CHAPTER-I

INTRODUCTION

1.1 Background of the study

Nepal is primarily an agricultural country with about 23.2 million human population of which 85.80 % population resides in rural area and 78% people are highly dependent on agricultural (CBS; 2001).Nepalese rural economy predominated by subsistence agriculture, is based on combination of crop production and animal husbandry. The average size of small-scale farm is about 0.96 hector per holding. Livestock is an integral component of farming system which has multiple benefit to rural people.

Animal husbandry makes up a vital part on agricultural production system of Nepal. It has been complementary to the crop production in the traditional agriculture in Nepal. In rural areas average farmer holds cattle and buffaloes for dairy products, for draught purpose and as a main source of fertilizer. Dung is used to make compost for the field and usually under condition of resource stress, as a raw material for fuel. The number of cattle and buffaloes is also increasing along with household.

The population living in rural areas are poverty ridden, where 35% of the rural people are poor (CBS, 2003).They are living with low life standard without enjoying even the basic amenities. Poverty in rural areas is reflected in low level of income, low level of literacy and poor health status. Poverty is also reflected in low level of energy use like other developing countries, we are heavily dependent on conventional sources of energy. It shows about 85.27% of the total energy requirement of the country. (CES; 2003). Conventional sources of the country

mainly comprises of fuel wood (75.78)%, animal husbandry (5.74%) and agricultural residue (3.75%). Share of non conversional sources (both commercial and non renewable energy) is very low. Moreover, energy is mostly consumed in residential sector which is 89.05% of the total energy consumption of the country (Shrestha et.al, 2003). The heavy dependency on biomas energy especially fuel wood, agriculture waste and cattle dung particularly in rural areas has given rise not only to environmental degradation and irreversible consequences to the country but also has caused the social burden on majority of the rural women and the large number of children who have to allocate about 20% of the work time for fuel collection (Joshi et, al., 2003).

Nepal produce about 41.4 million MT of livestock manure. It is estimated that about 81000 MT of dry dung cake, alternative to firewood which is equivalent to 20,000 MT of oil. If we compare the electricity with energy generated from existing biogas plants it would approximately reach 30MW.The estimated biogas potential of Nepal is sufficient to operate 1.9 million of biogas plants .Thus the potentiality of biogas technology is very wide in Nepal (Singh and et, 1996, cited in Gauli 2004: 1).

Nepal relies to a large extent on traditional resources as no proven significant deposit of fossils fuels are available Based on the studies conducted by various government agencies, the per capita energy consumption in Nepal is 15 GJ (CES, 2003)of which 89.05%is used in residential sector followed by 5.25% in industrial sector,3.44%in transport sector,1.35% in commercial sector, 0.79% in agricultural sector and 0.13% others. The sources of energy in energy balance of the country can be shown as follows; fuel wood - 75.78%, Agricultural residues-3.75% , Animal waste 5.74% , petroleum product 9.24% , electricity 1.47% and

coal3.53% and other renewable. The available energy from these above sources is mainly used food cooking (RETRUN,2003,cited form Gauli 2004;2)

Fuel wood , which is used as the primary source of household energy, comes from forest. Fuel wood has been and still is the major source of fuel daily used by rural mass in Nepal, on one hand , Nepal has an estimated area of 9.2 million hectores of productive forest of which only 3.4 million hector are considered as to be accessible for fuel wood collection. On the other hand, sustainable yield from this accessible area is estimated to be about 11 million tons in 1992/93 (Gauli,2004;2). These figures indicate a non-sustainable wood harvesting of about 30% such type of serious threat over forest leads the country towards grip of natural disaster. Experts in this field have forecasted that if this trends continues for a decade or two, there is absolute danger of turning several patches of fertile strips into desert.

Due to lack of fire wood for cooking purpose , many people in rural area are burning livestock dung and other agricultural wastes. The use of agricultural residues and animal dung for cooking purpose rather than being used as fertilizer reduces the crop yield in the rural area. LPG, kerosene and electricity as sources of cooking are accessible for few people and especially in urban area. They are very expensive and out of the affordability of normal rural family. Thus , in rural areas traditional energy sources will remain the main supplier of energy in the foreseeable future. Considering the energy scenario of Nepalese society, the strong and immediate need of alternative sources of energy was realized (BAJGAN; 2003,cited in Gauli 2004;2) .In search of finding alternative source of energy, a promising sustainable source of energy that was biogas.

1.2 Introduction of Biogas

1.2.1 Bio-gas

Bio-gas popularly known as Gobargas in Nepal, is a combustible gas produce by an aerobic fermentation of organic materials by the action of methanogenic bacteria within a temperature of 25 to 35^0c for certain period of time. This gas is composed of 60-70 percent methane, 30 to 40 percent CO_2 and some other gases. The methane gas is odorless 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 and generate electricity(BSP 2004). However the use of biogas in Nepal is limited to cooking and partly lighting till now.

1.2.2 Benefits and Uses of Biogas Technology

Biogas plants provide direct benefits especially to rural women as a result of the reduction of the work and when shifting from cooking on fuel wood to using biogas. Reduction in workload provides more time to the housewives for doing remunerative and productive works.

A big problem for the rural people especially to the housewives is indoor air pollution and smoke exposure inside the kitchen while cooking. Poor indoor air quality is one of the major risk factors for acute respiratory infection, coughing, headache and eye ailments with housewives, infants and children. the use of biogas significantly improves the air quality by vanishing smoke and soot from rural home thereby improving health of rural wives and children by preventing these diseases caused by conventional cooking. Not only that anaerobic digestion destroys harmful enteric bacteria viruses and intestinal

parasites due to connection of toilets and makes rural people free from flies and mosquitoes. Thus biogas results in better rural sanitation thereby contributing to public health.

The slurry is the outcome of biogas plant which can also be said bio-fertilizer if treated and applied properly can have higher fertilizer values, improves soil structure and contributes to maintain the content of organic matter in the soil. Moreover, high quality biogas manure which is rich in nitrogen and humus contributes in yield of crops and vegetable and eventually helps for generating income to biogas households.

In individual perspectives the primary impact of biogas plant is on 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. The that installation of biogas plants also helps in creating job opportunity for skilled land semiskilled human resources as the construction works requires considerable numbers of such manpower and contributes in rural poverty alleviation. (Gopalan; 1990 cited in Shrestha 2002;4)

There might be several other indirect benefits of biogas in terms of social educational and recreational but it is clear that with the growing demand of biogas, this technology has been gaining popularity day by day within Nepalese rural communities.

Till the end of December 2004, 1,23,395 biogas plants have been installed. Of the total about, 54.24 percentage biogas plants are installed in hill region where as 45.38 percentage in Terai, and 0.34 are installed in remote hill area. About 8,50,000 are directly benefited from the biogas plants. The program has so far covered 66 districts out of 75 districts(BSP, 2004).

