ALTERNATIVE ENERGY IN HEALTH AND EDUCATION

(A Case Study of Biogas Plant of Mirgauliya, Morang Nepal)

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INTRODUCTION

1.1 Background of the Study

Biogas is the source of alternative energy. Biogas is not a new phenomena, it is an ancient men's knowledge which is developed in modern era. Now it has become more reliable as an alternative renewable energy. Biogas is a high quality renewable fuel, can be used for many purposes besides cooking, lighting and many more. The famous traveler Marco Polo has mentioned the use of convent sewage tanks in China. The first sewage plant built in Bombay (Mumbai) in 1859. This technology was brought to the UK in 1895 by producing wood gas and later from coal. At the first stage this gas used for street lighting and homes. This technology was developed in the UK and Germany in the early 1900s for the treatment of sewage. Indonesia has built sewage plant in 1914.

In Nepal late father B.R Soursball has established first demonstration biogas plant in St.Xavier School Godavari, Lalitpur in1995. He was the pioneer of biogas technology for the Nepal, he was a Belgian teacher might have been from India. In 1968 Khadi and Village industries Commission (KVIC) of India built a plant for an exhibition in Kathmandu. After this some plants were established in different parts of Nepal. Interest on biogas increased slowly. The government of Nepal felt that it is very useful rural area and need to promote it. In the fiscal year (FY) 1974/75 the department of Agriculture set a programmer to install 250 floating drum type of biogas plants and Agriculture Development Bank (ADB/N) provided an interest free loan. The government felt a need to establish a separate autonomous body to promote the biogas plant installation. In 1977 Gobar Gas Company (GGC) was established jointly by ADB/N and Nepal Fuel Corporation. The GGC was given responsibility of advancing the development and promoting the installation of biogas plants extensively in the kingdom. Initially drum type plants were prepared by the GGC but after 1980 dome type of plant was recommended because of many inconveniences of drum model.

To promote biogas government announced a subsidy of Rs.5500 to the biogas plant installers in fiscal year 1982/83 as a part of special rice program in four Terai Districts.

Before 1985, the rate of installation of biogas ranged between 100 to 300 plants per year. The seventh five year plan (1985 -1990) had a target of 800 biogas plants per year, with total of 4000 units. A subsidy of 25 % on the capital cost and 50 % on interest of bank loan was announced. However, the program e was not regularized and subsidy provided only for last 2 years. During the period, 3862 plants were constructed by GGC.

In 1992, Biogas Support Programmers (BSP) was initiated as a joint venture of ADB/N, GGC and SNV-Nepal. In 1992.First phase of BSP project started in 1992.It is currently the end of forth phase, whose main objectives is to further develop and disseminate biogas plants as a main stream renewable energy solution in rural Nepal, while better addressing poverty, gender and social inclusion and regional balance issues. The subsidy scheme was changed to Rs.7000 in Terai and 10,000 for Hill districts. The subsidies were provided through the BSP. Later in 1995/1996.Rs. 12,000 was granted for inaccessible Hill district. From 1999/2000, the subsidies were reduced by 1000 i.e. Rs. 6000 for Terai, Rs. 9000 for Hill and Rs.11, 000 for inaccessible districts of Hill. Big Size plants were discouraged and small family sized biogas plants were offered with additional Rs.1000 while subsidy was curtailed for $15m^3$ and $20m^3$ plants. From the 2010/011,the subsidy policy has changed to Rs.9000 Terai(20district),Rs.12000 for hill(40 district) and Rs.16000 for inaccessible hill (15 district).Other new scheme has launched for the hill area that is Aadibasi/Dalit/Janajati will get 15000 subsidy for the installation of the below the $8m^3$ size biogas plant and other caste will get Rs.12000 subsidy . Beside this Rs700 will be granted for the additional transportation cost and other Rs.700 also for installing 6m3sizeGhimire, T (2006).

Total 2, 31,230 biogas plant had been built at the end of 31 Dec 2010.This programmed is reached 2769 ward and 75 Districts of Nepal. There were moreover 19167 plants established in Jhapa district and at least 1 plant established in Humladistrct during the 2010A.D. Now the policy of subsidies is remaining same as above in this (068/69) fiscal year. Shrestha, L. K. (2002*).*

A mixture of Methane and Carbon dioxide produced by bacterial degradation of organic matter and use as a fuel. Biogas is a gaseous matter produced from the organic wastes such as animal dung, human excreta and plant residues by the action of Bacteria in anaerobic condition i.e. in absence of Oxygen. The biogas is composed of mixture of different gases. Biogas is a wet gas because it picks up water vapor from the slurry .It

have also contains water vapor, other gasses are Nitrogen, Hydrogen and Hydrogen Sulfide consist in biogas Shrestha, L. K. (2002*).*

The chief component Methane gas is produced by bacteria while acting upon biodegradable materials in an anaerobic condition. It is mainly composed of 60-70 percent methane, 30-40 percent carbon dioxide and some other gases. It burns with clear blue flame similar to that of LPG. The biogas is colorless, generally odorless and burns with a clear blue flame Shrestha, L. K. (2002*).*

Biogas plant is a device that produces biogas. The structure of the plant consists of a central pit covered with a dome like structure. The pit serves as digester and the dome serves as gasholder. Animal dung is mixed with water and fed through the inlet tank. The dung in the pit is anaerobically digested by the bacteria which generate the gas. The gas bubbles up and collects in the dome, which is then supplied to house for use (Cooking and lighting) through the pipeline. After digestion, the digested slurry flows outside through the outlet channel .There are various designs of biogas plants in different countries.

The chief purposes behind the installation of biogas plants are cooking and lighting. It is used in cooking stoves in the kitchen. It burns with a clear blue odorless and smokeless flame. The utensils remain neat and clean or easy to wash cooking pots also. Cooking environment becomes healthier. It saves more time for cooking than that of firewood.

Biogas is used for lighting purpose in rural areas. However, due to low efficiency in its use for lighting is less recommended. It can also be used as a fuel in internal combustion engines. Such engines can be used in small cottage industries substitute of electricity. Biogas can be utilized for electricity production on sewage works .Bista, N.K. (1981).

Digested slurry produced after the digestion has rich nutrients and possessed good fertilizing quality. So, it can be used in substitution of chemical fertilizer. The excessive use of chemical fertilizers affect to the farmland fertility and lead to the destruction of biodiversity or degradation of environment.

1.2 Statement of the problem

Nepal is one of the poorest and least developed countries in the world with diminutive per capita income Rs.34732 (US $ 473) (CBS, Nepal 2016/17). The economic growth of the country measured by GDP is 5.56 percent per year 2016/17 live below poverty line as per the Nepal Living Standards Survey 2012/13 and the Genni Coefficient, which indicates inequality between the poor and reach is 41.4. According to the Nepal Labor Force Survey II there are only 2.1 percent unemployed labour in Nepal. (CBS, 2009).

Despite of higher technological advancement in the field of energy generation, many developing countries are facing the energy related problems such as rising prices of fossil fuels, depleting forest resources including environmental degradation and etc. and Nepal is no exception of this. Energy is a basic minimum requirement of human life for the betterment of human development process. Energy is needed in all major spheres of life which are directly connected with man's basic needs and progress such as in cooking, lighting and heating, transportation etc. Firewood, animal dung, agricultural residue and solar energy are used by the household and also in agriculture sector in rural areas of Nepal. Almost 85% of Nepalese people are highly dependent on firewood for energy, which has resulted into degradation of forest resources. By the cause of degradation of forest resources Nepal is facing many kind of environmental problems and cannot remain aloof from the global issues of environmental deteriorations.

In the Nepalese context, solar, water and wind energy have not been fully exploited. High consumption of fuel wood as a traditional source of energy leading to deforestation results into natural disaster such as soil erosion, flood, landslides and desertification etc. Firewood only has been the most common and traditional source of energy for Nepal that represents 84% of energy consumption which is mainly consume in rural Nepal. Bista, N.K. (1981).

The forest alone is not capable of sustaining the increasing demand of energy for fast growing population. Although there is huge potentiality of hydropower, due to the worse economic condition, lack of highly technical man power and strong political commitment only less than 1 % resources have been exploited. Other alternative source of energy such as solar power, and wind energy is negligible in use because of high cost of installation.

For the collection of firewood, rural women and children spend more time as well as on cooking and washing utensils. Smoke produced form firewood in poorly ventilated room with traditional stove creates smoke borne diseases such as respiratory problem including long-term asthma, lungs diseases headache and eye burning etc.

In Nepal, considerable amount of domestic energy requirement is met by the direct burning of dung. Such practice of using cattle dung as a source of energy has grave consequence on agricultural productivity. Not putting the manure back on the agricultural land as fertilizer deprives the soil of valuable nutrients and materials which drastically reduces crop production and results into food shortages. Dung obtained from cows, buffaloes and other animals can be better utilized if converted into biogas. Biogas is a reliable alternative source of energy, which replaces other expensive and polluted energy resources. It plays crucial role for the conservation of forest and environment, reduction of fossil fuels and self sufficient in energy production.

Considering the above situation, the chief importance of this study is to biogas is an appropriate alternative source of energy and to suggest and recommendation the promotion of biogas.

Due to the above difficulties on firewood using, Biogas technology is an only appropriate alternative source of energy in rural area which is feasible for installation and convenient to use. Biogas plant requires animal dung and human excreta or vegetable organic matters as raw materials which are easily available in rural areas. Hence the problems in the field of conventional energy need to be solved with proper measures.

