CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Nepal is primarily an agricultural country with about 23.2 million human populations of which 85.80 percent population resides in rural area and 78 percent people are highly dependent on agriculture. Nepalese rural economy, predominated by subsistence agriculture, is based on combination of crop production and animal husbandry. Livestock is an integral component of farming system, which has multiple benefits to rural people.

Animal husbandry makes up a vital part of agricultural production system of Nepal. It has always been complementary to the crop production in the traditional agriculture in Nepal. In rural area, 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 conditions of resource stress, as a raw material for fuel. The number of cattle and buffaloes is also increasing along with household.

Nepal relies to a large extent on traditional resources; as no proven significant deposits of fossils fuel are available. The sources of energy in energy balance of the country can be shown as follows; Fuel wood 75.78 percent, Agricultural residues 3.75 percent, Animal waste 5.74 percent, Petroleum Product 9.24 percent, Electricity 1.47 percent and Coal 3.53 percent and others/renewable. The available energy from these above sources is mainly used for cooking.

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.

Due to lack of firewood 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 source of energy was realized. In search of finding alternative source of energy, a promising sustainable source of energy that was biogas. (BAJGAIN; 2003)

1.2 Statement of the Problem

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

In the study area, which is in rural Nepal, mainly the problem of deforestation is faced by the people.

The main source of fuel for household work is firewood which is collected from the forest and the deforestation is being increased day by day. On the other hand smoke produced by firewood caused air pollution so for the sustainable environmental development alternative source of energy should be used. In the study area most of the people are farmers and they are also engaged in animal husbandry. Because of animal husbandry easy, cheap and long lasting alternative source of energy is biogas energy for the people of study area but there are many problems related to biogas plantation.

1.3 Objectives of the Study

The overall objective of the study is to assess the socio-economic impact of biogas technology on its users with special reference to agriculture and health. However the specific objectives of the study are:

- To enumerate and characterize the socio-economic characteristics of biogas users.
- To incorporate biogas user's perception towards biogas technology.
- To analyze the impact of biogas in environment and in health.

1.4 Limitation of the Study

This study has numbers of limitation like shortage of time, reliability of statistical tools used and lack of research experiences. Some other limitations are:-

- The study hasn't covered the whole sample biogas households of all VDCs of Kanchanpur district due to various constraints. Therefore findings and conclusions mayn't 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 isn't possible. So recall technique was used to get data and information in the past.

1.5 Organization of the Thesis

The study contains six chapters.

The first chapter gives introduction of the study. It contains background of the study, objectives of study, significance and justification of study.

The second chapter consists of the review of the literature related to the study.

The third chapter describes the research methodology of the study.

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

The chapter five describes socio-economic condition of biogas user households and information on biogas plants installed in study area, impact of biogas technology.

The chapter six contains Summary, Conclusion and Recommendations.

CHAPTER TWO
LITERATURE REVIEW

A collective body to work done by earlier scientists is technically called the literature. So review of any related field study is called the literature review. Every researcher needs to connect logically the previous study of his/her selected field.

Before proceeding for the research, a brief review of the literatures on biogas was made to have a good knowledge about the subject and to have a brief idea about the previous works done on the field of biogas. The outcome of some studies is illustrated hereafter.

Biogas energy is only one of the alternative sources of energy for cooking in the rural area. In rural community whose only fuel is wood, dung cake and crop wastes are benefited by biogas energy. Biogas production combines the short term economic needs of such community with conservation and the end of ecological degradation.

Biogas technology has been gaining popularity nowadays as a good alternative source of domestic energy.

Jan Baptita Van Helmont first determined in the 17^{th} century that flammable gases could evolve from decaying organic matter. An Italian National, Count AlessandroVolta concluded in 1776 that there was direct correlation between the amount of decaying organic matter and amount of inflammable gas produced. He wrote to a friend about combustible air. He wrote the submerged plant materials in the ponds and lakes continuously give off such gas. Later Volta's gas was shown to identical with methane gas.

In the developing countries like Nepal, the history of biogas isn't very old. First of all, the credit for introducing biogas technology in Nepal goes to late father B.R. Saubole. He established a model biogas plant in St-Xavier school in Godawary in 1955. Thereafter, the interest in biogas rose slowly and kept on process of installation of biogas plants in the different parts of his country. Fortunately, initial successes encouraged the Department of Agriculture (DOA) and Agriculture Development Bank to install 250 biogas plants in the Agriculture Year (1975/76). During this year,

Agriculture Development Bank channelized 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 in Nepal was initiated mainly 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 biogas development and number of household size biogas plants has increased rapidly. Alternative Energy Promotion Center (AEPC) was formed as a recognized government body under the umbrella of Ministry of Science and Technology (MOST) for the promotion of alternative energy in Nepal. Apart from these organizations, other national and international agencies notably UNICEF, Save the Children Fund/USA, New Era, Dev-part Consult, East Consult, CMS/Nepal (Pvt.) Ltd, etc have also made significant contribution in the promotion and development of biogas technology in Nepal.

Biogas, popularity known as Gobar gas in Nepal, is a combustible gas provided by an anaerobic fermentation of organic materials by the action of Methanogenic bacteria within a temperature of 25 to 35 degree centigrade for certain period of time. This gas is composed of 60-70 Percent Methane, 30-40 Percent Carbon dioxide and some other gases. The Methane gas is colorless, odorless and burns with clear blue flame without smoke. It produces more heat than kerosene, fuel wood, dung cakes and charcoal. Biogas can be used for cooking, lighting, running, engines and generate electricity. However, the use of biogas in Nepal is limited to cooking and lighting only till now. (BSP 2009)

Biogas plants provide direct benefits especially to rural women as a result of the reduction of the workload when shifting from cooking on fuel wood to using biogas. Several studies document on average time saving of three hours per day mainly due to reduction in time used for collecting fuel wood, cooking and cleaning of utensils. 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 banishing 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.

Biogas reduces indiscriminate deforestation. Another environmental benefit of biogas is maintenance of ecological balance by reduction of about 380000 tons of Carbon Oxide annually. One biogas plant saves about 2.3 tons of fuel wood per year. It roughly saves about 0.03 hectors of forestland per year. Thus with 100000 biogas plants installed in Nepal, the biogas would save approximately 30 tones of bio-compost per year. About 90 percent farmers use the bio fertilizer in Nepal. The three million tons of 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 vegetables and eventually helps for generating income to biogas households. (Bajagain; 2003)

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.

Biogas technology is also potentially useful in the recycling of the nutrients back to the soil. Burning non-commercial fuel, such as dung and agriculture residues, in rural area, where they are used as fuel instead of as fertilizer, leads to a save ecological imbalance since the Nulvients-Nitrogen, Phosphorus, Potassium and micro nutrients are essentially last from the ecosystem. Biogas production from organic materials not only produces energy but the preserves the nutrients which can in some cases be recycled back is the soil in the form of slurry.

Similarly in the area of public health and pollution control biogas technology can solve another major problem that of the disposal of sanitation wastes.

Digestion of these wastes can reduce he parasitic and pathogenic bacteria counts by over 90 percent breaking the vicious circle of re-infection via drinking water, which is many rural areas is untreated.

The study "Biogas processes for sustainable development" summarize, biogas technology is receiving increased attention form officials in developing countries, due to its potential to bring an ecological viable solution to the following problems.

- Dependence on imported sources of energy.
- Deforestation, which leads to soil erosion and thereafter to a drop in agricultural productivity.
- Providing inexpensive fertilizers to increase food production.
- The disposal of sanitary wastes, which can solve public health problem.
- The disposal of industrial wastes which causes water and air pollution.

With the growing significance of this process, it is appropriate to mention same of the historical developments which have occurred during the last 100 years of anaerobic digestion. In many cases, this may help to clarify the state of the art at the end of the 20^{th} century.

BSP (2004) "Final report on biogas program, phase III," shows that use of energy in sustainable way when it is an integral part of an ecological cycle. So burning of firewood, dung cake and agricultural residues are practiced in Nepal is not sustainable. BSP-Nepal would like to acknowledge the contribution of various individuals and organizations involved in the formulation, development and implementation of biogas program, phase III. It focuses on the joint cooperation of all individual as well as organization for the success of biogas programs.

