# CHAPTER - I

# INTRODUCTION

## 1.1 Background of the Study

Nepal is one of the poorest and least developed countries in the world with diminutive per capita income of and 470 (World Bank, 2008). It is small country with 147181 Sq. km area inhabited by more than 23 million people (Population Census, 2001). Its economic and social situation is in a weak condition. The population is predominantly and other sectors of the economy are quite small. National account data reveal that all factor cost share of agriculture in the total GDP was around 39 in 2007/08. Most of the rural population has the tradition of raising cattle as an integral part of their farm in addition to draft power and milk, cattle produce them necessary manure in the form of dung people are dependent mainly of firewood for their energy requirement. They use it for cooking space heating and other purposes.

The low level of economic development is also reflected in the level of energy consumption percapita energy consumption. In Nepal is a great disparity in the energy consumption pattern of the people as there is a disparity in the income consumption altitudes aspirations, life styles of Nepali people when divided energy into three parts by their sources namely traditional, commercial and renewable/alternative. Traditional energy occupied 87.8% commercial energy 11.5% and the renewable/ alternative energy 0.7% of the total energy consumption (Economic Survey, 2007/08).

This signifies that a large proportion of energy consumption is met by traditional energy. Sources with increasing pressure on forest

resources of rise with increasing pressure of population growth in Nepal demand for fuel is increasing at an alarming rate about 90% of total energy demand is met by burning of firewood agricultural residue and animal waste leading to serious consequences such as exploitation of indigenous forest resources deprivation of organic matter to agricultural land irreversible loss or soil fertility and loss of productively as well as environmental and health hazards. The use of forest resource beyond its regeneration capacity has resulted in ecological consequences in terms of soil erosion, floods and loss of top soil.

Rural people have been facing tremendous difficulties in collecting firewood as it is becoming both scarce and costly. Kerosene and other sources of fuel are not available on time in required quantity in various part of the country. Petroleum products the most important form of commercial energy are totally imported in Nepal. Eventhough percapita level of consumption of petroleum products in Nepal is one of the lowest in the would the financial burden of its impact is quite heavy.

In order to overall the difficulties of energy and to provide the energy to the rural people, biogas as an alternative energy is essential in these days. There are so many alternative energy sources which are environmental friendly and easy to use. In Nepal the main sources of alternative energy are hydropower, solar energy wind energy, biogas energy etc. As the exploitation of hydropower, solar energy, wind energy involves a better technology and higher cost biogas remains the best alternative that stands technically and economically feasible the introduction of biogas helps in reducing firewood, kerosene consumption conserving environmental sanitation, reducing to workload to women and children and also increase agriculture production so biogas energy is much more useful energy in the context of Nepal which is also feasible

for rural people and easy to use in Nepal as total of 190000 family size biogas plants have been installed by the end of March 2009. Covering 69 distriefs in the terai, bill, remote hill region (Biogas, Bulletine, 2009).

The aims of the present study will be to evaluate the overall impact (socio-economic, environment) of Biogas in Bungkot VDC of Gorkha. This study will be important not only to the rural areas of the country but also for resources management in the nation as a whole. It is expected to extend help in formulating policies and strategies in the field of Biogas technology and as a whole in the field of alternative energy it is believed that this technology may play valuable role for upliftment of socio-economic standard of Nepalese people in general and rural people in particular.

## 1.2 Statement of the Problem

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

Firewood has been the most common and teaditional source of energy for Nepal firewood represents about three-fourth of the total energy consumption which is mainly consumed in rural Nepal a great part of this is consumed in the residential sector for cooking purposes Although there is huge potential of hydroelectricity only less than 1% has been harnessed. Other alternative sources of energy such as solar power and wind energy is negligible in use because of high cost of installation.

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. The depletion will lead to many natural culomities such as soil erosion, land slides, floods and destruction of the natural balance.

For the collection of firewood, rural women spend a great part of their time further more they spend considerable amount of time in cooking and washing the another problem of using firewood in kitchen is the smoke produced which makes the women suffer from indoor air pollution.

Under these conditions a search for the right kind of alternative energy becomes a most therefore the present energy problem leads to the study of a proper alternative source of energy such as biogas.

Biogas plant installation is one of the best alternative sources of energy it is comparatively advantageous than other renewable energy. Sources it helps to improved the sanitation condition of rural women and children. It helps largely in upliftment of socio-economic status of rural people. However the adaptation of renewable/ alternative source of energy and replacement of commercial and traditional energy has been challenging issues in Nepal. Due to high potentiality of biogas (2.7 million CBS, 2008) appropriate geography for earning from carbon development fund the biogas (known as gobergas) could be an influential technology to explore in Nepal. Biogas requires animal dung or human excreta or vegetable orange matters as raw materials which are readily available generally free of cost.

So renewable/alternative energy sources like biogas can help in either reducing or replacing use of fuelwood as the energy sources for cooking and lighting. Thus biogas can play vital role in slashing down,

demand of firewood such can ultimately influence in reducing deforestation.

## 1.3 Significance of the Study

Nepal is rich in water resource how ever due to lack of funds it is still underutilized. Next best is biogas, which is rural based technology and considered as Ram-Rajya. Many studies done on biogas energy have drawn the positive impact on women health and their socio-economic and environmental activities.

Biogas energy is less costly than micro-hydropower and other electricity. It is easy in installation. Biogas technology has no doubt can contribute to an energy sector of Nepal. This simple technology contributes a lot in lessening the burden on the forest resource. By promoting the mutilation of biogas we can prevent deforestation. Deforestation is the main causes of many natural calamities such as landslide, floods. Soil erosion etc.

Installation of biogas plant would help towards agricultural production. The digested slurry contains more nutrients and can be used as a good fertilizer. The biogas plant further help in saving time and money both in collecting the firewood and in cooking activities. It provides a smokeless environment in the kitchen. All these advantage show the importance of biogas.

As energy with this kind of technology, the working up and results would be better achieved if there are timely follow-ups and troubleshooting. Provided it is true with biogas technology too. Therefore examing the past performance of this technology is important

for better running of the installed plant and for better running of the installed plant and for new installation.

This study which is confined to only Bunkot VDC where the main source of income is agriculture and animal husbandry is in practice since time immemorial it is expensive for the people of these areas to use other commercial sources of energy such as oil kerosene or gas burning of firewood or other biomass fuels in traditional cooking stoves generally produces excessive. Smoke and can cause serious damage to health especially that of women who directly involves in cooking. The development of the biogas plant which reduces the emission of smoke can therefore significantly contribute towards improving the quality of life of the people in this area.

## 1.4 Objective of the Study

The general objective of the study is to evaluate and assess the socio-economic impact of biogas plant ingtallation on its users. However the specific objectives are as follows:

1. To study the biogas plant as an alternative of forest resource.
2. To assess socio-economic benefit of the users from the biogas.
3. To suggest measure for suitable policy formulation.

## 1.5 Limitation of the Study

This study attempts to assess the socio-economic impact of biogas plant on its users in Bungkot VDC, Gorkha district. However it has following limitations.

a) This study deals importance of biogas plants in Bungkot VDC only.

b) This study considers only socio-economic aspects. It does not deal with the technical aspect of biogas plants.

c) It is an individual study so it does not cover whole aspect of biogas but it can references for further study.

## 1.6 Organization of the Study

The study in total consists of Eight chapters. The First chapter of the study includes introduction, statement of the problem, objectives, significance and limitation of the study. In the Second chapter review of literature and the Third chapter include methodology where research design, nature and source of data, sample size, data collection tools and technique and data processing and analysis, Fourth chapter include evaluation of biogas energy in Nepal socio-economic status of the respondents are given in chapter Five. Where chapter Six and Seven discusses the socio-economic benefit of Biogas plant. Summary, conclusion and recommendation are given in chapter Eight.

