CHAPTER – I

INTRODUCTION

1.1 General Background

The energy usage in most developing countries mainly constitutes of bio-energy, mainly in the form of firewood but also as straw and cattle manure etc. Another significance of especially the least developed countries (LDC) is that most of the energy consumption comes from household use as opposed to a larger part industrial usage in the developed countries.(Li et al 2005) The use of firewood have many negative effects, both social and environmental. Mostly women and children collect the firewood and this can take several hours per day leaving this group with less time for education, employment and recreation. The use of firewood and other forms of biomass as a cooking fuel is also directly related to exposures of the hazardous particles from the smoke that these fuels produce when burned. (Gautam et al 2009) The use of firewood is also an important factor in the declinement of forests in the world and thereby an important factor to climate change. Other negative effects from excessive biomass usage are erosion, degrading soils and water resources. Converting from today's use of biomass into cleaner ”greener” technologies in rural developing areas would increase the standard of living, health and local environment and at the same time help reduce climate change. Furthermore it would give an improved chance of economical development. (Bajgain et al 2005)The use of biogas as an energy source has proven itself to be an important strategy in solving the problems of energy usage in rural areas of developing countries. By using existing substrates like dung and other waste products to produce biogas, single households and communities can become more or less self-sufficient in terms of energy. The biogas can be used as a clean cooking fuel without the effects of hazardous particles typically associated with firewood and can also be used electricity or for heating. (Bajgain et al 2005) 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. The chief component being methane gas. It is the mixture of gas produced by methaoneogenic 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 LSG. The biogas is colorless, odorless and buns with a clear blue flame (BSP 2010).

Nepal is one of the poorest and least developed country in the world with lowest per-capita income $1 per day. Nepal is a small country with an area of 1,47,181 sq.km inhabited by 2,31,514,23 people (population census 2001). The land area can be roughly divided into three physiographic region like: the mountain, the hills and the plains, out of total population 86 percent live in rural areas as well as 14 percent live in urban areas (census, 2001).

The economy of Nepal is primarily based on agriculture and other sectors of the economy are quite small. National account data shows that at factor cost, the share of agriculture in the total G.D.P was around 40 percent (2003/004 MOF/HMG, 2004), Most of the rural population has the tradition of raising cattle as an integral part of their farm people are depended mainly on firewood for their energy requirement. They use it for cooking, space heating and other purposes.

The low level of economic development is reflected in the lesser range of energy consumption. Per – capita energy consumption in Nepal is 336kg of oil equivalent (kgoE)2 (BSP bulletin, December 2004.). Energy consumption pattern is divided into three parts by their sources, namely traditional, commercial and renewable. Large proportion of energy consumption is met by traditional energy resources with increasing pressure on forest resources leading to environmental imbalances to rise with increasing pressure of population growth. Nations demand for fuel is increasing at an alarming rate. About (86-90percent) total energy demand is met by firewood, animal dung and Agriculture residue (NPC– tenth Plan (2002– 2007).

Nepalese rural economy, predominated by subsistence agriculture is based on combination of crop production and animal husbandry. The average size of small – scale farm is about 0.96 hectors per holding.

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 system in Nepal. In rural area, average farmer hold cattle and buffaloes for dairy products. Dung is used to make compost for the field and usually under condition of resource stress, as a raw material for fuel. The number of cattle and buffaloes is also increasing along with households. Nepal produces about 41.4 million MT of livestock manure per year. It is estimated that about 8,1000 MT of dry dung cake, alternate to firewood which is equivalent to 20,000 MT of oil. If we compare the electricity with energy generated from existing biogas plants, it would approximately reach 30 MW. The estimated biogas potential of Nepal is sufficient to operate 1.9 millions of biogas plants. (BSP – N 2006).

Rural people have been facing difficulties in collecting firewood as it is becoming both scare and costly. Kerosene and other sources of fuel aren't available in time and in required quantity in various parts of country.

A plant owner in the Terai has saved 55 quintals of firewood (65 percent of the requirement) and 102 liters of kerosene (65 percent of the requirement). While it is 41 quintals of firewood (62 percent of the requirement) 83 percent liters of kerosene (62 percent of the requirement) in the hills. It would make a tremendous impact against the deteriorating situation of the forest as well as in saving lot of foreign exchange due to import substitution. The rate of firewood to kerosene saving in terms of value in the terai comes to 73 i.e. 27 while it is 81 i.e. 19 in the Hills (Impact study of Biogas installation in Nepal by Agriculture Development Bank).

Based on the studies conducted by various government agencies the per-captia energy consumption in Nepal is 15GH (RETRUD) i.e. 2003 of which 89.05 percent is used in residential sector followed by 5.25 percent in industrial sector, 3.44 percent in transport sector, 1.33 percent in commercial sector, 0.79 percent in agriculture sector and 0.13 percent in others. The source of energy in energy balance of the country can be shown as follows I fuel wood – 75.78 percent, Agriculture

residue 3.75 percent, Animal waste 5.74 percent, Petroleum product 9.24 percent, Electricity 1.47 percent and coal 3.53 percent and others are renewable. The available energy from these above sources is mainly used for cooking (RET, 2003).

Biogas as an alternative energy, so it is essential in these days. There are so many alternative energy such as hydropower, solar power, wind energy, biogas and so on. Thus, biogas remains the best alternative energy that stands technically, economically and environmentally feasible. The cost of wind and solar power are expensive for the rural people than biogas.

The biogas technology to be the simple convenient and reliable then other sources of energy. It helps to reduce firewood and kerosene consumption, conserving environmental, reduce sanitation problem, reducing work load to women, children and also increase agriculture production. So, bio-gas energy is more useful in the context of Nepal. This is also feasible and cheap then other energy. Policy of HMG/N is to promote biogas technology. In Nepal, 1,23,395 family size bio-gas plants have been installed in the end of 2004. Bio-gas programme has been run in 65 districts of Nepal. The bio-gas plants are located in Nepal are, 57 percent Terai, 37 percent Hills, and 6 percent in Mountain regions (Bio-as Nepal, 2004; Published by BSP).

This technology increasingly accepted by all ethnic groups in both the hills and the Terai. There is not any significant social barrier to the technology especially when cow, buffalo dung is used as slurry. Since, combustion of biogas does not produce toxic fumes and carbon residues on the bottom of pots and pans, health conscious rural people (especially women) favor this technology. The plant owner in the Terai reported that the level of gas production decreased by about 25 percent during winter. It may go beyond 50 percent in Hills (Impact study of Bio-gas installation in Nepal, Agricultural Development Bank).

1.1.1 Introduction to Biogas

Bio gas from manure, vegetable waste and algae, considered for the isle of man. Biogas can be substituted for natural gas or prepare as fuel for boilers and electrical generations, Biogas systems convert animal dung into methane gas, which is

flammable and can be used as a domestic fuel for cooking and lighting – slurry is used for organic fertilizer.

The given data are useful in the design of biogas plant.

Table 1.1 –Design of biogas plan

Suitable digesting temperature	20-350 c
Retention time	40-100 days
Biogas energy content	6 kwh/m3=0.61x diesel fuel
Biogas generation	0.3-0.5m3 gas/m3
	Digester volume x day
1 cow yield	9-15kg dung/day = 0.4m3gas
Gas requirement for cooking	0.1-0.3m3/person
Gas requirement for lighting	0.1-0.15m3/h

Source: 2nd National conference on science & tech RONAST: Kathmandu.

Biogas has different types gases in which the composition of the gases is shown in the following table.

Table 1.2 –These type of Gas found in Bio-gas

Description	Percent (Quantity)
Methane	50-60 percent
CO2	30-40 percent
Hydrogen	5-10 percent
Nitrogen	1-2 percent
Water vapour	0-3 percent
Hydrogen sulphize	Little

Source:- Singh. R.B; A Technical Evaluation of Renewable Energy Biogas in Nepal. SCITECH Journal NEC April 2004, Vol 7 No.2.

Since this study is originally related to the socio-economic impacts of biogas in Nepal, it is focused on the contribution of biogas in gender development i.e. women empowerment. The domestic energy of Nepal is becoming feminized and the role of women in households' energy management is the crucial. Most of the women in Nepal have no access to education since the long due to the collection of

energy for domestic purpose. However, at present, after the introduction of biogas plants it is gradually increased the rate of empowerment. This study is conducted on Kanyam VDC as a case study on women in respect to socio-economic impacts of biogas.

1.2 Statement of the Problem

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 etc. and Nepal is no exception of this.

Energy is a basic 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 survival and progress such as in cooking; lighting and heating 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 all Nepalese people are highly dependent on firewood for energy, which has resulted into degradation of forest resources.

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 about three fourth of total energy consumption which is mainly consume in rural Nepal.

The forest alone is not capable of sustaining the increasing demand of energy for growing population. Although there is huge potentiality of hydropower, only less than 1 % has 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, 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 dirty 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 decrease the rate of deforestation to improve the health situation of rural women and children and to utilize the saved time on income generating activities and in Kanyam Vdc of Ilam district. Digested slurry reduces the undue use of chemical fertilizer leading to higher productivity in Kanyam VDC of Ilam Nepal. The condition of women in this VDC is ameliorating bit by bit.

1.3 Objectives of the study

The general objective of the study is to find out the socio economic impacts of biogas in Nepal. However, the specific objectives are:

- To investigate the social impacts of biogas in rural community.
- To find out the impacts of biogas in environment of the study area.
- To suggest biogas as the alternative solution to gender disparity.

1.4 Significance of the Study

It is well realized that bio-gas technology is very much suitable for Nepalese context. Bio-gas technology has no doubt, a good contribution in the energy sector. This simple technology contributes to preserve down the use of forest resources. By promoting bio-gas installation, we are preventing deforestation. Thus, it is regarded as a sustainable source of energy. As we know, bio-gas as a renewable energy clearly offers the great significance of this study. The introduction of bio-gas technology in the study area are helpful for reducing the dependency on forest

resources for household purposes. It helps to save money and time in collecting firewood and cooking activities. It provides the smokeless environment in kitchen. Raising rate of chemical fertilizer helps to increase production cost and decrease the soil fertility day by day on national level, the introduction of the bio slurry as an organic fertilizer can generate highest productivity without spending the money on buying chemical fertilizer.

The bio-gas plant benefited the people to increase agriculture productivity reduces the emission of smoke and improving the quality of life of the people in this area. It has direct benefit to the rural women in respect to the health and education.

All these advantages show the importance of bio-gas. It is found that the use of bio slurry fertilizer is better than the chemical fertilizer. As the study is aimed to see the impact of bio-gas in rural areas and found that the use of slurry (fertilizer) is better than chemical fertilizer in terms of cost and productivity. It is especially beneficial for a poor agrarian economy like ours. It provides a renewable source of energy, when the entire world is today scared of saturation of the non-renewable sources of energy fossil fuel.

This study is help to addressing problems formulating realistic policies and programmes there by bringing about environmental balance, social justice and rural poverty reduction by providing appropriate feedback to concerned agencies. This study has to be thought to bring sustainable energy development of surroundings of the Kanyam VDC of Ilam district.

1.5 Limitations of the Study

This study has its own limitations for lack of time and resources. So, it has based on Kanyam VDC of Ilam district. This study has following limitations;

This study has focus on the domestic biogas system only.

It has only cover Kanyam VDC of Ilam district especially in women issue.

It focus on socio-economic impact of biogas in concerned VDC.

