CHAPTER ONE
INTRODUCTION

1.1 General Background

The growing awareness of the pollution problems, associated with inadequate management of animal manure and organic waste, emphasizes the need for appropriate solutions to deal with the problem. A strengthening of the overall policy on environmental protection, as regards waste as well as manure handling, with well defined enforcement measures, will stimulate the dissemination of the appropriate biogas technologies.

Almost every country of the world is gripped by one or other sort of economic or political crisis, of these the crisis of energy, which has regarded as both economic and political problems, has posed a serious challenge for the stability and prosperity of many developed and under developed countries.

With the increase of population and demands of development efforts energy as economic problem has come to appear in Nepal as well. The population pressure has emanated. The need to higher supply of energy as consumption has increased both quantitatively and qualitatively. Similarly, the attempt of mechanization and establishment of industries has multiplied the already existing high demands of energy.

Biogas is the mixture of gas produced by methane-based bacteria acting upon biodegradable materials in an environment that is lacking air. It is mainly composed of 60-70% Methane, 30-40% Carbondioxide and some other gases. It is colourless and burns with a clean blue flame similar to that of Liquid Petroleum Gas (LPG) allowing for virtually smoke free combustion. Biogas can be used for cooking and lighting,

refrigeration, engine operation and electricity generation. To date, biogas is used mainly for cooking (80%) and lighting (20%) in Nepal.

The technology has been available in Nepal since the mid 1970s, but it was not until the early 1990s that the number of installations was substantially scaled up by the Biogas Support Program (BSP). This programme was established in 1992 by the Nepalese, Dutch and German governments.

The Biogas plants being constructed under BSP has following characteristics:

- Fixed dome individual plant per household.
- Sizes: 4,6,8,10,15 and 20 cubic metre.
- Feed materials: Cattle dung and water
- Feasible up to 2100 metres.

General Status

Table 1 show the number of biogas plants installed in Nepal since 1992: Nepal is divided into three east-west bands running the full width of the country; by the end of the third phase, more than 111000 plants were installed more on hills and Terai regions as shown in Figure 1.

Livestock plays and important role in the Nepalese farming system, with 2.7 million households owning cattle and buffalo (estimate 2001). the technical potential of biogas plants in Nepal is about 1.9 million: 57% in the plains, 37% in hilly areas and 6% in mountainous regions (BSP 2004).

Currently, the Biogas Support Programme has a target of increasing the number of quality biogas plants by an additional 200000 by 2009 in at least 70 out of the 75 districts of Nepal. BSP has given special attention to developing appropriate biogas plants designs, especially for remote and high altitude areas.

Table No. 1

Phase	Biogas plants installed
First phase (1992-1994)	6824
Second Phase (1994-Feb. 1997)	13375
Third Phase (March 1997-June 2003)	91196

Total	**111395**

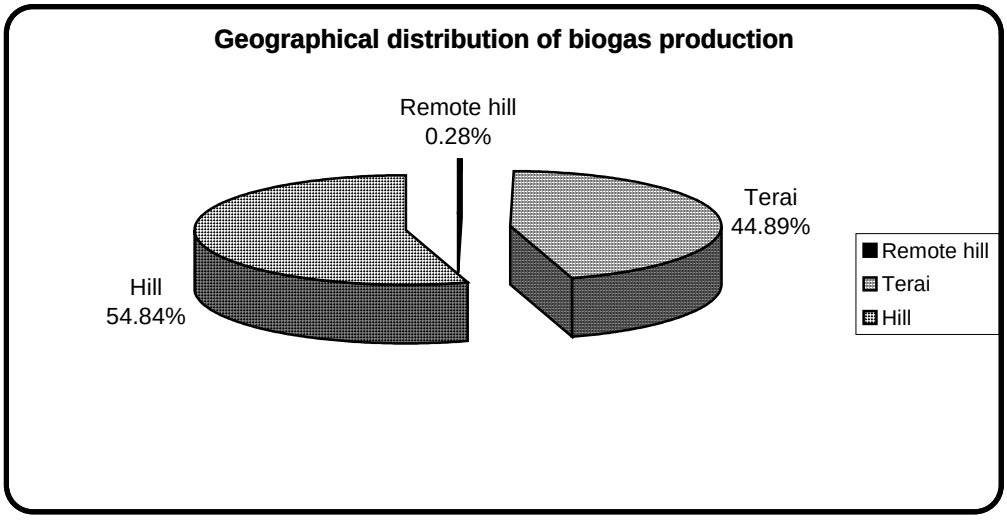
Source: BSP, 2004

Existing Practice

The challenge is to achieve 2,00,000 new installations in just 6 years: more than the total biogas plants installed since the 1970s to date, and ultimately to reach the total technical potential of biogas in the country. It is thus important to understand the current practices and modalities of the BSP.

Key elements of the sectoral approach adopted by BSP include:

Figure No. 1



- A uniform technical design for all biogas plants.
- Thorough quality control and monitoring of production, installation and after-sales services.
- Continuous R & D efforts to meet the needs of end-users.
- Outreach and awareness programmes.
- Financial support for end-users through a government subsidy of US $70=US$150 (5000-11000 Nepali Rupees per plant)
- Stimulation of financial support mechanisms such as micro-credit facilities.

Biogas construction companies are responsible for marketing and installing biogas plants and providing maintenance and after-sales services guarantees for at least three years operation and maintenance training to all households on day-to-day maintenance and minor repairs. BSP's policy of regular quality control and supervision of newly constructed plants ensures the quality of plants and services.

According to BSP, around 97% of the total plants installed since 1992 are operation. About 80% of the total plants are of four cubic metre and six cubic metre sizes; a six cubic metre plants requires around 36 kg of cow dung per day in hilly areas (mixed with an equal amount of water) to get a stove burning for 3.5 hours, This increases with altitude because of the retention time (average duration that dung remains in the digester). Around 60% of the biogas consumed is used for cooking.

Annually, each biogas plant can save more than four tones of firewood and 32 liters of kerosene. The annual time saving for firewood collection and cooking averages 1000 hours in each household with biogas plants. Each biogas plant produces about five tones of organic, fertilizer annually, which can mitigate about five tones of carbon dioxide equivalent per year (1,5). The credits thus earned could provide alternative financing for the sustainability of biogas program in Nepal.

The existing practice has focused on environmental benefits, subsidy, quality control, awareness creation etc. as the main drivings. There are other pertinent issues which need attention to scale up biogas in Nepal. But this project report normal focus on micro financing and health benefits.

Micro-financing

The average plant costs about NRs. 25,000 (NRS 74=US$1), Which is too costl for some potential users to pay off in a country where 38% of the Nepalese live with US$ 1 per day (11). The government of Nepal currently provides subsidy through the BSP and the Alternative Energy Promotion Center (AEPC). This clearly indicates that the

poor, who do not have the cash to pay for systems, can't benefit from biogas and access these government subsidies.

Micro Finance Institutions (MFIs) could provide loans to those wishing to purchase biogas plants who cannot pay the upfront cost. MFIs are strategically located in the rural areas and have enabled easy access through their simple procedures. The total membership of MFIs in Nepal comprises more than 500000 rural customers (12% of the total households in Nepal), receiving financial as well as non-financial services. Table 2 shows the outreach of MFIs in Nepal.

Additionally, it is estimated that there are around 330000 dairy farmer households (Woinrock 2004) who are potentially significant users of biogas. Winrock estimates that more than 800000 farmer households in Nepal are potential customers of micro-credit for the installation of biogas plants. It may not be technically or economically feasible for all dairy cooperative members to install biogas plants, but with a large proporation of dairy cooperative member households without biogas plants, there is a potentially huge market.

Winrock International Nepal, in collaboration with AEPC/BSP, is mobilizing MFIs in order to achieve the set target of 200000 additional installations by 2009, with plans for further scaling up beyond that date. Winrock international has developed manuals and has already trained more than 80 micro-finance institutions. MFIs to finance biogas.

Health Benefit Aspects

Biogas can have significant health benefits. According to the Integrated Environmental Impact Analysis carried out by BSP for 600 biogas users (Figure 2) and 600 non-users, four percent more non-biogas users have respiratory diseases than those who own biogas plants (3). Qualitative information from various household surveys carried out by BSP has revealed that problems like respiratory illness, eye infection, asthma and lung problems have decreased after installing a bio-gas plants (Tables 3 & 4).

According to the Biogas Users' Survey conducted in 2000 with 100 households, biogas can have positive impacts on the health of its users. Out of 42 respondents who had respiratory problems in the past, it was reported that the problem has improved for 34 of them. Similarly, those who had problems like asthma, eye infections and lung problems found that their problems had decreased after displacing dirtier fuels with biogas.

Table No. 2

Total Membership of MFIs in Nepal (as of December 2003)

S.N	Type of MFIs	Number of institutions	Number of members
1	Development Banks	9	253166
2	Saving and Credit Cooperative	1786	248195
3	Financial Intermediary NGOs	30	18391
	Total	1825	529752

Sources: Directory of MFIs, Center for Micro-finance

Source: BSP/Nepal

Photo No. 1
Nepali woman cooking with biogas

Table No. 3

Health Benefits of Biogas

Disease	Problems in the past (HHs)*		Present status of HHs	
	Yes	No	Improved	Remained same
Eye infection	72	18	69	3
Cases of burning	29	71	28	1
Lung problem	38	62	33	5
Respiratory problems	42	58	34	8
Asthma	11	89	9	2

Dizziness/headache	27	93	16	11
Intestinal;/diarrhea	58	42	14	44

* HHs = households

Sources: Biogas Users' Survey 2000, BSP

Table No. 4

Health Benefits of Biogas (2)

Particulars	Decrease	Increase	No disease
Disease	20	-	80
Cough	53	-	47
Headache	33	3	67
Nausea	5	-	95
Chest pain	15	1	85
Lethargy	11	-	89
Respiratory disease	41	-	59
Malaria	8	2	92
Typhoid	10	4	90
Total (%)	**22**	**1**	**77**

Source : BSP Nepal

User's Buying Capacity

It is dependent on the economical status of the farmers, operation cost of biogas and the price of competing fuels in the area. Rich farmers, can easily buy a biogas plant either on loan or cash.

National Sample Census of Agriculture 1981/82 reflected that less than 1 hector of land holding households have cattle of 62% and buffalo of 64%. The biggest group in the Terai has 1-2 hectors land having cattle of 16% and buffalo of 14%. By land holding area this is the group who can buy biogas plants. Besides land holdings we should also consider the service or business of the owner. Most of the people in Nepal (71%) use fuel wood, followed by agriculture waste (15%), animal waste (9%), Kerosene (2%), Biogas (2%) and electricity and LPG (0.5%).

Cost Calculation and Analysis of a 8 cu.m.

The cost of a 8 cu. m. Biogas plant built in hills costs Rs. 25920/- (quotation of 2000/01) as follows.

1. Appliances and charges from company

Table No. 5

Particulars	Amount (Nrs)
Biogas appliances	2415/-
GI pipe of its fittings	3200/-
Construction charge	4500/-
Guarantee charge	600/-
Promotion fee	500/-
Sub total	11215/-

Construction Materials and Labour Cost

Table No. 6

Particulars	Quantity	Amount (Nrs)
Birck or stone	1700 PC	5100/-
Sand	80 bag	1200/-
Gravel	40 bag	480/-
Labour	30 man days	1800/-
Rod –8 mm	13.5 kg	365/-
Cement	18 bag	5760/-
Sub total		**14705/-**

Total cost is Rs. 25920/-

It is assumed that life of biogas plant is 25 years and present value of firewood and kerosene is Rs. 1.25 per kg and Rs. 10.50/Litre respectively and plant nutrients present in the dung is N = 0.58, P=0.25% and K = 0.5%.

It is also assumed that the maintenance cost of the plant is Rs. 400/ year and produces 2.2 m3 of gas per day. Government has provided a subsidy of Rs. 10,000 for 8 cu.m. plant installed in hills.

A. Saving and Expenditure

– Annual Savings

Savings of fire wood (6kg/ day at the rate of Rs. 1.25/kg)	=2700/-
Saving of Kerosene (2.5 lit/months at the rate of Rs. 10.50/lit)	=315/-
Saving of chemical fertilizer (estimated 17500 kg gobar)	= 2000/-
Total Savings	= 5015/-

Price of NPK saved is based on price of urea, DAP and MOP and 45% subsidy in urea. i.e. Rs. 20.31%/kg of Nitrogen, Rs. 15.49/kg Phosphorus and Rs. 10/kg of Potassium.

– Annual Expenditure

Total investment cost is Rs. 25920/-

The running cost

– Labour cost – 15 minutes in a day @ Rs. 70/Day	=800/-
– Operation and maintenance cost is estimated	= 400/-
– Miscellaneous cost	= 100
Total expenditure	= 1300/-

B. Pay back Period: Pay back period is calculated as follows:

$$\text{Pay back period with subsidy} = \frac{Total\ investment\ cost - Subsidy}{Annual\ saving - Annual\ Expenditure}$$

$$= \frac{25920\ Z10000}{5015\ Z1300}\ X\frac{15920}{3715}\ X\ 4.3\ years$$

$$\text{Pay back period without subsidy} = \frac{25920}{3715}\ X\ 7\ years$$

In our country, the available means of providing energy are traditional (fuel wood, agric residue, animal waste and commercial coal petro-products, electricity)

Table 7

Structure of Energy Consumption 1999 to 2002 (in thousand tons of oil)

Energy Types	1999	2000	2001	2002
1. Traditional				
Fuel wood	5816	5941	6068	6189
Agric residue	285	292	299	305

Animal waste	430	448	457	466
2. Commercial				
Coal	61	236	246	297
Petro-products	661	700	734	790
Electricity	89	99	108	115
Total	7342	7725	7912	8162

Source: - Statistical Pocket Book, Nepal, 2002

From the above data, it becomes clear that the people in Nepal consume 76.64% of fuel from firewood even today. This amount indicates that the forests in Nepal are being used beyond their capacity, which is alarming indicator of deforestation. Nepal has been placed in second position after Brazil in potential water resources. However, due to financial and technological constraints in one hand and selfish nature of the political leaders in the past in the other, favourable environment to harness the potential was not created. The total hydro electricity potential of Nepal is 83,000 mega watts where as energy supply is 1.35% (Nepal Population and Environments Facts and Figures, 2003.). The government to implement programmes to install biogas plants, which is a cheap and user-friendly technology. The villager uses the fuel indiscriminately, which has become the prime factor of deforestation, landslide and land erosion, etc. one of the important means of energy, which is widely used in villagers in the use of cowdung as fuel. Due to the shortage of their sources of energy, the people are making wide use of the cow dung for cooking purposes by burning it. Although the cow dung is cheap, people get less benefit by using it as fertilizers. One of the important technological improvements that have proved to be of great benefit to solve energy problem in rural area is the installation of biogas plant.

“Gobar” is a Nepali word for cowdung. The production of Gobar gas is simply a digestion process in the absence of oxygen by cultural bacteria breaking down cow-manure. Bacteria breakdown the organic matter into methane gas & Carbon-dioxide. Leaves residue of organic matter and water.

