CHAPTER-I

INTRODUCTION

1.1 Background of the Study

Nepal is a land locked mountainous country situated in the foothill of Himalayas where agriculture is the pre- dominant. Nepal is primarily an agricultural country with about 232 million human population in which 85.80 percent population resides in rural and 78 percent people are high dependent on agriculture is based on combination of crop production and animal husbandry.

Energy takes part a great role for the economic development of a nation. Any nation can't achieve economic growth for modernization of agriculture because energy is the infrastructure of industrialization. Per capita consumption of energy is an indicator of the development of a country.

The estimated biogas potential of Nepal is sufficient operate 1.9 millions of biogas plants. Thus the potentiality of biogas technology is very wide in Nepal.

At individual perspectives the primary impact of biogas plants is an poverty alleviation by reducing expenses on fuel for cooking and to some extent lighting. At the national level it helps in reducing import bills of the country in chemical fertilizer and petroleum products. Not only that installation but biogas plant also helps in creating job opportunity for skilled and semiskilled human resources as the construction work requires considerable number of such manpower and contributes in rural poverty alleviation.

Till the end of December 2003, 1, 11, 395 biogas plants have been installed. Insolate about 54.84 percent biogas are installed in remote hilly region whereas 44.88 percent are in Terai and 0.28 percent are installed in remote hilly area. About 780000 person are directly benefited from the biogas plant. The program has so far covered 65 districts out of 75 districts (BSP, 2004).

The number of plant have been made up to now is only 186010 (9.79%), where as it's total possibility is 1.9 million.

During the period of 17 years, it can be seen to have produced averagely 11.15 plants per year. Which come to be less than 235 averagely per company comparing the no. of construction company of the last year (BSP, 2008).

1.2 Historical Background of Biogas

Biogas has been gaining popularity now a day as a good alternative source of domestic energy looking back over the origin and development of this technology, we find the history of biogas started in eighteenth century.

The first person to report the existence of biogas was A. Volta. He was an Italian national. In 1776, he wrote to a friend "Combustible air."

Volta wrote that the submerged plant materials in the ponds and lakes continuously give off such gas. Later, Volta's gas was shown to be identical with methane gas.

It took over hundred years to se the gas for mankind. The plant for methane generation was set up in 1900 in leper asylum in India. Another plant was installed in Indonesia in 1914.

Interest in biogas rose very high at the time of beginning of second world war. By 1950, about 1000 biogas plants were built by French. German converted their some 30,000 automobiles to run on biogas to save the petroleum fuel during the world war. The energy crisis followed after the war drew attention of many countries towards biogas." In the developing countries like Nepal, to meet the growing energy demand of the growing population, biogas gradually became popular.

1.3 Introduction to Biogas

1.3.1 Biogas

Biogas, popularly known as Gobargus in Nepal, is an combustible as provided by an anaerobic fermentation of organic materials by the action of Methanogenic bacteria with in a temperature of 25^0 to 35^0. For certain period of time. This gas is composed of 60-70 percent methane, 30-40 percent CO_2 and some other gases. The methane gas is orderless and burns with clear blue flame without smoke. It produces more heat than kerosene, fuel wood, charcoal and dung cakes. Biogas can be used for cooking, lighting, running, engines and generate electricity. However, the use of biogas in Nepal is limited to cooking and lighting only till now.

1.3.2 Use and Benefits of Biogas Plant

The main use of biogas is for cooking. It is used in cooking stoves in the kitchen. It burns with a clear blue and smokeless flame. The utensils remain clean and cooking environment remains healthier. It consumes lesser time to cook than in firewood.

Biogas can be used for lighting purpose too. However, due to low efficiency its use for lighting is less recommended.

It can also be used as a fuel in internal combustion engines. Such can be used in small cottage industries where there is no electricity supply.

Slurry produced after digestion has rich nutrients and possesses good fertilizing property. So, it can substitute high cost chemical fertilizer too.

1.4 Statement of the Problem

Money developing countries are facing the energy related problems such as rising prices of fossil focus depleting forest resources etc. and Nepal is no exception to this.

Due to the population growth the demand for energy is increasing day by day in the country. Major shares of the energy consumption meets through traditional sources The renewable energy sources are biogas promotion will be significant one to struggle for improving this condition.

Fire wood has been the most common and traditional source of energy for Nepal, Fire wood represents about 75 - 78 percent of the total energy consumption which is mainly consumed in rural Nepal. A great part of this is consumed in residential sector for cooling purpose.

The forest serves as the main sources of firewood. So excessive use of firewood has posed a serious burden on the forest. Our population is increasing day by day while the forest area is decreasing. So, the forest alone is not capable of sustaining the increasing energy demand of growing population. In this situation, there is a threat of depletion of the forest. This deplication will lead to many natural calamities such as soil erosion, landslides, floods and destruction of the natural balance.

Nepal has a theoretical potential of 83,000 MW and commercial potential of 42000 MW of hydroelectricity. But till to date, only 548 MW of hydro electricity has been harnessed. It contributes about 1.3 percent of total commercial potential and shares 1.47 percent of total energy consumption of the country (ADEC and NBPG, 2006).

For Nepal, being an agriculture country, livestock plays an important role in the Nepalese farming system. The total household with cattle and buffalo in Nepal was estimated to be 2.7 million in 2001. Based upon the study of technical biogas potential of Nepal, it is estimated that a total of 1.9 million plants can be installed in Nepal out of which 57 percent in plains, 37 percent in hills and rest 6 percent in remote hills or in mountain region (BSP, 2008).

Potentiality and Biogas Construction

Technical potentiality of biogas plants - 1.9 million plant
Total constructed (2009) - 1189632 plants

Figure 1.4.1

Construction of Biogas Plants

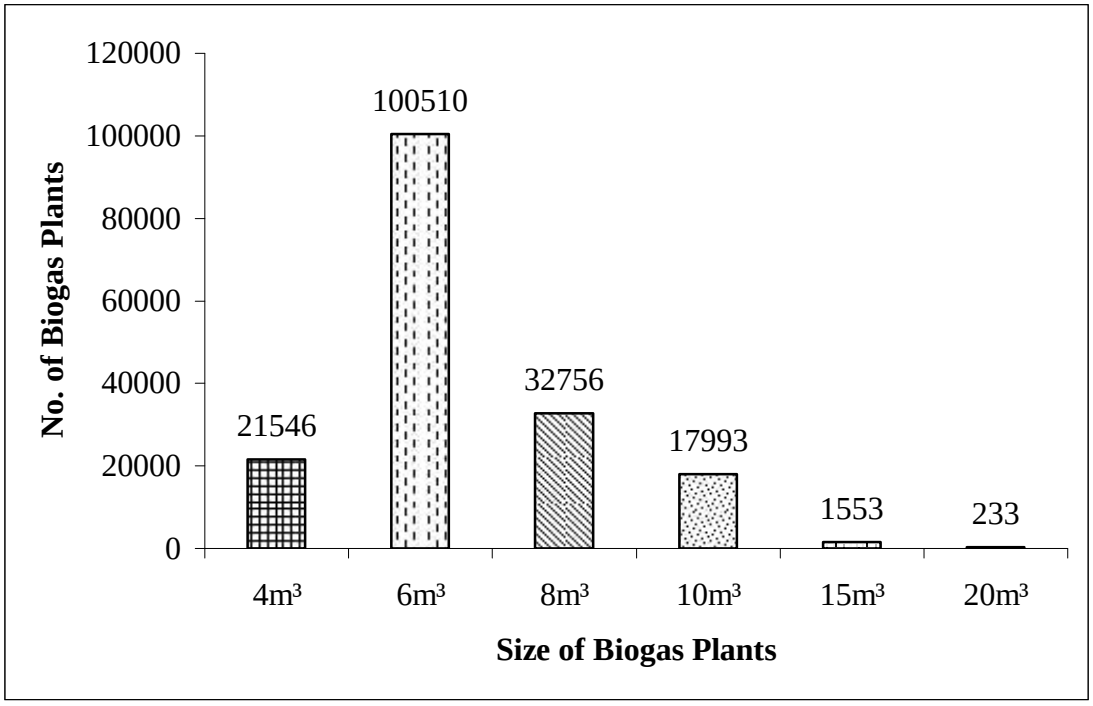
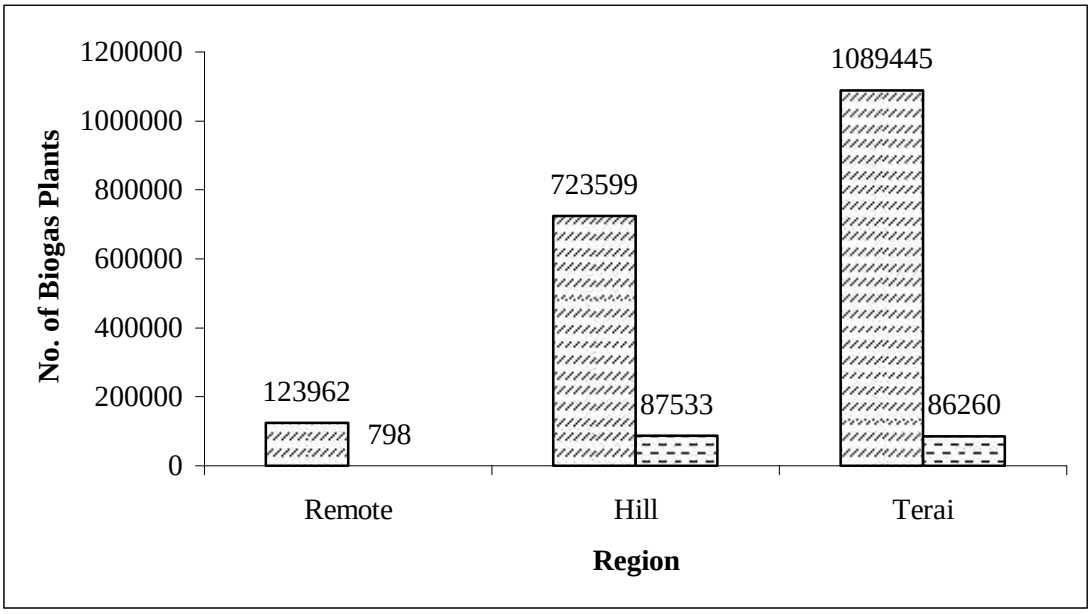


