

Biogas User Survey 2007
National Domestic Biogas and Manure Programme
(NDBMP)

Final Report

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The study team also expresses its sincere gratitude to the field staff of POs in Gazipur district for their spontaneous assistance and cooperation during the reconnaissance visit.

Abbreviations and Acronyms

ASS	After Sales Services
BASA	Bangladesh Association for Social Advancement
BCSIR	Bangladesh Council for Scientific and Industrial Researches
BMP	Biogas and Manure Program
CEGIS	Center for Environmental and Geographic Information Services
CPO	Construction Partner Organization
DoE	Department of Environment
DPHE	Department of Public Health and Engineering (DPHE)
EMP	Environmental Management Plan
GO	Government Organizations
GS	Grameen Shakti
GTZ	German Technical Cooperation
HBCC	Hosain Biogas and Compost Fertilizer Company
IDCOL	Infrastructure Development Company Limited
IGA	Income Generating Activities
KBCC	Kamrul Biogas and Compost Fertilizer Company Ltd
KII	Key Informant Interview
LCPO	Loan and Construction Partner Organization
LGED	Local Government Engineering Department
LGSS	Local Government Support Service
LPG	Liquified Petroleum Gas
MDG	Millennium Development Goal
NDBMP	National Domestic Biogas and Manure Program
NGO	non-government organizations
NOC	No Objection Certificate
O&M	Operation and Maintenance
PO	Partner Organization
RREC	Rahman Renewable Energy Company Limited
RSF	Rural Services Foundation
SB	Srizony Bangladesh
SNV	Netherlands Development Organization
SOUL	Save our Urban Life
SS	Shubashati
UA	Upazila Administration
UAEO	Upazila Agriculture Extension Officer
UFO	Upazila Fisheries Officer
UNO	Upazila Nirbahi Officers
UP	Union Parishad

Executive Summary

Bangladesh is a predominantly agricultural country. The potentials of biogas production and its use in the country are very high. The Infrastructure Development Company Ltd (IDCOL), with support of the Netherlands Development Organization (SNV) and possible support from KfW, Germany, started implementing the National Domestic Biogas and Manure Programme (NDBMP) in Bangladesh from September 2006. NDBMP aims to construct 60,000 high quality domestic biogas plants by the end of 2010 throughout the country. In line with this aim, some 2,450 domestic size biogas plants were installed by the end of 2007. IDCOL needed to conduct this Biogas User Survey in order to know the effectiveness and appropriateness of the biogas plants as well as their impact on livelihood, health, sanitation, environment etc.

The study had the scope to find out the project impact on health, sanitation and socio-economic conditions, the physical status, functionality, operation and maintenance of the plants, user satisfaction and perception of both users and non-users, non-user demand for biogas, and impact on agriculture, energy, emission reduction and environment and on gender sensitivity.

The biogas user survey was a descriptive study. It was conducted in the community of biogas users where biogas plants were installed from September 2006 to the end of June 2007 for the use of biogas and organic manure. The multi-stage systemic random sampling was used for selecting the sample districts. The sample plants were selected for accomplishing the study from 10 randomly selected districts. The sample districts included Dinajpur, Lalmonirhat, Joypurhat and Rangpur of Rajshahi division, Gazipur, Mymensingh, Faridpur and Rajbari of Dhaka division, and Kushtia and Magura of Khulna division. The sample size, determined in consultation with IDCOL, was 50. Fifty user households and two biogas consumers of one of the sample biogas plants were interviewed for assessing the impact of the biogas plants. Other than these user households, 20 non-user households were also interviewed for assessing the need for biogas plants in the community. Fifty sample households with biogas plants from 10 sample districts were selected considering:

- Existence of cow, poultry and/or night soil based biogas plants
- Representation of POs. Plants of all relevant POs in the selected area were covered
- Gender sensitivity (women owner of biogas plants).

The study collected information from 39, 8 and 3 cow, poultry and night soil and cow dung/poultry litter based biogas plant users respectively. These plants were constructed by nine (9) POs.

The results of the biogas user survey are as follows:

Sl. No.	Particulars	Findings
1	Occupation of plant owner (%)	
	• Business	42
	• Service	18
	• Farming	12
	• Others	10
	• No occupation (Housewife)	18
2	Level of education of biogas plant owners (%.)	
	• Illiterate	2
	• Literate but no institutional education	4
	• Primary or equivalent	10
	• Secondary or equivalent	34

Sl. No.	Particulars	Findings	
	• SSC degree or equivalent	12	
	• HSC degree or equivalent	14	
	• Bachelor degree or equivalent	12	
	• Master degree or equivalent & above	12	
3	Fund used by the owner for plant installation (%)		
	• Credit facility received from the POs	36	
	• Own source	64	
4	O & M training received (%)	42	
5	Period of plant in operation (average in month)	7	
6	Plant in operation (%)	88	
7	Plant functioning well (%)	78	
	• Significantly	64	
	• Moderately	23	
	• Minimally	13	
8	Fulfill household demand for biogas (%)	54	
9	Use of gas (%)		
	• In cooking stove	96	
	• In both of cooking stove and hajag light	4	
10	Feeding rate of raw material (kg)	Cow	Poultry
	• 1.2 m ³	35	-
	• 1.6 m ³	45	-
	• 2.0 m ³	57	-
	• 2.4 m ³	70	35
	• 3.2 m ³	71	63
	• 4.8 m ³	129	63
10	Volume of gas used (m ³ per day) (hour x 0.33 m ³)		
	• 1.2 m ³	0.5	
	• 1.6 m ³	0.9	
	• 2.0 m ³	1.26	
	• 2.4 m ³	1.32	
	• 3.2 m ³	1.29	
	• 4.8 m ³	2.1 ¹	
	Firewood used by the users before plant installation (kg/day)	16	
	Firewood used by the users after plant installation (kg/day)	6	
	Firewood saved from biogas use (kg/day)	10	
11	Time saved from cooking (hour per day)		
	• 1.2 m ³	0.16	
	• 1.6 m ³	2.0	
	• 2.0 m ³	1.24	
	• 2.4 m ³	2.1	
	• 3.2 m ³	3.3	
	• 4.8 m ³	2.84	
	Monthly saving of firewood cost per user household (Tk.)	646.00	

¹ Some of the owners do not use the produced gas completely.

Sl. No.	Particulars	Findings
	Compost pit for storing slurry (%)	
	• No pit	16
	• One pit	42
	• Two pit	42
13	Use of bio-manure (%)	74
	• Crop cultivation	86
	• Home gardening	32
	• Fish culture	43
	• Selling	8
14	Fertilizer cost saved against bio-manure use (Tk./decimal)	13
15	User satisfaction (operational plants: 44) (%)	
	• Satisfied	87
	• Dissatisfied	13
	Degree of satisfaction (%)	
	• Significantly	64
	• Moderately	28
	• Minimally	8
16	After Sale Service: received (%)	66
17	Relation between PO and beneficiaries (%)	
	• Good	58
	• Moderate	28
	• Bad	14
19	Benefits derived from the plant (%)	
	Gender benefit	
	• Easy to cook	60
	• Other works can be done simultaneously during cooking	42
	• Women get more leisure time for recreation	40
	• No smoke in kitchen	28
	• Smoke-black free utensils – easy to clean	26
	Health benefit	
	• No eye irritation due to smoke	79
	• No respiratory problem	85
	Economic benefit	
	• Selling of saved fuel	44
	• Increase income	22
	Agricultural benefit	
	• Obtain high quality manure from slurry	20
	• Use of slurry as fish feed	12
	Environmental benefit	
	• Conservation of environment	40
20	Problem faced by the users (%)	
	• Some time cooking can not possible due to insufficient gas supply	34
	• Not getting better After Sale Service	22
	• Frequent (every month) payment of credit installment	18
	• Low quality mixture device	14

Sl. No.	Particulars	Findings
	<ul style="list-style-type: none"> Insufficient training given to the users 	12
	<ul style="list-style-type: none"> Difficult to cook a large volume of food 	10
	<ul style="list-style-type: none"> Optimum use of slurry is unknown due to lack of knowledge 	10
21	Cost recovery period (month) Considering per household gas consumption @ Tk.500.00 per month the return comes equivalent to Tk.18500.00 only by gas use for cooking.	37
22	Non-user having knowledge about biogas plant	90%
23	Lessons learnt	
	<ul style="list-style-type: none"> The required number of cattle and/or poultry birds can be minimized by using night soil. But night soil use is not socially accepted. 	
	<ul style="list-style-type: none"> The users, especially the poultry based plant users have much more quantity of raw material per day than required. The efficiency of gas production and heat generation in the cooking stove of poultry based plants is also higher. 	
	<ul style="list-style-type: none"> The reason for the 33% of non-operational plants is technical fault in construction, which indicates inadequate supervision by POs and insufficient technical knowledge of masons. Again, due to this reason some users have had to reconstruct the plant and incur additional cost. 	
	<ul style="list-style-type: none"> Women perceived that they were benefited most by biogas plant installation. 	
	<ul style="list-style-type: none"> The beneficiaries (20% - 30%) lose interest in plant installation due to the higher construction cost 	
	<ul style="list-style-type: none"> There is lack of coordination among different government agencies at upazila level and IDCOL. 	
24	Conclusions	
	<ul style="list-style-type: none"> There is no provision of more than 4.8 m³ size plants under NDBMP. But larger size plants can be installed, as a huge volume of raw material in the dairy and poultry farm remains unused. There is a great need for larger size biogas plants for household consumption and commercial purposes. There is a great opportunity for versatile use of biogas technology throughout the country. 	
	<ul style="list-style-type: none"> Training is an essential ingredient for ensuring proper implementation of a development initiative. Proper training is a must for the POs and masons in curbing the technical fault in plant construction. Proper construction will save the plant users from incurring additional cost for reconstruction of plants. 	
	<ul style="list-style-type: none"> Proper slurry management and use can reduce the fertilizer crisis to a large extent and can improve soil health, crop yield. But due to lack of knowledge some users (16%) do not have any slurry pit and others do not have any standard size pit for slurry storing. The users, therefore, need to be trained on the management and use of slurry, standard size slurry pit construction, etc. 	
	Recommendations	
	<ul style="list-style-type: none"> More/adequate ASS to the users and training of POs urgently required. 	

Sl. No.	Particulars	Findings
	<ul style="list-style-type: none"> The provision for subsidy money may be increased proportionately with the plant size for its promotion among the medium and small farm holding households. 	
	<ul style="list-style-type: none"> The quality of the supplied appliances should be improved for its durability and efficiency. 	
	<ul style="list-style-type: none"> In the case of gas distribution line the metallic pipe should be changed with polyethylene to check leakage, ensure cost effectiveness, easy repair and maintenance and so on. 	
	<ul style="list-style-type: none"> The capacity of the POs should be verified properly through performance evaluation by IDCOL for achieving the target and sustainability of NDBMP. 	
	<ul style="list-style-type: none"> The importance of using bio-slurry is not given proper emphasis by the POs. Adequate user motivation campaign and demonstration organized jointly by IDCOL, the Agriculture Extension Department and the Fishery Department is recommended. 	
	<ul style="list-style-type: none"> A target-based yearly plan should be developed for each union/upazila/district by IDCOL in association with the government agencies including the Local Administration, LGED, Livestock, Agriculture, Fisheries, Public Health, Union Parishad and POs 	
	<ul style="list-style-type: none"> There should be a strong team for trouble shooting of plants and appliances for future dissemination of the technology. A loop research team is also required for the project. 	

Chapter 1

Introduction

1.1 Background

Bangladesh is a predominantly agricultural country. The potentials of biogas production and its use in the country are very high. Considering its importance, biogas technology was introduced in Bangladesh in 1972 at the premises of the Bangladesh Agriculture University (BAU). Afterwards for promoting biogas, the Bangladesh Council of Scientific and Industrial Research (BCSIR), Environment Pollution Control Department, Danish International Development Assistance (DANIDA), Local Government Engineering Department (LGED), Department of Livestock Services (DLS) and Grameen Bank undertook various other efforts (IDCOL/SNV, 2006).

Likewise, the Infrastructure Development Company Ltd (IDCOL) with support of the Netherlands Development Organisation (SNV) and possible support from KfW, Germany started the National Domestic Biogas and Manure Programme (NDBMP) in Bangladesh from September 2006. NDBMP aims to construct 60,000 high quality domestic biogas plants by the end of 2010 throughout the country. In line with this, some 2,450 domestic size biogas plants were installed by the end of 2007 under NDBMP. IDCOL needed to conduct this Biogas User Survey in order to know the effectiveness and appropriateness of the biogas plants as well as their impact on livelihood, health, sanitation, environment etc. The major environmental benefit from using biogas as an energy resource is that there is no net production of greenhouse gases. The carbon-di-oxide released during biogas combustion originally was organic plant material and so is just completing a cycle from atmosphere to plant to animal and back to the atmosphere. Methane is a more severe greenhouse gas than carbon-di-oxide and capture of biogas as a fuel prevents the release of methane into atmosphere. Land application of solids and anaerobic lagoon treatment of liquid waste releases a substantial amount of methane to the atmosphere. As the capture of the methane for use as a fuel would significantly reduce the net greenhouse gas production, comparative analysis of pollutant emission between biogas and other type of methane sources should be delineated. IDCOL has felt the necessity of obtaining necessary feedback about the technology, and monitoring both the technology and its impact on user satisfaction by conducting appropriate and detailed surveys at regular intervals. A Biogas Users Survey, therefore, was conducted in December 2007.

1.2 Objectives of the Study

1.2.1 General Objective

The main objective of the Biogas User Survey was to make a comprehensive assessment of the impacts of the biogas plants installed so far on energy, health & sanitation, and agricultural systems as well as technical, socio-economic, environmental and gender concerns. In addition to local impacts, the survey has also provided information to evaluate the global environmental impacts of biogas plants.

1.2.2 Specific Objectives

The specific objectives of the study were to assess and analyze:

- a) The impact of biogas plant on health and sanitation,
- b) The impact of biogas plant on socio-economic condition,

- c) The technical, physical, financial and institutional information related to biogas plant,
- d) Biogas plant user satisfaction and perception,
- e) Perception of non-users about biogas use and its demand,
- f) The impact of biogas plant on gender,
- g) The impact of biogas plant on agriculture, and
- h) The impact of biogas plant on energy, emission reduction and environment.

1.3 Scope of Work

In furnishing the objectives of the study the following work was required to be accomplished under each of the specific objectives:

- a. Impact on Health and Sanitation
 - Status of toilets, toilets used and toilets attached to biogas plant
 - Exposure to indoor air pollution and reduction of smoke in the kitchen due to biogas
 - Respiratory and eye infection
 - Incidence of gastro-intestinal diseases
 - Mosquito induced diseases and nuisance
 - Fire/burning accidents
- b. Impact on Socio-economic Conditions
 - Time and money saved through different household and biogas related activities
 - Use of the saved time in different income generating activities
 - Changes in income and access to natural resources
 - Employment generation
 - Determination of economic level of biogas owners as compared to non-users
 - Educational status
- c. Information on Biogas Plants
 - Instruction on operation as provided by the Construction Partner Organizations (CPOs)
 - Operation and maintenance of the biogas plants including training
 - After- sales-services (ASA) provided by the CPOs
 - Plant operation rate, problem and maintenance cost
 - Major problems faced by the users
 - Dung availability per day and burning hours of biogas stove
 - Functioning biogas plant
 - Plants financed by financial institutions or with cash
 - Other organizations supporting biogas
- d. User Satisfaction and Perception
 - Their awareness, requirements and suggestions for possible improvement
 - Operation and maintenance training received by them
 - Satisfaction/ dissatisfaction
 - Sources of biogas information
 - Repair and maintenance
 - Family member responsible for contacting the PO

- Time and types of services provided by the PO
- e. Perception of non-users about biogas use and its demand
- Their awareness about biogas and organic manure use
 - Their demand of biogas and organic manure
 - Benefit and problems of biogas plant construction, biogas and organic manure use
- f. Impacts on Gender
- Women's participation in decision making process
 - Construction, operation, maintenance and management of biogas plant
 - Ability of women to contact the CPO 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 plant installation
 - Enrollment of girls in schools
 - Income generation and productive work
 - Women's involvement in social work
 - Time involvement of women vis-à-vis men in household chores like cooking, feeding, fuel wood collection, operation of biogas plant, etc.
- g. Agriculture Impacts
- 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 plants
 - 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 the decomposing materials 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 farm income
- h. Energy, Emission Reduction and Environmental Impacts
- Daily household 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
 - Daily gas production and consumption
 - Local (household) environmental condition before and after the installation of biogas and its impact on global environment.

Chapter 2

Literature Review

Bangladesh is an agriculture-based populous country 76% of whose population lives in rural areas. With the increase of population, energy crisis is on the rise and due to the increase of demand for conventional energy, the pressure on biomass energy is increasing day by day. In Bangladesh every year over 40 million tons of biomass energy such as wood, straw, cow dung, tree leaves, household wastes, paddy husk, jute stick, etc. are used. In this country about 41% of the total requirements of energy is met from agricultural wastes and 8.7% from cow dung. As a result of this the land is deprived of bio-materials and nutrition rich ingredients. A country needs to have 25% of its area as forests to maintain ecological balance, but in Bangladesh only 9% of the land is forest area. The continuous decrease of forest area is creating imbalance in nature and environment. As a result, changes are also experienced in weather.

Alessandro Volta of Italy who made the unexpected discovery of combustible air on 14 November 1776 was the first who named it as “Biogas”. Humphrey Davey in 1800 discovered it from farmyard manure and in 1803-1806 his friend William Henry named it as “Methane”.

Due to their widespread research, utilization and dissemination of biogas technology, the People’s Republic of China is recognized today as the leading country in biogas technology. The Biogas Research & Training Centre (BRTC) of Chinese Hydraulic Biogas Digesters for Asia Pacific Region was established in 1979 at Chengdu of Sichuan Province. India is the second leading country for its contribution of Floating Top Cover and Fixed Dome Plant.

The technology was first introduced in Bangladesh in 1972 by Prof. M A Karim at the Bangladesh Agriculture University, Mymensingh and subsequently by the Bangladesh Academy of Rural Development (BARD) at Comilla. The Bangladesh Council of Scientific & Industrial Research (BCSIR) installed more than 25000 plants; the Local Government & Engineering Department (LGED) installed about 1900 plants; and the Environment & Pollution Control Department (EPCD) installed 220 plants. The Danish International Development Assistance (DANIDA); Bangladesh Small & Cottage Industries Corporation (BSCIC); BRAC; BUET; some NGOs; Department of Youth & Sports and other organizations are doing similar research & dissemination work throughout the country.

With a view to fulfilling the demand for organic fertilizers, technologists have developed appropriate technology to produce biogas from such materials as cow dung, human excreta, household wastes, poultry litter etc. The biogas produced through this technology contains 62-67% methane, which can be used as fuel. The remaining portion is mainly carbon dioxide. The biogas produced through this technology can be used:

- For cooking
- As a source of light
- For generating electricity by using generators to operate fans, radios, televisions and electric bulbs
- For operating pumps for irrigation purposes.

The residue after fermentation is a high quality organic fertilizer that can be used in croplands and in pisciculture. The other aspect of biogas technology is the hygiene factor. The raw materials that

generate biogas scatter in the environment and create pollution including indoor air pollution, smoke in the kitchen, respiratory difficulties and eye infection. However, when these raw materials are used in biogas plants, the area becomes pollution free. As biogas reduces expenses in fuel for cooking & lighting and saves significant time spent in collecting fuel wood and dung cakes, it has economic and social implications for gender issues especially in terms of social work and women's participation in decision-making processes. Besides, use of biogas has brought about a change in the composting practice such as piling up manure, turning the decomposing materials for aeration, effective use of slurry on crop growth & productivity and ultimately increase in income of plant owners.

