CHAPTER – ONE

INTRODUCTION

This study is designed to assess the socio-economic impact of bio-gas plant in Dhikurpokhari V.D.C., Kaski. It also examines the effect of bio-gas slurry in agriculture production of the respondents of the study area. Moreover, impact of biogas on the health and sanitation, time and money, saving, special benefits from the saving, have provided additional understanding of the topic.

1.1. General Background

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 27 while it is 81 i 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 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 (RETRUD, 2003).

Bio – gas as an alternative energy, so it is essential in these days. There are so many alternative energy such as hydro power, 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-gas 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) favour 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).

This study is important not only for rural area of country but also the resource management in the nation as a whole. It also helps to formulating policies and strategies in the field of bio-gas technology.

1.2 Historical development of Biogas in world and its potentiality in Nepal

Biogas technology has been gaining popularity now a days as a good alternative source of domestic energy, The origin and development of such popular biogas was used for heating both water in Persia during the 6th century. Marco polo mentions the use of covered sewage tanks. It probably goes back 2000-3000 yrs ago in ancient Chinese literature. In 1808, H.Davy made experiments with strawy manure in a retort in a vacuum and collected biogas. He wasn't interested in the gas but rather rotten or not rotten manure. However, He determined that methane was present in the gases produced during the anaerobic digestion of cattle manure (CES i 2001).

Jan Baptita van Helment first determined in the 17th century that flammable gases could evolve from decaying organic matter. An Italian National count Alessandro Volta concluded in 1776 that there was direct correlation between the amounts of decaying organic matter and amount of inflammable gas produced. He wrote to a friend about combustible air. He wrote that submerged plant materials in the ponds and lakes continuously give off such gas later Volta's gas was shown to identical with methane gas.

It took over hundred years to use the gas for man kind: The plant for methane generation was set up in 1900 in leper asylum in India. Another plant was installed in Indonesia in 1914. Interest in biogas rose very high at the time of beginning of 2nd world war. By 1950, about 1000 biogas plants were built by French German converted their some 90,000 automobiles to run on biogas to save petroleum fuel during the world. The energy crises

followed after the was drew attention of many countries towards biogas (Karmachrya: 1992).

The first bio-gas plant was constructed in Nepal by B.R. Saubolle, a school teacher in 1995 at St. xaviers school, Godavari. In 1968, Khadi and village Industries commission (KVIC). India built a plant for an exhibition in Kathmandu. The agriculture department of HMG/N launched a bio-gas plants construction programmes in a systematic way. During fiscal year 1975/76, which was declared as the "Agriculture year" by His Majesty's Government of Nepal (HMG/N) The Agriculture Development Bank (ADB/N) provided free of interest credit to install 196 plants against a target of 250 of the "drum type" bio-gas plants (New ERA 1985:7).

The development and dissemination of biogas technology in Nepal was initiated in an organized way after the establishment of Gobar Gas Tatha Krishi Yantra Vikash (P.) Ltd. (Gobar Gas company – in short) in 1977 with three main shareholders, the Agriculture Development Bank (ADB/N). The fuel corporation of Nepal (FCN) and united Mission to Nepal (UMN). In 1974, Development & consorting services (DCS) built four floating drum plants of KVIC design. Ever since its establishment the Gobar Gas company has been solely responsible for promoting and installing Gobar gas plants all over Nepal. However, the result of the programme of the company in the initial years was not so encouraging in comparison to its national potentials.

Research on various design of biogas plants such as floating steel dome design, concrete fixed dome design, breasted tunnel design plastic bag bio-digester. Ferro cement gas holder, brick mortar dome and mud dome were tested and experimental at Butwal. Fixed dome design a Chinese

modification plant was introduced in Nepal in 1980. After several modification, fixed dome design, which is more popular in Nepal.

During the period of 1981 to 1986, GGC developed and tested various designs of biogas plants such as floating drum design, fixed dome design, tunnel design. Plastic bag design bio-digester and so on. Similarly, various types of biogas appliances such as gas pipes, mixture machines gas taps, stokes, lamps, water drains, gas meters, agitators, manometers etc were developed modified and tested. Slurry coming from the plant was applied to various croup, e.g. vegetable and cereals. It was also used for feeding fish and animals. However, most of the research on the subject was limited to experiments and papers.

Research was also conducted in the application of gas for running engines for agro-processing, pumping water for irrigation generating electricity especially on community basis until 1986, GGC (Gobar Gas company), installed 60 such plants. But most of them could not continue functioning due to some special problems.

In 1992 BSP was introduced at different stages for massive dissemination of the technology in the country. In 1995, Nepal Biogas promotion group (NBPG) was established as an umbrella organization of all the construction companies.

For the promotion and extension of the program. In 1996, His Majesty's Government of Nepal (HMG/N) setup Alternative energy promotion centre (AEPC) under the Ministry of science and Technology (MOST). The role of

AEPC is as the networking at the central level policy making (GGC profile 2001 i 1,2).

Biogas plant installation is increasing over the years with the government initiation. Government has promoted credit facilities to the people in the provision of land ownership certificated through ADB/N. Government is supporting to various organization and agencies for its development.

As the forest resource is decreasing, threatening the environmental problem, government is being aware to develop the biogas installation activities, including national planning process. Biogas installation program was in corporated in the seventh plan (1986-90) period and the emphasis has been continued even in the tenth plan (2002 – 2007). In this course, HMG/N has made strategies for the further development of biogas. Privatization Policy is becoming the key efforts to the government to increase biogas plants in the country (WECS: 1994/95).

Table 1.1 Subsidy Rate for Biogas Plants

Plant size	Terai Districts	Hill districts	Remote Hill Districts
4 & 6 cubic meter	Rs 5,500	Rs 8,500	Rs 11,500
8 & 10 cubic meter	Rs 5000	Rs 8,000	Rs 11,000

Note: Eighteen low biogas penetration districts receive extra Rs. 500.

The potential for biogas generation is based on the number of cattle and buffaloes. In Nepal, house hold with animals are 27,84,585 and the potential biogas household is 19,37,015 (BSP, 2005), Regarding the potentiality of Biogas is higher in terai then hill, remote hill and mountain.