Figure No. 1.4.2

Geographical Region Wise Construction



Various facts and figures indicate that biogas is a suitable source of energy in rural Nepal and it needs to be promoted an extended effectively. Unfortunately, we have been able to install only about 8 percent biogas plant of total technical potential (BSP, 2004). Some of the reasons for slow progress in adoption of biogas technology in the country side are observed to be:

- Ignorance of the farmers as regards the usefulness of the technology.
- Easy access to forest in some areas to collect firewood.
- Non-cooperative attitude of the plant owners to convey and motivate other neighbours as regards the usefulness of biogas technology.
- Unhealthy competition between recognized biogas plant construction comparatives.
- Unavailability of easy loans to poor farmers due to lack of collateral needed by the bank.
- Difficult and lengthy process of loan sanctioning.

Thus there may be one or more reasons as mentioned above in specific area for slow adoption of technology. Realizing the facts the study was carried out to collect answers to the following question:

1. What is the socio-economic condition of biogas households in Shreepur VDC ?
2. What are the positive and negative perceptions of biogas users towards biogas in Shreepur VDC ?

3. What sorts of impacts (especially on gender role, agriculture and sustainable land use) the users are experiencing after the adoption of biogas technology in Shreepur VDC ?

4. What are the problems faced by biogas users from adoption of biogas technology in Shreepure VDC ?

5. What are the suggestion of biogas users for the speed adoption of biogas technology ?

1.5 Objectives of the Study

(a) To enumerate and characterize the socio-economic characteristics of biogas users:

(b) To examine the impacts of bio-gas in relation to the following aspects.

- Gender use
- Environmental health and sanitation
- Agriculture status and sustainable land use.
- House hold economy.

(c) Suggest remedies for the implementation and promotion of bio-gas plantation .

(d) To make relevant recommendation to policy makers .

1.6 Importance of the Study

The increasing demand for fuel wood due to population pressure is one of the causes of forest duplication . This is composed by overgrazing of cattle. Consequently fertile fields turn into barren lands flash flood occurs more frequently and sedimentation increase in rivers dams and cannels. Fuel wood is now scare and less accessibility to the rural people

for their fuel needs because Nepal has no commercial deposit of fuels. Enslaving world oil price and its inaccessibility within the country limit the use of commercial sources, thus imported petroleum fuels are not the most feasible alternative sources. The important of study is to decrease the deforestation.

The next important of study is to raise the agriculture productivity. It is modern source of fuel which may be beneficial to the health comparing traditional source of fuel then it may raise the health and living years of the people. Therefore, the importance is to find out the feasibility of installation bio gas plants as an alternative source of energy could help for the forest, land health and productivity preservation and substitution to the kerosene and chemical fertilizer. It also serves the lighting purpose of the people those who have no electricity facilities.

1.7 Limitation of the Study

There are following limitations of the study.

- This study is only confined on the plants installed in Shreepur VDC at Lalpur of Kailali district, thus it can't represent country as a whole.
- This study only deals with the socio-economic impact of Bio-gas plant in Lalpur village.
- The analysis of slurry production gas generation is based on appropriate.
- All the data mentioned in this study are based on secondary as well as primary sources.

1.8 Organization of the Study

The report has been divided into 7 chapters. The first chapter gives introduction of the study. It contains background of the study, historical

background of the study, objective of the study, importance of the study and introduction to biogas technological.

The second chapter consist of the reviews of the literature on impacts of biogas technology on users.

The third chapter describes the methodology of the study.

The chapter four provides the description of study site pertaining to geographical and socio-economic situation.

The chapter six consists of impact of biogas technology and major findings of the study.

And lastly, chapter seven contains conclusion and recommendations.

CHAPTER-II

LITERATURE REVIEW

Review of literature is a critical summary of research on a topic of internet, generally prepared to put a research problem in context or to identify gaps and weakness in prior studies so and to justify a new investigation.

In this biogas is suitable and dependent alternative source of energy. There are so many researches and studies were carried out . Local national level and international level seminars and works were done. Here is brief summarized on the related subject matter bio-gas and it's analysis.

Biogas is the mixture of gas produced by the methanogenic bacteria while acting upon biodegeradable materials in an anaerobic (without oxygen) condition. Biogas is mainly composed of 50-70% of methane (CH_4), 30-40% carbon dioxide (CO_2), 5-10% Hydrogen (H_2), 1-2% Nitrogen (N_2),0.3% water vapour (H_20) and Traces of Hydrogen Sulphide (H_2S) (Karki and Dixit, 1984).

N.K. Bista (1981) "Bio-gas is considered as the most reliable alternative energy resource replacing fuel wood of which the greatest part is used for cooking specially in rural area of Nepal. It means that this is the urgent need for substituting rural energy through non conventional energy."

ESCAP publication (1975), The worship on Bio gas technology utilization of Asia and pacific region held. At Manila in 1975 was organized by ESCAP. There were altogether 20 participants from 12 different countries. Every participants analyzed. About working strategies

problems faced and proposed programmes on bio gas energy sector . The contribution of the bio-gas technology were also discussed in each nation's context.

Center for Rural technology find carried out a study entitled "Bio gas latrine project Assessment for UNICFF. According to the report attachment of toilet to biogas has helped in creating better sanitation around the household and improved health users. The adoption of bio gas technology has resulted in saving of 12.9 metric ton of fuel wood and it has helped in protects 108 nectars of forest area. Likewise agriculture production has been increased . Up to 20-25 percent after the use of bio gas starry . (CRT; 1994).