The Netherlands Development Organization (SNV), German Technical Co-operation (GTZ), Grameen Shakti of Grameen Bank, Infrastructure Development Company Limited (IDCOL) and other organizations are also implementing the biogas project activities throughout the country. SNV has implemented a project in Nepal over the last few years. With the 95% success of the project, SNV expanded the program to other Asian countries and started the mission in Bangladesh in 2004. IDCOL with the support of SNV and financing by KfW of Germany started the National Domestic Biogas and Manure Program in Bangladesh from mid 2006 and installed 1200 family size biogas plants out of 60000 high quality domestic plants. The successful implementation of the program depends on the easy functioning of the plants, direct and indirect benefits enjoyed by users, socio-economic impacts, environmental issues, health & sanitation, women's involvements etc. The major environmental benefit from using biogas as an energy resource is that there is no net production of greenhouse gases. The carbon dioxide released during biogas combustion originally was organic plant material and so is just completing a cycle from atmosphere to plant, plant to animal and back to the atmosphere. Methane is a more severe greenhouse gas than carbon dioxide and capture of biogas as a fuel prevents the release of methane into the atmosphere. The capture of methane for use as fuel would significantly reduce the net greenhouse gas production.

This study covered 50 biogas plants in 10 districts with a view to obtaining necessary feedback about the technology, monitoring of the technology and its impact on users. Twenty non-user households were also surveyed under the study.

Reference:

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Technical study of Biogas plants installed in Bangladesh. Prokash C Ghimire Oct. 2005.

Chapter 3

Study Approach and Methodology

3.1 Study Design

The Biogas User Survey was a descriptive study consisting of a community survey. In accordance with the objectives of the study communities were covered in areas where biogas plants have been implemented from September 2006 to end June 2007 for the use of biogas and organic manure. It is important to mention here that in 2006 and 2007, a total of 205 and 1570 biogas plants were implemented respectively. The plants were constructed in 60 districts of Bangladesh by 9 Lending and Construction Partner Organizations (LCPOs), 5 Construction Partner Organizations (CPOs), 5 Lending Partner Organizations (LPOs), and 2 Manufacturing Partner Organizations (MPOs). They are commonly known as POs.

The purpose of the study was to assess the impact of biogas plants on households. The general approach of the study was, therefore, to blend both quantitative and qualitative fronts. Both of these approaches were important for capturing the operation and maintenance of biogas plants, plant operation rate, maintenance cost and its impact on socio-economic condition, health, agriculture, environment, etc. in biogas user households.

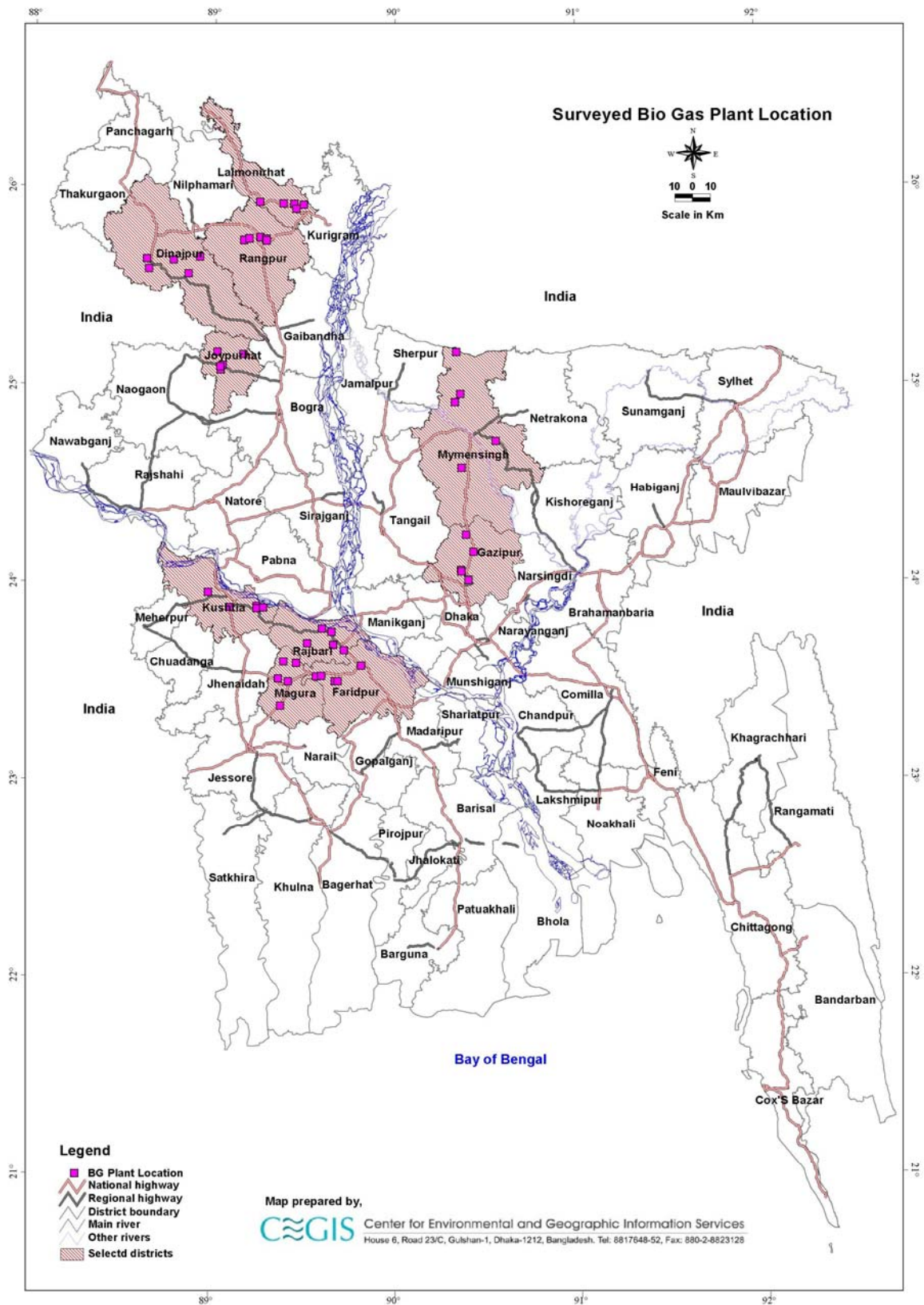
The study also assessed the demand for biogas and organic manure use in non-user households. The present study, therefore, collected information from both users and non-users in the community of areas with biogas plants.

3.2 Study Area

About 1112 biogas plants were installed in different locations of Bangladesh (in 53 districts out of 60 by the end of June 2007 i.e. within the time frame of this study). As per the discussion with IDCOL, districts rich in natural gases were excluded from the survey. As such, the districts of Sylhet and Chittagong divisions were excluded from the sample frame. The districts included in the sample frame from the other four divisions were considered on the basis of:

- Higher concentration of biogas plants (25 to 89),
- Existence of cow, poultry and night soil based biogas plants.

As per the ToR, the study collected information from 10 potential districts for preparing the study report. The multi-stage systemic random sampling was used for selecting the sample districts. The sample plants were selected for accomplishing the study from the 10 randomly selected districts. The sample districts included Dinajpur, Lalmonirhat, Joypurhat and Rangpur of Rajshahi division, Gazipur, Mymensingh, Faridpur and Rajbari of Dhaka division, and Kushtia and Magura of Khulna division. These districts are shown in Map 1.



Map 1. Selected Sample Districts for Biogas User Survey

3.3 Determination of Sample Size

The sample size in any sample survey is an important factor, as sampling in research is unavoidable since time, money and efforts do not allow studying all possible members of a population. The Consultant (CEGIS) in consultation with IDCOL, therefore, determined the sample size as 50 for the present study. Fifty user households and two (2) biogas consumers of one of the sample biogas plants were interviewed for assessing the impact of the biogas plants. Other than these, 20 non-user households were also interviewed for assessing the need for biogas plants in the community.

3.4 Distribution of Sample

The objective of the sample survey was to obtain an accurate assessment of the current situation in the project area related to biogas plants and the perception of biogas users so that the changes due to the project could be captured. Fifty sample households with biogas plants from 10 sample districts were selected considering:

- Existence of cow, poultry and/or night soil based biogas plants
- Representation of POs. Plants of all relevant POs in the selected area were covered
- Gender sensitivity (women owner of biogas plants).

The samples were drawn proportionately, 44 plants for cows and 6 for poultry. The study truncated the size of cow-based plants and increased the size of poultry based plants to 40 and 10 respectively without hampering their representativeness. Five interviews were conducted uniformly in each of the selected districts. Four (4) samples were distributed for cow based plants and one (1) for poultry based plants in each district primarily. Later, according to IDCOL' suggesiton, the night soil based biogas plants were incorporated in the sample list prior to starting the field survey. In connection with this, five (5) out of the 50 sample plants were distributed for night soil based plants. Out of these five plants only three (3) were night soil based in the field, the others had the provision but were disconnected from the plants; those were actually cow based. The raw materials of night soil based plants are the combination of either cow dung and night soil or cow dung, poultry litter and night soil. Table 3.1 shows the changed distribution of the sample number. The reason for change is the switch over from using poultry litter to cow dung. Poultry farm owners have stopped their poultry business due to the recent 'Bird Flu' epidemic and high price of poultry feeds. As such, this type of plants is treated as cow based plants.

On the other hand, however, two (2) interviews were held with non-user households in each of the 10 selected districts. On the basis of availability, two more interviewes were held with the consumers of one of the biogas plants. Thus, 72 interviews were conducted in the sample community.

Table 3.1 Distribution of Sample by Type of Raw Material Used and Sample Area

District	Upazila	Name of PO	Type of raw material			
			Cow	Poultry	Night Soil	Total
Dinajpur	Chirirbandar	GS	1	0	0	1
	Dinajpur Sadar	GS	2	0	0	2
	Parbotipur	RREC	2	0	0	2
Faridpur	Boalmari	KBCC	1	0	0	1
	Faridpur Sadar	KBCC	1	0	0	1
	Madhukhali	KBCC, GS	3	0	0	3
Gazipur	Joydevpur	RSF, BASA	1	2	0	3

District	Upazila	Name of PO	Type of raw material			
			Cow	Poultry	Night Soil	Total
	Sreepur	HBCC, GS	1	1	0	2
Joypurhat	Joypurhat Sadar	RREC	2	1	0	3
	Panchbibi	RREC, GS	2	0	0	2
Kushtia	Kumarkhali	KBCC, Subashati	3	0	0	3
	Kushtia Sadar	SB	1	0	0	1
	Mirpur	GS	1	0	0	1
Lalmonirhat	Aditmari	SOUL	1	0	0	1
	Lalmonirhat Sadar	SOUL, GS	1	1	1	3
	Kaliganj	SOUL	1	0	0	1
Magura	Magura Sadar	KBCC	2	0	0	2
	Shalikha	KBCC	1	0	0	1
	Sreepur	KBCC, HBCC	1	1	0	2
Mymensingh	Gouripur	GS	1	0	0	1
	Haluaghat	GS	0	1	0	1
	Phulpur	GS	2	0	0	2
	Trisal	GS	1	0	0	1
Rajbari	Baliakandi	KBCC	0	0	1	1
	Rajbari Sadar	KBCC, GS	3	0	1	4
Rangpur	Rangpur Sadar	SOUL, KBCC, GS	4	1	0	5
Total			39	8	3	50

3.5 Study Implementation

The study was implemented in 10 selected districts of Bangladesh by CEGIS and in collaboration with IDCOL. The following activities were carried out to accomplish the study.

3.5.1 Review of Literature

Relevant literature and documents related to the Biogas User Survey were reviewed to have a clear understanding of the program and its effect on the target population.

3.5.2 Technique of Data Collection

Both quantitative and qualitative information were collected by applying the in-depth interview method, key informant interview (KII) and observation.

For collecting quantitative and qualitative information, well designed structured questionnaires and checklists were used.

In line with the approaches the study collected data exploiting four techniques, which were as follows:

Reconnaissance: Senior professionals made preliminary visits to two locations of the project in Gazipur district to discuss with officials concerned and beneficiary communities. The field visits helped develop ideas for improving the study process and identify important issues for preparing the Inception Report and developing data collection instruments. The visits facilitated establishing a good rapport with all stakeholders in the whole process of project planning, design and implementation.

Household survey: An in-depth survey was conducted on households selected through a statistical method, with statistical validity. A well-prepared questionnaire was used that included questions on the demographic characteristics of households as well as socio-economic, gender, agricultural, health and sanitation status, satisfaction of users, desire of non-users, maintenance and utility of plants,

environmental perspective, technical and social problems encountered with plant users, and information on biogas consumers of sample biogas plants. Particular questions on self-assessed poverty situation were also asked.

Key informant interview (KII): This strategic tool was used for capturing local knowledge about the social dynamics and local potentials to optimize the facility (plant as well as biogas production). This information supplemented those collected from questionnaire interviews. Some specific issues regarding biogas potentials, institutional capacity, structural operation and maintenance etc. came out from the KII. The key informants were the indirect stakeholders of the program, including the UNO and other upazila level officials (of Agriculture, Fisheries, *Jubo Unnayan*) and CPO, LPO and LCPO representatives.

Field observation: While in the field, the Consultants carried out field observation for checking the quality and physical condition of the plants. GPS reading was taken for each of the plant locations.

3.5.3 Development/Finalization of the Data Collection Instruments

In line with the study objectives and methodology, the Consultant (CEGIS) developed and tested data collection instruments. Based on the results of the field test, the draft instruments were revised and sent to IDCOL for approval. The feedback from IDCOL was incorporated in the final version of the instruments and necessary copies were reproduced for field data collection. According to the study design three sets of data collection instruments were prepared. These were:

- Questionnaire for user household survey;
- Questionnaire for non-user household survey;
- Checklist for key informant (UNO, CPO, LPO, etc.) opinion collection.

3.6 Number of exercises done under the technique of data collection

Primary data was collected from the target beneficiaries, POs and upazila level officials by conducting a household survey, KII and physical observation. Based on the list of biogas plants provided by IDCOL and the sample design of the study, 50 user-household interviews and physical observation, 20 non-user household interviews, and 19 KII were held for data collection. Out of the 19 KII, 10 were conducted with upazila level officials (one in each of the districts) and 9 with the POs. The detailed scenario is shown in Table 3.2.

Table 3.2 Distribution of Activities by Study Area

Place of Visit	Activities with Sample Number			
	Household Survey		KII	
	User	Non-user	UNO	PO**
Dinajpur	5	2	1	1 (SOUL)
Lalmonirhat	5	2	1	1 (GS)
Joypurhat	5	2	1	1 (RREC)
Rangpur	5	2	1	0
Kushtia	5	2	1	2 (SB, SS)
Magura	5	2	1	1 (HBCC)
Faridpur	5	2	1	0
Rajbari	5	2	1	1 (KBCC)
Gazipur	5	2	1	2 (RSF, BASA)
Mymensingh	5	2	1	0
Grand Total	50*	20	10	9

* Two more, excluding the 50 user-household interviews, were held with the biogas consumers of a sample plant.

** Name of POs: Save our Urban Life (SOUL), Rahman Renewable Energy Company Limited (RREC), Kamrul Biogas and Compost Fertilizer Company Ltd. (KBCC), Srizony Bangladesh (SB), Shubashati (SS), Hosain Biogas and Compost fertilizer company (HBCC), Rural Services Foundation (RSF), Bangladesh Association for Social Advancement (BASA), Grameen Shakti (GS)

3.7 Quality Control of Data Collection

CEGIS always ensures quality of data of any study that it conducts. The senior professionals engaged in data collection ensured data quality for this study through:

- GPS based field interview location tracking
- The team members internally discussed the findings to ensure reliability
- Consistency check of instruments developed
- Solving any new problem that might arise in the field.

3.8 The study team

The study team was formed considering the expertise and experiences needed for conducting the study efficiently. In accordance with the ToR, the team was comprised of a Biogas Expert, a Socio-economist and a Data Analyst. However, in conducting the study other experts needed to be included internally from CEGIS. The other team members, mostly senior professionals, included engineers, economists and sociologists. The team was divided into three study groups for conducting the survey. The expert senior professionals were engaged in collecting data considering the comprehensive and participatory nature of the study. Table 3.3 shows the designation and name of the team members.

Table 3.3: Nominated team members under the study

Designation	Name
Team Leader (Biogas Expert)	Mr. Shamsul Haque
Environmental Expert	Mr. Mujibul Huq
M&E Expert/Socio-economist	Mr. Nityananda Chakravorty
Environmental Sanitation Engineer	Mr. M. Waji Ullah
Socio-economist/ Gender Specialist	Dr. Dilruba Ahmed
Database Expert/Data Analyst	A.K.M. Hasan
Research Analyst (Sociologist)	Mr. ATM Shamsul Alam
Research Analyst (Economist)	Mr. Subrata Kumar Mondal
Research Analyst (Environmental Engineer)	Mr. Kazi Kamrul Hasan
Research Analyst (Environmental Engineer)	Mr. Nandan Mukherjee
Research Analyst (Agriculturist)	Ms. Fouzia Nusrat
Research Analyst (Ecologist)	Mr. Md. Amanat Ullah

3.9 Limitations of the Study

1. The sample size of the biogas plants was determined purposely for each of the randomly selected districts and the sample size was uniformly distributed i.e five (5) plants were selected from each district. This was done to address the:

- representativeness of the relevant POs of the selected areas
 - gender sensitivity (women owner of biogas plants)
 - availability of poultry based biogas plants, and
 - cost effectiveness of field work.
- 2 Alternative samples were chosen in case the study team was misinformed about the location or the existence of any of the sample biogas plants. For example, three biogas plants, reported to be constructed by RREC in Parbotipur (1) and Joypurhat Sadar (2) upazilas, were not found in the locations mentioned in the biogas plant list given by IDCOL. Therefore, three other plants were selected from the list of the sample frame. It is important to mention here that one selected plant² was not found in the address mentioned, but all records related to that plant were available.
- 3 The addresses of biogas plants provided by IDCOL were incomplete, which made it quite difficult to locate the plants.

3.10 Data Processing, Tabulation, Analysis and Report Writing

Collection, compilation and analysis of data are essential before the preparation of a report. Tabulation, compilation and analysis of the data were done on the computer. Before data entry into the computer, the filled-in questionnaires were properly edited. Data was processed using the program packages of SPSS, Excel, etc. Graphs, bar diagrams, pie charts, etc. were used for analysis and MS Word was used for report writing.

3.11 Expected Outputs

The specific formal outputs were furnished in the Inception Report, Draft Report and Final Report.

A. Inception Report: The Inception Report covered an overview of the assessment process that was followed for the study. It reviewed the proposed methodology in more intensive and practical terms and was revised in consultation with the Client (IDCOL). The report formed the basis for finalizing the methodology and modalities of assessment and analysis. The report specifically included the following milestones:

- a. *Literature review:* This comprised an overview of relevant documents, information, data and publications pertinent to the assignment.
- b. *Work plan:* This provided the implementation plan including the duration of each activity, milestones, and deliverables.
- c. *Final methodology:* This was an agreed version of the methodology finalized by incorporating the valuable suggestions of the Client.
- d. *Questionnaire, checklists and formats:* These instruments were developed by CEGIS as needed and finalized in close collaboration with the Client for ensuring efficient outputs.

The Inception Report was submitted to the Client on 6 January 2008.

² ID # RBJP1106, Ms. Salma Begam, Police Line Joypurhat Sadar upazila, Joypurhat

B. Draft Report: The Draft Report contained all the topics required by the contract. It addressed all the objective variables of the assessment study. The topics that were covered included the following:

- Percent of farmers satisfied with biogas facility (level of satisfaction)
- Number of plants functioning well,
- Quantity of dung (average) fed every day
- Major problems faced by farmers
- Number of plants connected to toilets
- Quantity of smoke reduced in kitchen due to use of biogas,
- Time saved and spent on cooking,
- Quantity of firewood saved,
- Money (amount) saved for using biogas,
- Conclusions and recommendations

C. Final Report: The Final Report contains the topics mentioned under the Draft Report, but it has been finalized by incorporating changes and additions based on the Client important comments. This report has been finalized in close cooperation with IDCOL.

Chapter 4

Users' Demographic Information and Profile of Biogas Plants Implemented

This chapter describes the demographic characteristics of the user households and the profile of biogas plants implemented in the user households. Demographic information focuses on the gender identity of the users, household size, occupation and educational level of the biogas plant owners. The profile of biogas plants includes construction period of surveyed biogas plants, purpose of use and operational status of biogas plants, possession of biogas use appliances, possession of livestock and poultry birds, availability of raw material and its use, plant operation rate, function and maintenance cost and training on operation and maintenance of the biogas plant, and institutional aspects of biogas plant implementation. These issues are described below.