When cattle dung human excreta and other organic wastes are decomposed in an airtight digester within a temperature range of 25 to 35 degree centigrade period of

time, the methoanogonic bacteria decomposes them to form biogas. In other words, biogas is the mixture of gas produced by methanogenic bacteria while acting upon biodegradable materials in an anaerobic condition. It is mainly composed of 60-70 percent methane, 30-40 percent carbon dioxide and other gases. It is about 20 percent lighter than air. It is an odorless gas that burns with clear blue flame similar to that of LPG (Biogas Nepal 2002). The calorific value of this gas is comparatively higher than that of traditional fuel sources.

Among the commercial energies, the biogas is suitable in the Nepalese context because Nepal has sufficient holdings with livestock and livestock numbers are given in following table.

Table 8

Holding with Livestock and Livestock Numbers, Nepal 1981/82 and 1991/92

Livestock Type	**Holdings ('000)**		**Livestock ('000)**	
	1981/82	1991/92	1981/82	1991/92
Cattle	1261.90	2067.10	6501.60	7359.30
Yak	6.9	9	55.5	58.6
Buffaloes	778.6	1307.80	2379.70	3116.30
Goats	787	1382.80	3643.70	5515.50
Sheep	99.9	92.7	677.10	602.8
Pigs	164.1	267.5	433.6	495.8
Chickens	716.9	1400.40	7368.6	12333.10
Ducks	37.2	92.6	142.3	280.3
Pigeons	116.8	215.8	830.7	1419.9
Total	**2194.0**	**2736.10**		

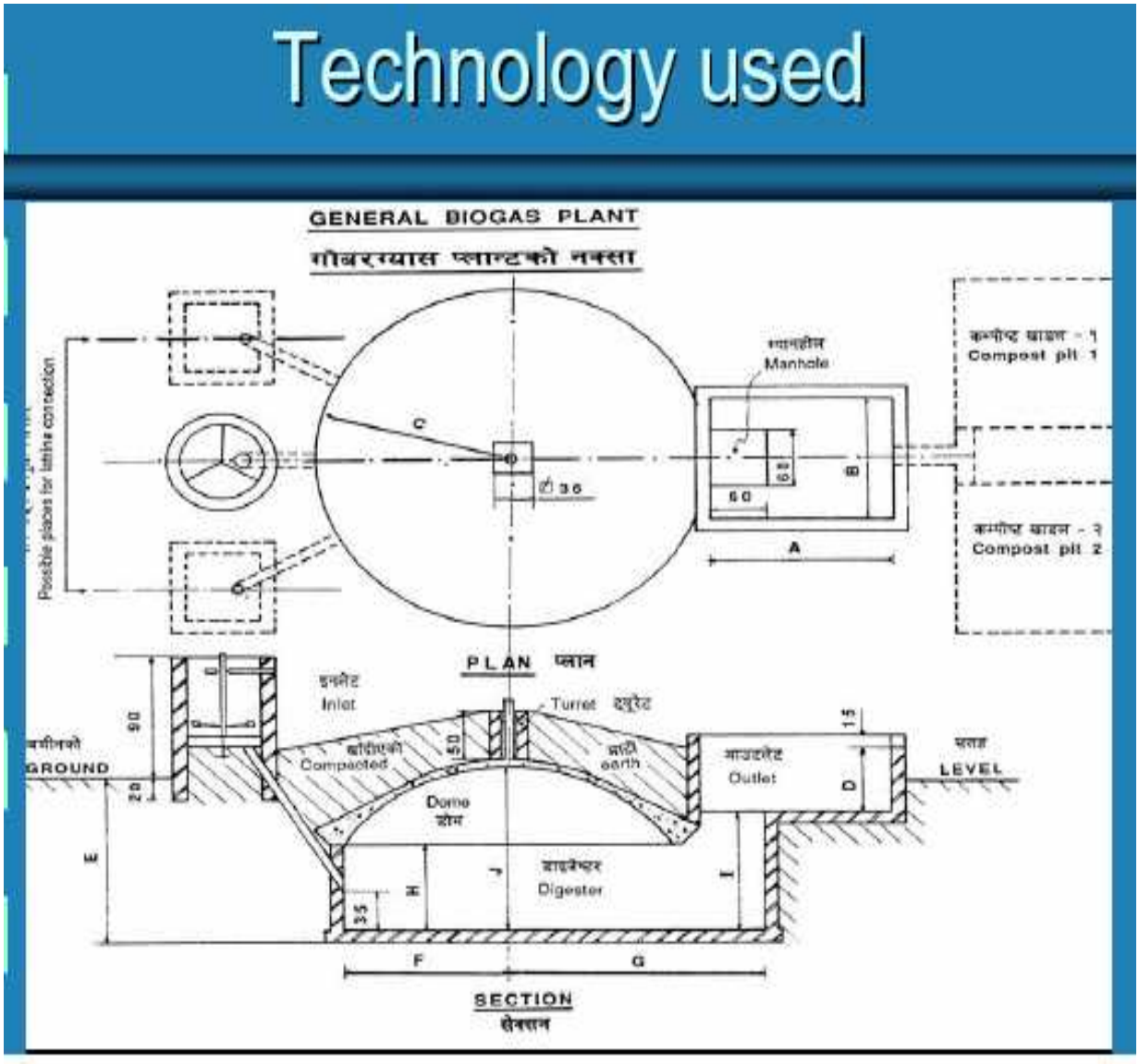
Source: Statistical Pocket Book. Nepal. 2002

From above table it becomes clear that Nepal has sufficient row materials for biogas generation. Gobar gas is mainly for farmers. Because the farmers, on the one hand, have livestock in abundant number, on the other hand, they centralize their activities on agriculture. Therefore, cow manure is used as fertilizer. If the farmers establish Gobar gas plant, they need not bother for energy for cooking, lighting, running duel-

fuel engine and generate electricity purpose. More over, the digested slurry also can be used as very good manure. So, it becomes a better source after the process of digestion both fuel and fertilizer purpose.

There are other forms of cellulose (containing cells) containing materials of organic origin such as animal waste and human wastes, which could be supplemented for gas generation. Further, the spent slurry of a biogas plant is a valuable organic fertilizer, which is rich in nutrient value than the ordinary compost. The digested slurry raises 10 to 30 percent crop production (Gober Gas Ko Ledo Baat Baneko Uchchakotiko Compost Mal BSP Push, 2058).

Biogas technology not only furnishes renewable and alternative sources of energy but also fertilizer, which are two vital components for the economic development of Nepal.



Feed Materials: Cattle Dung and Water

Photo No. 2

Cooking Food with Biogas and Lighting Biogas Lamp

Photo No. 3

Installation of biogas plant requires the feeding of dung regularly and hence the farmers have to keep required number of livestock for this purpose. This helps in regular supply of dung to the farm. More over, as the cattle have to be kept at sheds for the dung, the problem of overgrazing in reduced. The kitchen remains smoke-free and hence the smoke borne extent. When toilet is attached to biogas plant, it helps in

better sanitary condition around the houses. Cooking is faster in biogas and the cooking utensils remain free from black shoot. A considerable amount of time is saved due to reduction of cooking time. Time required to clean the utensils and time taken to collect fire wood from jungle, which could be utilized to some other income generating activities. Installation of Biogas plants also helps in creating job opportunity for skilled and semi-skilled human resources as the construction works require considerable number of such manpower.

Though Gobar gas plants have been known for several decades in many countries, they have only recently become important due to increase in the price of petroleum and chemical fertilizer. The design and capacity of the plant depends upon the gas and slurry needed and the availability of the animal wastes. General a Gobar gas plan has following main parts.

Digesters (to take digestion process for Gobar), dome (to collect gas), outlet (for the outcome of the digested slurry), inlet (to put mixture of Gobar and water), a couple of compost pits (to storage the slurry), gas pipe, stove and gas lamps (pipe is required to distribute the gas from gas holder to kitchen stove and lamps, valve (to obtain and stop the gas according to need). It has also turret (a small tower) manhole and agitator (Biogas Nepal, 2002) & (Gramin Pravidhi Ek Sangalo)

In this plant, the mixture of cow dung and water is generally equal (1:1 ratio) the Gobar and water is poured by inlet to the digester pit and the slurry through digestion process and with the help of bacteria is broken down into gas and residue. The gas is collected to dome and the residual liquid, due to the repetitive feeding to the digester pit, is thrown out through the outlet (Biogas Nepal 2002)

The materials required for the construction of Gobar gas plant are as follows. Bricks, sand, gasholder, cement, pipe etc. the main cost lies on the purchase of gasholder, which is made of steel. Once the plant is constructed, it works 25 to 30 years with a little maintenance.

The smallest capacity for the family size plant is of $4m^3$, $6m^3$, $8m^3$ & $10m^3$ many factors influence the amount of gas produced from the cow dung.

- Environmental factors
- Operational factors

Environment includes the nutrient availability in the dung, temperature of the day and night, PH level of the solution and Toxic materials and operational factors includes composition or organic substrate, retention time, concentration of substrate and organic loading ratio, air tightness of digester, degree of mixing and agitation C/N ratio of substrate and heating and heat balance etc. [Source: Articles of Dr. Yabraj Dahal, Unpublished]

Some biogas equivalents to other source of energy are given the following table.

Table 9

Some Biogas Equivalents

Application	Lm3 biogas equivalent
Lighting	Equal to 60-100 watt bulb for 6 hours
Cooking	3 meals for a family of 5-6
Fuel replacement	0.7 kg of petrol
Shaft power	Able to run a one hose power motor for 2 hours
Electricity generation	Able to generate 1.25 kilowatt hours of electricity

Source: Renewable Energy: Articles of Dr. Yubraj Dhal (Unpublished)

Similar to above table one cubic meter of biogas is equivalent to

- 3.47 kg of wood
- 0.62 liters of kerosene oil
- 0.61 liters of diesel oil
- 1.5 kg of coal
- 1.25 kg of LPG
- 13.0 kg of fuel dung

Source: Renewable Energy: Articles of Dr. Yubraj Dhal (Unpublished)

Generally, there are three designs of Biogas plants are given below:

Floating steel rum design, fixed dome design, tunnel design, among, above design fixed dome design in very popular design in Nepal (Biogas Tech. in Nepal 2002).

Now let us see the estimated cost as well as livestock's (cows, oxen, he-buffaloes, she-buffaloes) requires installing Gobar gas plants of different capacity for different size of family.

Table 10

Cost and Livestock Require for The Installation of Gobar Gas Plant of Different Capacity for Different Size of Family

Capacity of Gobar Gas Plants cu.m.	Livestock in Nos.	Estimated Cost (in Rs.)		Number of Family
		Terai	Hill	
$4m^3$	2-3	Rs. 20044/-	Rs. 20364/-	3-4
$6m^3$	3-4	Rs. 23353/-	Rs. 23673/-	4-6
$8m^3$	4-6	Rs. 27163/-	Rs. 27703/-	6-7
$10m^3$	6-9	Rs. 30443-/	Rs. 31083/-	7-8
$15m^3$	9-14			9-12
$20m^3$	14			12-18

Source: Gobar Gas & Agricultural equipment Development (P) Ltd. Kathmandu.

As per the table, for the plant of 4 cu.m. capacity the required number of livestocks must be 2 to 3 and estimated coast is Rs. 20,044/- for Terai and Rs 20,364/- for hill. The number of livestocks requirement for the biogas plants of various capacities as explained by the above table.

After the end of Second World War, peoples in Germany felt acute shortage of fuel, in connection to develop and alternate source the slowly started to develop biogas. On the same manner countries like Austria, Italy, Russia, Kenya, Uganda and South Africa also started to produce biogas. In United Kingdom, the gas plant made is slurry in 1929. (Karki, A.B.)

In India S.V. Desai in Pusha research institute have used Gobar gas successfully in 1939. in 1950 Jashu Bhai Patel improved in the design made by Desai for easy handling by villagers and was named as “Gram Laxmi” After that he again designed gas plant and was named it as “Gram Laxmi Doshro” In the year 1953 Mr. Patel mixed the both design and prepared other design which after all was named it is “Gram Laxmi Teshro”.

Source: Karki, A.B. Gobar Gas Samaya Ko Mang & Hank 2002

In the context of Nepal, biogas technology was first pioneered in mid 1950; father B.R. Saubolle, a Belgian teacher at Godavari St. Xavier's School. He constructed a micro model digester out of an oil drum. Thereafter, some groups, through their own initiative built a few biogas plants in Katmandu.

Genuine interest in biogas development came during the energy crisis in 1973. Due to the crisis "Energy research and development Group" was established under Tribhuvan university in 1975. Biogas received further impetus during the agriculture year (1974/75) with a subsidized loan from the agricultural development bank of Nepal (ADB/N). As many a 199 biogas plants were built by private contractors under the supervision of the department of agriculture. The design of biogas paints, which are composed of floating steel drums for storage was directly transferred from India. Some private contractors and development consulting services of the united mission to Nepal popularized the plant at that time.

Due to the rapid growth of population and depletion of national resources of energy an unsolved problem in supplying the energy is created. To reduce the burden over the forest for energy, "Gobar gas tatha Krishi Yantra Vikas (P) Ltd. "Popularly known as the "Gobar Gas Company" (GGC) was established in 1977 as a specialized company with the saint venture of agricultural development bank of Nepal (ADB/N) Nepal, fuel corporation presently named as timber corporation of Nepal (TCN) and the united mission to Nepal (UMN) ("Rajat Mahotsav Bisheshanka Smarika 2058")

Like "Gobar Gas Company another biogas related institution (Biogas support programme) was established in July 1992. Biogas support programme (SNV/BSP) created with support from the Netherlands development organization (SNV-Nepal) has been the principle donor that has been involved in the promotion of biogas programme since 1992. (Biogas Nepal 2002). The first and second phase of BSP programme (1992 to 1997) was successfully completed by the construction of 20,200 plants against a target of 20,000 plants construction.

The overall objective of the third phase of BSP programme (1998 to 2002) was to further, develop and disseminate biogas as indigenous, sustainable sources of energy in rural areas of Nepal.

The BSP's third phase programme aimed to construct additional 1,00,000 biogas Plants in Nepal [Abstracts of biogas related publication (1992-2002)] HMG/N's aimed to construct 2,00,000 Biogas plant (equivalent to 44mw) in 10^{th} 5 year plan in 65 districts. (Tenth Plan, 2059-2064).

This study covers only Mukundapur Village Development Committee. Mukundapur VDC is one of the popular village development committees of Nawalparasi District of Lumbini Zone, which lies in western Development region of Nepal. The VDC is 14 Km. southwest form the Bharatpur Municipality Chitwan. Mukundapur Namuna VDC is situated in the south bank of Narayani River. VDC owns the most fertile land where people cultivate different crops. Even in decreasing condition, fruit garden and other trees are natural resources to provide woods for different purpose to the villagers. However, woods are mainly used for cooking purpose.