1.3 Statement of Problem

Many research have been conducted to examine the impact of biogas plants by development agencies and academicians and many positive result have been reported. However, it is not necessary that a technology has similar impacts at all areas. It means a technology may have positive impacts in one area but negative in others. Thus, in this context, this research study aims to find the answers of following questions in study area:

- What is the extent of time saving among the biogas plant users ?
- How the saved time has been utilized ?
- What is the extent of firewood savings ?
- What is the extent of increase in agricultural productivity?
- What is the extent of change in health and sanitation related problems ?

1.4 Objectives of the Study

The overall objectives of the study is to assess the socio-economic impact of Biogas users in the study area. However the specific objectives of the study are:

1. To analyses the socio-economic characteristics of biogas households.
2. To assess impacts of biogas plants on family economy including agricultural production.
3. To examine the impact of biogas plants on daily time saving and use of saved time pattern of the biogas households.
4. To study the impacts of biogas on health and sanitation of the household's member and the environment.

5. To find out impacts of biogas on the workloads of women.

1.5 Significance and Justification of the Study

Biogas technology has no doubt the good contribution in the energy sector of Nepal. This simple technology contributes a lot in lessening the burden of the forest resource. By promoting the installation of biogas we are perverting deforestation. Deforestation is the main cause of many natural calamities such as landslides. Floods, soil erosion etc.

It is well realized that biogas technology is very much suitable for Nepalese context. Because of high cost of installation of micro hydropower plants and sophisticated technology involved in exploitation of solar and wind energies, these options aren't affordable to rural population. Biogas is cost effective, simple, user-friendly technology. Thus this is regarded as sustainable energy in Nepalese context. The biogas further help in saving money and time in collecting firewood and cooking activities. It provides the smokeless environment in the kitchen. Moreover installation of biogas plant would help towards agricultural production. The digested slurry contains more nutrients and contributes in increasing agricultural production.

From the above considerations, the researcher initiated an impact study to acquire useful information and observation with regard to adoption of biogas technology, user's perception, usefulness as well as it's effect on farm production and daily life of farm families in Tupche VDC of Nuwakot district. Thus finding and recommendation of the present study are likely to contribute to an endeavor to bring sustainable development of mid hill of Nepal.

1.6 Organization of the Report

The entire report has been divided into 6 chapters. The first chapter gives introduction of the study. It contains background of the study, historical development of biogas in world and Nepalese context, objectives of study, significance and justification of study and introduction to biogas technology.

The second chapter consists of the review of the literature on impacts of biogas technology on users.

The third chapter describes the methodology of the study.

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

The chapter five describes about socio-economic characteristics of biogas plant owner and also the impact of biogas plant in the study area.

The chapter six discusses about the biogas technology and major findings, conclusion and recommendations are stated in this chapter.

1.7 Limitation of Study

Each and every study has its own limitation. No study can claim to be free from constraints of resource time and so on. Being a social science research, the present study isn't free from some errors associated with quality of data and their interpretation despite sincere efforts were made to minimize the likely errors due to design and methodology of this study. However the present study has following limitations.

- The present study is one which has tried to assess the socio-economic impact on sample biogas households of only Tupche VDC. It hasn't covered the whole sample biogas households of all VDCs of Nuwakot district due to various constraints. Therefore findings and conclusion may

not be generalized and implemented at national level. However outcome will represent the area with similar geographical and socio-economic conditions.

- The study has been completed within a short period. Due to this, direct observation of biogas plants and dragging information in all seasons wasn't possible. So recall technique has been used to get data and information in the past.

- The research is limited to few socio-economic variables. It is also limited to simple statistical tools.

Therefore, the findings of the research may not be generalized to wider scale. However despite above mentioned limitations, the present study provides a comprehensive understanding of general socio-economic impact of biogas technology of the study site.

CHAPTER-II

REVIEW OF LITERATURE

2.1 Concept of Biogas Technology

Biogas or G*obar* gas is a clear & odorless combustible gas, which is produced when organic matter contained in animal excreta, such as dung & human night soil & tender plant or residues, such as leaves, stems & straw, are aerobically fermented with the help of methanogenic bacteria in air or water-tight container called biogas plants. Chemically biogas is just methane gas. Biogas burns with the clear blue flame without giving smoke. Its flame temperature is up to 800^{o}C & it has a calorific value of 5,650 KCal per cubic meter of gas (Adhikari, 2002; 7).

Biogas provides excellent fuel for cooking & lighting & there by reduces the pressure on the existing forest & import of Kerosene from abroad. In most of the developing countries, chemical fertilizer has to be imported from abroad. It is costly. Use of biogas not only produces an excellent fuel but also an excellent quality of organic fertilizer. Generally 20-30 percent increase in yield of various crops has been reported by the use of biogas effluent. Biogas save time in cooking and provides the housewife leisure time. Moreover, they are relieved from the toxic smoke produced from wood burning. It reduces suffering from eye and lung disease caused by smokes. Cleaning the pots becomes easier and life span of utensils increases. It improves hygiene in village and reduces the number of flies as well as parasites. In depth it helps to create a healthier environment in the surrounding. The poorer section of the society can benefit from a community biogas programme (Karki and Dixit, 1984; cited in Tamrakar, 2002; 15).

Biogas technology has various benefits. It provides fuel for cooking and also lighting others fuels can be saved considerably namely the consumption of firewood, kerosene and LPG. Time and money can be saved by cooking on biogas which is faster than using kerosene or firewood. Due to the clean and healthy environment the living standard of the people may increase. Biogas also provides the highly nitrite organic manure for field which rises the productivity and lessen the requirements of chemical fertilizer. From the macro perspectives it saves the natural resources such as forest and prevents the problem of deforestation.

2.2 Historical Development of Biogas in World and Nepalese Context

Biogas technology has been gaining popularity nowadays as g good alternative sources of domestic energy. The origin and development of such popular biogas was used for heating bath water in Persia during the 6th century . Marco Polo mentions the use of covered sewage tanks . It probably goes back 2000-3000 years ago in ancient Chinese literature. In 1808, H. Darg made experiments with straw, manure in a retort in a vacuum and collected biogas. He determined that the methane was present in the gases produced during the anaerobic digestion of cattle manure (CES;2001).

