of the biogas owners in this regard.

Table 7-35: Recommendation of Equipment for the removal of Hydrogen Sulphide Gas

Unit: HHs

Ecological Location	Recommended	Not Recommended	Total reporting
Hill	0	332(100)	332(100)
<i>Terai</i>	3(1.7)	175(98.3)	178(100)
Total	3(0.6)	507(99.4)	510(100)

The above figures without and within the parenthesis show the number of respondents and percentage

The above table reveals that no household in hill were recommended this equipment while only 3 households in *Terai* were recommended the use of Hydrogen Sulphide Gas removing equipment.

7.13 SUBSIDY

Apart from gas production, installation of biogas has many advantages like agricultural productivity enhancement, improvement in health and sanitation, better socio-economic and environmental situation etc. Government provides subsidy for the installation of biogas plant. BSP-N has been providing subsidy to the households for installing the plant which varies for different ecological belts and capacity of plants. A total of 18 districts are categorized as Low Penetration Districts (LPDs) which receive extra Rs.500/- subsidy per plant.⁷ BSP-N has also initiated piloting of 'additional subsidy for the poor again the amount differing in different ecological belt and the provision made only for plant sized 4 and 6 cubic meters. This subsidy is targeted for the poor possessing at least some land and one adult cattle.

The table below depicts number of the biogas owning households that have received and not received subsidy, respectively.

Table 7-36: Number and Percentage of Households Receiving Subsidy

Unit: HHs

Ecological Location	Yes	No	Do not know	Total
Hill	315(94.9)	9(2.7)	8(2.4)	332(100)
<i>Terai</i>	93(52.2)	57(32.0)	28(15.8)	178(100)
Total	408(80.0)	66(12.9)	36(7.1)	510(100)

The above figures without and within the parenthesis show the number of respondents and percentage

As evidenced by **Table 7-36**, 80 % of the responding households have received subsidy while 12.9 % have not received any subsidy. In the hills 95 % of the respondents have received subsidy while the rest 5% households are equally divided among Not received and Do not Know. In quite contrast, only about 52 % of the respondents in *Terai* have reported to have received subsidy while 32% have not received and 18% did not know about it. The findings differ from last year's result greatly. Last year more than 95 % of the responding households both in hill and *Terai* had reported to have received subsidy for the installation of biogas plants. The high number of households reporting not receiving subsidy in *Terai* are the households in Saptari and Sarlahi, particularly women headed and so-called low caste groups' households. This can be justified by the fact that probably the women are unaware of this provision. Also since it is not provided in cash but in kind, they may not have known or regarded it as subsidy. Other reasons could be that different person signed on the subsidy receipt or even it is possible that it was not signed at all.

⁷ BSP Year Book 2007

Chapter 8

COMPANY'S VIEWPOINTS ABOUT BIOGAS USERS

The viewpoints of the local biogas companies can be significant while assessing the impact of biogas technology in the livelihood of its beneficiaries because of the close association of the plant owners with these companies. With this objective, the perceptions of the biogas companies situated locally in the sample districts were collected by administering the checklist (**Annex II**). The findings are summarized below under different sub-topics.

8.1 DESCRIPTION OF INTERVIEWED BIOGAS COMPANIES

A total of 30 Biogas Companies located in 14 districts were selected randomly to collect their view points on different aspects pertaining to the installation of biogas plants. None of the companies were found to have office in Dolakha district. However, Rastriya Gobar Gas Company, Kathmandu branch and another company in Ramechhap district are looking after the biogas installation and promotional activities in this district. **Table 8-1** below depicts the details of the Biogas Companies selected for the present purpose.

Table 8-1: List of Biogas Companies Interviewed

S.N.	Dev. Region	District	Company Name	Company Code	Address
1	Eastern	Sankhuwasabha	Makalu Biogas Tatha Urja Vikash Company P.Ltd.	MBC	Tamaphok-8
2		Jhapa	Danfe Gobar Gas Company	DGG	Anarmani, Birtamod
3		Jhapa	Krishi Bikash Gobar Gas	KRI	Anarmani, Birtamod
4		Jhapa	Kamala Biogas Company	KML	Anarmuni-3
5		Morang	Sana Krishak Samudaik Gobar Gas	SKG	Indrapur, Biratnagar
6		Siraha	Gobar Gas Company	GGC(SIR)	Siraha-8
7	Central	Sarlahi	Everest Gobar Gas Company	EGC	Lalbandi-1
8		Sarlahi	Gobargas tatha Krishi Yantra	GGC	Lalbandi-1
9		Sarlahi	Biogas	BBG-SAR	Netragunj-7
10		Sarlahi	Kantipur Gobar gas	KNT	Lalbandi-1
11		Nuwakot	Shri Janabhawana Gobargas Udhyog P.Ltd.	JGY	Bidur-1
12		Nuwakot	Kisan Gobargas Udhyog	KGY(NUW)	Bidur-1
13		Bhaktapur	Gobargas tatha Krishi Yantra P.Ltd.	GCC/KAT	Minbhawan, Baneshwor
14		Lalitpur	Rapti Gobargas Company P.Ltd.	RAP/LAT	Chapagaon, Takhel
15		Lalitpur	Everest Biogas Company	EGC	Chapagaon 6
16	Western	Kaski	Gobargas tatha	GGC	Pokhara-8, Simalchaur

			Krishi Yantra Bikash P. Ltd.		
17		Kaski	Rastriya Gobargas Company	RGG	Pokhara- 8, Srijana chowk
18		Kaski	Bageshwori Gobargas Company	BGG	Pokhara-8 New road
19		Kaski	Gandaki Gobargas Sewa Kendra	GGK	Pokhara-8 Prithvi chowk
20		Kaski	Manakamana Gobargas Sewa Kendra	MKG	Pokhara-8,Sabhagriha path
21		Kaski	Pragati Biogas Service Center	PGB	Pokhara-8 New road
22		Tanahu	Pragati Biogas Company	PGG	Vyas-11
23		Tanahu	Ratnajyoti Gobargas tatha Urja Bikash Company	RAN	Bandipur, Dumre
24		Tanahu	Machapuchre Biogas Company	MGG(TAN)	Vyas-2
25		Syangja	Gandaki Gobargas Company	GGK	Waling-2
26		Syangja	Bageswori Gobargas Company	BGG	Putalibajar-1
27	Midwestern	Bardiya	Rastriya Gobargas Company	RGG	Gularia-6
28		Bardiya	Paschimanchal Dhaulagiri Gobargas Sewa	PDG-BAR	Gularia-6
29		Pyuthan	Gobargas tatha Krishi Yantra Bikash Company	GGC	Bijayanagar-6
30	Far western	Bajhang	Biogas tatha Urja Bikash Company	BBI	Bajhang

8.2 CRITERIA FOR CHOOSING WORKING AREAS BY THE COMPANIES

Regarding the choice of working areas by the companies, the above listed companies were queried about the criteria they take into consideration during the selection. With the exception of few, all the companies seemed to be clear regarding their set criteria for the selection of their working area. The criteria as cited by the companies in order of importance are summarized in **Table 8-2** below.

Table 8-2: Criteria Set by Companies for Working Area Selection

S.N	Criteria	Order of Importance
1.	Number of cattle/livestock	First Order
2	Access to road and transportation facility	
3	Availability of construction materials (sand, gravel, bricks etc) at local level	
4	High number of farmers willing to install biogas (high potential demand)	
5	Scarcity or problem of firewood	Second Order
6	Warm climate area	
7	Economic status of farmers	

8	Population density	Third Order
9	Availability of water	
10	Cattle shed and household area	
11	Service motive	
12	Access to financial institutions	
13	Local base	

Number of cattle/livestock in the house holds, transportation facility and access to road, local availability of the required construction materials like sand, gravels, bricks, etc and high potential demand were in the criteria of first order of significance for selecting the working areas. Similarly, problem of firewood, availability of enough water, economic status of farmers and climatic condition with regards to gas production and population density were given second order significance and cattle shed and household area, service motive, access to financial institutions and local base were given third order significance as criteria for selection.

8.3 OTHER ORGANIZATIONS INVOLVED IN BIOGAS PROGRAM AT LOCAL LEVEL

In most of the surveyed districts, local branch offices of Biogas Companies were found to be operating. It is gratifying to note that even the remotest of the surveyed district Bajhang has a Biogas Company, which has signed agreement with District Cooperative Office to work together in the field of biogas. Besides biogas companies, many districts except Syangja and Pyuthan are reported to have a number of other organizations involved in biogas promotion activities. In these two districts, not even the biogas companies were found involved in promotional activities. **Table 8-3** below depicts different organizations other than Biogas Companies, which are actively involved in biogas related activities.