1.3 Research Question

Biogas is produced by methanogenic bacteria while acting upon the biodegradable materials in an anaerobic condition. It is composed of 50 to 70% methane (CH_4), 30 to 40% carbon dioxide (CO_2), and some trace gasses like Hydrogen, Nitrogen, Hydrogen Sulphide [2, 3]. As biogas has 70% methane, it could be used as a source of energy. Energy content of biogas can also be transformed into various other forms such as mechanical energy and heat energy (for cooking and lighting) through combustion. Biogas can contribute to the reduction of greenhouse gas emissions by substituting fossil energy sources. Despite its multiple benefits for the empowerment of rural

households, there is dearth of studies which assess the plant owners' opinion about the impact of biogas on health and education in rural areas. The main purpose of this study was to provide some empirical information about biogas plant owners' views on the effects of biogas on health and education.

The general objective of this study is to assess the health and education impact of biogas plant in Mirgauliya Morang. However, the specific objectives of this study are as follows:

1. The role of biogas in Health and education. s
2. To study the health and education impact of biogas plant.
3. To study the potential benefits of biogas plant by product (slurry) as fertilizer for agricultural production.

1.4 Significance of the Study

Biogas plant installation is an appropriate alternative, sustainable and renewable source of energy in rural areas. It has gained momentum now a day in the absence of adequate development of energy sources such as hydropower, solar power and wind energy which require more capital for installation and operation. Biogas technology simply reduces the workload of women and children in family for collecting firewood and washing utensils. Time and money saved after the installation of biogas plant, can be utilized on income generating activities. Biogas technology mostly helps to improve the health and sanitation of rural people and creates smokeless and healthy environment in the kitchen. Biogas also reduces the prevalence of insects in higher rate than that of earlier due to the neat and clean environment. Biogas directly helps to reduce the rate of forest depletion. The consumption of firewood is curtailed after the installation of biogas plant. Reduction in the rate of forest depletion ultimately reduces the range of natural disasters such as flood, landslide, soil erosion and desertification. Installation of biogas plant helps to increase the production of crops and digested slurry avoids the undue use of chemical fertilizer which is beneficial for protecting the nutrients of fertile land. Nepal has great potentiality of biogas plants, in all area. It is estimated that 14, 97,392 households have potentiality to install the biogas plant in Mountain, Hill and TeraiBista, N.K. (1981).

Above mentioned benefits reveal the importance of bio-gas plant installation in rural areas. In Nepal, hydropower has great potentiality but it is untapped due to lack of

capital and trained man power and weak political attention. Likewise, wind power and solar energy including other renewable sources of energy require large amount of capital for installation and operation. Among other renewable source of energy biogas is the most appropriate, renewable and alternative sources of energy in Nepal where large majority of the people are living in rural areas and have the tradition of rearing cattle and buffaloes and an integral part of their farming. Biogas has both positive and negative impacts on its uses. Except the increase in the prevalence of mosquitoes, biogas has several positive impacts upon its users. Bista, N.K. (1981).

1.5 Limitations of the Study

This study has attempted to analyze the health and education impact of biogas plant installation in MirgauliyaMorang. However, it has following limitations:

1. This study is primarily based on Health and Education impact of biogas plants installation in Mirgauliya Morang.
2. This study deals with the problems and importance of biogas plant installation in Mirgauliya only.
3. This study considers only Health and Education aspects but not the technical aspects of biogas plant installation.
4. It is an individual study, so it can not cover whole aspects of biogas but it can be reference for further study in this subject.

1.6 Organization of the Study

The study has been organized into five chapters. Chapter one describes about introduction of biogas. This chapter have eight sub topics, and en-lights historical background, historical development of biogas in Nepal, introduction to biogas technology, biogas plant statement of the problem, objectives of the study, significance of the study, limitation of the study and organization of the study.

Chapter Two is related with the literature review which includes conceptual review and review of literature; sharing experiences are submitted in chronological order.

Chapter Three comprises the energy in Nepalese context which included background of the country, energy situation in Nepal, introduction of institutions related to biogas promotion sector and energy situation of Morang district.

Chapter Four deals with the research methodology which comprises research design, introduction of study area ,rationale for the selection of the study area, nature and sources of data, sample size, technique and tools data collection and analysis and presentation of data.

Chapter Five includes major findings and conclusion of this study.

CHAPTER -II

LITERATURE REVIEW

The literature is reviewed from the thesis presented by former students, report, bulletins, journal and information published by various agencies and books in the concerned topic. A brief review of literature on biogas was made to have good knowledge and brief idea about the previous research and publication.

2.1 Empirical Review

Biogas is a gaseous matter produced from the organic wastes such as animal dung, human excreta and plats residue by the action of bacteria in anaerobic condition. The production of biogas carried out in special digesters, which are widely used in Nepal, China and India. It is also called swamp gas. Biogas typically refers to a gas produced by the biological breakdown of organic method in the absence of oxygen. Biogas is produced by anaerobic digestion or fermentation of biodegradable materials as biomass, manure, sewage, municipal waste, green waste, plant materials and energy crops (www.answer.com/topic/biogas, 8/18/2010).The mixture of gas produced by Methanogenic bacteria while acting upon biodegradable materials in an anaerobic condition. It is mainly composed of 60-70 percent methane, 30-40 percent carbon dioxide, and some other gases. It is about 20 percent higher than air. It is an odorless gas that burns with clear blue flame similar to that of LPG gas (BSP, 2005)

Bista (1981) has focused that biogas is considered as one of the most reliable alternative energy resource replacing fuel wood of which the greatest part is used for cooking especially in rural areas of Nepal. It means that there is the urgent need for substituting rural energy through non-conventional energy resources.

Britt (1994) has shown concise overview of studies specifically designed to measure the effects of biogas on women's workloads in different geographical setting of Nepal and the studies were done in Rolpa, Rupandehi, Nuwakot, and Chitwan district.

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.

Theoretically, all the biodegradable materials can be used to produce biogas through anaerobic decomposition. However, in practice, it is only the animal dung (especially cow dung) that has been primarily used as feedstock for methane generation. The technology of using other plant materials as feedstock is not developed fully to be commonly practiced at the field level, mainly because of inadequate research (Karki et al., 1997)

In the context of Nepal, the technology is appreciated and used mainly as a alternative sources of gas energy for household cooking and lighting and the digested slurry as better organic manure for agricultural crops and vegetables (Karki et al., 1994)

2.2 A short introduction of Nepal

Nepal is a small land locked country; it is surrounded by China to the north side and India to the east, west and south side. Nepal has occupied the total land mass area of the world is 0.03% and 0.3% of the Asia. It is situated between 80° 04'E to 88° 12'E longitude and 26° 22'N to 30° 27'N latitude. It extends almost east to west along the Himalayan range of Asia. The total land area of the Nepal is 1, 47,181 sq. k.m. Nepal has divided in 3 topographical regions, Himalayan, Mountain and Terai. Terai is regarded as the food storage of the nation. It has very much plain and fertile land. Most of the food produced in Terai.

2.3 Background of the country

Agriculture is main occupation of the Nepalese people and our economy depends upon the agriculture. In total GDP approximately 0ne third of the part has bearded by the agriculture sector. Almost 84% people are living in rural area, occupying the agriculture is their rural livelihood along with animal rearing. Our agriculture is based upon the animal mainly in rural area. Animal is used for sloughing, caring, riding, milking and meat purposes. Animal dung is used for manure and fire burning as a fuel cake. Rural people used animal dung for cooking and heating purpose .The valuable source of organic manure is being ash in vain and scares foreign exchange being used for import to chemical fertilizers and petroleum products. This scenario creates a critical question towards us, one side our organic manure is not utilizing properly in the farm land and other side foreign exchange is spending to import the chemical fertilizers. It is proved that long use of Chemical fertilizer in the farm land may lead to

the degradation of fertile soil and decreased the productivity of the land. Highly dependency on the firewood for the energy requirement leading to the pressure in forest or own land private forest for the purpose of cooking, lighting and space heating.

Our agriculture farming system is based on tradition; farmers are not adopting modern technique, equipment, manure, seeds and other hybrid technology to farming field. There is not sufficient facility to irrigation in all season. Therefore our productivity is very low among the other neighbor countries.

The spreading population growth rate (2.25%) is very high for the least developed countries like as Nepal. By the cause 0f population growth Government could not success to achieve to fulfill the primary basic needs.

Energy is a key instrument of the nation's progress. Energy consumption level is an indicator of the development of nation. The level of per capita energy consumption reflects the level of nation's development .It is tied with equal proportion, where higher level of energy consumption indicates the higher level of development and lower level of energy consumption indicates lower level of development.

2.4 Review of Literatures

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 students, reports and paper presented in seminars, bulletin, journals and information published by various concerned agencies and books in the concerned topics. The summary of outcome of some of the studies has been illustrated hereafter.

The Ministry of Agriculture (MOA) observed the fiscal year 1975/76 as the "Agriculture year" Biogas was included as a special programmer for its effectiveness in controlling deforestation and preventing burning of cow dong which otherwise could be used as fertilizer. Interest free loans were provided to the farmers willing to install biogas plant. Private contractors under the supervision of Department of Agriculture (DOA) constructed the first 250 family size plants during the year 1975/76. All these plants were of floating dorm type design based upon Khadi and village Industries commission of India.

Profile (2001), this profile remarks the various use of biogas plant. According to it, biogas is a high quality fuel; it is used for many purposes. The main uses of biogas are summarized below.

2.5 Energy situation in Nepal

Nepal is an under developing country so our energy consumption rate is very low. Nepal's per capita annual energy consumption is about 14 Giga Joule (GJ),which is very lower among the other countries. Due to this we are very poor and nation is also poor. At the present age of higher technological advancement, Nepal's energy consumption or even energy production situation is in miserable condition .Energy is a basic requirement of the people but our planner and government has not accepted seriously. In rural area 80% of the population living and most of the peoples are compelled to use traditional energy sources for their domestic uses, such as firewood, agricultural residues and animal dung.