1.6 Organization of the Study

The study is organized in six chapters. The first chapter deals with introduction and general background of the study. The second chapter tells about the

review of the related literatures. Similarly, the third chapter discuss about research methodology. The forth chapter describe the study area and its people. The fifth chapter is concerned with the analysis and interpretation of the data and the last chapter is about the summary, conclusion and recommendation of the study.

CHAPTER- II

LITERATURE REVIEW

There are some books, booklets, bulletin published in the subject bio-gas plant. Most of them are published by foreign writers but only the few books are published by the Nepalese writers. The books of Nepalese writer are not enough for only regarding the bio-gas plant. Among the several books, bulletins are published by both foreign and Nepalese writer. The literature review are collected from selected number of books and related fields.

(GGC profile 2001:7)Biogas is a wet gas as it picks up water vapor from the slurry. Biogas is about 20 percent lighter than air. The main components of biogas are methane which is colorless odorless and test less. But due to the presence of other gases, it gives some smell similar to that of garlic of rotten eggs.

(BSP 2009), Biogas is the mixture of gas produced by methanogenic bacteria while acting upon hide gradable materials in an anaerobic condition. It is mainly compassed 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.

2.1 Renewable energy investment trend

There is a positive trend in investment in renewable energy sector. Generally, a look at renewable energy finance and investment reveals following trends: Analysis of the investment figures reveals that the global investment is growing in all regions, but emerging markets are expected to become the core. Sector preferences reflect the maturity and potential of the technology. Private

investors are becoming more bullish due to favorable policies and supportive political factors. Investment banking firms are showing interest. Venture capital favors clean energy. The bond market is starting to finance wind farms; Market growth looks set to remain study.

2.2 Nepal's policy for promoting investment in energy sector

In Nepal pioneering works in renewable energy sector started with private initiatives. Intermediate Technology Development Group (now Practical Action) helped to transfer micro-hydro technology in Nepal and provided technical assistance to private entrepreneurs. The biogas technology also started with private initiatives. The government and donors came at a later stage. But their involvement in the sector helped to standardise the technology and scale up the dissemination. Currently Nepal's policy for promoting investment in energy sector can be summarised as follows: Nepal has made honest efforts to attract private to invest in renewable energy sector. In micro-hydro, the subsidy provide by the Nepal government with own and donor money covers around 50 percent of the investment cost. The other 50 percent is invested by beneficiary community or private sector entrepreneur. In Biogas sector too about 40 percent cost is covered by the subsidy and the rest by beneficiary households. In case of solar energy, government subsidy covers less than one third of the market cost of the solar panel and the two third cost is born by the subscribing household. The overall policy of the government is to develop and implement innovative financing mechanism and reduce the subsidy and promote private sector financing. In recent period government of Nepal has entered into the carbon trading and the money so earned is planned to invest in financing renewable energy sector.

2.3 Introduction to Biogas sector of Nepal

Biogas technology has become very popular in this region especially in China, India and Nepal. China reported 17 million existing biogas users in 2005, up from previous reports of 12 million. Biogas remains a priority in India, with about 3.8 million household-scale biogas plants now reported installed, up from prior reports of 3.7 million, and 66,000 new plants were expected to be installed from

early April 2005 to April 2006(Renewable Global Status Report 2006). Similarly, the number of biogas users in Nepal has reached to 172,500 as of July, 2007.

The Biogas Support Program (BSP) started in July 1992 with funding from the Directorate General for International Cooperation of the Netherlands (DGIS) of the Netherlands government through the Netherlands Development Organization in Nepal (SNV/N). Kreditanstalt fuer Wiederaufbau of Germany (KfW) also started funding the BSP from Phase–III, which started in March 1997 and lasted in June 2003. Until Phase–III, BSP was directly implemented by SNV/N. The BSP Phase–IV, which covers the period July 2003 to June 2009, is being It has been further estimated that the potential number of technically feasible biogas plants in Nepal are 1.9 million. The geographical distribution of the potential is given in Table 3. Table 3 depicts that out of the total 1.93 million potential plants, 56. 24 percent fall in Terai, 37.36 percent in Hills and the rest in Remote Hills. Until 2006, only 8.08 percent of the total potential has been materialised. In case of remote hills, the achievement is only 0.57 percent of the potential.Source: NBPG (2007) Biogas Sector in Nepal: Highlighting Historical Heights and Present Status 3.3 Present status. The biogas program reached 67 districts and 2,665 Village Development Committees (VDCs) till July 16, 2007, out of 3,913 VDCs in Nepal.

2.4 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 residue and animal wastes (dung cakes). Commercial energy consists of electricity, petroleum product and coal. Petroleum and coal are imported which amounts almost one third of the country's export earning (Mathew and Wim 1999). Energy sources other than traditional and commercial energy, are included in the alternative energy. Nepal has huge potentially of hydropower estimated at 83,000 MW of which 40,000 MW is considered to be technically feasible. But till now, only 400 MW of hydropower has been installed which contributes about 1% of total energy requirement of the country.

Firewood contributes about 78% of total energy consumption, which is mainly consumed in rural Nepal. Forests (which includes community, public, private

forest) and private forms are the sources of firewood. The resources for firewood are depleting due to overexploitation and lack of proper management.Other biomass sources, agricultural residue and animal dung contribute about 10% of energy requirement.Petroleum and coal together makes about 12% of the total consumption. These are completely imported.Sector wise analysis shows that residential sector consumes about 89% of the total energy consumption.

Dr. Poornakanta Adhikari (1996) in report entitled effects of bio-gas on family health, sanitation and nutrition: has evaluated both positive and negative impacts of bio-gas. The positive impacts on health were most significantly reduction on eye diseases, headache, coughing and throat ache. The negative impacts of bio-gas were increased prevalence of mosquito and loss of warmth in house in winter, sanitation conditions and practices were improved and the study reported 62 percent reduction in firewood collection.

According to bio-gas support program (Phase III). The bio-gas technology is one of the viable devices among alternative energy source in the country Nepal. 1,23,395 number of plants are built by BSP – Nepal in the end of fiscal year 2003/004. If this capacity could be utilized in an effective manner. It can fulfill about 10 percent of the country's total energy requirement without adversely effecting the production of the agriculture. Based on the estimated that a total number of 1.9 million domestic bio-gas systems can be installed in Nepal.

According to the final report of bio-gas use survey 2000/001, a bio-gas user household saves 990kg of firewood & 6 liter of kerosene oil per year. The gas production was insufficient of in the winter as reported by majority of the respondents one third of the household are attached their latrines to the bio-gas plants. Above half of the respondents used the slurry in the cultivated land and other uses in gardens. The decrease in occurrence of disease was the positive benefit of bio-gas plant installation. However negative part of installation was increased prevalence of mosquito and some even reported occurrence of typhoid. Most of the household were in the value of male. The major problem in the bio-gas plant is the value problems, high rate of interests, high cost and non-availability of spares, increased prevalence of mosquito.

(Pokharel 2001: 8): Bio-gas promotion has suffered due to the initial capital cost required for the plant, low yield of gases in region with cold climate and low social acceptance of use of gas. The capital cost involved in the stage still discourages the most rural people from making effective use of bio-gas potential. A possible alternative is identified as being the community sized Issues are concerning the mode of community ownership, its organizational form for day to day operations and equitable distribution of the benefits from the byproducts still remains unanswered.

(Shrestha 2002,3)- Bio-gas plant is a device to produce bio-gas. The structure of the plant consists of central pit covered with dome structure. The pit serves as digester and the done serves as gas holder. Animals dung is mixed with water and through by inlet. The dung in the pit is an aerobically digested by the bacteria with generation of gas. The gas bubbles up and collects in the dome which is then supplied to house for its use through the pipeline. After digesting the digested slurry flows outsides through the out let.

2.5 Bio-gas plants in the context of Nepal: An Evaluation

Nepal government encouragement to farmers to install Gobar gas plants. Which makes cooking easier and more convenient. The economic analysis of the community Gobar gas plant showed that the saving in diesel from the dual fuel engine was not so high as expected? The plants are unable to generate enough gas during the winter season. When customer demand for processing grain is very high. Gobar gas plants were constructed for farmers. Who had at least 3-6 large livestock. In addition, low temperature for 3-4 months during the winter brings down gas production to a level just sufficient for cooking once a day. The main technical problem was leakage of gas through the main valve. Individually owned Gobar gas plants are managed by the family's servants. The servants do all the necessary work such as. Collecting dung, mixing with water and feeding.

Win.J.Van.NES (1992:7) stated that the potential number of biogas bridge plants in Nepal is estimation was 13 million, out of which 62 percent more than 8,00,000 plants in Terai, 37 percent or almost 5,00,000 plants in mountain. The most potential district for biogas plants are, Rupandehi, Siraha, Dhanusa, Morang,

Sarlahi, Syanga, Gulmi, Sindhuli, Kothang and Dhanding. It is useful for 4 main areas.

- Individual household unit
- Community units
- Large scale (commercial area)
- Municipal / industrial projects

In each of these cases, the economic feasibility of individual facilities depends largely.

It's potential to bring an economically viable solution to the following problems.

a. Dependence on imported source of energy
b. Deforestation which leads to soil erosion and therefore to a drop in agriculture productivity
c. Providing inexpensive fertilizers to increase food production
d. The disposal of industrial wastes, which cause water pollution
e. The disposal of sanitary wastes, which cause severe public health problems.
f. The weak health status of women of rural women.
g. Economic dependence of women on male.

WECS(1994:95): stated that it is imperative to develop and implement technologies which prevent this important source of farm input from direct burning . In the context, biogas technology has proved to be very successful. Since, it not only produces gas for house hold purpose such as, heating, cooking, lighting and industrial propose such as , generating mechanical power, but also provides good fertilizer in the form of digested slurry with significant nutrient value. Thus, improving the soil fertility of agriculture land.

Sigdel and Das (1990): had done a study entitled “Bio-gas development in Kaski district” in rural context. They had surveyed 13 biogas plants in Leknath V. D.C. The report revealed that there was a growing awareness in this technology as forest saver. People felt that it would be applicable in a semi-urban area where people were richer since majority of the village people suffered from problem of

found capital to repay loan and installation cost was found to be high. Realization of subsidy could be observed.

UN Publication (1979), proceeding of the workshop on biogas and other related energy held at Suva and the seminar on “Rural energy development “ held at Bangkok, Manila, Tehran and Djakarta, under the “Energy development series” deal on the biogas and integrated farming systems and say emphasis. Therefore on the biogas plants especially on possible effects on the rural life there by analyzing direct benefits and indirect social benefit as well. As analysis these plants supply on efficient and clean fuel for cooking and free the rural women from smoke and disease caused by traditional fuels like firewood, dung cakes etc further more, it provides extra time for these women providing them opportunity to earn extra income. Moreover the manure from these plants is superior as compared to farm yard manure. There is almost double amount as much humus in biogas slurry as contained in farmyard manure. This manure doesn’t contain terminative weed seeds: the cost of weeding in the field is lessened and the production increase by 25 to 50y depending on the crop. The indirect social benefits include the advantage of residue from the plants and not attracting the mosquitoes and files. Besides this, biogas technology provides a means of high of hygienic disposal of night soil.