Table 2.1

Design of Biogas Plant

Specific Gravity	0.55
Suitable digesting temperature	20.35^0C
Retention time	40-100 days
Biogas energy content	6 K Wh/m^3 = 0.61 diesel fuel
I cow yield	9-13 kg dung/day = 0.4m^3 gal
Gas requirement for cooking	0.1 - 0.3 m^3 / Person
Gas requirement for lighting	0.1-0.15 m^3 / hrs
pH	6 - 7
Biogas generation digester volume	6.3 - 0.5m^3 gas/m^3

Source: Karki, et al. 2005.

The volume of gas produced from plants of both of the types totally depends upon the temperature inside the digester. Higher the temperature, higher is the level of daily gas production. Temperature between 30-35 degree centigrade is taken as suitable one for

formentation. Likewise pH of 7 to 8 is considered as the best (ADB/N, 1986: 83, 84).

United Nations (UN) (1979: 45) has carried out a study on biogas. In the journal entitle, "Energy Resources Development Series". It is viewed that the commercial fuels are not easily available in rural area. Despite the increment in their costs day by day, the villagers mainly depend on non commercial fuels like firewood; cattle dung cakes, and agriculture western. This encourages reckless demolition of trees to meet the needs of fuel which adversely affects the rain fall. This in turn, disturbs the ecological balance. Use of cattle dung as fuel deprives the soil of the organic manure which results in poor crop yield.

NEPECON had carried out a survey in 2001 entitled "Biogas user's survey; 2000/2001 for AEPC." A total of 200 biogas household were selected for the survey. The survey suggested the following findigns:

- On an average a biogas household saver 990 kg firewood and 6 litres of kerosene per annum as a result of biogsas installation.
- Average time saving of the sampled biogas households for permorning various biogas related activities amount to be about 1.31 hour /day or 1 hour 18 minute. With this calculation in saving a daily wage labour can earn around Rs.4180 per year.
- About 41 percent of the respondent utilized slurry in compositing from white 28 percent applied it in dried form.
- Bio gas households perceive from 12 to 23 percent increment yield of crops and vegetables due to slurry application.

- Around 67 percent 67 percent of plant owner practice stall-feeding, 30 percent do practice postal stall feeding and per it's grazing while 3 percent leave their animal for grazing.

- 47 percent respondent perceived a decrease in visit of hospital / medical clinic after biogas plant installation.

- All respondent have perceived an increase in mosquito breeding after biogas installation (NEPECON; 2001).

Similarly, east consult had conducted a survey entitled "Biogas user survey 2003/2004 for AEPC. A total of 118 biogas household were chosen for the survey. The report suggested. The following findings:

- The combined figures are Brahmins and Chhetri were found 74 percent.

- Literacy among the plant owners was 75.24 percent in hill and 86.35 percent in Tarai.

- The majority of biogas users increased yield response in paddy (39.83 percent), maize (48.31 percent), potato (62.71 percent) and vegetables (57.63 percent).

- Cattle shed was improved by 1.6 times after the biogas installation.

- Cattle shed was improved by 1.6 times after the biogas installation.

- The decrease in fuel wood was found 6.28 kg and 7.23 kg. per day in summer and winter while 15.68 kg. and 19.36 kg. in summer and winter in Terai.

- The decrease in consumption of kerosene per household per annum in hill was 17.83 lit, and 13.57 lit. while figures for the Tarai are 64 lit and 70.77 lit. in summer and winter respectively.

It recommended

- AEPC/BSP should carry out effective monitoring and evaluation to maintain the sustainability of biogas plants.
- Effective training to the end users especially females as well as to the technicians should be carried out.
- It is recommended to conduct the precise research preferably in collaboration win Department Agriculture and or Nepal Agriculture Research Council to study the influence of slurry on insect pest and crop diseases.

New Era (1985) has made a significant study on biogas programme of Nepal under the title "Biogas Plants in Nepal: Alternative study". The major reason for conducting the study is to evaluate the working and the economic condition of gober gas plants. Another reason for conducting this study is to see how the subsidy program for community gober gas plants has benefited small farmers. This study attempts to evaluate the working of the gobergas plants, both individually and community-owned, with emphasis on the management, maintenance and the economics of the plants. It also deals with the socio-economic characteristics of the plans owners versus non-owners.

Since the main purpose of this study was to evaluate community gober gas plants, samples of the family owned gober gas plants were taken in the same districts when the community gober gas plants were taken in the same districts when the community gober gas plants existed.

Altogether, 30 gober gas plants were selected for the study out of them 10 were from community - owned, 20 were from family-owned. The major supporting agencies for plants were UNICEF/UNDP, ADB, SEDP and USAID.

So far as the gobar gas seems only to have attractive the rich people in community. Easy availability of loans from ADB/N to install the gober gas plants and the bright gas lumps provided by the gobergas plants seem to be the major motivating factors. However, the surveys found that almost half of the lamps were not working because the lamps were highly vulnerable to breakage and hence required frequent repairs.

The economic analysis of the community gobber gas plants showed that the saving diesel from the duel-fuel engine would make the mill more profitable since less diesel would be used. But the mans have had to be operated mostly on diesel would be used. But the means have had to be operated mostly on diesel alone because the plants are unable to generated enough gas during the winter season when customer's demand for the processing grain is very high. The prevalling high consumption of the diesel may be attributed to the insufficiency of engine resulting from faculty installation of the huller and engine. As a result, many community plant owners found themselves in much higher debt than they should have been. They seemed to have developed the feelings that if the mill was operated on diesel fuel only, their income would have been much higher.

Proceedings of the workshop on biogas and other related energy held at Suva and the seminar on 'Rural energy development held at Bangkok, mainla, Tehran and Djakarta under the 'Energy development series' deal on the biogas and integrated farming systems and lay

emphasis therefore on the biogas plants, especially on possible effects on the rural life thereby analyzing direct benefits and indirect social benefits as well As analysis, these plants supply and efficient and clean fuel for cooking and free the rural women for smoke and diseases caused by traditional fuels like firewood, dung cakes etc. Further more, it provides extras time for these women, providing them opportunity to earn extra income. Moreover, the manure from these plants is superior as compared to farm ward manure. There is almost double amount as much humus in biogas slurry as contained in farmyard manure. This manure doesn't contain germinative weed seeds; the cost of weeding in the field is lessened and the production increases by 25 to 50 percent depending on the crop. The indirect social benefits include the advantages of residues from the plants and not attracting the mosquitoes and flies. Beside this, biogas technology, provides a means of hygienic disposal of night soil (UN Publication, 1979).

Britt had conducted a research study entitled "The effect of Biogas on Women's Workload in Palpa, Rupandehi, Nuwakot, Chitan and Mahottori District for the biogas support program. The outcome of the study states that given the overwhelming work load for womeni n most part in Nepal, the saving in time is quite significant. But, it also remarks that introduction of biogas technology doesn't appear to fundamentally alter the position of women. So called traditional or unequal patterns in the division of labour are sustained with women working for long hours only substaining one labour activity for another (Britt, 1984).

The Seventh Plan (1985-1990), for the first time, recognized the role of RETs in the conservation of forests and in providing alternative sources for meeting the energy needs of the rural population. The plan incorporated few policies addressing technology like biogas, solar

thermal, wind energy, improved cooking stoves (ics) and small water turbines / improved water mills. A few policies and programs on RETs relevant to sector were as follows:

- Encouraging the development of alternative energy sources especially biogas, solar and wind energy with emphasis on making the private sector participation more active;
- Set forth a target to install a total of 4,000 biogas systems, and provisioned 25 percent subsidy on investment costs and 50 percent subsidy on bank loans;
- Allocated a budget for an estimated expenditure of NRs.154.80 million for the development of RET and expected private sector to invest NRs.104.8 million. A sum of NRs.50 million was allocated for subsidy and the balance was for support activities.

The Eight Plan (1992-1997) gave special attention on alternative energy. For that, the estimated investment amount for incorporated RET program was NRs.1650 million of which NRs.33.5 million (20 percent) was to come the government mainly in the form of subsidy and remaining was expected to come from private sector of the total public sector outlay on RET development, it had allocated 15 percent in micro-hydro, 75 percent in biogas, 3 percent (NRs.10 million) in solar energy, 6 percent in biomass energy and 1 percent in wind energy.