Amount different public offices such as police office, post office, livestock service center, health post, also 2 secondary schools and 5 primary schools are in Mukundapur VDC.

The total population of this VDC is 10,439 among them 5358 are male and 5081 are females, (Population of Nepal, Population Census, 2001). The farmers of this VDC keep animals and fowls for different purpose. As they keep, cows and buffaloes for milk: he buffaloes he goats, pig for meat; goats for meat, oxen to plough land and fowls, ducks for meat and egg.

The total number of household in this VDC is 1803. Among them 953 household have both land & livestock & 150 household have livestock only (Population of Nepal, Population census 2001).

Potentiality of Biogas in Mukundapur VDC is very high because of 953 household have both land & livestock. The main source of energy, which the villagers using, fuelwood and cow dung for cooking and kerosene for lighting. Use of firewood results in deforestation and used of dung bums valuable fertilizer. These problems can be overcome by installing a biogas plant. Mukundapur Namuna VDC agriculture is dominated by a mixed farming system in which crop and livestock husbandry is combined. This necessitates that many household maintain a few animals.

This study is concerned with the study of feasibility of installing Gobar Gas plant in Mukundapur namuna village development committee in Nawalparasi district on the base of three major factors land, livestock and size of family.

1.2 Statement of the Problem

The study is concerned with feasibility study of Gobar Gas plant in Mukundapur Namuna Village Development committee of Nawalparasi District.

Gobar Gas plants play a vital role for the conservation of forest, reduction in the consumption of imported kerosene, substitute the imported chemical fertilizer and provided slurry to increase agricultural production. Similarly, it make rural people self sufficient in energy and fertilizer by exploiting indigenous resource Gobar and saves foreign exchange reserves which are urgent to us for importation of capital good for developmental purposes. Though Nepal has greater potential supply of hydropower the present economic and technological condition seems inadequate to exploite this resources. In this context, no one can argue against to accept Gobar gas plants which is cheap and intermediate technology. Thus, the expansion of the installation of Gobar gas plants in every nook and corner of country is the demand of the present situation.

Fire and fuel plays a significant role in the maintenance of daily life as well as in the industrial operations. Generally, we need it for burning, cooking and lighting purposes. In Nepal we use fire wood from forest for cooking purpose which is becoming the major cause of deforestation. When deforestation regularly occurs, it

will create a danger possibility of soil erosion, destruction of national wealth and the natural beauties. We either require kerosene oil or electricity except this for heating and lighting purpose where we cannot find both of them in the low price and sufficient quantity all over the country. Electricity, still remains unavailable in the hilly region because of transmission problem and huge investment in this situation we can supplement the required fire and fuel energy out of the processed Gobar gas plants if established in the various parts of the country. It can be completed with less cost in comparison to that required for producing electricity.

Like any other village, this Mukumdapur village is also suffering from problem of energy for consumption purposes. 20 years ago, this VDC was very rich in fuel wood. This VDC's areas were almost covered with fruit garden and other trees, but because of rapid deforestation and cutting of land by Narayani River. Now a day, many trees are not available in this VDC. Therefore, the villagers are suffering form the problem of the fuel wood for consumption.

Energy sector is the backbone of the modern society. Mukundapur Village Development committee has been facing energy problems such as raising the prices of fossil the forest resources. In the context of Mukundapur village development committee, Solar, Wind and Water energy have not been fully utilized. Mukundapur VDC energy consumption pattern is consumption of fuel wood Kerosene and Electricity which one very costly.

So far the Kerosene is concerned the villagers must depend upon the retailer shopkeeper of local market and Narayangarh Bazaar and the dealer's of Nepal Oil Corporation. The supply of Kerosene also is irregular. They are the main sources of kerosene supply to the villagers. Sometime international obstacles cut off the supply of Kerosene, and many times the dealer of N.O.C and retailer shopkeeper of Local Market and Narayangarh Bazaar make artificial scarcity of kerosene. The villagers often suffer from the shortage of kerosene. When we develop the biogas installation

then the demand of kerosene reduces and money may be saved then we push balance of payment (BOP) upward so the alternative choice of energy is only biogas.

The people of Mukundapur Namuna VDC depend upon Kerosene, cow dung cakes and fuelwood for cooking purposes. These villagers lose many times to collect fuelwood and to make dung cakes. This is big problem of Mukundapur VDC. Electrification in Mukundapur VDC has become effective, but it is very costly.

The agriculture of Mukundapur VDC face the fertilizer problem to increase the productivity by which we may increase the standard of living of farmer. Hence, we can say that biogas installation is one of the most appropriate substitutions for other energy sources. It needs raw materials such as animal dung, human wastes, agricultural residue etc. Such kinds of raw materials are easily found many family of Mukundapur VDC and the generated biogas reduces the demand of kerosene, fuelwood and dung cakes. Slurry is the source of better fertilizer hence it cuts the use of chemical fertilizer.

Deforestation, Smoke Kitchen, Dirty House and Surrounding Area .

Photo No.4

The Mukundapur Village Development Committee areas cow's and buffalo's dung is burnt to generate energy. Such burnt dung as domestic cooking fuel ensure a loss of nitrogen, phosphorus and potassium, which otherwise could be used as an effective fertilizer. We can use slurry in our field, which is one kind of organic fertilizer. For the cultivation purpose, after taking energy as benefit from the simple yard manure, this is also more beneficial to raise agricultural production. Thus once the biogas plant is built is not only gives the energy for the fuel purpose but instead wastages can be used as an effective fertilizer and it reforms the structure of soil. Biogas plant is also possible for lighting purpose in the Mukundapur VDC.

Like any above problem family of Mukundapur VDC is also suffering from problem of dirty house and surrounding area from Gobar, dirty kitchen from residue and dung cakes eye disease especially to the house wives from smoke of firewood and eye disease of the children.

In the view of above reasons, it was felt necessary to conduct a feasibility study of biogas plant in this village development committee. It is believed that if the plants turn out to be feasible, then this will not only solve the problem of fuel in this village but will also help to provide fertilizers for their land and thus increase the productivity and other problems of VDC and will prove this study as a model study.

1.3 Scope and Limitation of the Study

Gobar gas plants are not installed in various parts of the Nawalparasi Districts, but the study sees feasibility of biogas plants in Mukundapur VDC.

This study will focus on the various aspects of Gobar gas plants. Generally we are going to deal feasibility of Gobar gas plants in that VDC. However, we will concentrate our study on the economic aspects only.

This study aims at the feasibility study of biogas plant. Mukundapur Village Development Committee. It was choose as a model area. Mukundapur Village Development Committee is one, among 73 VDC's in Nawalparasi. It is in south east Nawalparasi having surrounded by “Ganidakot VDC” in east Amarapuri VDC in west its population is 10439 & with 1803 household as a whole in this VDC. [Population Census 2001]

This study was limited mainly due to time constraints. This project report covers only those aspects that were possible within this time. The availability or publications regarding Gobar gas plants were limited.

This sort of study on the VDC was of its first nature. As observed by the researcher the following were the limitations underlying the study.

- The feasibility study is mainly based on three major factors livestock holding, size of the family and size of land holding.
- The data collections of primary nature, random sapling method were adopted.
- Cost benefit analysis has not been considered.

1.4 Significance of the Study

The most urgent problem faced by the people is the shortage of fuel and for farmers fuel and fertilizers. Firewood is day by day becoming scarce as well as costly. Kerosene and other source of fuel can neither be made available in required quantity in various parts of the country nor could easily be transported. In view of this reality, cattle dung can be widely used as the conventional source of energy.

Gober gas is the viable alternative by means of which more energy could be extracted for fuel and at the same time the slurry could be used to maintain the strengthen the land productivity, which is rich of nutrient as compare to dung and it is odorless and attracts no insect which is very useful to the crops because it raises agricultural production. This slurry has the cropping intensity and it save the money because it is the substitution of chemical fertilizer.

Biogas saves the money the money which we divide to buy the kerosene and it also fulfills the necessary of lighting purpose which the people of Mukundapur VDC have to pay higher bill to the electricity office. These saving money villagers may use to reform their agriculture sector i.e. to raise the infrastructure of agriculture.

Biogas checks the deforestation then the villagers use produced timber for other purposes. Forest do not only give the villagers timber but raw materials for the paper factory and herb factory and by the dirt leaves the villagers may make compost fertilizer, then we can easily raise employment opportunities in these factories and by the compost fertilizer we may raise our products. The indirect benefits of forest preservation are checking the fold, landslides and raising the sources of water. By sufficient water, using it for the irrigation so we may increase the agriculture production.

This study gives the priority to the livestock, the dung we use in the biogas plants but other meat, milk etc, which are rich source of protein, form this farmers earn a lot of money. By the livestock the villagers can use marginal agricultural land to make it more productive and economically efficient.

By the substitution of petroleum fuel by biogas, such kind of biogas programme are expected to play a significance role in future to the balance to payment (BOP) deficit through reducing the import of petroleum energy.

Clean House and Surrounding area After Installation of Biogas Plant

Photo No. 5

The other economic significance of it is when the villagers extend the biogas programmes it creates extent the biogas programmes it creates employment opportunities in the process of installation, then even if small size the villagers can remove the poverty of those people who are engage in installation process.

Biogas saves time in comparing the cooking process, fuel wood collection and washing of cooked and food taken utensils, these saving time if the villagers spend in other money earning Sectors in the village areas i.e. in small scale cottage industry then the villagers earn the money.

Clean Kitchen & Wonderful Housewives
After Installation of Biogas Plant
Photo No. 6

The advantage of biogas plant have gone to the cook of the household, who works in the kitchen. Due to its smokeless nature they are prevented from so many diseases then their medicine bill may be very low comparing to the previous condition where there was no biogas plants. When people are healthy they may work more and they earn more money.

The biogas plants could give double benefits one is energy and second is slurry. The user could save money what he/she may spend for the energy. Even if when mix the toilet in the biogas digester it gives more gas comparing to the dung mix condition then economically form the less costly raw materials.

1.5 Objective of the Study

The general objective of this study is to acquire the possibility of installing Gobar gas plant as an alternative source of energy in Mukundapur Village Development Committee. The specific objectives are as follows:

- To study the livestock ownership by the villager in the VDC with a view to estimate the availability cow dong for plant.
- To study the family size for capacity of plant.
- To study the land holding for collateral if necessary.

1.6 Methodology

In order to meet the objective of the feasibility study of Biogas plant in Mukundapur village development committee, the exploratory design has been used. Both primary and secondary data / information were used in this study, but its research is heavily based on primary data. The methods followed to prepare this project report are given below.

Design of the study

The research design applied in this study the “Exploratory study approach”. It is chosen here for feasibility of biogas plants. This feasibility study of biogas plant in Mukundapur Village Development is based mainly on livestock holding, land holding and size of the family of the people. The data regarding these factors are based on the farmer’s response to a set of questions. The responses are to analyze to know the actual feasibility of biogas plant as an alternative source of energy. So the study because attempt is being mad to explore certain facts. But in the same time it is meant for action. So the research design followed in this study is action research design based on the field survey.

Nature & Source of Data

This project report almost based on two types of data. The first one is of primary. This primary Data / information were collected from different households of Mukundapur Village Development Committee.

This is secondary data were collected from books published research report, articles, bulletins and other relevant material provided by go vided by governmental and non governmental offices such as ministries, biogas company and other relevant agencies.

Data Collection and Processing Techniques

This study was based on the primary data. A little secondary data were used. For the data of primary nature the researcher concentrated mainly on the household of Mukundapur VDC, for which questionnaire and observation the method for data collection were as prime instrument.

The questionnaire forms were not distributed rather were asked individually of the sampled families of the population. The research did not follow the method of sending questionnaires rather they were individually asked about feasibility of biogas plant. In course of data collection the researcher found the most of the respondents were not aware of importance of biogas plant rather they were thinking it as a luxurious matter

which can be used only by the people of rich family. When they were explained about its purpose, they highly took interest in it.

Data Analysis Tools

Available data/information had been collected, complied and analyzed by means of simple statistical tools like average and percentages. The results also presented in bar diagram and in tabular form where it is needed.

Determination of Population & Sample Size

The population of the study is Mukundapur Village Development Committee in the district of Nawalparasi. Basically, it considers the number of ward units and next is of household in those wards. All the nine wards of this VDC are taken as the population. For the purpose of the study sampling of the households from each of these nine wards have been taken with a total population of 1803 households altogether while taking the sample it was really not possible to take the representative sample in view of the possible requirement of time and of course money. Therefore, the samples were taken randomly. The total household of this village development committee are 1803 among them 25% - 30% of household were taken sample from each ward by random sampling method. The households and sampled households in each ward of the VDC is shown in the table given below.

Table 11

The Households and Sampled Households in Each Ward of the VDC

Ward No.	Total Households	Sampled Families	Percent (%)
1	216	60	27.78
2	214	56	26.16
3	181	49	27.07
4	182	46	25.27
5	269	70	26.02
6	221	62	28.05

7	233	60	25.75
8	176	52	29.54
9	111	30	27.02
Total	**1803**	**485**	**26.89**

Source: - Field Survey, 2061B.S.

As indicated by the table, among 1803 families 216 families are in ward no. 1, of which 60 families representing 27.78% of the total sampled families were taken as a sample for this study. So is the case in ward no. 2 where 56 families out of 214 representing 26.16% of the total sampled families were taken as a sample.

Likewise ward no. 3, 4, 5, 6, 7, 8 and 9 which contain 181, 182, 269, 221, 233, 176 and 111 households respectively sample in these wards were taken as 27.07%, 25.27%, 26.02%, 28.05%, 25.75%, 29.54% and 27.02 respectively in respect to the households contain.