# CHPATER - II

# LITERATURE REVIEW

In the past decades several research studies and investigation have been made in innovation and development of biogas technology. Moreover seminars, workshops, symposiums and conferences have been held both in national and international level to reach the present stage of this technology. Similarly a number of books, booklets, Journals, reports, bulletins have been published pertaining to biogas.

Thus a brief review of the literature on Biogas plant was made to have good knowledge about the subject matter and analysis of the previous worked one on the field of biogas energy sector thereby providing a solid feed back to the researcher. The review is specially focused on impact of biogas. The summaries of out comes of some of these studies have been illustrated hereafter.

## 2.1 Conceptual Framework

### 2.1.1 Alternative Sources of Energy

- **AEPC (2000). in its Publication "An Introduction to Alternative Energy. Technology in Nepal."**- states that there is a dire need to substitute as well as supplement the traditional energy supply system by modern forms of sustainable energy in terms of resources and technology because of the country's dependence on imported fossil fuel high cost of grid connection and low and scattered population density, a decentralized energy supply system becomes the natural and feasible choice decentralized new and alternative energy system such as micro hydro, solar photovoltaic,

biogas, improved cooking stove etc provide feasible and environment friendly energy supply options in rural areas. The most important alternative/renewable energy technology in Nepal is related to pico hydropower and micro hydropower (up to 100 kw) biogas energy (Biogas, briquettes, gasifies, improved cooking stoves) solar photovoltaic. Solar thermal (Solar water heater, Solar drayer, solar cooker etc.)

- **In a ducatrient on Renewable Energy Perspective Plan of Nepal, 2002, planning commission-** stressed that rural alternative energy can play the role of a catalyst for poverty reduction by providing the modern from of energy. Micro hydro installation both at individual and community level has contributed to the local economy institutions building and dissemination of skills and setting industrial enterprises alternative renewable energy is clean energy and its uses for cooking and lighting reduce the pollution and health hazards associated with the fuel wood and kerosene renewable energy technology for rural Devt. (2003) institute of engineering T.U. Lalitpur, Nepal.

Alternative energy options are beaming the mainstream uption for rural Nepalis to access modern sources of energy some 45,000 new rural household are being provided services from biogas, solar pv, microhydro power etc. technology each year present.

So in Nepal forest is the largest natural resources not only interm of area coverage but also interm of use as fuel atmost more than 80% Nepalese live in rural area whose resource of fuel is firewood that has been used since long time back tratienally each year. If this ligacy continue for few years definitely Nepal turns into desert in this regard

alternative source of energy could be one of the best options to replace traditional resource of fuel which in a way control deforestation in another way protect environment.

### 2.1.2 Biogas in General

- **BSP (2009), in its "Annual Bulletin BSP-Nepal", describes that-** Biogas is mixture of gas produced by methanogenic bacteria while acting upon biodegradable materials in an anaerobic condition. It is mainly composed of 50-70 percent methan, 30-40 percent, carbondioxide and some other gases. It is about 20 percent lighter than air. It is an odorless gas than burns with clear blue flame similar to that of LPG gas.

- **AEPC (2000) in "An Introduction to alternative Energy Technology in Nepal"-** explains that Biogas technology is a complete system in itself with its objective factors such as microbes, plant design, construction materials, climate, chemical and microbial characteristic of inputs and the interrelationship among these factors influence production of gas in a digester the slurry from the biogas plant is supposed to be very fertile and its use in agriculture increases the productivity of crop tremendously.

Biogas technology has various benefits. It provide for cooking and also lighting other fuels can be saved considerably namely. The consumption of firewood, kerosene and LPG. Time and money can be saved as cooking biogas is faster than using kerosene of firewood. Due to the clean and healthy environment the living standard of the people may increase. Biogas also provides the highly nutrive organic manure for field which raises the productivity and lesion the requirement of

chemical fertilizer from the macro perspectives it saves the natural resources such as forest and prevents the problems of deforestation.

- **ADB/N (1996) in its study, "Impact of Biogas Installation in Nepal."-** elaborates that in biogas technology, an anaerobic fermentation of organic waste takes place causing its decomposition and a mixture of gases containing methare 60-70 percent evolves after the fermentation of the sludge like residue which is left behind can be used as an organic fertilizer (New ERA, 1999). The gas is colorless, odorless as well as toxicless and burus with clear blue flame. The slurry is not only odorless but also certains more nutnents like nitrogen, phosphorous and potash than in raw dung.

The volume of gas produced from the plants of both types totally depends. Upon the temperature inside the digester higher the temperature, higher is the level of daily gas production. Temperature between 30-39$^0$c is taken as suitable one for fermentation likewise ph of 7 to 8 is considered as the best.

- **GGC (2009), while preparing Gobar Gas Company Profile, further expresses the view that-** biogas the clean energy technology has also improved sanitation of local environment however poorest of poor could not be benefited from the program directly after installation of biogas the gain time was utilized in goat raising, poutry farming gain time was utilized in goat raising, poutry farming other income generating activity, child care, agriculture production. Thus it has improved the living condition of the rural people it is believed that proper use of slurry from the plant would increase agriculture production for about 10-15.

Biogas is a wet gas as it picks up water vapour from the slurry biogas is about 20% lighter than air. The main component of biogas is methane which is colourless, odorless and tasteless. But due to the presence of other gases it gives same smell similar to that of garlic or rotten eggs.

- **N.K. Bista (1981) in his article "Development of Himalayan Resource for Regional Cooperation and National Govt."-** is of the opinion that Biogas can considered as most reliable alternative energy resources in replacing fuel wood of which the greatest part is used for cooking specially in rural area of Nepal. In Nepal it thus, there is an urgent need for substitution rural energy through non conventional energy resources.

- **Ramkrishna Pokherel (1992) in his articles "Application of Biogas Technology in Nepal, Prohblems and Prospects."-** has discusses different types of gases while contain in biogas on the following gas, methare ($clt_4$). So 70% carbondioxide ($Co_2$) 40-50%, Hydrogen ($H_2$) 0.3%, Nitrogen ($N_2$) 5-10%, water vapour ($H_2o$) 0.3%, Hydrogen sulfide ($H_2s$) traces carbon monoxide (Co) and oxygen ($O_2$) very negligible in biogas.

## 2.2 Empirical Framework

### 2.2.1 Biogas in Nepalese Situation

- **AEPC (2008) Final Report of Biogas Users Survey-** Explains that Alternative Energy promotion centre was established in Nov. 1996. It has been responsible to implement biogas users survey. Since 1998 in continuation to AEPC's previous survey in this line. This study has been performed by AEPC through NEPCON.

In this survey 500 sample households were chosen from each for the Hill and Terai. This survey reports main expected outpust are:

- High satisfied users from biogas installation.
- High rate of operational and functioning of plant installation of quality biogas plants.
- Assessment of time saved and its utilization in income generating and other useful activities.
- Increase, number of users having connection with toilet.
- Substitution of firewood, kerosene by biogas there by saving money time improving in house pollution.
- Improve health and hygiene of the users especially women.
- Empowerment of Gender.
- Timely supervision, repair and maintenance of biodigesters by the company.
- Promoting the utilization of bioslurry to increase productivity of soils and crop production.

Specific Objectives are:

- Impact on health and sanitation
- Impact on socio-economic condition
- Impact on gender
- Impact on agriculture and
- Impact on energy, mission reduction and environment

The findings of this survey have been organized into eight chapter altogether. The first chapter gives the introduction of the survey and its objectives and discusses. The methodology adopted for this survey. The socio-economic impact of biogas is given in the second chapter. The third chapter deals with the findings on agriculture and land use pattern and the fourth chapter with the issues related to environment energy and emission reduction in the fifth and sixth chapter impact of biogas on health and sanitation and gender related issues are discussed, respectively. Chapter seventh assess the construction operation and maintenance aspects while also measuring the satisfaction level of the beneficiaries. The last chapter presents the conclusion and possible recommendations as derived from the survey finding.