Cooking: Biogas can be used in suitable designed blue flame, which is ideal for cooking. It is beloved that biogas will help in reducing deforestation as the majority of biogas owners use it for cooking.

Lighting: Most of the Nepalese people use kerosene for lighting lamps. Nepal has no indigenous sources of kerosene. As such the country has to expend scare foreign exchange and supplies are often unpredictable. Biogas owners, especially in the hills where there is in electricity, prefer lighting biogas lamps.

This profile also explains the uses of slurry which is obtained through biogas plant. These uses of slurry are given below:

Fertilizer: Fertilizer is the most essential inputs for any crop. The slurry is rich in various plant nutrients such as nitrogen, phosphorus and potash well fermented biogas slurry improves the physical, chemical and biological properties of the soil resulting qualitative as well as quantitative production of food crops. Nitrogen remains in the effluent of bio- fertilizer from the slurry, which some escapes as Ammonia gas.

Feeding fish and animals: Other uses of the slurry include putting it into ponds as feed for algae, water hyacinth, fish or ducks, it can be also used in hydroponics, where

plants are grown in a nutrient rich solution on a gravel bed or even as feed supplement for pigs and chickens.

Mushroom culture: The slurry coming from the biogas plants can also be used for mushroom cultivation.

Karki (2001) has implemented the research programmed to study the influence of bio-slurry application on maize and cabbage in Lalitpur district. The result of the experimentation has revealed the supremacy of organic manure in all forms viz. FYM (farm yard manures), slurry compost and liquid slurry over the inorganic manure. The increment in the field of cabbage and maize was realized after the application of slurry comport.

Ghimire (2001) has shown the biogas in relation to Forestry. He has estimated that installation of 1.3 million biogas plants (total potential of Nepal) would save about 4 million tons of firewood per year.

Lamsal (2001) shows the mineral values of slurry produced by biogas plant. According to him, the green plants (vegetables, crops etc) require 16 various nitrous elements for growth like the animals. The necessary nutrients are rich in slurry than in other chemical fertilizer.

Table No. 1

Composition of Fertilizer

S.N.	Fertilizer	Nitrogen %	Phosphorus %	Potash %
1	Ordinary compost manure	0.5-1.0	0.1-0.3	0.1-0.5
2	Farmyard manure	0.3-05	0.1-0.2	0.5-07
3	Fresh Slurry	1.6-3.7	1.7-2.2	0.8-3.6
4	Slurry compost manure	0.57-2.2	0.072-2.11	0-5.1
5	Average slurry compost manure	1.27	0.73	1.4

Source: Lamsal, 2001.

According to him, the slurry increases the physical Feature of soil. It increases the quality humus in soil. So, the Micro organisms grow in soil. Such soil preserves water in it. The soil of fertility increase he also describes the uses of slurry to increase the productivity land.

Karki et al. (2002) has focused the study in Dhading district. The study was mainly focused on the adaptation of Renewable Energy technology (RET) and its impact on income generating activities. The outcome of this study shows that three among the five of biogas users reported an increase in crop production by 5 to 10 percent due to the application of bio-slurry. However, users of other types of Renewable energy technology (RET) did not report an increase in crop production as experienced by the biogas users. The biogas use household's main income generating activities are agricultural based like vegetable, butter (Ghee) and local wine (Rakshi) production. Fertilizer required for vegetable production has reduced and so the amount of money of spending on chemical fertilizer.

SundarBajgain (2003) describes the benefits from biogas in Nepal. According to him the benefits of bio-gas can be summarized as follows:

Economic Benefits: Biogas reduces the expense on fuel for cooking and to some extent lighting. The high quality bio-fertilizer contributes for high yield of crop and vegetables, which eventually helps for generating income.

Health Benefits: A biogas 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 risks factors for acute respiratory infections with housewives and children. Biogas reduce the smoke expose cures and significantly improves the air condition inside the kitchen which ultimately improves the health condition especially eye infection, respiratory diseases, cough and headache.

Environmental benefits: From individual perspective the use of biogas significantly improves the indoor air quality in addition, installation of biogas plant results in better sanitation due to the connection of toilets. One biogas plants saves about 2.3 tons of fuel wood per year. It roughly saves 0.03 hector of forest land per year.

Gender Benefits: Biogas provides a direct benefit, especially to rural women, as a result of the reduction of the workload when shifting from cooking on fuel wood to

using biogas. It saves approximately 3.0 hours time a day per family mainly due to the reduction on time used for collecting fuel wood, cooking and cleaning utensil. He also explains the indirect benefits from biogas interims of social educational and recreational but it is clear that with the growing demand of biogas this technology has been getting popularity day by day with in the rural Nepalese society.

From the sides of biogas users group, the economic impact of biogas is explained in biogas user's survey (2003). This study analyzes the reduction of kerosene, fuel 2003 and chemical fertilizers due to biogas plant installation. So, biogas saves foreign exchange and money of biogas users group.

This table shows the savings hard money due to installation BG plants. Saving in kerosene consumption has two fold benefits; it saves money in terms of hard currency. Secondly, it is high Products of Incomplete Combustion (PIC) emitting fuel.

This survey shows other benefits such as health and sanitation on environment. Ramesh Silwal (2005) writes that biogas is a mixture of carbon hydrogen and nitrogen. The uses of biogas reduce the amount of carbon in the environment. The Clean Development Mechanisms (CDM) provides U.S Doller @$ 5 per ton of carbon. In Nepal biogas plants installation is reducing carbon. In Nepal, biogas plants installation is reducing carbon heavily among all the countries in the world. Nepal gets U. S. Dollar for reduction of carbon in environment through CDM after registration in Quota Protocol. There is a great economic benefit from biogas plant's installation.

Alternative energy promotion center (AEPC), Brief introduction tells about the involvement in biogas.

Development and promotion of biogas technology

- Quality control of biogas plants installed by recognized biogas construction companies.
- Coordinating Biogas coordination and slurry coordination committees.
- Conducting studying on users, survey cost analysis and impacts of biogas.
- Providing training to companies, users, NGOs involved in the technology.

Govinda Prasad Devkota explains (Renewable Energy Technology in Nepal, November 2007) that an estimate shows, one 6 cum biogas plant displace the use of 3 tones of fuel wood or 38 Ltr. kerosene annually. It is also calculated that it produces 27 tons of digested slurry and reduces 4.9 tones of carbon dioxide equivalent per year. This data shows the savings of to cut down 11.6 trees.

CHAPTER-III

RESEARCH METHODOLOGY

Research methodology is way of research problem. It deals with the methodology adopted in the study it contains the research design, selection of study area, source of data, sample size etc. This chapter deals with the research design, introduction to the study area, rational for the selection of the study area, sources of data, sample size and analysis and presentation of data. Tools of data collection and organization of the study are also included. These are described below. Research methodology is an important part and it plays crucial role in research work.

3.1 Research Design

Research design is a blueprint of a planned action while conducting a research work. It is a conceptual framework within which research is carried out. Research design refers to the procedures for the collection of data and its analysis. The research design in this study will be descriptive as well as analytical way which helps us to analyze and interpret the qualitative and quantitative data by asking questions. One of the major concerns of this study is to ensure the validity of the findings and conclusion.

3.2 Introduction of the Energy

There is no simple, yet accurate, scientific definition for energy. Energy is characterized by its many forms and the fact that it is conserved. We can loosely define *energy* as the ability to do work, admitting that in some circumstances not all energy is available to do work. Because of the association of energy with work, we begin the chapter with a discussion of work. Work is intimately related to energy and how energy moves from one system to another or changes form.

From a societal viewpoint, energy is one of the major building blocks of modern civilization. Energy resources are key limiting factors to economic growth. The world use of energy resources, especially oil, continues to grow, with ominous consequences economically, socially, politically, and environmentally.

This study is confined to the Mirgauliya of Morang district. It lies in the eastern development region of the country. The total area of this district is 185500 hector.

According to the census 2011 the population economically active (fourteen years and above) males and females are 422895 and 420325 respectively in the Morang district.

Morang district have 64 wards and 2 Municipalities. Mirgauliya Ward is located to the northern part of the district. The Mahendra highway passes through this ward. The ward borders with Indrapur or Haraincha ward in the east, National "Char koshe"Forest in the north, Sundarpur and Dulari is west andShisbaniJahada in the south.

The total household of this ward is 2692 and total population is 12913. Among whom 6351 are males and 6562 are female (CBS 2001).Most of the people in the study area speak Nepali language, despite of some ethnic groups like Chaudhary, Jhangar ,Rai speak their own mother language.

This ward has more fertile land and agriculture stands as a main occupation of almost of the people in this area. Only a few people are engaged in other sector like service, business labor and so on. The major agriculture productions of this ward are paddy, wheat, maize, Sugarcane, pulse, oilseeds and vegetables.

3.3 Rationale for the Selection of the Study Area

The present study will be carried out in Mirgauliyaof Morang district which is the part of eastern development region. The ward is 30 Km far away from the district headquarter Biratnagar. Its shape is lengthy moving from north to south direction.

The reason for selecting Mirgauliya as the study area is that the researcher is a native villager of this study area. Secondly, the researcher is familiar with the local biogas companies and the local people. Therefore, by selecting of this area, it is believed that more accurate information could be achieved during study.

3.4 Nature and Sources of Data

Both primary and secondary sources of data will be used to derive the objectives of the study.

3.4.1 Primary Sources of Data

This study is mainly based on primary data collection in Mirgauliya. All selected households in the selected wards are asked to respond to a brief structured

questionnaire to collect information on the Health and Education impact of biogas plant installation upon its users.

The primary information has been collected during the field survey with the help of questionnaire, interview and observation during field survey. To collect the quantitative information from biogas plant owner or respondent, interview method is mainly used. Thus the study is primarily based on interview with appropriate sample informants who have been given their opinion on different topics.