Establishment of ministry of science and technology can be taken as an important in eighth plan. During the plan period, a total of 30,494 biogas system were installed as against the target of 30000 systems.

The Ninth Plan (1997-2002) formulated long-term vision in the Science and technology sector. Accordingly, the fundamental goal of

rural energy system development was to increase alone with the goal, the plan set out the program continue the existing BSP with a new target of 90000 biogas system by maintaining the existing subsidy. The plan also set forth a program to carry out research in order to produce biogas in the hilly and mountain regions of the country. During this period, renewable energy subsidy policy-2000 and the 20 years alternatives energy perspective plan for renewable energy was also prepared.

The Ninth Plan had a target of installing 90,000 household biogas systems; only about 66 percent (53,678) of the target was achieved.

In the Tenth Plan (2002-2007), as popularity of biogas is growing among rural families due to it's diverse benefits. It was targeted to expand since it saves firewood, reduce dependency on imported energy and there is no negative impact in the people's health. In addition, the use of biogas plant brings no environmental pollution and the slurry which comes out from the plant as by product is used as the best fertilizer. So, the tenth plan has set a target of installing a total of 200,000 biogas system in 65 districts. Priority will be given to suitable and relatively smaller-size plants and necessary research would be carried out for its expansion in the Himalayan region and towards reducing the cost.

CMS (1997/98) with financial assistance of UNHCR had implemented a project at ward no. 1 of Pathari VDC of Morang district in which a community latrine cum-biogas plant was successfully established. The study of the project found that the pollution of the area was especially due to increasing pressure of population and lack of proper sanitation local inhabitants, passers-by and Bhutanese refugees are responsible for causing pollution in this area.

After the completion of the project, the following benefits were reported.

- Local people who used to walk 1 km. in the forest for defection got the permanent place for defection.
- People visiting Hatiya Bazaar twice a week for shopping got a proper place for urination and defecation.
- Bus passengers traveling on the route also got a facility of latrine.
- It helped to control environmental pollution in this area.

CHAPTER - III

METHODOLOGY

Research methodology that informs the production of particular kinds of research. It also provides a framework for selecting the means to find out analysis order and exchange information on particular issue (Chapa gain 2004:5:)

3.1 Research Design

For this study, descriptive analytical and explanatory design used to find out the sustainability of adopting this bio gas plant as well as qualitative research design used to analysis theory.

3.2 Selection of Study Area

To fulfill the objectives this study centered within the Shreepur VDC. Specially this study focused in Lalpur village which has significant potentiality. The area has been selected due to it's diverse socio - economic structure.

Nature and Source of Data

Research design determines the nature and source of data used for analyzing. Quantitative and qualitative sources collected by field survey. The household survey questionnaire was used to collect the primary data to get first hand information on the impact of biogas to its users.

As extensive library consultation was made for the collection of secondary data regarding biogas technology. The library consultation contributed a lot in depth understanding in depth of the issues under the

study. Eventually the understanding helped tremendously in designing of tools and field data collection method as well. The library research involved a wide range of materials such as book study report, information, bulletins, booklets etc. published by various institutions and personal working in the field.

3.3 Sampling Procedure and Sample Size

It was rather not possible to interview all the biogas households of Shreepur VDC in limited time. So out of them only 40 biogas plants were selected for the study. Simple random sampling was followed for the selection of samples.

3.4 Data Collection Tools and Techniques

Tools and technique of data collection are the key factor of research which determines the purity of data and information. Through a right method, real data can be gathered. Response of respondent the major focus of study which directly related with the livelihood outcome. In this study, the following data collecting tools and techniques used to gain primary data are as:

3.4.1 Field Survey with Open Questions

Keeping in view of objectives, a detail structured questionnaire was developed. The questionnaire was finalized after consulting with supervisor. It was protested in adjoining VDC and after then administered among sampled biogas households to get in-depth information and data pertaining to socio-economic characteristics of biogas households, impact of biogas on gender, health and sanitation, agriculture and sustainable land use. The interview was carried out by visiting door to door by the

researcher. If in case any sample household was found missing. There the neighbouring biogas sample household was applied for interview.

3.4.2 Observation

To collect further data and information than covered by questionnaire, the researcher visited some biogas plants and observed directly to have better idea about the biogas plants. Observation included on following:

- Biogas plants under construction.
- Working condition of biogas plants
- Working condition of cooking gas stoves
- Site of slurry output and its utilization in cultivated field.
- Sanitary condition around the household.
- Cleanliness of kitchen.

3.4.3 Focus Groups Discussion

The researcher also organized a focus group discussion with the potential key informants and other local people including women. Both respondent and non-respondent were invited to participate in the discussions. They all participated actively in discussion and provided valuable information regarding the impact of biogas on gender environment, health and sanitation, agriculture production, sustainable land use and pertinent issues regarding the status of biogas plants.

3.4.4 Key Informant Interview

The researcher also met village leaders, key informants, government officials, biogas companies, masons, non-biogas households of agriculture Development Bank and held informal discussion with

them. The informal meeting was particularly useful for matching the information collected through personal interview with the respondents.

3.5 Data Analysis and Presentation

After collecting required data. It analyzed and presented through quantitative and qualitative methods. The quantitative method include different table chart graphs where as qualitative method used to describe and analyze the facts and feelings of the respondents.

CHAPTER-IV

STUDY SITE OF THE DESCRIPTION

4.1 District Background

Kailali is one of the district of the seti zone of the far Western Development Region. Kailali district lies to the east of Kanchanpur district, South of Doti district, west of Bardiya district and north of Lakhimpur Khiri, Uttar Pradesh of India.

The average rainfall in this district is 1663 mm. The rain starts from mid-Jun and runs upto mid October. The highest recorded rainfall is 2303 mm. This average temperature is 18 to 34.5 centigrade. The maximum 430C in June and July and the minimum is 7.7^0C in January.

Because of fertile soil of this district, there is a lot of production rice and wheat. Rice and wheat are exported to other part of the nation. There are many mills and small industries in the district.

There are many roads in the district. East west highway and Dhangadhi Dadeldhura Highway pass through the district.

Nepali, Tharu, Pahadi language are the major language which are spoken over here. Tharu people speak Tharu language. Many Tharu people cannot speak Nepali.

Kailali is one of districts, annexed into the territory of unified Nepal in 1970 A.D. at the time of unification movement by the great king Prithivi Narayan Shah. Later on, it came under the sovereignty of British

East India company by the Sugauli Treaty. Followng the war of 1814-16 A.D. In 1857, a great military revolt was launched against British East India company. At that time Nepal helped the British East India company to suppress it by sending large numbers of military troops into action during the regime of the then Rana Prime minister Junga Bahadur Rana. The British were pleased with Nepal's help on the ward time and returned this territory in between Rapti to Mahakali River, hence, this district Kailali is a part of that returned territory.

The total population of Kailali is 616697. The total population growth is 3.89. Out of this population, 57.2 percent is economically active (15-0.59 years). Average family size 6.53. The average life expectancy at birth of the population is estimated at 58 years. Literacy rate in this area 52.6. Total population density in the Kailali 191. In Kailali District, 42 VDC and 2 municipality (CBS, 2003).

4.2 Lalpur Village: An Overview

4.2.1 Location and Accessibility

Lalpur village is about 15 km. north from the district headquarter (Dhangadhi). A Pakki Motorable road joins with Dhangadhi. There was a dense forest around Lalpur village about 20 years back but today a few hundred trees are left around this village. The researcher found a high school, a panchayat building, a health post, a telephone station, Gramin Bikash Bank, and many shops. There is also temple in Lalpur village.

4.2.2 Physical Feature

Lalpur has a plain area therefore plain and fertile lands are the main natural resources. Because of level and fertile land crop cultivation is easy and productivity is high. There is no proper irrigation system in this village. The whether of Lalpur varies around the year. The climate of this area is subtropical. Being the part of the tarai, it is a hot in summer and cold in winter. Soil types in this study area are mainly light to medium, textured sandy loam sands. It has mixtures of different clays such as black alluvial and sandy which is considered as fertile soil for paddy, wheat, maize, pulses, green vegetables, etc. The monthly mean maximum temperature in Lalpur are about 38^0C from April to June. The monsoon starts around mid-June when the comparative drops to around 30^0C and continues until about mid October. January is the coldest month, when the minimum temperature less than 8^0C.