- **Karki (2002). in his articles "A study of Renewable Energy Technology with Focus on Income Generating Activities"-** has focused the study in Dhading district, the study was mainly focused on the adoption of renewable energy technology (RET) and its impact on income generating activities. The outcome of this study shows that three among the five of biogas users reported an increase in crop production by 5 to 10 percent due to the application of bio-slurry. However user of other types of renewable energy technology (RET) did not report an increase in crop production as experienced by the biogas users. The biogas users HHs main income generating activities are agricultural based like vegetable. Butter (Ghee) and local wine (Rakshi) production. Pertilizer required for vegetable production has reduced and so the amount of money spending on chemical fertilizer. Dev part Nepal (2001) "Research study on optional biogas plant size daily consumption pattern and conventional fuel saving.

Has carried camed out the study of the impact of biogas on users and also taken non-biogas households for the study Syngja, Nuwakot, Chitwan and Morang districts were taken as the study area representing high hills, mid hills and tarai region of the country.

The out come of this study has shown that the whole quantity of dung produced is not collected by the biogas users and collected amount is also not entirely fed into the plant which reduced the plant efficiency. However, the plant efficiency was found to be increased with the latrine attachment. This study has also shown the comparatively greater benefits to biogas users than non-biogas HHs with regarded to cooking food because of time saved. Similarly, the total saving of kerosene was significant (2.7 litres per year per HHs). However, there seemed no specific correlation between average use of firewoodf and kerosene and the family size.

- **Mathew and Wim J. Van. Nes (1999) in their articles "Elements of success in rural household supply" has discussed the benefits of biogas which includes gender benefits, environmental benefits and health benefits.** It presents financial and economic assessment of the BSP, which illustrate economical attractiveness of the programme.

  The paper depicts the energy consumption pattern and states-

  i) Petraleum and coal are entirely imported requiring 35% of Nepalese export earning but meeting only 8% of the total energy demand.

  ii) Wood is used mostly 72% in the residential sector to meet energy demand.

  iii) The technical potential of biogas in Nepal is 1.5 million unit.

iv) The biogas plants till July 1998 are estimated to displace the use of 1,00,000 tons of firewood and 1.27 liters of kerosene annually.

This paper has provided other general idea about the biogas program in Nepal.

- **Karmacharya (1992) in his dissertation"An analysis of the socio-economic impact of biogas plants in Nepal"-** shows comparative analysis of installation of biogas plant under the Hill and Terai context.

Dadhikot village of Bhaktapur district for Hill site and Phoolbari village of Chitwan district for Terai site were chosen for the study. A total of 30 samples were chosen thus each site consisting of 15 samples the study takes economic approach and analysis is focused on the various type of benefits obtained and saving made through the installation of biogas plants.

No significant differences of impact were noticed between Hills and Terai. However, some noticed differences includes.

- Lamps uses patterns were zero in Terai but 27% in the Hills.
- Gas production was less in Hills.
- Use of slurry as fertilizer was low in Hill.

Has shown concise overview of studies specifically designed to measure the effects of biogas on women's workload in different geographical setting of Nepal and the studies were done in Rolpa, Rupendehi, Nuwakot, Chitwan districts.

The result from the study states the given the over whelming workloads for women in most part of Nepal, the saving in time in the majority of instances is quite significant. But it remarks that the introduction of biogas does not appear to fundamentally after the position of women. So called traditional or unequal patterns in the division of labors are sustained, with working women for long hours simply substituting one labour activity for another.

The research desired used were district based and village based workload effects were calibrated in terms of before and after installation of biogas. It was found from the study that estimated time saving for women in Rupendehi was 4 hours and 35 minutes can average in Nuwakot. However, in a village based research. The estimated time saving was found to be 1 hour and 55 minutes in pithuloa and 15 minutes in Hathiet village.

- **Sundar Bajgain and Indior (Sthapit) Shakya (2005) in their book "A Successful Model of Public Private Partnership for Rural Household Energy Supply"-** have made observations and data presented in this book are based upon the activities conducted by SNV/BSP from July 1992 to July 2003 i.e. phase I II and II of the program. Chapter I outlines the demographic location demographic, economy, energy profile and biogas potential of Nepal. Chapter II presents the Key indicaters measuring the success of the biogas program in Nepal. Chapter III provides a summary of the key factor that have contributed to the success of the biogas program. Chapter IV describes the role of various stakeholders involved in the devt of the biogas. Sector the social benefit accruted from the program are discussed in chapter V while the financial and economic benefits are presented in chapter VI the various challenges foresee in

implementing the program in the future and the opportunity available are discussed in chapter VII lastly the lesion learned and issues that required attention for more effective operation of the program are presented in chapter VIII.

- **Dr. P.K. Adhikari (1996) in his report "Effects of Biogas on Family Health, Sanitation and Nutrition" -** has concentrated on the impact study in the fields of health, sanitation and nutrition. Both positive and negative impacts has been evaluated.

Methodology (Source of information) consisted of

- Household opinion survey
- Women focus group discussion
- Key informants interview
- Field observation
- Pathological test of digested slurry.

The positive impacts on health were most significantly, reduction in eye disease, headache, coughing and throat ache whereas the negative impacts were increased prevalence of mosquito and loss of warmth in house in winter.

- **New ERA (1995) in its study "Biogas Plant in Nepal"-** has revealed that one of the main attraction towards the biogas plants of easy availability of gas for cooking almost all of the users used gas for cooking purposes and more than half of the owners used gas for lighting purpose as well. The main reason behained not using biogas for lighting were the availability of electricity frequent breakage of the gas. Lamp and mantle and insufficient gas particularly in winter were found however most of the users reported that they were satisfied with the use of gas for cooking.

The reason behind this satisfaction were mainly due to the less time for cooking no black shoot on cooking pot smokeless kitchen etc. Regarding the users of slurry only 44% of the users reported that the crop production was increased. The study has also revealed that the problem of eye disease and respiratory disease were reduced and the users felt some relief.

# CHPATER - III

# RESEARCH METHODOLOGY

This chapter discusses a set of methods, which are employed to conduct the research. The whole study is carried out on the basis of primary as well secondary data reliable and relevant study can be made possible only by applying scientific method. Hence, the primary purpose of this chapter is to discuss and design the framework for the research. Different procedures have been followed:

## 3.1 Research Design

For this study, a descriptive research design has been followed. The descriptive research has been utilized for the quantitative data obtained and derived during the study. The data that are not quantifiable have been explained literally. Analysis of the data has been made by generating the tables of averages and percentage.

## 3.2 Nature and Source of Data

Data is most important tool for research. Mainly two sources of data are used in the present research. Both sources of data have been used in this study.

### 3.2.1 Primary Sources

This study is mainly based on primary information obtained from field survey which is one of the main sources of primary data collection. The primary data have been collected during the field survey by structured questionnaire field visit and observation, interview. The

responses of biogas plant owners are regarded as the major sources of field information.

### 3.2.2 Secondary Sources

In addition to primary data, secondary data also have been used, wherever relevant to complete the study, such secondary data have been collected from different offices such as CBS (Central Bureau of Statistics), TU Central Library, AEPC (Alternative Energy Proportion Centre) BSP- Nepal, different books earlier research reports, central office of Biogas company etc.

## 3.3 Sample Size

In the VDC there are 34 biogas owning households since the number of biogas owning household is small all the 34 biogas households have been taken as the universe.

## 3.4 Data Collection Tools and Techniques

Data used in this study has been collected from field survey conducted in October 2009. The present study is based mainly on primary data they are used to estimate and evaluate the socio economic impact of biogas on the surveyed households. The survey is conducted through the formal method of interview through structured questionnaire key informant interview, observation. So following techniques have been used for data collection.