4.1 Demographic Information

4.1.1 Gender identity of the biogas plant owner

Twenty two percent of the biogas plant owners are female and the remaining majority (78%) is male.

4.1.2 Household size in the study area

The household size in the user household is 7.2 (Table 4.1). The reasons for this larger household size are: (i) some households are comprised of joint families; (ii) full time domestic helpers living with the households are included as household members. It is important to mention here that Table 4.1 shows the distribution of 49 sample households out of 50, as one household with a 4.8m³ size biogas plant is comprised of 56 members – most of whom are workers of the household owner. However, 58% of the members are male and 42% are female; 15% of them are less than 10 years old and the remaining 85% are more than 10 years old.

Table 4.1: Household size in the biogas user households

Plant size (m ³)	Number of households	Household size
1.2	3	3.7
1.6	3	5.3
2.0	11	6.4
2.4	8	9.1
3.2	13	7.4
4.8	11	7.9
Total	49	7.2

Source: Biogas User Survey 2007 by CEGIS

4.1.3 Occupation of the biogas plant owners

The major principal occupation of the male owners is business (42%) followed by service (14%), crop farming (12%) and others (10%). Others refer to village doctors and students. The subsidiary occupation of businessmen, service holders etc. is farming. Of the female biogas plant owners 4% and 18% are service holder and housewives, respectively. Some (40%) of them have income generating activities at the household level (Section 5.3.8).

Table 4.2: Distribution of plant owners by occupation

Occupation	% of plant owner		
	Male	Female	All
Business	42	0	42
Service	14	4	18
Farming	12	0	12
Others	10	0	10
No occupation (housewife)	0	18	18
Total	78	22	100

Source: Biogas User Survey 2007 by CEGIS

4.1.4 Educational level of the biogas plant owners

The vast majority of biogas plant owners have some formal education (Table 4.3). Thirty four percent of them attained secondary level of school education or equivalent followed by HSC (14%), SSC (12%) degree or equivalent and primary level education (10%). About one fourth of the owners have attained higher degree of education (bachelor and master degree or equivalent and above).

Table 4.3: Level of education of the biogas plant owners

Education level	% of plant owners		
	Male	Female	All
Illiterate	0 (0)	9 (2)	2
Literate but no institutional education	3 (2)	9 (2)	4
Primary or equivalent	8 (6)	18 (4)	10
Secondary or equivalent	36 (28)	27 (6)	34
SSC degree or equivalent	13 (10)	9 (2)	12
HSC degree or equivalent	15 (12)	9 (2)	14
Bachelor degree or equivalent	15 (12)	0 (0)	12
Master degree or equivalent & above	10 (8)	18 (4)	12
Total	100 (78)	100 (22)	100

Note: Figures without parenthesis show the intra group and within parenthesis inter group distribution of the male and female plant owners

Source: Biogas User Survey 2007 by CEGIS

4.2 Profile of Biogas Plants in User Household

4.2.1 Construction period of surveyed biogas plants

The surveyed biogas plants were constructed within the period of September 2006 to September 2007. One of the 50 sample plants was constructed in September 2007. It needs to be mentioned here that the study selected the samples from the sample frame of plants constructed within the period of September 2006 to June 2007. The actual date of construction of the particular plants was elicited during the survey. The plants started operating, however, from October 2006 to November 2007.

4.2.2 Purpose of use of biogas plant

The surveyed biogas plants were mainly implemented for cooking purposes. Out of the 50 plant users, two (4%) have provision for using *Hajag* light, but one of them has stopped using *Hajag* light, as the mantle of light is out of order frequently. Some other users who have poultry farms intend to use *Hajag* light for breeding poultry chicks in future.

4.2.3 Operational status of biogas plant

Forty-four surveyed plants are in operation at present while the remaining 6 are not (Table 4.4). The reasons for non-operation of the 6 plants are as follows:

- The plant (ID # HBMG1007) owner who wanted to establish a poultry farm obtained the required No Objection Certificate (NOC) from the Department of Environment (DoE) by submitting the Environmental Management Plan (EMP) of his poultry farm. The plant owner installed a biogas plant as per the EMP. However, the plant was never in operation at all.
- The plant (ID # KBMG1016) owner and his wife are old; they are not knowledgeable and are also not accustomed to operating a biogas plant. Initially their son operated the plant, but he does not stay with them anymore.
- The construction work of the plant (ID # RBDJ1004) has not yet been completed, as the owner lives far away from the plant. He will move near the plant in two months and start operating it when the construction work is completed.
- Two plants (ID # RBJP1014 and ID # SLLM1065) were in operation for a few months following construction. However, the owners feel that the service pipe is clogged with slurry or other material due to some technical fault at construction.
- The biogas plant (ID # KBMG1021) is not in operation due to the lack of raw material. The owner had a dairy farm initially with a good number of cows. He sold all the cows except one, which is not sufficient for operating the plant.

Table 4.4: Operational status of biogas plants

Status	Number	Percentage
Operational	44	88
Non-operational	6	12
Total	50	100

Source: Biogas UserSurvey 2007 by CEGIS

4.2.4 Possession of Biogas Use Appliances

Burner: Biogas users at 44 operational plants use burners for cooking. About 48% of them have one single burner and the remaining 31.8% and 6.8% have two and three single burners, respectively (Table 4.5). On the other hand 13.6% of users have no single burners but use double burners for

cooking. All single burners, however, are made by Noorea Engineering and Advance Engineering. The entitled POs supply single burners only. The users purchase double burners from market.

Table 4.5: Possession of burners in the user households

Plant Size (m ³)	% of users by number of single burner (n = 44)				
	1 Single	2 Single	3 Single	No single	Total
1.2	2.3	0.0	0.0	0.0	2.3
1.6	6.8	0.0	0.0	0.0	6.8
2.0	13.6	4.5	0.0	4.5	22.7
2.4	9.1	4.5	2.3	0.0	15.9
3.2	11.4	11.4	0.0	6.8	29.5
4.8	4.5	11.4	4.5	2.3	22.7
Total	47.7	31.8	6.8	13.6	100

Source: Biogas User Survey 2007 by CEGIS

Hajag light: Four percent (n=2) of users with 2.4m³ and 4.8m³ size plants have one *Hajag* light in each user household along with the biogas facilities for cooking.

4.2.5 Possession of livestock

This section describes the possession of livestock population of the respondent plant owners (n=50) irrespective of the operational or non-operational status of the plants. The study found that of the 50 owners 36 (72%) used only cow dung for operating the biogas plants, while eight (16%) owners used only poultry litter. The remaining 6 used either poultry litter and cow dung (3) or poultry litter, cow dung and night soil (3).

From among the only cow dung users 3 (25%) out of 36 owners reared buffalos (5 on average) along with their cattle. However, the average number of cows and calves of the only cow dung users (36) were 7 and 2, respectively (Table 4.6). It is evident from Table 4.6 that the households, except those of the 1.6m³ and 3.2 m³ plant size groups, possess on average more than or equal to the number of cattle population required for installing biogas plants.

The users (28%), however, of only poultry litter based and the combination of poultry litter, cow dung and night soil based plants did not rear buffalo. The poultry based plant users were found to have larger size plants ranging from 2.4 m³ to 4.8 m³. The poultry based plant users owned on average 2252 poultry birds in their farm, which was much higher than the required number (Table 4.7).

The poultry litter and cow dung based plant users were found to have on average 6 cows and 3787 poultry birds (Table 4.8). From among the poultry litter and cow dung based plant users two (67%) out of three possessed much more (1000 to 10,000) than the required number of poultry birds. More over they owned 6 cows on average. On the other hand, the remaining one plant user (33%) was found to own less number (360) of poultry birds than required (700), although he also owned 7 cows. In this context, the combination of poultry birds and cattle fulfilled the requirement of installing his biogas plant.

Furthermore, Table 4.8 shows that from among the night soil users two (67%) owned more than the required number of cattle and poultry birds. Only the remaining one (33%) had less than required. But he made up for it with night soil

Table 4.6: Distribution of average number of cattle by plant size and cow based plant users

Plant size (m ³)	Users		Average number of cattle			Required no.
	No.	%	Cows	Calves	All	
1.2	3	8	4	1	5	4
1.6	2	6	3	1	4	5
2.0	10	28	4	2	6	6
2.4	5	14	6	2	8	7
3.2	11	31	7	2	9	10
4.8	5	14	17	5	22	14
All/Average	36	100	7	2	9	-

Source: Biogas User Survey 2007 by CEGIS

Table 4.7: Possession of poultry birds in households by poultry based plants

Plant Size (m ³)	Number of poultry birds			
	Average	Minimum	Maximum	Required for plant
2.4 (n=2)	1850	1700	3700	350
3.2 (n=2)	1275	550	2550	450
4.8 (n=4)	3633	2700	5000	700
All (n=8)/Average	2252	-	-	-

Source: Biogas User Survey 2007 by CEGIS

Table 4.8: Possession of livestock by type and number in households with cow based plants

Plant Size (m ³)	Poultry & cattle based plants (n=3)				Poultry, cattle & night soil based plants (n=3)			
	Cows	Calves	All	Poultry	Cows	Calves	All	Poultry
1.2	-	-	-	-	-	-	-	-
1.6	-	-	-	-	3	-	3	0.0
2.0	-	-	-	-	4	4	8	0.0
2.4	-	-	-	-	2	1	3	500.0
3.2	-	-	-	-	-	-	-	-
4.8	5	1	6	3787	-	-	-	-
Total/Average	5	1	6	3787	3	2	5	-

Source: Biogas User Survey 2007 by CEGIS

4.2.6 Availability of raw material and its use

Cow dung based plants: It was revealed from the user survey that the users of 1.2m³ and 1.6m³ plants feed all their available raw material into the plants, which meet the required quantity. On the other hand, the users of 2.0m³ to 4.8m³ size plants avail higher quantity of raw material than the required quantity (Table 4.9). The users of 2.0m³ and 2.4m³ size plants utilize a little higher quantity than required/recommended. No variation and/or minor variation in the required/recommended quantity and the quantity of raw material actually used per day indicate good operation skills of the plant users.

But the use of less quantity compared to what is required indicates users' (3.2m³ plants) lack of knowledge.

Table 4.9: Daily availability and use of raw material for cow dung based plants

Plant Size (m ³)	No. of Users (n=31)	Average available raw material per day (kg)	Average use of raw material per day (kg)	Required quantity of raw material per day (kg)
1.2	1	35	35	35
1.6	2	45	45	45
2.0	9	67	57	55
2.4	4	70	70	65
3.2	11	99	71	85
4.8	4	300	129	130

Source: Biogas User Survey 2007 by CEGIS

Picture 1: A Cattle farm

Poultry litter based plants: Likewise 43% (n=3) of poultry litter users of 4.8 m³ size plants feed their plants only 63kg instead of 70kg per day, but they have a huge stock of raw material. On the other hand, 28% (n=2) of users of 3.2 m³ size plants feed their biogas plants 63kg instead of 45kg per day. The standard requirement and use of raw material is not in line with each other for 3.2m³ size plants (Table 4.10). These plants (3.2m³ size) discharge slurry before complete fermentation and as a result, the ideal composition of gas is not achieved. Besides, waste and environment management is significantly absent for all size of poultry litter based plants. Considering the waste and environment management aspects, these plants are not ideal in size.

Table 4.10: Daily availability and use of raw material for poultry based plants

Plant Size (m ³)	No. of Users (n=7)	Average available raw material per day (kg)	Average use of raw material per day (kg)	Required quantity of raw material per day (kg)
2.4	2	155	35	34
3.2	2	143	63	45
4.8	3	361	63	70

Source: Biogas User Survey 2007 by CEGIS



Picture 2: A Poultry farm

Poultry litter and cow dung based plants: The plants of this category are installed for poultry litter use. The users also utilize cow dung, as they rear cattle. The users of this category possess the largest size (4.8m^3) of domestic biogas plants. The users of this category utilize a higher quantity (123kg) of raw material than required per day. They avail 145kg of raw material per day.

Cow dung, night soil and poultry litter based plants: The users ($n=3$) of this category possess 1.6m^3 , 2.0m^3 and 2.4m^3 size biogas plants. On average they avail 64kg (ranging from 50 to 80kg) of raw material per day from cattle and poultry birds and they feed their plants all the raw material availed per day. Other than cow dung and poultry litter they also use night soil.

4.2.7 Plant operation rate, function and maintenance cost

As most of the surveyed plants started full operation seven months earlier on average, the survey could not distinctly identify the actual picture of plant operation rate. It may be mentioned here that in order to get a clear picture of the operation rate a minimum of one-year cycle is needed. However, out of the 50 plants, 44 are in operation, where 39 (78%) are functioning well. Considering the degree of the function, 64% are functioning significantly, 23% moderately and 13% minimally as reported by the users (Figure 4.1).

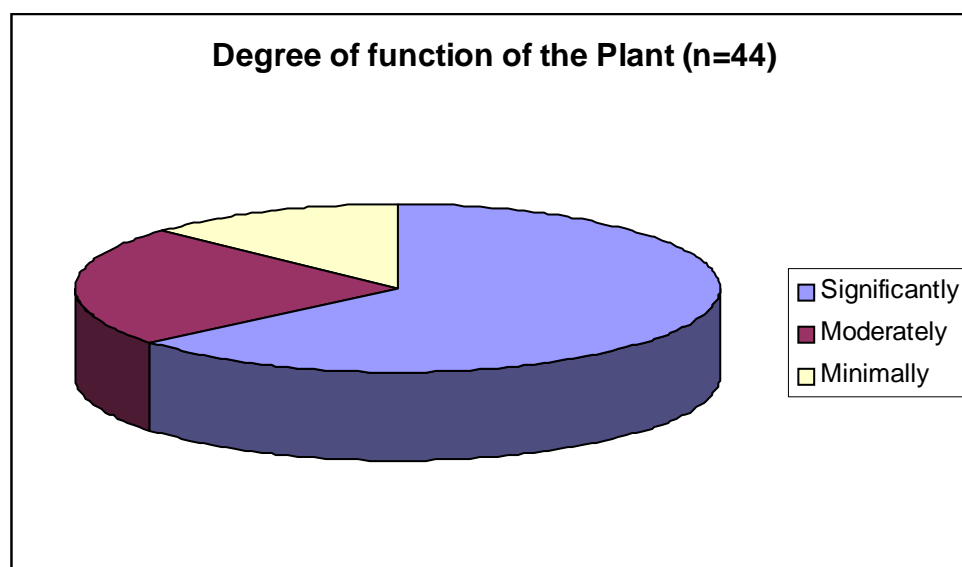


Figure 4.1: Degree of function of the plant

Most of the plants are almost new, but around 50% (n=23) of the functional plants need operation and maintenance services (Table 4.11). The cost of operation is comparatively high for some of the plants, as these are operated by full time domestic helpers appointed by the owners. On the other hand, the cost of maintenance is reported to lie in purchasing necessary appliances (mainly burners) for some of the plants.

Table 4.11: Monthly operation and maintenance cost

Plant Size (m ³)	No. of Plants (n=44)	No. of Plants requiring O&M	Average monthly O&M cost of plants (Tk.)
1.2	1	1	100
1.6	3	1	250
2.0	10	6	517
2.4	7	4	658
3.2	13	7	650
4.8	10	4	488

Source: Biogas User Survey 2007 by CEGIS

4.2.8 Training in operation and maintenance of the biogas plant

Not all users have a clear understanding of the operation and maintenance of biogas plants, and so a number of plants are not working satisfactorily. Some of the POs have recently started training programs for users. However, given the present support in terms of time and cost, the users are not interested in traveling a long distance from their homes to the PO office to attend the courses. The current status of O&M training provided by the POs to users is presented in Table 4.12.

Table 4.12: O& M training received by users

Sl. No.	Whether training received	Reported number and % of user households	
		Number (n=50)	Percentage
1	Yes	21	42
2	No	28	56
3	Plant not yet started	1	2

Source: Biogas User Survey 2007 by CEGIS

4.2.9 Instruction provided by the POs about O&M

Although IDCOL had instructed the POs to provide a user manual on proper operation and maintenance of the plant after it is constructed, in reality most of them did not do so. As a result, the users have inadequate knowledge about how to run a plant smoothly. It was observed during the field visit that only a few educated housewives could operate the stove properly and were still unaware of how to maintain the plant. During the survey, the users put forth the recommendation that a one-page pictorial laminated operation manual (about biogas plant and appliances) is hung on the wall in the kitchen to help beneficiaries perform O&M regularly and efficiently.

4.2.10 After Sale Services (ASS) provided by the POs

The After Sale Service (ASS) provided by POs is not up to the mark, though the coverage is good (66%) (table 4.13). Most of them do not have a local office in their working district, and this hampers the quality of their ASS. In some of the study areas, only one PO representative was observed to cover 2-3 districts from a long distance and so ultimately the level of ASS was very poor. For example, Mr. Md. Abdullah, Representative at Dinajpur of Kamrul Biogas and Compost Fertilizer Company Ltd. works alone in Dinajpur, Gaibandha and Panchagar districts.

Table 4.13: ASS of PO received by users

Sl. No.	Status of ASS	Reported number and % of user households	
		Number (n=50)	Percentage
1	Yes	33	66
2	No	16	32
3	Plant not yet started	1	2

Source: Biogas User Survey 2007 by CEGIS

4.2.11 Funding of biogas plant and relation between financial institutions and beneficiaries

The findings of the user survey show that the construction and other related costs are borne by either plant owners or by the POs. The average cost of plants of different size seems relatively higher than that of previously constructed plants by other organizations (e.g. BCSIR, LGED). It was found that 64% of the plant owners used own funds to meet the total cost. It was also revealed that NDBMP communicated with the economically well-off families capable of bearing the cost of biogas plants. Initially, this is important for promoting the biogas plant program. Nevertheless, the amount of subsidy money may need to be increased in future to bring small and medium farm-holding households under the coverage of the program.

For the well-functioning plant, the dealing between the user and loan provider POs is good. But the relation between the owner of the 'problem-plant' and the loan provider PO is bitter and there is an atmosphere of non-cooperation with regard to those plants. The survey result shows that the relation between POs and the owners is good for 58% while moderate and poor for 28% and 14% respectively.

Chapter 5

Impacts of Biogas Plant Use

Bangladesh is in a favorable position in respect of climatic conditions and availability of raw materials for biogas production. Biogas is a kind of fuel gas obtained by anaerobic decomposition of organic matter such as cow dung, garbage, poultry droppings, human excreta (night soil), agricultural residues, water hyacinth etc. The users under this study use cow dung, poultry droppings and night soil in their biogas plants to produce gas for domestic use.

This chapter assesses the impact of biogas plant on the different aspects of user households like health and sanitation, socio-economic condition, gender sensitivity, agricultural practices and environment. It also assesses the satisfaction and perception of biogas users and non-users. The findings and assessments are presented below.

5.1 Impact on Health and Sanitation

The health and sanitation section includes a description of the source of drinking water, status of toilets used and toilet attached to the biogas plant, exposure to indoor air pollution and reduction of smoke in the kitchen due to biogas, respiratory and eye problem, incidence of mosquito induced diseases and nuisance, and fire/burning accidents. A comparison has been made in the following sections between the situations before and after the installation of the biogas plants.

5.1.1 Source of drinking water

In the study area, 98% of the biogas users utilize hand tube wells (HTWs) to draw drinking water. Use of tube well water has increased from 90% to 98% after installation of biogas plants. A few (2%) of the users utilize tap water. About 6% used pond water before the installation of biogas plants, none of them do so at present (Table 5.1).

Table 5.1: Source of drinking water before and after installation of biogas plant by user household

Source	Access to source of water before (n=50)	Access to source of water after (n=50)
	% of household	% of household
HTW	90	98
Tap	4	2
Pond	6	0

Source: *Biogas User Survey 2007 by CEGIS*

5.1.2 Distance of water source from biogas plant

Thirty one percent of the water sources are found more than 20m away from the biogas plants while 63% are at a 10 to 20m distance. Only a few (6%) are relatively close to the water source i.e. within 0-5m. It is evident from this finding that 94% of the water sources are located at a safe distance of more than 10m from the biogas plants.