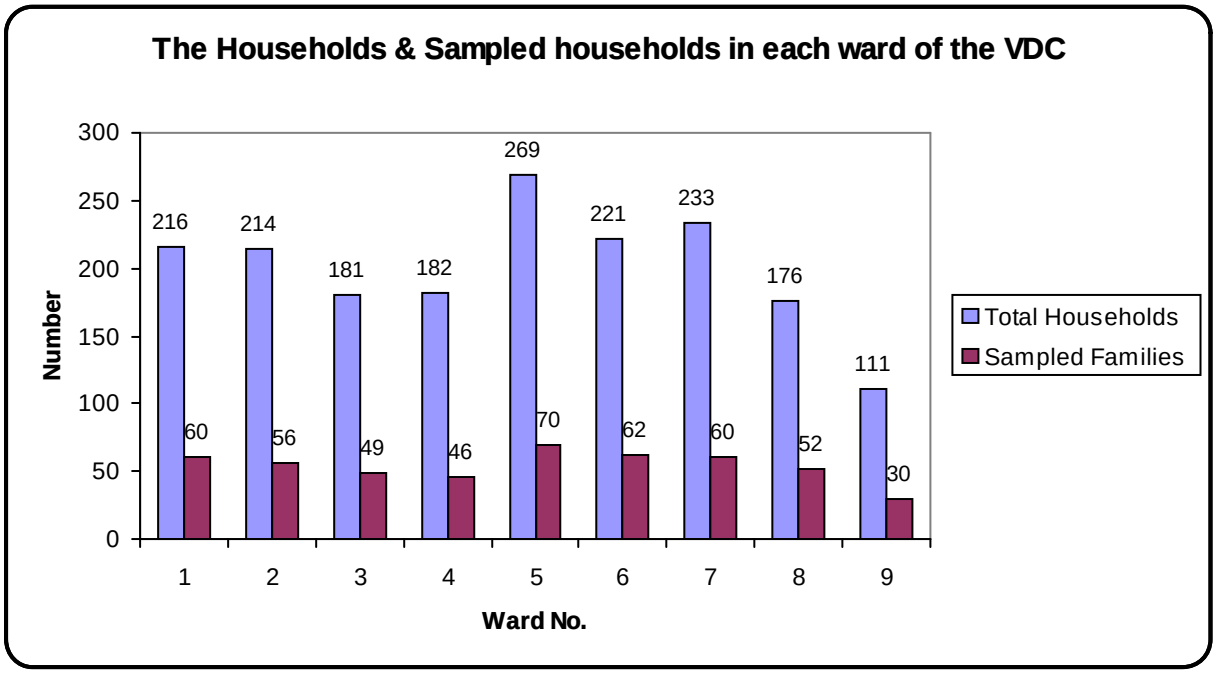


Figure No. 3

1.7 Review of the Literature

Even in decreasing condition fruit garden and others trees are natural resources to provide woods for different purposes to the villagers. However, woods are mainly used for cooking purpose. Among different public offices such as police office, post

office livestock service center, Health post, also two secondary schools and 5 primary schools are in Mukundapur VDC. The total population of this VDC is 10439, among them 5358 are male and 5081 are females, (population of Nepal, Population census 2001).

The farmers of this VDC keep animals and fowls for different purpose. As they keep cows and buffaloes for milk he buffaloes he goats, pigs for meat; goats for meat oxen to plough land and fowls, ducks for meat and eggs.

The number of household in this VDC is 1803. Among them 953 household have both land and livestock and 150 household have livestock only (population of Nepal, population census 2001).

Potentiality of biogas in Mukundapur VDC is very high because of 953 household have both land and livestock. The main source of energy, which the villagers using, fuel wood and cow dung for cooking and kerosene for lighting. Use of fire wood results in deforestation and use of dung burns valuable fertilizer. These problems can be overcome by installing a biogas plant in Mukundapur VDC. Agriculture is dominated by a mixed farming system in which crop and livestock husbandries are combined. This necessitates that many household maintain a few animals.

Like any other villages this Mukundapur village is also suffering from problem of energy for consumption purposes. 20 years ago, this VDC was very rich in fuel wood. This VDC's areas were almost covered with dense fruit garden and forest (others trees), but because of rapid cutting of land by Narayani river and deforestation, now a days, many trees are not available in this VDC. So the villagers are suffering from the problem of the fuel wood for consumption.

So far as kerosene is concerned the villagers must depend upon the retailer shopkeeper of local market and the dealer's of Nepal Oil Corporation. The supply of kerosene also is irregular. They are the main sources of kerosene supply to the times the dealer of

NOC and retailer shopkeeper of local market make artificial scarcity of kerosene. The villagers often suffer from the shortage of kerosene.

The people of Mukundapur VDC depend upon cow dung cakes and fuel wood for cooking proposes. These villagers lose many times to collect wood fuel and to make dung cakes. This is a big problem of Mukundapur VDC.

Electrification in Mukundapur VDC has become effective but it is very costly. There is not any probability of cheap electrification in this VDC up to now.

Almost every country of the world is suffering by one or other sort of economic or political crisis of energy, which has regarded as both economic and political problems, has posed a serious challenge for the stability and prosperity of many developed and under developed countries.

With the increase of population and demands of development efforts energy as economic problem has come to appear in Nepal as well. The population pressure has emanated. The need for higher supply of energy as consumption has increase both quantitatively and qualitatively. Similarly, the attempt of mechanization and establishment of industries have multiplied the already existing high demands of energy.

In our country, the available means of providing energy are traditional (fuel wood, agric residue, animal waste and commercial coal petro – products, electricity) structure of energy consumption (2001) are given below: -

Traditional	**In thousand of oil equivalent**
Fuel wood	6068
Agric residue	299
Animal waste	457
Commercial	
Coal	246
Petrol – products	734

Electricity	108
	7912

Source: (CBS 2002)

From the above data it becomes clear that the people in Nepal consume 76.64% from firewood, even today the villager use the fuel indiscriminately which has become the prime factor of deforestation, land slide and land erosion etc. one of the important means of energy which is widely used in villagers is the use of cow dung as fire wood. Due to the shortage of their sources of energy. The people are making wide use if the cow dung for cooking purposes by using it as fertilizers. One of the important technological an improvement that has proved to be of great benefit to solve energy problem in rural area is the installation of biogas plant.

The production of Gobar-gas is simply a digestion process breaking own cow – manure. Bacteria break down the organic matter into methane gas and carbon – dioxide leaves residue of organic matter and water.

In other words, biogas is the mixture of gas produced by methanogenic bacteria while acting upon biodegradable materials in an anaerobic condition. It is mainly composed of 60 – 70 percent methane, 30 – 40 percent carbon dioxide and some other gases. It is about 20 percent lighter then air. It is an odorless gas that burns with clear blue flame similar to that of L.P.G. gas. (Biogas Nepal 2002)

Gobar gas is mainly for farmers. Because the farmers, on the one hand, have livestock in abundant number, on the other hand, they centralize their activities on agriculture. So, cow manure is used as fertilizer. If the farmers establish Gobar gas plant, they need not other for energy for cooking and lighting purpose. More over, the digested slurry also can be used as very good manure. So it becomes a better source after the process of digestion both fuel and fertilizer purpose.

Generally, a Gobar gas plant has four parts: digester, dome, outlet and inlet. The outlet part is connected with a couple of compost pits. (Gramin Pravidhi Ek Sangalo) it has manhole, turret, gas pipe burner, agitator and gas lamp.

In this plant, the mixture of Gobar and water is near about equal (1:1 ratio), the Gobar and water is poured by inlet to the digester pit and the slurry through digestion process and with the help of bacteria, is broken down into gas and residue. The gas is collected to dome and the residual liquid, due to the repetitive feeding to the digester pit, is thrown out though compost pit (Bio Gas Nepal 2002)

Karki (2034) provides ad overview of historical development of biogas technology, it includes that so far, the history of biogas is concerned there is controversy about its establishment. After 2nd world war there was high energy crisis in German due to the insufficiency wood, coal, and petro-prodect. Alternative source of energy they adopted Gobar gas plant which run with cow dung. But German had adopted gas plant even earlier of 2nd world war. So they should be the inventor of Gobar gas. In India, first of all Dr. S.V. Desai, published successful research on Gobar gas in 1939. in 1950 Jashu Bhai Patel improved in the design made by Dr. Desai for easy handling by villagers and was named as “Gram Laxmi”. After that he again designed gas plant and was named “Gram Laxmi Doshro”. In the year 1953 Mr. Patel mixed the both design and prepared other design which after all was named it as “Gram Laxmi Teshro”.

Rajat Mahostsav Bisheshankar Smarika (2058) provides as overview on development of biogas in Nepalese context that biogas technology was first pioneered in mid – 1950s father B.R. Saudbolle, a Belgian teacher at Godavari St. Xavier’s School. He constructed a micro model digester out of an oil drum. Thereafter, some groups, through their own initiative built a few biogas plants in Kathmandu.

Genuine interest in biogas development came during the energy crisis in 1973. Due to the crisis “energy research and development group” was established under Tribhuvan University in 1975. Biogas received further impetus during the agriculture year

(1974/75) with a subsidized loan from the Agricultural Development Bank of Nepal (ADB/N). As many as 199 biogas plants were built by private contractors under the supervision of the Department of Agriculture. The design of biogas plants, which are composed of floating steel drums for storage, was directly transferred from India. Some private contractors and development consulting services of the United Mission to Nepal popularized the plant at that time.

Due to the rapid growth of population and depletion of national resources of energy and unsolved problem in supplying the energy is created. To reduce the burden over the forest for energy, Gobar Gas Tatha Kriskhi Yantra Vikas (P.) Ltd., popularly known as the "Gober Gas Company" (GCC) was established in 1977 as a specialized company with the joint venture of Agricultural Development Bank of Nepal (ADB/N). Nepal Fuel Corporation [presently named as Timber Corporation of Nepal (TCN)] and the United Mission to Nepal (UMN).

Like "Gobar Gas Company", another biogas related institution (Bio-gas support programme) was established in July 1992. Biogas support programme (SNV/BSP) created with support from the Netherlands Development Organization (SNV – Nepal) has been the principle donor that has been involved in the promotion of biogas programme since 1992. The first and second phase of BSP programme (1992 to 1997) was successfully completed by the construction of 20,200 plants against a target of 20,000 plants construction. The overall objective of the third phase of BSP programme (1998 to 2002) was to further develop and disseminate biogas as indigenous, sustainable sources of energy in rural areas of Nepal. The BSP's third phase programme aimed to construct additional 1,00,000 biogas plants in Nepal.

Gobar Gas Tatha Krishi Yantra Vikas (p.) Ltd. (2058) provides an overview on different mechanism of biogas plant that:

Table 12

Different Mechanism for Biogas Plants

Capacity of Gobar Gas Plant (cu.m.)	Dung needed initially (k.g)	Daily needed Dung (k.g.)		Per day needed water		Gobar Gas Lamp	Gobar Gas Stove (16cu.m)	Construction Period (day)	No of Cattle	No of Family
		Hill	Terai	Hill	Tarai					
4	1450	24	30	24	30	0	1	8	2-3	3-4
6	2200	36	45	36	45	1	1	8	3-4	4-6
8	2900	48	60	48	60	1	1	11	4-6	6-7
10	3500	60	75	60	75	1	2	11	6-9	7-8
15	5500	90	110	90	110	2	2	13	9-14	9-12
20	7200	120	150	120	150	3	2	15	14 or above	12-18

Source: - Fiscal Year 058/059 ma Gobar Gas Plant Nirman Garne Mulyasuchi.

Biogas Support Programme (Brochure) provides an overview on advantages to biogas plants that fuel energy for cooking, fuel energy for lighting, improvement of living conditions inside and outside the house, high quality natural fertilizer prepared, time and expenditure saved, labor intensive work reduced, deforestation reduced and improvement in house wives' health and also provides an overview on installing a biogas plant that contact a biogas company in close vicinity, contact a local plant, place dung and water in preparation on a regular basis after the plant is installed etc.

"Rajat Mahotsav Bisheshank Smarika" (2058) provided the views of and development of biogas technology in Nepal. It includes biogas plant design (a) floating drum design: The floating steel drum design has formed that basis of KVIC programme in India since 1950s. In this design, slurry is kept in a cylindrical pit in the ground. The pit is usually lined which floats in the slurry. (b) Fixed dome design: it is the basic design used in China. It is an under ground digester pit, lined with brick and concrete, with a dome shaped cover, made with brick or concrete. This design is used in Nepal

and other design are tunnel design, floating HDPE drum design fibrocement gas holder, plastic bag bio-digester mud dome, brick mortal dome.

Biogas Nepal (2002) provides an overview on potential of biogas in Nepal. That Nepal is agricultural country, livestock plays an important role in the Nepalese farming system. The total cattle and buffalo population in Nepal was estimated to be 9.3 million (i.e. 6.3 million) cattle and 3.0 million buffalo) in 1990/91. Based upon the study of technical biogas potential of Nepal. It is assumed that a total of 28.1 million ton of dung would be available per day for biogas production. This indicates that there is a high potential of biogas production in Nepal as a whole. The potential number of biogas plants in Nepal is estimated to be about 1.3 million out of which 62% in plans, 37% in hills and rest 1% falls in mountain region. Potentiality & biogas production.

- Total technical potential-1.4 million plants (1992)
- Total economic potential- 60,00,000 plants
- Total production upto 2002-95,400 plants (under BSP)

And this book also provides expected benefit from BSP III. That reduction of work load of 90,000 households, annual savings of approximately 170,000 ton of fuel wood, 72,000 tons of agricultural waste, 40,000 tons of dung cake, 4.5 million liters kerosene, annual reduction of CO2 emission of 250,000 tons, saving on NPK and organic matter, available to sustain soil fertility, improvement of health by attachment and use of 60,000 toilets, reducing in door population and smoke and generation of employment to max 10,500 person years.

Gobar Gas TAtha Krishi Yantra Vikas (P) Ltd. (2001) “Profile” provides an overview on biogas plants and its use that use of biogas for cooking, lighting, running engines, electricity generation, refrigeration, use of slurry for fertilizer, feeding fish and animals and mushroom culture.

K.B. Kunwar (1994) provides an overview on “biogas and credit supply in Nepal. It’s also includes that there are 7 million cows, 4.2 million buffalos through the country. Assuming that animal could excrete 4 to 10 kg dung every day and the dung of four

animals is sufficient to produce gas for average family in 19 Terai districts and 18 hills district and 162479 and 60368 plants could be installed respectively. Despite having enormous potentiality and necessity, only 4943 plants in hills and 8908 plants in Terai have been set up until now.

Chawal O.P (1985) provides an overview on various use of biogas that the possible uses of gas. Comes under three broad categories; fuel or heating purpose, light and power, that is as fuel for engines. Fuel in the most direct age of gas in our country and in face it is the most efficient means of utilizing the energy in the gas. The fuel efficiency of dung is 11 percent and that of biogas form the same dung is 60 percent. Various estimates have been given regarding the requirement of gas per head in our rural areas. These are generally theoretical calculations. It is roughly 2.5 m to 3.8 m per head per day depending upon the economic condition of the farmer. Normally 93 m^3 capacity unit is considered sufficient to meet the fuel and lighting needs of a family of 85-6 members. Because of various socio-economic disparities, it is different to drow a hard line. As already mentioned efficient burners and gas lamps have been developed for this purpose, for varying requirements. The gas can be used in poultry industry also.

Petro, powerine and kerosene oil engines have been converted and successfully run on biogas by KVIC, PRAD and IARI. In case of diesel engines, using a biogas to diesel fuel ratio of 85:15, the conversion process has been perfected by KVIC. Presently, some engineering firms have started manufacturing biogas converted engines, which automatically switches on to alternatives fuel on which it is based, in case the supply of biogas is excirausted. A one HP engine consumes about 0.45 m^3 in one hours. The Tulsi Shyam Temple at Gujarat has been using 85m^3 gas unit based on 300 cattle to run an engine that drives a water pump and a flour mill, in addition to generation 7.5 KVA of power for 4 hours at night. The plants is working since 1966 and was installed by KVIC. The desirability of utilizing biogas for power on the farm is an apparent choice in view of the high usage of energy for his purpose and also use biogas slurry.