### 3.4.1 Structured Questionnaire

Keeping in view of the objectives a detail questionnaire was prepared and informations were collected from the respondents. The questionnaire was finalized after consulting concerned experts pretest of

the questionnaire was done at the vicinity of the study site to ensure its correctness. The approved questionnaire was served as a basic tool of data collection.

### 3.4.2 Unstructured Interviews

To collect further information questionnaire with open-ended questions was made available with concerned people who included:

- Government and NGOs officials

- VDC peoples

- Staffs of biogas companies

- Labours

- Owners of biogas plants

- Households without biogas plants

### 3.4.3 Field Visit and Observation

All of the biogas plants sites were visited directly to have better idea about the status of biogas plant.

- Biogas plant under construction.

- Working condition of biogas plant.

- Working condition of cooking gas stores and light.

- Site or slurry out put and its utilization in cultivated field.

- Sanitary condition around the households.

- Cleanliness of kitchen.

The direct observation provided information about how the biogas plant was constructed. How it was connected with the kitchen how the slurry is composted and used in the field.

## 3.5 Data Processing and Analysis

Data obtained from both primary and secondary source was coded and cast in appropriate format in table of average and percentage. Data analysis was done on the basis of biogas, percentage and mean. After this previous information as output has been documented in this report.

Information collected from questionnaire have been transformed in to a master sheet and data is tabulated on the basis of master sheet.

Information is grouped, sub grouped and classified as per the necessity and so as to meet the objectives of the study. The systematic analysis have been done using simple statistical tool such as percentage, average etc. have been used. The data that are not quantifiable have been explained in descriptive way.

# CHAPTER - IV

# EVOLUTION OF BIO-GAS ENERGY IN NEPAL

## ) Energy Situation in Nepal

Nepal, mainly dependent on traditional resources of energy that supplied by country's fragile and waning forest is among the least energy consumpting. Countries in the world (Baskota et al., 1999) but country's energy consumption has increased by 54% in last fifteen years (between 1985-2000) (HMG/N, 2001). The average final energy consumption of Nepal is about 400kg of oil equivalent and $CO_2$ emission percapita per year is about 0.1mt (WB, 2001). The energy problem in Nepal arises not only from execessive reliance on non-renewable energy resources but rather from the fact that one from of energy resources (fluelwood) is being consumbed at an unsustainable rate while the vest potential of other forms of renewable/alternative energy virtually unused. There is already a significant deficit in biomass. Supply and there are no substinites available for rural masses for immediates future. The use of traditional fuel is also extremely inefficient forest covers neary 38% of the country area and more than 90% of the people are depending on fuelwood, crop residue and animal dung for their required energy services like heating, cooking, lighting. The scenario of shifting from traditional fuel to commertial fuel in one side is not fast and on other side not sustainable. Those shifting are going towards fossil fuels, more than 80% of the Nepalese are farmers, their produce are being dried traditionally on solar energy, which is still unaccounted for in the national energy consumption scenario. Traditional from of food processing and cottage industries are also relying on fuel wood.

So alternative energy options are beaming the main scream option for rural Nepal is to access modern sources of energy. Some 45000 new rural households are being provided services from biogas, solar PV, micro-hydropower etc, technologies each year at present.

In village of Nepal more than 98% of domestic energy consumption is derived from firewood, agricultural waste and animal dung in activities like collection of wood animal dung, agricultural residue.

In Nepal forest is the largest natural resources not only interms of area coverage but also interm of use as fuel almost more than 80% Nepalese live in rural areas whose resources of fuel is firewood that has been used since long time back traditionally which cause huge deforestation each year. If these legacies continue for few years, definitely Nepal turns into desert in this regard. Alternative energy technology could be one of the best options to replace traditional resources of fuel which in a way control deforestation in another way protests environment.

Energy is the means meeting both the bare requirement of life support and for development efforts. It is required for the fulfillment of daily needs and for development activities. Nepal has one of the lowest percapita energy consumption in the wood of more 15 GJ and the lowest precipitate commercial energy utilization of 1 GJ. The low level of energy consumption has the direct impact on the development of the country. The energy consumption reflects the poverty of Nepal.

In the above context use of alternative sources of energy such as biogas and fuel efficient cooking, stoves, saves women's time and protect

their health. The introduction biogas technology in 1990s has been made possible by acceptance of biogas plants by rural people.

## ) Introduction of Biogas and Biogas Plants

Biogas is the mixture of gas produced by methanogenic bacteria while acting upon biodegradable materials in an anaerobic condition. It is mainly composed of 50-70% methane, 30-40% carbon dioxide and some other gases. It is about 20% lighter than air it is an odorless gas that burns with clear blue flame similar to that of LPG gas. (BSP, 2009)

Biogas plant is a device to produce biogas. The structure of the plant consists of a central pit covered with a dome like structure. The pit serves as digester and the dome serves and gasholder. Animal dung is mixed with water and fed through the inlet. The dung in the pit is anaerobically digested by the bacteria with generation of gas. The gas bubbles up and collects in the dome which is then supplied to house for its up through the pipeline. After digestion the digested slurry flows outside through the outlet.

## )Brief History of Biogas and Its Potential in Nepal

The first Gobargas plant was constructed in Nepal by B.R. Saubolle a school teacher in 1955. In 1968 Khadi and Village Industries Commission (KVIC) India built plant for an exhibition in Kathmandu. The agriculture department of HMG/N lunched a gobargas plants. Construction programme. In a systematic way during fiscal years 1975/76 which was declared as the "Agriculture Year" by His Majesty's Government of Nepal (HMG/N). The agriculture development Bank (ADB/N) provided free of interest credit to installation 196 plants against a target of 250 of the "drum type" gober gas plant (New ERA, 1989).

The development and dissemination of Biogas technology in Nepal was initiated in an erganzed way after the establishment of Gobar Gas Tatha Krishi Yantra Vikas (P) Ltd. (Gobar gas company in Short) in 1977 with three main shareholders. The Agriculture Development Bank (ADB/N) the Fuel Corporation of Nepal (FCN) and United Mission of Nepal (UMN) in 1974 Development and Consorting Services (DCS) built four floating drum plants of KVIC design. Ever since its establishment the gobar gas company has been sole responsible for promoting and installing Gobar gas plants all over Nepal. However the result of the programme of the company in the initial years was not so encouraging in comparison to its national.

**Potentials**

Research in various designs of biogas plant such as floating steel dome design, conceret fixed dome design precarted tunnel design, plastic bag, biodigester Ferro cement gas holder brick moter dome and mud dome were tested and experimented at Butwal. Fixed dome design a Chinese modification plant was introduced in Nepal in 1980s. After several modification fixed dome design (GGC Model, 1990) is the only recognize design which is more popular in Nepal.

During the period of 1981 to 1986, GGC developed and tested various designs of Biogas plants. Such as floating drom design fixed dome design tunnel design, plastic bag design biodigester and so on. Similarly various, types of biogas appliances such as gas pipes, mixture, machines, gas taps, stoves, lamps, water drains, gas meters, agitators, manometers, etc, were developed modified and tested on the other hand experiments with various alternatives feed stock such as eupatonum species, wall hyacinth, night soil and rice straw were experimented slurry.

Coming from the plant was applied to various crops, vegetables, cereals. It was also used for feeding fish and animals however most of the research on the subject was limited to experiments and papers.

Research was also conducted in the application of gas for running engines for agro-processing pumping water for irrigation and generating electricity specials.

Currently, there are some biogas companies having around 170 offices in different parts of the country 16 appliance accessory manufacturing workshops and the largest rural Development Bank of Nepal (ADB) and over 130 micro finance institutes providing credit to Biogas Users (BSP, 2007). As a result 29000 biogas plants have been installed at 69 distrect of the country by March 2009 about, 123000 plants have been altached with toilet (Biogas Bulletin 2009 March BSP).