Jan Baptita Van Helmont 1st determined in the 17th century that flammable gases could evolve from decaying organic matter. An Italian National, count Alessandro Volta concluded in 1776 that there was direct correlation between the amount of delaying inflammable gas produced. He wrote to a friend about combustible air. He wrote that submerged plants material in the ponds and lakes continuously give off such gas. Later Voltas gas was shown to identical with methane gas. It took over 100yrs to use the gas for mankind; the plant for

methane generation was set up in 1900 in le per asylum in India. Another plant was installed in Indonesia in 1914. Interest in biogas rose very high at the time of beginning of 2nd world war. By 1950, about 1000biogas plants were built by French; German converted their some 90,000 automobiles to run on biogas to save petroleum fuel during the world war. The energy crisis followed after the war drew attention of many countries to wards biogas (Karmacharya; 1992 cited in Gauli 2004;3)

In the developing countries like Nepal, the history to biogas isn't very old. First of all the credit for goes to late father B.R. Saubole . He established a model biogas plant in St-xavier school in Godavary in 1995.Thereafter ,the interest in biogas rose slowly and kept on process of installation of biogas plant on the different parts of the country. Fortunately, initial successes encouraged the Department of Agriculture (DOA)and Agriculture Development Bank(ADB) to install 250 biogas plants in the Agriculture year (1975/76). During this year. ADB canalized interest free loans throughout the country. Then to promote biogas technology, Gobar-Gas Tatha krishi yantra shala vikas pvt. Ltd was established in 1977 with the capital finance from UMN. ADB/N and dissemination of biogas technology after the establishment of GGC.

With the establishment of biogas support program (BSP) in 1992 as a joint venture of ADB/N, GGC and SNV Nepal, the pace of household size biogas plant has increased rapidly. Alternative Energy Promotion Centre (AEPC) was formed as a recognized government body under the umbrella of Ministry of Science technology (MOST) for the promotion of alternative energy in Nepal. Apart from these organization other national and international agencies notably UNICEF, save the children Fund/USA, New Era, Devt-part consort East Consult,

CMS/Nepal (Pvt) Ltd, etc have also made significant contribution in the promotion and development of biogas technology in Nepal (Gauli 2004;4)

2.3 Findings of the Previous Studies

For the purpose of the study of this subject, literature of various writers is reviewed. The literature is reviewed from the thesis presented by former student, reports and paper presented in seminar, bulletin, journals and information published by various concerned agencies and books in the concerned topics. The summary of outcome of some of these studies has been illustrated hereafter.

Biogas is considered as the most reliable alternative energy resources replacing fuel wood of which the greatest part is used for cooking specially in rural areas of Nepal. It means that there is the urgent need for substituting rural energy through non-conventional energy resources.

"Biogas users survey 1992-1993" written by East consult (p) ltd. has also focused on effect, impact, benefits, advantages, disadvantages of the biogas users in Nepal. Overall the impact of the biogas plant was found to be positive. It is encouraging to note that the non biogas households were also willing to install the biogas plant. It has explained that biogas is much useful to rich and medium farmers, but not to the poor farmers who are not capable enough to install it due to their disability to pay for such plants. They are still in difficult position to solve their basic needs and have survival problems. Since majority of the plant owner have either a secondary occupation or surplus production to generate financial income, repayment of loans is not found to be a serious problem. All the plant owners were happy that they have invested properly and that are quite sure

that their investment would benefit them for a longer duration (East consult 1994, cited in T. Laxmi 1997; 17).

Sigdel and Das had done a study entitled "Biogas Development in Kaski District" in rural context. They had surveyed 13 biogas plants in Lekh Nath VDC. The report revealed that there was a growing awareness in this technology as forest saver. People felt that it would be applicable in a semi urban area where people were richer since majority of the village people suffered from problem of searching capital to repay loan and installation cost was found to be high. Realization of subsidy could be observed (Sigdel and Das 1990, Cited in Gouli, 2004; 13)

"Effect of biogas on the workload of women in the village of Madan Pokhara in Palpa district in Nepal" written by Marieke Van Viet (1993) highlights on the rural women in Nepal confronted with a high workload. They do most of the domestic and agricultural works. Depletion of natural forest resources like forest will even worsen their situation. Biogas is considered as a promising renewable energy source probably to reduce the workload of women. Biogas influenced positively to all the families with regard to the time spent on collection of firewood and cooking fuel. She further explains that collection of water to feed the plant took extra time for a few families who had to go to a public tap. Other households had a tap on their yard. Mixing of dung and water required little time by all households. In general, due to utilization of biogas, women saved minimum one hour and maximum 2.5 hours a day. Besides these workloads, biogas had other positive effect related to cooking and lighting of the household (cited in Tamrakar, 1997; 16)

Karmacharya (1992) has shown the comparative analysis of installation of biogas plant under the hill and terai context.

Dadhikot village of Bhaktapur district for hill sits and phoolabari village of Chitwan district for terai site were chosen for the study. A total of 30 samples were chosen, each site consisting of 15 samples.

The study has taken economic approach and the analysis is focused on the various type of benefits obtained and savings made through the installation of biogas plants.

Energy situations in global and Nepalese context has been dealt in detail.

No significant differences of impacts were noticed between hills and terai. However, some noticed differences include-

1. Lamp uses pattern was zero in terai but 27% in the hill.

2. Gas production was less in hills.

3. Use of slurry as fertilizer was low in hill.

Britt (1994, cited in Uprety, 2004; 16) has shown concise overview of studies were done in Rolpa, Rupendehi, Nuwakot, and Chitwan districts.

The result from the study states that given the overwhelming 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 alter the position of woman. So called traditional of unequal

patterns in the division of labours are sustained, with working women for long hours simply substituting one labour activity for another.

The research design used were district based village based. Workload effects were calibrated in terms of before and after installation of the biogas plants.

It was found from the study that estimated time saving for women in Rupandehi was 4 hours and 30 minutes (on average) and 2 hours and 35 minutes (on average) in Nuwakot. However, in a village based research, the estimated time saving was found to be 1 hour and 55 minutes in Madanpokhara, 3 hours and 14 minutes in Pithuva and 15 minutes in Hathilet village.

WECS (1994/95: 70) has argued that by the use of biogas there was an increase in agriculture productivity through increased soil fertility from the slurry. It was also considered as a positive impact of technology on the economy. Moreover the time and money saved through impact of technology on the economy. Moreover the time and money saved through improved health and hygienic e.g. reduced cases of eye and respiratory illness and the number of burning cases could be considered as an other direct positive impact on the economy.

The New ERA study has revealed that one of the main attractions towards the biogas plants is the easy availability of gas for cooking. Almost all of the users used gas for cooking purpose as well. The main reason behind 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 uses of slurry, only 44 percent of the users reported that the problem of eye diseases and respiratory diseases were reduced and the users felt some relief (New ERA 1995, Cited in Uprety, 2004; 17)

Ghimire has shown the biogas in relation to forestry. He has estimated that installation of 1.3 million of biogas plants (total potential of Nepal) would save about 4 million tons of firewood per year (Cited in Ghimire; 2002)

Thus from all the findings it can be safely conduced that biogas has been and very useful technology that has impacted the life of it's and user in a positive way.

CHAPTER-III

RESEARCH METHODOLOGY

3.1 Research Design

For this study descriptive research design has been followed. The descriptive research has been applied for the qualitative data obtained and derived during the study. The data which were quantifiable, were explained literally. Analysis of data has been made by generating the tables of averages and percentages.