5.1.3 Status of toilet used

Sixty nine percent of the users utilize sanitary latrine with septic tank while 31% use ring slab latrine. There is no significant change between the before and after situations of plant installation – more or less similar practices prevail as before (Table 5.2).

Table 5.2: Toilet used in the user household

Type of toilet	% of households	
	Before	After
Sanitary Latrine	67	69
Ring slab	33	31

Source: Biogas User Survey 2007 by CEGIS

5.1.4 Toilet attached biogas plant

The biogas plants of a vast majority (93%) of users are not attached to toilets (table 5.3). This means that only about 7% are attached to toilets and are functioning. Some (16%) of the users have kept the provision of connecting their plants to toilets as per the design of IDCOL in case they want to make the connection in future.

Table 5.3: Toilet attached to the biogas plant by user household

Item	% of household (n = 44)
Attached	6.8
Not attached	93.2

Source: Biogas User Survey 2007 by CEGIS



Picture 3: An extra pipeline for connecting with toilet to add night soil in future

5.1.5 Perception on night soil based biogas plant in the community

Irrespective of religion most of the population dislike night soil based biogas plants. Of the three users interviewed, one did not disclose to his wife that he had installed a night soil based biogas plant and requested the study team not to disclose the fact to her. Another user did not disclose to his neighbors

or close relatives that he used night soil as feed for his biogas plant in order to avoid their disdain. But the relatives and neighbors of another user did not react negatively to the use of night soil. This user and his father and brothers use slurry as bio-manure for crop cultivation. The reasons, however, for people disliking night soil based biogas plants are summarized below:

- It is a matter of choice. Traditionally, the users cannot think of using night soil for any purpose, whatever it may be.
- Social non-acceptance of night soil as bio-manure for use in the crop field. It will be difficult to convince the laborers to use it in the crop field if they came to know about the night soil manure. Some of the users, therefore, do not like to take the risk of attachment, although they themselves personally have no dislike of night soil based biogas plants.
- For the same reason mentioned above, the users would not be able to sell bio-manure of night soil if they want to sell it in future.
- A wrong notion prevails among the users – that cooked food is contaminated with bad odor if cooked with biogas from night soil based plants.

5.1.6 Night soil user perception

The users have come to know about the use of night soil from television and work place. Their perceived benefits derived from this type of plants are summarized as:

- It saves them from the need to construct septic tanks on their land. The digester of the biogas plant is used as the septic tank of latrines and the owners derive dual benefits from the plant in terms of digester use.
- They can be free from tension for a long time. The ring slab latrine is constructed for a short duration, as it needs shifting from one place to another. But the septic tank-cum digester of the biogas plant has long durability and does not need shifting within a short time.
- Air pollution free.
- No bad odor of excreta.
- The night soil loses its identity with cow dung, i.e. it looks like slurry of cow dung. It has already been mentioned earlier that the raw materials used for night soil based plants are the combination of cow dung and night soil or cow dung, poultry litter and night soil.
- The slurry is used as bio-manure.

5.1.7 Exposure to indoor air pollution and reduction of smoke in the kitchen

Combustion of biomass (fuel) creates smoke, which pollutes the indoor air of the kitchen. In this respect, the users were asked to state the intensity of pollution in the kitchen. The indoor air pollution was moderate (42%) to severe (54%) before installation of the biogas plant. Whereas after installation, the kitchen air is pollution free in 65% of cases. Table 5.4 shows the detailed scenario of the kitchen. It is important to mention here that 25% of the users reported their indoor air pollution intensity as moderate; they had to use both biogas and biomass for cooking, as the produced biogas did not fulfill their demand entirely.

Table 5.4: Status of indoor air pollution by the user household

Intensity of pollution	% of user households	
	Before	After
Severe	54	2
Moderate	42	25
Minimal	2	8
No pollution	2	65

5.1.8 Incidence of respiratory, eye and gastro-intestinal problems/diseases

The users suffer from eye irritation and respiratory problems due to cooking in a smoke polluted environment and from inhaling smoke. The incidence of eye irritation and respiratory problems has been reduced significantly after the installation of biogas plants (Table 5.5).

Table 5.5: Incidence of eye, respiratory and gastro-intestinal problems/diseases

Intensity of incidence	% of households by problems/diseases			
	Before		After	
	Eye	Respiratory	Eye	Respiratory
Severe	15	15	0	0
Moderate	48	21	13	6
Minimal	8	19	8	8
No problem/disease	29	46	79	85

Source: Biogas User Survey 2007 by CEGIS

5.1.9 Mosquito induced diseases and nuisance

The users have not suffered from mosquito-induced diseases before or after the installation of biogas plants but suffer from mosquito-induced nuisance. Table 5.6 shows that the mosquito-induced nuisance has decreased to some extent after the installation of biogas plants. In the opinion of the users, the incidence of mosquito-induced nuisance varies with change of seasons, i.e. it decreases in winter and increases in summer.

Table 5.6: Mosquito-induced nuisance suffered by the user household

Intensity of nuisance	% of user households	
	Before	After
Severe	29	19
Moderate	21	13
Minimal	4	19
No pollution	46	50

Source: Biogas User Survey 2007 by CEGIS

5.1.10 Fire/burning accidents

None of the users suffered accidents from burning after installation of biogas plants. But some (7%) of them had suffered severely and another (7%) minimally from burn accidents before installation.

5.2 Impact on socio-economic condition

5.2.1 Time saved in the user household

It is assumed that the biogas plant will save a significant amount of time for each and every household that have installed it for different purposes e.g., daily cooking and fuel wood collection. The study tried to calculate the previous (without biogas plant) and present (with biogas plant) average cooking and fuel wood collection time. The previous and present average cooking and saved time by plant size are presented in Table 5.7. It is observed in the table that plants of almost all size have saved time from 1 to 2.5 hours for cooking purposes except the 1.2 size plant. The overall time saved is 1.78 hours per day as reported in the same table. It should be noted that the 1.2m³ size plant is less gas productive and could not meet client expectation.

Table 5.7: Plant wise previous and present average cooking time per day

Previous				Present			Plant wise time saved (hrs.) per day
Plant size (m ³)	Total plants	Average cooking time (hrs.) per day	Total time used per day	Total plants	Average cooking time (hrs.) per day	Total time used (hrs.) per day	
1.2	3	5.33	15.99	1	5.33	5.33	0
1.6	3	5.33	15.99	3	4.33	12.99	1
2	11	5.00	55	10	3.5	35	1.5
2.4	8	4.75	38	7	4	28	1
3.2	13	6.76	87.88	13	4.23	54.99	2.5
4.8	12	7.27	87.24	10	4.95	49.5	2.3
Total	50	-	300.1	44	-	185.81	-
Average			6.00	Average		4.22	1.78

Source: Biogas User Survey 2007 by CEGIS

The plant wise present and previous average fuel collection (i.e. biomass collection and dung cake preparation) time and saved fuel collection time per day are presented in Table 5.8. It is assumed that one household usually cooks two meals per day for consumption. It is observed in this table that on average about 1 hour is saved per households per day for biomass and cow dung collection. The saved time by plant size is also presented in the last column of the table. Beside this, a significant amount of time is saved due to use of carbon free utensils which requires less time to be cleaned. It is indicative information, which says that this type of biogas plant can save a huge amount of time for many people and could be used for different income generating activities as well as social welfare activities.

Table 5.8: Plant wise present and previous average fuel collection time per day

Previous				Present			Plant wise time saved (hrs.) per day
Plant size (m ³)	Total plants	Average fuel collection time (hrs.) per day	Total time used per day	Total plants	Average fuel collection time (hrs.) per day	Total time used (hrs.) per day	
1.2	3	2.32	6.96	1	2	2	0.16
1.6	3	3.66	10.98	3	1.46	4.38	1.1
2	11	2.08	22.88	10	2.6	26	-0.26
2.4	8	3	24	7	0.8	5.6	1.1
3.2	13	2.78	36.14	13	1.18	15.34	0.8

Previous				Present			
Plant size (m ³)	Total plants	Average fuel collection time (hrs.) per day	Total time used per day	Total plants	Average fuel collection time (hrs.) per day	Total time used (hrs.) per day	Plant wise time saved (hrs.) per day
4.8	12	1.4	16.8	10	0.32	3.2	0.54
Total	50		117.76	44		56.52	
Average			2.36	Average		1.3	1.07

Source: Biogas User Survey 2007 by CEGIS

5.2.2 Fuel use in the households

It is understood from the secondary source³ that people in the country use traditional fuels in the unorganized sectors are rice straw (37%), cow dung (16%), firewood (15%), rice hulls (13%), twigs leaves (6%), jute stick (4%), bagasse (3%), other wastes (6%). The users of this study use more or less the same items. But none of the users under the study use kerosene or electricity as fuel.

Table 5.9 shows the previous and present quantity of fuel-wood used from nature per day by different plants. The quantity of total saved fuel wood per plant is presented in the last column of the table. It is calculated in the table that on average 10 kg. of fuel wood has been saved per day per household. On the basis of this one can easily calculate the total annual saved fuel per household. A huge amount is thus saved on fuel cost and the environmental conservation is maintained.

Table 5.9: Plant wise present and previous average used fuel wood

Previous				Present			
Plant size (m ³)	Total plants	Average used fuel wood (kg.) per day	Total wood (kg.) per day	Total plants	Average used fuel wood (kg.) per day	Total fuel wood (kg.) per day	Plant wise saved fuel wood (kg.) per day
1.2	3	10	30	1	9	9	1
1.6	3	17	51	3	5	15	12
2	11	16	176	10	6	60	10
2.4	8	11	88	7	3	21	8
3.2	13	17	221	13	7	91	10
4.8	12	18	216	10	5	50	13
Total	50	-	782	44	-	246	-
Average			15.6	Average		5.6	10

Source: Biogas User Survey 2007 by CEGIS

5.2.3 Money saved in the user household

The plant wise average monthly fuel cost including biogas and dung cake (previous and present) is presented in Table 5.10. The difference is also presented as monthly saved fuel cost. The total plant wise saved amount for plants is shown in the last column. The plant wise amount was previously reported to be Tk.1058 per household per month, but it is now Tk. 412 per household per month after plant implementation. The average money saved per plant per month is calculated to be Tk. 646. This amount will become huge if IDCOL can implement sixty thousand plants. The savings would also

³ Statistical Year Book 2004-05, Bangladesh Bureau of Statistics, Bangladesh

serve the national economy no doubt. It should be noted that none of the sample household used kerosine as fuel for cooking purposes.

Table 5.10: Plant wise present and previous average monthly fuel cost

Previous				Present			Plant wise saved fuel cost (taka)
Plant size (m ³)	Total plants	Average monthly fuel cost (taka)	Total fuel cost (taka)	Total plants	Average monthly fuel cost (taka)	Total fuel cost (taka)	
1.2	3	667	2001	1	400	400	267
1.6	3	667	2001	3	373	1119	293
2	11	715	7865	10	150	1500	565
2.4	8	700	5600	7	214	1498	486
3.2	13	1412	18356	13	715	9295	696
4.8	12	1425	17100	10	433	4330	991
Total	50	-	52923	44	-	18142	-
Average			1058	Average		412	646

Source: Biogas User Survey 2007 by CEGIS

5.2.4 Use of saved time by user household

It is reported in this study that 80% of the plant owners use the saved time for different purposes. The main purposes are income generation, recreation, education and household chores. The percentage of plant owners distributing saved time in different ranges to the different sectors is presented in Table 5.11. How much time they give to the sectors depends on the relation of the sectors to their livelihood and family welfare.

Table 5.11: Percentage of households reporting different use of the saved time

Range of saved time	Income generating sector	Recreation sector	Education Sector	Households sector
up to 25%	50	64	68	86
26-50%	22	18	26	6
51-75%	14	8	2	0
75-100%	10	6	0	4
Not applicable	4	4	4	4

Source: Biogas User Survey 2007 by CEGIS

5.2.5 Use of saved fuel wood from nature

Likewise, 80% of the plant users reported that they also used the saved fuel wood in different ways. They mainly sell the saved fuel wood for more money, which generates more income. At the same time, the trees and bushes are preserved for environmental conservation. Some rich people also distribute fuel wood to poor people free of cost for social welfare. Table 5.12 presents the percentage of plant users sharing saved fuel wood in different income generating and environmental conservation sectors.

Table 5.12: Percentage of households reporting different uses of saved fuel

Range of saved fuel	Income generating through sale	Environmental conservation through preservation of tree and bushes
up to 25%	58	50
26-50%	16	18
51-75%	14	4
75-100%	8	24
Not applicable	4	4

Source: Biogas User Survey 2007 by CEGIS

5.2.6 Status of educational facilities

The educational status of a household depends on how well educational pursuits are facilitated in that household. With this type of biogas plant, a parent can easily prepare food in the morning and help with the children's homework before they leave for school. The self assessed statements of plant owners on educational status is presented in Table 5.13 which reveals that 44% of the plant owners claimed that their children's education was being facilitated more day-by-day after biogas plant installation. No response/not applicable refers to those households without school going children.

Table 5.13: Educational facilities

Sl. No.	Facilities	Percentage reporting of plant owner
1	Increasing	44
2	Decreasing	2
3	No change	22
4	No response/not applicable	32

Source: Biogas User Survey 2007 by CEGIS

5.2.7 Poverty status of user household

To determine the economic level of biogas owners in this study, self assessed poverty status was considered as an indication for plant owners. For comparing the users and non-users of biogas plants, the without plant and with plant situations were considered. Table 5.14 indicates that 90% of the households that had no biogas plants were also surplus family round the year. Only 6% of the households were reported as breakeven round the year. No deficit households were observed previously who had no biogas plant. But with the biogas plant, the surplus households have now increased from 90% to 92%. On the other hand, 4% of the households were reported as deficit households round the year. The main reason is the uncertainty of the poultry sector, e.g. bird-flu is the one the main uncertainties for biogas plants.

Table 5.14: Self assessed poverty status

Sl. No.	Poverty status	Percentage reporting of plant owner	
		Previous	Present
1	Surplus	90	92
2	Breakeven	6	-
3	Deficit	-	4
4	Not applicable	4	4

Source: Biogas User Survey 2007 by CEGIS

5.2.8 Employment status of user community

The study tried to understand the scope of employment generation brought about by biogas plant installation in the locality. There are multiple opportunities for employment generation in the biogas sector, including mainly construction work, operation and maintenance work as well as monitoring work. Other than these, the supply sector of different appliances is another major sector for employment generation. The biogas plant is an integrated approach, which is related with the poultry or dairy farm, which is also labor intensive and help generate employment. In the study, 32% of plant owners reported that they employed assistants (both male and female) for the operation of the biogas plant round the year. Some plant owners sold biogas to other families on a rental basis, thus creating some employment opportunities. Besides, a significant number of people are employed through POs for construction and monitoring work.

5.3 Impact on Gender

5.3.1 Women's participation in decision making process

One of the targets of NDBMP is to attain the Millennium Development Goals (MDGs) in terms of addressing gender equality by empowering women in decision making and maximizing their participation in the biogas plant implementation and use of it. In the study area, men initiated most of the cases (70%) in terms of the idea of implementation of the plant at household level primarily for domestic use of fuel. Only 16% were women followed by both men and women (4%) and others (10%) who took the initiative for plant installation. Others who took the initiative were sons, cousins, neighbors and the POs. In the decision making process although men were predominant (Figure 5.1), women also played an important role. The decision of plant installation was made by 42% of men (household head) alone and 38% of both men and women followed by women alone (16%).

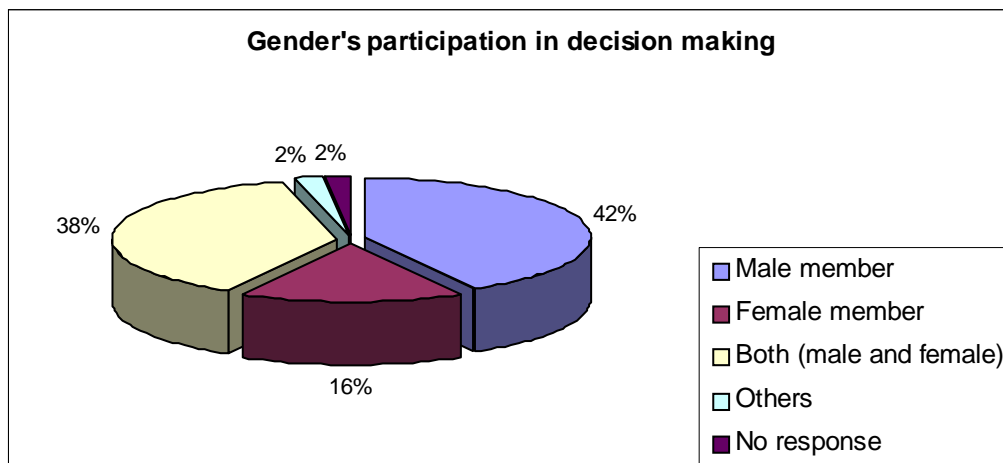


Figure 5.1: Gender participation in decision making

5.3.2 Construction, Operation, Maintenance and Management of Biogas Plants

Good construction quality, proper operation and maintenance and good management ensure proper functioning of the plants and biogas production. Construction work was done by masons provided by the POs in the study area. In some cases, the plant was not constructed as per the design and so had to be built again. The users had no idea about design specification of the plant and therefore, did not know how to monitor the construction work. The POs are fully responsible in this respect. The cases where the plant had to be rebuilt indicate that the PO representatives and masons were not well trained and the construction work was not properly supervised by the POs. In such cases the users incurred much loss, as the cost became higher for paying twice for the construction work. The users and POs, however,

were reported to have monitored the construction work of the plant. The gender sensitivity in biogas plant operation, maintenance and management is shown in Figure 5.2. In all these respects, i.e., operation, maintenance and management and construction monitoring, men (household members and domestic helpers) played a predominant role.

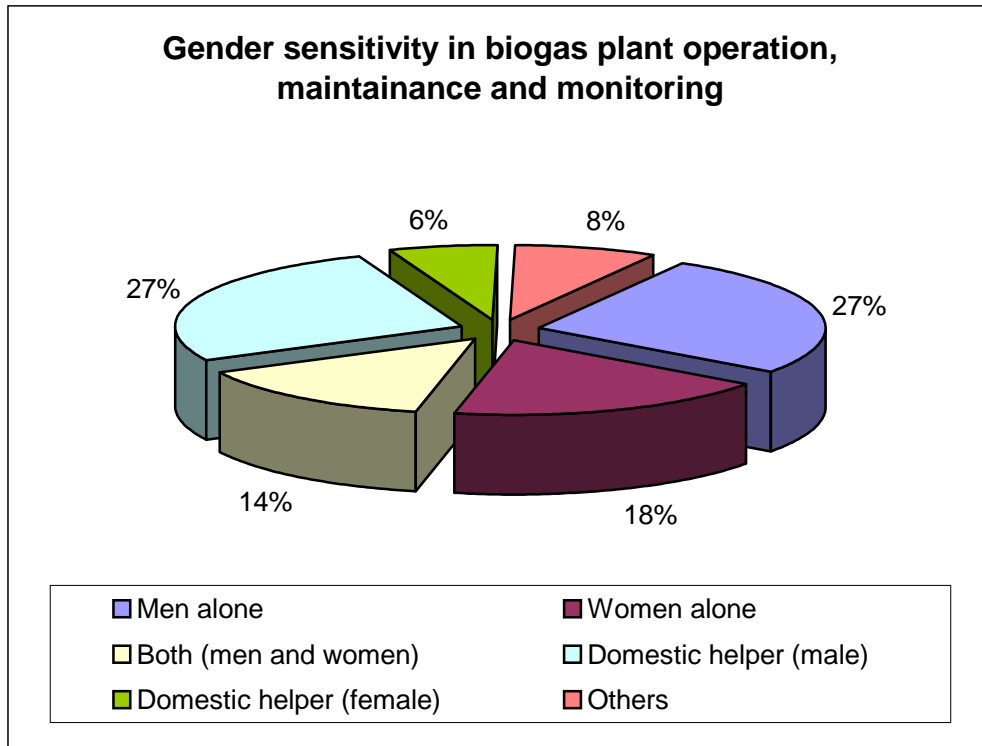


Figure 5.2: Gender sensitivity in operation, maintenance and management

5.3.3 Ability of women to contact the PO for services/repairs

Men play a major role in contacting the PO for services and repairs required in the study area. Seventy six percent of men alone followed by both men and women (12%) and women alone (6%) contacted the PO. In some cases other members of the household also contacted the PO (Figure 5.3). Cell phone (mobile) availability made the contact with POs easier.