Table 8-3: List of Organizations Involved in Biogas Promotional Activity in the Respective Districts

District	Other organizations
Sankhuwasabha	Renewable Energy Development Program (REDP).
Jhapa	Sahara Nepal, Kamali Sahakari Sanstha, Ban-Upabhokta Samuha, Mahila Sahakari Sanstha
Morang	Sahara Nepal Co operative, Samudaik Ban Samuh, Grameen Bank
Lalitpur	DDC office,
Kaski	MDO, DFD, ACAP, Seed Foundation, World Vision, Red Cross, Nepal Environment Promoter, Nepal Forest Conservation Center, LI-BIRD BSP Nepal NBPG, Cooperative Societies, Ban Upabhokta Samuha, REDP
Bardiya	Terai Bhu-Paridhi Karyakram (provides loan), Samudaik Ban Upabhokta Samiti, Jilla Ban Maha Sangh, ADB/N
Bajhang	District Cooperative Office

8.4 TYPES OF SERVICES PROVIDED BY THE COMPANIES

The Biogas Users' survey 2006/07 has reported about 60 recognized biogas companies actively working in the promotion of biogas in Nepal. Among these some are well established and are rendering good services and some are newcomers and hence lack experience. However, irrespective of their establishment tenure they have a lot of similarities regarding the types of services they provide to the users as revealed by the interviews and survey. Apart from the construction of biogas plant with pipe fitting, following are the major services being provided by the interviewed biogas companies.

- Provide pre-construction counseling to the potential users and motivate them to install biogas plant;

- Provide Repair and Maintenance(R&M) services and replace spare parts free of costs within the guarantee period of one year;
- Conduct annual supervision of biogas plant for three years after the installation of plant;
- Supply different kinds of appliances and spare parts as required;
- Conduct supervision visits upon users' complaints/requests;
- Provide training to women users on the operation, R&M of biogas plants;
- Provide training to user farmers with regards to slurry management;
- Provide after sales services to the clients; and
- Assist and facilitate the farmers in finding financial institutions for loan.

8.5 ROUTINE AND REQUEST VISIT OF COMPANY TO SUPERVISE INSTALLED PLANTS

After sales service is one of the important factors for popularizing biogas. For this purpose the company should visit the users not only during the guarantee period but also afterward upon request.

a) Frequency of Post Installation Visits by the Companies

Regarding the frequency of post plant installation visits by the companies, 37 % of the companies interviewed said that they make such visits more than three times a year which is less as compared to BUS 2006 reporting 59%. The percentage of companies stating such visits thrice annually is 23 % which is more than last years result. Other 23% companies mostly in the Eastern and Central Development Regions stated that they make supervision visits twice a year which is again more compared to the last year (17%) and the remaining 13% reported making only once post installation which is a percent less than previous the year. This data differs with the one as reported by the users because the companies are talking about the newly constructed plants still within the 3 years pre-paid and guarantee period while 60% respondents are for plants older than 3 years.

Table 8-4: Frequency of Post Installation Visits by the Companies

S.N.	Frequency of Visit	Respondent %
1	Once a year	13
2	Twice a year	23
3	Thrice a year	27
4	More than three	37

b) Visits upon request and Problems Reported By Biogas Company

All the Companies interviewed stated that they receive requests for visits by the users complaining problems in their plants. In this context, the Biogas Companies were asked to state the problems encountered by the owners and for which their services are sought. The major problems encountered by the plant owners are bulleted as under:

Major Technical Problems in Biogas:

- Leakage of gas from tap and pipe
- Problem in gas tap, problem in gas burner and blockage of gas
- Leakage in pipe
- Blockage in pipe due to slurry, blockage in inlet pipe and blockage in toilet
- Damage in water drain washer

- Low gas production in winter
- Problem in slurry mixer
- Breakage in rubber hose pipe
- Breakage in lamp glass and mantle

8.6 SUGGESTIONS TO IMPROVE THE PERFORMANCE OF PLANTS

The success of biogas technology is directly proportional to the satisfaction of the plant users. If plants function well and provide expected output then the owners will be satisfied while on the other hand improper functioning and constant problems in operation leads to their dissatisfaction. A plant that is constructed using good quality of materials and is technically correct functions well. Hence, during the interview, the companies were also asked about their suggestions for improving the performance and based on the feedback given to them by plant users and also upon their own experience, they have cited the following:

- Provision of skilled technicians;
- Provision of regular monitoring and spot checking;
- Provision of location specific plant size and model;
- Arrangements by BSP-N to check that companies follow code of conducts;
- Provision of refresher trainings to company staff at all level;
- Create awareness among users;
- Encouragement and understanding among users to use urine, cover the dome with mulch/composting, oiling gas tap fortnightly, daily feeding plant as per requirement and use other materials like weeds/grass if dung is less; and
- Provision of users' training to both old and new users.

Of these suggestions made, it can be noted that majority of them are already put into implementation by AEPC and BSP-N. However, for steady progress and better performance and benefits to owners, further efforts to bring these suggestions into complete practice with more seriousness can be beneficial for the project, companies and the owners in the long run.

8.7 MAJOR CONSTRAINTS AND STEPS TAKEN TO MITIGATE THE PROBLEMS

Major Constraints Faced by the Companies:

- Little training to the staff and trained mason leaving country for better jobs
- Dearth of trained mason during peak construction period
- Problem of material transportation to remote areas
- Weak management within the company (GGC)
- Unavailability of materials and appliances on time
- Financial problem of the company (GGC)
- Unhealthy competition among companies
- Subsidy amount not released on time.

Steps taken for Mitigating the Constraints:

- Arranged for users' training
- Concentrated more on plants and looked for quality appliances in time
- Facilitated farmers in getting loan from banks, co-operatives or micro finance

- Helped farmers in carrying the materials in case of transportation problem
- Coordinated with other institutions (Energy Development Office)
- Requested BSP/N for solutions on several issues
- Coordinated with GO/NGOs.

Due to the fact that most of the companies are the local branch offices with head offices located elsewhere, the steps being taken to mitigate problems and constraints faced could not be specifically mentioned by the companies. Despite this, the remotely placed Company at Bajhang seemed quite enterprising as it has coordinated with the Energy Development Office and linked the amount of Rs. 4500 provided for constructing toilet with the biogas program. According to them, this effort has eased their work remarkably.

8.8 COMPANY'S VIEW POINT ABOUT SUBSIDY

Almost all the companies interviewed unanimously shared that subsidy should continue and a separate subsidy program for the poor and deprived communities is deemed essential. In fact it should be increased according to the market price and its disbursement process should be made easy and timely. Only by providing subsidy, penetration of the programme to the lower socio-economic strata is possible.

8.9 STATUS OF INSTITUTIONAL CAPACITY OF COMPANY

When asked to self assess and evaluate the status of their institutional capacity over the last three years in terms of business expansion, employment increment and overall revenue, except for the company working in Bajhang, which had initiated the activity last year only, all the companies have responded in terms of increased, decreased and remained same. A total of 50% companies stated that their capacity has increased. Compared to the last year's survey (BUS 2006) which had 24% company's asserting their decreased institutional capacity, the percent seems to increase this year with 27% stating their decreased capacity. The remaining 23% revealed that their status has remained same over the last three years. Slightly lower capacity of performance is attributed to frequent *Bandha* and transportation strikes prevalent country wide.

8.10 DEMONSTRATION ON BIO-SLURRY UTILIZATION

One of the most significant outcome of the use of biogas is the bio-slurry that comes as a by-product and utilization of which enhances the crop production. When asked whether they conduct demonstration and training on bio-slurry utilization at the time of installation, 85 % of the respondent companies said that they do while the rest 15 % asserted that they don't conduct such demonstration.

8.11 COMMITMENTS MADE TO USERS BY COMPANIES

Regarding the commitments made by companies to the users during the plant installation, it was found that besides general assurances like good service, regular repair and maintenance and after sale services, no other specific commitments were made by them.