3.2 Rationale for the Selection of Study Area

Tupche VDC of Nuwakot district has been chosen for the study. It is 4 km far from district headquarter Bidur. The reason to select this VDC was:-

As the study is carried out to fulfill the project work requirement of Master's degree in rural development by a student. The researcher is bound by scarce financial resources. So, this study area which is easy to accessible for researcher is selected. Therefore by selection of this area, it was believed that more reliable information could be a ragged due to familiarity with local people and local biogas company personnel. Thus all these facts were guiding factor to select this VDC as the study area.

3.3 Sampling Procedure and Sample Size

Out of the total 138 biogas owning households a sample of 30 household's has been sampled for the study. The total 138 biogas households has been taken as the universe and simple random sampling technique (lottery method) is followed for the selection of samples.

3.4 Nature and Sources of Data

Both primary and secondary data and information were used to receive in depth impact assessment of biogas on users. Major emphasis has been given to primary data.

The household survey questionnaire has been used to collect the primary data to get first hand information on the impacts of biogas to its users.

As extensive library consultation has been made for the collection of secondary data regarding biogas technology. The library consultation contributed a lot in depth understanding the 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 personnel working in the field.

3.5 Tools and Techniques of Data Collection

Mainly primary data has been taken for the study. The interview schedule served as the chief source of primary data while secondary data were taken from the concerned institution and books.

The interview schedule was developed and then used to solicit the information from the households.

The questionnaire has been pre-tested and then finalized on the basis of feed back. The finalized interview schedule was administrated to the respondents.

The focus group discussion has also been conducted with the help of check list. The household observation was also done to get the real impact of the biogas plant.

3.6 Data Processing and Analysis

The data obtained from the survey was coded and categorized according to the required variables. Then the coded data was converted into tables of averages and percentages. The analysis of impact was made through averages and percentages.

CHAPTER IV

STUDY SITE DESCRIPTION

4.1 District Background

The district Nuwakot gets its name after nine kots they are Belkot, Kailashkot, Bhairbkot, Malkot, Dhuwakot, Payshkot, Simikot, Shailankot and Dhaibungkot.

The old fortresss town of Nuwakot used to be an important strategic out post. It controlled the ancient trade routes of Tibet and kings of Medieval Nepal maintained large garrisons here. Nuwakot palace (Sata tale Darbar) possesses on hill top which recall the traditional architecture of Kathmandu valley. The place of Nuwakot was once the place of great king Prithvi Narayan Shah.

Nuwakot district is stretching from 84^0 58^0 to 85^0 30^0 east latitude and 27^0 45^0 to 28^0 6^0 North longitude. Nuwakot has an area 1,121sq km or 12100 hector with population 28,8478 (CBS, 2001). Among them 142731 are male 145747 are female and the annual population growth rate 1.59 percent. The total households in 2001 are 53169 and population density is 257 per sq. km. The rank of Nuwakot district is 32 on the basic of population and where as 67 on the basis of area coverage. It comprises of 61 VDC and 1 Municipality. Out of the total population 92.76% of people live in rural area. The large number of population has their mother tongue as Nepali. Most of the people follow Hindu religion where as other are rare (CBS, 2001).

Nuwakot district lies on Northern part of Kathmandu valley. Sinduplchowk on the east. Dhading on the west and Rasuwa in the North. Bidur is the headquater of Nuwakot. It is just 75km for from Kathmandu valley.

The district climate is different according to altitude and reason as cold in winter and hot in summer the elevation of the district is from 540m to 2500meters and average annual temperature has maximum 31.8 Celsius and minimum 11.8 Celsius and annual rainfall is 2200mm.

Almost all district land terrace and Bidur, Trishuli, Battar, Devighat, Dopcheesowar, Betrawati are the important place of Nuwakot. Trishuli and Tadi are the main river of Nuwakot. Two large hydroelectricity project, Trishuli (21mw) and Devighat (14mw) are also situated in this district.

Agriculture and animal husbandry are the main occupation of the people and almost all people are dependency on agriculture. Nuwakot district has 43677 hector of cultivated land. The major crops grown in the district are Paddy Maize, Wheat, Millet and Potato. Agriculture in this district is still based on traditional skills of the farmers. Limited modern technologies of farming practice have been reached in this district. As a consequence farming in this district is of subsistence type rather than commercial.

Livestock is an integral part of farming system in the district and most of the households are keeping one or more types of livestock on their house. The major livestock found in this district are cattle, buffalo, oxen; duck, pigs, goats, poultry. Cattle, buffalo, goats and poultry are commonly raised by all ethnic/castes and group. Where as a few specific castes/ethnic groups raise sheep mules and pigs.

Literacy rate of Nuwakot district is 51.15 percent for both sexes where as 62.14 percent for male and 40.41 percent for female. Net enrollment ratio is 92.9 percent in lower primary, 36.7 percent in lower secondary and 23 percent in secondary. There is 0.312 percent human development index(CBS, 2001).

4.2 Energy situation in Nuwakot district

In urban and semi-urban areas of Nuwakot district, majority of people use liquefied petroleum gas and kerosene for cooking purpose. But in rural areas, people use firewood for cooking purpose. Thus, firewood has been chief energy source in the district.

Among 61 VDC of Nuwakot district 54 VDC have got electricity facility. The electricity is used mainly for lighting and running cottage industries. Due to the frequent rise in price of petroleum oil and costly electricity biogas installation has gained momentum in these days. According to BSP there is technical potential of 23333 biogas plant of which only1550 (6.7%) plants have been installed(BSP, 2004).

4.3 VDC Background

Tupche VDC is a VDC among 61 VDC in the Nuwakot district. The VDC has been purposively selected as study site based on preliminary site visit and according to the rational of study. The VDC lies at the southern part of Nuwakot district shortly border with Rasuwa district in the east. The VDC extends from east to south as triangular shape on the eastern and southern slope the land mass formed along the bank of Trishuli river system.

Tupche VDC has subtropical climate i.e. hot in summer and cold in winter with the average rainfall of 2200mm. According to metrological data of Sakura NGO, maximum temperature is 29^0 c and minimum temperature is 7^0c.

There are 1239 household with a population of 6264 comprising male 3076 and female 3188. The average household size is 5.39. There are II ethnic/caste groups namely Brahamin is the dominant ethnic group in the VDC. About 99%

of population follow Hindu religion and while other religions are negligible in number. Both nuclear and joint families exist in this VDC.

Agriculture is the main occupation for more than 80% household of the VDC. Farming is mostly integrated type in which majority of households have been growing various food grains, seasonal vegetables and perennial fruit crops along with livestock and poultry. Although the VDC is connected with road, agriculture production is mostly subsistence's and traditional type. Now a days problem of labour force has been a limiting factor to sow and harvest agriculture production. Shortage of manpower in livestock rearing and agriculture production is really attribute to people's growing conciseness and concern with formal education and out migration of labour force. Trishuli and Salakhu are the main river streams of this VDC. There is limited irrigation facilities in this VDC. However irrigation land has irrigation facility from modern managed irrigation cannels and some of other have traditionally managed irrigation cannels during rainy seasons from local streams.