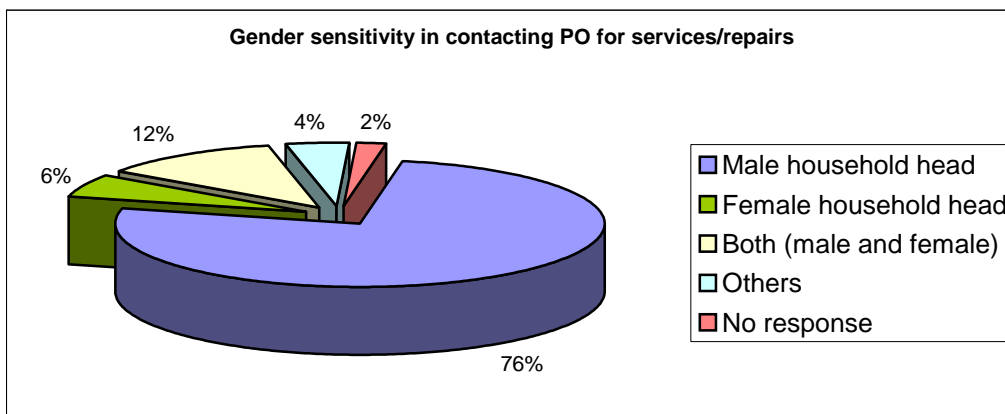


Figure 5.3: Gender sensitivity in contacting POs for services/repairs

5.3.4 Technical know-how of either men or women

For the current users, biogas technology is a newly introduced technology. The survey results show that 68% of the men alone (either household male members or domestic male helpers) followed by both

male and female members (10%), domestic helpers (8%) and female members alone (6%) have technical knowledge (Figure 5.4). The degree of technical know-how related to biogas plant depends on the training, education, experience and intuition of users. It was observed that 42% of the users received training (formal and/informal) from the POs. Informal training refers to the instruction given by the POs during installation of biogas plants at household level. In some cases literate women users had learnt from the booklet/leaflet provided by the POs. They solved technical problems by following the instructions written in the booklet/leaflet (manual). It needs to be mentioned here that some of the user households do not have the manual.

Figure 5.4: Technically knowledgeable persons in user households

5.3.5 Benefits derived by the women and children from the installation of biogas plants

The primary result of biogas plant is biogas, which is mainly used in the household for cooking purposes. In the cultural context of the society of Bangladesh, therefore, women are the main users. During the survey, the users were asked who benefited the most from the installation of the biogas plant. The spontaneous answer was 'I am' i.e. the woman herself. The users also described how they were benefited from using biogas. The benefits are summarized below:

Gender benefits:

- Easy to ignite gas stove and cook; cooking requires less time as biogas is quicker and saves time (60%). It makes conjugal life happier. Some (8%) of the women users said that their husbands were very fond of tea and asked for it frequently. This irritated the women sometimes, as it was troublesome and to some extent time consuming to ignite the stove with biomass. But now as they can easily prepare tea with the biogas stove, they do not feel irritated anymore.
- Biogas use saves cooking time, women can use the saved time for other activities (42%),
- Women can manage leisure time for recreation (40%).
- Biogas is smoke free (28%). Women, therefore, can easily cook inside a kitchen even if it is attached to the bedroom, or even cook in the bedroom itself. In the rural area, women used to cook in open space, especially in dry season due to the smoke from biomass. During the month of Ramadan (Arabic month) they used to feel embarrassed to cook *Sehri* (last meal that starts the fast) late at night in open space. In some cases, the users of biogas now use the room for cooking as a kitchen-cum-dining room.
- Can do other activities simultaneously, as cooking with biogas does not require constant attention (18%).
- Can take care of children's education while cooking; so it is possible to give more time for children's education (18%).
- No eye irritation due to smoke free biogas (14%),
- Very helpful for the working women. They easily complete cooking before going to work (10%)
- Cooked food can be served at any time after warming it (8%)
- Easy to clean and wash smoke-black free utensils
- Kitchen remains smoke-black free (8%)
- Possible to keep the dress clean in the black-smoke free environment
- Easy to entertain guests by quickly prepared snacks
- Children and adolescents can also cook snacks with the biogas stove
- It is easy to warm water for bathing in winter

Environmental and agricultural benefits

- Bad odor and pollution free air in the household as well as in the community due to better management of poultry waste

- Can get slurry as better quality organic fertilizer
- Can apply bio-manure (slurry) in crop land as needed
- The shed leaves are used for farmyard manure, which was used as fuel before installation of the biogas plant
- Use slurry as fish feed

Fodder use

- Increased use of rice straw as fodder instead of fuel
- At the same time increased use as compost biomass – the leftover of fodder as well as waste are put in the slurry pit.

Hajag light use

- For brooding chicks
- For children's education during electricity load shedding (power cut)

Economic benefits

- Saving the expenses of septic tank construction due to use of night soil
- Selling saved fuel,
- Increased income. It needs to be mentioned here that a user supplies gas to neighbors (3) from his biogas plant at the cost of Tk 300 per month per single burner. There is a great demand for biogas in the community. As a result those who have gas facilities can easily sub-let their houses. The biogas consumers do not have any complaint against the gas supply. All the consumers and gas suppliers (plant owner) are happy with the benefit from the biogas plant.

No benefit

It is important to mention here that only 8% of the users found no significant benefit from the biogas plant installation.

5.3.6 Health and workload change before and after biogas plant installation

Some positive changes have occurred in women's health condition after biogas plant installation. In a very few cases, women had developed sores on their fingers for making cow dung patties. After installation of the biogas plant they do not need to make the patties anymore and so they no longer have the sores. In another case, a woman had 'Chronic Dacryocystitis' (clogged eye duct) in her eyes due to cooking in a smoke polluted environment from using firewood and other biomass. She even had to undergo surgery to save her eyes. She now feels comfortable in cooking with biogas.

Women (78%) claim that their workload has decreased after biogas plant installation (Figure 5.5). The study revealed that 10% of women found no decrease in work load; this is because they spent the saved time on other household chores. On the other hand, 4% of women claimed that their work load had increased as they found biogas plant operation laborious in terms of maintenance and management, slurry management, livestock caring, etc. They felt overloaded with work as there were household chores to perform in addition to operating the plant.

Figure 5.5: Changes in stress and workload after biogas plant installation

5.3.7 Enrollment of girls in schools

There is no association with enrollment of girls in schools and biogas installation, as the user households are relatively well-off. Their school going children had been enrolled in school long before the installation of biogas plants.

5.3.8 Income generation and productive work

Forty percent of the women are now engaged in income generating activities (IGAs). They contribute their saved time from cooking for IGAs. They work in their poultry farm. Some of the women users are school teachers, who sometimes also use their saved time (even while cooking) in checking examination scripts. One of the teachers benefited greatly from cooking with biogas during her teacher training course at the district headquarter. Every day, she had to commute early in the morning to the district headquarter from the upazila where she lived. Because she had the biogas stove, she could quickly finish cooking for her family before leaving for the day.

5.3.9 Women's involvement in social work

Women (34%) are able to remarkably manage time for social work after the biogas plant implementation. The social work refers to visits to neighbors and relatives. This indicates that the relationship of the users with their neighbors and relatives has become more congenial.

5.3.10 Time involvement of women in household chores like cooking, feeding, fuel wood collection, operation of biogas plant, etc.

Women used to spend time on average 5.5, 1.1, 1.9 and 1.1 hours approximately per day respectively for cooking, children's education, feeding, and fuel wood collection before installation of the biogas plant (Table 5.15). Their time involvement for cooking (75%) and fuel wood collection (84%) has decreased significantly. Twenty five percent of the users found no change in time involvement in cooking before and after installation of the biogas plant. Forty three percent of the women increased their time involvement on children's education after starting to use biogas for cooking. A low percentage of women (14%) found no change in the before and after feeding time involvement.

Table 5.15: Women's time involvement for different purposes before biogas installation

Plant size (m ³)	Purposes			
	Cooking	Education	Feeding	Collecting fuel wood
1.2	6.0	0	2.3	1.1
1.6	6.0	1.7	1.8	1.7
2.0	5.1	1.4	1.9	0.8
2.4	4.0	1.7	2.3	1.3
3.2	5.8	0.9	1.5	1.0
4.8	6.1	1.2	1.8	0.7
Hour per day	5.5	1.1	1.9	1.1

Source: Biogas User Survey 2007 by CEGIS

Figure 5.6: Status of women's time involvement after biogas plant installation

5.4 Impact on Agriculture

5.4.1 Cattle population

Many of the users have the business of either cattle fattening or dairy. As a result they have a good number of cattle. The maximum sale of cattle is made during the occasion of *Eid-ul Azha* (Muslim festival). It needs to be mentioned here that the present study was conducted immediately after *Eid-ul Azha*. The study team, therefore, found a difference in the cattle population before and after the festival.

This variation in cattle population influences the feeding of biogas plants. However, to assess the impact of biogas plant implementation on cattle a comparison was made of the cattle population before and after biogas plant implementation. After refers to the present condition. Table 5.16 presents the cattle population in the user household by size of plants. The table shows that the minimum number of population in the 3.2 m³ plant size households before biogas plant implementation is zero. One of the users started cattle rearing and biogas plant installation simultaneously. He started rearing only because of the biogas plant. In addition to this case, the minimum number of cattle was two in the group of 3.2m³ size plant users. It is evident from this table that cattle population on average is good enough in terms of the requirement of cattle population for installation of biogas plants in households with the plant size of 1.2m³, 2.0 m³, 2.4m³, and 4.8m³; whereas users with the plant size of 1.6m³ and 3.2m³ have less population than required. Furthermore, in total 50% of the users have less cattle population than required. The users, however, used cow dung as manure for crop cultivation before implementation of biogas plants.

Table 5.16: Distribution of livestock population before and after biogas plant implementation

Plant Size (m ³)	Previous cattle population			Present cattle population			Required cattle	% of users by	
	Mean No.	Max	Min	Mean No.	Max	Min	Number	<Req. no.	>Req. no.
1.2 (n = 3)	5	10	2	5	6	4	4	0	100
1.6 (n = 2)	3	4	2	4	6	2	5	50	50
2.0 (n = 10)	9	18	4	6	12	2	6	60	40
2.4 (n = 5)	7	10	1	8	10	6	7	20	80
3.2 (n = 11)	11	36	0	9	21	2	10	64	36
4.8 (n = 5)	39	80	6	24	50	1	14	60	40
All (n = 36)	11	80	0	9	50	1	-	50	50

Max = Maximum, Min = Minimum

Source: Biogas User Survey 2007 by CEGIS

Grazing method: The grazing method in the user household is both open field grazing and stall feeding type. Before and after installation of the plants 21% and 8% of the users respectively allow their cattle open field grazing while 79% and 92% feed in the cattle stall. Stall feeding has increased after installation of the plants. It is important to mention that cattle from improved breed are exclusively fed in stalls but the native breed are mostly fed both in the grazing field and stall.

Shed management: The users are cautious about the management of shed. The management of shed to some extent depends on the socio-economic condition (e.g. financial capability, land use, etc.) of the users. It was observed that 72% and 76% of the users respectively before and after implementation of the biogas plant managed their sheds properly.



Picture 4: Slurry pit with boundary

Animal health: Animal health was assessed as good, moderate and bad. Seventy six percent and 24% of the users respectively claimed that the animal health was good and moderate before implementation of the plant while 83% and 17% claimed it was good and moderate after implementation. This indicates that after implementation of the plants, animal health has improved due to better management of shed and cow dung and the emphasis on feed management.

Feed and fodder management: Some of the users cook rice and warm water for feeding cattle by using biogas. Most of the users cannot cook cattle feed by using biogas: (i) biogas produced is good enough for cooking for household members but not for the cattle, (ii) there is an absence of suitable gas stove – larger size gas stove is needed for cooking cattle feed. Fodder management is becoming troublesome due to price hike of fodder and crop failure due to flood.

5.4.2 *Dung Patties for Burning Purposes and Manure for Composting Purposes*

The practice of dung patties preparation has decreased. Forty six percent (46%) of the cow based plant users have excess cow dung after fulfilling the requirement of the plants. This excess cow dung is used for patties preparation and composting purposes and a few of the users prepare patties.

5.4.3 *Change in the composting practices*

There has been a change in the users' practice of compost preparation from cow dung and poultry litter before and after installation of the biogas plants. In this respect their practises in piling, decomposing and turning the decomposing materials has decreased, as the materials (cow dung and poultry litter) are fed in the biogas plants (Table 5.17). Those who have excess materials after fulfilling the requirement of the plants for biogas production pile them for decomposition.

Table 5.17: Changes in composting practices by user household

Whether practise	Before biogas plant installation (%)			After biogas plant installation (%)		
	Pilling	Decomposing	Turning	Pilling	Decomposing	Turning
Yes	73	69	39	61	60	33
No	27	31	61	39	40	67

Source: Biogas User Survey 2007 by CEGIS

5.4.4 Slurry Use Pattern and its Effectiveness

Most of the users either have one (42%) or two (42%) pits for storing slurry. A few of them (16%) have no slurry pit at all. No standard sized slurry pit was found in the biogas user households. The users store bio-slurry in the slurry pits for on average of 53 days which range from 14 to 97 days. The variation of storing time depends on the type of use, practice of drying, and depth of slurry pit. The fish farmers use slurry within an interval of 14 days as fish feed. In other case, those who sell bio-manure used to dry semi-dried slurry spread on the ground. They transfer a small quantity of slurry from the primary pit to a secondary pit of shallow depth for a few days and then take it from the secondary pit to spread it on the ground for drying. Seventy five percent of the users dry slurry; 95% of them dry under the sun and the rest dry it in the shade. Most of the users (78%) do not add any other materials with slurry for decomposition. Only 22% add other organic materials with slurry in the slurry pit. From among these users who add other materials 90% add kitchen waste, waste of livestock fodder (straw), ash, water hyacinth and green compost manure (10%). Seventy four percent of the users use bio-manure (slurry) for field crop cultivation (86%), home gardening (32%), fish culture (43%) and for selling (8%) purposes. Twenty eight percent of the users have not yet used bio-manure, as their manure is not yet dry. They are willing to use it for crop production in the coming season (Boro). From among the users, however, 57%, 31% and 11% use bio-manure respectively in dried, semi-dried and liquid form.

Effectiveness of slurry: All the slurry/bio-manure users feel that bio-manure increases soil fertility. They find the effectiveness of slurry as good (87%) and moderate (13%). Slurry use increases their crop yield. On the other hand, it decreases the use of inorganic fertilizer and thus saves on average Tk.13 per decimal per year. Ultimately, it increases the income of the household from crop and fish production.

Picture 5: Drying bio-slurry

Picture 6: Collection of Bio slurry

Picture 7: Compost carrying to field

Picture 8: Application of Bio slurry to crop field

5.5 Impact on energy, emission reduction and environment

5.5.1 Utilization of available fuel by user household for cooking

The traditional practice of fuel use for cooking by rural households is imperative for the local as well as global environment. The issue of carbon emission from fuel burning is a critical issue for the physical environment. The daily utilization of fuel from nature is also important for conserving the environment as a whole. The study households perceived that the pre-plant period fuel use was not friendly for the environment compared to their present use (Table 5.18).

Table 5.18: Environment friendly fuel use by households at pre and post-plant periods (n=44)

Sl. No.	Status of environment friendly fuel use	Pre-plant period		Post-plant period	
		Number	Percent	Number	Percent
1	Yes	3	7	40	91
2	No	41	93	4	9

Source: Biogas User Survey 2007 by CEGIS

The household choice is to use multiple fuels for cooking in general as per availability. It was observed that most of the surveyed households used firewood followed by cow dung, agriculture residue and LP gas as main fuel in different priority groups for cooking before the construction of their biogas plant (Table 5.5.2). Firewood was given the highest priority in the first group while both firewood and cow dung scored the highest priority in the second group. Use of agriculture residue stood third in the second priority group and LP gas stood third jointly with agriculture residue in the first priority group. Use of kerosene was reported to be nil by the users before installation of the biogas plant. Firewood, cow dung and agriculture residue are very important for the emission of carbon in the air. Households using firewood, agricultural residue and cow dung are habituated with the earthen cooker, while gas and kerosene stoves are used only by the LP gas user. It may be noted that the use of LPG is not much significant here, though it is seen as a good start for such users in accepting the biogas system.

5.5.2 Changes of household practices in fuel use after biogas plant

A significant change has been observed in the households' practice of fuel use after the installation of the biogas system. Biogas has the highest priority followed by firewood, agriculture residue, cowdung and LP gas at the post-plant period. The use of firewood and agriculture residue is also significant at the post event. These two have the first and third positions respectively in the second priority group (Table 5.19). The demand for cooking fuel, as expected by the household at pre-event, seems not to have been met properly and therefore, the use of firewood from nature remains high even after having the biogas plant. It may be mentioned here that, an undisturbed supply of gas creates comfort for cooking but when the users face any problem in gas supply they move to the alternate source of fuel. In such cases, the firewood receives priority, as it is most available in the rural area. The use of cow dung has decreased significantly, as this is the main input of biogas plant. In connection with the cooking stove, it was observed by the study that almost all (90%) of the plant owners used approved stoves for cooking. The rest of the owners were found to use local brand stoves due to ignorance or technical difficulties.

Table 5.19: Type of fuel used before and after construction of plant (functional) by the household for cooking purposes

Sl. No.	Types	Reported no. and % of households by priority level (before)						Reported no. and % of households by priority level (after)					
		Priority-1		Priority-2		Priority-3		Priority-1		Priority-2		Priority-3	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	Fire wood (b-n = 43; a-n = 30)*	30	70	12	28	1	2	6	20	21	70	3	10
2	Agriculture residues (b-n = 11; a-n = 8)	4	36	6	55	1	9	1	13	5	63	2	25
3	Cow dung (b-n = 18; a-n = 3)	6	33	12	67	0	0	0	0	0	0	3	100
4	Natural/LP Gas (b-n = 9; a-n = 3)	4	44	3	33	2	22	1	33	0	0	2	67
5	Kerosene	0	0	0		0		0	0	0	0	0	0
6	Biogas (b-n = 0; a-n = 44)	0	0	0	0	0	0	36	82	6	14	2	5

*b-n is the size of 'n' for before plant period and a-n is the size of 'n' for after plant period

Source: Biogas User Survey 2007 by CEGIS

5.5.3 Daily gas production and consumption

A biogas plant usually produces gas as per its design capacity, the amount of input and its proper operation and maintenance. So the size of plant, availability of raw materials and technical knowledge on operation are important for maintaining the standard level of gas production. However, as per the plant-size, most of the surveyed plants were reported to be below the standard level of production considering the cooking hours.

In order to determine the consumption of gas by the surveyed households, the total hours of their daily use were calculated and compared with the standard rate of production for the respective plant sizes. The result showed that the average consumption of gas was low as per the production standard for all plant sizes. The difference is very significant here for the bigger size plants (e.g. 3.2 m³ and 4.8 m³) where the consumption is almost half than its standard (Table 5.20).

Table 5.20: Comparison between the standard and actual consumption of biogas at household level (n=44)

Sl. No.	Plant size (m ³)	Total no. of plants	No. of plants (functional)	Actual use of gas (hours/day) for cooking	Standard burning hours
1	1.2	3	1	1.5	2-3
2	1.6	3	3	2.7	3-4
3	2.0	11	10	3.8	4-5
4	2.4	8	7	4	5-6
5	3.2	13	13	3.9	7-8
6	4.8	12	10	6.2	10-12

Source: Biogas User Survey 2007 by CEGIS

During the field visit, 36% (n=16) of the plants were identified as not having met the expectation of households in terms of gas production level. Consequently, there was confusion and mistrust between the PO and beneficiaries hampering the smooth promotion of biogas plants in those particular localities.