Chapter 9

CONCLUSION AND RECOMMENDATIONS

9.1 CONCLUSION

9.1.1 Impact on Socio-Economic Conditions

Deriving from the findings, in general, it can be concluded that biogas technology has had a positive impact on the socio-economic status of the user households. With more than 60% plants being installed for more than three years, it seems that the biogas technology has been quite successful in uplifting the socio-economic status of the users as evidenced by their access to the utility services like electricity, means of transportation and communication, literacy status, the types of houses and their loan repayment status. Specifically, biogas technology is found to be inclusive, with people from different ethnic groups using it. It is found to be very successful in saving the time of users which is thus used by them for income generating activities, enhancing their own knowledge base as well as getting involved in social works for the benefit of their own community. With long durability of plant, they are required to spend minimal amount on its repair and maintenance. It is found that still majority of people make investment from their own cash saving and only a quarter take loan from bank. This shows that only people with adequate cash in hand or collateral can take loan from banks thereby making it inaccessible to the poor. This gap should be taken care of by easing the process of loan sanction to the potential users. But the piloting of additional subsidy for the poor by BSP-N can be looked upon as a good initiative for making this technology reachable by the poor. Hence disseminating information on subsidy among the user farmers and potential users is deemed essential so that all the people get familiar with this incentive provided to them.

9.1.2 Impact on Agriculture and Related Issues

From the findings it can be concluded that use of organic manures is in increasing trend among the biogas users and the slurry compost is replacing FYM slowly. This trend is positive for the sustainable agriculture. However, despite the increased use of organic manures, the productivity of crops cultivated is not showing remarkable increase except in kitchen garden. This could be because the lack of proper storage practices of compost resulting in the loss of its nutrients. This issue needs to be considered in future program. Further more, the use of chemical fertilizers has not decreased despite increased use of compost manures hence, the actual effectiveness of slurry compost in enhancing the productivity is difficult to analyze. It is quite satisfying to note that installation of biogas plant has had positive impact on animal farming practices and raised awareness among users on better shed management as evidenced by the fact that most of the gas users have adopted stall feeding practices and have constructed improved/concrete shed floor.

9.1.3 Impact on Energy, Environment and Emission Reduction

Biogas is an environmentally sustainable technology which uses locally available resources for the production of renewable form of energy. It has significantly helped reduce fuel wood and kerosene consumption thereby reducing the indoor air pollution and GHGs emission. Besides, biogas has also benefited the country through carbon trade in international market by contributing in global carbon emission reduction.

9.1.4 Impact on Health and Sanitation

Based on the findings, it can be concluded that the level of awareness among people regarding the significance of health, hygiene and sanitation in and around their household has increased remarkably. Consequently, the users of biogas have benefited with improved health condition of family members (females, males and children) with significant reduction in the incidence of respiratory diseases, eye infection and water borne diseases like diarrhea, dysentery. Moreover, women, who spend most of their time in kitchen, have been the prime beneficiaries of the biogas plants in terms of improved health status. Hence, biogas has played a vital role in improving the health status and thus uplifting the living standard of rural people by providing them with clean fuel.

9.1.5 Impact on Gender

It is found that biogas technology has benefited rural women in many ways, especially in reducing their work burden of household chores thus saving their time. Women are able to utilize this saved time in information collection, income generation, social work and other community related activities after the use of biogas. Since, women are the ones who spend more time in kitchen, biogas technology has also had a positive impact on their health as it reduces indoor smoke thereby reducing the incidence of respiratory and eye related diseases. However, from women's equity and empowerment perspective, they are still in the background because they do not have ownership of properties and resources so far and they have no crucial participation in the decision making in household matters including biogas installation. It is therefore acknowledged that there is a need to involve them actively in decision making, planning and management of biogas plants besides others reflecting a bleak scenario of their socio-economic status. Similarly, local governmental, non-governmental and community based organizations need to encourage women to utilize their saved time in productive/income- generating activities, which will make them economically empowered and hence raise their socio-cultural status as well.

9.1.6 Impact on Construction, Operation and Maintenance

From the findings, it can be concluded that the shortage of firewood seems to be the main reason for installing biogas. Users of biogas plants are satisfied with the plant operation. The reasons for the satisfaction are smokeless kitchen, efficiency in cooking and washing utensils, saving fuel wood and tasty food. However, the major reasons for dissatisfaction with using biogas remained as less taste of food cooked in biogas as compared to fuel wood and other reasons beside cooking is the difficulty in company dealings. Biogas for lighting is not very popular among the users and those using it are less satisfied due to frequent breakage of glass and mantle which is a nuisance and cost incurring. Moreover, it is satisfying to note that about 96.2% of biogas plants surveyed are producing gas smoothly. However, among those plants not producing gas, failure of appliances in the kitchen was cited to be the major reason. It is gratifying to note that the users have adopted daily feeding practice of plant and due to sufficiency in gas, they do not feed all the dung available. Since feeding night soil is not as popular in Terai as in hill, some effort to encourage its use is needed to be put in.

9.2 RECOMMENDATIONS

During the period of study, based on the observations and findings, certain gaps were identified in the biogas programme in Nepal. Hence, the Consultant would like to put forth these recommendations that can be useful to fill up these lacunae anticipating sincerely that these will be considered and implemented by AEPC/BSP-Nepal in future.

- A. Previous year's recommendations which need to be reinforced more efficiently and regularly:

- 1) With the increasing numbers of biogas companies and appliance manufacturers venturing into this programme, stringent monitoring and evaluation of the quality of their services should be carried out.
- 2) In order to avoid malfunctioning of the plants and breakdown of appliances and accessories, quality control measures by AEPC/BSP-N in bio-digester construction, procurement of biogas appliances and spare-parts should be enforced.
- 3) To enhance users' knowledge base on services of different biogas support organizations and adequate contacts between the stakeholders and clients, suitable interactive programmes should be conducted by AEPC/BSP-N.
- 4) Biogas users training should also be provided to old users who have not received it. Effective training to the users especially females, community members as well as technicians/service providers should be continued. The area in which users require training should be identified and imparted accordingly.

B. Previous year's recommendations which are yet to be implemented:

- 1) Users' suggestion on additional institutional support to bear appliances and civil structure cost should be addressed.
- 2) With increasing access of the community to cooperatives for taking loan, a simple and straightforward process for sanctioning loan for biogas should be materialized. The banks should adopt simple repayment process.
- 3) To encourage the farmers to use bio-slurry, simple demonstrative experiments at their field on bio-slurry utilization on crops and vegetables should be conducted.
- 4) Analysis of bio-slurry from different institutional biogas plant using different feeding materials should be done to assess its macro as well as micro nutrient contents as fertilizer.
- 5) Analytical study of feeding materials and bio-slurry to detect pathogens should be continued.
- 6) The farmers should be provided training on environment and sanitation aspects as they handle bio-slurry, FYM and Compost which may contain pathogens.
- 7) Study of CO₂, CH₄ and NO₂ emissions should be done to estimate the benefits of emission reduction
- 8) Device for the removal of Hydrogen Sulphide Gas (H₂S) from biogas should be included in the list of appliances to be provided to users during installation and companies should be trained on the installation and use of device.

C. Recommendations for this Year:

- 13) BSP/N should make an annual agreement on the quality of the appliances with the companies on a mandatory basis.
- 14) BSP/N should conduct information dissemination programs about subsidy to the farmers so that they become aware of this provision.
- 15) It is found that farmers are still unaware of impact of slurry on the incidence of pest and crop diseases, hence an assessment and demonstration on the above should be conducted.
- 16) Cattle urine utilization in gas production should be included in the biogas users training as it increases the gas production as well as the nutrient content of bio-slurry.
- 17) The selection of biogas companies by AEPC/BSP-N should follow a strict procedure to avoid/minimize the entry of fraudulent companies to the extent possible.

- 18) While making supervision visits and visits upon request, the checking of kitchen appliances particularly, the rubber hose, burner and stop cork by the company personnel must be made compulsory.
- 19) The masons and technicians of the companies should be given refresher trainings.
- 20) A separate R&D on the assessment of plant life and its performance should be conducted.
- 21) The findings show that the companies are lagging behind a little bit in terms of supervision of the installed plants even during the guarantee period. Hence, timely supervision and follow up of the installed biogas plants during and after guarantee period should be encouraged.
- 22) A focused technical study is warranted after the interaction with the users in order to calculate the accurate efficiency of the biogas and other technical aspects of it.
- 23) For effective promotion and sustainable use and management of slurry, BSP-N should collaborate with the Directorate of Soil Management of the Department of Agriculture (DOA) and its Sustainable Soil Management Project (SSMP).
- 24) This study is conducted each year and recommendations are made. Hence, AEPC should document the recommendations that are implemented and also mention it in the TOR so as to ease the job of the consultants.