3.4.2 Secondary Sources of Data

This study is primarily based on primary sources of data but some secondary data are also used for background purpose. Secondary information are collected from all the materials concerning to the biogas plants such as books, journals, newspaper, published and unpublished articles and other reports etc.The major issues on health and education impact of biogas plant installation in rural area are derived from BSP and other private biogas company's publication, population monograph of center bureau of statistics. The chief sources of secondary data are as of:

a. Previous studies and research reports and record of relevant agencies.
b. Progress reports (activities reports, and the annual reports of the program)
c. Major conference reports on biogas support programmers and other official documents.

3.5 Sample Size and Sampling process

Selected study area Mirgauliya has been divided into several (9) . It has different type of activities in 6 or 9 due to the access of highway many business activities has been occupying by the people such as, milk diary, grain mills, petrol pump, hardware, grocery, emporium, electronic equipments maintenance services are conducting .The present study has been concentrate only on 9 . These mirgauliya have most of the plants. 30 of biogas plant have been selected by using simple random sampling technique (lottery method).

3.6 Techniques and Tools of Data Collection

The data in this study have been collected from field survey by conducting questionnaire to the biogas plant owner of selected area of Mirgauliya of Morang .The

present study is based mainly on primary data. They are used to estimate and analyze about the health and education impact of rural setting. Secondary data collected from the related books, papers, bulletin, calendar, journals, news papers and internet web address etc.

3.6.1 Questionnaire

A structural question has been asked to the respondents during the house hold survey. The question had asked to the head of the family member. In the absence of head of the family, other matured family members taken for an interview.

CHAPTER - IV

ANALYSIS AND PRESENTATION OF DATA

After collecting the required information and data, the researcher have checked and verified them manually to reduce errors and tabulation the data. Later the data interpreted by using simple mathematical interpretation procedure. The data is presented by bar diagram, pi-chart etc. in order to show the analyzed data of plant holders. The descriptive information of the data has been shown according to percentage.

Table No. 2:Design of Biogas Plant

Suitable digesting temperature	20-35oc
Retention time	40-100 days
Biogas energy content	6kwh/m3 = 0.61×diesel fuel
Biogas Generation	0.3-0.5m3 gas/m3Digester volume x day
1 cow yield	9-15 kg dung/day = 0.4m3 gas
Gas requirement for cooking	01-0.3 m3/ person
Gas Requirement for lighting 1 lamp	0.1-0.15m3/hrs

Source: (Karki, et.al. 1994), BSP, 2004

4.1.1 Energy situation in Nepal

Nepal is an under developing country so our energy consumption rate is very low. Nepal's per capita annual energy consumption is about 14 Giga Joule (GJ), which is very lower among the other countries. Due to this we are very poor and nation is also poor. At the present age of higher technological advancement, Nepal's energy consumption or even energy production situation is in miserable condition .Energy is a basic requirement of the people but our planner and government has not accepted seriously. In rural area 80% of the population living and most of the peoples are compelled to use traditional energy sources for their domestic uses, such as firewood, agricultural residues and animal dung.

4.1.2 Energy

Energy does play an important role in meeting basic needs .there is broad linkage between the energy and human development advanced access to energy services is necessary for productive use of energy, which will guarantee sustainable development. In energy sector less than 2 percent techno-economical potential has been harnessed so far. Traditional energy sources covers the about 85% of the total consumption. Agriculture residue, firewood and animal dung covers 85% of the total fuel consumption. Nepal had consumed 9911 ton equivalent to petroleum power energy in fiscal year 066/67and 6571 ton in first eight months of 067/68.it was increased by 5.5% of the previous year.((MOF,yearly rep.2068)

In FY 2009/10, among the consumption of traditional energy, the share of firewood was 75.3 percent, agricultural residues 3.6 percent and livestock residues 5.6 percent. In the first eight months of the current FY 2010/11, estimated ratio for the same items were 77.1 percent, 3.6 percent and 5.7 percent respectively. In FY 2009/10, Consumption of commercial category of energy in stood at 9.7 percent, 2.9, and electricity 2.3 percents for petroleum oil, coal, and electricity respectively. While in the first eight months of FY 2010/11, the share of these items were 8.2, 2.4 and 2.2 percents respectively. The data reveals that Nepalese economy's dependence on traditional energy has not changed yet. (MOF, yearly rep.2068)

4.1.3 Electricity

By the end of FY 2009/10 from all projects across the country, 697 MW of electricity has been generated. Of the total electricity generated, 689MW has been connected to the national grid, while for the rest, 8 MW have been supplying micro hydro-electricity centers at the local level. Likewise, including the thermal electricity centers production of 53.4 MW and solar centers' production of 100 KW, the total electricity production has reached 751 MW. The total electricity available, 2925.35 GWH is estimated to be consumed within Nepal. (MOF,yearly rep.2068)

4.1.4Coal

In Nepal Coal is generally used in Brick chimney to make bricks, tiles etc. In FY 2009/10, coal consumption rose by 61.8 percent as compared to the previous FY and totaled 292 TOE. In the first eight months of the current FY 2010/11, its consumption

rose by 1.8 percent as compared to the same period in the last FY 2009/10, totaling 157 TOE. (MOF,yearly rep.2068).

4.1.5 Petroleum products

Petroleum product is our main resources of imported energy. Our dependency has been increasing day by day on the petroleum products. All transport means are based on petroleum products. The Government has been funding Nepal Oil Corporation to import such products.

In FY 2009/10, consumption of Petroleum Products (POL) rose by 25.2percent totaling 913,198 Kilolitres (KL) while LP Gas consumption went up by 21.9 percent totaling 141,171 Metric Tons (MT). In the first eight months of FY 2009/10, the consumption of POL and LP gas was 558,114 KL and 86,403 MT, respectively. For the same period in the current FY 2010/11, the consumption of POL increased by 13.2 percent reaching 631,951 KL and LP gas by 16.4 percent totaling 100,540 MT. (MOF,yearly rep.2068)

4.2 Alternative Energy Promotion Center (AEPC)

His Majesty's Government, Ministry of Science and Technology established the Alternative Energy Promotion Center (AEPC) in November1996. Alternative Energy Promotion Centre (AEPC) has been established with the objectives of sustainable developing alternative / renewable energy technology in Nepal and supplying it to rural sector, bringing improvements in the livelihoods of specially the rural citizens by operating various mini industries and enterprises based on alternative energy technology, alleviating poverty and conserving the environment. Basically AEPC provides Biogas plants to the poor rural people. AEPC has established a rural energy debt fund with the support of KFW assistance to support the rural people for installation of biogas plant.

AEPC mobilize economic resources received from the Government of Nepal and donor agencies in a well-managed, simple and speedy way so as to invest in micro hydro electricity projects, solar energy electricity system and improved bio-fuel system and to coordinate with banks to manage necessary credits. AEPC has supporting to increase the access of low-income people unto bio-gas.

In the field of alternative energy following activities has done in 2070/71.

Table No.3: Alternative Energy Promotion Center (AEPC)

S. N.	Activities	2072/73	2073/74
1	Solar Dryer/cooker distribution	318	18
2	Gobar gas plant installation	19511	6774
3	Training Related with Gobar Gas Technology (persons)	23106	-
4	Improved (Iron) cooking stoves installation	18000	1537
5	Improved(clay)cooking stoves installation	60000	28529
6	Home Solar Energy System Installed (Nos.)	36135	41884
7	Improved Water Mills Installed (Nos)	986	243
8	Micro Hydro Electricity Production (Kilowatt)	867	3660
9	Research Related with Alternative Energy	13	-
10	Micro Hydro Electricity Plant	828	-
11	solar lamp	-	4077

(Source: AEPC report; 2018)

4.2.1 Biogas Sector Partnership Nepal (BSP-Nepal)

Biogas sector partnership Nepal (BSP-Nepal) is the implementing agency of Biogas support Programme Phase –IV .BSP-Nepal was established as an NGO in 2003 to take over the implementation responsibility of Biogas Support Programme (BSP).Which formerly was managed directly by the Netherland Development Organization (SNV).

4.2.2 Biogas Support Programmed (BSP)

BSP has been playing a vital role for the promotion and development of biogas in the country. The biogas support programmed was initiated in July 1992 to develop and promote the use of biogas in Nepal.

Phase I and II this programmed was supported by HMG Nepal and Netherland Development Cooperation in Nepal (SNV/N)

This programmed has launched In 1992 with the help of (SNV/Nepal) the government of Netherland .Nepal government and KFW has also supported from 1993 to 2003 BSP has installated 124000 biogas plant during the 1992-2005and among them 75 percent of the plants are attached with toilet.(BSP Nepal)In the fourth phase of this programme is supported by the technical collaboration of alternative energy promotion center(AEPC) , SNV/Nepal and the Netherland Development Agency(NEDA). Third phase of programme (BSP III 1997-2002), was supported and financed by the Germany. Implementation of BSP-III phase was conducted jointly with three banks (Agricultural Development Bank of Nepal, RastriyaBanijya Bank, and Nepal Bank Limited), and 50 recognized private biogas companies.

The BSP became the first clean development mechanism (CDM) project of Nepal with registration of 2 projects in 2005with 19396 biogas plants. Two more CDM projects with 40602 plants are in pipeline of registration. (BSP-newsletter, May, 2018)

The revised overall objectives of BSP-IV phase (July 2003- July2009)is to further develop and publicize biogas plants as a mainstream renewable energy solution in rural Nepal, while better addressing poverty, social inclusion and regional balance issues.