Source:- Final report on the bio-gas support programme, phase III

1.3. 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 1.2 – Design of biogas plant

Suitable digesting temperature	$20\text{-}35^{0\,c}$
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 = $0.4m^3$gas
Gas requirement for cooking	$0.1\text{-}0.3m^3$/person
Gas requirement for lighting 1 lam	$0.1\text{-}0.15m^3$/h

Source: 2nd National conference on science & tech Ronast: Kathmandu

These type of Gas found in Bio-gas.

Description	Percent (Quantity)
Methane	50-60 percent
CO_2	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

Figure no. 1

Type of dome

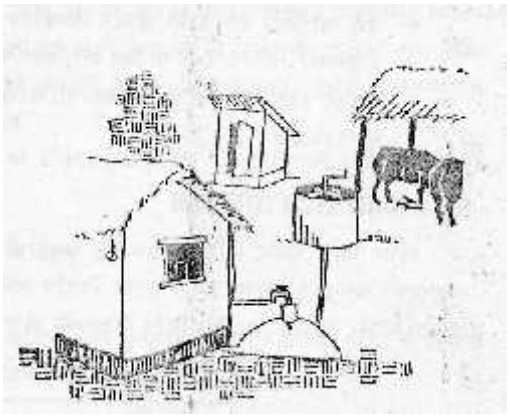
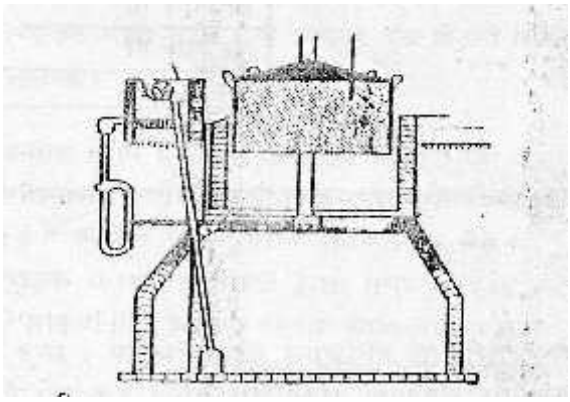


Figure no. 2

Type of drum



1.4 Statement of the Problem

Energy is a critical component of the development process. It is needed in all sphere of life which are directly connected with mans survival progress as in cooking, lighting, heating etc. Many developing countries are facing the problem of energy due to price high of fossil fuel and periodical shortages and international dispute in fuels. More of the houses in rural area are using firewood, animal dung and agriculture residue.

Almost all Nepalese depend on traditional type of cooking stove (chulo) that consume unnecessarily large quantity of firewood. Using firewood causes indiscriminate destruction of the forest resources. It shows that the deforestation results into natural calamities such as, landslides, flood, soil erosion etc.

Consequently, firewood collection consumes more time, more expenditure and ultimately produces ill health of the people. Therefore, people spend life always in poor condition, socially, culturally, economically and environmentally hazardous. Other alternative source of energy such as solar power, wind energy. Micro hydro power are in negligible in use of high cost of installation. To reduce these problems, alternative sources of energy like bio-gas should be utilized. Thus, it is sure that bio-gas technology remains as a major sources of energy in Nepal.

Some part of Nepal, energy is met by direct burning of dung. It also results in food shortages. Dung is obtained by cows, buffaloes, and other animals. It can be best utilized if converted into bio-gas. It is an sustainable renewable

alternative and useful source of energy in Nepal which reduces other expensive and pollution full energy sources.

Some of the reasons for slows progress in biogas Technology.

- Ignorance of the farmers as regards the usefulness of the Technology.
- Easy access to forest in some areas to collect firewood
- Unhealthy competition between recognized biogas plant construction companies
- Unavailability of easy loans to poor farmers due to lack of collateral needed of the bank.
- Difficult and lengthy process of loan sanctioning
- Unavailability of water to feed into biogas digesters.
- Unavailability of land and animals.
- Attitude of farmers not to use gas generated from cattle dung and human excretal cultural and religious taboos.

1.5 Objectives of the study.

The general objective of the study is to analyze the impact of bio-gas plant to its users.

The specific objectives are as follows.

1. To assess the socio-economic characteristics of bio-gas users.
2. To study the bio-gas as an alternate fuel source to forest resources.
3. To study the benefit of biogas slurry.

1.6 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 will be 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.

All these advantages show the importance of bio-gas. It’s 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 will 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 will also help to bring sustainable development of mid hill of Nepal.

1.7 Limitations of the Study

This study has its own limitations for lack of time and money. So, it focuses on the particular area because it has certain limitations which are as following.

1. This study is focus on the domestic bio-gas system only
2. It only covers Dhikurpokhari V.D.C. of Kaski district
3. It focus on socio-economic impact of bio-gas in concerned VDC

1.8 Organization of the study:

The study in total consists of six chapters. The first chapter of the study includes introduction, brief history of biogas and its potentiality in Nepal. Statement of the problem objectives, significance and limitation of the study.

In the second chapter, literature review is presented. The third chapter include methodology, where research design, nature and sources of data techniques of data collection, selection of the study area, brief introduction of the study area, the sample and sampling procedure, and method of data analysis are given.

Socio-economic and demographic characteristics of the respondents are given in chapter four. Whereas, chapter five discusses the use and impact of biogas, conclusions and recommendations are given in chapter six.

CHAPTER: TWO
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, bulletin are published by both foreign and Nepalese writer. The literature review will be collect from selected number of books and related fields.

(BSP 2005)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.

(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 component of biogas is 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.

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 in the value problems, high rate of interests, high cost and non-availability of spares, increased prevalence of mosquito.

(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.

(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 by products still remain unanswered.

Final evaluation of Nepal India conservation (NICE-1994). The report states that, NICE program was run in five villages of Bardiya district as an around Royal Bardiya National Wild Life Camp with as goal of conservation of environment through bio-gas technology.

Its was a follow-up programmed after introduction of 10 Deenbandhu model bio-gas in 1991. NICE successfully adopted this new Indian model. There were altogether 8o Deen bandhu model plants of size 2,3,4 m^3 installed. In their report a comparison has been given between Deenbandhu model and convention GGC model bio-gas plant. Deenbandhu model is shown to be at least 20 percent cost effective with hydraulic retention time. Performance of the plant was good. The finding were improvement in health and sanitation of the families and lesser load on the near by forest for firewood.

Bio-gas plants in Nepal, An Evaluation

Despite the 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.

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.

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.