4.2.3 Settlement Pattern

A mentioned above Lalpur village is inhabited by the Tarus (Dangaura Tharu). Brahmin and Chhetries of Doti and Dadeldhura. It has been learn the Rana Tharus left the villages and shift the neighbouring village where they had majority. Some Rana Tharus settled down to India where they had marriage relations. But Dangura Tharus do not have the marriage relation in India, Dangura Tharu are known as Chaudhary Tharu of Kailali and Kanchanpur arrived from Dang Deukhuri approximately 30-35 years back. Thus, the same Tharus have settled down in Lalpur village. Since these Tharu have came from Dang, they are known as Dangaura Tharu. Dangura Tharus, Brahmins and Chetries replaced Rana Tharu of Lalipur Village

One can easily make out the Tharu people in Kailali because they have dark complexions, muscular slim bodies and an average Nepali height. They are friendly, honest and hand working people therefore other people have taken undue advantages of this innocent tharus. Dangura tharus have been their own separate language but most of the other people fo Tarai can easily understand the Tharu language. Now most of the Tharus of Lalpur can communicate in Nepali language also. Dangura Tharus are simple in nature, therefore they like simple dress but unfortunately they are extremely illiterate

4.2.4 Population Composition

Different castes, ethnic and religious groups had been settled in this area. Although the demographic characteistics were heterogenious in this area, Tharus comprised the majority Brahman, Chhetri were minorities, more than 70 percent of population was Tharu, hence the dominant mother tongue of the people of this study are was the Tharu language.

4.2.5 Religio-Cultural Aspect

Religion and Festival: The people of this study area Hindu. The hill-migrants, such as Brahman and Chhetri follow Hinduism. Whereas, the Tharus are Animist by tradition, believing in on ghosts, magical-tantric rituals and sprit worship.

Dress and Ornament

Langutia and Fand made from white cotton, are traditional dresses of male Tharu, where as lehenga, choliya and gatiya are the traditional dress of female Tharu. These days many males of these villages were a

shirt, past, cap, vest, swester, jacket, etc. Whereas as females wear a blouse, Sari/Dhoti, petticot, lungi, etc.

4.2.6 Social Aspect

Lalpur is underdeveloped and backward in terms of it's physical infrastructure and service facilities. This area is lacking in local roads, metallic roads, electricity, marketing and other basic facilities for the people. There are neither industries/factories nor commercial institutions established.

There is no veterinary or agricultural service center nor any other form of institution that can provide service for agriculture or livestock. There is a Gramin Bikash Bank and Sajha Sansthan established by the government. There is also health post, an Ayurvedic clinic and high school run by government.

Local peoples have not allowed opening a liquor shop in Lalpur. But Tharus drink 'Jaand' (local drink) prepared by themselves in their own houses, which is not sold. A few people do come from Dhangadhi to buy chicken, goats and crops from the village. Electricity is also available in Lalpur.

4.2.7 Economic Aspect

A major community with a deep-rooted Kamaiya system, the Tharus, constitutes a large bulk of the population of this village.

Since the agriculture is based mainly on the manual labour in the study area, there must be equilibrium of labour and land holding size for an ideal subsistence farming household. The households with large

landholding size an absence of sufficient manpower need some laborers to employ. Similarly, the households with smaller landholding size or landless family with many members need some of their family to be employed somewhere else for their living. In the study area, there is no alternative economic opportunity besides agriculture, including livestock rearing. The smaller landholding or landless Tharu, who are the native people of the study area, were not interested in regestering the land in their name. Thus, cleaver people from hills got most of them and compelled them to serve to the landlords. A householder who owns some land is locally called Kisan (Farmer), where as a laborer employed by him to Fetch labour of his household is called Kamaiya. Thus, Tharus of the study area have been stratified into two groups as Kisan (farmer) or landlord and Kamaiya or land less on the basis of their diverse economic status. To solve his hand-to-mouth problem, the Kamaiya has to do everything according to the order of his master, the landlord.

CHAPTER - V

SOCIO-ECONOMIC CHARACTERISTICS OF BIOGAS USER

5.1 Socio-economic characteristics of Biogas user.

5.1.1 Population and Household Size

The total population of the 40 sampled house hold was 241 with an average of 6.02 which is not equal to national average. Households with maximum number of family was 8 as minimum numbers was 3. It was found that 40 mal persons were living outside the village for job.

Table 5.1

Distribution of Family Size in Biogas Household

S.N.	Family size	No. of Household	Percentage
1	Small (upto 4 person)	14	35
2	Medium (5-7)	16	40
3	Larger (8 and above)	10	25
	Total	40	100

Source: Field Survey, 2009.

5.1.2 Caste/Ethnic Composition of Plant Owners

Ethnic composition of Biogas households shows that about most of the respondents were Brahmins, then Chhetri, Chaudhary, Thakuri and Dalit.

Table 5.2

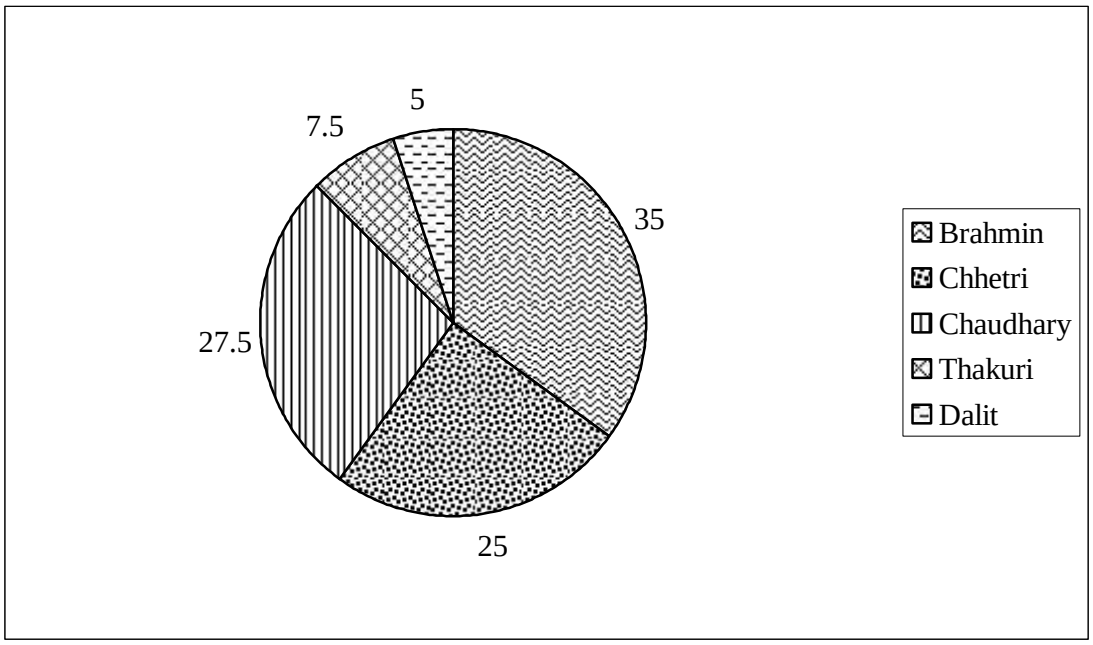
Ethnicity of Biogas Households

S.N.	Caste	No. of Household	Percentage
1	Brahmin	14	35
2	Chhetri	10	25
3	Chaudary	11	27.5
4	Thakuri	3	7.5
5	Dalit	2	5
	Total	40	100

Source: Field Survey, 2009.

Figure 5.1

Cost Distribution of Biogas Household in Study Area



5.1.3 Occupation

Field survey shows that majority of biogas households (40 percent) are service holder. Beside service, other occupation were agriculture (20 percent), business (30 percent), wage earning (10 percent).