As a continuation of BSP phase I and II, phase III commenced in March 1997 and finished in June 2003. The target of phase III was to construct 1 which causes, 100000 high qualities, smaller biogas plants during the project period. Some of the main objectives of BSP III were to maximize the benefits to biogas related applied research,

strengthen the capital of biogas institution and ensure continued operation of all biogas plants installed under BSP.

In the study carried out by Charla Brilt (1994) argued that biogas clearly has a lot of promises in Nepal. It is a renewable relatively inexpensive decentralized alternative energy source. It can help to meet energy demand in rural areas while lessening deleterious consequences of fuel-wood use in an increasingly forest deficient world and alleviating problem in the supply of organic fertilizers.

BSP (1996) a meeting report shows that the reduction in the workload especially of women, caused by introducing the biogas technology. The following noted activities were collection of firewood cleaning utensils and cooking in smokes – full kitchen, reduced but mixing of water and dung and carrying water more than before were affected. No clear relation was found between the installation of biogas plant and it's spent on fodder collection grazing animal as well as caring and feeding application of dung to fertilize the fields. Besides feeding with dung and water operation and maintenance of the biogas plant hardly require extra labor. The average saving in time amounts three hours per household per day which is given in table.

Table-2.1: Average Effect of a Biogas Plant on the workload of typical Biogas Households

Activities	**Saving Time (in hours/day)**
Collection of water	-0.40
Mixing of water and dung	-0.25
Collection of firewood	+1.40
Cooking	+1.70
Cleaning Utensils	+0.65
Total	+3.10

Source: BSP 2009

The meeting report mentions that most women express great satisfaction, particularly with the cooking aspects of biogas. Biogas is quicker and easier for cooking than fuel-wood. Moreover, biogas is smokeless and doesn't require. Constant attention or blowing on the coals, women can put a pot on the burner and do other activities while

the food is cooked. In summer the heat during cooking is less. This warmth was missed however in winter. In general women feel the coughing less reducing headache and have fewer problems of eye-irritation. Cases are reported about older women who could no longer cook. On open fire, but they were able to cook again with biogas. This issue was also explored in the study.

BSP (2009), "Technical introduction of Biogas" showed that use of energy is sustainable only when it is an integral part of an ecological cycle. Burning of firewood dung or agricultural waste in practiced in Nepal is not sustainable when the use of fuel wood exceeds replication, resulting in deforestation and secondly, when organic matter including nutrients is destroyed in the process.

Biogas on the other hand, is a sustainable and renewable source of every because it is a closed ecological cycle. The organic materials that are fed in to the plant are used without being destroyed. The nutrients and organic matters (apart from some carbon and hydrogen) will still be available in the slurry and can be returned to the soil. Burning of biogas doesn't contribute to global warming because the plants use an equal amount of CO in the ecological cycle. It is thereafter important that the nutrients are returned to the soil. So that plant will grow and bind the CO. Furthermore, burning biogas is much cleaner than burning biomass.

The biogas plants have been brought in operation under BSP till July 2007 (11944 units) produce annually about 7 million m^3 biogas and 0.4 million tons of digested dung (7 percent dry matter). According to BSP 2009, the environmental benefits are:

a. **Saving on traditional energy sources: -** When biogas is used for cooking, it will save on fuel-wood, agricultural waste and dung cakes. The annual save on fuel wood is estimated at some 42000 ton. The reduction on the emission of CO will amount to almost 60000 ton per year assuming an emission co-efficient of 14 ton CO per ton firewood. The organic matter and plant nutrients of agricultural waste and dung cakes which are otherwise burnt are available to sustain the fertility of the soil. Increased crop production through difficult to quality will also to sequestration of CO.

b. **Saving on commercial energy sources: -** When biogas is used for lightings, it will save kerosene. The annual saving on kerosene is estimated at 670000. The reduction on the emission of CO will amount to almost 2000 ton per year assuming an emission of 2.8 kg. CO per liter kerosene. (BSP – report the meeting the development policy)

c. **Improving Soil Fertility: -** By installing a biogas plant the management with regard to dung on the farm will improve on daily basis. Dung is collected and fed to the digester. If properly stored, treated and applied to the fields; biogas slurry has higher fertilizer value than ordinary farmyard manure and is able to increase to soil fertility. Biogas slurry is always favorable compared to the ashes of agricultural and animal waste used for cooking purpose. In addition to possible saving on nutrients, biogas slurry contributes to sustain the organic matter in Nepalese soil, which is decreasing rapidly. This tendency endangers the agricultural production in figure. BSP report showed that most of the adopter of biogas technology has so far been among the larger and medium farmers. Smaller farmers too have been increasingly attracted to the program. The flat rate subsidy policy favor smaller plant size and smaller farmers more than the large one. While on addition, the increasingly active involvement of NGO in the promotion, organization financing and construction of biogas plants on the basis of self help, had the effect of burning biogas within the reach of even smaller farmers with fewer cattle than larger farmers. However, biogas will never benefit these without cattle and these are generally among the very benefit in the indirect way only because of reduced pressure on the forest and greater availability of firewood.

Installation of biogas plants have resulted in significant health effects. The main positive effect is in the level of indoor are pollution. Several studies have shown air pollution and smoke exposure in rural Nepal, expressed in reparable suspended particulates.

According to the outcome of the study carried out by Gobar Gas Company (GGC) in Kanchanpur District in 2010, biogas had every positive indication for the speedy extension of the impacts on the workload of women. They were liberated from difficult tasks of coking in smoke filled kitchen, collecting of firewood from dangerous Jungles and cleaning of cooking vessels with black shoots. They now felt comfort in cooking and enjoying it.

A study conducted by BSP in December 2004 “A successful Model for Rural Households Energy Supply in Developing Countries” Illustrated about the benefits of biogas technology in many aspects. It shows that, biogas systems provide multiple benefits at household, local, national and global levels with manor impacts on gender, poverty, health, employment and environment. Sampled plant owners were optimistic regarding the role of companies, despite their not so effective after sale-services. Similarly, the role of ADB/N on loan sanctioning was also appreciated. Even though other two banks had started to invest in this sector the farmers still prefer ADB/N to get loan to install biogas plants, ADB/N has to improve its service delivery keeping in view the farmers trust on it, the study revealed that the subsidy was one of the major attractions for most of the users to install biogas plants, however, it had still not reached the needy poor through they had sufficient number of cattle and thus the dung to operate biogas plant successfully, one of the encouraging facts noted was that the marginal groups of the population too were well motivated to install biogas plant. Despite these positive effects, reduction in gas production during winter season, frequent breakage of gas lamps delay in rendering post installation operation and maintenance works from companies behalf were some of the problems to be addressed efficiently in the days to come for more positive outcomes from the installation. This study also argued that the number of households that construct plant in cash was increasing day by day; even the small farmers had started constructing biogas plants. Another encouraging fact noted were the users increasing appreciation as regards the effectiveness of the digested slurry.

Energy situation in Nepal:-

The energy resources of Nepal can broadly be classified into three categories; traditional, commercial and alternative energy. Traditional energy includes firewood, agriculture and animal wastes (dung cakes). Commercially energy consists of electricity, coal and petroleum product. Petroleum and coal are imported which amounts almost one third of the country export is earning (Mettew and wim, 1999)

Nepal has wonderful hydropower potential estimated at 83000 MW of which 40000 MW is considered to be technically feasible. But till to date, about 600 MW of hydropower has been installed which contributes about 1 percentage of total energy requirement of the country.

Firewood contributes about 78 percentage of total energy consumption, which is mainly consumed in rural Nepal. Forest (which includes community, public, private forest) and private farms are the sources of firewood. The resources for the firewood are depending due to over exploitation and lack of proper management.

Other biomass sources, agricultural residue and animal dung contribute about 10 percentage of energy requirement.

Petroleum and coal together makes about 12 percentage of the total consumption. These are completely imported.

Sector-wise analysis shows that residential sector consumes about 89 percentage of the total energy consumption.

Nepal's per-capita energy consumption is estimated to be 14.6 Giga Joules.