Dilip Adhikari (1991) and also Devkota, G.P. (1994) discusses with biogas batteries. According to his experiment, we may generate electricity from the digested slurry. From it we may generate 3 to 12 voltages electricity. This electricity can be used to lighting purposes as well as to run TV, radio and cassette player. These batteries can be used easily in our houses to the necessary functions. To produce electricity we should attach a drum size battery on the outlet part of a plant. In this battery there should be vacuum rooms in each raws. In this vacuum rooms we have to replace +ve and –ve plates. According to him form a 10 cu.m. biogas plants, if we generate electricity and if it is used for the lighting purposes and if we use generated gas for the only cooking purposes, this plant serves as equal to a 15 cu.m. plant.

Devkota, G.P. (2001) "Biogas Technology in Nepal. A sustainable source of Energy for rural people" provides an overview on the development and dissemination of biogas technology, its various alternative feedstock were fed inside the digester and were limited in research and reports. However, the following alternative feedstocks were tested and experimented rice straw, water hyacinth, banmara, (Eupatorium species) and industrial waste. It includes; Building biogas digester on a long scale would become a practical approach to improving the environment pollution in the respective area. In Nepal, the wastes form the industries such as Bhrikuti Paper Factory in Nawalparasi district, Gorakh Kali Rubber Industry in Gorkha district, and the sugar mills, and distilleries at various places were used for producing biogas. These industrial wastes were tested and experimented in the laboratory at the R & D unit of GGC at Butwal. As a result, a 10 cubic meter plants was installed at Lalbandi running with the waste form a local distillery. Similarly, urban sewerage can also be used for producting biogas. A 20 cu.m. plant was installed in Nepalgunj municipality in the western, form the municipality.

R.K. Pokharel and R.P. Yadav (1991) have discussed the problems and prospects of biogas in Nepal on the following ground:

- The government does not have a consistent policy for the promotion of biogas to meet energy needs. This reflected nature of its subsidy policy. Therefore, it is now high time that the government made a firm policy commitment in this area, in particular, and towards the development of renewable energy resources in general.
- There is no specific department of ministry responsible for promoting the development of renewable energy resources. At present, several departments and ministries are engaged in promoting different energy technologies but their efforts are not coordinated rendering it hard to identify one in tuition to plan and implement renewable energy policies. Since activities are uncoordinated and isolated, there is no systematic future plan or direction. It is important to make a specific department in the government responsible for the development of renewable energy resource.
- The initial installation cost of existing biogas designs is high and beyond the reach of the majority of rural families in Nepal. Research into more cost-effective designs is essential if biogas is to be accessible for poor households as well.
- Low gas production during the winter months, particularly in the colder hilly region, has been a constraint to the promotion of biogas in the hills and mountains. Research is needed into methods of maintaining higher temperatures in the digester pit, so that optimum gas production can be ensured throughout the year.
- There is very little publicity, particularly of the audio-visual king, and a better extension and dissemination programme is essential.
- Construction materials such as cement, GI pipes, biogas lamps and other appliances are unavailable in some parts of the country. They are also difficult to transport to the remote hilly areas. Transportation subsidies will be necessary if biogas plant installation in inaccessible areas is to be promoted. Here again, a definite government policy is needed to assess the amount of subsidy required.

- Community biogas plant construction has not been successful in many places, but why it failed is unknown. Can such community biogas plants be promoted to enable poor householders, who cannot afford and maintain a small plant to derive the benefit.
- The ADB/N has already taken a lead in the promotion of biogas. Other commercial banks should be encouraged to participate in the promotion of renewable energy resources.

Non Conventional Energy (Jan. –Feb. 2000) provides an overview on biogas generated from kitchen wastes. This topic describe about Bharat Electrical Limited (BEL) of India. That has installed a biomethantion plant. Which is fueled by waste generated at the company canteen kitchens. Large quantities of sold waste e.g. cooked unused food, vegetable and fruit peelings, etc. is generated form these kitchens, which serve break fast and meals for 12,000 people every day. The biomethanation plant has two bio-reactors, each with a capacity of 60 m^3. about 400 kg/day of solid waste is fed into each reactor which yield 58.8 kg equivalent. The gas is used as fuel to cook in the kitchens. Gobar Gas Ek Jankari and also Navikaraniya Urja Anaudan Byabstha (2057) provides an overview on facilities of biogas plants that after installed biogas plants, HMG/N provides subsidy on the basis of location, and plants size. The subsidy is being provides subsidy on the basis of location, and plants size. The subside is being provides to family sized plant under this programme.

Table 13

Subsidy on the Basis of Location and Plant Size

Particulars	4 & 6 Cu.m	8 & 10 cu. m
All municipalities of the Kathmandu Valley, Heatauda Municipality, All districts of Terai decided by (HMG/N) Dang & Chitwan districts	Rs. 6,500	Rs. 5,500
VDCs out of Kathmandu Valley Municipalities, Hilly districts, Sindhuli, Udaypur, Makwanpur excluding (Hetauda Municipality as decided by MHG)	Rs. 9,500	Rs. 8,500
Excluding dang & Chitwan district and the districts headquaters connected by road and districts not connected by road up to 2053/4/1 which are Terahthum Sankhuwshbha,	Rs. 11,500	Rs. 10,500

Bhojpur, Solukhumbu, Okhaldhunga, Khotang, Ramechhap, Manang, Dailekh, jajarkot, Rolpa, Jumla, Kalikot, Mugu, Humala, Bajura, Bhajang, Accham, Darchula		

Baikalpik Urja Pravidhika Samkshipta Jankari (AFPC) provides an overview on cost of biogas plants under this following table.

Table No. 14

Plant Cost of Terai and Hill Region

Region	**Plants Cost & Size**			
	4 cu.m.	6 cu.m.	8 cu.m.	10 cu.m.
Terai	Rs. 20,000	Rs. 23,500	Rs. 27,000	30,500
Hill	Rs. 20,500	Rs. 23,700	Rs. 27,700	Rs. 31,500

Abstracts of biogas related publication (1992-2002) provides an overview of feasibility of biogas plant in Nepal that the number of household with cattle and or buffalos in Nepal in 1992 was estimated to 2.3 million installation of biogas plants was considered technically feasible for 69 percent of those households. This implies a technical potential for biogas of 1.5 million plants. At the end of 1990/91, about 0.4 percent potential for biogas of was tapped. The average size of the potential biogas plant was found to be between 6 and 8m^3.

Laxmi Tamrakar (Oct. 1997) a student of Humanities and social science, Tribhuvan University conducted an impact studies of Pharping village Development committee namely "Impact of Biogas in Pharping Village Development Committee of Kathmandu District, Nepal" provides an overview on slurry and its use that in most developing countries chemical fertilizers has to be imported from abroad. It is costly and its continuous application without the addition of organic manure is detrimental to the physical properties of soil. In view of this, the use of slurry from biogas plant is more worthy. Some plant owners used biogas slurry. In liquid form directly to the field more than half of the plant owners are using it as compost in order to make good compost, slurry is made to flow from the outlet directly into the compost pit and the organic materials are mixed for decomposition. After few weeks, the compost is ready

to be used as fertilizer. Mr. Rabi Raj Panta (Sep. 1978) a student of Humanities and Social Science, Tribhuvan University conducted a case study of Anandaban Village Panchayat namely “significance of biogas plant in Nepales Economy”. The performance and problem of Gobar Gas plants in the Panchayat. For the collection of primary data regarding the existing situation and performances of the plant owner in the Panchayat, the researcher adopted the questionnaire and interview technique. The case study found it out that the technology of biogas plant in new to Nepal and farmers in large are innocent of it. It is advertising agencies are concentrating only on few parts of the nation and material supply agents are few in number. There have retarded the development of the Biogas plant. The study viewed that since rural masses are getting fuel wood either without cost or in a cheap price the popularity of the plants is not so much spreading in the VDC as it ought to be. Even the interest free loan could not attract the rural people to be engaged. Another important finding of the case study is that most of the farmers are below subsistence level where holdings of land in less than one hectare. In such stage their property either insufficient to offer as a security for the loan taking or they have already offered their property as a security to the credit providing agency at the time they had secured credit for other agriculture purposes in the past. Finally, the case study concluded that lack of demonstration plant is one of the major factors hampering in the establishment of biogas plant in the VDC.

Survey of users of Biogas plants in Nepal (July, 1995) provides an overview of biogas plant and financial aspects that there are 19 percent of marginal farmers owning the biogas plants and 55 percent of the sample households belong to medium and large farmers. The average size of the operational land holding of the sampled households is 1.75 hectares. Average number of livestock among the sample is 5.69 per household.

Dung is the main feeding material for the biogas plants. In addition, about one third of the users were found to be using the human excreta by attaching their latrines to the biogas plant.

To make the biogas affordable for the rural Nepalese people, the government provided financial support in the form of loan and subsidy. Form 1991/92, the government started to give subsidy at the rate of Rs. 7,000 (for Terai) and Rs. 10,000 (for hill) to the people willing to install a biogas plant. Furthermore, there is a provision for loan, presently government loan and subsidy are channeled through Agricultural Development Bank of Nepal (ADB/N).

Of all the plant owners, 73 percent have acquired loan from ADB/N to install biogas plant, 8 percent have taken assistance from the International plan and 19 percent did not take any loan. Most of the owners have positive attitudes toward ADB/N regarding the loan transaction. For most of owners, the loan sanction period ranges from 2-15 days.

Most of the plant owners seemed well off by rural Nepalese standards as characterized by large to medium land holdings. The socio-economic indicators such as a average land holding. (1.26 ha), livestock ownership (4.81 no), literacy level (77%) and income from secondary sources other than agriculture further show that the plant owners come from richer sector of the society. 53 percent of the users told that they would have taken loans from the bank (64% from ADB/N, 4% form RBB) to install their plants and the others constructed it on cash. It has been reported that repayment of biogas loan has a good record and biogas loan have performed well. The average percentage overdue on outstanding loan, for the period 1988/89 to 1993/94 was about 12 percent for biogas loan against 35 to 40 percent of all loans as reported by the MIS division of the ADB/N. the present user survey also has found that about 10% of the plant owners have repaid all the bank loans and only about 14 percent were having due payment. The remaining percent were paying on time. Loan repayment is not difficult for 67 percent. The performance of banks was told to good in sanctioning loan and it also provides about environment impact of biogas that biogas help in the reduction of CO2 emission Installation of biogas has helped in protecting. The environment of checking forest depletion. It has been estimated that the sampled 100

plants have helped in saving approximately 3.2 hectares of forest-calculated based on gas consumption.

A study on the effective demand for biogas in Nepal (june 1998) provides an overview about biogas plant. The main objective of this study is to define an accurate effective demand for short, medium and long term for biogas installations and to know the socio economic variables that influence the potential demand for biogas plants and an effective promotional and marketing strategy with view to develop its market. In this study three districts namely kavrepalanchowk, Gulmi and Saptari were surveyed as suggested by the term of references of the consultant. Three sets of questionnaires were designed. Focus Group Discussion (FGDs) were held in surveyed VDCs to obtain information as regards to demand and supply situation of biogas plants, image of technology concerned and status and satisfaction of after-sale-services of companies. The average family size of 6 was common to all surveyed households except in Kavre and Gulmi where the average family size was of 7 persons.

Majority of the sample had agriculture as their main occupation (62%), while the servicemen, businessmen and professionals consisted of 26.6 percent. The most common plants that were installed were to sizes 4-10m^3, which constituted about 84 percent of the total plants installed.

The total cultivated land of households was taken as proxy to economic status. The total cultivated land were grouped into households cultivating less than 10 Ropani of land (defined as marginal farmers), 10 to <20 Ropani (defined small farmers), 20 to <60 Ropani, as medium farmers and finally farmers holding more than 60 ropani were defined as large farmers. The land cultivated showed a positive relationship with the demand for biogas the proportions of households installing biogas plants increased with the increase in the amount of land. Only 7 percent of the marginal farmers had installed plants compared to 16 percent medium formers and 25.9 percent for large farmers and 58 percent of marginal farmers had installed 4 to 6 m^3 plants and 57 percent of large farmers have installed 10+m^3 plants.

Biogas users survey, 1998/99 (April 1999) provides an overview about role of subsidy, Bank loan and repayment for biogas plant. The principal objectives of this studies is directed towards evaluation the effect of biogas on users of plants through a survey of altogether 100 biogas households covering 11 districts of Nepal, farmers for interview were selected by applying the method of systematic random sampling. During the field visit, information were collected by administrating the structured questionnaire to 100 sampled farmers. The enumerators were also instructed to record the special observations and remarks if any, in their field diary. The 11 districts choosen for biogas user's survey 1998/99 in the three ecological zones of Nepal viz, Terai, hills and remote hills, were Kanchanpur, Banke, Rupandehi, Rautahat, Salyan, Parbat, Palpa, Udayapur, Dhankuta, Ramechhap and Terathum, in Nepal, the three commercial banks namely Agricultural Development of Nepal (ADB/N) Rastriya Banijya Bank (RBB) and Nepal Bank Limited (NBL) have been involved in providing loan for installation of biogas plants. In this study, about 45 percent respondents have expressed their satisfaction in terms of the effective loan sanctions and accessibility to the bank. About 55 percent of the respondents were found expressing their satisfaction towards bank due to timely sanctioning of loan (i.e. 15 days after submission of application). This sort of findings has shown the appreciable role being played by the bank to encourage the farmers to install biogas plant. The subsidy on biogas meets a substantial potion of the construction cist of the plants. That is way biogas installation has been quite attractive to the construction companies as well as to the farmers. The status on loan repayment has been quite encouraging. Amongst the surveyed households, 24 percent expressed that they have repaid all the loan, while the rest 21 percent, 35 percent and 20 percent sid that they have paid the first, second and third installments of the loan respectively.

Biogas users survey 1998/1999 (April 1999) provides an overview about construction of compost pits. Compost pit is an essential requirement of biogas plant for collection of slurry. The availability of compost pit facilitates the protection of slurry from surface flow and sunshine and also assists in the process of decomposition. As per the field observation, the high priority accorded by slurry Extension programme in

digging compost pit according to plant size is being followed by the biogas owners only to some extent. Devpart- Nepal Research study on optional biogas plant size, daily consumption pattern and conventional fuel saving. Final report, BSP (March 2001) provides an overview about family size versus biogas plant capacity. The objectives of his study were (a) to obtain reliable date regarding the actual savings on conventional fuel for an average biogas household in the hills and Terai; (b) to obtain reliable date regarding the replacement value of biogas versus conventional creating fuels; (c) to determine which plant volume is the most efficient (cost effective) given average annual temperature and daily feeding; and (d) to collect accurate data regarding the daily consumption patterns for different family consumption, climatic zones and seasons. Devpari consult Pvt. Ltd. Carried out the study in 80 biogas and 40 non-biogas households for complete one-year cycle in Syanga, Nuwakot, Chitwan and Morang districts. The average family size was 5.85 person per household for biogas households. The average landholding size per family was 21.5 Ropani (1.07 ha) for biogas households and the result of study showed that for a family having four or less members, 4 m^3 capacity plant are enough. In other words smaller sized plant is sufficient to fulfill demands in Terai regions in comparison to those in hilly regions. The biggest size needed is 8m^3 capacity for families having more than 10 members in Chitwan and Nuwakot.