Table 5.3

Occupational structure of Biogas households

S.N.	Occupation	No. of Households	Percentage
1	Agriculture	8	20
2	Service as	16	40
3	Business	12	30
4	Wage earner	4	10
	Total	40	100

Source: Field Survey, 2009.

5.1.4 Land ownership Pattern

The landholding status of wages households was been presented, in table 54. It shows that 45 percent biogas households owned 10-20 kattha of land similarly 107.5 percent biogas household owned less that 10 katha of land. This indicates that small and medium landholdings were assocate with sample households. Only a few house hold owned above 20 kattha land (10 percent).

Table 5.4

Land Ownership Pattern

S.N.	Land Holding in Kattha	No. of Household	Percentage
1	Less than 10 kattha	7	17.5
2	10-20	18	45
3	20-50	11	27.5
4	Above 50	4	10
Total		40	100

Source: Field Survey, 2009.

5.1.5 Livestock Ownership

Livestock services as the source of dung for Biogas plants. They are the source of raw materials needed to run biogas plants. Livestock population of sample biogas plants is presented in table 5.5

Table 5.5
Livestock of sample Biogas Households

S.N.	Types of animal	No.	Percentage
1	Cow	57	29.38
2	Ox	74	38.14
3	Buffalo	63	32.47
4	Bull	-	-
5	Other	-	-
	Total	194	100

Source: Field Survey, 2009.

5.1.6 Economic Status

Income level is the major indicator of accessing economic status in the society. The research study indicated the economically medium level households have adopted bio as technology at widespread level.

Table 5.6
Income level of Biogas Households

S.N.	Income level (Annual)	No.	Percentage
1	Below Rs. 20,000	3	7.5
2	Rs.20000-60000	21	52.5
3	Rs.60000-80000	9	22.5
4	Above Rs.80000	7	17.5
	Total	40	100

Source: Field Survey, 2009.

Above the table shows that majority of households (52.5) followed by 22.5 percent households with Rs. 60,000-80,000 income. This depicts that medium level of biogas households form economic point of view are associated with scale adaptation of biogas technology.

5.1.7 House Type

Housing status is also an indicator of wealth among biogas households Nearly 45 percent of sample biogas households are living in ardhapakki, 15 percent reside in kachha house and 40 percent live in pakki house.

Table 5.7

Nature of House of sample Biogas Households

S.N.	Types of House	No.	Percentage
1	Kachhi	6	15
2	Ardhapakki	18	45
3	Pakki	16	40
	Total	40	100

Source: Field Survey, 2009.

5.1.8 Educational Status

Education is the basis of development of efficient manpower. Education al status of sample biogas households is presented in table 5.9.

Table 5.8

Educational status of sample Biogas Households.

S.N.	Educational status	No.	Percentage
1	Literate	2	5
2	Below S.L.C.	6	15
3	Intermediate	22	55
	Bachelor or above	10	25
	Total	40	100

Source: Field Survey, 2009.

5.1.9 Drinking Water Availability

The facilities for drinking water is the important indicator of development. The source of drinking water is presented in table 5.10.

Table 5.10

Source of Drinking Water

S.N.	Source of Drinking water	No.	Percentage
1	Well	3	7.5
2	Hand pump	37	92.5
3	Tap water	-	-
4	Cannel	-	-
	Total	40	100

Source: Field Survey, 2009.

Above the table shows that 99 percent of the sample biogas households are dependent on Hand pump. Followed by 7.5 percent on well on source.

5.1.10 Toilet Status of Biogas Households

Table 5.10

Toilet Status of Biogas Households

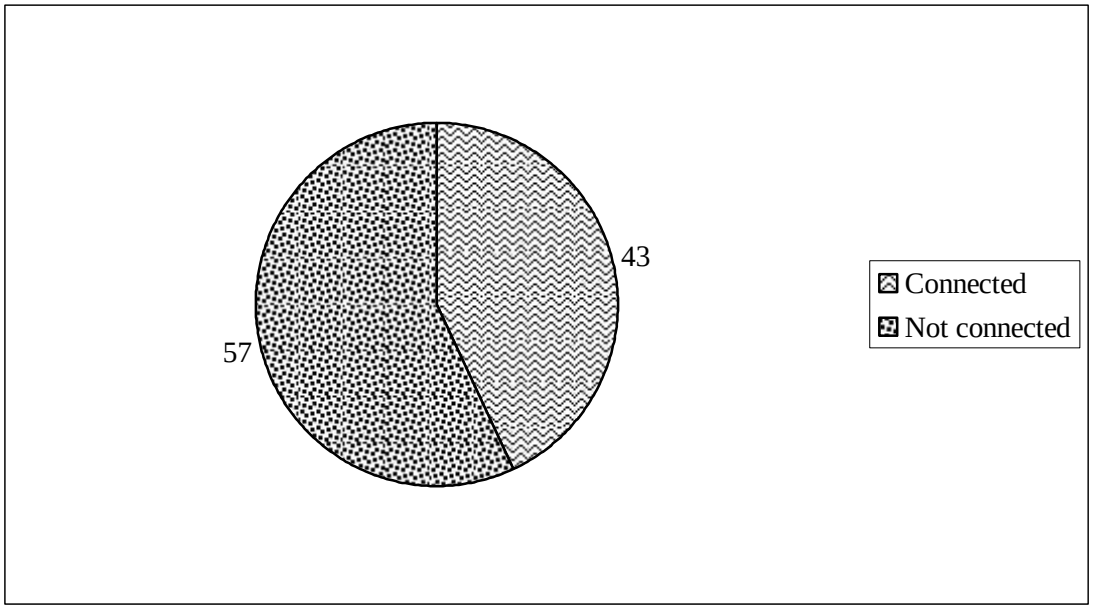
Toilet status	Types of toilet		Total No.	Percent
	Pakki	Kacchi		
Yes	29	6	35	87.5
No	-	-	5	12.5
Total			40	100

Source: Field Survey, 2009.

Above table shows that among survey households 87.5 percent surveyed households 87.5 percent have their own toilet while remaining 12.5 percent use open jungle, river banks. Among these 35 toilets 29 were pakki and while were kachhi in nature.

Figure 5.2

Toilet Attachment with Biogas Plant



Above figure shows that out of toilets contracted by sample biogas households 57 percent are Not connected with biogas plant and only 43 percent toilet are connected with plants.

5.2 Information on sample Biogas plants.

5.2.1 size of biogas plant:

Majority of the biogas plants were of the size 6ms (77.5 percent) followed by 8m (22.5 percent.)

Table 5.11

Size of biogas plant

S.N.	Size	No of Plants	Percentage
1	$6m^3$	31	77.5
2	$8m^3$	9	22.5
3	$12m^3$	-	
4	$19m^3$	-	
	Total	40	100

Source: Field Survey, 2009.

5.2.2 Reason for Biogas Installation

About 85 percent sample biogas households reported that the main reason for the installation of biogas was easy and smokeless cooking while 10 percent biogas households reported due to saving in time and 5 percent getting ride from firewood collection. Thus, easy smokeless and comfort cooking was main guiding and pushing factor for biogas installation.

Table 5.12

Reasons for Biogas installation

S.N.	Reason	No.	Percentage
1	Easy and smokeless cooking	34	85
2	Saving in time	4	10
3	Get ride from the fuel	2	5
4	Add prestige	-	-
	total	40	100

Source: Field Survey, 2009.

5.2.3 Source of Communication for Installation of Biogas Plants

Majority of biogas households reported that respective biogas companies were the main source of communication regarding the biogas plant prior to installation. Neighbour/friends/relatives served as the second important source of communication for biogas households.

Table 5.13

Source of Communication for Installation of Biogas Plants

S.N.	Source of communication	No.	Percentage
1	Radio/T.V	3	7.5
2	Neighbor	14	35
3	Nearest Biogas companies	7	17.5
	Friends	16	40
	Total	40	100

Source: Field Survey, 2009.

5.2.4 Sources of Funding of User Household

Beside subsidy the biogas households had to bear rest of the cost by themselves. Provision of loan was available for this purpose though the bank.