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Annex-I: List of Field Staff and Places Allocated

Working Schedule of Biogas User's Survey

District	Bajhang+Kaski		
Nos. of Biogas User	13+41	=	54

Conducted by: Bhanu Bhakta Sapkota

WORK PLAN SCHEDULE

Kathmandu – Narayanghat (1)
Narayanghat - Dhangadi (1)
Dhangadi – Attariya-Deulob(1)
Deulob- Tarmel (1)
Tarmel –Chainpur (2)
Chainpur –Ritthapata –Tarmel-Jhota (1)
Jhota (1)
Jhota –Parakatne (1)
Moyal-Attariya (1)
Attariya (1)
Attariya –Narayanghat –Kathmandu (1)

Kathmandu – Pokhara(1)
Prithvichok – Birauta –Prithvichok (1)
Pokhara np (4)
Hemja-Buspark-Prithvichok(3)
Prithvichok-Hemja-Lwangghalel-Prithvichok(1)
Prithvichok-Hariyakharka-Prithvichok (1)
Prithvichok-Birauta-Prithvichok (1)
Prithvichok-Kaskikot-Prithvichok (1)
Prithvichok-Hemja-Bagar-Prithvichok-Kathmandu(1)

District	Nuwakot
Nos. of Biogas User	70

Conducted by: Tilak Kr. Shrestha

WORK PLAN SCHEDULE

Kathmandu – Trishuli (1)
Trishuli-Manakamana (2)
Manakamana-Batter (1)
Batter-Kharenitar (2)
Kharenitar-Narjamandap (1)
Narjamandap-Bahunbesi-Battar (1)
Battar-Jilling (1)
Jilling-Battar(1)
Battar-Thanapati(1)
Thanapati-Sunxhani-Battar(1)
Battar-Chaughada-Madanpur(2)
Madanpur-Bidur (16)
Bidur-Okharpauwa-Trishuli-Kathmandu(1)

District	Pyuthan		
Nos. of Biogas User			50

Conducted by: Kashi Raj Rizal

WORK PLAN SCHEDULE

Kathmandu-Khalanga (1)
Khalanga –Bijuli (3)
Bijuli-Dharampani (2)
Dharampani-Khalanga–Dhakhanwadi (4)
Dhakhanwadi-Bijuwar –Bagdula (1)
Bagdula –Khaprangkhola(Dharmawati) (6)
Dharmawati-Lung (1)
Lung-Bagdula(Dharmawati)-Torwang (3)
Torwang-Puja (1)
Puja-Bagdula(1)
Bagdula-Khalanga(2)
Khalanga-Sari (3)
Sari-Khalanga (1)
Khalanga-Kathmandu (1)

District **Sankhuwasabha**
Nos. of Biogas User 65

Conducted by: Manohari Basnet

WORK PLAN SCHEDULE

Kathmandu- Dhankuta (1)
Dhankuta –Khadbari (12)
Khadbari-Tamafok (12)
Tamafok-Jaljala (2)
Jaljala-Siddhakali (2)
Siddhakali-Madimulkharka (2)
Madhimulkharka-Khadbari (1)
Khadbari-Dhankuta(1)
Dhankuta-Kathmandu (1)

District **Lalitpur+Bhaktapur**
Nos. of Biogas User 30+9 = 39

Conducted by: Sudeep Devkota

WORK PLAN SCHEDULE

Kathmandu-Godavari(1)
Godavari-Chhampi ((2)
Chhampi-Bhukhel ((1)
Bhukhel-Gotikhel (2)
Gotikhel-Manikhel (2)
Manikhel-Nalu (1)
Nalu-Jharuwarasi(1)
Jharuwarasi-Bhattedanda (2)
Bhattedanda-Pyutar (1)
Pyutar-Bungmati (1)
Bungmati-Godawari-Kathmandu (1)
Kathmandu-Chhaling (2)
Chhaling-Nankhal (1)
Nankhal-Balkot (2)
Balkot-Kathmandu (1)

District **Tanahun**
Nos. of Biogas User 45

Conducted by: Gobinda Poudel

WORK PLAN SCHEDULE

Kathmandu-Damauli (1)
Damauli-Dumre-Damauli (1)
Damauli-Kalimati- Bhanjyang (1)
Chockchisapani-Simalchaur (1)
Padukuna-Dudhekuna (1)
Chockchisapani-Rupakot (1)
Ullehar-Basbari (1)
Basbari-Tuhurepasal (1)
Tuhurepasal-Kafalswara (1)
Kafalswara-Besi-Chockchisapani (1)
Chockchisapani-Bhansar-Satiswara (1)
Dhakalkuna-Kamidanda-Gauriswara (2)
Gagaude-Kyamin (2)
Torikharka Kalasti-Pathasera-Barlachi (1)
Barlachi-Silanghari (1)
Silanghari-Duleganda (1)
Dudeganda-Dhorfirdi-Syaulibazar (2)
Dhorfirdi-Dhuleganda-Damauli (1)
Damauli-Kathmandu (1)

District **Syangja+Dolakha**
Nos. of Biogas User 14+15 = 29

Conducted by: Bhanu Bhakta Poudel

WORK PLAN SCHEDULE

Kathmandu – Manthali
Manthali (5+1) – Manthali
Manthali – Phulasi (1+1)
Manthali - Kathmandu
Kathmandu – Gorkha
Prithivi Narayan NP (23+7) – PNNP
PNNP – Paluntar
Paluntar (13+3) – Paluntar
Paluntar - Kathmandu

District **Bardiya**
Nos. of Biogas User 50

Conducted by: Chandra K. Sharma

WORK PLAN SCHEDULE

Kathmandu-Bardiya (1)
Basgadi-Kalika (5)
Basgadi-Mainapokhar (1)
Mainapokhar-Deuthala (1)
Deuthala-Gulariya (4)
Gulariya-Dhodari (3)
Dhodari-Bagnaha (2)
Bagnaha-Pannaha(1)
Paunaha-Khairichandanpur (2)

Gulariya-Basgadi (3)
Basgadi-Kathmandu (1)

District **Saptari**
Nos. of Biogas User 15

Conducted by: Bibha Jha

WORK PLAN SCHEDULE

Kathmandu-Kanchanpur(1)
Kanchanpur-Fattepur-Kanchanpur(5)
Kanchanpur-Lahan-Gaighat (1)
Gaighat-Lahan-Kanchanpur (1)
Kanchanpur-Fattepur-Kanchanpur(4)
Kanchanpur-Bhardah-Topa(1)
Topa-Bhardah (1)
Bhardah-Portaha-Bharadah(1)
Bhardah-Kalyanpur(1)
Kalyanpur-Bishanpur-Pipara West Sisbari-Lahan (1)
Lahan-Lalbandi(1)
Lalbandi-Janakpur-Kathmandu (1)

District	Sarlahi
Nos. of Biogas User	72

Conducted by: Ram Binod Jha

WORK PLAN SCHEDULE

Kathmandu-Lalbandi(20)
Lalbandi-Sasapur-Lalbandi(2)
Lalbandi-Bhaktipur(6)
Sagamath-Lalbandi-Chainpur-Birta(3)
Birta-Chainpur-Lalbandi(1)
Lalbandi-Nawalpur-Lalbandi(2)
Lalbandi-Janakpur(1)
Janakpur-Kathmandu(1)

District	Jhapa
Nos. of Biogas User	47

Conducted by: Santa Kr. Shrestha

WORK PLAN SCHEDULE

Kathmandu-Bhadrapur (1)
Bhadrapur-Chandragadi(1)
Chandragadi-Milanchock (1)
Milanchock-Balubadi(2)
Balubad-Sigdel Basti (1)
Sigdel basti-Dhajjan tole-Charali (1)
Charali-Duwagadi-Dhajjan—Birtamod (1)
Birtamod-Charpane-Jagatbasti (1)
Jagatbasti-Charpane-Birtamod-Ramchok (2)
Birtamod-Beldangi-Chaitubari-Birtamod (1)
Birtamod-Simalchock—Dangibari (3)
Dangibari-Laxmipur-Birtamod (1)
Birtamod-Gherabari-Birtamod (2)

Birtamod-Baniyani (1)
Birtamod-Singimari (1)
Birtamod-Balubari(2)
Birtamod-Kathmandu (1)

Conducted by: Tilak Kr. Shrestha

District	Rautahat
Nos. of Biogas User	1

WORK PLAN SCHEDULE

Kathmandu-Chandranigahapur (1)
Chandranigahapur-Basbiti Jingadiya(2)
Chandranigahapur-Kathmandu (1)

IV. Data Sheet

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 No.