Biogas processes for sustainable development by URI Marchaim

They address the human survival, animal and plant population over vast section of our globe. After the challenges of environmental crisis, require a new vision and new diplomacy, new leadership and new policies. In a world, that is daily more complex and economically interdependent. Bio-gas gives more cumulative impact on the poor countries then on the rich.

The benefits of biogas are reduction of odours, reduction or elimination of pathogenic becteria and the use of the environmentally acceptable slurry. Bio-gas technology is also potentially useful in the recycling of nutrients back to the soil. Breaking the various circle of reinfection via drinking water, which is mainly rural areas is untreated. Industrial waste treatment, using anaerobic digestion and biogas technology is also possible. It is also useful for government officials, researchers economic analyst, funding agencies to meet present and future challenges. To meet for soil conservation and enrichment, as folder for fish and animals for pollution reduction in human and animal wastes. It is useful for 4 main areas.

1. Individual household unit
2. Community units

3. Large scale (commercial area)
4. Municipal / industrial projects

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

Its 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.

Sigdel and Das (1990): had done a study entitted “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, 2001 : 1) 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.

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 districts.

The result from the study states that given the overwhelming workloads for women in most part of Nepal the saving in time in the majority of instances is quite significant.

But, it remarks that the introduction of biogas doesn't appear to fundamentally alter the position of women. So called traditional or unequal patterns in the division of labours are sustained, with working women for long hours simply substituting one labour activity for another.

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

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

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.

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, etal (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. 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.

The bio gas technology as suggestion by the study has been helpful in relieving members from daily house hold chores. However, proper skill training needs to be imparted to the beneficiaries for producing marketable production. This of course requires initial capital requirement which these days is readily available from rural lending institutions in view of the above the study has been suggested to implement the bio gas technology in a more intelligent in a more integrated approach in future days.

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)

Policy of Government

Tenth plan

Only 7 percent of the total people living in the rural areas are currently using electricity service generated from sources of alternative energy. While looking into the total national power consumption trend of last five year traditional source of energy is only contributes 80-90 percent while the share of commercial energy is only from 10-14 percent. In totality 77 percent of

the total power consumption is generated from firewood while 9 percent from agriculture by products dung and remaining 14 percent from imported petroleum product, coal and electricity. The per-capita Nepal is equivalent to 336 kg oil energy while per-capita consumption of power from commercial sources is 46 kg oil energy.

Quantities targets

1) Providing electricity services to 12 percent of the rural people from the source of alternative energy. Under this plan, electricity will be supplied to 1000 VDC's.

2) Proving 44 MW energy by installing 2,00,000 biogas plant in 65 district.

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 will be 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 further more, 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 reduction 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.

CHAPTER- THREE

Methodology

This chapter deals about sets of methods which are employed to conduct research. The whole study is carried out the whole primary as well as secondary data. So, the relevant and reliable data made possible only by applying scientific method. This research is mainly devoted to achieve the objective of the study.

3.1 Selection of study area

The present study has been carried out in Dhikurpokhari VDC of Kaski district, which is located in the western development region. The socio-economic status of this district is normal. Main sources of energy are traditional source of energy but in urban area fossil fuel is use properly the present study aims to evaluate the socio-economic impact of bio gas in Dhikur pokhari V.D.C of Kaski district.

The reason for selecting Dhikur pokhari as the study area is that the researcher is familiar to the study area. He is also familiar with the local bio gas companies and the local people. Therefore, by selecting of this area, it is believed that more accurate information could be collected during the study area

3.2 Brief introduction of study area

This study is related to the Dhikurpokhari V.D.C. of Kaski district. The total area of this district is 2017 sq. km. According to the census 2001 the population of Kaski is male 184995, female 165532.

There are 42 VDC, one sub-metro politancity, one municipality in Kaski out of 42 VDC Dhikurpokhari is developed because Phokhara Bagalung highway is connected to VDC. This VDC is situated in VDC the west part of district. The VDC boarders with Kaskikot VDC in the east, Lumle and Salyan VDC in west Bhadura tamagi VDC on south and Dhampus, Hyanija VDC in north. Some part of Lumle agriculture centre(LAC) has located in Dhikuripokhari VDC.

The total household of this VDC is 1687 and total population is 8081. Among which 3741 are male and 4340 female (census, 2001). Table 3.1 presents the ward-wise and sex-wise distribution.

Table 3.1; population of ward wise and sex – wise distribution.

Ward No	Total Households	Population				Total Population
		Male	Percent	Female	percent	
1	211	466	12.45	587	13.52	1053
2	226	492	13.15	557	12.83	1049
3	128	314	8.39	338	7.78	652
4	244	615	16.43	649	14.95	1264
5	261	527	14.08	668	15.39	1195
6	184	398	10.63	430	9.90	828
7	151	314	8.39	359	8.27	673
8	107	220	5.88	276	6.35	496
9	175	395	10.55	476	10.96	871
Total	1687	3741	100.00	4340	100.00	8081

Source: Population census, CBS, 2001

Despite being most of the people in the study area speak Nepali language some ethnic group like Gurung, Thakali speak their own language. Agriculture is the main occupation of people consequently some are involved in business service etc. The major crops of the agriculture are paddy, wheat, maize, millet. This place is very suitable for spent life.

This VDC has been facilitated with 5 high school,(2 government school ,2 English medium school, 1 community school) 18 primary school(17 government, 1 English medium school) one plus two, one campus (affiliated by T.U), one post office, two bank, one police office (now complementary destroy by Maoist conflict)one forest office, one health centre, Agriculture research centre and one veterinary. The major inhabitants of the VDC are Brahaman, Chettry, Damai, Sharki and other ethnic group likes Gurung Thakali etc.

3.3 Research design

The research has been carried out with exploratory research design. In order to fulfill the objectives, information has been collected from the field study, household survey, interview and observation are the main techniques that has been utilized to obtain the information from bio gas users only the bio gas users families have been taken into consideration for interview. Primary as well as secondary data has been utilized. Analysis of data has been made from the averages and percentage.

3.4 Universe and Sample Size

The universe includes all the bio-gas users of the Dhikurpokhari V.D.C. of Kaski sample refers to a part chosen from the population.

Therefore, sample has been taken as the representative of the biogas plants in Dhikurpokhari V.D.C.

There are altogether 120 biogas plants in Dhikurpokhari V.D.C. A total of 30 households with biogas plants has been taken as the sample for the study using simple random sampling with from 9 wards. Sample size of each ward is not homogenous. The name of the owner of biogas plant has been obtained from central office of BSP.