4.3 Nepal Biogas Promotion association (NBPA)

Nepal biogas promotion association (NBPA) represents the private biogas sector in Nepal. It was established in Nepal as an umbrella organization of the biogas construction companies. The assisting partners of the NBPA are BSP, KFW, SNV and Government of Nepal It was established for the supporting over construction companies. NBPA is supporting 100 over companies and providing 3000 jobs in Nepal. The future of biogas promotion in Nepal looks very promising.

4.3.3Gold Standard Biogas Project (GSP)

This project is started in December 2006 by assigning bilateral memorandum among the alternative energy promotion center (AEPC), world wildlife fund (WWF) and biogas sector partnership-Nepal (BSP-Nepal).This project has been working in selected 41 wards of Ten districts of Terai. The districts are Kanchanpur, Kailali, Bardiya, Banke, Dang, Parsha, Chitawan, Rautahat and Makawanpur. In the selected ward of buffer-zone conservation and wildlife area. The installation of biogas plant has been funding by WWF programme. The total target was 7500 Nos. Toilet attached biogas

plant construction in selected area within the 2007-2010.Financial and other subsidies, policies are same to be the other general programme.

4.4 Energy Situation in Morang Districts

Most of the wards have got electricity supply and electricity is highly used for the purpose of lighting and heating. The technical potential Biogas plant 23670 Nos. In Morang district, among then 10721 Biogas plant has been established up-to the 31St December 2010 to derive the energy source for domestic or residential purpose. The livestock distribution seems 7.25 animals per households in Morang (2001CBS).The total energy consumption scenario of Morang districts is as follows;

Table No.4: Total energy consumptions in Morang

Kind of Energy	Consumption in Percent
Firewood	50.81
Kerosene	11.38
LPG	5.65
Biogas	2.11
Dung cake	28.56
Others	0.96
Not identified	0.53
Total	100

(Source: profile, 2018)

In Morang District the following kind of energy using by following no of households for the lighting purposes.

Table No.5: Energy using by lighting purpose in Morang

Kind of Energy	Households	Percentage
Kerosene	106844	63.64
Biogas	244	0.15
Electricity	59696	35.56

(Source: profile,2018)

In urban, municipality areas, most people use liquefied petroleum gas (LPG), kerosene and firewood used respectively for cooking purpose. Rural motor-able market have also access of LPG, but most of the rural, people used firewood (from own private land or government forest), animal dung cake (Guitha) for cooking purpose. Therefore, firewood has been the chief source of energy (50.81%) in Morang district. (DDC profile, Morang)

4.4.1Uses of Biogas

In rural area biogas technology is an alternative source of renewable energy .It is widely used in both the developed and developing countries. In developing countries, biogas is valued more as a source of energy for household cooking, lighting and slurry for the agriculture manure.

The main domestic use of biogas in rural household is for cooking and lighting. In my studying area Mirgauliya Morang, almost all of the households who use biogas using for cooking purpose. Every household has access to electricity, so no one wants to use biogas for lighting purpose. The minimum use of biogas for cooking is found to be 2 hours while the maximum use is 3 hours.

Since biogas is a high quality fuel. It can be used for various purposes besides cooking and lighting. It can be used for agro-processing, pumping water and generating electricity. Many countries are using for run automobile dual engine. A short description on each use is mentioned below.

4.4.2 Cooking

The main uses of biogas are for domestic purpose, at present context it is used for cooking and lighting. Now days lighting works is displaced by the access of electricity. Newly published data shows that 70 percent of households has connected electricity (CBS, May,2018). Although in rural remote area peoples are still using biogas for lighting also. Biogas can be used with appropriate designed burners to give a clean, smokeless, odorless blue flame, which is ideal for cooking. Biogas helps to reduce firewood consumption about 64 percent, so, it helps to prevent from rapid deforestation process.

4.4.3 Lighting

Most of the people use kerosene for lighting lamps in rural setting of Nepal. We have no indigenous sources of kerosene, nation used to import oil expending scare foreign exchange, which is increasing year by year. Biogas can be used with suitable type of gas lamp for lighting .It lights clear florescent type and it is suitable for domestic uses. The daily activities of households are being so easier before installation of biogas plant. The consumption of kerosene has been reducing.

4.4.4 Operating dual fuel engine

Biogas is a high grade fuel, which can be used internal combustion engines. We knew that Germany had used 90000 automobiles to run engine successfully from biogas. It is more usual to use it in duel fuel engines. About 70 percent of diesel requirement can be replaced by biogas for operating duel fuel engine such as Kirloskar, Usha etc. This type of engines can be use;

- For running agro-processing equipments.
- For water pumping.
- For generating small scale electricity.

4.4.5 Running Boilers/Refrigerators

Biogas can be used for boilers, refrigerators and milk chilling plants.

4.4.6 Uses of Bio-slurry

When dung is digested inside the digester plant slurry comes from the outlet of plant. It can be used in farm which directly helps to increase agriculture productivity and other important works. The various uses of slurry can be summarized as follows:

4.4.7 Fertilizer

Fertilizer is an essential component of better production of any crop. The slurry is rich in various plant nutrients as nitrogen, phosphorous and potash. Well-fermented biogas slurry improves the quality of soil resulting increased the production and productivity of land. It is depend upon how the slurry was used in farmland. Bio-slurry is more than a soil conditioner, which builds good soil surface, provides and releases plant nutrients. It was found that the slurry from anaerobic fermentation of a biogas digester improves the physical and chemical properties of soil. Since there are no more parasites and pathogens in the slurry, so, it is highly recommended for use in farming.

4.4.8 Health Impacts

Biogas plant installation has Health and Education impact. Among them Health impact of biogas is of great importance. Health impacts of biogas are mostly intangible and need to be assessed from user's perception.

4.4.9Education Impacts

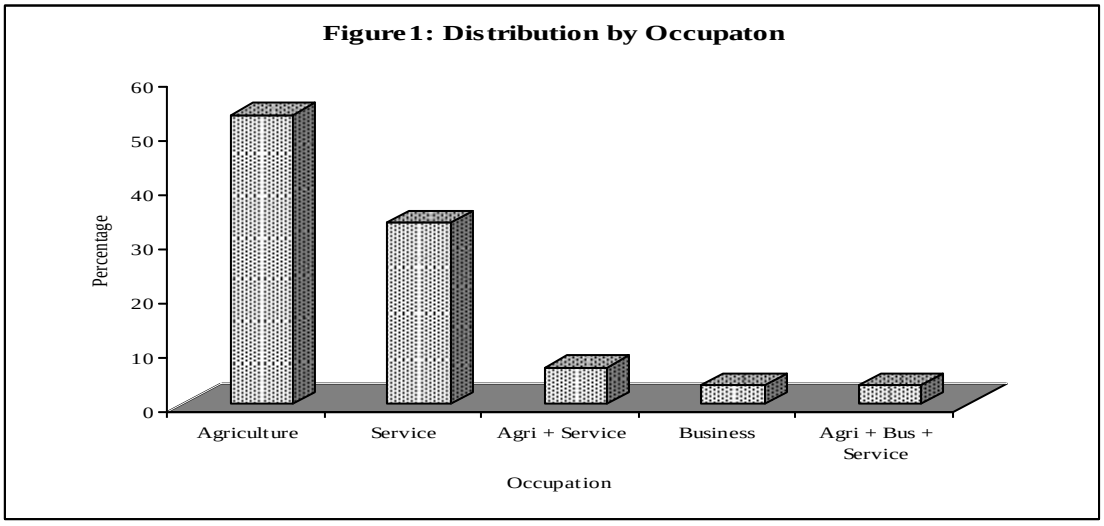
After the installation of biogas plant it saves minimum two or more hours per day and that time may be utilized in education generating activities they give more time for their study. And it helps them for other house hold work too such as agriculture farming, cottage industries, handicrafts, goat rising and poultry farming etc. Thus rural unemployment and poverty issues will be reducing.Women and children used to spend many hours collecting firewood or biomass fuels for heating and cooking. They have less time remains for education, other development works or income generating activities. The biogas energy solves all energy problems of the households; they have more time remains for productive activities. Addressing the problem of poverty requires adequate educational opportunities, health care and accessible sanitation facilities, these issues are solved by the rural energy .Renewable energy in the rural

areas used in commercial forms assist to income generating activities, and helps falling the poverty.

4.10 Occupation

The main occupation of the plant holders is agriculture, besides this service and business are the main occupation of plant owners. The main occupation practiced by the sampled households is mentioned in the figure.

Figure No. 1: Occupation status



The Figure-1 shows that the 53.3 percent of the plant owner are involved in agriculture sector, 33.3 percent in service, and 6.66 percent in agriculture plus business, 3.33 percent in business and agriculture plus business plus service. Besides this they have other income sources such as, remittance, animal farming for milk, goat rearing and taking pensions, which supports to fulfill their basic requirement.

4.4.11 Family Size

The result of the survey reveals that average family size of the sampled biogas household is 6.2 persons. Household with maximum number of family members have 16 whereas the minimum number is 3. Table 7 shows that distribution of households by family size.

Table No.5: Distribution of Households by Family Size

S.N.	Family Size	No. of Households	Percentage
1.	1-3	2	6.7
2.	4-6	21	70
3.	7 and above	7	23.3
Total		30	100
Average family size is 6.2 per household.			

Source: Field Survey, 2018.

Table 5, shows that among all 30 plant owners, 21 households (70%) have 4 to 6 members. Only 7 households (23.3%) have 7 and above members. 2 households (6.7%) have 3 members. The average family size is 6.2 per household.

4.4.12 Educational Status

Most of the plant owners are literate (93.4%). About 10 percent owners out of total interviewed have completed class 8. Other 26.66 percent have completed test pass to SLC and remaining 13.3 percent of total plant owners have completed IA to BA. There are 6.66 percent are illiterate. Table 8 shows the educational status of the sampled plant owners.