5.5.4 Local household and global environmental condition and its changes

The environmental condition of the study households was assessed by a number of indicators e.g. air pollution status in the kitchen; overall environmental condition of the kitchen, living room, cattle/poultry-shed and surrounding area of the homestead; social environment in terms of tolerability of odor of raw materials etc. This provided an idea about the local environment.

The status of air pollution in the kitchen was very bad at pre-plant stage as reported by the households. The situation has improved significantly (Figure 5.7) after installation of the biogas plant. Nevertheless, around 30% of the total plant owners still face minimum to severe level of air pollution in their kitchen due to use of firewood/agriculture residue for supplementing the biogas. This is due to the technical problem faced by those households in ensuring smooth supply of gas for cooking. Considering the overall environment of the kitchen, 72% of households reported good, 20% moderate and the rest bad environment in the kitchen.

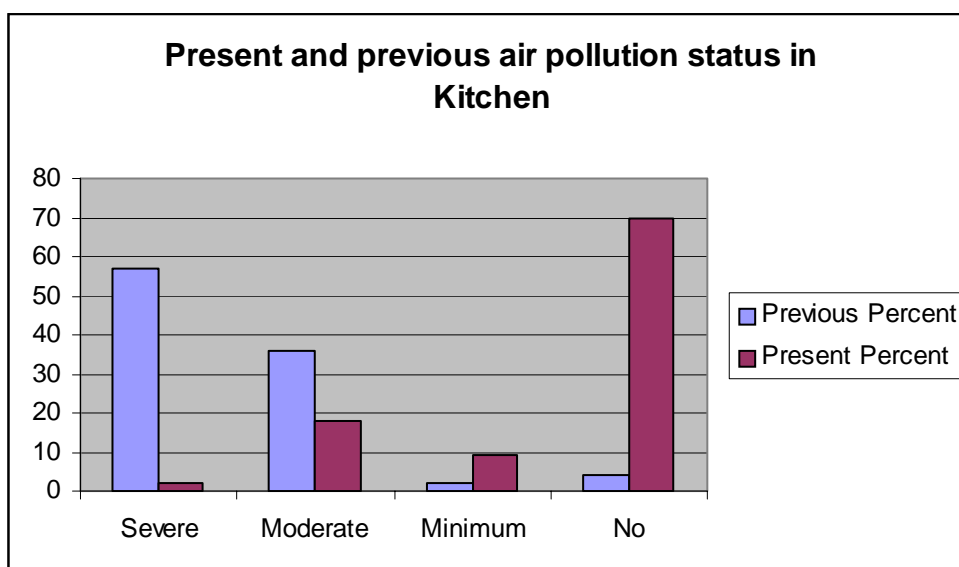


Figure 5.7: Present and previous air pollution status in kitchen

There have been significant changes in the environment of cattle/poultry sheds since the plants have been installed. The survey revealed that about 68% of the sheds were in moderate and 26% in good condition at the pre-plant period while 72% were in good and 24% in moderate condition after the plants were installed. The environmental condition of the plant owner's homestead, specifically the living room was reported to be 77% in moderate, 14% in bad and only 9% in good condition at the pre plant period (Table 5.21). Significant changes occurred after installation of the plants as 82% were in good and the remaining 18% were in moderate condition.

Table 5.21: Surrounding environment of the plant owner's homestead (n=44)

Sl. No.	Type of pollution	Pre-plant period		Post-plant period	
		Number	Percent	Number	Percent
1	Good	4	9	36	82
2	Moderate	34	77	8	18
3	Bad	6	14	0	0

Source: Biogas User Survey 2007 by CEGIS

The social environment in terms of tolerability of odor of raw materials by the neighbor was moderate to good in the pre-plant period, while it is now good to moderate as reported by the respondent households (Figure 5.8). Considering the waste management and the control of bad odor, it was observed that a good feeling and satisfaction had developed between the plant owner and their close neighbors where the biogas plant was running well.

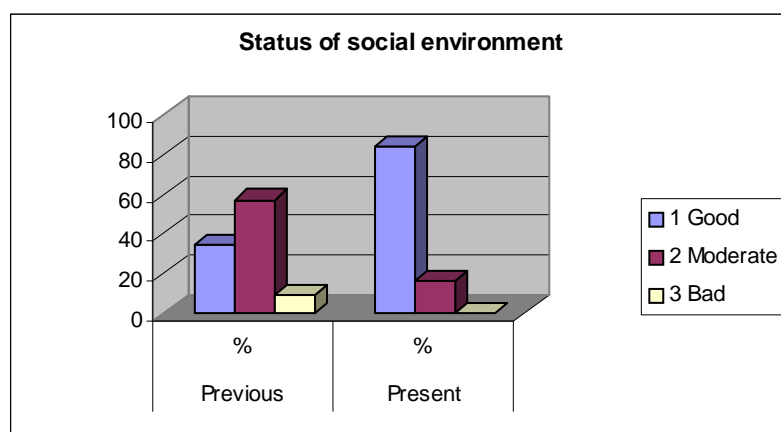


Figure 5.8: Status of social environment

The global environment condition is mainly dependent on the degree of carbon emission. Carbon emission can be measured using the standard calculation derived from the rate of burning of firewood, dung cake, agriculture residue and kerosene for the purpose of cooking. It was revealed that a good amount of carbon had been released by the surveyed households before the biogas plants were installed. A gross calculation is shown in section 5.2.2, which describes that a family used about 16 kg of average natural firewood per day before the installation of the biogas plant while the amount is about 6 kg at after installation. So, a family saves about 10 kg of natural firewood on average per day, which releases less amount of carbon emission into the global environment. The biogas plants are also contributing to the local environment by conserving the natural trees and bushes of rural areas.

5.6 User Perception and Satisfaction

The study collected information from the users on their perceptions and satisfaction related to biogas use after installation of the plants. This section describes issues related to user awareness, requirements and suggestions for possible improvement, operation and maintenance training received, repair and maintenance, satisfaction and dissatisfaction, and problems faced.

5.6.1 User awareness, requirements and suggestions for possible improvement

The users reported to have derived the idea of biogas plant from the POs (26%) followed by relatives (20%), neighbors (20%), radio and television (18%), booklet/leaflet (12%) and friends and work place (4%). One half of the users were found to be aware of IDCOL but the remaining half had no knowledge of IDCOL and so requires training for proper operation and maintenance of biogas plants. They extended suggestions for improving their knowledge of proper operation of biogas plants. Their requirements and suggestions are summarized in table 5.22.

Table 5.22: Users requirements and suggestions

Requirements	Suggestions
Need awareness development training and motivation work (40%)	Increase number of union/upazila wise POs for easy communication and availability of service.
Need better after sale service by PO (32%)	Follow up supervision can be given by IDCOL trained technicians in each union for better maintenance of the plants.
Need correct design of biogas plant to ensure supply of gas (12%)	Loans should be provided for increasing livestock population.
Need loan for cattle rearing (6%)	Increase training program and ensure user access to them

5.6.2 Operation and maintenance training received

About 56% of the plant users did not receive training from POs. They do not know the process of subsidy money disbursement of IDCOL and do not have sufficient knowledge about how to operate a biogas plant. Only 42% of the plant users have received training from POs on the operation and maintenance of plants.

5.6.3 Repair and maintenance

The overall functional status of the bio gas plants of the surveyed area shows that the POs have hardly done any major maintenance work and so a number of plants have become non functional. Many parts like the pit shed of the plants were also found missing and the slurry drainage pattern of the plants was not found. Most of the gas plant pits were found to be full of slurry, which suggests that they never turned the decomposing materials for aeration.

5.6.4 Satisfaction and dissatisfaction of the users

Eighty seven percent of the users of the 44 operational plants reported to be satisfied with the plants. The degree of satisfaction was measured by the ranking scale of *significantly satisfied*, *moderately satisfied* and *minimally satisfied*. From among the users 64% were found to be significantly satisfied. The remaining 28%, and 8% were moderately and minimally satisfied, respectively. Those who were found to be satisfied moderately and minimally did not get sufficient gas from the plants as per the requirement for cooking. The survey findings reveal the following reasons for unavailability of gas pressure: a) insufficient input of raw materials; b) distribution line problem; and c) lack of technical knowledge.

Thirteen percent of the users were found to be dissatisfied, as:

- Gas supply was insufficient for cooking. Therefore the users utilized other sources of fuel along with gas.
- Except for houses where POs visit for loan installment collection, no other user household received ASS properly.

5.6.5 Problem faced by users

Although 6% of the users interviewed were found to have no problem in running their biogas plants, the survey identified many problems faced by the rest. The main problem for users is insufficient gas production, lack of ASS, frequent payment of credit installment, problem with appliances, insufficient training etc (Table 5.23). The main reason for insufficient gas production is the difference between owners' fuel need and ultimate plant size. The underground gas distribution line is also responsible for hampering the smooth supply of gas as reported by some of the users. As this is a newly introduced technology, ASS does not meet user demand. There are some gaps observed between the user and POs. The POs are not sufficiently aware of the need to provide clear information to the beneficiary on BGP technology and calculation of subsidy money mentioned in the leaflet. In some places the relation between the PO and the user is found to be bitter and hostile. For example, a very poor relation was observed between the Rahman Renewable Energy Company Limited and their beneficiaries in most of the plants at Joypurhat. This type of non-cooperation creates problems for the loan recovery system and ASS. Another problem was observed related to biogas plant appliances. The supplied gas burners are reported to be too small, of poor quality, less durable and to have too big utensils that cannot be used properly on the stoves. The mixture device including the handle and blade is also of low quality as reported by the user. The need for training was also emphasized by the user for appropriate O&M.

The following table shows the problems mentioned by the users.

Table 5.23: Types of problems faced by the plant owners

Sl. No.	Types of problems faced (n=50)	Number reported	Percentage
1	Sometime cooking is not possible due to insufficient gas supply	17	34
2	Poor After Sale Service	11	22
3	Frequent (every month) payment of credit installment	9	18
4	Low quality mixture device including handle and blade	7	14
5	Insufficient training given to the users	6	12
6	Difficult to cook a large volume of food	5	10
7	Optimum use of slurry is unknown due to lack of knowledge	5	10
8	Size is not appropriate as per availability of raw materials	4	8
9	Volume of gas chamber was not built based on the need of user	4	8
10	Insufficient light in <i>hajag</i>	4	8
12	Gas supply hindered by water/slurry in distribution pipe	3	6
13	Waste management is poor due to excess of raw materials	3	6
14	No grant/subsidy money received by user	3	6
16	Bad investment as BGP is not functioning properly	3	6
17	Sometimes neighbors complain about the bad smell	2	4
18	No accessories for repairing burner, mixture device available in local market	2	4
19	Service is not available for emergency repair of burner, mixture device, service line, etc.	2	4
20	GI pipe use for transmission is a problem due to non flexibility and higher cost	2	4
21	No lightening facility provided as per promise of PO	2	4
22	Subsidy money is poor	2	4
23	Others	8	16

Source: *Biogas User Survey 2007* by CEGIS

5.7 Perceptions of non-users households about biogas use and its demand

5.7.1 Awareness about biogas and use of organic manure

A brief survey was conducted with 20 non-user households at nearby locations of the surveyed sample user households to assess perceptions about biogas technology, need for biogas plants and other related issues. The findings of this household survey have been compiled in this section.

The level of awareness about biogas technology and biogas plant was found to be generally limited in most of the surveyed areas. Only a number of educated and economically solvent families of some areas where some previous biogas programs had been implemented under BCSIR and LGED were found to be familiar with the biogas plant and its usefulness. The current IDCOL program has created some curiosity about the biogas technology in places where a number of plants have been installed already. As per the household survey, 18 out of 20 respondents had an idea about the biogas plant while the same number reported to have seen the plant previously in their locality or in a nearby area.

The status of education and occupation of the respondents of non-user household survey are shown in tables 5.24 and 5.25.

Table 5.24: Education of non-user respondents

Sl. No.	Education status	Number of respondents	Percentage of respondents
1	Illiterate	4	20
2	Literate but no institutional education	3	15
3	Primary or equivalent	3	15
4	Secondary or equivalent	4	20
5	SSC or equivalent	1	5
6	HSC or equivalent	3	15
7	Graduation or equivalent	1	5
8	Post Graduation or equivalent	1	5
	Total	20	100

Source: Biogas User Survey 2007 by CEGIS

Table 5.25: Occupation of non-user respondents

Sl. No.	Occupation	Number of respondents	Percentage of respondents
1	Service	2	10
2	Business (rice mill, poultry/cattle farm)	7	35
3	Farmer	9	45
4	No occupation (Housewife)	2	10
	Total	20	100

Source: Biogas User Survey 2007 by CEGIS

The households who have used the LPG for cooking are more knowledgeable about the potentiality of biogas. Most of these families are now facing a big challenge in getting LPG at a reasonable price. Therefore, these families are eager to switch over the source of fuel from LPG to biogas.

The use of organic manure in agricultural land, especially for winter crops, is common all over the country. But the use of bio-slurry is generally unknown to the common farmer, except the plant owner who has been trained by the respective POs to use spent slurry in agriculture and fish culture. The present use of cow dung as per the household survey is given in Table 5.26.

Table 5.26: Present use of cow dung/poultry droppings by non-user household (n=20)

Sl. No.	Use type (multiple use)	Number of household use
1	As fertilizer in crop field	11
2	As fish feed for fish culture	6
3	As fertilizer in home garden	11
4	Patties for burning	4
5	Sale to other farmer	2
6	No use	3

Source: Biogas User Survey 2007 by CEGIS

5.7.2 Demand for biogas and organic manure

The problem related to energy crisis is increasing day by day in the country. The problem has been found at the household as well as the poultry/cattle farm level in both rural and urban areas. More and

more people in areas with well-functioning biogas plants are gradually showing interest in installing new ones mainly for cooking, waste management and fertilizing crops. However, in areas where biogas plants are not functioning well, there is no interest in installing new ones. Biogas is a relatively new technology and people are very cautious about accepting it after assessing the technical and financial aspects.

Eighty percent of the non-user households were found to be interested in installing biogas plants. Those who did not want to install a plant gave the following reasons for their disinterest (see Table 5.27).

Table 5.27: Reason for non-user households not wanting biogas plants (n=20)

Sl. No.	Reason	No. of HH reported
	Biogas plants are not working properly in nearby areas	4
	Number of cows is not sufficient	2
	Insufficient raw materials	2
	Not enough economic ability	3
	Not interested in taking loans from NGOs/POs	2
	Not used to utilizing gas for cooking	2
	Satisfied with firewood as it is easily available	3
	Lack of awareness	2
	Total	20

Source: *Biogas User Survey 2007 by CEGIS*

5.7.3 Benefit and problems of biogas plant

According to the households they face a crisis in meeting their fuel and energy demand. About 75% of the users interviewed face this kind of energy crisis at the household level. The households reported that cooking, fertilizing of land and lighting were the main reason for installing the biogas plant (Table 5.28). The biogas plant as a source of fuel and fertilizer brought much benefit to the household. On the other hand, technical problems (in areas where the existing plants were not working well) and high cost were the main problems as reported in the study.

Table 5.28: Purpose of installation of biogas plant (n=20)

Sl. No.	Purpose (multiple purpose)	No. of households reported
1	Fertilizer	8
2	Fish feed	4
3	Waste management	3
4	Commercial	2
5	Cooking	13
6	Lighting	7
7	Other	1

Source: *Biogas User Survey 2007 by CEGIS*

Chapter 6

Lessons Learnt

This chapter is written on the basis of the results discussed in the previous chapters and observation of the study team during field work. The study identified the strengths as well as the weakness of the project. The analysis of the data has given rise to a number of lessons, which are as follows:

- A newly introduced technology has great potential in rural households.
- The technology is a source of multiple benefits although in most cases the uses are limited to cooking and applying manure in agricultural land and for fish culture. The residue (bio-slurry) is a good source of organic manure, fish feed etc.
- The biogas plants at household level are cost effective. The recovery period of cost is about 3 years.
- The required number of cattle and/or poultry birds can be minimized by using night soil. But night soil use is not socially accepted.
- Cattle sale at a large scale interrupted gas production for sometime. But plant owners did not bother about it due to the financial benefit from cattle sale and on the other hand, there was provision of cooking with fuel wood and biomass to some extent (for cooking cattle feed regularly, occasional large-scale cooking for the guests, rice parboiling, etc.).
- The users, especially the poultry based plant users have much more quantity of raw material per day than required. The efficiency of gas production and heat generation in the cooking stove of poultry based plants is also higher.
- There is a great demand for biogas in the rural area. In a few cases, plant owners (poultry based) supply biogas to other households, which is an indication of local level production and marketing of gas to households.
- The training provided by POs is inadequate.
- The reason for the 33% of non-operational plants is technical fault in construction, which indicates inadequate supervision by POs and insufficient technical knowledge of masons. Again, due to this reason some users have had to reconstruct the plant and incur additional cost.
- Proper emphasis was not given to slurry management and no instruction was given to the users on pit design and measurement specification for pit construction. As a result, no slurry pit was constructed following the defined specifications of IDCOL.
- Women perceived that they were benefited most by biogas plant installation.
- About 20% to 30% of the beneficiaries lost interest in plant installation due to higher construction cost.
- The study found that the project was contributing in alleviating poverty by achieving the following:
 - Use of bio-manure in increasing crop/vegetable production
 - Use of bio-manure in increasing fish cultivation
 - Conservation of environment by saving firewood

- Saving money from not using firewood, etc. comprehensively.

- The NDBMP empowers women in taking initiative (20%) and decision making (54%) for implementation of biogas plants. . Women save cooking time and use saved time on children's education, household chores, maintaining social congenial relationship, gardening, recreation, etc.
- There is lack of coordination among different government agencies at upazila level and IDCOL.

Chapter 7

Conclusions and Recommendations

7.1 General

There are many causes of the deteriorating environment in and around the houses in which we live. Industrial complexes pollute rivers, air and soil. Households also pollute the environment around. There is an urgent need to improve the environment wherever possible by applying appropriate technology and methods. The project is an example to preserve environmental factors in and around households and other areas served by the plants. NDBMP not only contributes in improving the environment but also in minimizing fuel and manure crisis for cooking and crop production, respectively. The project is, therefore, unique for two considerations:

- It helps to improve the environment in the food related system of households.
- It promotes the production of hygienic agricultural and related products through use of organic fertilizers produced for the plants as bi-product.

Based on the household survey results and findings, certain conclusions and recommendations have been worked out which are mentioned below.

7.2 Conclusions

- The project has initiated a good system to ensure a hygienic condition in rural kitchens and therefore is a contributor to ensuring public health.
- The biogas plants result in saving time and money in cooking. They are also useful for increasing agriculture and fish culture production.
- There is no provision of more than 4.8 m³ size plants under NDBMP. But larger size plants can be installed, as a huge volume of raw material in the dairy and poultry farm remains unused. There is a great need for larger size biogas plants for household consumption and commercial purposes. There is a great opportunity for versatile use of biogas technology throughout the country.
- Training is an essential ingredient for ensuring proper implementation of a development initiative. Proper training is a must for the POs and masons in curbing the technical fault in plant construction. Proper construction will save the plant users from incurring additional cost for reconstruction of plants.
- Proper slurry management and use can reduce the fertilizer crisis to a large extent and can improve soil health, crop yield. But due to lack of knowledge some users (16%) do not have any slurry pit and others do not have any standard size pit for slurry storing. The users, therefore, need to be trained on the management and use of slurry, standard size slurry pit construction, etc.
- The plants can be a source of self-employment and hence alleviation of poverty.

- The use of biogas requires the use of distribution pipes, burners and other parts, which have generated a market demand for the items. Expansion of the project will further expand the market potential of these items.
- The pilot has developed a framework for both expansion as well as improvement in the operational, technical and management aspects of the use of biogas. The result can be applied in wider areas.