An integrated Environment Impact Assessment (June 2002) provide an overview about impact on energy use and climate change. This study was conceived as on integrated environment impact assessment (IEIA) for BSP phase III (BSP III). The basic objective of the study was to quantify the impacts of BSP III as a result of the installation and use of biogas for cooking and for lighting to a certain extent. A total of 19 districts covering 4 developments regions of the country were chosen for sampling out of the 13 district, 10 districts comprise of hill and 9 of Terai. Around 97 percent of the installed biogas are found in operational. The average biogas plant size in Terai is 7.85m^3 and in case of the hills, it is 6.49m^3, the overall average size being, whereas most of the biogas households (BGHs) in hills have just a single biogas stove per plant. The average biogas lamp per plant is 0.14 for both Terai as well as the hills.

The average quantity of dung available per day per biogas plant (BGP) for Terai and the hills are 41.71 kg and 27.21 kg responsibility, the average being 33.5kg. Majority of total surveyed BGHs feeding per day is 58.87 kg for Terai and 38.94 kg for hills. However, the result if survey show that the feeding percentage in case of Terai and hills is 70.85 percent and 69.88 percent, respectively indicating underfeeding of plants.

Carbon dioxide Emission Reduction at National level. At present 738 million gram equivalent of carbon dioxide emission is being reduced everyday at the national of carbon dioxide emission is being reduced everyday at the national level due to the national level due to the replacement of conventional fuels by the biogas plants once the BSP III targets are achieved, the biogas plants have a potential of saving about 859 million-gram equivalent of carbon dioxide emission per day. Similarly, when all the technically feasible biogas plants will be installed, these plants will lead to the daily saving of 11; 170 million-gram equivalent of carbon dioxide emission.

Biogas users survey 2000/01 (June 2001) provides an overview on financing of biogas households. The principal objective of this study was directed towards evaluating. The effect of biogas on users of plants through a survey of altogether, 100 biogas households covering 10 districts of Nepal. In condition to BSP's and AE PC's previous biogas users survey in this line, this study was initiated by latter organization to monitor the effects of biogas programme on users in the fiscal year 2000/01. Nepal Engineering consultancy Services Centre Ltd. (NEPECON) was entrusted with responsibility to conduct biogas users survey 2000/01 from November 1998 to 31 January 1999. a total of 10 districts (i.e. 5 hill districts and 5 Terai districts) covering five developmental regions of the country were sampled for this study. Three commercial banks namely Agricultural Development Bank (ADB/N), Nepal Bank Limited (NBL), Rastriya Banijya Bank (RBB) are involved in providing the loans to farmers for the construction of biogas plants. 62 percent respondent had installed the plant on bank loan, while 38 percent commissioned it without any loan. 50 percent respondent were of the opinion that it takes a month to sanction loan for biogas installation, while 36 percent said it is sanctioned within half a month rest (14%)

opinioned that 1 to 2 months or even more than 2 months are required for loan sanctioning. About 52 percent of the plant owners have repaid the bank loan, while the rest 48 percent have not done so.

1.8 Organization of the Study

This study has been organized into three chapter the first chapter presents introduction, background, statement of the problem, scope and limitation of the study, significance of the study, objective of the study. It also deals with methodology, reviews the literature and depicts the over all picture of the study.

The second chapter deals with data analysis and major findings, the assessment of the feasibility study of establishment of biogas. In the third chapter, conclusion and recommendation are included.

CHAPTER TWO

DATA ANALYSIS AND MAJOR FINDINGS

2.1 Data Presentation and Analysis

As has been explained in the introduction chapter, the study attempts to confine the feasibility study on establishment on biogas plant in Mukundapur Namuna Village Development Committee specially in light of three major factors livestock holding, family size and land holding size. The number of livestock in primary factor for establishing the gas plant, without having sufficient number of livestock, installation of gas plant is wastage of money and time. The landholding is also equally important. The economic condition of farmers in general are not that much capable to afford for the installation of gas plant. Whatever they save, use to meet the need of clothing and other necessary materials. For the installation of biogas plant generally they need external sources in the form of loan. Agriculture Development Bank is making appraisable efforts to meet the need of farmers to some extent. However Agriculture Development Bank is providing loan, it needs certain biogas of land as collateral for loan to be provided.

Despite land holding family size also pays a great role for the installation of gas plant. Higher the family members higher capacity plant is needed provided that the land holding by family is sufficient for higher capacity.

2.2 Wardwise Analysis of Livestock Holding, Land Holding and Family Size.

Table 15
The Number of Livestock Holding, Land Holding and Family Size of Respondents in Ward No. 1

No. of livestock	No. of family	Land holding (in bigahas)				Size of the family						
		Below 1	1-3	3-6	Above 6	Below 3	3-4	4-6	6-7	7-8	9-12	12-18
0-1												
2-3	35		35				8		28			

3-4												
4-6	15		15					10	4			
6-9	10			10						10		
9-14												
Total	**60**		**50**	**10**			**8**	**10**	**32**	**10**		

Source : Field Survey, 2062 B.S.

As shown by the above table, the total number of respondents in word no. 1, in 60. The number of respondent in a range of 0-1, 3-4, 9-14 and 14 or above 14 livestock holding are nil. Out of the total respondent numbers, 35 were found in a range of 2-3 livestock holding these families have got a landholding in a range 1-3 Bigaha. Out of these 35, 8 families have got family size in a range of 3-4 and the other 28 families have got family size in a range of 6-7. the farmer is allowed to establish the plant as prescribed by prime factors together with allied factors, size of the family and livestock holding where as the later is not permitted by size of the family. However, in sampled survey in ward no. 1, 15, at of 60 were found in a range of 4-6 livestock holding. All these families have got a landholding in a range of 1-3 bigaha. Out of these 15, 10 have got family size in a range of 4-6, where as rest 4 have got a family size of 6-7 family members. This analysis makes clear that 10 out of 15 respondent have options to choose 4 cu.m., 6 cu.m. and 8 cu.m. capacity plant. These 10 respondents have sufficient livestock holding and landholding, they are free to select alternative capacity plant. Since their family size permits it to do so.

So also 10 respondent out of 60 were found in a range of 6-9 livestock holding. This families have got a size of family holding in a range of 7-8 family members. Thus, from the view point of quantity of livestock and from the size of landholding this families are permitted to establish in a plant of 10 cu.m. capacity.

To sum up the analysis of the stage of affairs in ward no. 1. out a good prospectus of establishing biogas plants. The number of families, allowed for installation of gas plants by major factors, stand for 60% of the total sampled family respondents in word

no. 1 so one can conclude that there is a feasibility of establishing biogas plant in ward no. 1 from view point of the factors stated above.

Using the same approach as in ward no. 1, even in ward no. 2 has been made to find out the number of families having feasibility for installation biogas plant by making sample survey. The number of respondents their family size, landholding and livestock holding by these respondents are stated by below give table.

Table 16
The Number of Livestock Holding, Land Holding and Family Size of Respondents in Ward No. 2

No. of livestock	No. of family	Land holding (in bogahas)				Size of the family						
		Below 1	1-3	3-6	Above 6	Below 3	3-4	4-6	6-7	7-8	9-12	12-18
0-1												
2-3	17	17					17					
3-4	25		17					25				
4-6	14		9	6					6	9		
6-9												
9-14												
Total	**56**	**17**	**26**	**6**			**17**	**25**	**6**	**9**		

Source : Field Survey, 2062 B.S.

As shown in table, the total number of respondent in ward no. 2 is 56. The number of respondent in a range of 0-1, 6-9, 9-14 and 14 or above 14 livestock holding are nil. Out of these 56 respondents, 17 were found in a range of 2-3 livestock holding, who also have got landholding below one bigaha and family size in a range of 3-4 family members. Since these families have below one bigaha landholding, they are not permitted by the major factors themselves. Further, 25 respondent were found in a range 3-4 livestock holding. These respondents have got a landholding in a range of 1-3 bigaha and have got family size in a range of 4-6 members. Since, the prime factors and allied factors allow all of these family to establish a plant of 6 cu.m. capacity.

So also the 5 respondents were found in a range of 4-6 livestock holding. Out of these 5, 3 have got landholding in a range of 1-3 bigaha, where as 2 have got in a range of 3-6 bigaha. Further, 2 out of 5 have got a family size in a range of 6-7 family members and the rest three have got a family size in range of 7-8 family members. Thus, all the respondents can establish the plant of 8 cu.m. capacity from two allied factors size of the family and landholding.

Summing up all the analysis of the state of affairs in ward no. 2, one can conclude that out of the 56 sampled families 30 families have a good prospectus of establishment of biogas plants. The number of respondents who are satisfied for the establishment of biogas plant stands for 53.57% of the total sampled family respondents in ward no. 2. So there is a feasibility of establishing biogas plant in ward no. 2 from view point of major factors stated above.

Even in ward no. 3, the same sample method was used to find out the families having feasibility of adoption of gas plant in that particular ward. The number of respondent, family size and landholding by these respondents are started by below given table.

Table 17

The Number of Livestock Holding, Land Holding and Family Size of Respondents in Ward no. 3

No. of livestock	No. of family	Land holding (in bogahas)				Size of the family						
		Below 1	1-3	3-6	Above 6	Below 3	3-4	4-6	6-7	7-8	9-12	12-18
0-1												
2-3	12		12				12					
3-4	19		4	12	3			4			14	
4-6	14	10	4						14			
6-9	4			4						4		
Total	49	10	20	16	3		12	4	14	4	14	

Source : Field Survey, 2062 B.S.

As illustrated by table 11, the total respondents in ward no. 3 are 49, among them, 12 were found out in a range of having 2-3 livestocks. This family also have got a landholding in a range of 1-3 bigaha and have got a family size in a range of 3-4 family members. Since these families have sufficient number of livestock, prime factors and feasible family size and landholding as allied factors, have feasibility of establishing the plant of 4 cu.m. capacity.

So also 19 families were found in a range of 3-4 livestock holding. Out of these 19 families 4 have got a landholding in a range of 1-3 bigaha. 5 have got in a range of 3-6 bigaha where as the other 3 has got a landholding above 6 bigaha. So far the family size in concerned these families, 14 families have got family size in a range of 9-12 family members and other others 4 families have got family size in a range of 4-6 family members. The forms is not allowed to establish the plant as prescribed by prime factors together with allied factor, size of the family and livestock holding whereas the latter is permitted by size of the family.

Likewise, 14 families out of 49 families were found the livestock holding in a range of 4-6 livestock. Out of these 14, 10 have got landholding below 1 bigaha where as the other 4 have got in a range of 1-3 bigaha landholding. All of these 14 respondents have a family size in a range of 6-7 family members. However, only 4 families were permitted to establish a plant of 8 cu.m. capacity by two allied factors size of the family and landholding. And the other 4 families are prohibited to install biogas plant due to under holding of land though he is permitted by size of the family.

Finally, 4 out of 49 were found in a range of 6-9 livestock holding. These families have got landholding in a range of 3-6 bigaha and family size 7-8 family members. Thus, from view point of family size and landholding these families have feasibility to establish a plant of 10 cu.m. capacity.

Summing up the analysis of states of affair in ward no. 3, out of the 49 sampled families 26 families have a good prospectus to establish the plants of different capacity. The number of families allowed for installation of gas plant by major factors

stand for 53.06% of the total sampled families respondent in ward no. 3. however one can conclude that there is a feasibility of establishing biogas plant in ward no. 3, as the above stated major factors allow for that.

So far the case of ward no. 4 is concerned, the same technique of random sampling was used to find the feasibility for the installation of biogas plant. The respondent number , family size and landholding by these respondents are stated by below given table.

Table 18
The Number of Livestock Holding, Land Holding and Family Size of Respondents in Ward No. 4

No. of livestock	No. of family	Land holding (in bigahas)				Size of the family						
		Below 1	1-3	3-6	Above 6	Below 3	3-4	4-6	6-7	7-8	9-12	12-18
0-1	31		23	6	5		8	18		3		6
2-3	10	5	3	2		2	8					
3-4	3		3					3				
4-6	2			2				2				
6-9												
Total	46	5	29	10	5	2	16	23		3		6

Source : Field Survey, 2062 B.S.

As shown by the above table, the total number of respondent in ward no. 4. in 46. The number of respondent in a range of 6-9 and above livestock holding is nil. In course of analysis were found in a range of 0-1 livestock holding. Among them 31 families, 23 families have got landholding in a range of 1-3 Bigaha, 6 families have got in a range of 3-6 Bigaha and 5 families have got above 6 Bigaha landholding. Further, in these 31 families, 8 families have got families size in a range of 3-4 family members, 18 have got in range of 4-6 family members 3 families have got in a range of 7-8 family members and 6 families have got in a range of 12-16 family members. Since the livestock holding in a range of 0-1 livestock holding is uneconomical from the construction and operational view point, this rang of livestock holding has not been proved feasibility to these families if this families need to establish the plant of more than that range of livestock holding, the number of livestock do not allow to do so.

So also size families were found in a range of 2-3 livestock holding. Out of these size, 5 have got below I Bigaha landholding 3 have got in a range of 1-3 Bigaha and only 2 has got holding in a range of 3-6 Bigaha. In spite of landholding, all these families have got a family size in a range of 3-4 family members except 2 who has got below 3 family size members. Thus, out of these ten families, only five families have a feasibility of establishing 4 cu.m. biogas plant. So far the case of not three families are concerned, five of these have got landholding below one Bigaha hence he is not permitted to install the plant.

Likewise, three families out of 46 were found in a range of 3-4 livestock holding. Since these families have got a landholding in a range of 1-3 Bigaha and family size in a range of 4-6 family members, he is free to install the plant of 6 cu.m. capacity.

So also two families was found in a range of 4-6 livestock holding. This family also has got a landholding in a range of 3-6 Bigaha and family size in a range of 4-6 family members. Thus, this family also has feasibility to establish the biogas plant of 6 cu.m. and 8 cu.m. capacity.

From the analysis of this table, the ten respondents out of 46 have got feasibility to install the plant of different capacities remaining within a bracket of major factors. The number of prospectus, thus stand for 47.83% of the total respondents. So, the installation of biogas plant in ward no. 4 also is feasible, since the major factors are feasible.

The similar approach and technique were used in sample survey, ward no. 5, as in other wards to find out the number of livestocks, size of the family and landholding by the respondent so that it will be easy to see whether the respondents have feasibility or not. The respondent numbers, family size and landholding by respondent are stated by below given table.

Table 19
The Number of Livestock Holding, Land Holding and Family Size of Respondents in Ward No. 5

No. of livestock	No. of family	Land holding (in bogahas)				Size of the family						
		Below 1	1-3	3-6	Above 6	Below 3	3-4	4-6	6-7	7-8	9-12	12-18
0-1	59	12	28	14	5		12	20	8	12		8
2-3	3		3				3					
3-4	8			8				8				
4-6												
6-9												
Total	**70**	**12**	**31**	**22**	**5**		**15**	**28**	**8**	**12**		**8**

Source : Field Survey, 2062 B.S.