Among 40 households, 33 household (82-50 percents had their own source of funding for installing biogas plants. Distribution of households according to the source of money for installing the pants is shown in the table 5.1.4

Table 5.14

Sources of Self Investment of Sample

S.N.	Source	No.	Percentage
1	Own source	33	82.5
2	Loan from ADB	5	12.5
3	Loan from other friend/ relative.	2	5
	Total	40	100

Source: Field Survey, 2009.

5.2.5 End- use of Biogas

All the biogas households reported that they are using biogas only for cooking purposes. As there is provision of electricity facility use of biogas wasn't for lighting purpose.

5.2.6 Dung Availability

Livestock dung is the main input for operation of biogas plant. So its availability sufficient quantity mut. Majority of sample biogas households had reported that the sufficient quantity of dung to operate the plants. As a consequences most of sample biogas users have not

connected there toilet to operator biogas plants to gas production. The per capita dung production of sample household was 17-18 kg.

5.2.7 Source of Water

Majority of sample plant owner reported that they do not have any problems as regards to water for operating the plants. They are using generally hand pump, well etc to mix dung.

CHAPTER - VI

IMPACT OF BIOGAS TECHNOLOGY ON USERS

In general the research study confirms the very positive impact of biogas technology at the household level covering gender issues, health, agriculture and other.

6.1 Impact on Saving of Money

However extent of saving differs family to family due to various reasons a considerable amount of firewood was saved after their installation of biogas plants among biogas households. Average amount of firewood saved was 4 Bhari firewood per month, Rs.600 at current price has been saved.

Table 6.1

Saving of Fire Wood

S.N.	Quantity of firewood saving	No.	Percentage
1	1-20 Bhari	11	27.5
2	21-40 Bhari	18	45
3	41-60 Bhari	9	22.5
4	Above 60 Bhari	2	5
	Total	40	100

Source: Field Survey, 2009.

6.2 Impact on Agriculture and Sustainable Land Use

6.2.1 Impact on Slurry Use Pattern

All the biogas households had used slurry as fertilizer in their fields. Slurry use pattern of biogas households is presented in table 6.2

Table 6.2

Slurry Use Pattern of Biogas Households

S.N.	Form of slurry	No. of household	Percentage
1	As liquid	2	5
2	As compost	38	95.0
	Total	40	100

Source: Field Survey, 2009.

The table shows that majority of plant owners about 95 percent used slurry as compost form while 5 percent household used in as liquid.

6.2.2 Status of Agriculture Production

The users surveys and impact studies carried out by different institutions biogas companies, NGO/INGOs consultancies and individuals have reported that agricultural production is increased after the adaptation of biogas as technology. However the present study indicated quite different scenario in case of production status of which is presented in table 6.3

Table 6.3

Slurry Use and Agro-Production Status of Sample Biogas Households

S.N.	Extent of problem status	No. of Household	Percentage
1	Decreased	2	5
2	Remained same	13	32.5
3	Increased	25	62.5
	Total	40	100

Source: Field Survey, 2009.

In the table shows that the study that 62.5 percent felt increased in production, 32.5 percent said that remained same due to composting and 5 percent felt decrease in production.

6.2.3 Extent of Use of Chemical Fertilizer

The impact of biogas slurry on use of chemical fertilizer is presented in table 6.4.

Table 6.4

Extent Use of Chemical Fertilizer after Installation of Biogas Plants

S.N.	Extent use	No. of household	Percentage
1	Reduced	13	32.5
2	Remained same	18	45
3	Completely reduced	7	17.5
4	Increased	-	-
5	Never use	2	5
	Total	40	100

Source: Field Survey, 2009.

When asked about the impact of biogas slurry on the use of chemical fertilizer, 45 percent of total sample biogas households told there was remained same to use of chemical fertilizer after installation of biogas plants 32.5 percent of total sample biogas households told that they reduced the use of chemical fertilizer 5 percentage household totally stopped using chemical fertilizer.

6.2.4 Impact of Natural Resources Management (Sustainable land use)

About 75 percent of the sample of biogas households are involved in management of nearly community forest after the installation of biogas plant while 25 percent of biogas household were not involved in community forest management due to their own farm forestry.

Majority of the respondent are involved in community forest management. The report shows that decrease trend of encroachment of

people into forestland. The installation of biogas plant was seen as important factor leading to this tendency.

6.2.5 Perceived Problems

Table 6.5

The Major Problem Faced by Biogas Users

S.N.	Problem	No. of Household	Percentage
1	Technical problem	6	15
2	Insufficiency of manure	4	10
3	Decrease in agricultural	3	7.5
4	High interest rate of loan bank	7	17.5
5	Insufficiency of gas during winter	20	50
	Total	40	100

Source: Field Survey, 2009.

The table shows that the major problem faced by biogas users, technical problem, insufficiency of manure, Decrease in agriculture production, high interest rate of Bank loan, and insufficiency of gas during winter.

6.2.6 Perception Towards Biogas

Positive

Almost all biogas households were satisfied with biogas due to clean, saving in time and comfort cooking, smoke free environment.

- Most of the 95 percent of biogas household opine that biogas installation is financially feasible, affordable to rural people.
- Above 90 percent of biogas households have perceived that biogas plant installation has easy and smoke less cooking.

Negative perception:

- The villagers felt bad smell in their kitchen.
- Increase in mosquito due to installation of biogas was the principal negative perception reported by almost all biogas households.
- All most all biogas households reported use of biogas isn't unsuitable for all cooking purposes and needs more concentration while cooking.

6.2.7 Suggestion of Sample Biogas Households

Biogas households have given suggestion on the basis of the problems perceived by them for wider dissemination of biogas technology in rural Nepal.

- Subsidy should be provided directly only to small and marginal farmers through government agencies instead of private biogas companies.
- Regular supervision of the installed plant should be done.
- The user should be provide technical knowledge in order to carry out simple operation repair and maintenance of biogas.
- Research should be carried out to tower the cost of biogas plant and to increase the efficiency of gas production in winter.

CHAPTER - VII
CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusion

Nepal is an agricultural country. Majority of people depend upon agriculture for their sustenance. Livestock raising is an integral part of crop livestock integrated hill farming system. The farmers can't abandon livestock rearing indeed because they can't produce field crops without livestock manure. On the other hand, they can't withstand frequent rise in price of petroleum fuel. The fuel wood availability is being decreased due to rapid deforestation. In this context biogas technology is an alternative, sustainable and affordable to rural people in Nepal.

7.1.1 Socio-Economic Condition of Biogas Households

Service was the main occupation of biogas households under the study. The majority of biogas households were Brahmin (35 percent) chaudhary 27.5 percent, food security condition is good. Majority fo households were medium on almost all aspects on the basis of socio-economic indications.

7.1.2 Information of Sample Biogas Plant

All the sample plants were in operation and producing sufficient gas except during cold months size of $6m^3$ biogas plant was very popular (77-5 percent) in this VDC as compared to others. Friends were the main source of communication to encourage the installation of biogas plants.

Biogas was used only for cooking purpose. Majority of biogas households had adopted biogas technology through their self initiatives.

Most of the biogas households had installed their biogas plants on their own source.

7.1.3 Impacts of Biogas Technology

Majority of biogas households have connected (57 percent) their toilet to biogas plants due to encouragement of biogas companies. Such toilet attached biogas plant is an appropriate alternative technology in study area. Some biogas households didn't connect because of social and cultural taboo. Certainly it has made contribution in improving quality of indoor air, health of household members, reduction in medical expenses, drudgery and health hazards of rural people by no doubt.

7.1.3.1 Impact on Household Economy

A considerable amount of money was saved after biogas installation due to saving of considerable amount of firewood, majority of biogas households used it in general household expenditure while some households used it n education of children and some in agriculture activities.

7.1.4 Major Problems

Respondent's perception of major problem faced by biogas households in the descending order were, technical problem insufficiency f gas, high interest rate, spare parts not easily available and costly.