7.3 Recommendations

- The NDBMP is contributing to conserve rural forest resource and environment. The project should continue to enable household to construct biogas plants so that forest resources of the country can be preserved.
- With every technology based service and product, maintenance is a serious problem. Preventive maintenance is an approach to ensure continuity of service provision from technical products. It is suggested that a system of preventive maintenance be developed within the project so that users get undisturbed supply of biogas from the plants. The maintenance services can be provided by IDCOL trained technicians in each area.
- More/adequate ASS to the users and training of POs urgently required.
- The provision for subsidy money may be increased proportionately with the plant size for its promotion among the medium and small farm holding households.
- The complex payment procedure of subsidy money should be simplified so that the plant owners get the full amount easily.
- In micro credit system the rate of interest should be reduced and installment payment should be simplified to reach medium and small farm holding households.
- The quality of the supplied appliances should be improved for its durability and efficiency.
- In the case of gas distribution line the metallic pipe should be changed with polyethylene to check leakage, ensure cost effectiveness, easy repair and maintenance and so on.
- The capacity of the POs should be verified properly through performance evaluation by IDCOL for achieving the target and sustainability of NDBMP.
- The importance of using bio-slurry is not given proper emphasis by the POs. Adequate user motivation campaign and demonstration organized jointly by IDCOL, the Agriculture Extension Department and the Fishery Department is recommended.
- For promotion of the program, well-planned publicity through print and electronic media, rallies, and poster & billboard installation is required.
- A target-based yearly plan should be developed for each union/upazila/district by IDCOL in association with the government agencies including the Local Administration, LGED, Livestock, Agriculture, Fisheries, Public Health, Union Parishad and POs.
-
- There should be a strong team for trouble shooting of plants and appliances for future dissemination of the technology. A loop research team is also required for the project.

- IDCOL should develop a cell of research and development (R & D) and need to conduct result based research on biogas technology. R & D will innovate low cost option and improved flexible better design for its sustainability.
- The plant operation period is only seven months. The impact of biogas plant cannot capture properly within this short time. To know the impact and the problems related to the promotion of plants a regular basis biogas user survey may be conducted.
- To find out the plant location easily and prepare data base of plants GPS based Management Information System may be developed.

Annex-1 List of Surveyed Biogas Plants

Division	District	Upazilla	Owner Name	Plant ID Number	Plant Size	Plant Type	Longitude	Latitude
Rajshahi	Dinajpur	Parbatipur	Md. Rafiqul Islam	RBDJ1015	4.8	4	88.919	25.649
		Parbatipur	Sirajul Islam	RBDJ1004	2.0	1	88.857	25.564
		Chirirbandar	Md. Mahiuddin	GSDJ1005	4.8	1	88.774	25.634
		Dinajpur Sadar	Md. Asraful Alam	GSDJ1019	4.8	4	88.638	25.588
		Dinajpur Sadar	Mrs. Tuhina Ahmed	GSDJ1030	2.4	1	88.626	25.639
Dhaka	Faridpur	Sadar	Md. Mahdi Hasan	KBFR1058	4.8	1	89.814	23.576
		Madhukhali	Md. Farhad Miah	GSFR1006	3.2	1	89.568	23.522
		Madhukhali	Ms. Shikha Guha	KBFR1027	1.6	1	89.670	23.497
		Madhukhali	Mr. Kartic Chandra Sikder	GSBW1002	2.0	1	89.595	23.524
		Boalmari	Md. Jahangir Fakir	KBFR1035	3.2	1	89.686	23.498
	Gazipur	Gazipur Sadar	Nazmul Ahmed	HBGZ1013	4.8	2	90.427	24.154
		Sreepur	Anawara Begum	GSMN1012	3.2	1	90.387	24.241
		Gazipur Sadar	Jamirjan Begum	BSGZ1004	2.4	2	90.399	24.015
		Joydevpur	Aktaruzzaman	RSTG1004	3.2	2	90.359	24.064
		Gazipur Sadar	Anawar Hossain	RSGZ1006	1.2	1	90.361	24.056
Rajshahi	Joypurhat	Panchbibi	Md. Selim Mondol	GSJP1005	3.2	1	89.161	25.158
		Panchbibi	Md. Raju	RBJP1014	1.2	1	89.018	25.167
		Joypurhat Sadar	Md. Sahadat Hossen	RBJP1107	2.0	1	89.050	25.103
		Joypurhat Sadar	Mr. Sree Joydev Sarkar	RBJP1097	2.4	2	89.037	25.078
		Joypurhat Sadar	Md. Abdus Salam Mondol	RBJP1094	2.0	1	89.035	25.094
Khulna	Kushtia	Kumarkhali	Md Abul Kashem	SBKT1012	2.0	1	89.241	23.883
		Mirpur	Md. Emdadaul Huq	GSKT1005	3.2	1	88.978	23.951
		Kumarkhali	Ms. Shewly Khatun	KBKT1012	2.0	1	89.243	23.870
		Kumarkhali	Md. Amanat Ali	KBKT1009	3.2	4	89.279	23.875
		Kustia Sadar	Tasir Uddin	SRKT1016	2.0	1	89.091	23.876

Division	District	Upazilla	Owner Name	Plant ID Number	Plant Size	Plant Type	Longitude	Latitude
Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Md. Amanullah Chawdhuri	SLLM1046	1.6	1	89.440	25.916
		Lalmonirhat Sadar	Md. Tahmidul Islam Biplob	GSLM1001	4.8	2	89.452	25.891
		Aditmari	Mrs. Brajabala	SLLM1065	2.4	1	89.380	25.917
		Kaliganj	Sree Dinesh C. Pal	SLLM1115	3.2	1	89.249	25.925
		Lalmonirhat Sadar	Mrs. Sultana Mahmuda Begum	SLLM1092	2.0	4	89.492	25.911
Khulna	Magura	Sreepur	Kamrul Ahasan	HBMG1007	4.8	2	89.459	23.591
		Magura Sadar	Ms. Afruja Khatun	KBMG1053	2.0	1	89.416	23.498
		Shalikha	Md. Jahangir Alam	KBMG1051	2.4	1	89.373	23.374
		Sreepur	Mia Md. Oliul Mowla	KBMG1016	1.2	1	89.389	23.599
		Magura Sadar	Md. Fariduzzaman	KBMG1021	4.8	1	89.360	23.512
Dhaka	Mymemsingh	Phulpur	Billal Hossain	GSMM104	3.2	1	90.358	24.956
		Haluaghat	Md. Emdadul Haque Milon	GSMS0103	3.2	2	90.336	25.169
		Phulpur	Ms. Murshida Begum	GSPU1010	2.0	1	90.328	24.915
		Trishal	Md. Dewan Rezawl Karim	GSMM1037	3.2	1	90.363	24.585
		Gauripur	Farid Uddin Ahmed	GSGU1001	4.8	1	90.551	24.720
	Rajbari	Baliakandi	Kazi Mamun	KBRB1069	2.4	4	89.519	23.693
		Rajbari Sadar	KM. Rezaul Karim	KBRB1006	1.6	4	89.601	23.768
		Rajbari Sadar	Dr. Sultana Alam	KBRB1064	2.4	1	89.652	23.752
		Rajbari Sadar	Md. Torap Ali Mondal	KBRB1035	3.2	1	89.661	23.686
		Rajbari Sadar	Wazir Hasan Bablu	RBB007	2.0	1	89.719	23.660
Rajshahi	Rangpur	Rangpur Sadar	Sree Madhob Kumar	SLRP1030	4.8	1	89.253	25.747
		Rangpur Sadar	Md. Zulfiqar Ali (Rocket)	SLRP1024	2.4	1	89.162	25.733
		Rangpur Sadar	Mrs. Hasina Begum	KBRP1002	3.2	1	89.285	25.740
		Rangpur Sadar	Atm Ruhul Islam	GSRP1001	4.8	2	89.193	25.741
		Rangpur Sadar	Md. Ibrahim Khalilullah	KBRP1017	4.8	1	89.287	25.731

Center for Environmental and Geographic Information Services (CEGIS)

House # 6, Road # 23/C, Gulshan-1, Dhaka-1212.

Annex-2 Questionnaire for Biogas Plant User Survey under NDBMP, 2007

Plant ID Number:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Plant Size:	<input type="text"/>						

Latitude:

D
M
S

Longitude:

D
M
S

A. General information

1. Personal information of Biogas Plant (BP) owner

1.1 Name of Plant Owner :..... 1.2 Age:

1.3 Father's/Husband's Name :.....

1.4 *Para/mahalla* :..... 1.5 Village:.....

1.6 Post office :..... 1.7 Union:.....

1.8 Upazila :..... 1.9 District:

1.10 Division :.....

1.11 Occupation* (code) 1.12. Education** (Code)

1.13 Male member (>10yrs) 1.14 Male member (< 10 years)

1.15 Female member (>10yrs) 1.16 Female member (< 10 years)

*code: 1 - Service; 2 - Business (specify); 3 - Farmer; 4 - Day laborer; 5 - Fisherman; 6 - House wife; 7- Others (Gold smith, Potters, Carpenter, Tailor, Village Doctor, Mason, Barber, Vender, Van puller, Rickshaw puller, Boatman etc.specify in any)

**code: 1- Illiterate; 2- Literate but no institutional education; 3- Primary or equivalent; 4- Secondary or equivalent; 5- SSC passed or equivalent; 6- HSC passed or equivalent; 7- Graduation or equivalent; 8- Post Graduation or equivalent

2. Basic Information on biogas plant and associates

2.1 Production of plant (m ³)	<input style="width: 50px; height: 20px;" type="text"/>	2.2 Plant construction period	Month, Year	<input style="width: 20px; height: 20px;" type="text"/>	<input style="width: 20px; height: 20px;" type="text"/>	Duration -days
	Yes -1; No- 2					
2.3 Is it in operation	<input style="width: 50px; height: 20px;" type="text"/>	2.4 Plant operation time	Month Year	<input style="width: 20px; height: 20px;" type="text"/>	<input style="width: 20px; height: 20px;" type="text"/>	
	Yes -1; No- 2					Yes -1 No- 2

2.5	Use of plant for cooking	<input type="text"/>	2.6	Use of plant for <i>hajak</i> light	<input type="text"/>
		<small>Yes-1; No-2</small>			
2.7	Use of plant for electricity	<input type="text"/>	2.8	Total nos. of double burner	<input type="text"/>
2.9	Total hrs. used for double burner	<input type="text"/>	2.10	Total nos. of single burner	<input type="text"/>
2.11	Total hrs. used for single burner	<input type="text"/>	2.12	Total nos. of <i>hajak</i> light	<input type="text"/>
2.13	Total hrs. used for <i>hajak</i> light	<input type="text"/>	2.14	Total nos. of generator	<input type="text"/>
2.15	Total hours used for power generation	<input type="text"/>			<input type="text"/>

3. Source of raw materials for biogas plant

Information		Information			
3.1.	Number of cows	<input type="text"/>	3.2. Number of buffalos	<input type="text"/>	
3.3	Number of calves	<input type="text"/>	3.4	Number of ducks	<input type="text"/>
3.5	Number of hens	<input type="text"/>	3.6	Daily available raw materials	<input type="text"/>
				<small>Kg/day</small>	
3.7	Loading rate to plant per day*	<input type="text"/>	3.8	Ratio of raw materials : water	<input type="text"/>

* code: 1 - Once; 2 - Twice; 3 - More

4. Physical features of biogas plant

Information		Information					
4.1	Number of slurry pits	<input type="text"/>	4.2	What are the size of the pits (m)	<input type="text"/>	<input type="text"/>	<input type="text"/>
		<small>Yes-1; No-2</small>			<small>Length</small>	<small>Width</small>	<small>Depth</small>
4.3	Pit boundary exists	<input type="text"/>	4.4	Pit shed exists	<input type="text"/>	<input type="text"/>	<input type="text"/>
					<small>Yes-1</small>	<small>No-2</small>	
4.5	Gas distribution device*	<input type="text"/>	4.6	Gas transmission method**	<input type="text"/>		
4.7	Name of MPOs provided appliances for BP construction***	<input type="text"/>					

* code: 1- GI pipe; 2- Plastic pipe; 3- MS pipe

** code: 1- Under ground; 2- Over head

*** code 1-Advace Engineer; 2- Nuria Engineer; 3- Others (specify.....)

5. Institutional Information and cost

Yes-1; No-2					
5.1	Do you know about IDCOL	<input type="text"/>	5.2	How you knew the biogas plant*	<input type="text"/>
		<small>Yes-1; No-2</small>			<small>Tk.</small>
5.3	Have you got any cash as grant from IDCOL/CPO	<input type="text"/>	5.4	Amount as grant from IDCOL /CPO	<input type="text"/>
		<small>Tk.</small>			<small>Tk.</small>
5.5	Total expenditure of BP	<input type="text"/>	5.6	Expenditure by HHs owned	<input type="text"/>
		<small>Yes-1; No-2</small>			
5.7	Loan taken	<input type="text"/>	5.8	From where*	<input type="text"/>
		<small>Tk.</small>			<small>Nos.</small>

5.9	Taka per installment	<input type="text"/>	5.10	Number of loan recovery installment	<input type="text"/>
		Tk.			Tk.
5.11	O&M cost per month	<input type="text"/>	5.12	Amount of loan	<input type="text"/>
		Yes -1 No-2			Yes -1 No-2
5.13	Are you getting any training on O&M of BP provided by CPO	<input type="text"/>	5.14	Are you getting any After-Sales-Services (ASS) of BP provided by CPO	<input type="text"/>
5.15	Relation with CPO**	<input type="text"/>	5.16	Relationship with LCPO**	<input type="text"/>
5.17	Relation with LPO**	<input type="text"/>			

* code 1- CPO 2- Relatives; 3- LPO; 4- LCPO; 5 - Neighbors,
6- Television 7- Friends 9- Bank 8- Local NGOs 10- Others (specify.....)
** code 1- Good 2 - Moderate; 3 -Bad

6. Usefulness

6.1	Does the plant fulfill the demand	<input type="text"/>	6.2	Has the plant produce gas regularly	<input type="text"/>
		Yes -1 No-2			Yes-1 No-2
6.3	Is the plant useful	<input type="text"/>	6.4	If yes, how intensive*	<input type="text"/>
		Yes -1; No-2			
6.5	Is the plant functioning well	<input type="text"/>	6.6	If yes, how intensive*	<input type="text"/>
		Yes -1 No-2			
6.7	Are you satisfied with the plant	<input type="text"/>	6.8	If yes, how intensive*	<input type="text"/>

* code: 1- Significantly; 2- Moderately; 3- Minimally

B. Impact Analysis

7. Impacts on socio-economic Condition

Before biogas plant installation		After biogas plant installation	
7.1	Used time for cooking per day	7.2	Use time for cooking per day
	hrs. <input type="text"/> Tk./month		hrs. <input type="text"/> Tk./month
7.3	Fuel cost per-month	7.4	Fuel cost per-month (other than bio-gas)
	<input type="text"/> Tk./month		<input type="text"/> Tk./month
7.5	Lightening cost	7.6	Lightening cost (other than bio-gas)
	<input type="text"/>		<input type="text"/>
		7.7	Do you saved the time
			<input type="text"/>
		7.8	If yes, the time used as below: % of time
		7.8a	Income generating sector
			<input type="text"/>
		7.8b	Recreation sector
			<input type="text"/>
		7.8c	Education sector
			<input type="text"/>
		7.8d	No use
			<input type="text"/>
7.9	How much fuel wood used from nature (bush and tree)	7.10	How much fuel wood use from nature (bush and tree)
	Kg. / Day <input type="text"/>		Kg. / Day <input type="text"/>
			Yes -1 No-2

Before biogas plant installation		After biogas plant installation	
		7.11	Do you use of the saved fuel <input type="text"/>
		7.12	If yes, which sector <input type="text"/> % of wood
			7.12a Income generating sector (sale) <input type="text"/>
			7.12b Environmental conservation (no use) <input type="text"/>
	Hr. per day		Hr. per day
7.13	Total time spent for fuel collection per day previously <input type="text"/>	7.14	Total time spent for fuel collection per day presently <input type="text"/>
		7.15	Educational facilities of hhs member* <input type="text"/>
7.16	Self assessed poverty status** <input type="text"/>	7.17	Self assessed poverty status** <input type="text"/>
			Yes -1; No- 2
7.18	Do you sale the gas to others HHs (if yes, must go through the question no- 14)		<input type="text"/>

*code: 1- Improving; 3- Decreasing ; 3 - No change

**code: 1- Surplus; 2 - Breakeven 3- Deficit

8. Impacts on health and sanitation

Before biogas plant installation		After biogas plant installation	
8.1	Previous status of toilet of this hhs* <input type="text"/>	8.2	Present status of toilet of this hhs* <input type="text"/>
			Yes-1 No -2
		8.3	Do you have attached toilet to biogas plant? <input type="text"/>
8.4	Previous air pollution status in kitchen by smoke** <input type="text"/>	8.5	Present air pollution status in kitchen by smoke** <input type="text"/>
8.6	Previous infection due to smoke on:	8.7	Present infection due to smoke**
	8.6a Eye infection** <input type="text"/>		8.7a Eye infection** <input type="text"/>
	8.6b Respiratory infection** <input type="text"/>		8.7b Respiratory infection** <input type="text"/>
8.8	Previous incidence from diseases**:	8.9	Present incidence of diseases**
	8.8a Typhoid** <input type="text"/>		8.9a Typhoid** <input type="text"/>
	8.8b Tuberculosis ** <input type="text"/>		8.9b Tuberculosis** <input type="text"/>
	8.8c Diarrhoea** <input type="text"/>		8.9c Diarrhoea** <input type="text"/>
	8.8d Gastro-intestinal diseases** <input type="text"/>		8.9d Gastro-intestinal diseases** <input type="text"/>
8.10	Previous incidence of mosquito/flies induced diseases ** <input type="text"/>	8.11	Present incidence of mosquito/flies induced diseases** <input type="text"/>
8.12	Previous Accidents due to fire/burning** <input type="text"/>	8.13	Present accidents due to fire/burning** <input type="text"/>

*code: 1- Sanitary Latrine; 2- Ring slab; 3- Hanging /pit; 4- No facilities/open

**code: 1- Severe; 2- Moderate; 3 Minimal; 4 - No pollution /infection/ diseases

9. Impacts on gender

Issues		Issues			
9.1	Who has taken initiative to install BP*	<input type="text"/>	9.2	Who has taken decision to install BP*	<input type="text"/>
9.3	Who is responsible for operation*	<input type="text"/>	9.4	Who was monitoring the const. work*	<input type="text"/>
9.5	Who is responsible for maintenance & management of BP*	<input type="text"/>	9.6	Who is responsible to contact with CPO for servicing/repairing*	<input type="text"/>
9.7	Who is responsible to contact with LCPO for servicing/repair and loan*	<input type="text"/>	9.8	Who is responsible to contact with LPO for loan*	<input type="text"/>
8.9	Who is technically knowledgeable person about BP*	<input type="text"/>	9.10	Who is benefited mostly in this family from this BP*	<input type="text"/>
9.11	Benefits derived by the women & girls after BP, how**	<input type="text"/>	9.12	Present stress and work load***	<input type="text"/>
		hr. per day			
9.13	Previously time involvement in cooking	<input type="text"/>	9.14	Presently time involvement in cooking***	<input type="text"/>
		hr. per day			
9.15	Previously time involvement for children education	<input type="text"/>	9.16	Presently time involvement for children education***	<input type="text"/>
		hr. per day			
9.17	Previously time involvement for feeding	<input type="text"/>	9.18	Presently time involvement for feeding***	<input type="text"/>
		hr. per day			
9.19	Previously time involvement for collecting of fuel wood	<input type="text"/>	9.20	Presently time involvement for collecting of fuel wood***	<input type="text"/>

* code: 1- Male member; 2- Female member; 3- Children (girls); 4-Children (boys)
5- Servant (male); 6- Servant (female) 7- Both (male and female) 8- Others (specify.....)

** code: 1- Increase enrollment of girls in schools; 2- Involve income generating activities;
3- Involve social works; 4 - Involve educational work 5- Others (specify.....)