As illustrated by table 13, the total respondent in ward no. 5 is 70. Among the total respondent, 59 were found in a range of 0-1 no. of livestock holding. The livestock holding in a range of 0-1 livestock, which is uneconomical from construction and operational view point, is not feasible for these families even though their families even though their family size and landholding permit it.

Likewise, I respondent out of 70 was found in a range of 2-3 livestock holding. This three respondent has got a landholding in a range of 1-3 Bigaha. This family has a family size in a range of 3-4 family members. In this analysis, this family has feasibility for installation of 4 cu.m. capacity of biogas plant.

Finally, eight respondents out of 70 were found in a range of 3-4 livestock holding. All these respondents have got landholding in a range of 3-6 bigaha. Further, these families have got a family size in a range of 4-6 family members. These eight families can choose the biogas plant of 4 cu.m. or 6 cu.m. capacity.

This analysis, regarding the required number of livestock, landholding and family size in ward no. 5 indicates that out of the total respondents 12 respondent families have good prospectus. So this prospective number stands for 68.57% of the total sampled families.

Using the same approach as in ward no. 5, even in ward no. 6 has been made to fine out the number of families having feasibility for installation biogas plant by making sample survey. The number of respondents their family size, landholding and livestock holding by these respondents are stated by below given table.

Table 20
The Number of Livestock Holding, Land Holding and Family Size of Respondents in Ward No. 6

No. of livestock	No. of family	Land holding (in bogahas)				Size of the family						
		Below 1	1-3	3-6	Above 6	Below 3	3-4	4-6	6-7	7-8	9-12	12-18
0-1												
2-3	38	28	10						21	10		7
3-4	17		14	4			4	14				
4-6										7		
6-9	7		7									
Total	**62**	**28**	**31**	**4**			**4**	**14**	**21**	**17**		**7**

Source : Field Survey, 2062 B.S.

As illustrated by above table, the total number of respondent family in ward no. 6 is 62. The number of respondents in a range of 0-1, 4-6, 9-4 and 14 or above 14 livestock holding is nil. Among them livestock holding range 2-3, 28 out of 38 families the other 10 families have got land in a range of 1-3 bigaha landholding. Further, 21 families have got family size in a range of 1-3 bigaha landholding. Further, 21 families have got family size in a range of 6-7 family members, 10 families have got family size in a range 7-8 family members and seven families have got family members. It is therefore from the viewpoint of landholding, the 28 families holding below 1 bigaha, cannot be permitted to establish a biogas plant and also from the view point of family size, these 38 families cannot economically establish biogas plant since the size of family is larger. In light of size of family, they need a plant of greater than 6 cu. m. capacity for which their livestock holding do not allow and if they run a plant of lower capacity, it will be uneconomical for the family size. Do also 17 families were found in a range of 3-4 livestock holding. Among these 17 families, 14 families have got landholding in a range of 1-3 Bigaha and four family has got

landholding in a range of 3-4 livestock holding. Among these 17 families 14 families have got landholding in a range of 1-3 Bigaha and four family has got landholding in a range 3-6 family members and four family has got family size in a rang of 3-4 family members. Thus, all these 17 families can establish and biogas plant of 6 cu.m. capacity form two allied factors size of family and family and landholding. Finally, 6 sampled families were found in a range of 6-9 livestock holding. These families have got landholding in a range of 1-3 Bigaha and family size in a range of 7-8 family members. Thus, landholding these both families have a feasibility of establishing of a biogas plant of 10 cu.m. capacity.

To survey up the analysis of the state of affairs in ward no. 6 out of the 62 sampled families 21 families have a good prospectus of establishing biogas plants. The prospective number stand for 38.87% percent of the total sampled families' respondent in the ward no. 6. Hence, there is a feasibility of establishing biogas plant in ward no. 6 from view of three major factors stated above.

Even in ward no. 7 using the same approach and technique of sampling was used to find out the families having feasibility of adoption of gas plant in that particular ward. The number of respondents' family size, landholding and livestock holding by these respondents are stated by below given table.

Table 21
The Number of Livestock Holding, Land Holding and Family Size of Respondents in Ward No. 7

No. of livestock	No. of family	Land holding (in bogahas)				Size of the family						
		Below 1	1-3	3-6	Above 6	Below 3	3-4	4-6	6-7	7-8	9-12	12-18
0-1	15	15						15				
2-3	12		9	3			3			9		
3-4	9		9					9				
4-6	24	15	6	3				15	9			
6-9												
Total	**60**	**30**	**24**	**6**			**3**	**39**	**9**	**9**		

Source : Field Survey, 2062 B.S.

As shown by the above table, the total number of respondent families in ward no. 7 is 60. Among them 15 families were found in livestock holding in a range of 0-1. These 15 families have got landholding below one Bigaha and all these 15 families have got family size holding in a range of 4-6 family members. It is clear that form the viewpoint of the landholding. These 15 families cannot permitted to establish a biogas plant and also from the view point of family size, these 15 families cannot economically establish biogas plant since the size of family they need plant of 6 cu.m. capacity for which their livestock holding do not allow and if they run a plant of lower capacity it will be uneconomical for the family size.

So also 12 families were found in a range of 2-3 livestock holding. Out of these 12 families, 9 families have a landholding in a range of 1-3 bigaha and other 3 family has landing in a range of 3-6 bigaha, but 1 family out of 12 families has 3 family size in a range of 3-4 family members, 9 families have a family size in a range of 7-8 family members.

Thus, among these 12 families, three families can establish a biogas plant of 4 cu.m. capacity from two alived factors size of the family and landholding and rest 9 families cannot permitted economically to establish biogas plant since the size of family is larger. In the base of size of family, they need a plant of 8 cu.m. and 10 cu.m. capacity

for which their livestock holding do not allow and if they run a plant of lower capacity it will be uneconomical for the family size.

Among 60 sampled families, 9 families were found in a range of 3-4 livestock holding and all these families have got landholding in a range of 1-3 bigaha and these 9 families have a family size in a range of 4-6 family members. Thus, all of these families can feasibility to establish biogas plant of 6 cu.m. capacity form two allied factor size of family and landholding.

Finally, 24 sampled families were found in a range of 4-6 livestock holding; out of these 24 families have landholding below one bigaha. These 15 families cannot permitted feasibility to establish biogas plant form the viewpoint of landholding 6 families have landholding in a range of 1-3 bigaha and 3 family has landholding in a range of 3-6 bigaha. Further 15 have a family size in a range of 4-6 family members and 9 families have a family size in a range of 6-7 family members. Thus from viewpoint of two allied factor family size and landholding only these 9 families have a feasibility of establishing a biogas plant of 8 cu.m. capacity.

To sum up the analysis of the state of affairs in ward no. 7. Out of 60 sampled families 32 families have a good prospectus of establishing biogas plant. The prospectus number stands for 53.33% percent of the total sampled families respondent in ward no. 7. Hence there is a feasibility of establishing biogas plant in ward no. 7 from view point of major factors stated above.

Even in ward no. 8, the same approach and technique of sampling was used to find out the families having feasibility of adoption of gas plant in that particular ward. The number of respondent family size, landholding and livestock holding by these respondent are stated by below given table.

Table 22
The Number of Livestock Holding, Land Holding and Family Size of Respondents in Ward No. 8

No. of livestock	No. of family	Land holding (in bogahas)				Size of the family						
		Below 1	1-3	3-6	Above 6	Below 3	3-4	4-6	6-7	7-8	9-12	12-18
0-1	10	5	5					10				
2-3	15		15				15					
3-4	17		17				5	13				
4-6	10		10						5		5	
6-9												
Total	**52**	**5**	**47**				**20**	**23**	**5**		**5**	

Source : Field Survey, 2062 B.S.

As shown by the above table, the total number of respondent family in ward no. 8 is 52. Among them, range 0-1. 5 out of these 10 have got below one Bigaha land, where as the other 5 have got 1-3 Bigaha landholding and these 10 families have a family size in a range of 4-6 family members. In view of the exports, the installation of below 4 cu.m. Biogas plant is uneconomical from both construction and operation viewpoint. Installation of 4 cu.m. biogas plant needed at least 2-3 livestock holding. So from viewpoint of livestock holding and family size, these four families cannot permitted feasibility of establishing biogas plant.

So also size respondents families were found in a range of 2-3 livestock holding. These families have a landholding of 1-3 Bigaha range and have a family size in a range of 3-4 family members. Thus, these families members. Thus, these families are permitted to establish a plant of 4 cu.m. capacity from both allied factors of family size and landholding size.

Among the 21 respondents, 7 respondents families were found in a range of 3-4 livestock holding heaving a landholding of 1-3 Bigaha range and have a family size in a range 4-6 family member. Basing on the prime factors size if landholding and size of the family permit them to establish 4 cu.m. 6 cu.m capacity biogas plant. Out of these

17 families 5 families can permitted to establish 4 cu.m. capacity biogas plant and rest 10 families can permitted to establish 6 cu.m. capacity biogas plant.

However, in course of sample survey, 10 families out of 52 were found in a range of 4-6 livestock holding. All these respondents families have a landholding of 1-3 bigaha range, out of these 10 respondents, 5 have got a family size in a range of 6-7 family members and the other 5 families have got in a range of 9-12 family members. Basing on the analysis it is clear that out of these 10, who have a family size in a rang of 6-7 family members have feasibility of establishing biogas plant of 8cu.m. capacity and others who have a family size in a range of 9-12 family members have not feasibility of establishing biogas plant because the size of family they need a plant of 10 cu.m. capacity for which their livestock holding do not allow and if they run a plant of lower capacity it wall be uneconomical for the family size.

To sum up the above analysis of state of the affairs in ward no. 8 out of 52 sampled families 16 families have a good prospectus of establishing biogas plant. The prospective number, even in this case stand for 30% percent of total sampled family respondents in ward no. 8 it is therefore conclusion can be drawn that there is feasibility of establishing biogas plant in ward no. 8 remaining in the area stated by major factors.

Even in ward no. 9, the sample method was used to find out the families having feasibility of adoption of gas plant in that particular ward. The number of respondents, family size, landholding and livestock holding by these respondents are stated by below given table.

Table 23
The Number of Livestock Holding, Land Holding and Family Size of Respondents in Ward No. 9

No. of livestock	No. of family	Land holding (in bogahas)				Size of the family						
		Below 1	1-3	3-6	Above 6	Below 3	3-4	4-6	6-7	7-8	9-12	12-18
0-1												
2-3	8	4	3			2	6					
3-4	14		11	4				8		6	3	
4-6	6		4		2			2	4			
6-9	2			2						2		
Total	**30**	**4**	**18**	**6**	**2**	**2**	**6**	**10**	**4**	**8**	**3**	

Source : Field Survey, 2062 B.S.

As indicated by the above table, the total respondents in ward no. 9. Among them 8 out of 30 were found in a range of 2-3 livestock holding. Out of 8, 4 have got landholding below 1 Bigaha and the other 3 have 1-3 Bigaha landholding. But, the 2 family have got a family size below 4 and the 6 families have got a family size in a range of 3-4 family members therefore, from the view point of landholding and family size 3 of 8, who holds land in a range of 1-3 Bigaha, is permitted to establish a plant of 4 cu.m. capacity. But the next 4 families are restricted by allied factor landholding.

So, also, 14 respondents were found in a range of 3-4 livestock holding. Out of 14 families, 11 families have got landholding in a range of 1-3 Bigaha and other 4 families have got landholding in a range of 3-6 Bigaha. Further, eight families have got a families size in a range of 4-6 size in a range of 7-8 family members and other 3 families have a family size in a range of 9-12 family members. Out of these 14 families, only 8 families, who have a family size in a range of 4-6 family members, have feasibility of biogas plant of 6 cu.m capacity and other 10 families cannot economically establish biogas plant form the viewpoint of family size because the size of family is larger. In light of size of family, they needed 10 cu.m. and 15 cu.m. capacity biogas plant for which their livestock holding cannot allow and if they run a plant of lower capacity it will be uneconomical.

Among 30 sampled families, 6 families were found in range of 4-6 livestock got landholding in a range of 1-3 Bigaha and other 2 family have got landholding above 6 Bigaha. Further two family has a family size in a range of 4-6 family members and other 4 families have a family size in a range of 6-7 family members. All of these families have feasibility of establishing biogas plant of 8 cu.m capacity form 2 allied factors size of family and landholding.

Finally, 2 sampled families were found in a range of 6-9 livestock holding and has got landholding in a range of 3-6 Bigaha and has a family size in a range of 7-8 family members. This family and permitted to establish biogas plant of 10 cu.m. capacity.

To sum up the analysis of the state of affairs in ward no. 9, out of 30 sampled families, 12 families have a good prospective of establishing biogas plant. The prospective numbers stand for 36.36% percent of the total sampled families respondent in ward no. 9. Hence there is a feasibility of establishing biogas plant in ward no. 9 from viewpoint of major factors stated above.

Now, the researcher's effort is to show the total number of family, total households of landholding (in Bigaha) in different range and total size of family in different range etc. are stated the table given below.

Table 24
The Number of Livestock Holding, Land Holding and Family Size of Respondents in VDC

No. of livestock	No. of family	Land holding (in bogahas)				Size of the family						
		Below 1	1-3	3-6	Above 6	Below 3	3-4	4-6	6-7	7-8	9-12	12-18
0-1	115	32	56	20	10	-	20	63	8	15	-	14
2-3	150	54	90	5	-	4	72	-	57	34	-	7
3-4	112	-	75	28	3	-	9	84	-	6	17	-
4-6	85	25	48	11	2	-	-	29	42	16	5	-
6-9	23	-	7	16	-	-	-	-	-	16	-	-
Total	**485**	**111**	**276**	**80**	**15**	**4**	**101**	**176**	**107**	**87**	**22**	**21**

Source: Field Survey 2062 B.S.

As indicated by the table, the total number of sampled families in Mukundapur VDC, is 485, out of these 485 sampled families 111 families and 276 families are holding the land below one bigaha and 1-3 bigaha range respectively, where other 80 and 15 families are holding the land in a range of 3-6 bigaha and above 6 bigaha respectively. Similarly, in a case of family size holding, 4 families out of total sampled families have got family size below 3 family members, where as 101 families have got a family size in a range of 3-4 families members and 176 families have got in a range 4-6 family member, 107 families have got in a range of 6-7 family members. 87 families have got in range of 7-8 family members, 22 families have got a rang of 9-12 family members and 21 families have got a family size in a range of 12-18 family members etc.

Further, out of total sampled families, 115 families have got livestock holding in a range of 0-1 livestock holding and also 150, 112, 85 and 23 families have got livestock holding in a range of 2-3, 3-4, 4-6 and 6-9 livestock holding respectively.

2.3 Major Findings of the Study

The researchers' effort is to show the major findings of the study in a summary sheet. Out of the sampled households the households sampled for the feasibility study for biogas plant are stated the table given below.