Table -6: Distribution by Educational Status

S.N.	Education	Male	Female	Total	Percent
1.	Illiterate	1	1	2	6.66
2.	1 up to 5 class	4	9	13	43.33
3.	6 up to 8 Class	1	2	3	10
4.	Test to SLC	6	2	8	26.66
5	IA TO BA	4	-	4	13.3
	Total	16	14	30	100

Source: Field Survey, 2018.

The data presented in table 6 reveals that majority of the plant owners are literate (93.34%). Among them 43.33 percent respondents are normal literate only they have completed class 1 up to 5. 10 percent have completed grade 6 up to 8. 26.66 percent have completed class 6 up to SLC and rest 13.3 percent has passed IA to BA. The education status of the plant owner is satisfactory.

4.4.13 Landholding

The main occupation of all plant owners being agriculture, all of them have their own land to cultivate. While calculating the landholding, only operational land holding has been taken into account. Table 9 shows the distribution of land holding status of the plant owners.

TableNo.7: Distribution by landholding

S.N.	Land (in Katthas)	No. of Households	Percentage
1.	Below 10	11	36.67
2.	11 to 20	10	33.33
3.	21 to 30	3	10
4.	31 to 40	3	10
5.	41 and above	3	10
Total		30	100
Average Landholding is 15.5 Katthas Per Household.			

Source: Field Survey, 2018.

Table 7 shows that average landholding size per household is 15.5 Katthas. The maximum landholding of the visited household is 70 Katthas and the minimum land is 1 Katthas. Majority of the plant owners (36.67%) have below 10 Katthas of land and only 10 percent have 41 and above Katthas of landholding.

4.4.14 Caste/Ethnicity

There are different castes and ethnic groups in Mirgauliya. The data on Caste/ethnicity of the sampled biogas household is given in Table 10.

Table No.8: Distribution of Caste/Ethnicity

S.N.	Caste/Ethnicity	No. of Households	Percentage
1.	Bramhan	19	63.33
2.	Chhetri	10	33.33
3	Janajati	1	3.33
Total		30	100

Source: Field Survey, 2018.

Table 8 shows that the majority of the households under study are Bramhans (63.33%) followed by Chhetri (33.33%)and janajati (3.33%).The reason behind the higher percentage of biogas users (Brahmins) is found that they are socially and economically and educationally forward in each and every sector. They were conscious about biogas.

4.5 Uses of Biogas

Biogas technology is an alternative source of energy requirement especially in rural areas. It is widely used in both the developed and developing economies in agricultural or rural, industrial and municipal waste systems. In developing countries, biogas is valued more as a source of energy for household cooking, lighting and slurry for its fertilizing value. It has great value for the reduction of green house effect. The net heating value of the fossil fuel produced 43.3MJ/kg but biogas has less net heating value (12 MJ/kg) than other energy sources.

The main domestic use of biogas in rural household is for cooking .In Mirgauliya all of the households use biogas only for the cooking purpose. Since every household has the access to electricity, no one use biogas for lighting purpose. The minimum use of biogas for cooking is found to be 2 hours while the maximum use is 4 hours.

All the respondents replied in favor of biogas for cooking and they expressed great satisfaction with cooking aspect of biogas. According to them, the main benefit of cooking is biogases were no difficulty and comfort in cooking and it removes drudgery of women. They also reported that they were ease and free from smoke borne diseases as they cooked in smoke-free environment. Other benefits mentioned were biogas did not need constant attention or blowing as in firewood; they were able to do other works while the food being cooked.

4.6 Impact of Biogas Plant Installation

This section shows the impact of biogas in reduction of workload, use of saved time, impacts on health and sanitation, environment and agriculture production by the use of bio-slurry.

4.6.1 Size of the Biogas Plant

Various types of biogas plants having different size have been introduced on promoting and development by the companies. $4m^3$, $6m^3$, $8m^3$, $10m^3$ and $15m^3$ are widely used size of biogas plants in rural areas. But most of the people used 6m3size of biogas plant in rural area.

Table No.9: Distribution of Biogas by Plant Size

S.N.	Plant Size	No. of Households	Percentage
1.	$4m^3$	2	6.67
2.	$6m^3$	16	53.33
3.	$8m^3$	6	20
4	$10m^3$	4	13.33
5	$15m^3$	2	6.67
Total		30	100

Source: Field Survey, 2018.

Table 9 shows that five types of biogas plan sizes, $4m^3$ $6m^3$, $8m^3$,$10m^3$and $15m^3$ were reported. About 53.33 percent of interviewed households have $6m^3$ capacity plant followed by 20% households have $8m^3$,13.33% have $10m^3$ and 6.67% have $4m^3$ or

$15m^3$ size of biogas plant. Study shows that $6m^3$ capacity plants have been widely used in the study area.

4.6.2 Construction Company

Recent data reveal that in Nepal more than 250 private construction companies have been established to make bio-gas plant. Their contribution is very considerable to promote and develop biogas. Table 12 shows that distribution of Construction Company.

Table No 10: Distribution by Construction Companies

S.N.	Construction company	No. of Households	Percentage
1.	Mechigobar gas company	15	50
2.	Munalgobar gas company	6	20
3.	Nepal gobar gas company	6	20
4.	Sana krishaksamudaikgobar gas company	3	10
Total		30	100

Source: Field Survey, 2018.

4.6.3 Loan

The loan is provided for the establishment (installation) of biogas plant in initial phase. They are ADB/N and laligurans finance company. However, some of the plant owners have installed biogas on self.

Table No 11: Loan distribution by institution

S.N.	Financed by	No. of Households	Percentage
1.	Self	15	50
2.	ADB/N	11	36.67
3.	Laligurans finance company	4	13.33
Total		30	100

Source: Field Survey, 2018.

Table 11 shows that majority of the plant owners (15 householders) out of total interviewed have established by own investment (50%).The 36.67 % of households taken loan from ADB/N and 13.33% were taken from Laligurans Finance Company.

4.6.4 Sources of Information, Encourage

There are several sources of information about the biogas plant installation. Radio/TV, Newspaper, Neighbour, Gobar Gas Construction Company is major sources of information. The plant owner had encouraged by local Gobar Gas Companies agents.

Table No. 12: Distribution by Sources of Information

S.N.	Source	No. of Households	Percentage
1.	Neighbor	17	56.67
2.	GGCC	11	36.37
3.	Radio/T.V.	2	6.67
Total		30	100

Source: Field Survey, 2018.

Table 12 shows that majority of the plants owners (56.67%) has got information through their neighbors', followed by Gobar Gas Company (36.37%) and Radio/TV is (6.67%).

4.6.5 Reasons for Biogas Plant Installation

The main reasons behind the installation of biogas plant are cooking, lighting and operation to equipments. But in the sampled field area, all plant holders (100%) installed the biogas to get rid of firewood collection and face the unavailability of firewood. So easy and smokeless cooking is the main reason for biogas plant installation.

Table No. 13: Reasons for Biogas Plant Installation

S.N.	Reasons/Problem	No. of Households	Percentage
1.	Firewood Collection and unavailability	24	80
2.	Easy and Smokeless Cooking Toilet	6	20

Source: Field Survey, 2018.

Table 13 shows that the main reason behind the installation of biogas plant is easy and smokeless cooking (80%) followed by due to lack of toilet (6.7%), to get rid of firewood collection (6.7%) and environmental protection (3.3%). Only 3.3 percent out of total interviewed reported that the main reason for biogas plant installation is resource conservation.

4.6.6 Toilet Attached With Biogas Plant

It is found that nobody has attached toilet with the biogas plant in my sampled area; respondents are not eager to attach toilet with the plant due to the dirty feelings. They answered if they had attached toilet with the plants the digested slurry would be dirty and no one carry and use it to farm. Other main cause is most of the villagers believed in traditional culture and plant has producing sufficient gas for the cooking.

4.7 Livestock

Livestock is an integral part of agricultural farming in Nepal. It fulfills the demand of manure for land, meat to eat and milk to drink. Since livestock dung is the main raw material for installing biogas plant, all plant owners have some kind of livestock.

4.7.1 Livestock Population

The situation of the livestock holding in the sampled household in the study area is presented in table 14.

Table No. 14: Livestock Population

S.N.	Total no. of Livestock	No. of Households	Percentage
1.	Below 3	12	40
2.	4 to 6	13	43.3
3.	7 and above	5	16.7
Total		30	100
Average livestock population is 4.3 per household.			

Source: Field Survey, 2018.

Table 14 shows that the average livestock population is 4.3 per household. About 40 percent respondents out of total interviewed reported that their livestock population is below 3. 43.3 percent or majority of the respondents have 4 to 6 and only 16.7 percent out of total interviewed stated that their livestock population is 7 and above.

4.7.2 Total Dung Production

The objective behind the livestock rearing is to produce dung for biogas plant in this study. Dung production situation found in the sampled household in the study area is presented in table 17.

Table No. 15: Dung Production

S.N.	Dung Produced per day (in kg)	No. of Households	Percentage
1.	Below 10	2	6.66
2.	11 to 20	8	26.66
3.	21 to 30	11	36.66
4.	31 to 40	6	20
5.	41 and above	3	10
Total		30	100
Average dung production per day is 22.4 kgs.			

Source: Field Survey, 2018.

Table 15 shows that majority of plant owners (36.66%) have 21 to 30 kgs dung production per day. About 26.66 percent have 11 to 20 kgs of dung production per day whereas only 20 percent have 31to 40 kg, 10 percent of households have 41 above kgs. of dung production and 6.66 percent have produced below 10 kgs of dungs per day.