About 87 percentages of the Nepalese people live in rural areas and rural residential sector consumes 89 percentage of total energy. Cooking activates makes a share of 65 percentage of the total rural energy consumption. The rural area consumes only 30 percentage of total commercial energy consumption. (WECS, 2003)

Subsidy

BSP provide the subsidy for biogas installer through Biogas Company. Its provide rate is different in terai, hill and remote hill which we can see better in Table given below.

Table-2.2: Subsidy Rates in Rs.

Region	**2, 4 & 6 m^3**	**8 m^3**
Terai Districts	Rs. 9,700	Rs. 9,000
Hill Districts	Rs. 12,700	Rs. 12,000
Remote Hill Districts	Rs. 18,700	Rs. 18,000
Very Remote Hill Districts	Rs. 20,000	Rs. 20,000

Source: Internet Source,Google.com (Biogas Energy), BSPN, 2009

Table-2.3: Additional Subsidy for the poor, Dalit, Janajati and Conflict Victim

Region	**2, 4 & 6 m^3**
Terai Districts	Rs. 2,000
Hill Districts	Rs. 2,500
Remote Hill Districts	Rs. 3,500

Source: BSPN, 2009

The above tables show that the subsidy rate is different in terai, hill and remote hill. BSPN provided high subsidy rate in remote hill and hill districts that terai. Because in terai there are different facilities likes electricity, solar and they are rich than hilly people. Again the BSPN provided additional subsidy rate for the poor, Dalit, Janajati and Conflict Victim people.

CHAPTER THREE
METHODOLOGY

3.1 Research Design

For the study descriptive research design was followed. The descriptive research was applied for the qualitative data obtained and derived during the study.

3.2 Rationale for the Selection of Study Area

Tribhuvanbasti VDC of Kanchanpur District was chosen for the study. It is 50 km far from district headquarter Mahendranagar. The reasons to select this VDC will be:-

As the study was carried out to fulfill the thesis requirement of Master's Degree in Rural Development by a student, the researcher was bound to incur minimum financial expenditure. So this study area is more accessible for the researcher. Thus all these facts will be guiding factors to select this VDC as the study area.

- Animal farming was almost main occupation of the villagers.
- Scarceness of the firewood in the study area.
- The study area was far from jungle area.
- The study area was a newly introduced to Biogas Plant and was remote/undeveloped area.

3.3 Sampling Procedure and Sample Size

At the end of year 2067, 200 biogas plants have been installed in various parts of Tribhuvanbasti VDC. It was not possible to interview all the biogas households of Tribhuvanbasti VDC in limited time. So out of them, only 30 Households were selected on the for the study basis of simple random sampling. Therefore in summary

Universe	:	200 Households
Sample size	:	30 Households
Sample Percentage	:	15 Percent
Sample Procedure	:	Simple Random

3.4 Sources of Data

Both primary and secondary data and information were used to receive in-depth impact assessment of biogas users. The household survey questionnaire was used to collect the primary data to get first hand information on the impacts of biogas users.

Extensive library consultation was made for the collection of secondary data regarding biogas technology. The library consultation contributed a lot in-depth understanding the issues under the study. Eventually, the understanding helped tremendously in designing of tools and field data collection method. 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 Data Collection Techniques and Tools

The following techniques and tools have been used to collect primary data of the study area.

a. Household Survey

Household Survey was conducted as a technique to collect the information of the socio-economic characteristics of the respondents. For the purpose structured questionnaires were prepared as tool. The respondents were requested to answer the questions related to their socio-economic characteristics, the problems they are facing in biogas technology and their views regarding the impact of biogas technology.

b. **Focus Group Discussion**

Focus Group Discussion was conducted as a technique to collect the information of the advantage and disadvantage of biogas plants. 8 participants from study area were grouped and discussed the structured questions. For the purpose structured questionnaires were prepared on tools to discuss in group. In the discussion, the advantages and disadvantages of biogas technology, slurry management, impact of biogas technology and how to make biogas pro-poor were the focused aspects.

c. Key Informants of Interview

The primary data had also been collected from key informants who were technocrats of biogas technology, using the semi and unstructured interview method. The interview had also been taken as cross checking for the data obtained from questionnaire.

The respondents had been interviewed on the basis of impact study of biogas energy, relating the field of socio-economic status, health and sanitary situation, gender participation and energy use situation.

d. Field Observation

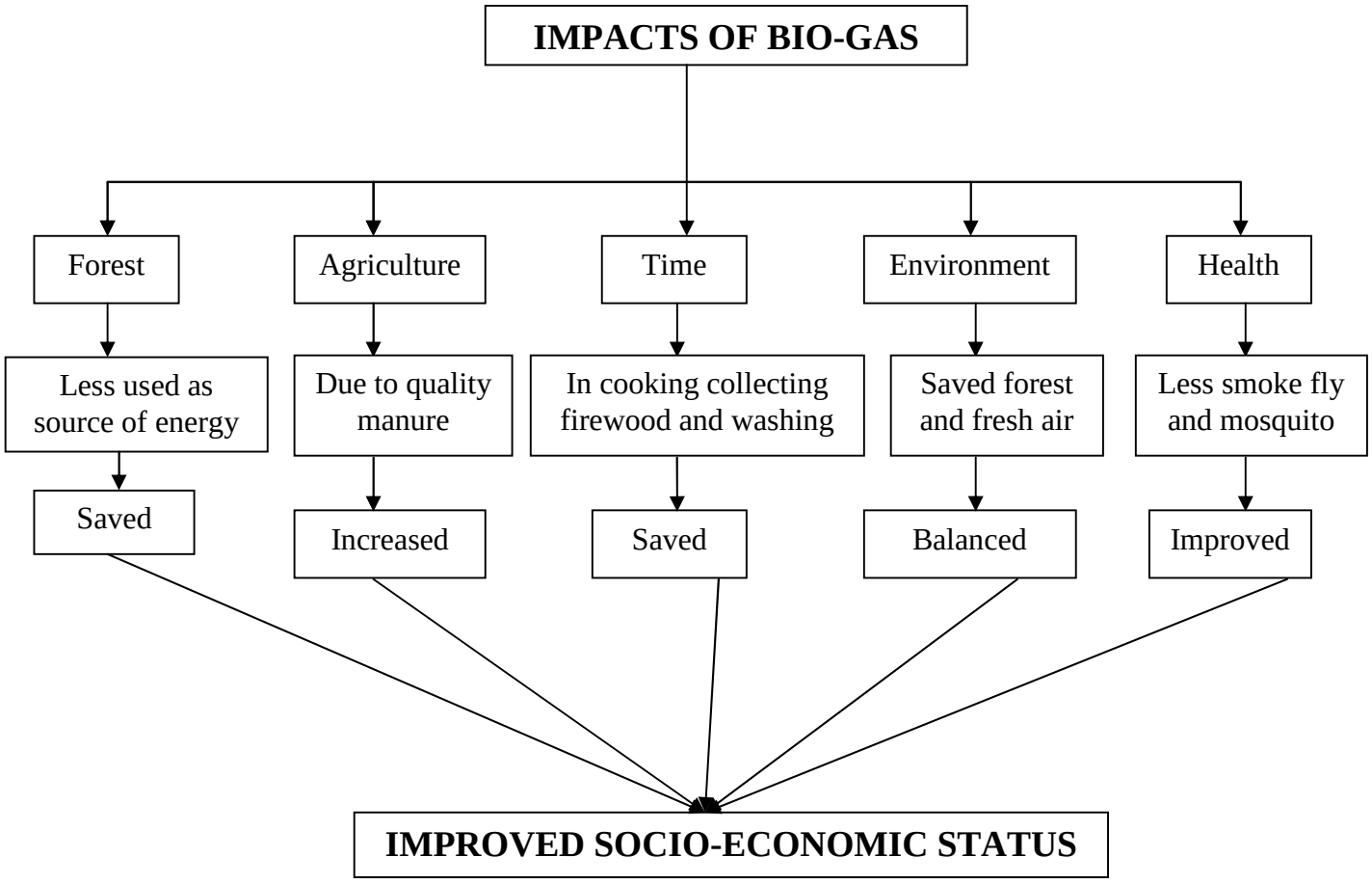
Each household with biogas plant of the study area had been observed. The data were recorded in check list which is the tool of observation technique, while observing the household environment, biogas plants, burning stoves, cooking time, kitchen room.