The government has inspired people to install the biogas plant by providing sub studies which varies according to the geographical setting.

The total households 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 plant can be installed in Nepal out of which 57% in plains, 37% in hills and rest 7% in remote hills or in mountain region (BSP 2007).

## ) Biogas as Rural Alternative/Renewabe Energy

Biogas is mixture of gas produced by methanrebased bacteria acting upon bioderroable materials in an environment that is lacking oxygen. The Biogas systems installed by the BSP are of the fixed dome type. Ne capacities of the system presently promoted are of 4,6,8 and 10 m3, using cow and buffalo dung and water as the main feed materials.

The popular sizes are 4 and 6m3 size. A 6m3 system requires 36 kg of dung and an equal amount of water per day in the hilly areas. To burn a stove for 3.5 hours.

Biogas can be used for cooking lighting, refrigeration as well as operating machine. However to date biogas is popularly used in Nepal for cooking used for cooking, biogas, has to large extent helped in reducing the use of fuelwood and hence conserve the forests. In replacing kerosene for cooking and lighting, biogas has helped reduce expenses on imported fuel. The slurry from the digester is also used as fertilizer in the fields. This has enhanced agricultural production and replaced the use of chemical fertilizer. This technology has social implications. such as health benefits from reduced indoor pollutions and livelihood enhancement from income generation opportunities such as masonry available in this sector. In recent years this technology has also indicated potentials as a source of national income through carbon trading under the clean development mechanism (CDM).

# CHAPTER - V

# SOCIO ECONOMIC STATUS OF BIOGAS USERS

This chapter deals with the socio-economic condition/status of the biogas plant owners in Bungkot VDC.

Ethnicity/caste, occupation, family size education status, Land holding, livestock, size of biogas, reason for biogas, source of information for installation biogas plants were the main variables considered in this chapter.

## 5.1 Ethnic/Caste

There are different caste and ethnic groups in Bungkot VDC. The data on ethnicity of the biogas households is given in table No.5.1.

**Table 5.1: Ethnicity/Caste of Households**

| S.N. | Ethnicity/Caste | No. of Households | Percentage |
|---|---|---|---|
| 1. | Newar | 17 | 50 |
| 2. | Brahman | 6 | 17.647 |
| 3. | Chhetri | 4 | 11.764 |
| 4. | Magar | 3 | 8.823 |
| 5. | Gurung | 3 | 8.823 |
| 6. | Bishwokarma | 1 | 2.941 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

The above table shows that majority of biogas users were Newar (50%) and so this reveals that Newar who are considered as high class have adopted this technology.

## 5.2 Occupation

Survey of the occupation shows agriculture as the main occupation of the area (70.588%) 20.588% of the respondents were involved in services and only 8.823% were involved in business.

**Table 5.2: Occupation of the Respondent**

| S.N. | Occupation | No. of Households | Percentage |
|---|---|---|---|
| 1. | Agriculture | 24 | 70.588 |
| 2. | Services | 7 | 20.588 |
| 3. | Business | 3 | 8.823 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

The frame have more land and more animals for the dung need for the biogas in occupation to the servicemen and businessmen therefore the percentage of biogas installation by the farmer is high.

## 5.3 Family Size

Distribution of the households according to the family size is shown in the table below.

**Table 5.3: Distribution of Family Size**

| S.N. | Family size | No. of Households | Percentage |
|---|---|---|---|
| 1. | Small (1 to 4 persons) | 9 | 26.476 |
| 2. | Medium (5 to 7 person) | 21 | 61.764 |
| 3. | Large (above 8) | 4 | 11.764 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

The table shows that maximum number of respondents had medium sized family with 5 to 7 person. Minimum family size was 4 persons whereas maximum family size was 17.

## 5.4 Educational Status

Educational status of plant owners and their family member.

**Table 5.4: Educational Status**

| S.N. | Educational | No. of person | | | | Total | |
|---|---|---|---|---|---|---|---|
| | | male | % | female | % | number | % |
| 1. | 1-5 class | 15 | 23.076 | 10 | 21.276 | 25 | 22.321 |
| 2. | 6- SLC | 28 | 43.076 | 21 | 44.680 | 49 | 43.75 |
| 3. | Above SLC | 10 | 15.384 | 8 | 17.021 | 18 | 16.071 |
| 4. | Literacy | 9 | 13.846 | 5 | 10.638 | 14 | 12.5 |
| 5. | Illiterate | 3 | 4.615 | 3 | 6.382 | 6 | 5.357 |
| | Total | 65 | 100 | 47 | 100 | 112 | 100 |

Source: Field Survey, 2009

The data presented in table 4 reveal that majority of the children belong to 6 to SLC category only 25 person are in 1 to 5 class, 49 children are in 6 to SLC, 18 children are in above SLC 14 are literate (who can read and write simple letters) and only 6 persons are illiterate this result shows that only the old people are illiterate and people allow their children to school for study. So the education status of this area is satisfactory.

## 5.5 Land Holding

The land holding status of biogas household has been presented in table 5 it shows that about 23.529 percent biogas households owned 11-20 ropanies of land similarly 17.647 percent biogas households owned less than 10 ropanies and 29.411 percent biogas households owned 21-30 and above 30 ropanies of land.

**Table 5.5: Land Holding Status of Biogas HHs**

| S.N. | Landholding (Ropanies) | No. of households | Percentage |
|---|---|---|---|
| 1. | Less than 10 | 6 | 17.647 |
| 2. | 11-20 | 8 | 23.647 |
| 3. | 21-30 | 10 | 29.411 |
| 4. | Above 30 | 10 | 29.411 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

## 5.6 Livestock

Livestock dung is the main raw materials for installing biogas plant. All the plant owners have same kind of livestock. The situation of the livestock holding in the sampled household in the study area is presented in table 5.6.

**Table 5.6: Livestock Population**

| S.N. | Livestock | Number | Percentage |
|---|---|---|---|
| 1. | Cattle | 50 | 41.666 |
| 2. | Buffalo | 70 | 58.333 |
| | Total | 120 | 100 |

Source: Field Survey, 2009

## 5.7 Size of Biogas

Three size of biogas plants $6m^3$, $8m^3$ and 10 $m^3$ were reported. Majority of the biogas plants were $8m^3$ and $6m^3$.

**Table 5.7: Size of Biogas Plants**

| S.N. | Size of biogas plant | No. of HHs | Percentage |
|---|---|---|---|
| 1. | $6m^3$ | 9 | 26.470 |
| 2. | $8m^3$ | 20 | 58.823 |
| 3. | $10m^3$ | 5 | 14.705 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

## 5.8 Reason for Biogas Installation

About 44.117 percent sample biogas households reported that the main reason for the installation of biogas was easy and non-smoking cooking while 17.647 percent biogas HHs reported save of time, 8.823 percent reported conserve environment and status symbol, 5.882 percent due to all the above reason.

Thus smokeless and amfort cooking was main guiding and pushing factor for biogas installation.

**Table 5.8: Reason for Biogas Installation**

| S.N. | Reason for biogas installation | Number of plant | Percentage |
|---|---|---|---|
| 1. | Easy and non smoking cooking | 15 | 44.117 |
| 2. | Save of time | 6 | 17.647 |
| 3. | Status symbol | 3 | 8.823 |
| 4. | Conserve environment | 3 | 8.823 |
| 5. | Increase production | 2 | 5.882 |
| 6. | All of the above | 5 | 14.705 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

## 5.9 Source of Information for Installation 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 served as the second important source

of communication for biogas. HHs while 5 biogas HHs obtained information from friends and 4 biogas HHs obtained information from radio/T.V.