The name of the selected household has been transformed into household survey and the house of these owners have been searched randomly for conducting.

Table 3.2 shows the distribution of total household and sample households of the study area.

Table 3.2 Ward wise Distribution of Sample Size

Ward No	Household with Biogas Plant	Sample size
1	16	4
2	18	4
3	6	1
4	20	5
5	10	3
6	11	3
7	13	3
8	7	2
9	19	4
Total	120	30

Source: Field Survey, 2006.

3.5 Sources of Data

This study aims to bringing the socio-economic information for the Bio-gas users in Kaski at Dhikurpokhari V.D.C. Both primary and secondary data/information has been used. Primary data has been collected through field survey, interview and observation.

Secondary data/information has been used for reviewing the status of previous study. That has been collected from various. Published and unpublished sources Data will be aggregated of facts and numerical.

3.6 Techniques and tools of data collection:

The data used in the study has been collected from field survey Conducted in June 2006. The researcher will follow the certain methods or techniques, to collect data/information. According to the nature of problem, topic information and data vary. These techniques tool or method has been adopted by researcher to carry qualitative information.

3.6.1 Techniques and tools

3.6.1.1 Household Survey

The household survey has been conducted in order to collect qualitative and quantative facts about socio-economic aspect of the users and impact bio-gas. Information also has been collected through discussion with the people. The primary data has been collected from the selected house of V.D.C. Questionnaire has been used as a tool for interviewing the user of biogas plants. The respondent of the household has fill the questionnaire. The nature of study is based on primary source.

3.6.1.2 Key informant interview

The primary data also has been collected from key informant using the structured or unstructured interview method as well as open and close ended questions. The interview has been taken as cross checking for data obtained from interviewing those key informants The key informants are energy

specialist, staff of biogas company, intellectuals of biogas, local biogas user people who are not include for household survey.

3.6.1.3 Field visit and observation.

Each household selected in by randomly. The researcher has been visited and observed directly. Data has been recorded while observing the household who are participants in the programme.

3.6.1.4. Tools-check list

It helps to remember what information s/he has to collect and verify in the field. Here the respondent is not asked to make a choice but to respond to each item on the list.

2.7 Data processing and Analysis

Information collected from questionnaire have been transformed into a master sheet and data is tabulated on the basis of master sheet. Information is grouped, sub-grouped and classified as per the necessity so as to meet the objective. After the completion of data collection data has been processed with the help of computer. It has been analyzed by using manual chart, diagram and classifications of the variables. After analyzing data, it has been carried out to maintain consistency.

CHAPTER: FOUR

SOCIO-ECONOMIC STATUS OF BIOGAS PLANT OWNERS

This chapter deals with the socio-economic condition of the biogas plant owners in Dhikurpokhari V.D.C. caste ethnicity, occupation, family size land holding pattern, livestock population are the main variables considered in this study.

4.1 Caste/Ethnicity

Caste is divided in the past by their occupation and it is also social division. There are different castes and ethnic groups in Dhikurpokhari VDC. The data on ethnicity/caste of sampled biogas households is given in Table 4.1

Table 4.1 Ethnicity of sampled Households

S.No.	Ethnicity/Caste	Number	percent
1	Brahmin	19	63.30
2	Chhetri	6	20.00
3	Gurung	2	6.67
4	Sharki	2	6.67
5	Other	1	3.30
	Total	30	100.00

Source: Field survey, 2006

Table 4.1 shows that the majority of the simpled household under study are Brahman (63.3 percent), Chhetri (20 percent), Gurung (6.7 percent), Sharki (6.7 percent), &the remaining 3.3 percent belong to other castes. The reason

for behind the higher percentage of biogas users (Brahmin) is found that they are socially & economically forward in every field.

4.2 Occupation

Occupation focus man for increasing life standard. The main occupation of plant owners is agriculture. Beside agriculture, service and business are the second main occupation of plant owners occupation of sampled household is given in the table 4.2

Table 4.2 Occupation distribution of Plant owners

S.No	Occupation	No. of Household	percent
1	Agriculture	17	56.76
2	Service	8	26.76
3	Business	5	16.66
Total		30	100.00

Source: Field survey, 2006

This table shows that higher percentage of plant owners are engaged in agriculture sector. About 56 percent of the plant owners are involved in agriculture, 26.66 percent in service 16.66 percent in business besides agriculture, most of the households has secondary source of income as well. They are pensions, business, government job etc. These support them for fulfill their needs and increasing quality of life.

4.3 Family Size

Family size shows about the number of father, mother and children. Small size of family is indicator of happiness life. Distribution of sampled household by family size is given in Table 4.3.

Table 4.3 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, 2006

Table 4.3 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.

4.4 Land holding

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	4	13.33
Small	11 to 20	16	53.33
Medium	20 to 30	6	20.00
Large	10 to above	4	13.33
Total		30	100.00

Source: Field Survey 2006

Land holding pattern is not equal. So, the table 4.4 shows that the land distribution of small farmers (53.33 percent) is very high. So, most of the owners have small size of land due to the small farmers are increase. Marginal farmer are 13.33 percent. Medium farmer are 20 percent in sampled household. Large no. of land holding (13.33 percent) is low in sampled household. This shows that lard fragmentation ratio is high.

CHAPTER: FIVE

Use and Impact of Biogas Plants

5.1 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 is given in the Table 5.1

Table 5.1 Size of the biogas plant

S. No	Size of biogas plant	No of Households	Percent
1	$6m^3$	18	60.00
2	$8m^3$	10	33.33
3	$10m^3$	2	6.66
	Total	30	100.00

Source: Field Survey 2006.

Sixty percent people in this study area installed $6m^3$ Biogas plant. 33.33 percent people in the study area installed $8m^3$ Biogas plant. 6.66 percent people in this study area installed $10m^3$ Biogas plant. So, the $6m^3$ biogas plant were popular in this area.

5.2 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 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.

5.3 Cost

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

5.3.1 Cost of installation

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

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

The average cost for installation of biogas 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 from of labour and construction materials.

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

5.3.2 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 for 8 and 10m3 – Rs 8500. After the time passed subsidy rate also decreased.

5.3.3 Self Investment of the Users

Beside subsidy, the respondents had to bear rest of the cost by themselves. Provision of loan was also available for this purpose through Banks community forest user group, source of self-investment is given in Table.