AEPC (2009), Biogas technology is a complete system in itself with its set objectives (cost effective, production of energy and soil nutrient). Factors such as microbes, plant design, construction materials climate, chemical and microbial characteristics of inputs and the inter relationships among these factors influence production of gas in a digester. The slurry from the biogas plant is supposed to be very fertile and its use in agriculture increases the productivity of crop tremendously.

Karki (2001) has implemented the research programme 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 FYMC (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.

Karki, et.al (2002) have to used the study in Dhading district. The study was mainly focused on the adoption of renewable Energy Technology (RET) and its impact on income generating activities. The outcome of this study show that among the five of bridge as outcome of this study show that three among the five of biogas user reported an increase in crop production by 5 to 10 percent due, to the application of bio gas slurry.

Ghimire (1999) has tried to document the benefits of biogas produce by harvesting. The more popular and appropriate renewable energy resource cattle dung and assessed the immediate impact of biogas on respective users. The outcome of the study revealed that the main benefits of biogas plants to its owner was the cooking and lightning facilities that saved a considerable amount of money.

Economic analysis, which is not done in this case, this study has only dealt with the general impact of the biogas plant on the users. In general, biogas plants are found to have very positive impact on the users which is well appreciated by them. The total saving of 1.22 hours/days/family on an average from the installation of biogas plants suggests that it has been successful to lower the family workload.

However, use of other type of renewable energy technology (RET) did not report increase in crop production as experienced by the bio gas users. The bio gas users house hold main income generating activities are agriculture based like vegetable , butter (ghee) and local wine (rakshi) production, fertilizer required for vegetable production has reduced and so the amount of money spending on chemical fertilizer.

Centre for rural technology had carried out a study entitled. “Bio gas latrine project Assessment” for UNICEF. According to the report, attachment of toilet to bio gas has helped in creating better sanitation around the house and improved health of users. The adoption of bio gas technology has result in saving of 12.9 metric ton of fuel wood and it has helped in protecting 108 hector of forest area. Likewise agriculture production has been increased up to 20-25 percent after the use of bio gas slurry (CRT: 1994).

2.6 Bio-gas program

As the popularity of biogas is growing among rural families due to its diverse benefits, it would be expanded since it saves fire wood, reduce dependency on imported energy and there is no negative impact in the people's health. In addition, the use of bio gas plant brings no environmental pollution and the slurry, which came out from the plant as by product is use as the best fertilizer. So, the tenth plan has target of installing a total of 2,00,000 bio gas plant, including 199,500 private bio gas plants and 500 community bio gas plants. Priority are given to suitable and relatively smaller size plants and necessary researches would be carried out for its expansion in the Himalayan region and to reduce costs.

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

For, the collection of fire wood, rural women spent a great part of time furthermore, they spend considerable amount of time in cooking. Another problem of using firewood in kitchen is smoke produced which makes the women suffer from indoor air pollution.

To understand about bio gas provided direct benefit, especially rural area. For reducing work load when shifting from cooking on fire wood. It saves 3 hours time a day per family due to the reduction in time used for collecting fuel-wood, cooking and cleaning utensils.

In spite of the various literatures reviewed in the study site, the researcher himself had made different discussions in this field as the efforts to meet its objective. There are many literatures which are belonged to this topic and the literatures this study had cited were more or less thought to be sufficient and meaningful. This study done in these VDCs of Ilam district is a new despite their large coverage of it. In case of the nature of the literatures, almost all are taken from the national level reports. That is why it can be declared as the outcome of the great effort.

CHAPTER - III

Research Methodology

This chapter presents the framework of the study. It describes how the study completed and what methods used in the time of data agglomeration. In any research study, this chapter deserves important. This study forwarded on the basis of the following methods.

3.1 The Universe and Sample

The study conducted in Kanyam VDC wards 1 to 9, Ilam. There are around 7000 thousand populations in this VDC with consisting 1408 households. Among them, 30 households out of the 105 bio gas users of this VDC has taken as sample in the present study randomly from the bio gas users' households. Out of them including both male and female of different age group chosen by judgmental sampling.

3.2 Research Design

This study designed in an exploratory and descriptive framework to analyze the socio-economic impacts of biogas in Nepal and particularly the rural women of the study area. Descriptive research design is concerned with describing the parties of biogas and the related studies. The explorative research design has been used to explore the impact of installation of biogas on the socio-economic condition of the women of the study area.

3.3 Nature and Source of Data

Both primary and secondary information sources are used for the fulfillment of the objectives of the study to generate primary data. The study based on field survey where as secondary sources of information has collected from the relevant sources, books, published and unpublished documents and other related materials.

3.4 Techniques and Tools of Data Collection

The following data collection tools and techniques are applied in the study;

3.4.1 Interview

Interview schedule is designed for the collection of data. Structured, unstructured and open ended questions are prepared to seek the information on various aspects. Interview schedule is filled as a visiting the particular study area.

3.4.2 Questionnaire

The structured questionnaire are prepared for the information collection of the study area. Both open-ended and closed-ended questions are included. The local persons of the particular area has also be requested to fill up the questionnaire. They helped by the researchers to fill up the answers as they provided in case they could not write.

3.4.3 Interview with Key Informants

The key informants are interviewed for the information to this study. They are the representatives of VDC, biogas companies, local teachers and community development committees of the VDC.

3.4.4 Field Visit and Observation

Field visit and observation method are used to obtain the accurate information. Each household are selected in sampling and visited and observed. The condition of female of the particular area are observed and the data are recorded. The field visit also be done for at least two times during the study.

CHAPTER - IV

DATA PRESENTATION AND ANALYSIS

This chapter basically consists of the presentation and analysis of the data obtained from field survey conducted in 2014. This chapter deals with the socio-economic condition of the biogas plant owners in Kanyam VDC of Ilam district. Occupation, family size, educational status, landholding and caste/ethnicity are the main variables considered in this study.

4.1 Occupation

The main occupation of the plant owners is agriculture. Besides agriculture, agriculture and service and service are the main occupation of plant owners. Major occupations practiced by the sampled households are given in the table 4.1.

Table 4.1: Distribution by Occupation

S.N.	Occupation	No. of Households	Percentage
1.	Agriculture	15	50
2.	Business	2	6.7
3.	Service	3	10
4.	Floriculture	2	6.7
5.	Agro + Service	7	23.3
6.	Animal husbandry	1	3.3
Total		30	100

Source: *Field Survey, 2014*.

Table 4.1 shows that the higher percentage of the plant owners is engaged in agriculture sector. The 50 percent of the plant owners are involved in agriculture in both selected sampled households of the VDC, 23.3 percent in agriculture plus service, 10 percent in service, 6.7 percent in Floriculture, 23.3percent in agriculture plus service and 3.3 percent in animal husbandry. The farmers have more land and more animals for the dung needed for biogas in comparison to the serviceman and

businessman. Besides agriculture, most of the households has secondary source of income as well. They are government service pensions and other business. It supports them economically to fulfill basic requirements.

4.2 Family Size

The result of the survey reveals that average family size of the sampled biogas household is 5.6 Households with maximum number of family members have 9 whereas the minimum number is 3. The family size of the study areas is partly based on the family planning. It has been shown under the table.

Figure 4.1: Distribution by Occupation

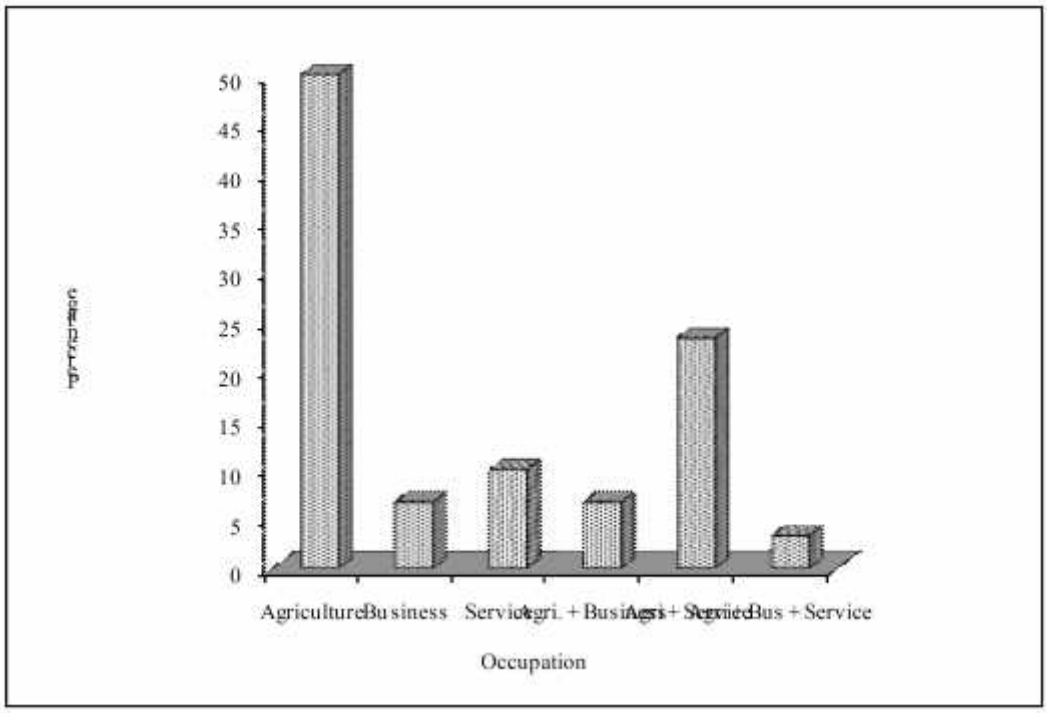


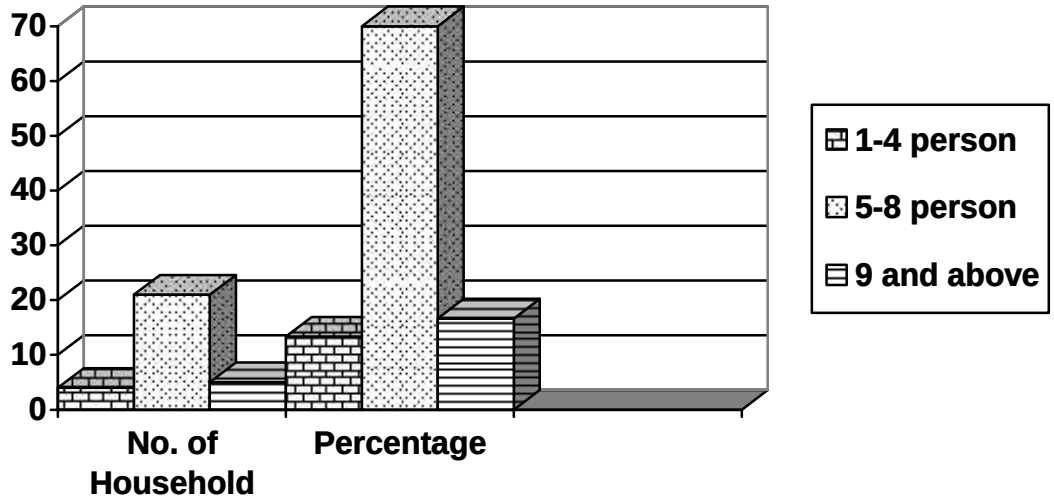
Table 4.2 Distributions of Households by family size

S.N	Family size	No. of Household	Percentage
1	1-4 person	4	13.33
2	5-8 person	21	70.00
3	9 and above	5	16.66
	Total	30	100.00

Source: *Field Survey, 2014.*

Table 4.2 shows that 21 household (70 percent) have 5 to 8 members which is categorized as medium size family. Only 13.33 percent household founds in 1-4 member group and 16.66 percent households founds in 9 and above size group. The percent of people are high in 5-8 family size, group. In the above table also disc rived this figure.