***code: 1- Increasing; 2- Decreasing 3- No change

10. Information on bio-slurry management

Issues		Issues			
10.1.	How many days you store bio-slurry in pit	<input type="text"/>	10.2.	Do you dry bio-slurry	<input type="text"/>
					Yes-1 No-2
10.3	How do you dry bio-slurry*	<input type="text"/>	10.4	Do you add any other organic materials with bio slurry	<input type="text"/>
					Yes-1; No-2
10.5	What type of materials you added**	<input type="text"/>			
		Yes-1; No-2			
10.6	Did you pilling cow dung regularly	<input type="text"/>	10.7	Do you pilling cow dung regularly	<input type="text"/>
		Yes -1; No -2			Yes-1 No-2
10.8	Did you decomposing cow dung regularly	<input type="text"/>	10.9	Do you decomposing cow dung regularly	<input type="text"/>
		Yes -1; No -2			Yes -1; No -2

10.10	Did you regularly turn the decomposing materials for aeration	<input type="text"/>	10.11	Do you regularly turn the decomposing materials for aeration	<input type="text"/>
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*code: 1- Open sun shine; 2-Under shade

**code: 1- Chemical fertilizer; 2- Green compost manure; 3- Kitchen wastage; 4 -others.(specify..)

11. Impacts on Agriculture

Issues		Issues			
11.1	Do you have any agricultural land	<input type="text"/>	11.2	How many decimal	<input type="text"/>
11.3	Are you a farmer	<input type="text"/>	11.4	Which type*	<input type="text"/>
11.5	Previous number of livestock population	<input type="text"/>	11.6	Present number of livestock population	<input type="text"/>
11.7	What was the grazing/feeding method for your cattle/poultry before BP	<input type="text"/>	11.8	What is the grazing/feeding method for your cattle/poultry after BP	<input type="text"/>
11.9	Previous cow shade management	<input type="text"/>	11.10	Present cow shade management	<input type="text"/>
11.11	Do you use the bio-slurry	<input type="text"/>	11.12	If yes, where***	<input type="text"/>
11.13	In which form you used bio-slurry	<input type="text"/>	11.14	How many time you sale this slurry per year	<input type="text"/>
11.15	How many time you use this slurry in agricultural land/pond per year	<input type="text"/>	11.16	Is the bio-slurry increasing soil fertility	<input type="text"/>
11.17	Previous animal health status***	<input type="text"/>	11.18	Present animal health status***	<input type="text"/>
11.19	Previous fodder management status***	<input type="text"/>	11.20	Present fodder management status***	<input type="text"/>
11.21	Effectiveness of this bio-slurry ***	<input type="text"/>	11.22	Is the bio-slurry helping to increase crop productivity	<input type="text"/>
11.23	Use this manure at agricultural sector how much taka has been saved per year from fertilizer	<input type="text"/>			<input type="text"/>
11.24	Do you think the income from agricultural sector is increasing after BP installation	<input type="text"/>			<input type="text"/>

* code: 1- Own cultivator; 2- Sharecropper (in); 3- Sharecropper (out); 4 - Lease (in); 5 - Lease (out)

**code:1- As fertilizer in crop field; 2- As fertilizer in home garden 3-As fish feed for fish culture
4- Patties for burning purpose; 5 - Sale to other farmer, 6- No use, 7- Other (specify.....)

***code: 1- Good; 2- Moderate; 3 -Bad

12. Impacts on environment

Before biogas plant installation			After biogas plant installation		
12.1	What types of fuel did you used for cooking*	<input type="text"/>	12.2	What types of fuel do you use for cooking*	<input type="text"/>
12.3	Was this fuel environment friendly	<input type="text"/>	12.4	Is this fuel environment friendly	<input type="text"/>

Before biogas plant installation				After biogas plant installation			
12.5	Self assessed household environment**		<input type="text"/>	12.6	Self assessed household environment**		<input type="text"/>
12.7	Self assessed kitchen environment**		<input type="text"/>	12.8	Self assessed Kitchen environment**		<input type="text"/>
12.9	Self assessed cow/poultry-shed environment**		<input type="text"/>	12.10	Self assessed cow/poultry -shed environment**		<input type="text"/>
12.11	Previous status of surrounding environment**		<input type="text"/>	12.12	Present status of surrounding environment**		<input type="text"/>
12.13	Previous status of social environment**		<input type="text"/>	12.14	Present status of social environment**		<input type="text"/>
12.15	Source of Drinking water***		<input type="text"/>	12.16	Distance of BP from drinking water source (m)		<input type="text"/>
12.17	Distance of BP from drinking water source (m)		<input type="text"/>				<input type="text"/>

*code: 1- Fire wood; 2- Agriculture residues; 3- Cow dung, 4- Heater; 5 -Natural gas;
6- Kerosene; 7 - Bio-gas

**code: 1- Good; 2 - Moderate; 3- Bad

***code: 1- HTWs 2- Well 3- Pond 4- others (.....specify)

13. Impacts on institutional aspects

13.1	Did you feel comfortable with this type of CPO/ LCPO for construction of BP	Yes -1 No-2	<input type="text"/>	13.2	If no, what type institute you suggest*	<input type="text"/>
13.3	Did you feel comfortable with LPO/ LCPO for loan	Yes -1 No-2	<input type="text"/>	13.4	If no, what type institute you suggest*	<input type="text"/>

*code: 1- Local NGO; 2- UP office; 3- Upazila DPHE; 4- Upazila LGED; 5- Local Bank;
6- IDCOL; 7- others (specify.....)

14. Information on bio-consumers

14.1. Rate: Tk. per month.....

14.2. Condition any:

14.3 Benefits any:

14.4 Problems any:

14.5 Suggestion any:

15. Benefits, Problems and Suggestions

15.1 What are the main benefits perceived by plant owner:

- a.
- b.
- c.
- .
- g

15.2 What are the main problems faced by plant owner:

- a.
- b.
- c.
- .
- g

15.3 What are the main suggestion for solve problems:

- a.
- b.
- c.
- .
- g

16. Expert comment/observation:

Signature of Investigator

Date:

Center for Environmental and Geographic Information Services (CEGIS)

House # 6, Road # 23/C, Gulshan-1, Dhaka-1212

**Annex-3 Survey with Potential Non-User Household for Need
Assessment of Biogas Plant**

Household ID Number:	
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1. Household Information:

- 1.1 Name of Household Head :..... 1.2 Age:
- 1.3 Father's/Husband's Name :.....
- 1.4 *Para/mahlla* :.....
- 1.5 Village :.....
- 1.6 Post office :.....
- 1.7 Union :.....
- 1.8 Upazila :.....
- 1.9 District :.....
- 1.10 Division :.....
- 1.11 Occupation* (code) 1.12. Education** (code)
- 1.12. Male member (nos.) 1.13. Female Member (nos.)

*Occupation Code:

1 - Service; 2 – Business (specify); 3 - Farmer; 4 - Day laborer; 5 - Fisherman; 6 - House wife;
7- Others (Gold Smith, Potters, Carpenter, Tailor, Village Doctor, Mason, Barber, Vender, Van Puller, Rickshaw Puller, Boatman etc.)

**Education Code:

1- Illiterate; 2- Literate but no institutional education; 3- Primary or equivalent; 4- Secondary or equivalent; 5- SSC passed or equivalent; 6- HSC passed or equivalent; 7- Graduation or equivalent; 8- Post Graduation or equivalent

2. Present Fuel and Energy Use in the Household:

2.1 <i>Source of fuel for cooking purpose with its use in %</i>		
	Yes -1 No- 2	%
2.2.1 Fire wood, Leaf etc.	<input type="text"/>	<input type="text"/>
2.2.2 Cow dung	<input type="text"/>	<input type="text"/>
2.2.3 LP gas	<input type="text"/>	<input type="text"/>

2.2.4	Other (specify:.....)	<input type="text"/>	<input type="text"/>
2.2	Source of power for lighting purpose with its use in %		
		Yes -1 No- 2	%
2.2.1	REB Electricity	<input type="text"/>	<input type="text"/>
2.2.2	PDB Electricity	<input type="text"/>	<input type="text"/>
2.2.3	Commercial generator based electricity	<input type="text"/>	<input type="text"/>
2.2.4	Kerosene based light generation	<input type="text"/>	<input type="text"/>
2.2.5	Solar energy based electricity	<input type="text"/>	<input type="text"/>
2.2.6	Other (specify:.....)	<input type="text"/>	<input type="text"/>
2.3	Are you facing any fuel and energy crisis	<input type="text"/>	

3. Availability of raw materials for probable Bio Gas Plant:

3.1.	Number of cows	<input type="text"/>	3.2.	Number of Buffalos	<input type="text"/>
3.3	Number of calves	<input type="text"/>	3.4	Number of ducks	<input type="text"/>
3.5	Number of hens	<input type="text"/>	3.6	Daily available raw materials (Kg.)	<input type="text"/>
3.7	Present use of cow dung/poultry droppings*	<input type="text"/>			

*** Use**

1- As fertilizer in crop field; 2- As fertilizer in home garden; 3- As fish feed for fish culture; 4- Patties for burning purpose; 5 - Sale to other farmer; 6- No use; 6- Other (specify.....)

4. Need of Bio Gas Plant by the Household:

		Yes-1; No-2
4.1.	Have you any idea/concept about Bio Gas Plant (BGP)	<input type="text"/>
4.2	Have you ever seen any BGP	<input type="text"/>
4.4	Do you want to install a BGP	<input type="text"/>
4.5	If yes, purpose of installation*	<input type="text"/>
4.6	If no, why	<input type="text"/>

***Purpose Code:**

1 – Fertilizer; 2 – Fish feed; 3 – Waste management; 4 – Commercial; 5 – Sanitation; 6- Other (specify.....)

7. Expert comment/observation:

Signature of Supervisor:

Date:

Annex-4 Checklist for KII

Bio Gas User Survey, 2007

A. Upazila Level (UNO):

1. Whether the IDCOL Bio Gas Program is known to you?
2. Are you involve/cooperate this program?
3. What is your opinion about the Bio Gas Program of IDCOL?
4. State the status of Bio Gas Program by other government agencies (e.g. LGED).
5. State the opinion/ suggestion/ recommendation on Bio Gas Technology and program of government agencies.

B. Construction Partner Organization (all individual CPO under each district's sample):

1. Whether you (CPO) are appointed by IDCOL?
2. Duration and experience of the CPO.
3. Number of BGP installed by you.
4. State the implementation process of Bio Gas Program.
5. Whether any users level training program arranged by CPO? State the number and type of training.
6. State the mechanism of subsidy money distribution system and its problem, if any.
7. State the status of After-Sales-Service for BGP?
8. State the problems (cost, approved appliances, design, size/capacity, gas distribution, co-ordination/interrelation among the stakeholders etc) faced by you to implement the program.
9. State the opinion and recommendation on the implementation of Bio Gas Program.

C. Lending Partner Organization (all individual LPO under each district's sample):

1. What is the credit mechanism among IDCOL, LPO, CPO and plant owner?
2. Status of credit installments recovery.
3. State the problems (fund availability, rate of interest of IDCOL, loan recovery, monitoring, co-ordination/inter-relation among the stakeholders etc) faced by you to implement the program.
4. State the opinion and recommendation on the implementation of Bio Gas Program.

Note: Collect the name of persons interviewed during KII and note the answer in separate paper/book.

Annex-5 Terms of Reference

For

Biogas User Survey 2007

1. Background

Infrastructure Development Company Ltd with the support of Netherlands Development Organisation (SNV) and likely support from KfW, Germany has started National Domestic Biogas and Manure Programme (NDBMP) in Bangladesh from mid 2006. Some 1,200 domestic size biogas plants are installed by the end of July 2007 under the NDBMP. NDBMP aims to construct 60,000 high quality domestic biogas plants by the end of 2010 through out the country.

The success of a programme cannot be judged merely by quantitative figures of biogas plants, but the functioning of the installed plants is very crucial as well as important. On the other hand, various direct and indirect but important benefits enjoyed by the users of biogas technology may be taken into consideration. It is imperative to know how far the users of biogas, who are the ultimate beneficiary of the programme, have derived benefits from their plants and the program as a whole and to what extent they are satisfied with the technology. It is equally important to assess socio-economic impact brought about by this technology. Thus, in order to obtain necessary feedbacks about the technology, it is essential to monitor both the technology and its impact on user satisfaction by conducting appropriate and detailed surveys at regular intervals.

This will be the first survey under the NDBMP to assess various impacts of biogas as well as to find out the effect of biogas on health and workload of women and children. The findings as well as recommendations of the survey report will be instrumental for further improvements. For this purpose, NDBMP wants to select suitable consultant for the conduction of the User Survey for the current year 2007.

2. Objectives

2.1 General Objective

The main objective of the Biogas User Survey is to make a comprehensive assessment of the impacts of the biogas plants installed so far on energy, health & sanitation, and agricultural systems as well as technical, socio-economic, environmental and gender concerns. In addition to local impacts, the survey also should provide information to evaluate the global environmental impacts of biogas plants.

2.2 Specific Objectives

The specific objectives will be to assess and analyse following aspects of biogas:

a. Impact on Health and Sanitation

Biogas reduces exposure to smoke and significantly improves air quality inside kitchen and also owing to the fact that biogas plant owners may chose to construct sanitary toilets, the survey should focus 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 due to biogas
- Respiratory and eye infection
- Incidence of gastro-intestinal diseases
- Mosquito induced diseases and nuisance
- Fire/burning accidents, general physical condition (stress, free time, time for feeding etc) among women, men and children

b. Impact on Socio-economic Conditions

As biogas reduces fuel expenses for cooking and lighting and also saves significant time spent in collecting fuel wood and dung cakes, this has economic and social implications. Following issues having socio-economic implications should be focused in the survey:

- Time and money saved through different household and biogas related activities
- Use of the saved time in different income generating activities
- Changes in income and access to the natural resources
- Employment generation
- Determination of economic level of biogas owners as compared to the non-users
- Financing source for biogas plants
- Educational status

c. Information on Biogas Plants

Following biogas plant related information should be assessed:

- Instruction on operation as provided by the Construction Partner Organizations (CPOs)
- Operation and maintenance of the biogas plant including trainings
- After- sales-services(ASA) provided by the CPOs
- Plant operation rate, problem and maintenance cost
- Major problems faced by the users
- Dung availability per day and burning hours of biogas stove
- Functioning biogas plant
- Plants financed by financial institutions or cash
- Dealing with financial institutions; how difficult/easy?
- Other organizations supporting biogas

d. User Satisfaction and Perception

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

- Their awareness, requirements and suggestions for possible improvement
- Operation and maintenance training received by them
- Means of communication on biogas

- Satisfaction/ dissatisfaction
- Sources of biogas information
- Repair and maintenance
- Family member responsible for contacting the CPO
- Time and types of services provided by the CPO and LPO

e. Impacts on Gender

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

- Women's participation in decision making process
- Construction, operation, maintenance and management of biogas plant
- Ability of women to contact the CPO for services/repairs
- Technical know-how of either men or women
- Benefits derived by the women and children from the installation of biogas plant
- Health and workload change before and after biogas installation
- Enrollment of girls in schools
- 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, operation of biogas plant, etc.

f. Agriculture Impacts

The prime source of raw material for biogas is the livestock/ poultry and the digested slurry is considered a high quality manure, impacts of biogas on two major components of the Bangladeshi farming systems, viz. livestock and crop/vegetables, should be assessed by considering following 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 the decomposing materials 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

g. Energy, Emission Reduction and Environmental Impacts

Biogas reduces the pressure on forests and alleviates deforestation as an average family size of biogas plant is considered to save more than 1.5 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 emission in the environment.

While assessing the energy and environmental benefit, major focus should be given on the following issues:

- 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
- Daily gas production and consumption
- Local (household) environmental condition before and after the installation of biogas and its impact on global environment

3. Approaches and Methodology

The Consultant should mention the detailed approaches and methodology for carrying out this study. But methodology shall include the desk study and review all the relevant literature related to user's survey. Based upon the review of the literatures, the consultant shall formulate the tools of data collection such as structured questionnaire, checklists for focus group discussions, observation sheets etc, including quantitative and qualitative outputs planned through these surveys, and areas of operation which shall be finalized in agreement with IDCOL.

It is aimed to have a minimum sample size of total 50 biogas households of 10 districts, constructed in 2006 and early 2007.

Random sampling shall be done based on NDBMP database representing various sizes both cow dung and poultry plants. Based upon the database available from NDBMP, the consultant shall prepare a detailed list of randomly selected 50 households (with biogas) in the 10 survey districts.

The consultant shall organize an intensive training for the members of field survey team prior to the pre-testing of questionnaire and field mobilization. The consultant shall prepare a detailed programme regarding the mobilization of survey team for field studies and will submit a copy to IDCOL to enable it to monitor the activity in the field.

4. Expected Output

- Inception Report
- Draft Report and
- Final Report

The report should provide the detail information regarding the objectives as mentioned in section 2. The report of the survey should also answer at least the following questions:

- I. How many farmers (%) are satisfied with biogas (level of satisfaction)?
- II. How many plants are functioning well?
- III. How much dung (average) is fed every day?
- IV. What are the major problems faced by farmers?
- V. How many plants are connected with toilet?
- VI. How much smoke has been reduced in kitchen?
- VII. How much time saved?
- VIII. How much firewood/ dung cakes saved?
- IX. How much money is saved?

5. Work Schedule

The project will be implemented from the first week of December 2007 for two months. The consultant shall elaborate detail work schedule to be carried out for implementation of the proposed programme. But the actual time will be determined after the agreement between IDCOL and the Consultant.

6. Team Composition

The team should be composed of

- Biogas/Environment Expert having more than 5 years experience in the relevant field who works as a Team Leader
- Socio-Economist having at least 5 years professional experience.
- Data Analyst having adequate experiences

The Consultant shall submit the name(s) of the required human resources to be assigned for execution of the proposed project. The detailed CVs of the experts to be involved for the conduction of this study must be submitted with their original signature and their commitment to provide the full time for this study.

7. Terms of Payment

Payment will be made according to the following schedule:

- 25% after signing the contract agreement
- 25% after submission of inception report & acceptance by IDCOL
- 25% after submission of the draft report & acceptance by IDCOL
- 25% after submission and acceptance of the final report by IDCOL

8. Duties and Taxes

The consultant shall pay all tariffs, duties, other taxes or charges levied by the Government of Bangladesh at any stage during the execution of the work.

9. Reporting

The consultant should submit reports in three stages of the study:

9.1 Inception Report

Before proceeding to the fieldwork, the Consultant shall submit *two copies* of inception report containing information collected from desk study and the detailed work plan. The Consultant shall consult with IDCOL prior to preparing the report, which contains detailed for the proposed work including methodology.

9.2. Draft Report

Incorporating all the details of the study and its finding, three copies of the draft report shall be prepared and submitted to IDCOL as per the given time schedule.

9.3. Final Report

After submission of the draft report, the Consultant shall organize a consultative workshop to present the findings of the study among the stakeholders and to get comments and suggestions, in consultation with IDCOL. In the final report, the Consultant should clearly mention the methodology, output of the study and recommendations based on the study by incorporating the comments and suggestions received from the stakeholders. Five copies of final report and an electronic copy (in CD) must be submitted to IDCOL including an executive summary. The reports must be prepared and performed in a professional way by adhering to strict quality standards.

10. Delays

In the event of failure to comply with the completion period, the consultant will have to request IDCOL for extension giving reasonable cause for such delays. If IDCOL does not find the causes reasonable, the consultant will have to pay penalty at rate of 2% of the total contract value of the order for each week's delay up to first three weeks. If the delay is more than three weeks, IDCOL shall have right to terminate the contract.

Annex-6 Photo Album

Biogas User Survey under National Domestic Biogas and Manure Programme (NDBMP)

Pictures of Biogas Plants and the Users



Interview with female plant user



Interview with male plant user



A new slurry pit



An under constructed plant



Mixing raw material



An out view of a plant



Underground Gas distribution line



Overhead Gas distribution line



Drying of dung patties



An inactive plant



A slurry pit



A slurry pit

Two single burners connected with gas line	Hajag light connected with gas line

Checking the hydraulic chamber while visiting	Checking water trap

Maintenance of burner	Carbon free utencils and kitchen
Use of gas	Flame of bio gas

Nozzle hole	Two types of stove

Agreement document with Grameen Shakti	Agreement document with Hossain biogas