Table 5.2 Source of self-investment for biogas

S. No	Source of self-investment	Number of household	Percent
1	Own source	5	16.66
2	Community forestry	4	13.33
3	Agriculture development Bank	21	70.00
	Total	30	100.00

Source: Field Survey 2006

Among, 30 households, 5 had their own source for the self- investment part. 4 household had given loan from community forestry and 21 household taken loan from the Agriculture development Bank.

5.4 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.

5.4.1 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 in Table

Table 5.3 Livestock Population

S. No.	Livestock	Number	Percent
1	cattle	28	24.77
2	Buffalo	45	39.82
3	Other (Goat sheep)	40	35.39
	Total	113	100.00

Source: Field Survey 2006

Table 5.3 shows that 39.82 percent sampled household of the plant owners have kept buffaloes. 24.77 percent sampled household of the plant owners have kept cattle, 35.39 percent sampled household of the plant owners have kept other animal. The dung of other animal don't use in plant.

Table 5.4 Distribution of Livestock Among the Households Under Study Area

No of livestock	Total household	percent
1-4	13	43.33
4-8	17	56.66
Total	30	100

Source: Field Survey 2006.

- The total number of cattle, buffalo and other animals include in total no of live stock. The average livestock population per household is 4.

43 percent household has 1-4 livestock and 56.66 percent household has 4-8 livestock in their farm out of 30 household 2 household have kept only buffalo and 4 household has kept 2 buffalo and a cattle.

5.4.2 Dung Produced

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

Table 5.5 Dung fed in bio-gas plant/

No	Plant size	Average dung fed kg/per day	High/low
1	6m3	35	Slightly high
2	8m3	45	Slightly low
3	10m3	50	Slightly low

Source: Field Survey, 2006

Dung feed in $6m^3$ is 35kg/, Dung feed in $8m^3$ is 45 kg and Dung feed in $10m^3$ is 50kg. So the dung feed in $6m^3$ equal to recommended but in $8m^3$ and $10m^3$ is slightly low then recommended.

5.4.3 Ratio Mixing

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 5.6 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, 2006

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.

5.4.4 Use of Biogas

Most of the household used biogas for cooking purpose. So, the finding shows that most of the sampled households had used two burners in their kitchen.

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.

5.5 Social Impacts of Biogas installation.

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

5.5.1. 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 category of works are firewood collection, cooking activities and working utensils.

Table 5.7 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, 2006

Table 5.7 shows that saving in time was considerable. It shows that after biogas installation less time spent for collect firewood from the forest. Great time (2.05 hours per day) was saved in firewood collection, Most of the household use firewood and sampled of 4 household use L.P.Gas. Firewood is collection from private and community forest. After installation of biogas the time for firewood collection is reduced.

5.5.2 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.

5.5.3 Time saved in cooking

Users of biogas plant felt that cooking on biogas stoves consumed time than firewood. Although, users do not express actually time they have saved comparison of time for after and before installation is shown in figure No. 5.7. In comparison of firewood, use of biogas plant made easier and consumed less time in cooking. Biogas stove is smokeless and cleaning utensils were also clear and less time take for clean them. Besides these reason, all member of family easily used Biogas. Cooking for gas stove is easy and smokeless cooking. On the average 1 hours time saved by the plant owners.

5.5.4 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 5.8 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, 2006

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.

5.5.5 - Health and sanitation

The study proves 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 have been deal in this section.

5.5.5.1 Use of Latrine

Among the survey household, 90 percent of the households have built latrine, 10 percent household are devoid of latrine.

Table 5.9 Use of latrine

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, 2006.

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.

5.5.5.2 Connection of latrine to Biogas plant

Table 5.10 Latrine connected to the Biogas plant

S. No	Connection of latrine to Biogas plants	No of Households	Percent
1	Latrine connected	21	70
2	Not connected	6	20
3	Do not have latrine	3	10
	Total	30	100

Source: Field survey, 2006

Only 70 percent of the household have connected their latrine to the biogas plants, i.e. They also used human excreta to produce biogas. 20 percent of household do not connected latrine to biogas plant. Caste is 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.

5.5.5.3 Reduction in disease

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

Table 5.11 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, 2006

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

Most of the household felt by eye burning & Headache. The main problem is smoke so the other disease also less affected.

5.5.5.4 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.

5.5.5.4.1: Fly

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

Table 5.12 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 2006.

5.5.5.4.2 Mosquito

The status of mosquito prevalence after biogas plant installation has been shown in table – 5.13

Table 5.13 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 2006.

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.

5.6 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.

5.6.1 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 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 5.14 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, 2006

- 1 Bhari is equivalent to 30kgs.

Table 5.14 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.

5.6.2 Specific Benefits from saving

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

Table 5.15 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, 2006

This table shows that bio-gas has good contribution in the field of education. 40 percent house hold invest their saving for the purpose of educating their children. Similarly 10percent 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

5.7 Impacts of slurry

One of the factor for establish biogas plant is the production of slurry, this is a 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, 1.2percent 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.

5.7.1 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 5.16 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, 2006

The above table shows that 80 percent people use slurry by re-compositing, 13.33 percent used slurry in dried form, 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.

Table 5.17 Reason for not using slurry in Liquid form

Reason	No of household	Percent
Too wet, difficult to transfer	14	46.70
Not aware of fertilizing value	7	23.30
Do not know application method	4	13.30
Toilet attached, too dirty to handle	5	16.70
Total responses	30	100.00

Source: Field Survey, 2006

This table shows that, about 46.7 percent biogas plant respondents have not used liquid slurry as they felt difficult to transfer in the field, 23.3 percent respondents were not aware of fertilizing value of slurry. 13.3 percent are unaware of the method of application 16.7 percent respondents not used the slurry because the plants are attached to toilet and they are not aware. So they believe in traditional norms and values.

5.7.2 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 5.18 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, 2006

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 agriculture production.

In various crop productions, paddy production has accounted the highest ratio than wheat, maize, oil seed so and other.

So, the slurry reduced the quantity of chemical fertilizer used in the crops.

3.8 Operation and Maintenance

- **Problems**

Biogas energy is an alternative source of energy. It has no all plus point some of are problems for users.