Figure 4. 2 : Distributions of Households by family size



4.3 Caste/Ethnicity

Caste is also counted as the major aspects of development of society. Caste is divided in the past by their occupation and it is also social division. There are different castes and ethnic groups in Kanyam VDC. The data on ethnicity/caste of sampled biogas households is given in Table 4.3.

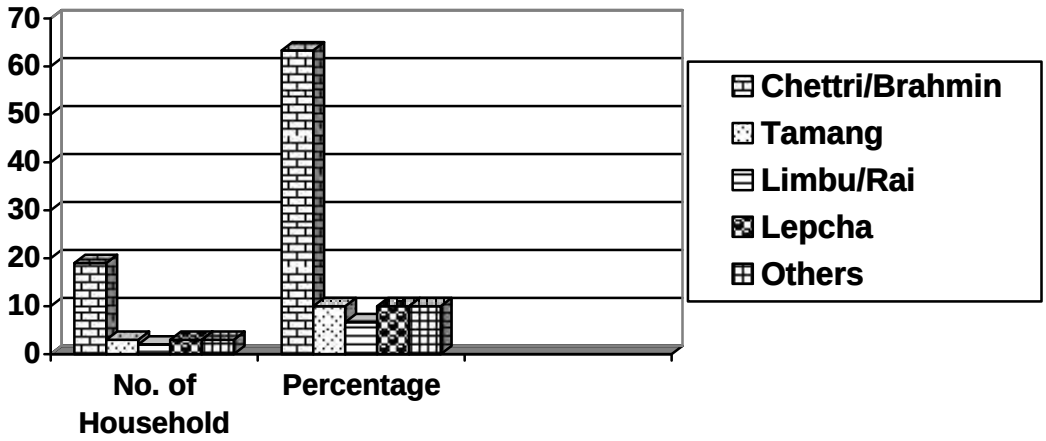
Table 4.3 Ethnicity of sampled Households

S.No.	Ethnicity/Caste	No. of Household	Percent
1	Chettri/Brahmin	19	63.33
2	Tamang	3	10.00
3	Limbu/Rai	2	6.67
4	Lepcha	3	10.00
5	Others	3	10.00
	Total	30	10.00

Source: *Field Survey, 2014*

Table 4.3 shows that the majority of the sampled households under this study Chattri/Brahman (63.3 percent), Tamang (10 percent),Limbu/Rai(6.7 percent), Lepcha (6.7 percent) and Othres(10 percent). The reason for behind the higher percentage of biogas users (Chettris/Brahmins) is found that they are socially & economically forward in every field. In the above table also disc rived this figure.

Figure 4. 3 : Ethnicity of sampled Households



4.4 Land holding Size

The main occupation of plant owners are agriculture, all of them have their own land to cultivate. Only operational land holding has taken into account. It is found that most of the cases, land is cultivated by owners themselves. All the plant owners have their own little land. Land distribution is given in the Table 4.4.

Table 4.4 Distribution of Land holding among sample household

Group	Land area in Ropani	No of Household	percentage
Marginal	Below 10	3	10.00
Small	10 to 30	8	26.66
Medium	30 to 50	15	50.00
Large	50+	4	13.34
	Total	30	100.00

Source: *Field Survey, 2014.*

Land holding pattern is not equal. So, the table 5.4 shows that the land distribution of medium farmers (50percent) is very high. So, most of the owners

have moderate size of land due to the urban prone area. Marginal farmer are 10 percent. Small farmer are 26.66 percent in sampled household. Large no. of land holding (13.34 percent) is low in sampled household. This shows that lard fragmentation ratio is high.

4.5 Educational Status

Most of the plant owners are literate (86.6%). About 23.3 percent owners out of total interviewed have completed class 1 to 5. 40 percent have completed grade 6 to SLC and remaining 23.3 percent of total plant owners have completed grade SLC and above. Table 3 shows the educational status of the sampled plant owners.

Table 4.5 Distribution by Educational Status

S.N.	Education	Male		Female		Total	
1.	Illiterate	1	4.8	3	33.3	4	13.4
2.	1 upto 5 Class	4	19	3	33.4	7	23.3
3.	6 up to SLC	11	52.4	1	11.1	12	40
4.	SLC and above	5	23.8	2	22.2	7	23.3
5	Intermediate	0	0	0	0	0	0
6	Bachelor	0	0	0	0	0	0
Total		21	100	9	100	30	100

Source: *Field Survey, 2014.*

The data presented in table 4.5 reveals that majority of the plant owners are literate (86.6%). Among male 52.4 percent respondents have completed class 6 up to SLC. Among female only 40 percent have completed grade 6 up to SLC. This result shows that only 4 persons (13.4%) are illiterate and they are old. Only 4.8 percent of total illiterate male whereas 33.3 percent are illiterate out of total illiterate female. So, the education status of the plant owner is satisfactory however, intermediate and bachelor completed respondents are zero.

4.6 Size of the Biogas Plant

Many types of Bio-gas plants were introduced in world. Properly used sizes of bio-gas plants are $4m^3$, $6m^3$, $8m^3$, $10m^3$. The factors e.g. capacity of Land

holding, capacity of livestock are the source for determining the size of the plant. Size of the bio-gas plant of sampled households is given in the Table 4.6

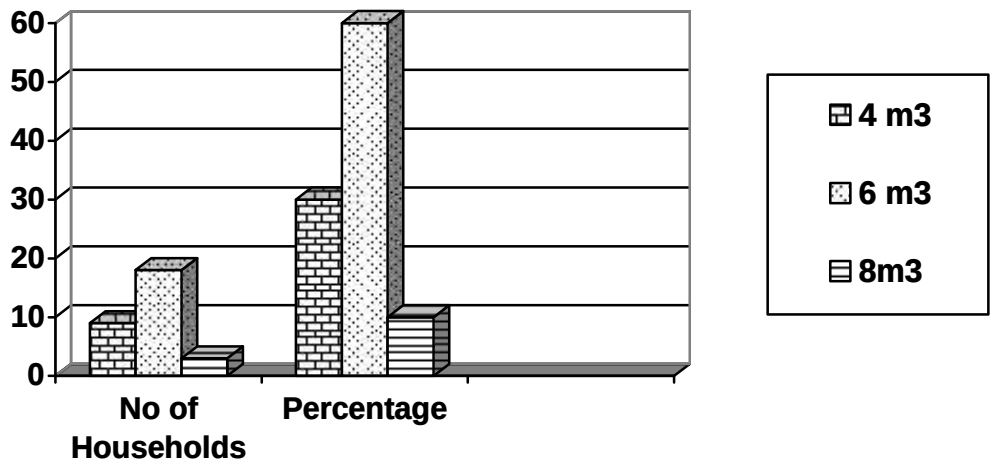
Table 4.6 Size of the biogas plant

S. No	Size of biogas plant	No of Households	Percent
1	4 m^3	9	30.00
2	6 m^3	18	60.00
3	8m^3	3	10.00
	Total	30	100.00

Source: *Field Survey, 2014.*

Sixty percent of the total sampled households in this study area installed 6m^3 Biogas plant. 30.00 percent people in the study area installed 4m^3 Biogas plant. Similarly 10.00 percent people in this study area installed 8m^3 Biogas plant. So, the 6m^3 biogas plants were popular in this area. In the above table also disc rived this figure.

Figure 4.4 : Size of the biogas plant



4.7 Reason for Biogas installation

Biogas technology is being widely used in both the developed and developing economics in agricultural, industrial and municipal waste systems. The main reason for the installation of biogas was to get rid of the firewood collection

and to have easy and smokeless cooking. About three-fifth (60 percent) of the respondents replied that they installed biogas to get rid of firewood collection. While rest of the respondents replied that they installed for easy and smoke less cooking as well as to get rid of firewood collection. It promotes double benefits as to save time and increase production. Besides women empowerment is another attraction to install in these sites.

4.8 Cost

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

4.8.1 Cost of installation

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

- Subsidy from BSP along with World Vision International Nepal
- Self-investment

The average cost for installation of biogas plant was Rupees 16,867. The reason for apparent variation in cost may be the personal contribution made by the respondent during the construction work in the form of labor and construction materials.

The cost of plant made included two factors-subsidy and investment by owner.

4.8.2 Subsidy

In the end of 1999 in Hills rate of subsidy was Rs 10,000. In the end of 2001 in Hills rate of subsidy was Rs 9,000. In the end of 2003 in Mid Hills subsidy Rate for 4 and 6m3 – Rs 9500. In the end of 2003 in Mid Hills subsidy Rate 4 m3 to 8m3 – Rs 8500. In these study area World Vision International has also contributed in cement, sand and tin for toilet attached biogas it shows these areas have got higher subsidy rate in comparison to other.

4.8.3 Self Investment of the Users

Beside subsidy, the respondents had to bear rest of the cost by themselves. Table 4.8.3 shows the source of self-investment for biogas in sampled households.

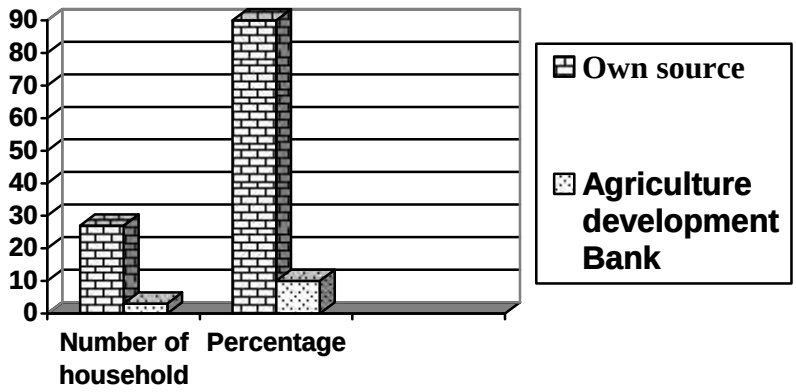
Table 4.7 Source of self-investment for biogas

S. No	Source of self-investment	Number of household	Percent
1	Own source	27	90.00
2	Agriculture development Bank	3	10.00
	Total	30	100.00

Source: *Field Survey, 2014.*

Among, 30 households, 27, (90 percent) of them had their own source for the self- investment part, including loan taken from local money lenders. and 3 household (10 percent) had taken loans from the Agriculture development Bank. In this respect people of this area investment in Bio-gas plant is high in their own resource. In the above table also disc rived this figure.

Figure 4.5 : Source of self-investment for biogas



4.9 Livestock

Livestock serves as the source of dung for biogas plants. Livestock dung is the main raw material for installing biogas plant so all of the plant owners have their own livestock.