Besides agriculture, the other sources of income of people are business services, remittance, pensions and wage labour. By caste the highest amount of earning from internal sources have accrued Brahmin and Chhetri while other lower class have least among of earning from wage labour.

Transportation and communication linkage in the VDC are fair. Tractor Trucks Bicycle, Motorcycle and Bus are the main modes of transportation. There are 7 telephone lines extended from district headquarter Bidur and more than 100s of CDMA function of telephone are available in this VDC. Almost all the ward do got have graveled road except 5 and 8 ward. Regular bus service is

available from this VDC to Kathmandu, that passes through district headquarter and links with Pasanglama highway.

The literacy status of this VDC is highest among all the VDC of Nuwakot district. There is one primary school in all the ward of this VDC, 1 higher secondary school and 2 high school i.e. one of English medium. Political awareness is also good in this VDC. Public health facilities is not satisfactory and adequate. Majority of people depend upon the private clinic at Trishuli Bazar.

Majority of people use to through garbage and filth over Bari (land) and road sides. It is report that nature of toilet in this VDC in pakki toil 30% Ardhapakki 40% Kachi 30% and open 10% there are not any public toilet in this VDC (VDC, survey, 2062).

Trishuli hydro project lies in the mid of this VDC which is the beautiful place for all the visitor. Trishuli river is the natural scenario that attract visitor who passes throw this VDC.

4.4 Energy Situation in Tupche VDC

Fuel wood, crop residues, biogas, kerosene, rive husk and electricity are the major sources of energy used for cooking food preparing livestock feed, space heating and lighting houses Tupche VDC. Among these resources biogas, fuel wood and kerosene are the most important sources of energy for cooking used virtually by the households residing in ridges and tars of this VDC, while electricity and kerosene are the main source of energy for lighting in this VDC

CHAPTER FIVE

SOCIO-ECONOMIC CHARACTERISTICS OF THE BIOGAS PLANT OWNERS

5.1 Ethnicity/Caste

Ethnicity/caste composition of the respondents shows almost half of the respondents were Brahmans 43.33%; about one quarters were Chhetri 23%; Gurunge 10%, Tamang 13.33%; and Damai/kami together composed only 10%.

Table 5.1: Ethnicity/Caste of Households

S.No.	Ethnicity/caste	No. of households	Percentage
1	Brahman	13	43.33
2	Chhetri	7	23
3	Gurung	3	10
4	Tamang	4	13.33
5	Damai/kami	3	10
	Total	30	100

Source: Field Survey, 2006

This figure shows that Brahmans are predominant in installing the biogas plants.

5.2 Occupation of the Respondents

Most of the HHs (83%) have their occupation as farming. Local business holders comprises job 3% of total households. 14% of total HHs are involved in service sector.

5.2 Occupation of the Respondents

S.No.	Occupation	No. of Respondents	Percentage
1	Farming/age	25	83
2	Service	4	14
3	Local business	1	3
	Total	30	100

Source: Field Survey, 2006

The farmers have more land and more animals for the dung needed for the biogas in comparison to the servicemen and businessmen. Therefore the percentage of biogas installation by the farmers is high.

5.3 Size of Family

The average family size of the sampled households was 7 persons per family. About 47% of the households have family size on and above the average. Distribution of the households according to the family size is shown in the table below.

Table 5.3: Distribution of Family Size

S.No.	Family size	No. of Households	Percentage (%)
1	Small (up to persons)	3	10
2	Medium(5 to 7 persons)	19	63
3	Large (above 8)	8	27
	Total	**30**	**100**

Source: Field Survey, 2006

The table shows that maximum number of respondents had medium sized family with 5 to 7 persons. Minimum family size was 4 persons whereas maximum family size was 18.

5.4 Landholding Pattern

The average landholding was 26.1 Ropani per household. Maximum landholding of the user was 60 Ropani and minimum was 3 Ropani distribution of the landholding of the households is shown in the table below.

Table 5.4: Landholding Pattern

S.No.	Land area in Ropani	No. of Households	Percentage (%)
1	Below 10	11	36.67
2	11 to 20	14	46.67
3	21 to 30	3	10
4	Above 30	2	6.67

Source: Field Survey, 2006

5.5 Installation and Use of Biogas

5.5.1 Size of the Biogas Plant

Only two sizes of biogas plants, $6m^3$ and $8m^3$ were reported. Majority of the biogas plants were of $6m^3$ capacity. Only two households had $8m^3$ plants.

Table 5.5: Size of the Biogas Plants

S.No.	Size of Biogas Plant	No. of Households	Percentage (%)
1	$6m^3$	28	93
2	$8m^3$	2	7
	Total	**30**	**100**

Source: Field Survey, 2006

However, in the area, smaller biogas plants of $4m^3$capacity were also present in other households which were not included in the sample.

5.5.2 Source of Information on Biogas

Before establishing the biogas plant, the chief source of information was the respective biogas company of the respondents. Neighbour served as the second important source. Two respondent obtained information from relatives.

Table 5.6: Source of Information on Biogas

S.No.	Source of Information	No. of Households	Percentage (%)
1	Neighbour	11	37
2	Biogas Company	17	57
3	Relatives	2	6
	Total	**30**	**100**

Source: Field Survey, 2006

The figure implies that primary source of information was the biogas companies. This is because they reach more to the people for the sake of their business. Whereas the neighbour in the second position implies that, people are convinced and satisfied with the advantages of biogas in the area who thereby encouraged their neighbours for the installation.

5.5.3 Reason for Biogas Installation

The main reason for the installation of biogas was to get rid of the firewood collection and to have easy and smokeless cooking. About three-fifth (60%) of the respondents installed biogas to get rid of firewood collection. While rest of the respondents replied that they installed for easy and smokeless cooking as well as to get rid of firewood collection.

5.6 Cost

The cost of installation can be observed through three parameters: total cost of installation; subsidy provided by institutions and, self-investment of the users.

5.6.1 Total Cost

The respondents were asked about the cost of installation. The total cost consisted of three factors:

- Subsidy from BSP
- Subsidy from local forest user group
- Self-investment

The average cost for installation of biogas was Rupees 16,867. The minimum cost per installation was Rupees 10,000. While the maximum cost was Rupees 18,500.

The reason for the apparent variation in cost may be the personal contribution made by the respondent during the construction work in the form of labour and construction materials.

The cost of plant establishment included two factors-subsidy and investment by the owner himself.

5.6.2 Subsidy

Every biogas company received a subsidy of Rs 7,000 from the BSP through the biogas company and Rs. 1,500 from the local community forest user group. Thus each biogas plant received a sum of Rupees 8,500 as total subsidy

5.6.3 Self Investment of the Users

Beside the subsidy, the respondents had to bear rest of the cost by themselves. Provision of loan was also available for this purpose through bank and community forest user group. Among 30 households, 23 had their own source for the self-investment part. Distribution of the households according to the source of self-investment is shown in the table. Besides self-investment, all of them received subsidies equally.