Table 5.19 Problems of bio-gas plant

S. No	Problems	No of household	Percent
1	Less Dung availability	15	50.00
2	Gas Generation not sufficient	12	40.00
3	Operational	3	10.00
	Total	30	100.00

Source: Field Survey 2006

This study shows that 50 percent of the respondents have problem of dung availability, 40 percent of the respondents have problem of gas production because they have little no of livestock pop. So the gas production is also low. 10 percent of the household have the problem of operational. Almost all of the household reported that, low gas production in winter.

Alternative for the insufficiency

Ninety percent of the households used firewood when gas was insufficient 10 percent household use L.P. gas for the insufficiency.

Maintenance service

Only minor maintenance and repair was needed for the biogas plant. So, the users had to experience no regular expenses for the maintenance and repair. Some users had problem of leakage from the main gas valve.

CHAPTER: SIX

FINDINGS, CONCLUSIONS AND RECOMMENDATION

6.1. Main findings

Biogas technology has important place for overall development of the study area. The findings are as follows.

1. The use of biogas is only for cooking and most of the households had built 6m3 biogas plant.
2. There is considerable reduction in workloads of the family member, especially for women. The household save 2.05hrs/daily firewood collection. 1 hrs/daily for cooking activities and 0.36 hrs saving for cleaning utensils.
3. In sampled household the users of biogas felt the reduction of smoke in the kitchen this had induced the frequency of respiratory problems. Induced by 67 percent.
4. Majority of sampled household reported that time has been saved and majority of respondent saved time has been used for agriculture activity (63.3percent)
5. Indoor air pollution of smoke or kerosene fumes had been reduced
6. Majority of sampled users household (70 percent) have felt the decrease in fly prevalence. It is because of clean environment at the surrounding.
7. Breeding of Mosquito has increased significantly in 66.6 percent of the sampled household. It is one of the negative impact of bio-gas plants.

8. Improvement in the indoor air quality and the kitchen surrounding had benefited for the women, elder people and childrens. So, the health impact such as eye infection, presence of respiratory disease and coughing have been reduced significantly.
9. Most of sampled households have saved firewood on each cooking time. The average saving for firewood by the installation of biogas plant per household is accounted Rs 1160 per month.
10. Fuel saving in summer is high compare for winter in the monetary valve. It is because of the insufficiency of gas in winter due to low temperature factor.
11. Sampled household of the plant owners had used slurry on the farm. It was found that 6.66 percent used slurry in liquid form, 13.33 percent used in dried form and 80 percent used the slurry after re-compositing with other waste biomass.
12. Most of the household have toilet facility (90 percent) but (70 percent) toilets were attached to the bio-gas, some of the people did not connect to the toilet because traditional and cultural belief valve and psychological prejudices to use human.
13. Most of the biogas plant owner used the slurry in composted form (80 percent). Application of bio-slurry to the crop has resulted in increased agricultural productivity, which has resulted in monetary gains for them. About 66.66 percent households had experienced the increased agricultural production through the application of bio slurry. However, 6.66% replied that their agricultural production rather decreased after the application of bio slurry in the field. But 26.66 percent household experienced virtually no change in the productivity after the use of bio- slurry as the fertilizer.

6.2 Conclusion

With the help of findings the conclusion have been drawn.

Dhikurpohari VDC lies west to tourist place pokhara. The VDC consists total households of 1687. Only 120 households have unstall bio-gas plant as an alternative fuel source. Out of these 120 HHs, 30 HHs were taken under study to examine the socio-economic impact brought by the bio-gas plant. Households under study use bio-gas mainly for cooking purpose. To gain the economic benefit, most of the households have connected toilet to the bio-gas plant but still few have separate toilet not connected with the plant.

The major advantage the bio-gas plant brought is the reduction of smoke free environment smoke in kitchen are other advantage is that the prevalence of insect has become very low than it was before installation of plant. This smoke free environment in the kitchen improve air quality ultimately leading to improvement in health condition of women because they have to always work in kitchen. Adversely, the installation of biogas plant has significantly increased the problem of mosquitoes.

Installation of bio-gas plant has saved Rs 1160 per household per month. This money was on expense for firewood purchase before installation of the plant. The households are satisfy with the saving they do. Most of the households have used slurry more in recomposition form and less in liquid form (6.66 percent)

6.3 Recommendations

These recommendations have been derived from the present study. It is recommended that the concerned organizations should take necessary steps to implement the recommendations of this study in the coming days.

1) It is found that, all the plant owners have used the gas for cooking purposes. Thus, it is necessary to conduct detail studies about the uses of bio-gas to other income generating sector also.
2) Initiate R&D (Research and Development) for developing low cost models appropriate for the poorest section of the population.
3) The use of human excreta and its advantages must be made known to the installers for this purpose training, seminars and workshop should be induesed regularly .
4) Encouragement should be given to utilize the saved time in the productive sector.
5) Realizing the fact that the use of biogas has lessened the import balance in terms of kerosene and LPG, increment of production and reduced pressure on forest resources. The government should come forward with long-term strategy with special attention to promote this technology in the more elaborative ways.
6) Women are the main user of biogas, special emphasis such as operation, maintenance and installation training has to be given directly to women. Women technicians should get a priority in the rural sector.
7) Importance and benefits of the biogas plant should be broad casted regularly by medium of communication. e.g newspaper, radio, T.V. etc

8) Most of the villagers produce vegetables to sell. Information should be given to them for apply bio-slurry on high valued cercal crops. It may helps to increase the production and income to the concerned people.
9) Cause for increase of mosquito/ flies population due to introduction of biogas should be investigated with necessary solution for the control of mosquito/flies.

10) The responses of crops to the application of different form of slurry should be determined by systematic field trials with adequate number of replications.