4.9.1 Livestock population

Cattle, buffalo and other were considered in the livestock population but the dung of cattle and buffalo were used in biogas waste of other animal dung not used for biogas plant livestock population were given as;

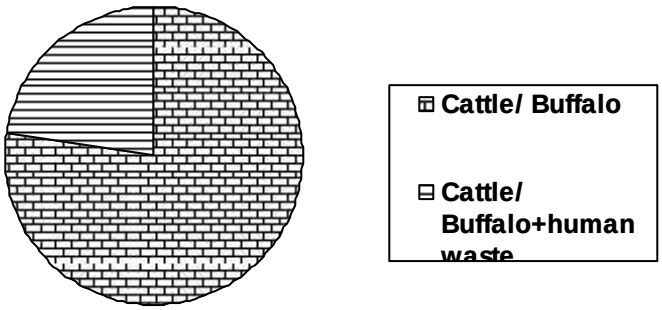
Table 4.8 Livestock Population

S. No.	Livestock	Number	Percent
1	Cattle/ Buffalo	25	77.50
2	Cattle/ Buffalo+human waste	5	22.50
Total		30	100

Source: *Field Survey, 2011*

Table 4.9.1 shows that 770.50 percent sampled household of the plant owners have made the Bio-gas plant using the dung of cattle and buffaloes. 22.50 percent sampled household have made the plant using the cattle- dung and human waste. It means there is mostly mixed type of biogas plant i.e. animal dung with toilet attached. In the above table also disc rived this figure.

Figure 4.6 : Livestock Population



4.9.2 Dung Produced

The raw material for bio-gas plant is dung. Quantity of dung is necessary for producing enough gas. Amount of dung fed was as follows.

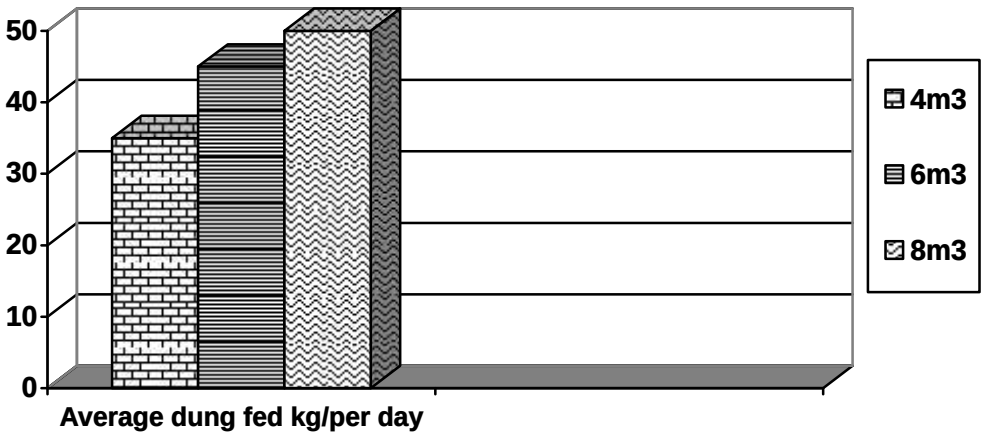
Table 4.9 Dung fed in bio-gas plant

No	Plant size	Average dung fed kg/per day	High/low
1	4m3	35	Slightly high
2	6m3	45	Slightly low
3	8m3	50	Slightly low

Source: *Field Survey, 2014*

This table shows that dung feed in different size biogas plants has various types. In respect to 4m3 biogas plant dung feed is comparatively then other sizes in the sampled households. In the above table also disc rived this figure.

Figure 4.7 : Dung fed in bio-gas plant



4.9.3 Ratio mixing in dung

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 gas will be affected it the amount of water is too low or too high.

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

Table 4.10 Ratio of Mixing

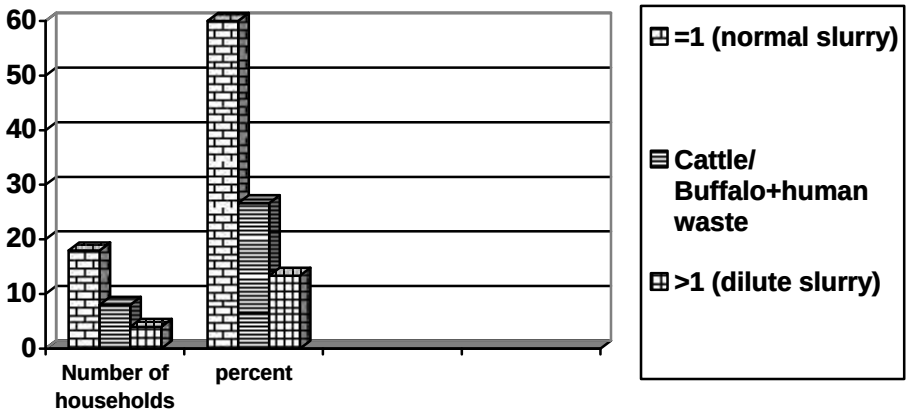
S. No.	Water to dung ratio	No of households	Percent
1	=1 (normal slurry)	18	60.00
2	< 1 (thicker slurry)	8	26.66
3	>1 (dilute slurry)	4	13.33
	Total	30	100.00

Source: *Field Survey, 2014*

The table shows that 60 percent of the households used equal amount of dung and water: 26.66 percent used less then recommended & 13.33 percent used

more then recommended amount of water in slurry. In the above table also disc rived this figure.

Figure 4.8 : Ratio of Mixing



4.10 Use of Biogas

Most of the households used biogas for cooking purpose. So, the finding shows that most of the sampled households had used two burners in their kitchen even though subsidized stove is only one burner. On an average, one household used biogas for 3 hours per burner. The minimum use was 2 hrs while maximum was 5 hrs. This cooking time is less than firewood cooking time.

4.11 Social Impacts of Biogas installation.

This section includes the impacts of biogas in the reduction of workload: use of gained time and impacts of health and sanitation and other impacts.

4.11.1. Reduction in workload and Time saving

After installation of biogas there is reduction in workload of the family members especially for women. The reduction of workload was measured in terms of saving in working time. Observation was made on 3 categories of work such as firewood collection, cooking activities and washing utensils.

Table 4.11 Reduction in workloads and time saving

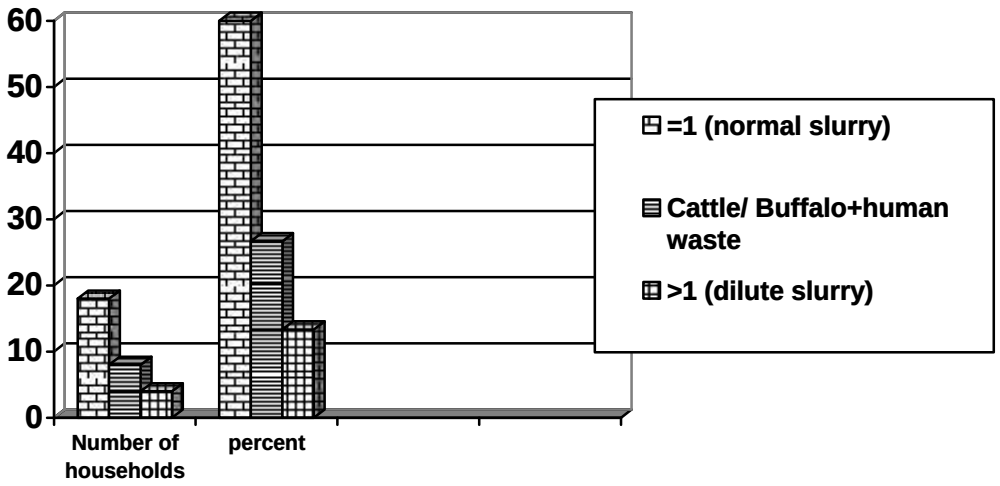
S. No	Category of work	Average time taken hours/day		Reduction in workload (saving in time hrs/day)
		Before installation	After installation	
1	Firewood collection	5.25	3.2	2.05
2	Cooking activities	2.40	1.40	1.00

3	Washing utensils	1.18	0.42	0.36
	Total	8.83	5.02	3.41

Source: *Field Survey, 2014*

Table 4.11.1 shows that saving in time was considerable. It shows that after biogas installation less time spent to collect firewood from the forest. Great amount of time (2.05 hours per day) was saved in firewood collection, Most of the households use firewood and sampled of 4 households used L.P.Gas. Firewood is collected from private and community forest. After installation of biogas the time for firewood collection is reduced. It is clear from this table that high level of time is saved by this biogas plants installation. In the above table also disc rived this figure.

Figure 4.9 : Reduction in workloads and time saving



4.11.2 Time saved in cleaning utensils

All of the biogas users have positive view for time saving in cleaning utensils. Almost all of the member of family said that biogas has resulted that cleaning utensils are very easy and quick because pots are not affected by smoke and do not become black. Before installation of biogas plant cleaning utensils take 40 minutes in average. 30-40 minute time has been saved by per household per day. So, they spent this time in increasing quality of life and social. It enriches the women to participate in different development activities.

4.11.3 Use of Gained time

After installation of biogas, time has been saved. Time saved in firewood collection, cleaning utensils, cooking activities has many positive benefits to the

households. Most of the household have used time for agriculture purpose. Use of gained time is shown in Table.

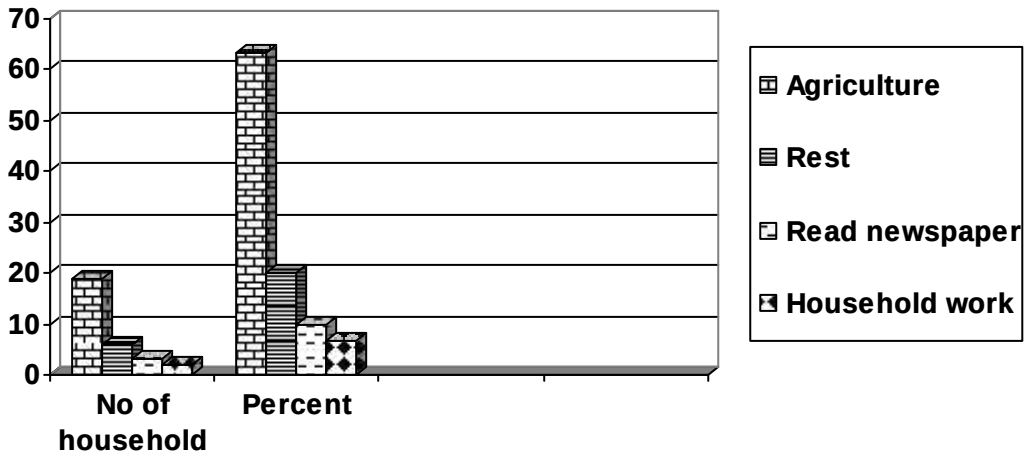
Table 4.12 Specific benefit of the gained time

S.No	Benefits	No of household	Percent
1	Agriculture	19	63.30
2	Rest	6	20.00
3	Read newspaper	3	10.00
4	Household work	2	6.70
	Total	30	100.00

Source: *Field Survey, 2014*

This table shows that (63.3 percent) of the respondents used their gained time in Agricultural purpose. 6.70 percent no of respondent used their gained time in Household work: 20 percent of the respondent use their gained time for rest. Only 10 percent of the respondent use their gained time for read newspaper. In this respect too, women has gained sufficient time to manage in other works. In the above table also disc rived this figure.

Figure 4.10 : Specific benefit of the gained time



4.11.4 Health and sanitation

The study proved that biogas plant has positive impacts towards health and sanitation. Use of latrine, connection of latrine to the biogas, reduction in disease, and change in the prevalence of insects has been dealt in the following sub- sections.

4.11.5. Use of Latrine

Among the surveyed households, 90 percent of the households have built latrine, 10 percent household have devoided latrine.