V.

VI. BIOGAS USERS SURVEY 2006/07

VII. QUESTIONNAIRE FOR BIOGAS USER HOUSEHOLDS

1.0	General Information	
100	Interview	
101	Name and caste of the respondent	
102	Name, surname and caste of the Biogas plant owner	Mr./Mrs.....
103	Date of interview	/ /2007
110	Location of the Household	
111	District	
112	V.D.C.	
113	Ward no. and Name of the village	
114	Walking distance from the road	.....day.....hour.....min.
115	Distance to water source	.....meter/ft. (minute.....)
120	Identification of Biogas Plant	
121	How did you get information about the installation of biogas plant?	1. Biogas company <input type="checkbox"/> 2. Neighbours/relatives <input type="checkbox"/> 3. Radio/Television <input type="checkbox"/> 4. Publicity/Extension/Training <input type="checkbox"/> 5. Others (specify)..... <input type="checkbox"/>
122	BSP plant code no./file no./...../...../
123	Dome Gas Pipe No. or Fiscal Year	.....
124	Plant Owner's Booklet No.	
125	Name of Biogas Company	

126	Date of the biogas plant installation	.....Year.....Month
127	Capacity of biogas plant	.....cubic meter
128	Construction material used in biogas plant (Tick as required)	Stone <input type="checkbox"/> Brick <input type="checkbox"/> Mud <input type="checkbox"/> Cement <input type="checkbox"/> Lime <input type="checkbox"/> Others (specify).....
129	Was any of your family members used as labour during installation of biogas? Yes <input type="checkbox"/> No <input type="checkbox"/>	If yes, No. of male used <input type="checkbox"/> No. of female used <input type="checkbox"/>
130	General Observation	
131	Type of house (Tick one)	1. Thatched roof <input type="checkbox"/> 2. Corrugated sheet roof <input type="checkbox"/> 3. Stone/tile roof <input type="checkbox"/> 4. Mixed roof <input type="checkbox"/> 5. Cemented roof <input type="checkbox"/>
132	Electricity (Tick one)	Yes <input type="checkbox"/> No <input type="checkbox"/>
133	Communication source (Tick as required)	1. None <input type="checkbox"/> 2. Radio <input type="checkbox"/> 3. Television <input type="checkbox"/> 4. Mobile phone <input type="checkbox"/> 5. Others (specify).....
134	Transportation source (Tick as required)	1. None <input type="checkbox"/> 2. Cycle <input type="checkbox"/> 3. Motorcycle/scooter <input type="checkbox"/> 4. Bullock/Tyre cart <input type="checkbox"/> 5. Others (Specify).....
140	Identification of Household Members	
141	Sex of the family head (Tick one)	1. Male <input type="checkbox"/> 2. Female <input type="checkbox"/>
142	Main occupation of the family head (Tick one)	1. Agriculture <input type="checkbox"/> 2. Business <input type="checkbox"/> 3. Service <input type="checkbox"/> 4. Industry <input type="checkbox"/>

		5. Others (specify).....
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143	Number of family members	Male	Female	Children ⁸	Total
144	Educational level (Above 5 years only)	Educational level		Male (Number)	Female (Number)
		1. Illiterate			
		2. Literate			
		3. Class 1 to 5			
		4. Class 6 to 10			
		5. SLC			
		6. Above SLC			
2.0	Energy Source for Cooking and Lighting				
201	Source of energy before and after the installation of plant (Tick as required)	Source		Before biogas summer	After biogas winter
		1. Firewood(bhari/month)			
		2. Kerosene(litre/month)			
		3. Agriculture residues(bhari/month)			
		4. Dung cake(Kg/month)			
		5. L.P.G.(cylinder/year)			
		6. Coal (Kg/month)			
		7. Saw dust (Kg/month)			
		8. Others (specify).....			
202	If you use firewood, where do you get it from? (Tick as required)	1. Forest <ul style="list-style-type: none"> a. Community forest <input type="checkbox"/> b. Government forest <input type="checkbox"/> c. Own forest/land <input type="checkbox"/> 2. Buy <input type="checkbox"/> 3. Others (specify).....			
203	When you brought firewood from the forest before the installation of biogas plant, to what extent was the forest degenerated? (Tick one)	1. Excessively degenerated <input type="checkbox"/> 2. Considerably degenerated (no. of forest/trees had decreased) <input type="checkbox"/> 3. Forest/Trees were not degenerated at all <input type="checkbox"/>			
204	Local price of the	Fuel	Price(Rs)	Unit	

⁸ Children : below six years

	energy source	1. Firewood		bhari
	Bhari/doko/thunche/tokari =Kg	2. Kerosene		litre
		3. L.P.G.		cylinder
		4. Dung cake		kg
		5. Electricity		per month
		6. Others		
210	Fuel Source for Lighting			
211	Fuel source for lighting besides from biogas	Source	Quantity	
			Before biogas	After biogas
		1.Kerosine (litre/month)		
		2.Electricity (unit/month)		
		3.Candles (Rs/month)		
	4. Solar light	Yes <input type="checkbox"/>	Yes <input type="checkbox"/>	
		No <input type="checkbox"/>	No <input type="checkbox"/>	
	5. Others (specify).....			
3.0	Environmental Impact/ Energy Utilization			
300	Stove/Environment			
301	Type and number of stove in use (Tick as required and state the no. of stove used)	Before biogas		After biogas
		1. L.P.G.stove <input type="checkbox"/>	1. Biogas Stove <input type="checkbox"/>	
		2. Kerosene stove <input type="checkbox"/>	2.L.P.G.stove <input type="checkbox"/>	
		3. Improved stove <input type="checkbox"/>	3.Kerosene stove <input type="checkbox"/>	
		4. Traditional stove <input type="checkbox"/>	4.Improved stove <input type="checkbox"/>	
		5. Rice bran stove <input type="checkbox"/>	5.Traditional stove <input type="checkbox"/>	
			6. Rice bran stove <input type="checkbox"/>	
302	Has the amount of smoke in the kitchen reduced after biogas installation? (Tick one)	1. Not reduced <input type="checkbox"/>		
		2. Reduced to some extent <input type="checkbox"/>		
		3. Reduced to a great extent <input type="checkbox"/>		
303	Time of daily use of fire wood stove	Before biogas		After biogas
		.....hour.....min		.....hour.....min
4.0	Health and Sanitation			
400	Toilet			
401	Have you constructed toilet in your house? (If No go to Q.No. 404)	Before biogas		After biogas
		Yes <input type="checkbox"/>	Yes <input type="checkbox"/>	
		No <input type="checkbox"/>	No <input type="checkbox"/>	

402	If yes, who motivated you to construct toilet? (Tick one)	1. Self <input type="checkbox"/> 2. Family/neighbour/relative <input type="checkbox"/> 3. Staff of biogas company <input type="checkbox"/> 4. Staff of NGO <input type="checkbox"/>																																																							
403	Is the toilet attached with biogas plant? (Tick one)	Yes <input type="checkbox"/> No <input type="checkbox"/>																																																							
404	If you have not constructed toilet, what is the reason?	1. Company did not suggest <input type="checkbox"/> 2. Extra cost burden <input type="checkbox"/> 3. Socio-cultural reason (specify) <input type="checkbox"/> 4. Others (specify).....																																																							
410	Diseases and Fire Related Accidents																																																								
411	Incidence of diseases in family members before and after biogas installation. 1. Increased 2. Decreased 3. Same 4. No diseases (Write 1, 2, 3, 4 as per requirement)	<table border="1"> <thead> <tr> <th rowspan="2">Disease & accident</th> <th colspan="3">Number</th> </tr> <tr> <th>Male</th> <th>Female</th> <th>Children</th> </tr> </thead> <tbody> <tr> <td>1. Eye infection</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2. Respiratory diseases</td> <td></td> <td></td> <td></td> </tr> <tr> <td>3. Cough</td> <td></td> <td></td> <td></td> </tr> <tr> <td>4. Diarrhoea</td> <td></td> <td></td> <td></td> </tr> <tr> <td>5. Dysentery</td> <td></td> <td></td> <td></td> </tr> <tr> <td>6. Round worm/parasitic infection</td> <td></td> <td></td> <td></td> </tr> <tr> <td>7. Encephalitis</td> <td></td> <td></td> <td></td> </tr> <tr> <td>8. Malaria</td> <td></td> <td></td> <td></td> </tr> <tr> <td>9. Headache</td> <td></td> <td></td> <td></td> </tr> <tr> <td>10. Tuberculosis</td> <td></td> <td></td> <td></td> </tr> <tr> <td>11. Fire related accident</td> <td></td> <td></td> <td></td> </tr> <tr> <td>12. Others(specify)</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Disease & accident	Number			Male	Female	Children	1. Eye infection				2. Respiratory diseases				3. Cough				4. Diarrhoea				5. Dysentery				6. Round worm/parasitic infection				7. Encephalitis				8. Malaria				9. Headache				10. Tuberculosis				11. Fire related accident				12. Others(specify)			
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5.0	Agriculture, Land Use and Manure/Fertilizer																																																								
500	Land Holding Including Kitchen Garden																																																								
501	Total cultivated land(Bigha/Kattha, Ropani/Aana)																																																								
	Lowland	Upland	Kitchen garden																																																						