4.7.3 Dung Feeding

The majority of the households have not feeding appropriate prescribed quantity of dung .The habit of dung feeding which is less than recommended amount. The recommended of 4m3 plant have to feed in Terai is 30 kg per day. In study area found that 6.66 percent households used to feed below than 10 kg dung per day .It is found that due to the very short time burning of gas is a cause of the plant operation .The situation of sampled household in the study area is presented in table 18.

Table No.16: Dung Feeding Per Day

S.N.	Amount of Dung (kgs/day)	No. of Households	Percentage
1.	10	2	6.66
2.	20	8	26.66
3.	30	11	36.66
4.	40	6	20
5	Above 41	3	10
Total		30	100
Average Dung feeding per day is 29.1kgs.			

Source: Field Survey, 2018

Table 16 shows that the average dung feeding per day is 29.1 kgs. About 37 percent of respondents out of total interviewed households reported that they use to feed 30 kg dung per day. It is followed by 20 kg. per day 26.66%), 40 kg. per day feeding (20%) only 10 percent out of total interviewed households use to feed more than 41 kg. dung and 6.66 % households used 10 kg of dung per day. Majority of the households use to feed dung less than recommended amount by Biogas Company.

4.8 Slurry

Slurry is produced from the biogas plant. Come from the outlet when dung is digested inside the plant (digester). Biogas is collected inside the dome and digested slurry is exited through outlet channel. It can be used in farm or fishery, which directly leads to increase agricultural productivity.

4.8.1 Slurry Used in Farm

Digested slurry is used in farm. In study area all households have used digested slurry in their kitchen garden and farm.

Table No. 17: Slurry Used in Farm

S.N.	Farm Item	No. of Households	Percentage
1.	Crop	4	13.33
2.	Maize	6	20
3.	Wheat	3	10
4.	Vegetable	10	33.33
5.	Paddy	7	23.33
Total		30	100

Source: Field Survey, 2018.

Table 17 shows that majority of the respondents (33.33%) out of total interviewed reported that they use slurry on kitchen garden for vegetable. About 23.33 percent respondents use on paddy, followed by 20 percent use slurry on maize, only 13.3 percent use the digested slurry on crop and remaining 10 percent is used on wheat.

4.8.2 Forms of Slurry Used

The digested slurry is used in different forms. In the sampled area the slurry is used in dried solid forms. It is also found that most of the plant holders using slurry without proper manner .They leave slurry in front of direct sunlight to making it dry soon. This bad practice would decrease the micro-nutrients from the slurry. In my sampled area 18

households (60%) has been using slurry without appropriate manner and rest (40%) used slurry according to recommended preparation manner.

4.8.3 Impact of Slurry on Agricultural Production

In this study, slurry use has increased productivity mostly. The impact of slurry is presented below (Table 18).

Table No.18: Impact of Slurry

S.N.	Impact of Slurry	No. of Households	Percentage
1.	Increased	22	73.3
2.	Remained Same	5	16.7
3.	Slurry have less nutrient	3	10.0
Total		30	100

Source: Field Survey, 2018.

Table 18 shows that about 73.3 percent out of total interviewed households expressed that their agricultural production has increased whereas only 16.7 percent reported that the agricultural production is remained same. Another 3 percent reported that digested slurry have less nutrients so it can't increase farm production.

4.9 Energy Source, Consumption and Saving

The chief purpose behind the installation of biogas plant is to reduce the use of firewood including other fuels such as LPG and kerosene etc. Biogas technology has got popularity as an alternative energy source especially in rural area. Consumption of energy before and after installation of biogas and saving of energy as an important impact of biogas plant installation has been presented below in detail.

4.9.1 Energy Type Used Before Installation of Biogas Plant

In my sampled area firewood was one and only energy source used before installation of biogas plant. All (100%) respondents replied that they were mainly dependent on firewood, due to the already access of electricity and easily access to the government

forest. Agriculture residues and own produced biomass has been using for livestock feeding purpose.

4.9.2 Saving on Time and Reduction in Workload

This study shows that the use of biogas technology has been able to save time and also to reduce workload in household. Table 21 shows that situation of saving in time in detail.

Table No. 19: Saving on Time and Reduction in Workload

S.N.	Activities	Average time taken (hours/day)		Reduction in workload (saving in times) hours/day
		Before installation	After installation	
1.	Firewood collection	3	-	3
2.	Cooking	3	1½	1½
3.	Washing utensils	1½	½	1
Total average time taken per house per day		7 ½ hours	2 hr	5½ hrs

Source: Field Survey, 2018.

Table 19 shows that the average time taken per day before installations 7½ hrs. After installation, 2 hrs per day is spent on all activities and the saving time per day is 5½ hrs. This time (5½ hrs per day) is used in own farm activities, livestock rearing ,manage the kitchen garden .It is also reported that they were free from the drudgery and directly reduces workloads in households activities.

4.9.3 Saving of Money on Energy

In this study, money is saved after the installation of biogas plant as compared to before installation of biogas plant. Especially in energy consumption. The situation of saving of money on energy in sampled households is presented in table 20.

Table No. 20: Average Saving of Money on Energy

S.N.	Types of Energy	Average Consumption of Energy (Rs./Month)		Average Saving (in Rs./month)	Cost Per Unit (inRs.)	Average Saving (in %)
		Before Installation	After Installation			
1.	Firewood	1800	-	1800	6/kg	100
Annual saving amount of money is (1800×12) Rs21600. Atleast10 kg per day/per households.						

Source: Field Survey, 2018.

Table 20 shows that the amount of money which saved after the installation of biogas plant is calculated. At the present market rate. Before installation Rs. 1800/- was spent but after installation it is totally reduced. Hence, the average saving amount of money is Rs. 1800/- per month. This table also classified that the annual saving amount of money (1800×12) is Rs. 21600 can be contributed to pay the loan on installment of expenditure of biogas plant.

4.9.4 Utilization of Saved Time

As shown in table 18 the average time saving per day is 4½ hrs. It has been utilizing in different activities. Saving of time has reduced the workloads in household activities. The use of saved time is presented in table 21.

Table No. 21: Utilization of Saved Time

S.N.	Activities	No. of Households	Percentage
1.	Farm Activities	13	43.3
2.	Child Care	3	10
3.	Kitchen Gardening	10	33.33
4.	Income Generation	4	13.33
Total		30	100

Source: Field Survey, 2018.

Table 21 shows that about 43.3 percent of respondents out of total interviewed reported that they use their saved time on farm activities followed by 33.3 percent use on kitchen garden , 13.33 percent use the saved time in income generation and 10 percent use for own child care. Data clearly shows that the saved time after the installation of biogas plant has been used mainly on agriculture farm production activities.

4.9.5 The Source of Firewood Collection before Installation of Biogas Plant

There are several source of firewood collection before installation of biogas plant. Among them, own land (private forest), government forest and market have been taken into consideration. This is shown in table 24.

Table No. 22: Sources of Firewood Collecting.

S.N.	Source	No. of Households	Percentage
1.	Government forest	26	86.87
2.	Market(firewood seller)	4	13.33
Total		30	100

Source: Field Survey, 2018

Table 22 shows that about 86.87 percent out of total interviewed respondents reported that they collect firewood from government forest and remaining 13.3 percent reported that they brought firewood from firewood seller in their own households. This table clarifies that the chief source of firewood collection was government forest.

4.9.6 Saving forest through the biogas installation

Biogas plant has other main contribution to the nature; it stops to cut down trees for the uses of firewood. Biogas helps in reducing the deforestation as it arrests for cutting of trees for firewood. Forest plays crucial role to keep maintain the environment balance. After the use of biogas plants the cutting down of the trees has reduced incomputable. In my sampled area I found that after the installation of biogas plant several households had not gone forest for firewood collection from the plant installation, the time was at least 5 year.

4.10 Loan

Many financial institutions have provided loan for the purpose of installing the biogas plant. Majority of the people have used to take loan from these (financial) institution and few of them have not taken loan while installation of biogas plant.

4.10.1 Biogas Plant Installation on Loan

According to respondent, out of 50% households have not taken loan and remaining 50% have taken loan from financial institutions for biogas gas plant installation. Table 23 clearly shows the situation of loan taken of sampled households.

Table No. 23: Investment Sources

S.N.	Sources of loan	No. of Households	Percentage
1.	Self investment	15	50
2.	ADB/N	11	36.67
3.	Laligurans finance	4	13.33
Total		30	100

Source: Field Survey, 2018.

Table 23 shows that about 50 percent of plant owners out of total interviewed reported that they have taken loan from financial institutions whereas 50 percent plant owners haven't taken loan. They are depended on self-finance.

This table also clarifies that plant owners (36.67%) have taken loan from ADB/N followed by 13.33 percent from finance company. Data reveal that the major source of loan is Agricultural Development Bank, Nepal (ADB/Nepal).

4.10.2 Interest Rate of Loan

As we know in earlier table the source of investment is loan from financial institution. Persons those who want to take loan should pay certain interest rate. Interest rate is presented in table 26.

Table No. 24: Interest Rate on Loan

S.N.	Interest Rate (in percentage)	No. of Households	Percentage
1.	14 to 16	5	16.67
2.	17 to 19	21	70
3.	20 to 22	4	13.33
Total		30	100
Average interest rate is 16.7 percent.			

Source: Field Survey, 2018.

Table 24 shows the distribution of interest rate on loan. About 70 percent plant owners out of total interviewed reported that they have taken loan by paying 17 to 19 percent of interest, followed by 16.67 percent have paid 14 to 16 percent and only 13.33 percent out of total interviewed plant owners have paid 20 to 22 percent of interest on loan. The average interest rate is 16.7 percent.

4.10.3 Perception on Existing Interest Rate

In this study it is found out that the plant owners have different perception regarding the existing interest rate on loan. Perception of plant owners for interest has been presented in table 27.