3.6 Data Processing, Tabulation and Analysis

In this section, the collected data were processed through editing, coding and tabulating. Then the organized data were subjected to analyze by using different statistical tools. For this study, the qualitative data were analyzed under descriptive method and quantitative data, obtain from structured questionnaire, and were analyzed by using tabulation method. The simple statistical tools such as percentage, graph, diagram, map etc. are also used for data presentation.

3.7 Conceptual Framework of the Study

For the data analysis, the conceptual framework of the study was prepared which is given below:



CHAPTER FOUR
INTRODUCTION TO STUDY AREA

4.1 Introduction to Kanchanpur District

Kanchanpur is one of the district of Mahakali zones in Far-western Development Region of Nepal. The district lies in the south-west direction of the zone. It is surrounded by Kailali district in the east, Uttaranchal of India in the west Dadeldhura district in the north and Uttar Pradesh (UP) of India in the south. The headquarters of this district is Mahendranagar. The district topography varies from the south 176 m to the north1528 m height from the sea level. The district lies with the geographical location of 80’ 03" east to 80’ 33" east longitude and 28’ 32" to 29’ 8" north latitude.

The area of Kanchanpur district is 1610 square kilometer. The district is about 200 km from Dipayal, the headquarters of Far-western Development Region and 709 km far from Kathmandu, the capital city of Nepal.

The district is somewhat rectangular in shape with the average length of 44 km in the east west and 34 km in north-south. Most of the area of district is flat. There are 19 VDCs and 1 municipality in the district.

The total population of the district was 377899 with growth rate of 3.91% in the census 2001. Out of which 191910 (50.78%) were male and 185989 (49.22%) were female. The population density of the district was 235 per sq.km. The population estimated up to July, 2007 is about 480000 with population density 298 per sq.km.

4.2 Introduction to Tribhuvanbasti VDC

4.2.1 Geographical Features

a. Location

Tribhuvanbasti VDC lies in the south- east direction of Kanchanpur district. The topography varies from 182 m to 221 m. The VDC is 61 km far from Mahendranagar, the headquarter of Kanchanpur district. Its boarders are as follows:

Direction	Adjoined by
East	India
West	Laxmipur VDC
North	Kalika VDC and Baisi-bichawa VDC
South	Parasan VDC and India

b. Climate

The climate of Tribhuvanbasti VDC is both hot and cold. During the summer season, the climate is hot and in winter it is cold. The average temperature ranges minimum 7^0c to maximum 43^0c. As other parts of the Terai, the source of rain is monsoon and average annual rainfall is 1575 mm.

c. Soil

The quality of soil differs from place to place in the VDC. The condition of soil in flats and lowland is fertile and alluvial type. The condition of soil in other parts is somewhat sandy and not as fertile as in lowland.

4.2.2 Demographic Features

a. Population

The total population of Tribhuvanbasti VDC was 12507 in 2001. Among them male were 6215 (49.7%) and female were 6292 (50.3%).

The population estimated up to July, 2007 is about 13,850 in the VDC. The ward wise households and total population is shown in the Table 4.1 below:

Table 4.1: Ward wise HHs and Population of Tribhuvanbasti VDC

Ward No.	Total HHs.	Total Population	Percentage of Total Population
1	331	1704	13.62
2	208	1041	08.32
3	222	1156	09.24
4	309	1603	12.81
5	297	1670	13.35
6	239	1345	10.75
7	175	1073	08.57
8	313	1729	13.82
9	168	1186	09.52
Total	2262	12507	100.00

Source: CBS, 2002

b. Educational Status

The literacy rate of Tribhuvanbasti VDC is low in comparison to presence of schools. Only 77% of the people are literate and remaining 23% are illiterate *(Source: Resource Centre Tribhuvanbasti, 2009)*. Table 4.2 below shows the number of school in the VDC:

Table 4.2: The number of Schools and Colleges in Tribhuvanbasti VDC

S.N.	**Kinds of School**	**No. of Schools**	
		Governmental	**Private**
1	Primary Level	1	1
2	Lower-secondary Level	1	-
3	Secondary Level	1	3
4	Higher Secondary Level	2	-
5	College (TU) B.A./B.Ed.	1	-

c. Economy and Occupation

The economy of Tribhuvanbasti VDC is completely agro-based. Nearly 90% of the households have agriculture occupation (*Source: District Profile Kanchanpur, 2065)*. A small number of people have engaged in non-agriculture work like government services, teaching, business, labors etc.

Out of the total population of this VDC, 15-59 age groups are economically active. They are nearly 51% and they are engaged in different occupations (*Source: District Profile Kanchanpur, 2065)*. The percentage of people engaged in different occupation is shown in Table 4.3 below:

Table 4.3: Percentage of People Engaged in Different Occupations

S.N.	Occupation	Percentage
1	Agriculture	88.00
2	Business	06.00
3	Services	03.00
4	Others	03.00
Total		100.00

Source: Resource Centre Tribhuvanbasti, 2007

d. Social Life

The social life of the people in this VDC is not completely traditional. It is gradually tending towards modernism. The living style like eating, clothing and housing is also not like that of traditional. The people from all 14 zones are available in Tribhuvanbasti VDC due to its Resettlement Program during seventies and Eighties. People's attitude towards conservation of environment has been also changed. They have been aware of environment and human health. They keep their homes, yards, paths as well as surrounding clean and tidy. They are developing community forests.

e. Major Crops

The main crops grown in Tribhuvanbasti VDC are paddy, wheat, maize, oil-seed,

lentil and sugarcane. Potatoes, vegetables and fruits are grown in small scales. The crops and percentage grown in the VDC are given below:

Table 4.4: Percentage of Crop Production in VDC Level

S.N.	Crops	Percentage
1	Paddy	42
2	Wheat	22
3	Maize	10
4	Lentil	07
5	Sugarcane	06
6	Oil-seed	05
7	Vegetables	04
8	Potatoes	02
9	Others	02
Total		100

Source: Agriculture Service Centre, Tribhuvanbsti, 2007

f. Live Stock

The livestock reared by almost all the farm families in this VDC are cows, oxen, buffaloes, goats, pigs and sheep. In farming system, these livestock play an important role to provide manure to the farmers for using in their farms.

Table 4.5: Percentage of Livestock Reared by Farmers in Tribhuvanbasti

S.N.	Livestock	Percentage
1	Cows/oxen	38
2	Buffaloes	35
3	Goats	18
4	Sheep	06
5	Pigs	03
Total		100

Source: Agriculture Service Centre, Tribhuvanbasti, 2007

4.2.3 Caste, Language and Religion

Different ethnic groups are found in the VDC. They use diverse language to communicate at their home. They adopt different religion as well. Following tables reveal them more clearly.

Table 4.6: Caste wise population distribution of Tribhuvanbasti VDC

S.N.	Caste	Percentage
1	Chhetri	51.55
2	Brahmin	17.21
3	Thakuri	9.33
4	Magar	4.37
5	Dalits	3.58
6	Tharu	3.30
7	Rai	1.94
8	Newar	1.84
9	Tamang	1.75
10	Gurung	1.16
11	Others	3.97
Total		100

Source: CBS, 2002

From the above table, the caste diversity of study area is as follows: most of the people 51.55 percentages are of chhetri and 17.21 percentage of people belong to Brahmin which is the second largest caste of the study area. Respectively Thakuri, Magar, Dalits, Tharu, Rai, Newar, Tamang and Gurung are found to be 9.33, 4.37, 3.58, 3.30, 1.94, 1.84, 1.75 and 1.16.

Religious diversity of Tribhuvanbasti VDC is given in the table below.

Table 4.7: Religious Diversity of Tribhuvanbasti VDC

S.N.	Religion	Percentage of Population
1	Hinduism	93.98
2	Buddha	5.11
3	Islam	0.14
4	Christian	0.58
5	Others	0.19
Total		100

Source: CBS, 2002

From the above table, 93.98 percentages of people belong to Hinduism. Similarly the second largest religion of study area is Buddhism and Christianity is the least percentage of study area which is only 0.19 percentages.