Table 4.13 Use of latrine by the respondents

S. No	Have latrine	No of Households	Percent
1	Yes	27	90.00
2	No	3	10.00
	Total	30	100.00

Source: *Field Survey, 2014.*

Out of 27 households have latrine, 10 percent of the households have no latrine and they use open field instead of latrine. This data shows that, after installation of biogas people are encouraged to use latrine for better sanitation. In the above table also disc rived this figure.

Figure 4.11 : Use of latrine by the respondents

4.11.5.1 Connection of latrine to Biogas plant

Bio gas plants can be connected with the latrine also. It is very amicable to the community clean and providing fuel for preparing the food items. The gas it provides a little bit viable than the animal dung. In the study area, the HHs connected to the latrine in bio-gas plants are shown below.

Table 4.14 Latrine connected to the Biogas plant

S. No	Connection of latrine to Biogas plants	No of Households	Percent

1	Latrine connected	5	16.40
2	Not connected	25	83.40
	Total	30	100

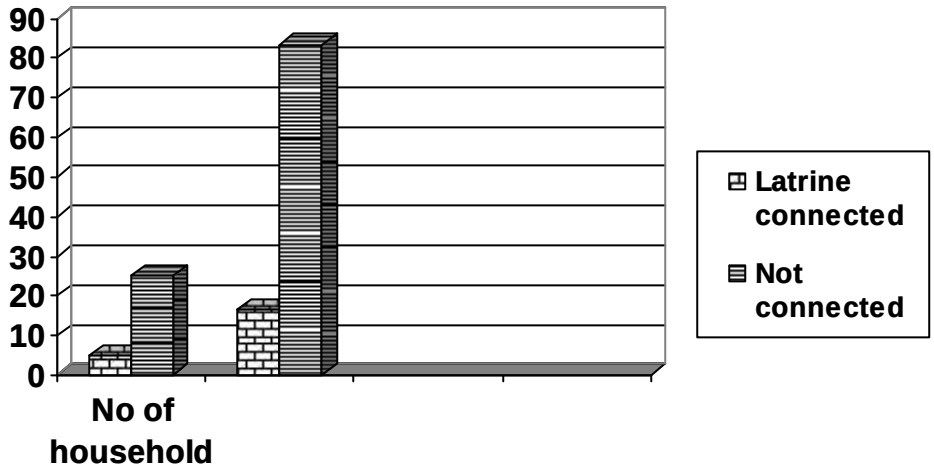
Source: *Field Survey, 2014.*

Only 16.40 percent of the households have connected their latrine to the biogas plants, i.e. they also used human excreta to produce biogas. The rest of households do not connected latrine to biogas plant. Caste does not affect to join latrine in biogas. The reason for not connect to the biogas plant are;

- Gas was sufficient and there was no need to connect.
- Because of tradition and cultural view it is felt unholy
- Felt dirty.

In the above table also disc rived this figure.

Figure 4.12 : Latrine connected to the Biogas plant



4.11.6 Reduction in disease

It is found that there is improvement in the smoke borne diseases such as, illness, eye burn, respiratory problems, headache and diarrhea due to installation of biogas.

Table 4.15 Reduction in disease

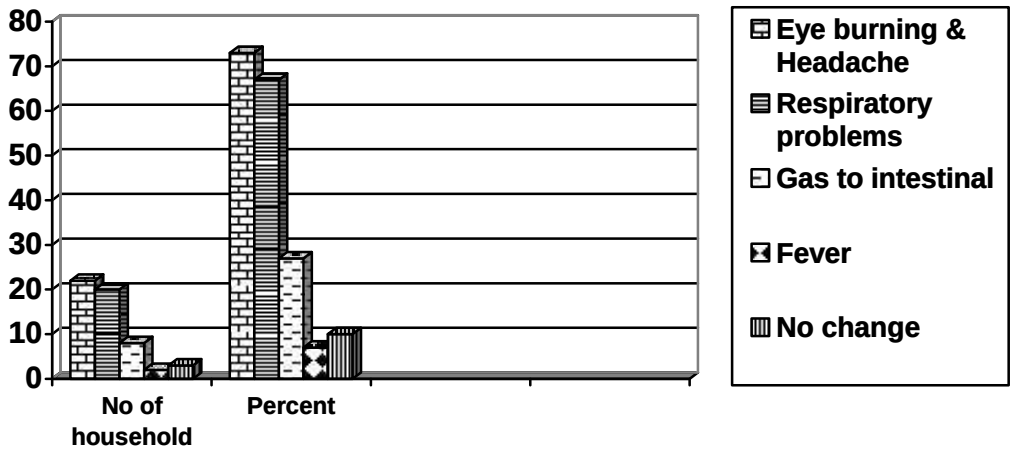
S. No	Illness	No. of households	Percent
1	Eye burning & Headache	22	73.00
2	Respiratory problems	20	67.00
3	Gas to intestinal	8	27.00

4	Fever	2	7.00
5	No change	3	10.00

Source: *Field Survey, 2014.*

Most of the household felt the reduction in eye burning & Headache. The main problem is smoke so the other disease also less affected. In the above table also disc rived this figure.

Figure 4.13 : Reduction in disease



4.11.7 Insect prevalence

Fly and Mosquito are taken for prevalence of insects. Most of the household have reported the change in prevalence of insects only little household did not report and change.

4.11.8 Fly

Production in the prevalence of fly has been reported from the study. 21 households is reported decrease in fly population, still 5 households have reported little increase 4 household felt neither increase nor decrease.

Table 4.16 Effect on Prevalence of fly

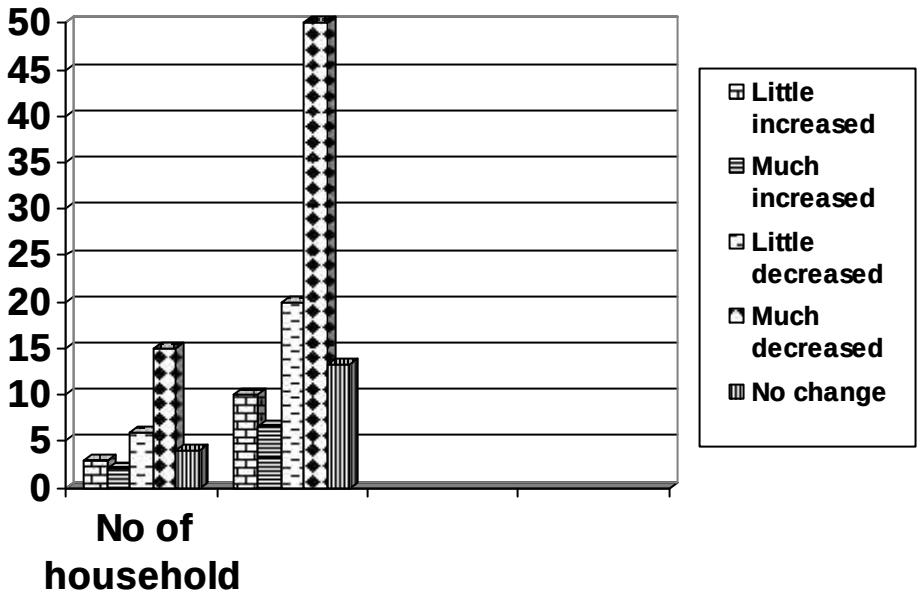
S. No	Fly prevalence	No of households	Percent
1	Little increased	3	10.00
2	Much increased	2	6.66
3	Little decreased	6	20.00

4	Much decreased	15	50.00
5	No change	4	13.33
	Total	30	100.00

Source: *Field Survey, 2014.*

In the above table also disc rived this figure.

Figure 4.14 : Effect on Prevalence of fly



4.11.9 Mosquito

The status of mosquito prevalence after biogas plant installation has been shown in

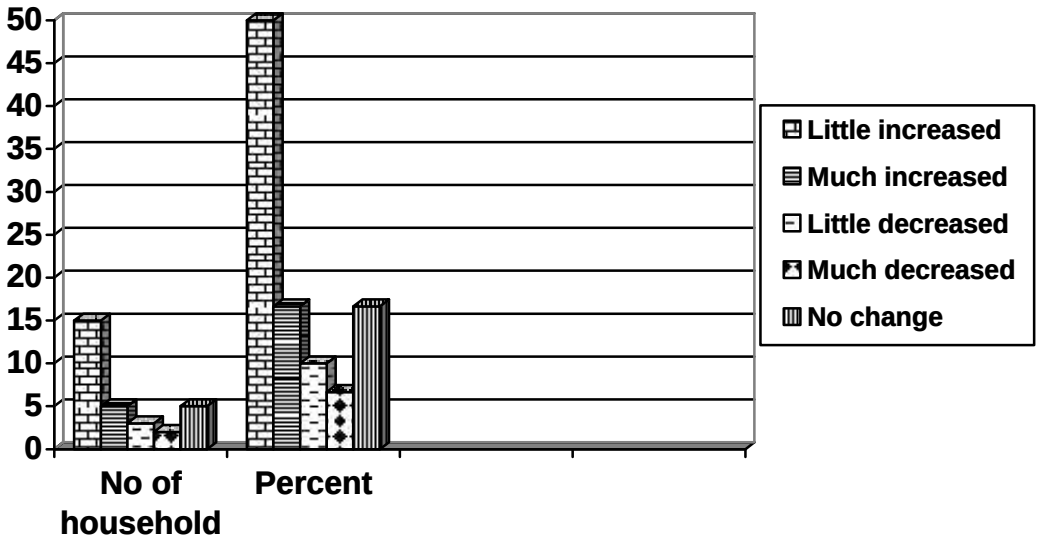
Table 4.17 Effect on Prevalence of Mosquito

S. No	Mosquito prevalence	No of Households	Percent
1	Little increased	15	50.00
2	Much increased	5	16.66
3	Little decreased	3	10.00
4	Much decreased	2	6.66
5	No change	5	16.66
	Total	30	100.00

Source: *Field Survey, 2014*

About 66 percent household reported for increased Mosquito after installation of biogas. 15 percent household reported for decreased prevalence of Mosquito after installation of biogas. 16 percent household reported for not change in prevalence of Mosquito after installation of bio-gas plant. In the above table also disc rived this figure.

Figure 4.15 : Effect on Prevalence of Mosquito



4.12 Economic Impacts of Biogas installation

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

4.12.1 Saving of firewood

Burns firewood, is still the most popular method of cooking, especially in most of the rural areas of Nepal. However in the household with biogas plants, little number of the traditional chulo (hearth) is still used in cooking purpose. As a result, there has been a significant decrease in the use of firewood in the study area. Therefore, the installation of biogas saved firewood.