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Annex I

Household Survey Questionnaire

1. Demographic Information

1.1 Name of the household head:

1.2 Sex: M/F

1.3 Caste/Ethnicity:

1.4 Ward number:

1.5 Occupation:

1.6 Land holding:…….. ropanies

1.7 Size of family: [ ]male [ ] female

1.8 Main occupation of family

a) Agriculture b) Business

b) Other

2. Information on biogas

2.1 Do you have biogas plant? Yes [ ] No[ ]

2.2 Size of that plant [ ]m^3

2.3 Type of Gobar gas plant?

a) Dome [ ] b) Drum [ ]

2.4 What is the name of your biogas company:

2.5 Reason for installation

a. Easy and smokeless cooking
b. Get rid of firewood collection/dung cake
c. Lighting
d. Save time
e. Increase crop production
f. Conserve environment

2.6 Cost

a. Total cost of biogas installation: Rs
b. Source of your finance
c. Subsidy amount

2.7 Livestock

Animal	Number	Dung produced	Used in biogas
		Per day	Y/N
Cow			
Buffalo			
Other			

2.8 Dung feed per day ……..kg

2.9 Water used for mixing ……..liters

2.10 Uses of biogas

Purpose	Number of burner/mantles	Use hrs/day/unit
Cooking		
Lighting		

2.11 Source of water

a. Well b. River
c. Hand pump d. Canal
e. Tap water f. Others

3. Saving

3.1 Source of energy used before biogas installation

a. Firewood b. Agriculture residue
c. Electricity d. Kerosene
e. Dung cake f. Others
g. L.P. gas

3.2 Source of the energy used after installation

a. Firewood b. Agriculture residue

c. Electricity d. Dung cake

e. L.P. gas f. Others

3.3 Energy consumption

Source of energy	Consumption per month		Saving per month	
	Before installation	After installation	Quantity/kg/d/w/m	Local cost/unit

Yearly income of family? Rs,,,,,,,,,,,,,,,,,,,,,,,,

What specific benefits do you get from the saving

4. Workloads

4.1 How frequently do you feed the biogas plant?

a) Daily b) Alternatively

4.2

Household Activities	Actives person responsible	Time allocated		Time saved/day
		Before inst.	After inst.	
Firewood collection				
Cooking				
Washing utensils				

4.3If yes, what they do in the gained time.

a) Positive work b) Negative work

5. Health and sanitation

5.1 If there any visible change in health and sanitation?

Yes [ ] No [ ]

5.2 Do you have latrine?

Yes [ ] No [ ]

5.3 If yes, when did you make?

a) Before installation b) After installation

5.4 Is it connected to the biogas plant?

Yes [ ] No [ ]

5.5 If not, why? ……

5.6 Has there been reduction in occurrence of disease?

Yes [ ] No [ ]

5.7 If yes, which disease

a) Respiratory b) Gas to intestinal

c) Skin d) ……

5.8 Change in insect prevalence

Insects	Change in prevalence		Extent of change		
	Increase	Decrease	Little	Much	Altogether

5.9 What improvement did you find in your surrounding after installation of biogas plant?

5.10 Do you have any water problem?

a) For household use

b) For biogas

5.11 Beside govar gas stoves do you also have traditional Cholo/other stove/Ageno

6. Slurry use

6.1 Do you use slurry as fertilizer?

Q [ ] Q [ ]

6.2 Slurry production

D	W	M	Y

6.3 How do you use it?

a) Directly b) By re-compositing

c) In dried form? D) With irrigation water

e) Other

6.4 Use of slurry

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

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

7. Problems

7.1 What problems do you face?

a) Operational b) Maintenance

c) Water availability d) Dung availability

e) Gas production f) Other

7.2 How do you manage for the insufficiency?

a) Use firewood (Q) b) Use kerosene (Q)

c) Other (Q)

7.3 What part of biogas plant needs frequent repair?

7.4 How much you spend monthly for maintenance?

7.5 Does your company provide maintenance service after the installation of plat? How frequently?

7.6 Are you satisfied with your biogas company

Yes [ ] No [ ]

7.7 If no, (what are the drawback of company?) do you have any complain about your biogas company?

7.8 Do you have any problem in paying the loan

8. Perception and suggestion

8.1 What is your perception about biogas/energy?

…….

8.2 Do you like to give any suggestion about biogas/plant/benefit/

…….

8.3 Do you suggest to other install the biogas?

……

Annex II

Check list

1) Participant caste

i) Brahmin ii) Chhetri

iii) Sharki iv) Other

2) Size of the biogas plant?

i) $4m^3$ ii) $6m^3$

iii) $8\ m^3$ iv) $10\ m^3$

3) Type of Biogas plant

i) Dome ii) Drum

4) No. of livestock population

i) cattle [ ] ii) buffalo [ ]

iii) other [ ]