Similarly, linguistic diversity has been included in the following table:

Table 4.8: Linguistic Diversity of Tribhuvanbasti VDC

S.N.	Language	Percentage of Population
1	Nepali	88.6
2	Magar	3.6
3	Tharu	2.6
4	Tamang	1.7
5	Newar	1.0
6	Others	2.5
Total		100

Source: CBS, 2002

The people of different castes and sub-castes live in this VDC. They are Hindus. As like other Hindus, they worship their gods like Shiva, Bishnu, Ganesh, Ram etc. All the people of this VDC celebrate different festivals like Dashain, Tihar, Holi etc. They live together and show great love and affection for one another. They believe each other, help and cooperate among themselves.

4.2.4 Natural Resources

In terms of natural resources, Tribhuvanbasti has some wetlands, rivers, lakes and forest. The wetlands are beneficial for different purposes like providing water to livestock for drinking and irrigation.

Other main natural resources of this VDC are tillable land jungle and bushes. Different kinds of trees like Sal, Sisam, Khair, Simal etc are found in national and community forests within the VDC. Various herbs are also found in the forest. Monkeys, Jackals, Foxes, Hares etc are available in the forests. The villagers use the forest for various purposes like wood for furniture and firewood, grass and leaves for fodder and different plants, roots for herbs.

a. Land Pattern

The total area of Tribhuvanbasti VDC is 25.30sq.km. Out of which the land capable of being cultivated is 2098 Ha and the cultivated land is 2010 Ha *(District Profile of Kanchanpur, 2065)*. Out of the cultivated land, the land distribution is as follows:

Irrigated Land - 680 Ha. Non-irrigated Land - 1330 Ha.

Other land distribution is shown in the table below:

Table 4.9: Land Distribution of Tribhuvanbasti VDC

S.N.	Land Type	Area in Sq. Km.
1	Tillable Land	22.70
2	Bushes	1.22
3	Jungle	0.63
4	Marshy Land	0.19
5	Sandy Land	0.4
6	Horticulture	0.1
7	Lakes	0.05
8	Rivers	0.01
Total		25.30

Source: District Profile, Kanchanpur, 2065

From the above table, 22.7 Km^2 of land is Tillable Land. Similarly 1.22 Km^2 of land

is covered by Bushes. Respectively Jungle covers 0.63 Km^2, Marshy Land covers 0.19 Km^2, Sandy Land covers 0.4 Km^2, Horticulture covers 0.1 Km^2, Lakes covers 0.05 Km^2, Rivers covers 0.01 Km^2.

b. Drinking Water

The people of Tribhuvanbasti use drinking water from hand pumps. Most of them used the wells in the past as the source of drinking water.

4.2.5 Infrastructure Development

a. Education

The VDC possess good numbers of schools for providing education. There are 2 primary schools, 1 lower secondary school and 4 secondary schools. Out of 4 secondary schools 3 are private and located in ward no. 2 of VDC. Two higher secondary schools affiliated to HSEB and only a single campus affiliated to T.U.is there launching B.A. and B.Ed. Programs.

b. Health

There is one sub-health post and 25 medical halls in the VDC. Most of the people get their treatment from the hospitals in Dhangadhi or nearby health post and hospitals in India.

c. Communication

There are 150 sets of land phones lines for communication and about 100 CDMA phone sets distributed by Tribhuvanbasti branch of NTC. Postal service is also available with Ilaka post office in Tribhuvanbasti.

d. Transportation

There is regular bus service for transportation to join the VDC with Belauri, Dhangadhi, Mahendranagar and Kathmandu. Around 25% of the total households have their own private motorbike to promote rural-urban linkage.

e. Electricity

Almost 85% of total household possess electricity for lighting. Electricity is utilized to run televisions and fans mostly.

f. Service Centre

There is a sub-agriculture service centre to take care and promote the agricultural activities of farmers. Veterinary service is also available in the VDC. Ilaka administration office issues the citizenship in the VDC.

g. Market centre

There is a small market centre named Punarwas Town Bazaar. The local people buy daily needed goods from the market and sell their agro products there. Besides the market, there is the periodic market on every Friday locally known as Hat Bazaar where local people buy or sell vegetables, fruits, meat etc. The market for sugarcane is very essential to consume the agro-product of local farmers in the VDC.

4.3 Energy Situation in Kanchanpur District

In urban and semi urban areas of Kanchanpur district, majority of people use LPG, Kerosene and electricity for cooking purpose. But in rural areas, people use firewood, animal dung and agriculture residues for cooking purpose. Thus, firewood has been chief energy source in this district.

There are 19 VDCs and 1 municipality in Kanchanpur district. In that district 75 percent people have got electricity facility. The electricity is used mainly for lighting and running cottage industries. Due to frequent rise in price of petroleum oil and costly electricity, biogas installation has gained momentum nowadays. According to BSP (2009), there is technical potential of 25,690 biogas plants of which only 4443 (17.87%) plants have been installed so far.

CHAPTER FIVE
DATA PRESENTATION AND ANALYSIS

This chapter basically consists of the analysis of the data obtained from field survey conducted in 2010. This chapter deals with the Impact Assessment of Biogas plant owners in Trubhuvanbasti VDC of Kanchanpur district. Occupation, family size, educational status, landholding and caste / ethnicity are the main variables considered in this study.

5.1 Ethnicity / Caste

Among the 30 household surveys in study is the caste ethnic representation of the biogas user household is provided in Table 1:

Table-5.1: Ethnicity / Caste Distribution of the Respondents

Ethnicity / Caste	Households	
	Number	Percentage
Brahman	19	63.34
Chhetri	06	20.00
Tamang	02	6.66
Magar	02	6.66
Gurung	01	3.34
Total	30	100

Source: Field Survey, 2010

Ethnicity / Caste composition of the respondents shows more than half of the respondents (63.34 percentage) are Brahmans, one fifth (20 percentage) was Chhetri and rest are Tamang (6.66 percentage), Magar (6.66 percentage) and Gurung (3.34 percentage). This table shows that, Brahmin is the highest caste to install the biogas plants than other caste.

5.2 Occupation

Observation of occupational distribution of respondents who have planted Biogas

plants is shown below in the table.

Table-5.2: Occupational Distribution of the Respondents

Occupation	Households	
	Number	Percentage
Agriculture	18	60
Service	09	30
Business	03	10
Total	30	100

Source: Field Survey, 2010

Survey of the occupation shows that agriculture (60 percentage) as the main occupation of the study area. 30 percentage of the respondents were involved in services and only 10 percentage were involved in business.

5.3 Family size of Biogas Owners

The average family size of the sampled households was 5.3 persons (159/30) per family. The family size of the respondents is shown in the table below:

Table-5.3: Family Size of the Respondents

Family Size	Households		
	Population	Households Number	Percentage
Small (up to 4 persons)	30	10	33.33
Medium (5 to 7 persons)	93	16	53.34
Large (above 8 persons)	36	04	13.33
Total	159	30	100

Source: Field Survey, 2010

The table shows that maximum number of respondents had medium size family with 5 to 7 persons which are 53.34 percentages. Minimum number of people in a household was 2 persons, whereas maximum number of people in a household was 10 persons.

5.4 Land Holding Size

Observation of land owned by the respondents (Biogas plant owners) is shown in the table below:

Table-5.4: Distribution of Land Holding Among Sampled Households

Land area in Kattha	Households	
	Number	Percentage
Below 10	03	10.00
11 to 20	10	33.33
21 to 30	04	13.33
Above 30	13	43.33
Total	30	100.00

Source: Field Survey, 2010

The main occupation of plant owners is agriculture; all of them have their own land to cultivate. Only operational land holding has taken into account. It is found in most of the cases that land was cultivated by owners themselves. All the plant owners had little land. The average land-holding was about 34 'kattha' per household, maximum landholding of the user was 80 'kattha' and minimum was 10 'kattha'.

5.5 Installation and use of Biogas

Size, source, reason, cost and use of biogas plants were the main variables consider in this section.

5.5.1 Size of the Biogas Plant

The table below shows the size of biogas plants in the study area:

Table-5.5: Size of the Biogas Plant of the Sampled Households

Size of the Biogas Plant	Households	
	Number	Percentage
6 m^3	27	90
8 m^3	03	10
Total	30	100

Source: Field Survey, 2010

Only two sizes of biogas plants 6 m^3 and 8 m^3 were reported. Majority of the biogas plants were of 6 m^3 capacity, only 4 household had 8 m^3 plants.