Table 4.18 Saving of firewood

S. No	Quantity of firewood saved/month	No of Households	Percent
1	1 to 10 bhari	18	60.00

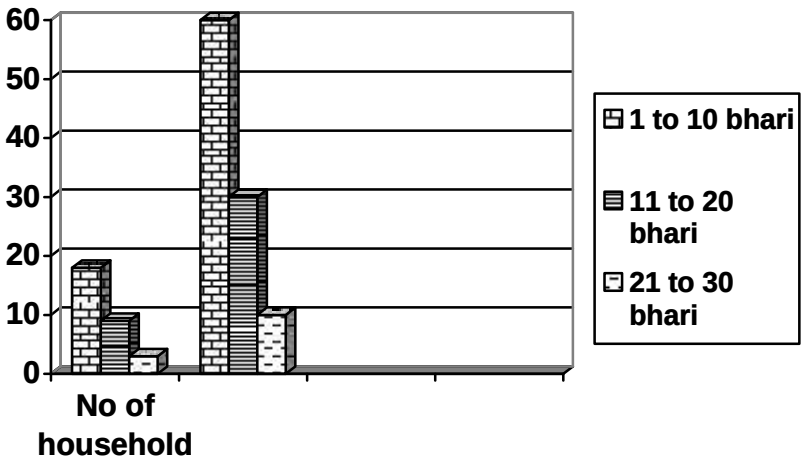
2	11 to 20 bhari	9	30.00
3	21 to 30 bhari	3	10.00
Total		30	100.00

Source: *Field Survey, 2014*.

- 1 Bhari is equivalent to 30kgs.

Table 4.12.1 shows the amount of firewood has been saved after the installation of biogas. Average amount of firewood saved per household is 11.6 Bhari per month. Hence, average monthly saving from the firewood with local pricing Rs 100 per Bhari Rs 1160 per month. In the above table also disc rived this figure.

Figure 4.16 : Saving of firewood



4.12.2 Specific Benefits from saving

The respondents save money from saving of firewood and they use the saving in following purposes.

Table 4.19 Specific benefits from saving

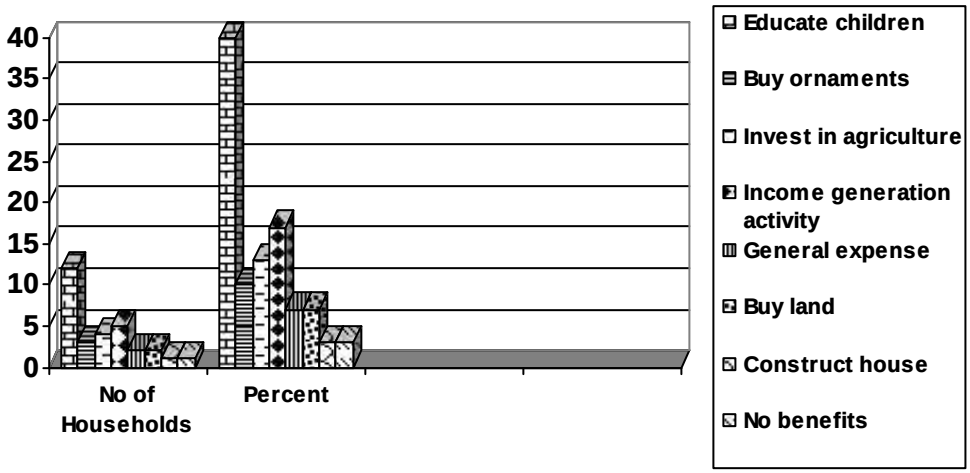
S. No	Specific benefits	No of Households	Percent
1	Educate children	12	40.00
2	Buy ornaments	3	10.00
3	Invest in agriculture	4	13.00
4	Income generation activity	5	17.00
5	General expense	2	7.00

6	Buy land	2	7.00
7	Construct house	1	3.00
8	No benefits	1	3.00
	Total	30	100.00

Source: *Field Survey, 2014.*

This table shows that bio-gas has good contribution in the field of education. 40 percent house holds invest their saving for the purpose of educating their children. Similarly 10 percent use to buy ornaments, 13 percent use to invest in agriculture, 17 percent use for income generation activity, 7 percent use in general expense, 7 percent use in buy land, 3 percent use in construct house & 3 percent do not use the saving money for any purpose. In the above table also disc rived this figure.

Figure 4.17 : Specific benefits from saving



4.13 Impacts of slurry

One of the factors for establishes biogas plant is the production of slurry; this is valuable organic manure for crop farming slurry has nutrients and the insect prevalence is low.

As per norms established by the GGC, the slurry produced from the biogas plant contains 1.6 percent nitrogen, 1.2 percent phosphorous and 1.0 percent potash against 0.5 percent phosphorus and 0.6 percent potash in livestock dung. Biogas slurry is high quality organic manure. The organic contain of the digested slurry

improves the soil texture, stabilizes its humid content, intensities its rate of nutrient depot formation and increases its water hording capacity.

4.13.1 Methods of using slurry on farm

Application of bio-slurry is different from place to place method of bio-slurry are presented in Table

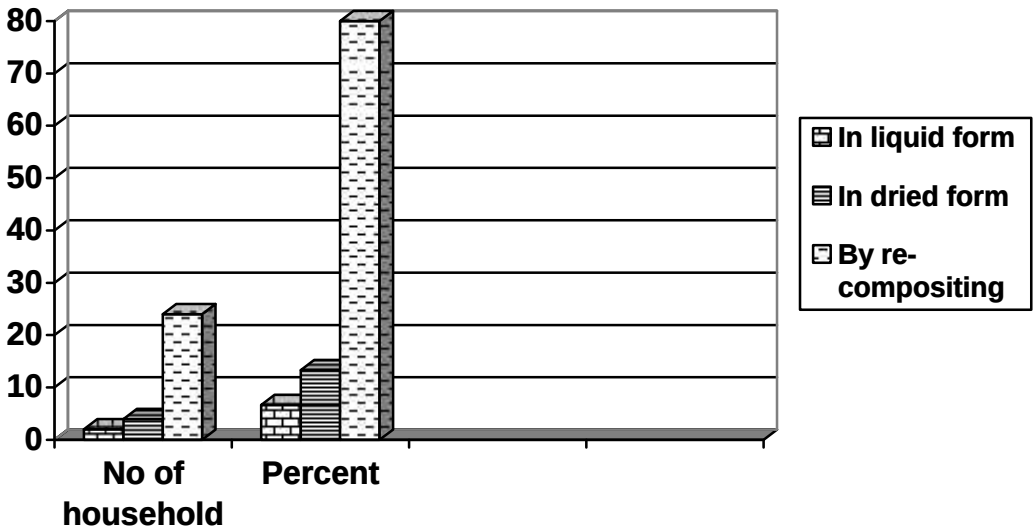
Table 4.20 Methods of Bio-slurry Applied

S. No	Method of Application	No of Households	Percent
1	In liquid form	2	6.66
2	In dried form	4	13.33
3	By re-compositing	24	80.00
	Total	30	100.00

Source: *Field Survey, 2014*

The above table shows that 80 percent people use slurry by re-compositing, 13.33 percent used slurry in dried form, and 6.66 percent used slurry in Liquid form. Less than 7 percent farmers only use slurry in liquid form. Slurry in liquid form is the best practice from the point of view of conservation of plant nutrients but this practice has a limitation for wider adaptability due to difficulty of transporting to the fields. In the above table also disc rived this figure.

Figure 4.18 : Methods of Bio-slurry Applied



4.13.2 Bio slurry generation and its agricultural application

The digested slurry can be used as manure in the fields. Many of the farmers used slurry for increasing crop production. The fact calculations are not possible. Use of slurry saved money; otherwise it saves money for buying chemical fertilizer.

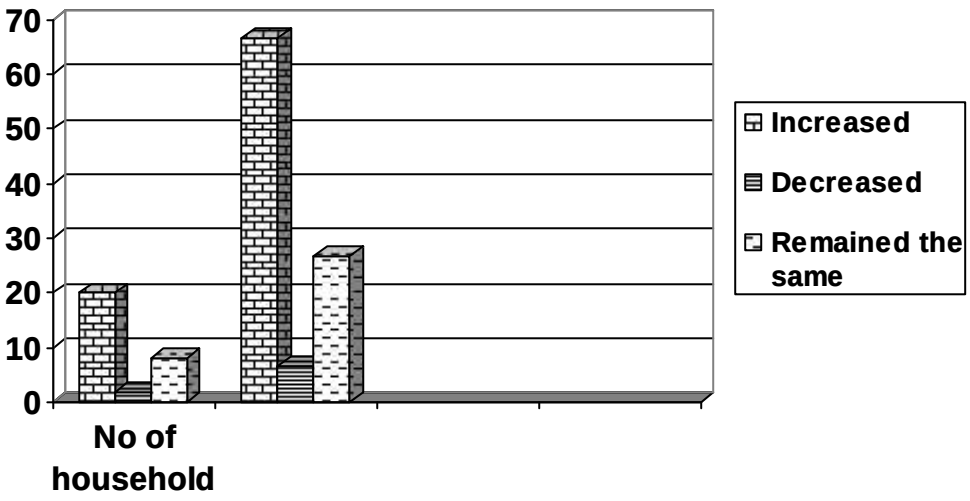
Table 4.21 Slurry and production

S. No	Agriculture	No of households	Percent
1	Increased	20	66.66
2	Decreased	2	6.66
3	Remained the same	8	26.66
	Total	30	100.00

Source: *Field Survey, 2014.*

This table shows that, 66.66 percent household felt that increasing in crop production, 26.66 percent percentage household felt agriculture production is remained same only 6.66 percent household felt about decreased. In the above table also disc rived this figure.

Figure 4.19 : Slurry and production



CHAPTER - V

MAJOR FINDING, CONCLUSION AND RECOMMENDATION

5.1 Major Findings

In the study area, total households are 1408 and total Biogas users are only 105. The selected households are 30.

- The result of the study indicated that Brahmans and Chhetri 63 percent dominate the installation followed by others. This survey revealed that marginal and small farmers have also installed Biogas. The data shows Brahman and Chhetri represent more installation then other caste. In this case we know that there are more households installation biogas of highest caste group in the study area.
- Population of the age of 25-29 was largest with 16.19 percent of the total population and smallest population within the age group of 55-59 and above 60 which represented 2.83 per cent each of the total population.
- In this study area data has shown that size of 6cu.m Biogas plant is more popular in the area compared to others. All the sampled plant owners have connected toilet with Biog gas. Basically, number of family member, less economy, no necessary more animals showed the people to install size of 6 cu.m.
- Most of the respondent 50 percent have agriculture as their occupation rest of the respondent 50 percent have other occupation as the source of income they are business 20 percent office 15 percent and teacher 15 percent. The beneficiation using slurry and keeping animal husbandry focused to the farmer 50 percent installation or more than other occupation.
- The data shows that one family consumes average 5 bhari (150 kg) firewood per month before installation of Biogas. One family consumes average 1 bhari (30 Kg.) of firewood per month after the installation Biogas. So,

average saving amount of firewood saving per family is 4 bhari (120 Kg.) per month. Therefore, considerable amount of firewood 1440 kg /hh/ year and is saved per family after the installation of Biogas plant. Hence, average annual saving from the firewood with local pricing of Rs. 100 per bhari amount Rs 4800 in monetary value. In the study area, there are 160 Biogas household, which have saved about 230400 kg. of firewood per year. Therefore, installation of Bio gas has considerably helped protection the environment and forest depletion.