**Table 5.9: Source of Information**

| S.N. | Source of Information | No. of plants | Percentage |
|---|---|---|---|
| 1. | Biogas company | 18 | 52.941 |
| 2. | Neighbour | 7 | 20.588 |
| 3. | Friends | 5 | 14.705 |
| 4. | Radio/T.V.` | 4 | 11.7647 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

# CHAPTER VI

# SOCIAL BENEFIT OF BIOGAS PLANTS OWNERS

This chapter includes the social benefits of biogas plants.

## 6.1 Reduction in Workloads and Saving of Time

After installation of biogas there has been considerable reduction in work loads of the family member especially of the women members. The reduction in workload has been measured in terms of saving in working time observation was made on 3 categories of works fuel management, cooking activities and washing utensils.

**Table 6.1: Reduction in Workloads and Saving of Time**

| S.N. | Category of work | Average time taken hrs/day | | Reduction in work load and saving of time hrs/day |
|---|---|---|---|---|
| | | Before installation | After installation | |
| 1. | Fuel manage | 3.93 | 0.23 | 3.7 |
| 2. | Cooking activities | 3.3 | 1.6 | 1.7 |
| 3. | Washing utensils | 1.2 | 0.55 | 0.65 |
| | Total | 8.43 | 2.38 | 6.05 |

Source: Field Survey, 2009

The table shows that saving in time is considerable. A great time (3.7 hour per day) is saved in fuel manage only. The total time saving of

6.05 hour per day indicators that half of the days workload of the family member have been reduced.

## 6.2 Use of Surplus Time

Due to the installation of biogas time has been saved considerably. Time saved in cooking cleaning, cooking utensils fuel manage, collecting firewood has many positive benefits to the HHs most of the HHs have used that saved time to farm activities and child care.

**Table 6.2: Specific Benefit of Surplus Time**

| S.N. | Benefit use | No. of HHs | Percentage |
|---|---|---|---|
| 1. | Farm activities | 15 | 44.117 |
| 2. | Child care | 6 | 17.647 |
| 3. | Education | 4 | 11.764 |
| 4. | Business | 3 | 8.823 |
| 5. | Entertainment | 2 | 5.882 |
| 6. | Kitchen garding | 2 | 5.882 |
| 7. | Income generating activities | 2 | 5.882 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

## 6.3 Health and Sanitation

The study has shown that biogas has positive impacts towards health and sanitation of the respondents. Use of toilet reduction in disease, source of drinking water have been detail in this section.

### 6.3.1 Toilet Attachment with Biogas Plant

Out of total toilets constructed by sample biogas household 91.176% toilets are attached.

**Table 6.3.1: Toilet Attachment with Biogas Plant**

| S.N. | Types of toilet | No. of household | Percentage |
|---|---|---|---|
| 1. | Connected with biogas | 31 | 91.176 |
| 2. | Non-connected with biogas | 3 | 8.823 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

With biogas plant while only 8.823 percent toilets are no attached with biogas plant which we can see in above table 6.3.

### 6.3.2 Reduction in Disease

The major impact of biogas plants on the reduction of disease is as follows.

**Table 6.3.2: Reduction in Disease**

| S.N. | Illness | No. of HHs | Percentage |
|---|---|---|---|
| 1. | Eye burning and headache | 12 | 35.194 |
| 2. | Respiratory problem | 10 | 29.417 |
| 3. | Fever | 6 | 17.647 |
| 4. | Whooping cough | 2 | 5.882 |
| 5. | No change | 4 | 11.764 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

Table 13 shows 35.294% eye burning and headache 29.294% respiratory problem, 17.647% fever, 5.882% whooping cough and 11.764% respondent didn't feel any change.

### 6.3.3 Sources of Drinking Water

The facilities for drinking water and toilet in rural area are the important indicators of development of the source of drinking water presented table 6.3.3.

**Table 6.3.3: Sources of Drinking Water**

| S.N. | Sources of drinking water | No. of HHs | Percentage |
|---|---|---|---|
| 1. | Tap water | 30 | 88.235 |
| 2. | Well | 3 | 8.823 |
| 3. | Stream | 1 | 2.943 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

Above table shows that 88.235% of the biogas households are dependent on tap water followed by 8.823 percent on well and 2.941 percent on stream sources.

# CHAPTER - VII

# ECONOMIC BENEFITS OF BIOGAS PLANTS OWNERS

This chapter discusses about the saving of firewood saving of money, specific benefits from the saving, slurry and agriculture, operation and maintenance, users perception and suggestion of biogas plant.

## 7.1 Saving of Firewood

Considerable amount of firewood have been saved after the installation of biogas plants. Average amount of firewood saved per household is 12.6 bhari per month. One bhari is equivalent to about 30 kgs.

**Table 7.1: Saving of Firewood**

| S.N. | Quantity saved/month | No. of HHs | Percentage |
|---|---|---|---|
| 1. | 1 to 10 bhari | 18 | 52.941 |
| 2. | 11 to 20 bhari | 14 | 41.176 |
| 3. | 21 to 30 bhari | 2 | 5.882 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

## 7.2 Saving of Money

Money saved in kerosene and LPG from the monetary point of view the decrease by 0.25 litre in summer and 0.19 litres in winter is equivalent to the daily saving of Rs.13.75 in summer and Rs.10.45 in

winter per household (Assuming 1 litre kerosene costs Rs.55.00). This is a saving of about Rs.412.5 in a month in summer and Rs.313.5 in winter.

The installation of biogas plant has also seemed to constitute in changing the consumption of LPG gas to some extent. The data in this connection are presented in table 7.2.

Comparision of the use of LPG before and after the installation of biogas plant.

**Table 7.2: Saving of Money**

| Status | LPG cylinder used per biogas HHs/year | |
|---|---|---|
| | In summer | In winter |
| Before installation of biogas plant | 3 | 3 |
| After installation of biogas plant | 1 | 2 |
| Decrease | 2 | 1 |

Source: Field Survey, 2009

The study reflects that the consumption of LPG in biogas household per year in summer and winter is found to be 2 and 1 cylinder respectively.

## 7.3 Specific Benefits from the Saving

The respondents were asked about the specific achievement made after saving many on buying firewood and LPG. Following table shows it.

**Table 7.3: Specific Benefits Made from Saving**

| S.N. | Specific benefits | No. of HHs | Percentage |
|---|---|---|---|
| 1. | Invest children education | 12 | 35.294 |
| 2. | Income generating activity | 6 | 17.647 |
| 3. | By ornament | 4 | 11.764 |
| 4. | Buy land | 3 | 8.823 |
| 5. | Construct house | 4 | 11.764 |
| 6. | Invest in agriculture | 4 | 11.764 |
| 7. | No benefit | 1 | 2.941 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

The table shows that biogas has good contribution towards the field of education 35.294% of the HHs have invested their saving for purpose of educating their children. Similarly 17.647% HHs invested for the income generating activities such as in small business.

## 7.4 Slurry and Agriculture

The digested slurry can be used as manure in the fields all of the HHs used slurry as fertilizer for increasing crop production. Though exact calculations were not possible use of slurry had certainly saved money which might have been otherwise used to buy chemical fertilizer.

### 7.4.1 Increment in Agriculture Production

Regarding an increase in production 28 HHs reported that there was an increase in their agriculture production and only 3 HHs

agricultural stated that production has decreased and 3 HHs did not feel any change in production.

**Table 7.4: Slurry and Production Increment**

| S.N. | Quantity saved/month | No. of HHs | Percentage |
|---|---|---|---|
| 1. | Agricultural production increased | 28 | 82.359 |
| 2. | Decreased | 3 | 8.823 |
| 3. | No change | 3 | 8.823 |
| | Total | 34 | 100 |

Source: Field Survey, 2009

## 7.5 Operation and Maintenance

**Problems:**

The study has shown that 75% of the households have no problems in running their biogas plants. 20% of the households have the problem of occasional leakage of slurry from the burner of gas stove. While 5% of households experienced problem of dung availability.