Table 5.7: Source of Investment for Biogas

S.No.	Source of self-investment	No. of Households	Percentage (%)
1	Own source	23	77
2	Community Forestry	1	3
3	Small Framers Development Project	3	10
4	Agriculture development Bank	3	10
	Total	**30**	**100**

Source: Field Survey, 2006

5.7 Livestock

Livestock serves as the source of dung for biogas plants. they are the source of raw material (dung) needed to run biogas plants. Water availability is sufficient in the village.

5.7.1 Livestock Population

Only cattle and buffalo were considered in the livestock population because, dung of only cattle and buffalo were used for biogas. Waste product by goat and pig and popularity was not used for biogas production.

The average number of livestock (cattle and buffalo) per household was 3.7 average number of cattle was 1.5 and average number of buffalo was 2.2. Buffaloes were more admired by the respondents.

Table 5.8: Livestock Population

S.No.	Livestock	Number	Percentage (%)
1	Cattle	44	40
2	Buffalo	68	60
	Total	**112**	**100**

Source: Field Survey, 2006

5.7.2 Dung Produced

Average dung produced per household was 49kgs. Minimum dung produced was 15 kgs while maximum dung produced was 95kgs.

5.7.3 Dung Feeding

The recommended amount of dung needed for $6m^3$ and $8m^3$ biogas plants in the Hills are 45 and 60 kg respectively. The average amount of dung fed was as follows:

Table 5.9: Amount of Dung Fed

Plant Size	Recommended amount (kg)	Average amount fed (kg)	High/low
$6m^3$	45	45.6	Slightly high
$8m^3$	60	57.5	Slightly low

Source: Field Survey, 2006

The average amount of dung fed was nearly as per recommendation.

5.7.3 Ratio of Mixing

Dung has to be mixed with water at the time of feeding the biogas plant. The recommended amount of water is equal part to the dung. Production of the gas will be affected if the amount of water is too low or too high.

The observed ratio of water to dung is 0.93 i.e. less water was used for mixing on the average.

Table 5.10: Ratio and Mixing

S.No.	Water to Dung ratio	No. of Households	Percentage (%)
1	1 (normal slurry)	18	60
2	<1 (thicker slurry)	8	27
3	>1 (dilute slurry)	4	13
	Total	**30**	**100**

Source: Field Survey, 2006

The table shows that 60% of the households used equal amount of dung and water; 27% used less than recommended and 13% used more than recommended amount of water.

5.8 Use of Biogas

All of the households used biogas only for the cooking purpose. Majority of the households had single burners in their kitchen.

On an average, one household used biogas for 4.5 hrs. per burner. The minimum use was 2 hrs while maximum use was 6 hrs.

5.9 Social Impact of Biogas Installation

The section includes the impacts of biogas in reduction of workloads; use of gained time and, impacts on health and sanitation.

5.9.1. Reduction in Workloads

After installation of biogas, there was considerable reduction in workloads; of the family members especially of the women members.

The reduction in workload was measured in terms of saving in working time. Observation was made on 3 category of works viz. firewood collection, cooking and washing utensils.

Table 5.11: Reduction in Workloads

S.No.	Category of work	Average time taken hrs/day		Reduction in workload (saving in time) hrs/day
		Before installation	After	
1	Firewood collection	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 2006

The table shows that saving in time was considerable. A great time (3.7 hours per day) was saved in firewood collection only. The total average time saving of 6.05 hour per day indicates that half of the day's workload of the family member was reduced.

5.9.2 Use of Gained Time

Table 5.12: Specific Benefits of the Gained Time.

S.No.	Benefits	No. of Households	Percentage (%)
1	Rest	3	10
2	Read newspaper	2	7
3	Household work	17	57
4	Walk outside	3	10
5	Agriculture	9	30
6	Income activities	5	7
7	Fodder collection	1	3
	Total	**30**	**100**

Source: Field Survey 2006

The table shows that most of the respondents devote to the household work and agricultural field works in their gained time. Only 7 percent of the households use their gained time in the income generating activities.

5.10 Health and Sanitation

The study has shown that biogas has positive impacts towards health and sanitation of the respondents. Use of latrine; connection of latrine to the biogas plant; reduction in diseases; and, change in the prevalence of flies and mosquitoes have been dealt in this section.

5.10.1. Use of Latrine

Among the surveyed households, 90% of the households had built latrines. 10% households were devoid of latrines

Table 5.13: Use of Latrine

S.No.	Have Latrine	No. of Households	Percentage (%)
1	Yes	27	90
2	No	3	10
	Total	**30**	**100**

Source: Field Survey, 2006

Out of 27 households having latrines, 5 households built their latrines only after the installation of biogas, Ten percent (10%) of the households had no latrines and they used open field instead of latrine.

This indicates that after installation of biogas, people were encouraged to use latrine for better sanitation practice.

5.10.2. Connection of Latrine to Biogas Plant

Table 5.14: Latrines Connected to the Biogas Plants

S.No.	Connection of latrine to biogas plant	No. of Households	Percentage (%)
1	Latrine connected	6	20
2	Not connected	21	70
3	Do not have latrine	3	10

Source: Field Survey, 2006

Only 20% of the Households connected their latrine to the biogas plant i.e. they use night soil to produce biogas. While 70% of households had not connected the latrines. Those who connected their latrine to the biogas were mostly Tamangs.

The reason for not connecting to the plant were, because,

- Gas was sufficient and there was on need to connect (4HHs)
- Because of tradition and cultural view it was felt unholy (10 HHs)
- Felt dirty (7 HHs)

5.10.3 Reduction in Disease

Households felt reduction in health related problems after biogas plant installation.

The major impact on the reduction of disease was as follows:

Table 5.15: Reduction in Disease

S.No.	Illness	No. of Households	Percentage (%)*
1	Eye burning and Headache	22	73
2	Respiratory problems	20	67
3	Gastrointestinal problems	8	27
4	Fever	2	7
5	No change	3	10

Source: Field Survey, 2006

** Number and Percentage exceeds the sample size above 100 because of the multiple responses.*

Number and percentage exceed the sample size sample size above 100 because of multiple responses.

5.10.4 Insect Prevalence

Fly and mosquito were taken into account for the study of change in prevalence of insects. Majority of the Households reported the change in prevalence of insects. Only 17% of the households did not report change.

5.10.5 Fly

Reduction in the prevalence of fly was reported from the study. Twenty-one Households reported the decrease in fly population. While still 4 Households reported increase and 5 households neither felt increase nor decrease.

Table 5.16: Effect on Prevalence of Fly

S.No.	Fly prevalence	No. of Households	Percentage (%)
1	Little increased	2	7
2	Much increased	2	7
3	Little decreased	6	20
4	Much decreased	15	50
5	No change	5	16

Source: Field Survey, 2006

Seventy percent (70%) of the households felt decrease in fly population.