Table No. 25: Perception on Interest Rate

S.N.	Perception	No. of Households	Percentage
1.	Satisfied	3	10
2.	Unsatisfied	27	90
Total		30	100

Source: Field Survey, 2018.

Table 25 shows that the perception of plant owners to the existing interest rate 90 percent are not satisfied with the interest rate on loan whereas only 10 percent were satisfied with the interest rate of loan for biogas plant installation.

4.11 Health and Sanitation

The study has shown that biogas has positive impacts towards health and sanitation of the respondents. Change in surrounding after the installation of biogas plant and the feeling of the menace of flies, or mosquito. Remarkable achievement has been made on health and sanitation of household. The situation of health and sanitation is presented below.

4.11.1 Change Found in Surrounding Environment

Table No. 26:Change Found in Surrounding

S.N.	Change Found	No. of Households	Percentage
1.	In Health	22	73.33
2.	In Hygiene	3	10
3.	In Sanitation	5	16.66
Total		30	100

Source: Field Survey, 2018.

Table 26 shows that about 73.33 percent respondents out of total interviewed reported that they found change in health, followed by 16.66 percent found change in sanitation. And only 10 percent respondents out of total interviewed reported that they found change in hygiene. The change is considered the improvement in all these given aspects in this study.

4.11.2 Feeling on the Menace of Flies or Mosquito

Table No. 27: Feeling on the Menace of Flies or Mosquito

S.N.	Activities	No. of Households	Percentage
1.	Remained Same	27	90
2.	Feelings increased	3	10
Total		30	100

Source: Field Survey, 2018.

Table 27 shows the feeling on the menace of flies, or mosquito, majority of the respondent (90%) out of total interviewed are reported remained same. And remaining 10 percent reported that mosquito and flies increased due to presence of liquid slurry nearby at home.

4.12 Social Impacts

Biogas plant installation has great social impact, economic impact and environmental impact. Among them social impact of biogas is of great importance. Social impacts of biogas are mostly intangible and need to be assessed from user's perception. The outcome of this study showed that there were some positive impacts of biogas that influenced the social aspects of beneficiary households directly. In my sampled area all respondent answered after the installation of biogas they felt that their social status has been increased in society.

4.12.1 Benefited by the Biogas Plant

This study found that the women are highly benefited by the installation of biogas plant. It is also a social impact of biogas plant installation. The situation of benefited members of households has been presented in table 28.

Table No.28: Benefited by the Biogas Plant

S.N.	Benefited Member	No. of Households	Percentage
1.	Woman	23	76.67
2.	Children	4	13.33
3.	Man	3	10
Total		30	100

Source: Field Survey, 2018.

Table 28 shows that majority of the respondents out of total interviewed reported that the woman are highly benefited by the biogas plant installation (76.67%) followed by 13.33 percent reported that children are benefited. And only 10 percent respondents out of total sampled households interviewed reported that men are benefited by the biogas plant installation. In overall women are highly benefited by the biogas plant installation.

4.13 Problems and Perceptions the Use of Biogas Plant

There are so many problems of the use of biogas plant, maintenance, operational, dung availability, temperature, gas leakages and paying loan are the major problems of biogas use. Besides this a problem is reported by some plant holders, that the cause of biogas in kitchen room the roof (karkatpata) has made hole in right above direction of the stoves. In this section perception of respondents also have been dealt in detail regarding the use of biogas.

4.13.1 Problems of Biogas Plant

Table No.29: Problems of Biogas Plant

S.N.	Problems	No. of Households	Percentage
1.	Maintenance	7	23.33
2.	Operational	3	10
3.	Dung Availability	3	10
4.	Low gas production (in winter season)	4	13.3
5.	Problem not reported	13	43.33

Source: Field Survey, 2018.

Table 29 shows that about 43.3 percent respondents out of total interviewed reported that they have not facing any major problem since the plant established, followed by maintenance problem is reported by 23.33 percent, problem of dung availability 10 percent, problem of operational 10 percent, and 13.3 percent respondents have problem of low gas production due to temperature especially in winter season. Due to the low gas production in winter most of the respondent (63.33%) is compelled to keep liquid petroleum gas cylinder instant of biogas.

4.13.2 Perception of Respondents on Utility of Biogas Plant

Table No. 30:Perception of Respondent

S.N.	Utility of Plant	No. of Households	Percentage
1.	Very useful	26	87.67
2.	Useful	4	13.33
Total		30	100

Source: Field survey, 2018.

Table 30 shows that about 87.67 percent respondents out of total interviewed reported that biogas is very useful and 13.33 percent respondent reported that biogas is useful. No one reported biogas is not useful.

4.13.3 Opinion on the Overall Energy, Health and Education Condition

There are several opinions regarding the overall energy, Health and Education condition of the biogas plant installation. In my sampled area all respondent opinions was overall energy, Health and Education condition has improved. In field observation it was found that the domestic environment was neat and clean inside or outside of the houses.

4.14Major Findings of the Study

Size of 6m^3 biogas plants was more popular (53.33%) in this area as compared to other size of plants (4m^3, 8m3, 10m^3, and 15m 3).The main source of loan for investment was ADB/N (36.66%).The main reason for installation of biogas plant is to get rid of firewood collection and to have ease in smokeless cooking.The use of biogas is only for cooking. There is a considerable reduction in the workload of the family member and women are highly benefited by the biogas plant installation.Subsidies provided by the BSP were very encouraging factor for installation of biogas.Majority of time has been saved and the saved time has been used mostly in farm activities followed by child care activities.Average amount of dung feeding was lesser than the capacity of plant.Toilet is not connected with the biogas plant. The women's health is improved after the installation of biogas plant, especially cooking persons. Average livestock population size is 3.6 per household.Average family size is 6.2 per household.Average landholding size is 15.5 Katthas per household.The users felt reduction in health related problems such as eye burning, headache, and respiratory problems such as cough.Majority of the plant owners are not satisfied with the existing interest rate for loan and they also want to decrease the interest rate of the installation of biogas plant.Almost of all plant owners use slurry on farm and agricultural production has been increased.Majority of respondents reported that the social status has been raised.

CHAPTER - V

SUMMARY AND CONCLUSION

5.1 Summary

Biogas technology is an appropriate alternative source of energy for household purpose. Forest resource is only the source of fuel wood for daily requirement of energy in rural area. Unbearable and excessive use of firewood directly leads to the poor forest towards the desertification. The sign and symptom has been rising in Churiya forest. So, the promotion and development of biogas is most essential in the context of Nepal. In this context, the present study on the Health and Education of biogas plant installation in rural area was made so far.

This study was conducted in Mirgauliya of Morang district. This study is based on the sample of 30 households who were selected by using simple random sampling technique. In this Ward, there are 446 households with the 2256 population (CBS-2001).Among them there were 75 household has installed the biogas plant. Total sampled households occupy only 6.72 percent of the total households in ward no.9 and 40 percent of the total biogas plant installed houses. Before conducting 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, Library of Post graduate campus Biratnagar, BSP office, Jhamsikhel, biogas company office and biogas experts were consulted.

5.2 Conclusion

This study was conducted in Mirgauliyaof Morang district. 30 households out of 75 biogas plant installed households have been taken as sampled households.

Being an appropriate alternative source of energy biogas technology has been proved very useful especially in rural setting. Excessively exploited deplorable conditions forests have not capacity to provide fuel to the increasing population is a today's main problems. To get rid of this problem biogas might be the one and only solution in present context.

Biogas has improved the Health and Education condition of biogas plant owners. It has reduced the workload of women in household activities because before installation of biogas plant they had to invest more time and after the installation of biogas plant they have spent less time on cooking, cleaning utensils and collecting firewood. The saved time is using in other productive works.

Biogas technology has also improved the health of women. It also improves the sanitation of domestic environment. It has helped to reduce the prevalence of smoke borne disease such as respiratory problem, cough, and headache and eye burning etc. This technology has also improved the overall energy, Health and Education condition of the plant owners along with nation.

The uses of biogas energy reduced the rate of deforestation, so it is highly effective on reducing the rate of deforestation. Before installation of biogas plant each household used to collect firewood from government forest in large amount whereas after installation it has been reduced by 80 percent. Biogas plant has improved the surrounding environment. And it also has improved the economic condition by saving money spent on energy source such as kerosene, firewood and LPG.

This study has also found that the biogas plant byproduct (slurry) has many potential benefits as fertilizer for agricultural production. Bio-Slurry has curtailed the use of chemical fertilizer and increased agricultural productivity with sustainability.

Biogas plant technology has been proved as an appropriate alternative source of energy to fulfill the increasing demand of energy requirement for growing population in rural setting of Nepal. The 2, 31,230 houses have got clean energy till the 2010. It is estimated that per year one biogas plant reduces equivalent to 7 ton of green house effect gases. Then 2, 31,230 biogas plant reduced equivalent to 16, 18,610 ton of green house effect gases. Thus biogas has been contributing to the nature and keeping the bio-diversity in balance.

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Education

Maya Rai is the student of class 4 in a school of Mirgauliya she is one of the person who had great education impact after the of bio gas in their area. Before she was studying under old kind of fire lamp which made her eyesvery weak and she could not see properly. But now because of the light of biogas she can read and write in better lighting condition.

Also before she had to go a long way to bring timber wood for fire and cooking their house but now because of biogas they can easy cook and they have better time to give for study which has significantly improved her marks.

Health

Ram Thapa is 55 years old man. He is one of the people who are benefitted by the use of biogas He is patient of asthma and chronic cough since a long period time. It happened because he was cooking under smoke and it had very adverse effect on his health. But after use of biogas he does not suffer from the smoke while cooking anymore. Also he doesn’t need to go a long way to get Woodstock for fire. This has also stopped deforestation in the area. He has stopped using the medicine.