About 90 percentage of the total sampled households in this study area installed 6 m^3 biogas plant. Similarly 10 percentage households in this study area installed 8 m^3 Biogas Plant. So the 6 m^3 biogas plants were popular in this area because of little land and small family size.

5.5.2 Reasons for Biogas Installation

The reasons of installation of biogas were found to be as the following as asked in the process of study.

Table-5.6: Reasons for Biogas Installation

Reason	Households	
	Number	Percentage
Easy and smokeless cooking	27	90
Environment Protection	02	6.66
Time Saving	01	3.33
Total	30	100

Source: Field Survey, 2010

About 90 percentage of the respondents installed biogas for easy and smokeless cooking while rest of the respondents replied that they installed for environment protection as well as to easy and smokeless cooking and time saving.

5.5.3 Cost of Plant Establishment

The data owners hadn't maintained up to date data records with regard to biogas installment 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.

Table-5.7: Cost of Plant Establishment (Amount in Rs.)

Plant Size	Average Cost	Minimum Cost	Maximum Cost
6 m^3	26000	22000	30000
8 m^3	33000	30000	36000

Source: Field Survey, 2010

The average cost for installation of 6 m^3 biogas plant was Rs. 26000, minimum cost per installation was Rs. 22000 and maximum cost was Rs. 30000.

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.

5.5.3.1 Self Investment of the Users

Besides the subsidy, the biogas households had to bear rest of the cost by themselves. Provision of loan was available for this purpose through ADBN.

Table-5.8: Source of Investment for Biogas

Source	**Households**	
	Number	**Percentage**
Own Source	03	10
Loan of ADB/N	24	80
Relatives	02	6.66
Money Lender	01	3.33
Total	30	100

Source: Field Survey, 2010

Above the table shows, 24 households (80 Percentage) installed biogas plant through ADB/N Loan. It shows that ADB/N is supporting very widely for the installation of biogas plant. 10 Percentages of the study area installed biogas on their own source. 10 percentages of the study area found to install biogas on Loan either from relatives or from money lenders.

5.5.3.2 Livestock

Livestock severe is the source of dung for biogas plants. They are the sources of raw material (dung) needed to run biogas plants.

Livestock Population

In the context of biogas livestock only cattle and buffalo were considered because dung of only cattle and buffalo is used for biogas. Waste produced by goat, pig and poultry was not used for biogas. So the population of the cattle and buffalo is shown in the table below:

Table-5.9: Livestock Possession Status of Biogas Sample Households

Types of Livestock	Number of households	Percentage
Buffalo	27	90
Cattle	03	10
Total	30	100

Source: Field Survey, 2010

From the table above, buffalo was kept in most of the sample households. 90 percentage of sample households kept buffalo and remaining only 3 households which is only 10 percentage kept cattle as a feeding source for their bio-gas plants. Other animals weren't counted as their waste was not used for biogas production.

5.5.3.3 Dung Produced

Livestock dung is the main source or the operation of biogas plant. So its availability in sufficient quantity is important. Average dung product per household was 40 kgs.

Minimum dung produced was 10 kgs and maximum dung produced was 70 kgs. (Field Survey, 2010)

5.5.3.4 Dung Feeding

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

Table-5.10: Ratio of Mixing

Water to dung Ratio	Households	
	Number	Percentage
1 (Normal Slurry)	18	60
<1 (Thicker Slurry)	09	30
>1 (Dilute Slurry)	03	10
Total	30	100

Source: Field Survey, 2010

The table shows that 60 percentage of the households used equal amount of dung and water, 30 percentage used less than recommended and 10 percentage used more than recommended amount of water.

So it has been seen that 40 percentage of the sampled households were unable to prepare the mixture of dung and water as prescribed. Therefore awareness programs should be conducted to make biogas plant holders able to get the maximum advantage from biogas.

5.5.3.5 Use of Biogas

In the study area all the households reported that they used biogas only for working. Because of the availability of electricity they didn't use biogas for lighting. Most of the households had two gas burners. On an average, they used biogas 3.5 hours per burner per day. The minimum use was 2 hours per day per burner and the maximum use was 5 hours per day per burner.

5.5.4 Impact of Biogas Installation

This section includes the impact of Biogas in reduction of workloads, uses of gained time and impacts on health and sanitation and other impacts.

5.5.4.1 Reduction in Workloads

After installation of biogas, there was considerable reduction in workloads of the family members especially of the women members. They had to spend a lot of time in firewood collection and washing blackened dishes by firewood smoke before but after the installation of biogas their work load has been reduced.

The reduction in workload was measured in terms of saving in working time, observation was made on 3 categories of works which are firewood collection, cooking activities and washing utensils which are clearly shown in the table below.

Table-5.11: Reduction in Workloads

Category of work	Time Taken Before Installing biogas (hrs/day)	Time Taken After Installing biogas (hrs/day)	Saved Time After Installing biogas (hrs/ day)
Firewood Collection	3	1	2
Cooking Activities	2	1	1
Washing Utensils	1	1/2	1/2
Total	6	2.5	3.5

Source: Field Survey, 2010

The table shows that saving in time was considerable. A great time (2 hours per day) was saved in firewood collection only. The total average time saving of 3.5 hours per day indicates that more than half of the workload of the family member was reduced.

Again the study was made to know where the respondents used the saved time.

5.5.4.2 Use of Saved Time

All the biogas users experienced significant time saving due to adoption of the biogas technology. In the study area, the saved time used by the respondents is shown in the table below.

Table-5.12: Uses of Saved Time Due to the Plantation of Biogas

Category of work done in the saved time	Households	
	Number	Percentage
Household Work	18	60
Agriculture	06	20
Income Activities	03	10
Rest	03	10
Total	30	100

Source: Field Survey, 2010

The table shows that most of the respondents (60 Percentage) use their saved time in household works, 30 Percentage of the respondents used their saved time in the income generating activities and agriculture. Only 10 Percentage respondents used their gained time to take rest.

5.5.4.3 Health and Sanitation

The relation of biogas plants to health and sanitation is studied under this topic. How biogas plants help to keep the environment clean and healthy has been studied by various measures below.

5.5.4.4 Use of Latrine

The study had been made to know the status of latrine in the study area the out-come of the study is shown below in the table.

Table-5.13:Use of Latrine

Status	Households	
	Number	Percentage
Use Latrine	27	90
Don't Use Latrine	03	10
Total	30	100

Source: Field Survey, 2010

Among the households 90 percentage of the households had used "Latrines". 10 percentage of households hadn't used latrines. This table indicates that after installation of biogas, people were encouraged to use latrine for better sanitation practice and to use their waste products i.e. defecation and urine.

5.5.4.5 Connection of Latrine to Biogas Plant

Table-5.14: Connection of Latrine to Biogas Plant

Connection of Latrine to Biogas Plant	Households	
	Number	Percentage
Latrine Connected	21	70
Not Connected	06	20
Do not have Latrine	03	10
Total	30	100

Source: Field Survey, 2010

The above table shows that only 70 percentage of the households connected their latrine to the biogas plant, 20 percentage of household had not connected the latrine. They had a concept that the food wouldn't be delicious and it would smell like methane gas or like toilet so they hadn't connected their latrines to biogas plant.10 percentage of the study area were found to have no latrine.

5.5.4.6 Reduction in Disease

In the process of study, a study was made to know the status of household members' disease before and after the plantation of biogas. The status is given in the table below.

Table-5.15: Reduction in Disease

Type of illness	Before installing biogas (per year casualties)	After installing biogas (per year casualties)	Reduction (per year casualties)	Reduction Percentage
Respiratory Infection	40	20	20	50
Fever	50	40	10	20
Eye Inflection and Headache	40	15	25	62.5
Others	30	20	10	33.33

Source: Field Survey, 2010

The table shows that 50 percentages of the respiratory infection was reduced by the plantation of the biogas. Similarly fever was reduced by 20 percentages and eye infection and headache were reduced by 62.5 percentages which is the highest and remarkable. Other diseases like Diarrhea, Cholera, T.B., Typhoid etc. were reduced by 33.33 percentages.