502	Changes observed in the production after biogas installation							
		Increased		Decreased		Remained Same		
	Lowland							
	Upland							
	Kitchengarden							
503	Yield of major crops grown in a year							
Lowland (Kg or Bhari per.....Bigha/Kattha or Ropani/Aana)			Upland (Kg or Bhari per.....Bigha/Kattha or Ropani/Aana)			Kitchen garden (Tick in the vegetables that were/are grown)		
Name of crop	Before biogas	After biogas	Name of crop	Before biogas	After biogas	Name of crop	Before biogas	After biogas
Rice			Maize			Leafy vegetables		
Maize			Millet			Cabbage		
Wheat			Wheat			Brinjal		
Pulses			Pulses			Pumpkin		
Potato			Potato			Cauliflower		
Vegetables (specify)			Vegetables (specify)			Beans		
Mustard			Mustard			Tomato		
Cash crops			Cash crops			Onion		
Others			Fruits			Others		
			Others					

504	Annual income from the crops in the above mentioned years, 1. Increased 2. Decreased 3. Same (Write 1, 2, 3 as per requirement)	1.Increased 2.Decreased 3.Remained same	<input type="text"/> <input type="text"/> <input type="text"/>
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505 Use of Manures and Fertilizers [1) Bhari =.....kg, 2) Bucket =.....litre]
(The enumerater should measure)

Type	Lowland		Upland		Kitchen garden	
	Before biogas	After biogas	Before biogas	After biogas	Before biogas	After biogas
Livestock manure(Bhari)						
Biogas slurry manure (Bucket)	-		-		-	
Slurry compost (bucket)						
Chemical fertilizers (Kg)						
Urea						
Di-ammonium phosphate (DAP)						
Potash						
Others						

506	After using slurry compost, what are the changes observed in soil fertility?	1. Increased 2. Decreased 3. Same	<input type="text"/> <input type="text"/> <input type="text"/>
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510 Information on Livestock and Poultry

511	Animals and birds presently being kept/reared. (Specify the number)	Type	Number
		1. Cattle	
		2. Buffalo	
		3. Pig	

		4. Sheep/Goat		
		5. Poultry		
		6.Others (Specify)		
512	Dung production per day (Enumerator should measure)	.....Doko/tok ari	.....Bucket	.....Kg
		Note: (1doko=.....kg) (1 bucket=.....kg)		
513	Amount of dung obtained per day after the installation of biogas	Increased <input type="checkbox"/> Decreased <input type="checkbox"/> Same <input type="checkbox"/>		
514	Fodder collection before and after biogas installation (Bhari/day) One Bhari=.....kg	Tick one	Before biogas(Bha ri/day)	After biogas(Bh ari/day)
		1. From forest <input type="checkbox"/>		
		2. Own Production <input type="checkbox"/>		
		3. Both <input type="checkbox"/>		
515	Condition of animal shed	Condition of shed	Before	After
		1.Smooth, earthen floor	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
		2.Smooth cemented/stone floor	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
		3. Urine collecting pit	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
516	Changes in livestock husbandary practices after the installation of biogas.	1. Stall feeding <input type="checkbox"/>		
		2. Forage production <input type="checkbox"/>		
		3. Fodder production <input type="checkbox"/>		
		4. Construction of animal shed <input type="checkbox"/>		
		5. Utilization of dung and urine for gas production <input type="checkbox"/>		
520	Use of Organic Residues, Slurry and Compost Manure			
521	How do you use crop residues? (Bran,Stover, Straw etc) (Tick as required)	Use	Before	After
		1. As fuel for cooking		
		2. For preparing cattle feed		
		3. For preparing slurry compost		
		4. For mulching		
		5. Others (Specify).....		
522	Do you use slurry manure? (If No, go to Q.No. 529)	1. Yes <input type="checkbox"/>		
		2. No <input type="checkbox"/>		

523	If you are using slurry manure, in what way are you using it? (Tick one)	3. Slurry as it is <input type="checkbox"/> 4. By preparing slurry compost <input type="checkbox"/> 5. After drying <input type="checkbox"/>
524	How do you prepare compost from slurry?	1. Heap method <input type="checkbox"/> 2. Pit method <input type="checkbox"/> 3. Others (specify).....
525	How many pits are there for composting the slurry from the biogas plant? (Tick one)	1. One <input type="checkbox"/> 2. Two <input type="checkbox"/> 3. Three <input type="checkbox"/> 4. None <input type="checkbox"/>
526	While preparing compost from slurry how many times do you turn it upside down? • Tick one	1. Once <input type="checkbox"/> 2. Twice <input type="checkbox"/> 3. Thrice <input type="checkbox"/> 4. None <input type="checkbox"/>
527	How do you store compost before using them in the field? • Tick	1. Spread on the floor for drying 2. Keep uncovered in heap 3. Keep covered in heap 4. Pile up in shade near animal shed 5. Pile up temporarily in the fields 6. Pile up as small uncovered heaps in the field 7. Pile up as small covered heaps before incorporating in the soil 8. Carry to the field and immediately incorporate in soil 9. Carry to the field during land preparation and incorporate in the soil 10. Others (specify).....

528	What are the impacts of slurry manure application on the incidences of insects and diseases on crops?	1. Decreased <input type="checkbox"/>	
		2. Increased <input type="checkbox"/>	
		3. No effect <input type="checkbox"/>	
		4. Do not know <input type="checkbox"/>	
529	If you do not use slurry manure, what could be the causes? (Tick as required)	1. Lack of knowledge about manure value <input type="checkbox"/>	
		2. Lack of knowledge about application technique <input type="checkbox"/>	
		3. Difficult to carry because of its wet nature <input type="checkbox"/>	
		4. Hesitation in carrying because of being attached with toilet <input type="checkbox"/>	
		5. Available in very small quantity <input type="checkbox"/>	
		6. Others (specify).....	
530	Have you done fish farming? (If No go to Q.No. 540)	Yes <input type="checkbox"/>	
		No <input type="checkbox"/>	
531	Have you used slurry as fish feed?	Yes <input type="checkbox"/>	
		No <input type="checkbox"/>	
532	If yes, how much is used per day?	.....litre	
		.....bucket	
533	State of fish production	Before biogas (kg/annum)	After biogas (kg/annum)
540	Production of Fodder Grass		
541	How do you solve the problem of fodder and forages? (Tick one)	Before biogas	After biogas
		1. Growing grass on the bunds <input type="checkbox"/>	1. Growing grass on the bunds <input type="checkbox"/>
		2. Planting fodder grass <input type="checkbox"/>	2. Planting fodder grass <input type="checkbox"/>
		3. Others (specify).....	3. Others (specify)..
6.0	Discription of Biogas		
600	Investment on Plant		