5.10.6 Mosquito

Out of total households, 20 households (67%) reported that mosquito had increased after biogas installation. While 5 households reported decrease in mosquito. Five households did not feel any change.

Table 5.17: Effect on Prevalence of Mosquito

S.No.	Mosquito prevalence	No. of Households	Percentage (%)
1	Little increased	14	47
2	Much increased	6	20
3	Little decreased	3	10
4	Much decreased	2	7
5	No change	5	16

Source: Field Survey, 2006

The table shows that 67% of the households reported the increase in mosquito population.

5.11 Economic Impacts of Biogas Installation

This section discusses about the saving of firewood; specific benefits of the savings; use of slurry in relation to agriculture; increment in production and operation and maintenance of biogas.

5.11.1 Saving of Firewood

Considerable amount of firewood was saved after the installation of biogas plants. Average amount of firewood saved per household was 12.6 Bhari per month. One Bhari is equivalent to about30 kgs. Maximum quantity of firewood saved was 30 Bhari where as minimum quantity saved was 4 Bhari.

Hence, average monthly saving from firewood with the local pricing of Rupees 70 per Bhari amounted Rupees 882 per months.

Table 5.18: Saving of Firewood

S.No.	Quantity Saved/Month	No. of Households	Percentage (%)
1	1 to 10*	17	56.67
2	11 to 20 *bhari**	10	33.33
3	21 to 30 Bhari*	3	10
	Total	**30**	**100**

Source: Field Survey, 2006

*1 *Bhari* is equivalent to 30kgs.

5.11.2 Specific Benefits from the Saving

The respondents were asked about the specific achievement they made by investing the money from the saving of firewood. Following answer were obtained:

Table 5.19: Specific Benefits Made from Saving

S.No.	Specific Benefits	No. of Households	Percentage (%)
1	Education children	12	40
2	Buy ornaments	3	10
3	Invest in agriculture	4	13
4	Income generation activity	5	17
5	General expense	2	7
6	Buy land	2	7
7	Construct house	1	3
8	No benefits	1	3

Source: Field Survey, 2006

The table shows that biogas has good contribution towards the field of education. 40 percent of the households have invested their savings for the purpose of educating their children. Similarly, 17% households invested for the income generating activities such as in small businesses.

5.11.3 Slurry and Agriculture

The digested slurry can be used as manure in the fields. All of the households 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 use to buy chemical fertilizer.

Twenty one households used slurry by composting while 9 households used it in dried form.

5.11.4 Increment in Agricultural Production

Regarding production increase, 25 households reported that there was an increase in their agricultural production. On an average, 18.83% increase in production was achieved. Two households did not fell change in production. However, 3 households felt change in production after the use of slurry.

Table 5.20: Slurry and Production Increment

S.No.	Agricultural Production	No. of Households	Percentage (%)
1	Increased	25	83
2	Decreased	3	10
3	No change	2	7

Source: Field Survey, 2006

Maximum increase in production reported was 30%.

5.11.5 Operation and Maintenance

- **Problems**

The study has shown that 77% of the households had no problems in running their biogas plants. 20 percent of the households had the problem occasional leakage of slurry from the burner of gas stove. While, 3% households experienced problem of dung availability.

- **Sufficiency of Gas**

A majority of households had experienced the problem of gas insufficiency in the winter.

❖ **Alternatives for the Insufficiency**

63 percent households used firewood when gas was insufficient where 13% of households used kerosene while 23% households used no thing for the insufficiency.

❖ **Repayment of the Loan**

Out of 30 households, only 1 HH had problem in paying the loan. Rest of the households has no problem in paying loan.

❖ **Maintenance Expenses**

Only minor maintenance and repair was 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 valve.

5.12 User's Perception and Suggestions

5.12.1. Perceptions

Except 3 households, all of the respondents were of positive opinion about biogas installation. They felt improvement in the quality of livelihood after installing the biogas plant. The people felt marked differences in saving of time, reduction in work burden, cleanliness of the environment, and better crop production.

5.12.2. Suggestions

Out of the total, 18 households i.e. 60% of the respondents had given the suggestion that "everyone should install the biogas plant"

Other main suggestions received were:

1. Subsidy for the biogas installation should be provided directly by HMG instead of through biogas companies

2. There should be provision of paying money in installment

3. Biogas installation should be made completely free for the poor people who cannot afford.

4. One house reported that the use of urine of livestock an water together for mixing with dung, increased the amount of gas production

5. One household suggested using stone instead of brick in the masonry works for biogas plant construction.

CHAPTER - VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

Biogas is becoming popular in the villages as an alternative source of energy for daily life. In this context, the present study on the socio-economic impact of biogas was carried out.

The study was conducted in Tupche VDC of Nuwakot district. The study is based on a sample of 30 households who were selected by using simple random sampling technique.

Before proceeding the study, a brief review on existing literature was made. The review focused mainly on the impact studies. For the reviews, central library of TU, BSP office and biogas experts were consulted.

The main objective of the study is to assess the socio-economic impact of biogas installation. This included both positive as well as negative impacts.

Analysis of the data has been made simply with percentages and tables. Data showed how the biogas plants helped to save firewood, reduced workloads, saved time and improvement on the health and sanitation. Use of slurry in regard to agriculture production was also been dealt. Following were some of the highlights of key findings.

1. Size of $6m^3$ biogas plants more popular in the region compared to $8m^3$ plants.

2. Biogas companies were reported as the main source of information regarding biogas by the households

3. People installed biogas as a substitute to firewood and to have easy in cooking.

4. Subsidies provided by the BSP and local community forest user group were very encouraging factor for the installation of biogas.

5. Average amount of dung feeding was as per recommendation by the majority of the households.

6. The users had tendency towards using lesser water for mixing while feeding dung in the biogas plant. They believed thicker slurry produced more gas.

7. Biogas was used only for the cooking purpose. No lighting use was reported.

8. On an average, one households saved firewood worth of Rs.882 per month. The time to collect firewood was also saved. This saving had contributed in preserving the nearby forest because; this forest had been the main source of firewood for the village.

9. After the installation, there was sufficient time saved in firewood collection, cooking and washing the dishes. The workloads of the women were reduced. But the extra time was devoted mainly in other household works and in agriculture. Only a few respondents used their time in income generation activities.

10. Cleanliness of household environment improved. The prevalence of fly was reduced.

11. One of the negative impacts of biogas plant was increased prevalence of mosquito.

12. With few exceptions, use of the slurry increased the agriculture production.

13. Most of the users had no maintenance problems. A few had the problem of slurry leakage from the burner of cooking stove.

All the surveyed biogas plants were in good running condition. The biogas company provided short trainings to the households. Therefore the users could do minor repair works by themselves whenever needed.