5.5.4.7 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.

Mosquito and Fly

In the process of study, questions were asked to know whether they feel the decrease in the prevalence of mosquito and fly or not. The answers of the respondents are

shown in the table below:

Table-5.16: Mosquito and Fly increment or Decrement After the Plantation of Biogas Plant

Status	Households	
	Number	Percentage
Decrease after biogas installation	24	70
Increase after biogas installation	04	13.33
No Change	02	6.66
Total	30	100

Source: Field Survey, 2010

Reduction in the prevalence of mosquitoes was reported from the study. About 13.33 percentages households reported that mosquito had increased after biogas installation, while 70 percentage households reported decrease in mosquito and 6.66 percentage households reported that they found no changed or difference in the prevalence of mosquito and fly before and after the installation of biogas.

5.5.4.8 Economic Impacts on Biogas Installation

The impacts of biogas on household's economy weren't tangible and hence the user often felt insignificant impact. This section discusses about the saving of firewood, specific benefits of the saving and use of slurry in relation to agriculture. It increases in production, operation and maintenance of biogas plants.

Saving in Firewood

In the process of the study, the firewood consumption is reported to be as the table by the respondents.

Table-5.17: Saving in Firewood in per month per household

	Consumed Before Installing Biogas	Consumed after Installing Biogas	Reduction in Consumption	Reduction Percentage
Firewood	50 bhari or 1500kg	10 bhari or 300kg	40 bhari or 1200kg	80

Source: Field Survey, 2010

From the table above, it is clear that the installation of biogas plants; reduced the consumption of firewood by 80 percentages. There is no doubt that biogas plant will help to conserve the forest and keep the balance in ecosystem.

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. This might have been otherwise used to buy chemical fertilizer. During research it was found that about 21 households used slurry by composting while 9 households used it in dehydrated form.

Increment in Agricultural Production

The Biogas user's surveys and impact studies carried. Different institutions biogas companies, NGO / INGOs community forest groups, consultancies and individuals have reported that agriculture, production is increased after the adoption of biogas technology. However the present study indicate different scenery incase of increment in agriculture production.

Table-5.18: Production Increment

Agriculture Production	Households	
	Number	Percentage
Increased	24	80
Decreased	03	10
No Change	03	10
Total	30	100

Source: Field Survey, 2010

From the table above, about 80 percentage respondents reported that their agricultural production is increased after the installation of biogas plant. Similarly about 10 percentage respondents stated that their agricultural production is decreased, in the household visit and observation the improper use of manure like dried manure and improper management of slurry was found to be the cause. And the remaining stated that they found no change in agricultural production before and after the installment of biogas plant.

We should encourage farmers to install biogas in agricultural Countries like Nepal because survey says that after the plantation of biogas agricultural production found to be increased.

5.5.4.9 Operation and Maintenance Problems

Table-5.19: Operation and Maintenance Problems

Operation and Maintenance Problems	Households	
	Number	Percentage
Having No Problem	21	70
Having Problem	09	30
Total	30	100

Source: Field Survey, 2010

The study has shown that 70 Percentage of the households had no problems in running their biogas plants, 20 Percentage of households had the problem of

occasional leakage of gas from the burner of gas stove. Provision of regular maintenance from the biogas related sectors is recommended.

a. Insufficiency of Gas

A majority of households had experienced the problem of gas insufficiency in the cold season

b. Paying the Loan

Out of 30 households, only one household had problem in paying the loan. Rest of the households had no problem in paying loan.

c. **Maintenance Expenses**

Only minor maintenance and repair was needed to the biogas plant. So, the users had to experience of regular expenses for the maintenance and repair. Very often, some users had problem of leaking from the main gas valve.

5.5.4.10 User's Perception and Suggestions

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 in time. Reduction in work burden, cleanliness of the environment and better crop production too.

All of them had given the suggestion that "Every biogas company should regularly supervise biogas plant for their respondents after warranty period." out of the total, 15 households i.e. 60% of the respondents had given the suggestion that "Everyone should install the biogas plant."

Other main suggestion received was:

1) Subsidy for the biogas installation should be provided directly by GON 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 very poor people who cannot afford.
4) One house suggested that the use of urine of livestock and water together for mixing with dung increased the amount of gas production.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary

Biogas is being popular in rural area as an alternative source of energy, essential and beneficial for developing countries like Nepal. Being an agricultural country, biogas can play a vital role for agriculture production. In this context, this study is mainly associated with the study of impact of biogas suggesting that it is the best alternative energy source in rural development.

This study was conducted in Tribhuwanbasti VDC of Kanchanpur District. This VDC lies in the south- east direction of Kanchanpur district. The topography varies from 182 m to 221 m. The VDC is 61 km far from Mahendranagar, the headquarter of Kanchanpur district. Due to this variation people of this locality were mainly influenced for agriculture farming as well as dairy farming.

The study was based on the following random sampling process.

Universe : 200 Households

Sample size : 30 Households

Sample Percentage : 15 Percent

Sample Procedure : Simple Random

The specific objectives of the study were:

- To enumerate and characterize the socio-economic characteristics of biogas users.
- To incorporate biogas user's perception.
- To analyze the impact of biogas in environment and in health.

The analyze data was presented simply with the help of percentage and tables as well

as figures. The presented data showed how the bio-gas plants help to save firewood, reduce workloads, save time, improve health and sanitation. Use of slurry was also significant for agriculture production. The following points are some of the highlights of key findings:

1. Brahmins about 63 percentage were more aware and forward about this technology than other caste.
2. Size of 6 m^3 biogas plants were more popular about 90 percentage in the region compared to 8 m^3.
3. Biogas was used only for cooking purpose. No lighting was found.
4. The time to collect firewood, to wash dishes and to cook was saved. In an average 3.5 hours per day was saved. The saving of firewood was found to be contributing in preserving the forest and environment.
5. The users felt reduction in health related problems such as eye irritation, headache, coughing, diarrhea and Tuberculosis (T.B.)
6. Household environment was improved. Prevalence of fly found to be reduced by 70 percentage respondents.
7. About 80 percentage of the respondents reported that the use of slurry increased agricultural production.
8. Most of the users (about 70 percentage) have less or no maintenance problem.

Although the biogas company provided short training and information to the households, almost all of the survey biogas plants are in good running condition. Therefore the users could do minor repair works by themselves whenever needed.

6.2 Conclusions

The following conclusions were drawn from the study:-

- Biogas has been very useful for the manpower working in kitchen of the family.
- The environmental sanitation and agricultural production are found to be upgraded. And the diseases caused by smoke are found to decrease in the households having biogas plants.
- The impact of biogas on biogas plant users is found to be positive due to its advantages like:

- ✓ Time saving
- ✓ Lessening workloads
- ✓ Smokelessness
- ✓ Good quality of compost fertilizer to increase the agricultural product.

6.3 Recommendation

This research work recommends some suggestions that adopted from field survey; considering the general findings of the study. Some recommendations have been suggested on the desired future of the implementation of biogas related activities to get positive impacts.

To be done urgently:

- ➢ Awareness programs should be conducted regarding the proper use of biogas plants and its usefulness.
- ➢ Easy loans should be provided to the farmers by the GON to preserve forest as well as environment by the use of biogas plants.

To be done for Long Run:

- ➢ Pro-poor policies on biogas should be made.

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APPENDIX I

QUESTIONNARE

General Information:

1.1 Name of the plant owner:

1.2 Address:

1.3 Sex:

1.4 Caste/Ethnicity:

1.5 Main occupation of family:

Agriculture	1	Business	2
Service	3	Others……..	4

1.6 Secondary occupation of family:

Agriculture	1	Business	2
Service	3	Others……..	4

1.7 Education Status:

Particular	Male	Female	Total
Illiterate			
Informal			
Primary			
Lower Secondary			
Secondary			
S.L.C.+			

1.8 Family size and status:

Nuclear Family	1	Joint Family	2

No. of Male…… No. of Female……..