601	How did you manage financing for construction of biogas plant? (Tick one)	1. Self <input type="checkbox"/> 2. Loan from village lender <input type="checkbox"/> 3. Bank loan (Large Banks) <input type="checkbox"/> 4. Loan from micro credit institutions (Cooperative, Rural Development Bank, Others) <input type="checkbox"/> 5. Others (specify).....
602	If you have taken loan (Tick one)	1. Paid all the installments <input type="checkbox"/> 2. Paid few installments <input type="checkbox"/> 3. Not paid any installment <input type="checkbox"/> 4. Others (specify).....
603	Have you received subsidy for installing biogas plant? 1. Received <input type="checkbox"/> 2. Not received <input type="checkbox"/> 3. Do not know <input type="checkbox"/>	
610	Functioning of Plant	
611	Reasons for installing plant (Tick as required)	1. Because of the problem of firewood <input type="checkbox"/> 2. Easy to cook <input type="checkbox"/> 3. Smokeless kitchen <input type="checkbox"/> 4. Improved sanitation because of toilet attachment <input type="checkbox"/> 5. Time saving <input type="checkbox"/> 6. Slurry can be used as manure <input type="checkbox"/> 7. Energy source for lighting <input type="checkbox"/> 8. Subsidy provision <input type="checkbox"/> 9. Others (specify)..... <input type="checkbox"/>
612	Is your plant currently producing gas? (Tick one)	Yes <input type="checkbox"/> No <input type="checkbox"/> If no, since how long? .....days
613	Did the plant ever stop producing gas in the past? (Tick one) (If No go to Q.No. 615)	Yes <input type="checkbox"/> If yes, for how many days? days No <input type="checkbox"/>
614	What could be the reasons for the halt in gas production? (Tick one)	1. No feeding <input type="checkbox"/> 2. Failure of appliances <input type="checkbox"/> 3. Civil structure damaged <input type="checkbox"/> 4. Do not know. <input type="checkbox"/>
615	Has the biogas company made any committment for improved services?	Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, what?.....
620	Plant Feeding	
621	How much dung is fed into the	1. Once a day .....kg/feeding

	plant? (Measure if necessary and ask the person who performs the job) (Tick one)	2. Twice a day .....kg/feeding 3. Every second day .....kg/feeding 4. Twice a week kg/feeding 5. Once a week kg/feeding		
622	If all the available dung is not fed into the plant, what could be the reason?	1. Gas is sufficient <input type="checkbox"/> 2. Fear of reduction in the nutritional quality of farm yard manure <input type="checkbox"/> 3. Lack of time <input type="checkbox"/> 4. Others (specify).....		
623	Type of plant feeding other than dung. (Tick as required)	1. Night soil <input type="checkbox"/> 2. Pig dung <input type="checkbox"/> 3. Poultry droppings <input type="checkbox"/> 4. Others (Specify).....		
624	Additional water required after installation of biogas	Total :litre/day 1. For mixing with dung to feed into plant .....litre/day 2. For livestock .....litre/day 3. Others (specify).....		
630	Gas Production from the Plant			
631	Number of stoves (Biogas) used. (Tick one)	1. One stove <input type="checkbox"/> 2. Two stoves <input type="checkbox"/> 3. More than two stoves <input type="checkbox"/>		
632	Number of biogas lamps (Tick one)	1. No lamp <input type="checkbox"/> 2. One lamp <input type="checkbox"/> 3. Two lamps <input type="checkbox"/> 4. More than two lamps <input type="checkbox"/> 5. Others (specify).....		
633	Daily consumption of gas for cooking hrs/day	Season	Stove in use (number)	Cooking time (hour) (Total time calculating each stove used)
		Summer		
		Winter		
634	Daily consumption of gas for lighting (Hours)	Season	Stove in use (number)	Lighting time (hour) (Total time in which each lamp is used)
		Summer		
		Winter		
635	Is the gas sufficient? (Tick one)	1. Always sufficient <input type="checkbox"/> 2. Never sufficient <input type="checkbox"/> 3. Sufficient only in summer <input type="checkbox"/>		

636	What do you do to increase gas production? (Tick as required)	1. Increase feeding <input type="checkbox"/> 2. Feed after heating in the sun <input type="checkbox"/> 3. Cover the dome with mud or straw <input type="checkbox"/> 4. Attach toilet with the plant <input type="checkbox"/> 5. Do nothing <input type="checkbox"/> 6. Feed other material into the plant (specify) <input type="checkbox"/>
640 Cooking		
641	Are you satisfied with cooking in biogas? (Tick one)	1. Fully satisfied <input type="checkbox"/> 2. Satisfied <input type="checkbox"/> 3. Not satisfied <input type="checkbox"/>
642	If fully satisfied/satisfied, give reasons (Tick as required)	1. Smokeless cooking <input type="checkbox"/> 2. Fast cooking <input type="checkbox"/> 3. Tasty food <input type="checkbox"/> 4. Easy and fast dish washing <input type="checkbox"/> 5. Constant watching not necessary <input type="checkbox"/> 6. Others(specify).....
643	If not, give reasons. (Tick as required)	1. Less tasty food <input type="checkbox"/> 2. Gas not sufficient <input type="checkbox"/> 3. Frequent failure of appliances <input type="checkbox"/> 4. Frequent repairs <input type="checkbox"/> 5. Hesitation due to toilet attached <input type="checkbox"/> 6. Others (specify).....
650 Lamp (Only if lighting connected)		
651	Are you satisfied with biogas lamp? (Tick one)	1. Yes <input type="checkbox"/> 2. Somewhat <input type="checkbox"/> 3. No <input type="checkbox"/>
652	If yes, what are the reasons for your satisfaction? (Tick as required)	1. Bright light <input type="checkbox"/> 2. Easy to use <input type="checkbox"/> 3. Can work even during night <input type="checkbox"/> 4. Others (Specify).....
653	If not, what are the reasons for your dissatisfaction? (Tick one)	1. Frequent breakage of lamp net <input type="checkbox"/> 2. Frequent breakage of glass <input type="checkbox"/> 3. Difficult to light <input type="checkbox"/> 4. Not transferable <input type="checkbox"/> 5. Others (Specify).....
660	Satisfied in other aspects of biogas	Yes <input type="checkbox"/> No <input type="checkbox"/> (If No, what could be the reasons) 1. Problem in company dealing <input type="checkbox"/>

		2. Problem in bank dealings <input type="checkbox"/>																																																																							
		3. Others (specify).....																																																																							
670	Repair of Plant																																																																								
671	Frequent failure of appliances given below (Tick in the appropriate appliances and fill number in other boxes) (Specify, no.of times the appliance damaged and within how many years)	<table border="1"> <thead> <tr> <th colspan="3">Appliance Failure</th> <th colspan="3">Repaired</th> </tr> <tr> <th rowspan="2">Appliance</th> <th rowspan="2">Frequency of failure</th> <th rowspan="2">In how many years time</th> <th rowspan="2">By company</th> <th colspan="2">Self</th> <th rowspan="2">No repair</th> </tr> <tr> <th>M</th> <th>F</th> </tr> </thead> <tbody> <tr> <td>1. Mixer</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2. Main Valve</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3. Gas pipe</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4. Water drain</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>5. Rubber hose</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>6. Gas taps</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>7. Stove</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>8. Biogas lamp</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Appliance Failure			Repaired			Appliance	Frequency of failure	In how many years time	By company	Self		No repair	M	F	1. Mixer							2. Main Valve							3. Gas pipe							4. Water drain							5. Rubber hose							6. Gas taps							7. Stove							8. Biogas lamp						
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8. Biogas lamp																																																																									
672	Breakdowns in civil structure (per annum) (Tick as required)	<table border="1"> <thead> <tr> <th rowspan="2">Structure</th> <th rowspan="2">Frequency</th> <th colspan="3">Repaired by</th> </tr> <tr> <th>Company</th> <th colspan="2">Self</th> <th rowspan="2">No repair</th> </tr> <tr> <td></td> <td></td> <th>M</th> <th>F</th> <td></td> </tr> </thead> <tbody> <tr> <td>1. Inlet pit</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2. Toilet</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3. Dome</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4. Digester</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>5. Water Drainpit</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>6. Water Drainpit cover</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>7. Outlet</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>8. Outlet cover</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Structure	Frequency	Repaired by			Company	Self		No repair			M	F		1. Inlet pit					2. Toilet					3. Dome					4. Digester					5. Water Drainpit					6. Water Drainpit cover					7. Outlet					8. Outlet cover																					
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673	Have you found gas leaking from plant/pipe/stove? (If No go to Q.No. 678)	Yes <input type="checkbox"/> No <input type="checkbox"/> Do not know <input type="checkbox"/>																																																																							
674	If yes, since when?monthday																																																																							
675	What have you done to stop this? (Tick one)	1. Informed the concerned authority <input type="checkbox"/> 2. Repaired the leaking point <input type="checkbox"/> 3. Informed BSP-N <input type="checkbox"/> 4. Others (specify).....																																																																							