6.2 Conclusion

Following conclusions were drawn from the study

1. Biogas has been proved to be very beneficial to the women members of the family.

2. The workloads of the women have been greatly reduced. Biogas has cut down the firewood need of the houses. So maximum labor and time was saved in firewood collection. Food could be cooked in lesser time. Since no smoke was produced, the cooking job was easy and could be done in relatively short time. The utensils were not blackened (unlike in 'chulhas'). So half of the time was saved in washing the utensils. Hence, A lot of time was saved.

3. Therefore majority of time was saved after biogas installation. However, most of the women had to involve in other household activities and agriculture. Only a few had used gained time in income generating activities.

4. The chances of occurrence of health problems such as burning of eyes, headache, diarrhoea and fever were reduced.

5. One of the negative impacts of biogas was the increased prevalence of mosquitoes. It seems that the slurry output pit served as the site for mosquito breeding.

6. Biogas has promoted good sanitation. Most of the people are using latrines. Some were encouraged to build their latrines after installation of biogas.

7. Majority of households have not connected their latrines to biogas plants due to traditional and cultural views.

8. Considerable amount of firewood has been saved after installation of biogas. With this, a good amount of money was saved. Most people used it in educating the children. Only a few people used it in income generating purposes.

9. With saving in use of firewood, the burden on the nearby community forest has greatly reduced. Also, since the livestock stall fed for dung collection, the burden of overgrazing on nearby forest has also reduced.

10. The digested slurry contains more nutrients. Thus nutrients are better saved if composted. However, in most cases the slurry was not managed properly.

11. Subsidy provided by local community forest user group is very encouraging.

6.3 Recommendations

1. 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.

2. The cause of increased prevalence of mosquito should be studied. It seems that proper composting of slurry would reduce the chance of breeding of mosquito and reduce their prevalence.

3. The cause of leakage of slurry from the burner should be studied and prevented. Precaution should be made in new constructions to avoid the problem.

4. Connection of the latrines to the biogas plants should be promoted. This would help further improving the sanitation.

5. For better management of slurry, training should be provided to the biogas users.

6. Insufficiency of the gas in winter season has been the major problem for the biogas users. So proper alternative design of biogas plant is an urgency.

7. A comparative study of using stone on place of brick should be made.

8. Women should be encouraged in construction training and operation and maintenance trainings. This would help towards gender balance issue.

9. The moment should be skilled with training so that they can work for income generating activities.

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Interview Schedule

Socio-Econo pact of Bio-gas Plants

Date:.

Name of Enumerator:.

Socio-Economic Characteristics

Name: Age: Sex: Education:

Address: Landholding Size: Size of the biogas plant: m3

1. Major Source of household in income

Agriculture ☐ Service ☐

Business ☐ Wage Earner ☐

Others .....

1.1. Land holding in local unites (Ropani)

Type of Land	Area in Ropani
Khet	
Pakho	
Total	

1.2. Cattle Holding (In numbers)

Cattle,..... Buffaloes,.....Goat,.....

1.3. Source of drinking water

Public tap ☐ Stream ☐

Private tap ☐ Tube Well ☐

Others,.....

1.4. Type of house

Kachha ☐ Ardha Pakki ☐ Pakki ☐

Others,.....

1.5. Is Your house connected with electric grid?

Yes ☐ **No** ☐

1.6. Why did you construct the Bio-gas plant?

Because of high no. of household size ☐

Bank advice ☐

Technician Advice ☐

Availability of dung ☐

Lack of fuel wood ☐

Prestige issue ☐

Others, if any.....

1.7. What advantage of Bio-gas program attracted you most?

Environment ☐ Health ☐

Saving of time ☐ Easy to cook ☐

Less expenditure ☐ Lighting ☐

Others,.....

1.8. End-use of Bio-gas

Cooking ☐ Lighting ☐

Both ☐

Others,.....

Socio-Economic Impact

2. Which fuel did/do you use for cooking before and after Bio-gas?

S. N.	Sources of Energy	Consumption per Month		Saving per Month	
		Before Installation	After Installation	Quality	Price (Rs.)
1	Fuel wood (Bhari)				
2	Agriculture residue (Bhari)				
3	Animal dung (Doko)				
4	Kerosene (Ltr.)				
5	LPG (Kg.)				
6	Others, if any				

2.1. Give information regarding time spent in following areas before and after installation of Bio-gas plant?

S. N.	Areas	Time Spent In Hours per Day	
1	Ful wood management	Before Installation	After Installation
2	Cooking		
3	Washing utensils		
4	Fodder collection		
5	Others if any		

2.2. Which Member of your family has been benefited most from Bio-gas plant?

Male ☐ Female ☐ Children ☐

Servant ☐ All the above ☐

2.3. How this gained time is utilized ?

Farm activities ☐ Wage abour ☐

Kitchen gardening ☐ Take rest/Entertainment ☐

Business/Income ☐ Others,.....

2.4. Have you ever feel the decrease of workload after the installation of Bio-gas Plant ?

Yes ☐ No ☐ Indifferent ☐

2.5. What are the sources of fire wood collection, would you indicated it in ranking Order ?

Before Installation of Bio-gas plant	After Installation of Bio-gas plant
Own land	Own land
From Market	From Market
Jungle	Jungle

2.6. How safe is cooking on Bio-gas compared to cooking on fuel wood/agriculture waste ?

More safe ☐ Less safe ☐ Indifferent ☐

2.7. Have you feel the decrease in the smoke after the installation of Bio-gas plant?

Yes ☐ No ☐ To some extent ☐

Very much ☐

Health and Sanitation

3. What has happened to the diseases, health problems of your family member had ?

Disease/Health Problem	Increased	Decreased	No Change
Eye illness/burning			
Coughing			
Acute respiratory			
Headache			
Others, Specify			

3.1. What is the impact of Bio-gas plant in health and sanitation ?

Positive ☐ Negative ☐

3.2. Have you experienced any change in the quantity of medicines used after the installation of Bio-gas plant ?

Decreased ☐ Increased ☐ Remained Same ☐

3.3. Do you find any change in the general cleanness of the surrounding after the installation of Bio-gas plant ?

Yes ☐ No ☐

Impact of Agricultural and Production

4. Do you use Bio-gas slurry as manure ?

Yes ☐ No ☐

4.1. Have you feel the effect of slurry on the production of crops ?

Production increased ☐

Production decreased ☐

Remained same ☐

4.2. What is the effect of slurry in comparison to chemical fertilizer ?

Money save ☐

Production increased ☐

Both ☐

4.3. Is there any change in use of chemical fertilizer after the use of slurry ?

Reduction of chemical fertilizer ☐

Increase in chemical fertilizer ☐

No change in chemical fertilizer ☐

Not applicable ☐

4.4. Have you feel the storing of digested slurry in pits has reduced the menace of flies and mosquitoes in an around your house ?

Very much ☐ Not at all ☐ To some extent ☐

Weaknesses and Suggestion

5.1.Weaknesses ……

5.2. Perceptions.....