CHAPTER 1 : INTRODUCTION

1.1 Background of the Study

Hydroelectricity is basically electrical energy that has been generated using natural forces such as gravity of flowing water. It's usually produced by dams because dams can store and direct large volume of water.

Hydropower has been recognised as a sustainable source of energy with almost zero input cost. Its benefits are that it is non-polluting in the sense that it releases no heat or noxious gases, it has low operating and maintenance cost, its technology offers reliable and flexible operation, and hydropower stations have increased efficiencies along with long life. Nepal's huge potential in hydropower is still untapped. Though Nepal has not yet been able to tap even one percent of its potential electricity capacity and 30 percent of Nepal's population is still deprived of electricity, it is fascinating to note that Nepal's start in 1911 in the hydropower generation almost dates back to a century. As a cheap, renewable source of energy with negligible environmental impacts, small hydropower has an important role to play in Nepal's future energy supply. Accordingly, micro-hydro system is becoming increasingly popular as an energy source in rural Nepal. Use of environmentally friendly technologies and implementation of sound legal and institutional issues are critical to improve the reach of the population to hydropower (MoIC, 2016).

To make the Plan targets in the power sector a reality, directing more resources to the power projects focusing on rural population remains the pre-

requisite. The major strategies of the power sector have been appropriately identified as promoting private sector participation in power generation and distribution, integrating rural electrification with rural economic development programs, and strengthening power infrastructure. The immense role of the power sector in contributing to the generation of broad-based, sustainable and high level of economic growth as well as improving the relative competitiveness of the economy both on a regional and global basis makes it imperative that the programs and activities on power sector development as visualized in the plans and policies be given the utmost urgency, priority and focus.

Hydroelectric power is becoming increasingly popular. The trends of energy consumption is predominated by traditional resources particularly fuel wood. Over utilization of forest create serious environmental problem. Nepalese people are using 300 kg to 900 kg fuel wood per head per year for cooling and heating. Fuel wood consumption in mountain has been estimated 640 kg/person for 1 year while in the Terai region it is 479 kg/person per year. Hydro-projects that generated small amount of mechanical or electrical power up to 100KW are called micro-hydro power. Generally, these projects are classified on the basis of amount of power produced into large, medium, small and micro-hydro (MoE, 2016).

Nepal has great potentiality of 83000 MW and it is estimated that 42000 MW is economically feasible. But nearly 1percent of this potentiality has been explored in Nepal. In Nepal Pharping hydro electricity of 500 KW was the first hydro plant established way back in 1911. This plant was the second hydropower of the south Asian countries. Water resources are immensely

available in Nepal and hydropower is clean renewable energy source. Among this micro-hydropower is more than renewable pollution free, relievable and easily available in the mountain and hillside of Nepal. So micro-hydropower is the best alternative among all the available energy in the context of our country and it compares well with other energy supply technologies on our difficult markets.

Nepal is a developing country. Energy generated from falling water through the use of turbine, is known as hydropower. This power can be used directly to run various machines or can be converted into electricity by using generator. Hydropower in Nepal has been used in two forms i.e. mechanical and electrical. The practice of use of hydropower in the form of mechanical energy in traditional water propelled mills, called *Ghattas,* goes to time immemorial. In Nepal, project up to 100 KW capacities are classified as micro hydro (AEPC, 2010).

Energy has accorded priority to meet sustainable development goal that ensure *Access to Affordable, Reliable, Sustainable and Modern Energy for all***.** Investments are centred on renewable/alternative energy so as to achieve SDG that aims at increasing the share of renewable energy in global energy mix substantially and doubling the global energy efficiency rate by 2030.The traditional sources of energy shares approximately three - fourth of total energy consumption. Likewise, Firewood alone shares two-third of total energy consumption (MoF, 2016).

Micro hydro is generally defined as decentralized small scale water power plant that generates electricity power up to 100KW and serves nearby

households thoughts a local grid for power generation. Micro hydro project have gained huge popularity in developing countries last of four decades.

Nepal is a land-locked country, situated in the Northern hemisphere, known as land of Mt. Everest, and birth place of Buddha which is sandwiched between two neighboring giants China (in the north) and India (in the east, west and south). It stretches in an area of 147,181 sq km, is a land of enormous geographical diversity divided east-west into three distinct ecological zones: the plains on the south, hills and mountains in the middle and the Himalayas on the north. Thousands of rivers and streams that flow north-south bisect the landscape into hundreds of small hills and hillocks. These three regions also display an immense diversity of human settlement patterns, population, land distribution, productive resources and levels of economic development.It is 1127 km far from the nearest point of the sea. It occupies 0.03 percent, of the world, and 0.3 percent of the Asia. Nepal is located in between the latitude of 26°22' to 30°27' North and the longitude of 80°4' East to 88°12' East. The country is rectangular is shaped with the average length of 885 km from east to west and 193km from North and South (MoIC,2016).

Although bestowed with huge hydropower potential, only about 74percent of Nepal's population has access to electricity. In fact, the perennial nature of Nepali rivers and the steep gradient of the country's topography provide ideal conditions for the development of some of the world's largest hydroelectric projects in Nepal. Most of the power plants in Nepal are run-of-river type with energy available in excess of the in-country demand during the monsoon season and deficit during the dry season (NPC, 2016).