Table 25
The Sampled Households, Feasibility Households for Biogas Plant and Capacities of Biogas Plant in Each Ward of the VDC

Ward no.	Sampled households	Feasibility households for biogas plant	Percent (%)	Feasibility capacities of biogas plant (cu.m.)			
				4	6	8	10
1	60	36	60.00	9	11	5	5
2	56	30	53.57	-	18	11	-
3	49	26	53.06	9	5	5	5
4	46	22	47.83	10	7	4	-
5	70	48	68.57	12	25	-	7
6	62	21	33.87	3	12	-	6
7	60	32	53.33	7	14	14	-
8	52	16	30.76	8	7	2	-
9	30	12	40.00	3	6	3	3
Total	**485**	**243**		**61**	**105**	**51**	**26**

(Note: Some feasibility households for biogas plants have option to choose different capacities of biogas plant) Source : Field Survey, 2062 B.S.

As indicated by the mentioned above table, among 60 sampled household, 36 households have got feasibility to establish biogas plants of different capacities in ward no. 1, it covers 60% of the sampled households. So is the case in ward no. 2 too where 30 feasibility households out of 56 sampled household representing 53.57% of the feasibility households have got feasibility to establish biogas plant of different capacities.

The research found that 26 out of 49 (53.06%) from ward no. 3, 22 out of 46 (47.83%) from ward no. 4, 48 out of 70 (68.57%) from ward no. 5, 21 out of 62 (33.87%) from ward no. 6, 32 out of 60 (53.33%) from ward no. 7, 16 out of 52 (30.76%) from ward

no. 8, and 12 out of 30 (40%) from ward no. 9 as feasibility households for biogas plants.

To sum up the major findings of the to the study in Mukundapur VDC is that out of 485 sampled households 243 households have got feasibility to establish biogas plants of different capacities. The representing feasibility households number stands for 50.10% of the total sampled family respondents.

Hence, it is clear form the above table that each ward of the Mukundapur VDC has got feasibility to establish biogas plant of different capacities from viewpoint of livestock holding, landholding and family size.

Figure No. 4

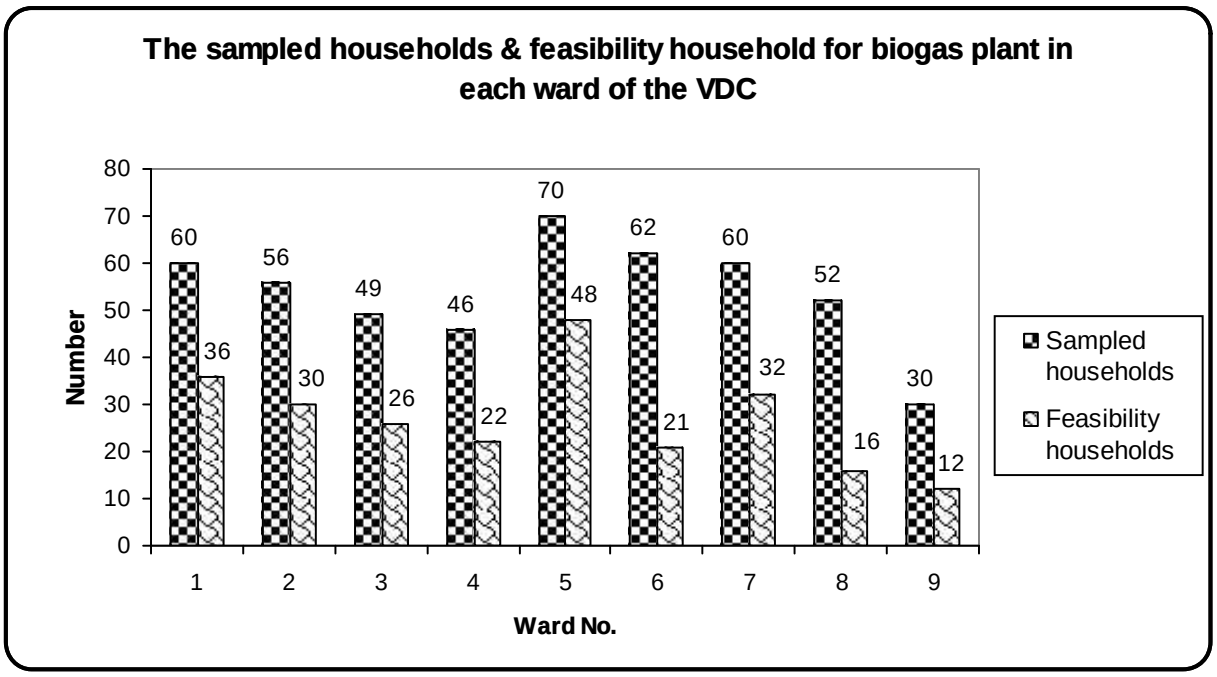
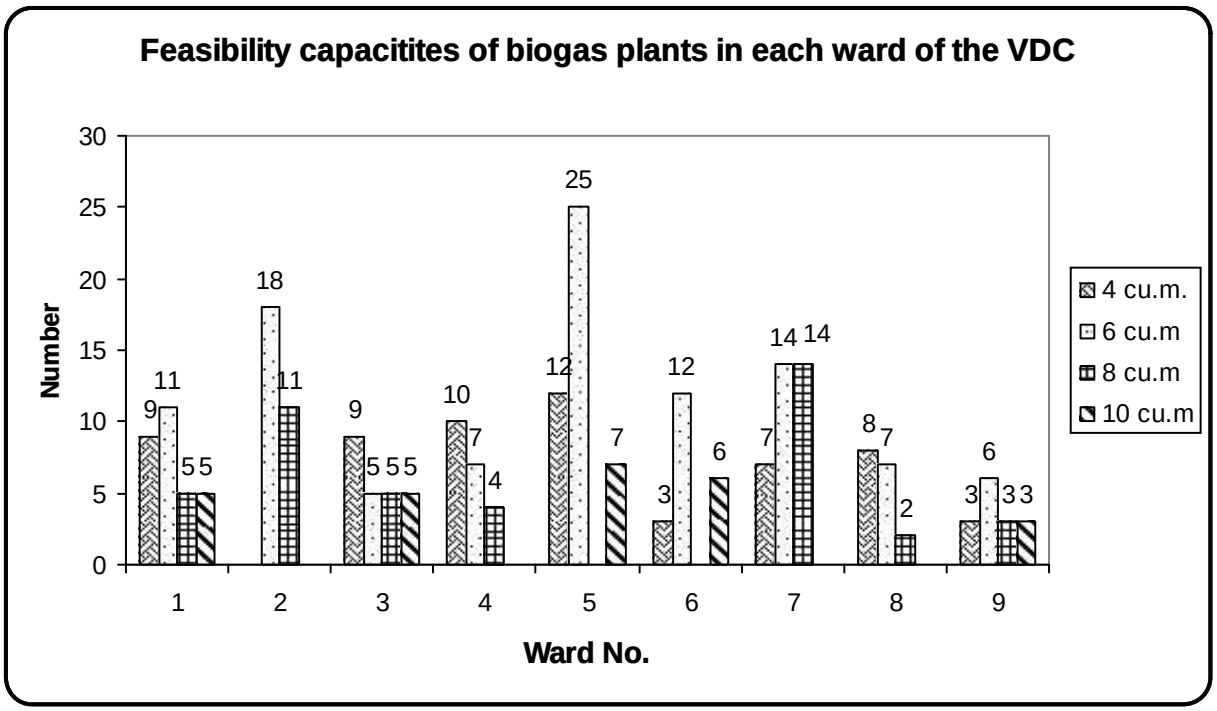


Figure No.5


Feasibility capacitites of biogas plants in each ward of the VDC
Number
Ward No.
4 cu.m.
6 cu.m
8 cu.m
10 cu.m
0
5
10
15
20
25
30
1
2
3
4
5
6
7
8
9
9
11
5
5
18
11
9
5
5
5
10
7
4
12
25
7
3
12
6
7
14
14
8
7
2
3
6
3
3

CHAPTER THREE

CONCLUSION AND RECOMMENDATION

3.1 Conclusion

Through the analysis of facts and figures made so far up to the previous chapter, the researcher has come to conclude that from the viewpoint of three major factors livestock holding, size of landholding and family size 243 families representing 50.10% of total sampled families in Mukundapur Namuna Village Development Committee have a good feasibility for the establishment of the biogas plant of 4 cu.m., 6 cu.m., 8 cu.m. and 10 cu.m. capacities. In the contest of biogas plants, out of total feasible households for biogas plants, 105 households have got 6 cu.m. capacities of biogas plants and also 61, 51 and 26 families have got 4 cu.m., 8 cu.m. and 10 cu.m. capacities of biogas plants respectively.

The analysis of the data/table is given below:

i. The highest feasibility percentage of biogas among the total ward is of 60% and 68.57% in ward no. 1 and 5 respectively.
ii. The lowest feasibility percentage of biogas among the total ward is of 33.87% and 30.76% is in ward no. 6 and 8 respectively.
iii. Among total sampled households, they have biogas plants having 6 cu.m. capacity in highest percentage. Out of 243 feasibility households, 105 households do have their biogas plants having 6 cu.m. capacity.
iv. Only 26 households out of 243 do have their biogas plants of 10 cu.m. It is the lowest in comparison to other biogas plant having different capacity.
v. Only 5 households in ward no. 1, 5 households in ward no. 3, 7 households in ward no. 5, 6 households in ward no. 6 and 3 household in ward no. 9 do have biogas plants having 10 cu.m.
vi. No biogas plant having more than 10 cu.m. is found in the entire VDC.
vii. 96 households, among sampled ones are found incapable to install biogas plant in their house because they own less than one bigaha of land and are considered unable to have the loan.

viii. 127 households out of sampled ones are considered unable to install biogas plants because they have only one or no livestock at all which is insufficient to run the biogas plant.

3.2 Recommendations

On the basis of conclusions the research recommends the following matters

i. It is found after the studies that ward 1 and 5 have highest feasibility of bigoas plant. So I would like to suggest the company to invest more and more biogas plant in those wards.
ii. The feasibility of 6 and 8 wards in lowest in comparison to others. So it seems to be futile to pay much attention to such places.
iii. It seems much more necessary to initiate the people to install biogas plants with 6 cu.m capacity because many households have install biogas plants with that capacity.
iv. Biogas plants with 10 cu.m. capacity are installed less in number. So it is futile to initiate the people to install such biogas plants in their households.
v. No biogas plants with having 10 cu.m. are found in ward 2,4,7 and 8. So it would be better not to try to install such biogas plants in those wards.
vi. It would be better if the people who have/own less than one bigaha of land are provided loan without any collateral.
vii. Stock farming is essential for the success of biogas plant because animal dung (cow & buffalo) are its primary raw material. Hence, a better veterinary service must be granted to the villagers by establishing a veterinary hospital of suitable size in the VDC.
viii. Concerned authorities of Agricultural Development Office, Agricultural Development Bank, Gobar Gas Company (GGC) and also Biogas Support Programme (BSP) must under take effective and efficient steps to grant facilities charging taken for establishment of the plant provision of construction materials essentials for the plant and assistance of its technical know how at reasonable cost. A training programme can be conducted in this regard to the technological aspect of biogas plant.

ix. Biogas plant efforts must be taken to commercialize its use.

x. The households of the VDC need to be given a high degree of demonstration effect of establishing of biogas plant so that they may be aware of various benefits and can enjoy by its use. Hence, a continuous demonstration programme must be conducted by Agricultural Development Office, Agricultural Development Bank, Gobar Gas Company and Biogas Support Programme (BSP).

xi. Experts and specialists have concluded that the fertilizers produced by the Gobar Gas Plant has an excess productivity of 10 to 30% over general compost fertilizer. Furthermore, it has been said that the use of chemical fertilizer does harm the soil composition in the long run. This defect can be overcome in one hand and soil productivity can be preserved on the other. By the use of the fertilizer produced by Gobar gas plants. It is therefore, demonstration farming must be started by agriculture office or alike in the panchayat to convince the villagers of the productivity increment by the use of such fertilizers in one hand and to popularize the use of such fertilizers on the other.

xii. All the more, what the researcher in tends to say is that the present study is a pilot study, now on its basis, the concerned authority, Agriculture Development Bank, Gobar Gas Company (GGC) biogas support programme (BSP) or alike must conduct such other study on this behalf so that furthermore detail information could be collected in order to confirm the feasibility of establishment of biogas plant to a greater scale in the VDC.

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APPENDIX

Questionnaires

1. What is your Name?

   _____

2. What is your village name?

   _____

3. In which ward of this VDC are you living?

   _____

4. How many members do you have in your family?

   Number of family _____

   a. below 3 [ ]
   b. 3 – 4 [ ]
   c. 4 – 6 [ ]
   d. 6 – 7 [ ]
   e. 7 – 8 [ ]
   f. 9 – 12 [ ]
   g. 12 – 18 [ ]

5. Do you have any livestock?

   Yes [ ] No [ ]

6. If yes, then please, tell me the number.

   Buffaloes, Cows and others

   a. 0 – 1 [ ]
   b. 2 – 3 [ ]
   c. 3 – 4 [ ]
   d. 4 – 6 [ ]
   e. 6 – 9 [ ]

7. Do you have any land or not?

   Yes [ ] No [ ]

8. If yes, how much land do you own? (in bighas)

a. Below 1 [ ]

b. 1 – 3 [ ]

c. 3 – 6 [ ]

d. Above 6 [ ]

9. Income from land

Yes [ ] No [ ]

10. Do you want to establish a Gobar gas plant in your house?

Yes [ ] No [ ]

11. If yes, of which size?

a. 4 cubic meter [ ]

b. 6 cubic meter [ ]

c. 8 cubic meter [ ]

d. 10 cubic meter [ ]

12. If no, what are the reasons?

a. Due to lack of money? [ ]

b. Due to shortage of livestock [ ]

c. Due to lack of technical knowledge [ ]

d. Due to high cost of plant [ ]

e. Already disliked Gobar Gas plant [ ]

f. Others …….

13. If you are given certain facilities like

a. Low rate of interest on capital

b. Supply of construction materials of cheaper rate.

c. Assisting of technical knowledge, do you want to establish Gobar Gas plant?

Yes [ ] No [ ]

14. Why do you want to establish Gobar Gas plant?

a. For cooking purpose. [ ]

b. For lighting purpose. [ ]

c. For having good manure. [ ]

d. For running a small industry. [ ]

CURRICULUM VITAE

NAME OF RESEARCHER	:	RAM PRASAD TIWARI
PERMANENT ADDRESS	:	VDC- MUDIKUWA
		WARD NO. 5
		DISTRICT-PARBAT (NEPAL)
TEMPORARY ADDRESS	:	BHARATPUR-12, CHITWAN
NATIONALITY	:	NEPALI
SEX	:	MALE
QUALIFICATION	:	SLC FROM HMG/NEPAL
		I.COM. FROM T.U. NEPAL
		B.COM. FROM T.U. NEPAL