5) Environment of surrounding

6) Prevalence of insect and fly

7) Have latrine or not

i) Yes ii) No

8) Connection of Latrine to Biogas plant

i) Yes ii) No

9) Slurry using method

i) Recompositing form ii) Liquid form

iii) Dry form

10) Impact of slurry in agriculture

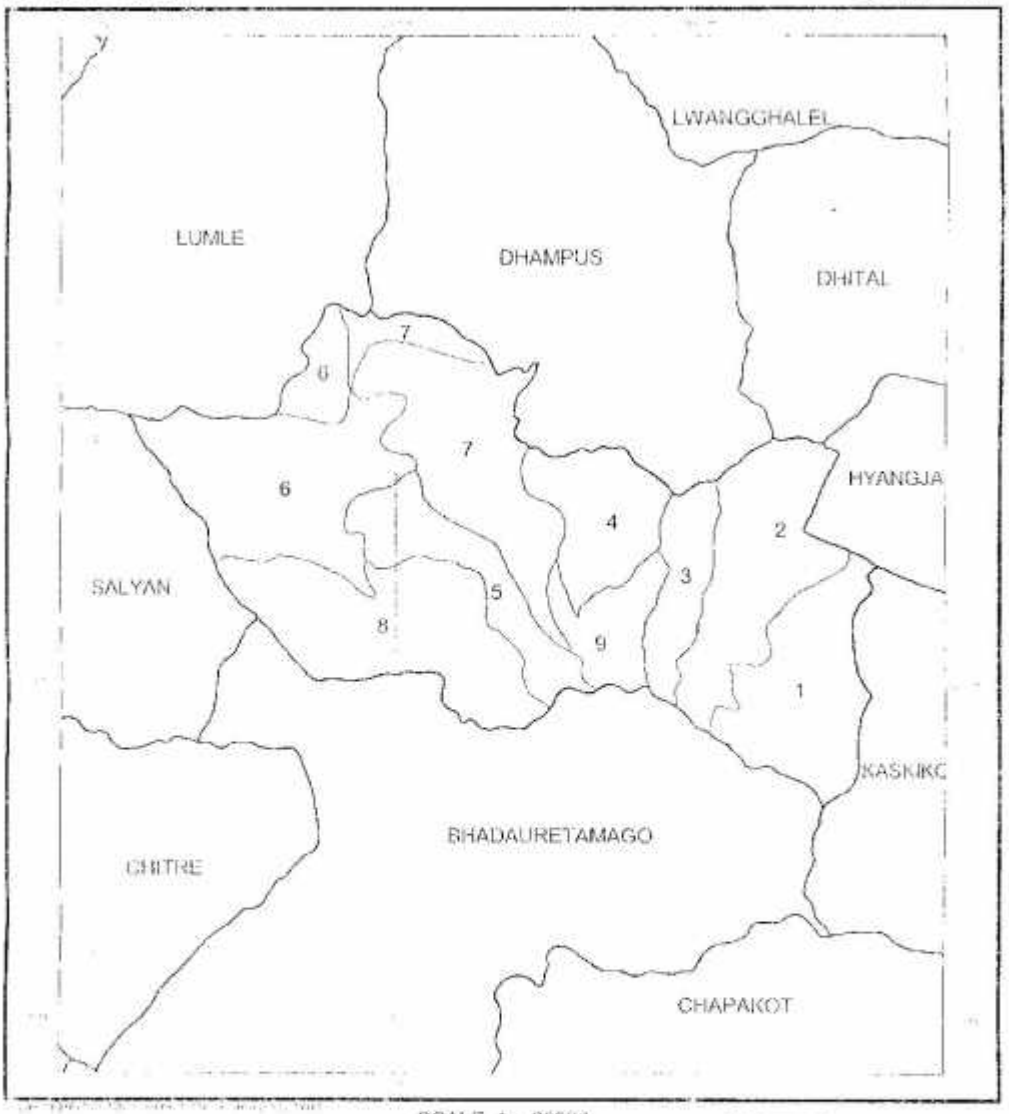
i) Positive ii) Negative

11) After installation of biogas plant socio-economic condition of the bio-gas user.

DHIKURPOKHARI VDC

DISTRICT : KASKI

VDC Code : 39011



SCALE 1 : 60000

LEGEND

VDC Boundary

Ward Boundary

BUKHEL VDC Name

5 Ward Number

DHIKURPOKHARI VDC

Area :23 Sq.Km.(Approx.)

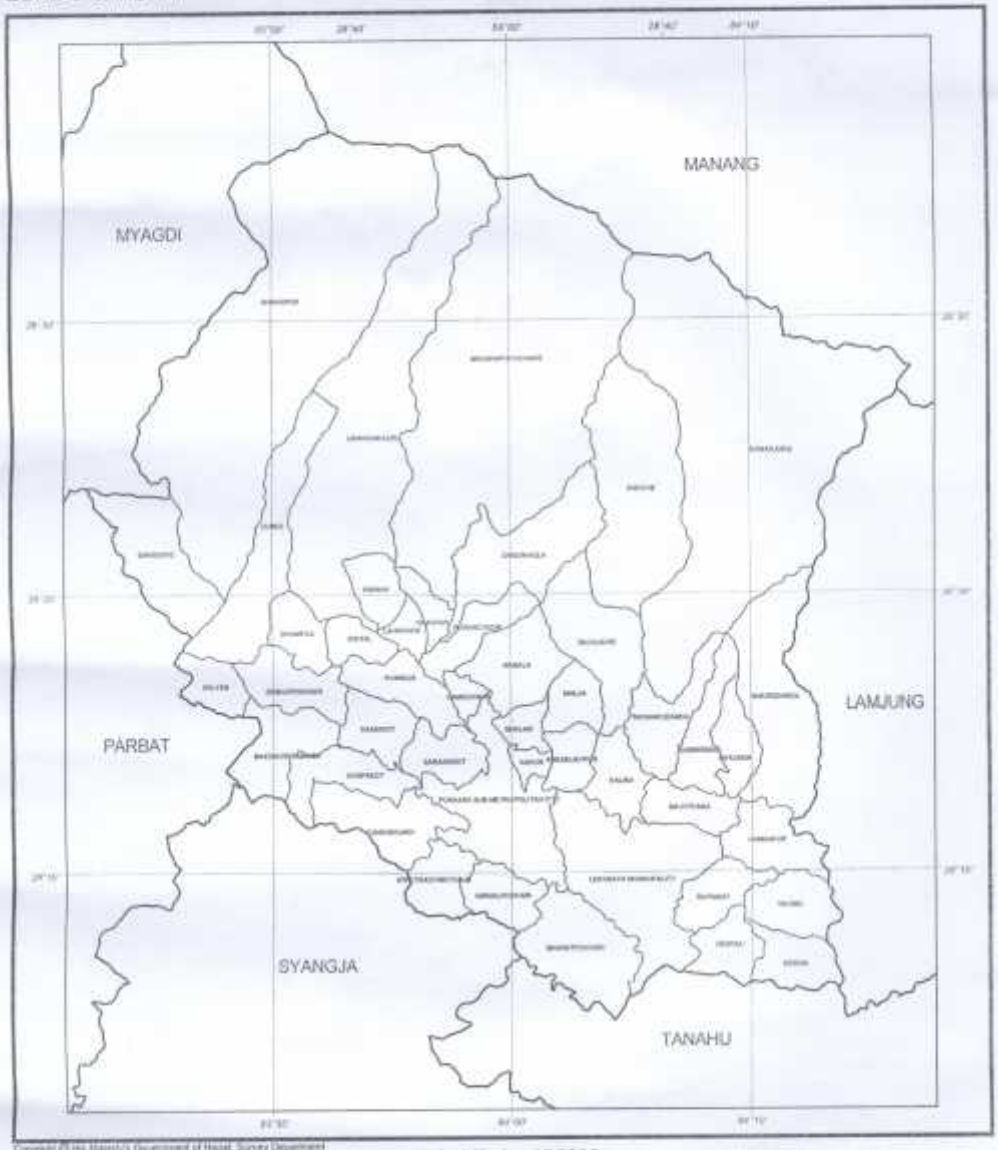
HORIZONTAL DATUM

Projection : MUTM

KASKI DISTRICT

ZONE : GANDAKI

Number of VDCs/Municipalities : 45



SCALE 1 : 375000

7500 0 7500 15000 Meters

LOCATION MAP

LEGEND

- District Boundary
- VDC Boundary
- MORANG — District Name
- VDC Name

Map compiled from National Topographic Database at scale 1:100 000. Internal administrative boundaries are not demarcated on the ground. Map produced by the Survey Department, National Geographic Information Infrastructure Project, (NGIIP) Kathmandu, 2005

DISTRICT : KASKI