- Alternative for the Gas Insufficiency:

  60% of the households used firewood when gas insufficiency 35% of the households used kerosene, LPG and candle while 5% households used nothing for the insufficiency.

- Loan Repayment

  32 households had no problem in loan repayment and 2 households had problem in loan repayment.

- Maintenance Expenses

Only minor maintenance and repair is needed for the biogas plant so the users had to experience no regular expenses for the maintenance and repair. Very often some users had problem of leakage from the main gas value.

## 7.6 User's Perception and Suggestions

### 7.6.1 Perceptions

Except 2 HHs all of the respondents were found of positive opinion about biogas installation. They felt improvement in the quality of livelihood after installating the biogas plant. The people felt market differences in saving reduction in workload saving firewood, cleanliness of HHs environment reduced indoor pollution and better crop production too.

### 7.6.2 Suggestions

Out of the total 34 HHs, 22 households have given the suggestion that "every one should install the biogas plant" other main suggestion received are:

32 households suggested that water should be supplied regularly to every villages by the government. One HHs suggested to use stone instead of brick in the masonary work for biogas plant construction.

# CHAPTER VIII

# SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 8.1 Summary

Biogas technology one of the clean energy technology is becoming popular in recent year in Nepal. Especially in the rural areas where each and every household keep cattle and buffaloes. The popularity of biogas in rural areas lies mainly in the fact that it enables an effective utilization of locally available resources. Realizing the existing problem of energy. HMG/N has incorporated the biogas installation programme in the 7$^{th}$ plan (1985-90) NPC -1985-90) and even after the restoration of democracy in Nepal, the importance of the rural energy has been felt at the policy and decision making level.

Socio economic impact of biogas in Bungkot VDC is chosen as a special topic to address the problem of energy in the study area and to provide the scope for the dissemination of the biogas technology which seems to offer potential for future development providing relevant and reliable information can surface the real implementation of the programme and may also make understand the deficiencies in the existing problems in the policy level raising concern over ecology and the impact on the environment of the use of firewood LPG and kerosene as a fuel has led to the installation of biogas in the study area. Nepal is heavily based on agriculture and it is suffering from the low productivity so its productivity has to be maintened for overall development. An immediate solution of this problem is to maintain the soil fertility. Which is possible only by the application of bio slurry on the farm instead of chemical fertilizer.

As biogas technology does not require procurement of raw materials from outside and the rural people can set up it utilizing their own resource and it might be helpful to improve the economy and keep clean environment as well biogas is seen as the topmost effective technology for the upliftment of the economy. Due to the higher productivity lesser drudgery for women and reduced pressure in the natural resources, this technology may provide the scope for maintaining the ecological balance in the study area as well as in the nation as whole.

The present study discusses the benefits of the biogas technology which accure at the level of individual family. Biogas is making significant contribution in meeting the cooking energy requirement in the study area. Higher standard of living, higher productivity, reduced pressures on the natural resources has been felt in the study area.

Bungkot VDC of Gorkha district has been taken as the study area. Total 34 households are bio-gas owners. So total universe have been taken as the sample.

Before selecting a topic a brief review of the literature related to the impact study of biogas on users have been studied primary as well as secondary data have been used in this study.

The main objective of this study is to study the biogas plant as an alternative sources of energy and to assess the socio-economic benefits of the users from the biogas plant.

Interview, questionnaire field observation have been taken as method of data collection and collected. Data have been analyzed using simple statistical tool such as average, percentage, table etc. biogas, stoves, seems to have succeed in substituting the traditional biogas and

fossil fuels. However it has not completely replaced the traditional energy user even now people are using chemical fertilizer in the field and firewood in the kitchen. The uses of biogas has bought the significant improvement in the quality of life of the family members and reduction on the workload of women who are the sole manager in kitchen and take the responsibility of cooking.

While talking about the plant ownership Newar are ahead in installing the plant and most of the plant owners have the occupation of agriculture. Marginal group having less than 10 ropanies land is the largest number as biogas plant owners every family has some livestock. The number of livestock was found maximum 8 and minimum 2, where keeping buffalo is found in almost all of the households.

Toilet attached biogas plant is seen in most of the household. Only 3 households had no attached biogas however those who have toilet attached plant is found to maintain the clean and healthy environment.

At last it can be said that the introduction of biogas technology in the study area has been proved successful and one of the effective renewable energy sources so far because of number of reasons namely in terms of production increment protecting environment from pollution checking the rate of deforestation, providing case to the women in the slurry area.

## 8.2 Conclusion

Energy is undoubtedly a fundamental means for meeting the needs of life support systems and developmental efforts. Nepal's energy supply is primarily based on three types of fuel sectors traditional, commercial and renewable. Traditional energy sources are the primary sources of

energy in the rural area. The use of renewable energy is very significant as presents.

Nepal has better options and resources potential for the development of renewable energy. It can be developed without destroying the environmental condition. Biogas energy is emerging as the major contributor in the current renewable energy resources development.

The development of the biogas energy can significantly cut down the use of firewood, animal dung, agricultural residue, kerosene, LPG in the study area, biogas was mainly used for cooking food. Biogas technology has primarily reduced the use of fuel cooked about 132 bhari of fuel wood has been found to be saved by each biogas plant in one year.

Most of the biogas users belong to the economically middle class in the village. The poor socially deprived and vulnerable people are unable to install the biogas plants. So it is obvious that upper class and so called upper caste people are enjoying the government subsides at large of course, the subsidy policy adopted by the government is a hall mark for biogas energy development but it has failed to reach to the majority of poor people. The strong cultural taboos still exist in the society. It is a good sign to find all the biogas plants with toilet attachment.

Following conclusions have been drawn from the study.

- Biogas has been proved very useful for the women members of the family.
- The workloads of the women have been greatly reduced. Biogas has cut the firewood need of house. So maximum labour and time was saved in firewood collection food could be cooked in lesser time. Since, no smoke is produced the cooking job is easy and

could be done in relatively short time. The utensils are not blackened (unlike in chulhar). So half of the time is saved in washing the utensils itence much time is saved.

- Therefore sufficient of time have been saved after biogas installation. As a result most of the women have extra time to get herself involved in other household activities like agriculture, child care, child education normal generating activities.

- The chances of occurrence of health problems such as burning of eyes, headache, lever are reduced.

- Biogas has promoted good sanitation because of growing use of toilet it has encouraged others to build their toilet after installation of biogas.

- Considerable amount of firewood has been saved after installation of biogas with this, a good amount of money was saved most people used if in educating the children few people used it in income generating and construction house. Some spend it in purchase of ornament and land there days.

- The digested slurry contains more nutrients. Thus nutrients are better saved if composted. The use of digested slurry has shown good increase in production. However, in most cases the slurry is not managed properly.

## 8.3 Recommendations

Following recommendation have been derived from the present study. It is recommended that the concerned organizations, should take

necessary steps to implement the recommendations of this study in the forth coming days.

- It is found that all the plant owners have used the gas for cooking purposes. Thus it is necessary to conduct deep studies about the uses of gas to other income generating sector.
- The use of human excreta and its advantages must be made known to the installers. For this training seminars and workshop should be implemented.
- Encouragement should be given to utilize the saved time in a productivity sector.
- For better management or slurry training should be provided to the biogas users.
- Insufficiency of the gas in cold season has been the major problem for the biogas users. So proper alternative design of biogas plant is becoming a need.
- A comparative study of using stone in place of brick should be made.
- Women should be encouraged in construction training and operation and maintenance training. This would help towards gender balance issue.
- A great deal of time and money of households has been saved after installation of biogas. Therefore women members should have chance to work in income generation activities. Concerned authorities should pay attention to this.