676	Has the gas use time decreased because of leakage?	Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, by how much time? .....hr ....min.
677	How do you find out about leakage? (Tick one)	1. Smell <input type="checkbox"/> 2. Using soap water <input type="checkbox"/> 3. Decrease in burner flame <input type="checkbox"/> 4. Others (specify).....
678	Average annual expenditure for repair (last year)	1. Appliances (Rs)..... 2. Civil structure (Rs).....
679	Have you received timely repair services from biogas company? (Tick one) (If No go to Q.No. 681)	1. Yes <input type="checkbox"/> 2. Yes, but delayed <input type="checkbox"/> 3. No <input type="checkbox"/>
680	How long does it take to receive this service from company? (After informing) (Tick one)	1. Within three days <input type="checkbox"/> 2. Within one week <input type="checkbox"/> 3. Within two weeks <input type="checkbox"/> 4. Within three weeks <input type="checkbox"/> 5. More than three weeks <input type="checkbox"/>
681	Have you received any training from the company? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, on what? (Tick as required) (If No go to Q.No. 684)	1. Plant use <input type="checkbox"/> 2. Repair and maintenance <input type="checkbox"/> 3. Health and sanitation <input type="checkbox"/>
682	To whom was the training given?	1. Husband <input type="checkbox"/> 2. Wife <input type="checkbox"/> 3. Others (specify).....
683	Do you think that you can undertake repair and maintenance on your own based on the training?	1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/> 3. Do not know <input type="checkbox"/>
684	Is there any supervision visit of biogas plant from the company staff? (Tick one) (If No go to Q. No. 686)	Yes <input type="checkbox"/> No <input type="checkbox"/>
685	If yes, tick mark in the corresponding column	(Within a year) Frequency of visit
		Regular
		Invited

		1. Once	<input type="checkbox"/>	<input type="checkbox"/>
		2. Twice	<input type="checkbox"/>	<input type="checkbox"/>
		3. Thrice	<input type="checkbox"/>	<input type="checkbox"/>
		4. More	<input type="checkbox"/>	<input type="checkbox"/>
686	Have you been recommended any device for pungent smelling gas (H ₂ S) removal?	Yes	<input type="checkbox"/>	No <input type="checkbox"/>
7.0	Gender			
700	Who has the Ownership of Property and Resources?			
		Male	Female	Both
1.	Land	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	Livestock	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	House	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	Vehicle/Tractor/Motorbike/Cycle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	Bank saving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.	Biogas plant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
710	Who Plays the Decisive Role in the Following Activities?			
		Male	Female	Both
1.	Decision to install plant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	Selection of biogas company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	Attachment of toilet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	Selection of Plant construction site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	Construction of animal shed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.	Bank property and economic affairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
720	What Types of Women Labour were Employed in Biogas Plant Construction?			
	Labor	Days	Remarks	
	Skilled	<input type="checkbox"/> days		
	Unskilled	<input type="checkbox"/> days		

721	Usually who does the feeding? • Tick one	1. Male member of the household <input type="checkbox"/> 2. Female member of the household <input type="checkbox"/> 3. Helper <input type="checkbox"/>
730	Time and Division of Work	
	Time Consumed Before and After Biogas Installation	Before Biogas (Minute) After Biogas (Minute)
731	Looking after livestock (per day)	
732	Fetching drinking water for livestock and plant (per day)	
733	For feeding plant (per day)	
734	Collecting firewood / dung cake (per week)	
735	Collecting fodder (per day)	
736	Cooking (per day)	
737	Washing utensils (per day)	
738	If there is time saving after biogas installation, how do you use your saved time? (Tick as required).	1. Adult education <input type="checkbox"/> 2. Recreation/ Watching TV/ Listening radio <input type="checkbox"/> 3. Reading newspapers and magazines <input type="checkbox"/> 4. Social work <input type="checkbox"/> 5. Others (specify).....
739	Do you use saved time in income generating/productive work? If yes, specify the work.	1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/>
750	Has the Women Participation in Local Social Service or Community Organization Increased After the Installation of Biogas as Compared to Before? Yes <input type="checkbox"/> No <input type="checkbox"/>	
751	If yes, in what kinds of service or organization? (Tick as required)	
	Organization	Remarks
	1. Mothers' group	
	2. Cooperatives	
	3. Forest users' group	

4. Others (specify)			
760	What changes have occurred in the time allocation on following matters for women after biogas installation? (Tick as required)		
	Changes	Increased	Decreased
	1. Child rearing and caring		
	2. Improvement in health and sanitation of the house hold surrounding		
	3. Take care of patients/elderly members of the family		
	4. Fetching water		
	5. Mixing dung and water		
	6. Collecting fodder		
	7. Collecting forage		
	8. Cooking food		
	9. Washing dish		
	10. Others (specify).....		
770	Womens' Perception on Changes in Social State (Tick as required)		
	Elements of social changes	Increased	Decreased
		No change	
	1. Cohesion/cooperation among female members of the family		
	2. Participation in the social service activities in neighbourhood		
	3. Health Center, Maternal-child health care and Family Planning activities		
	4. Others (specify)		
790	What are your suggestions to Biogas Program for enhancing the livelihood of female members and children of the family?		
	1.		
	2.		
	3.		
8.0	Opinion of the Respondents		
800	What are your other important suggestions for additional improvement?		

Name of the interviewer:

Signature:

3 **Biogas User's Survey 2006/2007**

3.1 Questionnaire B: Checklist for Biogas Company

2. Detail Information on Biogas Company

Name of Biogas Company: -----

Company Code: -----

Address:

What are your criteria for choosing the working areas?

Besides your company, which other organizations are working in your areas in promoting biogas?

○ -----

What types of services does the company provide to the Biogas Plant Users?

Routine and request visit of company to supervise installed plants

How many times are the visits made to the Biogas Plant Users for post installed services?

One time Two Times

3.1.1.1 Three Times More than three times

In case of any problem, do the farmers contact the Company?

Yes No.

If yes, what are their common problems?

1. -----
2. -----
3. -----
4. -----
5. -----
6. -----

*What do you think about subsidy? And what do you suggest for continuation of the subsidy?
Please give your opinion?*

3. Your Capability

How do you assess your capabilities within last three years in terms of expansion of business, increment in the employment and over all income of the Company?

Increased Decreased

3.1.1.2 Remained Same

G. Your suggestions to improve the performances of the plant

H. What are our major problems or constraints?

I. What steps have you taken to solve these problems?

J. Do you conduct demonstration of Bio-slurry utilization during the installation?

K. Have you made any commitment for improved services to users? If yes, what kind of commitment? Have you fulfilled them?

Name of the Interviewer-----

Signature .-----

Date of Interview: -----

Annex-III: List of Participants in the Draft Final Report Consultative Workshop

S.N	Name	4 Designation	Organization
1.	Araceli Lioret	Portfolio Coordinator	4.1 SNV/N
2.	Balaram Shrestha	Director A&M	BSP-N
3.	Bindu Manandhar	Senior Officer	BSP-N
4.	Hemraj Kharel	Statistician, BUS 2007	CMS
5.	Isha Sharma	Environmental Expert-BUS 2007	CMS
6.	Khagendra N. Khanal	Assistant Director	BSP-N
7.	Madhab L. Shrestha	Agriculture Expert-BUS 2007	CMS
8.	Mangala Shrestha	Gender Expert –BUS 2007	CMS
9.	Merina L. Sitoula	Socio-economist – BUS 2007	CMS
10.	Raju Laudari	Socio-economist	AEPC
11.	Rajan Subedi	Director	CMS
12.	Ram Prasad Dhital	RESS Co-ordinator	AEPC/RESS
13.	Saroj Rai	Executive Director	BSP-N
14.	Shanker Pande	Local Expert	Kfw
15.	Shanker Pradhan	Team Leader/Biogas Users' Survey	CMS
16.	Shekhar Aryal	Chairman	NBPG
17.	Subarna Rai	PMT Advisor	SNV/N
18.	Keshav Dawadi	Program Co-ordinator	NBPG
19.	Uttam Jha	OSID Advisor	SNV/N

Annex-V: Study Team Composition

S. No.	Name	Position
1.	Mr. Shanker Pradhan	Team Leader/Biogas and Energy Expert
2.	Dr. Mangala Shrestha	Gender Expert
3.	Mr. Madhav Lal Shrestha	Agriculture Expert
4.	Ms. Isha Sharma	Environment, Health and Sanitation Expert
5.	Ms. Merina Lohani Sitoula	Socio-economist
6.	Mr. Hem Raj Kharel	Statistician