- The impact of Biogas on the time allocation to biogas related activities are found to be positive in the sense that there is an overall saving in time because of plant installation. The study revealed that a family saved on 2.50 hrs per day after the installation of biogas plant. Time saving was observed in cooking cleaning of cooking vessels, collection and transportation of fuel wood.
- Additional time was imposed to collection water to feed the Biogas plant. There were no significant time differences in other Biogas related activities such as cattle raising collection of dung and transportation of manure to field before and after the installation of biogas plant.
- 80 percent of the total household respondents answered that they did experience significant tame saving.
- Those who experienced time replied that the saved time have been using in number of ways such as 40 percent domestic activities followed by 30 percent in agriculture activities., 15 percent in income generation and social working and taking rest both have 7.5 percent each.
- The study suggested that rural women revels have an opportunity to decide themselves what to do with the saved time. In subsistence agricultural economic time was found to be reallocated to activities that benefited the family unit and it is within this unit that to choices were made.
- All of the users allocated first priority to cooking as regards the use of product Biogas. When asked if they satisfied with Biogas cooking, 80 percent replied that they are fully satisfied, 15 percent told they are partially satisfied and remaining 5 percent told they are not satisfied. As regard, the

food cooked in biogas in comparison to that cooked in firewood. 75 percent of the total respondent said that it is same and 25 percent of them told it to be less tasty. It was felt that taste of food has nothing to do with the user's level of satisfaction. In other words, it was given less importance.

- All the respondents who replied in favor of the biogas working expressed great satisfaction with cooking aspects of Biogas. According to them, the main benefit of cooking in biogas was easy and comfort in cooking. They also responded that they were how freed from smoke borne diseases as they cook in smoke free environment.
- Most of the plants owners 98 percent replied that they use slurry form Bio gas plant in farm, the slurry was told to be used (sun-dried), compost 93 percent and the remaining 7 percent are used liquid.
- It is well accepted by the users that Biogas plants installation substantially helps to improve general health condition of the recipient family member. They informed that there were visible implications on personal health and general sanitary condition of the surrounding after the installation of Biogas plants.

5.2. Conclusion

Bio Gas technology, one of the clean energy technology in being popular in recent years in Nepal especially in rural areas where each and every household keep cattle and buffaloes. The popularities of Biogas in rural area lies in the fact that it enables an effective utilization of locally available resources. The present study has shown that biogas has been gaining popularity as an appropriate alternative source of domestic energy. Bio gas is a low cost technology, which is affordable to local environment in a sustainable manner. The study is conducted of Kanyam VDC of Ilam District. Society of this area is of mixed type where the people of all caste, ethnic groups and religions are living highly respecting each other’s customs, rituals, festivals and religions. Each and every group of people has their own honorable identity in the society. Its northeast Bio Gas as alternative energy source is being flourished in Kanyam VDC of Ilam district, which has a significant potentiality. The particular area is chosen for the study because it is easily accessible and heterogeneous in geographical socio-economic, cultural structure though the Bio

Gas plants installation is increasing, it seems mostly confined to the higher class and caste people. The poor and scheduled caste people have not equally benefited from the technology. Thus, the area is selected to causes and relationship of Bio Gas technology and to make to pro-poor. Nepal has better options and resources potential for the development of renewable energy. It can be development without destroying the environmental condition. Bio gas energy is emerging as the major contributor in the current renewable energy resources development. The outcome of the study has suggest that the ma in benefit of biogas plant to its owners is cooking facility that has saved a considerable amount of money, hence average annual saving form the firewood with local pricing of Rs. 100 per bhari amount Rs. 4800 in monetary value. So, installation of Biogas has considerably helped and protection the environment and forest depletion. Even the constructed Biogas condition by caste seemed vast different in number. The data shows Brahman and Chhetri represent more installation then other caste. In this case I know th at there are more households installation biogas of highest caste group in t he study area. BSP has introduced various size of Biogas plant. People can install appropriate Biogas plant on the basis of dung availability and demand of energy. Generally, many people install size Biogas plant. The majority of the households have adopted 6 cu.m. sized Biogas plant which shared 50 percent of the total plants. The size 6 cu.m. seems suitable for middle family, less economy and not necessary more animals to the installation. The survey indicated that almost all the families had agriculture as the main source of income. most of the respondents 50 percent have agriculture as their occupation rest of the respondent 50 percent have other occupations the source of income they are business 20 percent and office and teacher 15 percent each. The population of the study area has been settled a conglomeration of different caste and ethnic group such as Brahman, Chhetri, Tamang, Newar and Limbu. Most of the plant owners are associated with small to medium land holding along with larger land holding. This is a positive indicator of the effectiveness of Biogas programme in the area to reach the poor strata of the population. Thus, it can be concluded from the finding that most of the respondents have good access to land. Biogas plant is used directly for cooking purpose by connecting gas pipe to a stove. Among the study households 90 percent of them use two Biogas stoves while remaining 10 percent household use

one stove. The sampled Biogas user replied that the average cooking time was 3.5 hours/ day before installing Biogas. In most of the cases, women are responsible to clean the cooking as well as other vessels. In few cases, children and men are responsible for it women have reported that they used to spend about one our fo r cleaning vessel in a day before the installation of Biogas plant. The time required has decreased to about half an hour (30 minutes) after the installation.

This indicated their high level of awareness. The use of Biogas in the study area is limited to cooking human foods. People were found using firewood for heating purpose and spite of the availability of gas. When Biogas slurry composed stored handled and applied properly, it is considered to be high nutrient value. But there is a trend of improper handling of slurry and lack of composting practice. All of the sampled plant owners replied that they use slurry in farms as organic fertilizer. It was found that after the Bio gas installation; time of the gas holding children at home to read ha s increased. Because of the Biogas, workload of schooling children have been reduced, and they are inverting the saving time in reading and writing task. The study shows that installation of Bio Gas plant is very profitable in the study area .This is known by high internal rates of return, both financial and economic. The impact of biogas on household economic is not tangible and hence the users after feel in significant impact. The result of study indicates that biogas has saved a considerable amount of tie while cooking, cleaning their house, clothes. They have been utilizing the saved tine by engaging in income generating activities, taking care of children, by engaging in social and political activities and watching television or entertainments. Plant installation is itself considered to be social prestige. Biogas reduces desertification, and improves lowering of water table because of saving of the forest saving of the forest. So it is an environment friendly. Thus, the development of Biogas technology would be a milestone in the overall development of rural areas. It can cut down the use of both imported and traditional energy sources.

5.3 Recommendations

Considering the general findings of the study the following recommendations have been proposed for the future development of Bio-gas technology in the rural area in particular and throughout the country in general.

- Biogas technology is still expensive; the study shows that mostly Brahman and Chhetri have much benefited from Biogas technology compared to other caste. It does not seem fair from equity point of view, as every ethnic group needs to be provided equal opportunities to reap the fruit of development.
- It has been seen that farmers do not know proper utilization of slurry from Biogas plants therefore method of preparing compost and utilization in their land crops increase the production.
- Effective awareness programme should be lunched for the capacity utilization of biogas plant such as slurry management, utilization and so on.
- The poor and deprived of people should be the target focus group. Financial supports should be provided for them to install Biogas plants and side-by-side income generating programs should be promoted.
- Special plans, policies, strategies and programs at the local level to built up for Biogas energy development in the rural areas.
- Biogas Company should provide regular supervision and monitoring of the biogas plants.
- Training should be given to people on the techniques and methods of slurry management of compost preparation.
- Planning for energy development programmers should focus the poorest.
- Majority of Biogas users complained that construction materials are provided for subsidy amount and the biogas companies in comparison to market price overprice these materials. To check such crime, BSP has to make a list of construction, materials with their market price of local area and monitoring and supervision should be made effectively. Bio gas should be diversified to other activities like generation electricity, ruining engines etc.

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Appendix- I

QUESTIONNAIRE FOR THE HOUSEHOLD SURVEY

Personal Information

1. Name of the Respondents:

Caste: Age: Ward No:

Address: Locality:

2. Marital Status:

I Married: ☐ II. Unmarried: ☐ III. Divorced: ☐
IV Widow: ☐ V. Separated: ☐

3. Education:

I. Illiterate: ☐ II. Literate: ☐ III. Primary: ☐

IV Secondary: ☐ V. S.L.C: ☐ VI. Intermediate: ☐

VII. Bachelors: ☐ VIII. Master Degree: ☐

4. Main occupation:

a. Agriculture: ☐ b. Service : ☐ c. Animal Husbandry : ☐

d. Retail Trade and Shop: ☐ e. If other (specify): ☐

5. Household Members

Members	Age	Gender	Education	Primary Occupation	Secondary Occupation

6. Information about Family

I. Nuclear Family (up to 5): ☐
II. Joint Family (6 to 9): ☐
III. Joint family (Large above 10): ☐

7. Household Composition:

I. Total number of Male: ……..
II. Total Number of Female: …….

8. Who is the Head of the Family?

Male: ☐ Female: ☐
Others (Please specify): ☐

9. Specify the Literate Number of your family ?……

10. How did you get energy for cooking before installation of this bio gas plant?

I. Fire wood; ☐ II. Raw animal Dung: ☐ III. Kerosene: ☐

IV. LPG. ☐

11. How much energy do you need a day?

I. One Tons…… II. Half Tons……III. Unknown: …….

12,. Does this plant help to protect forest?

Yes; No…….. Unknown…….

13; How much land does your family possess?……

14. How many livestock have you reared?……..

15 What is the health condition of female after its installation?

I. High …..... II. Moderate…….. III. As it is……..

16. Is women education improved?

I.Yes ;……. II.No……

17. Is your bio-gas installation with toilet or without toilet?…….

18. If without toilet, why don't you use?……..

19. Does it save time to the kitchen? I.Yes ;……. II.No……

20. At present, what is your annual income? ……..

21. Is it improved in income after installation plant?

I.Yes ;……. II.No…… III. Unknown……..…

22. Have you received any incentives to install it?

I.Yes ;……. II.No……

23. If yes, Which project has been supported?

I. World Vision…….. II. BSP…….. III. AEPC……

. IV. If others specify it……..

24. Is it provided gas regularly?

I.Yes ;……. II.No……

25. If no, what is the factor?…….

26. How do you use its slurry?…….

27. Does this slurry increase the production?

I.Yes ;……. II.No…… III. Unknown……..…

28. Does slurry reduce in the use of chemical fertizer?

I. Yes significantly……. II. Moderately……. III Un known…….

29. Do you think this programme is effective in energy generation?……

30. Do you know about deforestation impact in environment?

a. yes b. no c. others

31. Does biogas help to reduce the environment pollution?

a. yes b. no c they are unknown

32. How long you have been using biogas?

a. 10 year b. 7year c. 5 year d.2 year e……

33. What is the size of your biogas plants?

a. 6 m3 b.8m3 c. 10m3

34. How many cattle do you have in your house?

a. cow b. buffalo c. goat d. others

35. Who are most benefited by use of biogas in your home? (you can choose more)

a. males b. females c. children d. others

36. Is there any change of role of women in social activities because of introduction?

of biogas in your house?

a. positive b .negative c. equal

37. What is the change in rural women life style after using biogas?

a. They get more time to involved in social activities.

b. It changed their economic status.

c. It helped improve educational activities.

d. other (if any)…….

38. What kind of social activities are you involved in?

a. informal education b. political activity c. religious activities

d. entrepreneurial activity

39. If you get involved in entrepreneurial activities, what kind of enterprise is it?

a. small grocery b. handicraft c. embroidery d. other……..

40. Which activities did you (women) get engaged before the installation biogas plant?

a. informal education b. political activity c. religious activities

d. others……

41. What problem do you normally face after the installation of biogas plant?

a. ……..

42. If no, what is your suggestion to the policy makers?……

43. If any comments …….

Thank You

Ilam District

Case Study Area

Gaseous matter produced from the organic wastes in Kanyam VDC, Ward No. 4