- Concerned biogas companies should carry out supervision and evaluation more elaborately.
- Dissemination of information should be done massively through the media like newspaper, radio, television etc.
- The concerned biogas companies should mobilize local NGOs to promote technology so that they can act as bridge between users and the companies.
- A consistent policy should be introduced to include the small marginal and poorest of the poor.
- Concerned agencies should conduct social awareness program among rural people to maximize the adaptation of biogas.
- Research should be carried out on lowering the cost of biogas plant to the increase efficiency of gas production in winter and control the breeding of mosquito.
- The cause of leakage of slurry from the burner should be studied and preventive measures should be made before new constructions to avoid the problem.

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# Questionnaire

**1. General:** **Date:**

Name of Head Household:

District: Sex:

VDC: Age:

Ward No.: Cast/Ethnicity:

Number of family member: Occupation:

Education Level: Land Holding (Ropanies):

**2. Information on Biogas Plant:**

2.1 How did you know about biogas?

a) Radio ☐ b) Biogas Company ☐ c) Friends ☐

d) Neighbours ☐ e) Others (specify) ☐

2.2 How much dung is necessary for this size of plant?

……..kg.

2.3 What is the purpose of Biogas production?

a) Cooking ☐ b) Lighting ☐

c) Both ☐ d) Others ☐

2.4 Which fuel do you use for cooking and lighting?

Cooking

Now…… Before……

Lighting

Now…… Before……

2.5 Is your house connected with electric grid?

a) Yes ☐ b) No. ☐

2.6 What is the source of water?

a) Well ☐ b) River ☐

c) Tap water ☐ d) Other (Specify) ☐

2.7 What is your feeling on the taste of food cooked on biogas?

a) more tasty ☐ b) less tasty ☐ c) No difference ☐

2.8 Reason for biogas installation

a) Easy and non smoking cooking ☐

b) Save of time ☐

c) Increase in crop production ☐

d) Status symbol ☐

e) Conserve environment ☐

f) All of the above ☐

**3. Site Selection and Construction**

3.1 Who selected the location of the plant?

a) Yourself ☐ b) Company staff ☐

c) Bank staff ☐ d) Other (specify) ☐

3.2 Were the female members consulted for the site selection?

a) Yes ☐ b) No ☐

3.3 Are you satisfied with the location of plant?

a) Yes ☐ b) No ☐

3.4 Was the construction a technician skilled?

a) Yes ☐ b) No ☐

3.5 Are you satisfied with the selected plant size?

a) Yes ☐ b) No ☐

**4. Economy**

4.1 What was the total cost of the plant?

a) Rs……. b) Labour……..

4.2 Did you take loan to construct the plant?

a) Yes ☐ b) No ☐

4.3 What is the source of income for repayment?

a) Sale of crops/animals/animal products ☐

b) Income from business ☐

c) Borrowing from other sources ☐

d) Have not planed any idea ☐

**5. Saving**

5.1 Sources of energy used before biogas installation?

a) Firewood ☐ b) Agriculture residue ☐

c) Electricity ☐ d) Dung cake ☐

e) Kerosene ☐ f) LPG ☐

5.2 Saving in time (work load)

| S.N. | Works | Time allocation | | Time saved | |
|---|---|---|---|---|---|
| | | Before install | After install | hrs. | day |
| 1. | Fuel manage | | | | |
| 2. | Cooking | | | | |
| 3. | Wasting utensils | | | | |

5.3 How did you utilize the time saved?

a) Farm activity b) Business

c) Entertainment d) Kitchen gardening e) Child care

f) Education g) Income generating activities h) Other specify

5.4 Saving in Money

| S.N. | Income Per Year | |
|---|---|---|
| | Before Install | After Install |
| | Rs. | Rs. |
| | | |

5.5 Do you think that extra activities have helped in financial earning?

a) Yes ☐ b) No ☐

5.6 Consumption and saving of fuel before and after Biogas installation (per month)

| S.N. | Source of energy | consumption per month | | Saving quantity | Month amount (Rs) |
|---|---|---|---|---|---|
| | | Before install | After install | | |
| 1. | Fuel wood | | | | |
| 2. | Agri residue | | | | |
| 3. | Dung cake | | | | |
| 4. | LPG | | | | |
| 5. | Kerosene | | | | |

**6. Education**

6.1 Educational level

| S.N. | Above 5 years only | Educational level | male number | female number | Total |
|---|---|---|---|---|---|
| 1. | Illiterate | | | | |
| 2. | Literate | | | | |
| 3. | Class 1 to 5 | | | | |
| 4. | Class 6 to 10 | | | | |
| 5. | SLC | | | | |
| 6. | Above SLC | | | | |
| Total | | | | | |

6.2 How many hours your children use in study?

a) Before Biogas installation…….hrs.

b) After Biogas installation…….hrs.

6.3 Are you satisfied of your child education after biogas plant installation?

a) Yes ☐ b) No ☐

**7. Health and Sanitation**

7.1 Have you experienced any change in the frequency of visits to hospital/health post/clinic for checkup after the installation of biogas plant?

a) Decreased ☐ b) Increased ☐ c) Remained some ☐

7.2 Do you find any change in the general cleanness of the surrounding after the installation of biogas plants?

a) Yes ☐ b) No ☐

7.3 Do you think biogas generates bad smell in the kitchen?

a) Yes ☐ b) No ☐

7.4 Do you have toilet?

a) Yes ☐ b) No ☐

7.5 When did you built toilet?

a) Before plant install ☐

b) After plant install ☐

7.6 If the toilet was constructed after installation of plant what impact the toilet had?

a) Decrease in worm infection reduce ☐

b) No change ☐

7.7 Have you felt the decrease in the indoor smoke after biogas plant?

a) No ☐ b) To smoke extent ☐

c) Very much ☐ d) Some ☐

7.8 Is there any visible change in health and sanitation?

a) Yes ☐ b) No ☐

**8. Slurry Use**

8.1 Do you use slurry as fertilizer?

a) Yes ☐ b) No ☐

8.2 How do you use it?

a) Directly b) By compositing

c) In dried form d) With irrigation channel

8.3 Use of slurry

| S.N. | Crops | Crop Yield | | Increment |
|---|---|---|---|---|
| | | Before slurry | After slurry | |
| 1. | Paddy | | | |
| 2. | Wheat | | | |
| 3. | Maize | | | |
| 4. | Oilseed | | | |
| 5. | | | | |

8.4 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 increased same what ☐

d) Production decreased same what ☐

e) Can not say ☐

8.5 If production increased which crops?

a) Paddy b) Vegetable

c) Fruits d) All

8.6 What the advantage of slurry over dung?

a) More effective ☐

b) Neutralized the soil ☐

c) No advantage ☐

d) Can not say ☐

**9. Problems**

9.1 What problems are you facing after installation of biogas plant?

a) Operational b) Maintenance

c) Dung availability c) Other (Specify)

9.2 Did you face any problems in getting the loan sanctioned?

a) Yes ☐ b) No ☐

9.3 What types of problem do you face?

a) Non-co-operative attitude of the bank staff ☐

b) Repeated visits ☐

c) Unusual delay ☐

d) Other (Specify) ☐

9.4 What problem did you face just after the installation of plant in carrying the slurry to the field?

a) Porters not ready to carry ☐

b) No problem ☐

c) Not applicable ☐

d) Liquid from difficult to carry ☐

**10. Finally**

1. Do you think that the installation of biogas plant has saved the other fossil fuel?

a) Yes ☐ b) No ☐

2. Are you satisfied with your company?

a) Yes ☐ b) No ☐

3. How much do you spend monthly for maintenance?

Rs……..

4. Do you think biogas plant is affordable to all?

a) Yes ☐ b) No ☐

5. Is the amount of gas sufficient?

Winter Yes ☐ No ☐

Summer Yes ☐ No ☐

6. How do you manage insufficient of energy from biogas?

a) Firewood ☐ b) Kerosene ☐

c) LPG ☐ d) Other (Specify) ☐

7. Do you have any suggestions?

……..

**The End**