7.1.5 Perceptions

The perception of the biogas households towards the impact of biogas technology was found both positive and Negative. Smokeless cooking, reductive in health problems and financial saving were major positive impact while less testy, rusting of cooking vessels. The biogas

households had also experienced disadvantages of biogas technology. They ware, high installation cost, bad smell due to leakage of gas, incidence of mosquitoes.

Thus on the basis of finding of the study, biogas technology is proved as cheap, sustainable and clean energy technology and has improved the living condition of rural people along with the improvement in sanitation of local environment. However poorest of the poor people couldn't be benefited from this technology. Anyway, to reach self-sufficiency in energy and fertilizer requirement of people residing in rural Nepal, such indigenous resource should be actively mobilized and economically utilized in the Nepalese context.

7.2 Recommendations

Development of any sector is never ending process so on the basis of key findings of the study, the following recommendations are made to get further desired impacts.

- Installation of biogas should not be provided where water problem is existent otherwise it would have negative impact on women.
- Concerned biogas companies should carryout supervision, monitoring and evaluation of installed biogas plants regularly.
- Toilet attachment of biogas plants praise worth in the study area. This is recommended to be adopted in other place also. Provision of some sort of financial incentives in construction of toilet will provided encouragement to the biogas house holds.
- It is realized from the study that biogas technology is mainly adopted by medium and higher-class people at wide scale level. So,

government should introduce consistent policy and make possible intervention for promotion so that access of biogas technology could reach at rural remote area and penetrate small, marginal and poor people.

- The installation cost of biogas plant is high due to several factors. So the companies should pay attention towards the lowering its administrative cost and improving the managerial efficiency.

- Concerned agencies should conduct awareness program about the positive impact of biogas technology to maximize adoption of biogas technology in rural area.

- There should be introduction of such creative programmers which would contribute for women empowerment through the better utilization of gained time.

- Majority of biogas users households have perceived the decline in agricultural production in study area. So, Trainings on proper management of biogas slurry should be done to ensure more agricultural production.

- The concerned biogas companies should mobilize local NGOs to promote biogas techno logy so that they can act as bridge between users and the companies.

- Despite the provision of subsidy, the adoption level is low as expected. Only medium and high class people enjoyed their subsidy therefore government should for mutate long term planning and clear cut policy regarding the subsidy be fixed in order to exploit the install the biogas plant.

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APPENDIX-I

THE SOCIO-ECONOMIC IMPACT OF. BIO GAS IN NEPAL

(A CASE STUDY OF SHREEPUR VDC, KAILALI DISTRICT, NEPAL)

HOUSEHOLD QUESTIONNAIRE MODEL

1) General

Name of the house owner ……

Sex: M/F

District …….. village …. ward No: …….

Name of respondent …….

Sex: M/F

Religion:

Ethnicity:

Educational Status

(a) Literate [ ] (b) below S.L.C. [ ] (c) Intermediate [ ]

(d) Bachelor or above .....

2. Socio-Economic Information

2.1 Occupation

a. Agriculture [ ] b. Service [ ]

c. Business [ ] d. Wage earner [ ]

e. Others [ ]

2.2 Income level (yearly)

a. Below Rs.20000 b. 20000 - 40000

c. 40000 - 60000 d. 60000 - 80000

e. Above Rs.80000

2.3 Land holding in local units

Bigha …..... Kattha …….

2.4 Live stock Holding

S.N	Types of animal	Total	Total production of manure (Kg or day)
1	Cow		
2	Ox		
3	Buffalo		
4	Bull		
5	Other		

2.5 Source of drinking water

a. Well [ ] b. Hand pump [ ]

c. Top water [ ] d. Cannel [ ]

f…….

2.6 Types of Hours

a. Kachha [ ] b. Ardha pakki [ ]

c. Pakki [ ]

2.7 Means of media

a. Radio [ ] b. T.V [ ] c. Other ……..

2.8 Toilet status

2.8.1 Do you have toilet

a. Yes [ ] b. No [ ]

If yes, what nature?

a. Kachhi [ ] b. Pakki [ ]

2.8.2 Do you have the connection of the toilet with the bio-gas ?

a. Yes [ ] b. No [ ]

3. Information on biogas

3.1 How did you know about bio gas?

a. Radio / T.V [ ] b. Neighbour [ ]

c. Nearest Bio gas company [ ] d. Friends [ ]

e. Others ……

3.2 Reason of installation

a. Easy and smokeless cooking [ ]

b. Saving in time [ ]

c. Get ride from fuel wood collection [ ]

d. Add prestige [ ]

e. Other ….

3.3 What is the size of your bio-gas plant ?

$6M_3$ [ ], $8M_3$ [ ], $19M_3$ [ ], $12M_3$ [ ]

3.4 End - use of bio gas

a. Cooking [ ] b. Lighting [ ] c. Both [ ]

d. Other.....

3.5 Financing

3.5.1 Did you take loan to construct the plant?

a. Yes [ ] No [ ]

3.5.2 If no, why didn't you take loan?

a. Well economic condition [ ]

b. Interest rate too high [ ]

c. Lengthily official formation [ ]

d. Other.....

3.6 Dung fed per day ….....…. kg

3.7 Water used for mixing

a. Tap water [ ] b. Well [ ]

c. Hand pump [ ] d. River [ ]

3.8 Is the gas sufficient produced by your bio gas plant?

a. Yes [ ] b. No [ ]

3.9 If no which energy source you use for cooking?

a. Fire wood [ ] b. Kerosene [ ]

c. LPG [ ] d. Others [ ]

3.10 In which month of the year the gas is insufficient

……

4. Impact of Bio gas on saving

4.1 Saving on time

S.N	Works	Before installation	After installation	Time save (HRS) per day
1	Fuel wood management			
2	Cooking			

4.2 What are you doing in your leisure time ?

(a) Business [ ] (b) Agriculture [ ]

(c) Nothing [ ] (d) Others [ ]

4.3 Energy consumption

Source of energy	Consumption per month		Saving per month	
	Before install	After install	Quantity Kg	Price
Fire wood				
Other				

4.4 Which member of your family has been benefited most from bio gas plant?

a. Male [ ] b. Female [ ] c. Children [ ]

d. Servent [ ] e. All the above [ ]

4.5 Is any improvement in educational status of your children after installation of bio gas plant?

a. Yes [ ] b. No [ ]

4.6 Participation of women in social organization.

Before installation		After installation	
Yes	No	Yes	No
1. 2. 3.		1. 2. 3. 4. 5.	

5. Impact on agriculture production

5.1 Do you use bio gas slurry on the fields?

a. Yes [ ] b. No [ ]

If yes which from?

a. as liquid [ ] b. As compost [ ] c. As social [ ]

If no what do you do with slurry?

a. Sale to other [ ] b. Give out other [ ]

c. Make dung cake [ ] d. Others …

5.2 Is there mosquitoes or insects are increased due to slurry ?

a. Yes [ ] b. No [ ]

5.3 If used in farms does digested slurry have any impact on the production of crops?

a. Production increased significantly [ ]

b. Production remained the same [ ]

c. Production decreased [ ]

5.4 If production increased, how?

Crop	Crop yield		Increment	
	Before slurry use	After slurry use	Quantity	x
Paddy				
Wheat				
Maize				
Potato				
Oil				
Seed				

5.5 Impact of slurry manure over use of chemical fertilizer

a. Stopped using it completely [ ]

b. Using less quantity [ ]

c. Still using same quantity [ ]

d. Increase in quantity [ ]

e. Other

5.6 What are advantage of slurry over dung?

a. Absorbed by the crops very easily [ ]

b. More effective [ ]

c. No advantage [ ]

d. Other [ ]

6. Perceptions towards bio gas

6.1 Do you think bio gas technology is affordable in rural area?

a. Yes [ ] b. No [ ]

6.2 Are you satisfied with bio gas cooking?

a. Yes [ ] b. No [ ]

6.3 What is your feeling on taste of food?

a. More testy [ ]

b. Less testy [ ]

c. More or less testy [ ]

6.4 Do you think bio gas raises social status of the family?

a. Yes [ ] b. No [ ]

Thank You !