Household No.	Family Type		
	Small(1-4)	Medium(5-7)	Large(8+)

1.9 Land Holding: Bigha……. Kattha……

1.10 Livestock pattern of household:

Name of animal	Buffalo	Cattle	Total
Number			
Dung Produced per day (kg)			

2. Use of Energy Pattern:

Information about per month consumption pattern of kerosene, firewood and agricultural residue and other (before and after the installation of Bio-gas Plant)

Items	Before	After	Change	Remarks
Kerosene (liter)				
Firewood (bhari/kg)				
Agricultural residue and dung cake (bhari/kg)				
LPG gas (cylinder)				
Electricity (unit)				

3. Technical aspect/pattern of Biogas plant:

3.1 When did you install this plant?

……..year ……month

3.2 Do you have installation document (guideline, booklet, member card etc)?

Yes 1	No 2

3.3 For what reason/purpose did you install the Bio-gas plant?

Easy and smokeless cooking 1	Environment protection 4
Lighting 2	Increase crop production 5
Time saving 3	All of the above 6

3.4 Who encouraged you to install the Bio-gas plant?

Biogas company staff 1	NGOs 4
ADB/N 2	Relatives 5
Govt. Agencies 3	Self motivated 6

3.5 What is the name of your Biogas company?

……..

3.6 Size of this Biogas plant (……) m^3

3.7 Type of Biogas plant:

Dome	1	Drum	2

3.8 How much dung and water do you mix and feed in the Biogas plant daily?

Dung in kg…….

Water in liter……..

3.9 Is your Biogas plant producing gas sufficiently?

Yes	1	No	2

3.10 If yes, what are the reason it producing gas sufficiently? Please specify.

……..

……..

3.11 If no, what are the reason it producing gas insufficiently? Please specify.

……..

…….…….

3.12 How many number of your family involve sharing the kitchen?

…….Person

3.13 Who usually work to bring dung and water to feed the Biogas plant?

Dung	Male…….1	Female……2
Water	Male…….1	Female……....2

3.14 In your opinion, which member of your family as really most benefited from it?

Children	1	Men	3
Young	2	Women	4
Others			5

3.15 What is your source of investment for installation of Biogas plant?

Subsidy (Rs……..)	Relatives (Rs……..)
Bank Loan (Rs…….)	Money Lender (Rs……..)
Own investment (Rs……....)	Total (Rs……..)

3.16 If Loan, what is the interest rate? ……%

4 Repair and maintenance:

4.1 Do you have any difficulty for the maintenance of Biogas plant?

Yes	1	No	2

If yes, specify……..

4.2 Do you have some suggestion about the Biogas plant for those people who are willing to install? Please specify:

……

……

4.3 Are you fully satisfied with the Biogas plant or not?

Yes	1	No	2

4.4 If yes, what are the reasons? Please specify

……..

……..

4.5 If no, what are the reasons? Please specify

……..

……..

5 Time saving patterns of Biogas plant users:

5.1 How much time did you spend to collect firewood before and after the installation of Biogas plant?

Before	After
…….	……

5.2 Where did you go to collect the firewood before the installation of Biogas plant?

From forest	1	Collect from own land	3
Buy from the market	2	Others	4

5.3 How much time would you spend for cooking a day before and after?

Before	After
…….	……

5.4 If it has saved time in firewood collection and cooking how is you utilizing surplus time?

Farming activities	1	Study	3
Gardening	2	Household activities	4
Social Work			5

6. Financial benefits after the utilization of Biogas plant:

6.1 In your opinion, what is the economic impact of Biogas plant?

Saving expense in Kerosene	1
Saving expense in Electricity	2
Saving expense in Firewood	3
Saving expense in Chemical fertilizer	4

6.2 How are you utilizing the savings for the productive sector?

Business	1	Agriculture and livestock	3
Education	2	Lending Money	4
Others Specify			5

6.3 Do you think that Biogas plant has increased helped your living standard?

Yes	1	No	2

7 Impact of Biogas plant for the following health, sanitation and environment:

7.1 Do you that the following health, sanitation and environmental problems have been reduced after installation of Biogas plant?

Kitchen Environment	Yes	1	No	2
Respiratory inflection	Yes	1	No	2
Cough	Yes	1	No	2
Eye infection	Yes	1	No	2
Tuberculosis	Yes	1	No	2
Headache	Yes	1	No	2
Gynae diseases	Yes	1	No	2
Mosquitoes	Yes	1	No	2
Flies	Yes	1	No	2

7.2 Do you believe that installation of Biogas plant has helped to clean the kitchen?

Yes	1	No	2

7.3 Do you believe that installation of Biogas plant has helped to control the environment degradation?

Yes	1	No	2

7.4 Have you attached your toilet to the Biogas plant?

Yes	1	No	2

If no, why? …….....

8 Advantage of Bio-gas slurry:

8.1 Would you find any advantage of Biogas slurry in your farm?

Yes	1	No	2

If no, why? …….....

8.2 Do you think that Biogas slurry has increased agricultural production?

Yes	1	No	2

8.3 Do you think that Biogas is more effective in agricultural production than chemical fertilizers?

Yes	1	No	2

8.4 Would you find any sufficiency and insufficiency of gas production in summer and winter?

Yes	1	No	2

8.5 Say preferentially (1,2,3) the use of slurry for agriculture production:

For fruit	…..	For agro crops	…..
For vegetable production	…..	For plantation crops	…..

8.6 Biogas plant owner's view on slurry for agricultural production as compared to along:

Similar like dung	1
Less fertile than dung	2
More fertile than dung	3
Can't say actually	4

9 Slurry use:

9.1 Do you use slurry as fertilizer?

Yes	1	No	2

9.2 Slurry production:

Day	Week	Month	Year

9.3 How do you use it?

Directly	1	In dried form	3
By re-compositing	2	With irrigation water	4
Others			5

9.4 Use of slurry:

Crops	Crop yield		Increment
	Before slurry use	After slurry use	
Paddy			
Wheat			
Maize			
Oil seed			
Others			

9.5 Do you face any problem with slurry application/management?

Yes	1	No	2

10 Problems:

10.1 What problems do you face?

Operational	1	Dung availability	4
Maintenance	2	Gas production	5
Water availability	3	Others	6

10.2 How do you manage for the insufficiency?

Use firewood	1	Use kerosene	2
Others			3

10.3 What part of the Biogas plant needs frequent repair?

……

10.4 How much you spend monthly for maintenance?

……

10.5 Does your company provide maintenance service after the installation of plant?

Yes	1	No	2

If yes, how frequently……

10.6 Are you satisfied with your Biogas Company?

Yes	1	No	2

10.7 If no, what are the drawbacks of company? Do you have any complain about your Biogas Company?

……

……

10.8 Do you have any problem in paying the loan?

Yes	1	No	2

11 Monitoring and care of Biogas plant:

11.1 Do you have any difficulty for the maintenance of Bio-gas plant?

Yes	1	No	2

If yes, specify……..

11.2 Do you have some suggestion about the Biogas plant for those people who are willing to install? Please specify…

……..

……

11.3 Do you anything else that you would like to share with researcher about queries?

……..

11.4 Monitoring and care situation of plant by company?

Yes	1	No	2

12 Perception and suggestion:

12.1 What is your perception about biogas plant?

……..

……..

12.2 Do you like to give any suggestion about Biogas plant, Benefit, Company and Others?

12.3 Do you suggest to other install the Biogas?

Yes	1	No	2

FGD Questionnaire

1. Tell me some advantage and disadvantage to installation of Biogas plant.
2. Since having Biogas, how do you feel about your health?
3. Would you find any advantage of Biogas slurry in your farm or not? Discuss.
4. Do you face any problem with slurry management?
5. As a whole, are you satisfied with your Biogas plant or company?
6. Is it appropriate for poor or not?

Check List

Household No…… Date & Time:

Observed Element	Status	
Household Environment		
Biogas Plants		
Burning Stoves		
Cooking Time		
Kitchen Room		

Technocrats Questionnaire

Name of the Technocrats: Company's Name:

Job starting year: Working area:

1. What is the problem & prospects of Biogas installation?
2. Is it suitable for all people, basically for poor?
3. Analyses its:
   - --- Strength
   - --- Weakness (SWOT Analysis)
   - --- Opportunity
   - --- Threats
4. Tell me some about its: Policy challenges?
   Technical challenges?
   Financial challenges?
   M & E challenges?

APPENDIX II

BIOGAS PLANT FIGURE