It is estimated that 2.27percent of the world's total hydropower potentially is in Nepal (NPC-2002-07). The total potential power of water of Nepal has been estimated roughly about 83,000MW, of which 42,000MW is economically feasible. The annual peak power demand of the Integrated Nepal Power System (INPS) in fiscal year 2016/2017 is estimated to be 1444.06MW. Out of 1444.06MW of peak demand, only 961.2 MW could be supplied and 482.9MW was shed. Again, in the data 961.2MW supplied, 907.6 MW was contributed by NEA's hydro, 53.4 MW by NEA thermal, 100 KW by solar energy , and 350 MW by import (MoIC, 2016).

As of now, all 75 districts of Nepal have access to electricity with reference of Economic Survey 2016/2017. The availability of electricity contributes significantly to the overall development of the country on the one hand, and its consumption reflects the economic condition of the other hands. Therefore, it has become highly important to harness the abundant water resources to generate electricity of the development of Nepal.

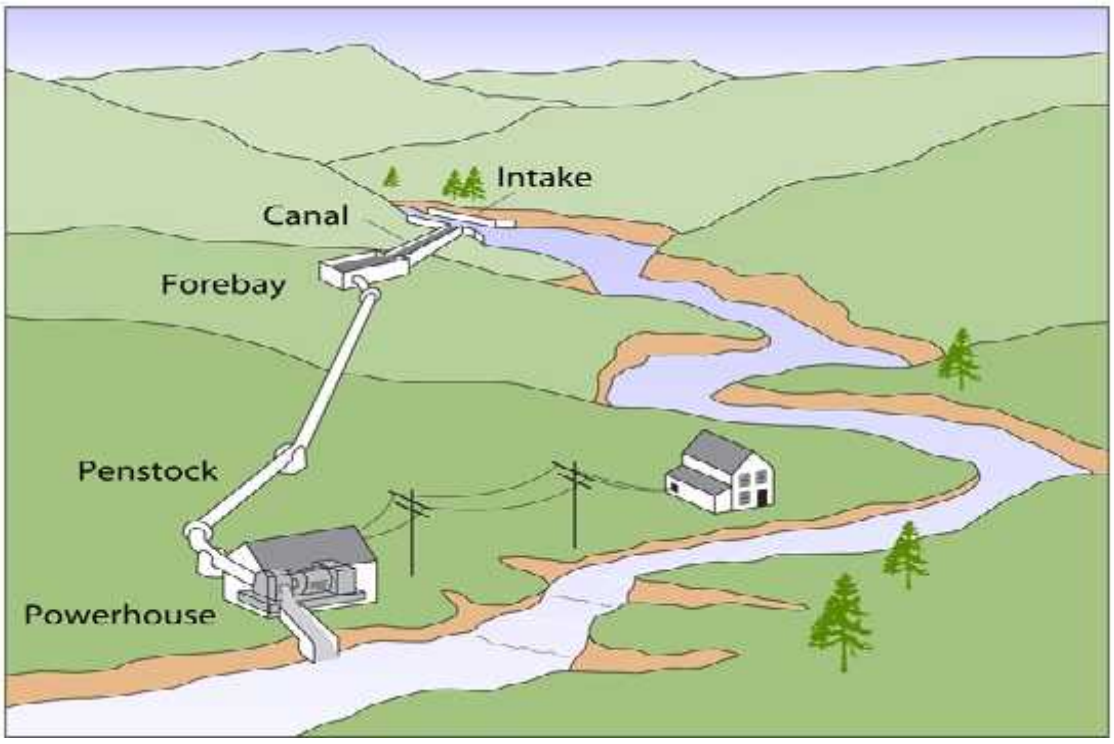
In the present condition of Nepal, energy plays the vital role of fulfilment of resources. It is the primary need for all economic and social development. But very little efforts have been made towards harnessing water resources and developing hydropower. Irrigation, water supply and hydroelectric power are the three prime sectors of water use in Nepal. Hydropower is non-consumptive category of water use.

The strong need of hydropower development in Nepal lies under the fact that hydropower based economic growth can be promoted only when the electricity generated from water is domestically used for "value addition"

and then exported the manufactured goods that will be cheaper or competitive. It is due to lower input price of electrical energy used in manufacturing, which will ensure the fulfilment of the dream of high economic growth rate through the generation of income and employment.

Usually, the trends of energy consumption is predominated by traditional resources particularly fuel wood. Over utilization of forest create serious environmental problem. Nepalese people are using 300 kg to 900 kg fuel wood per head per year for cooling and heating. Fuel wood consumption in mountain has been estimated 640 kg/person for 1 year while in the Terai region it is 479 kg/person per year but the water resources are immensely available in Nepal and hydropower is clean renewable energy source.

Figure 1.1: General Layout of a Micro- Hydropower



Source :- Google

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An investigation of gender and micro hydropower shows that men and women have a different view of the benefits from the plant. For men, the biggest advantages are leisure, quality of life and a better education for the children whereas the women see the advantages in reduced workload, expenditures and an improved health care. Women in developing countries spend much time on domestic duties that are necessary for the family to survive. Often they have to walk long distances to collect fire wood and water. Indoor cooking is done over open fire in bad light, both of which are tiring for their eyes, time-consuming and unhealthy due to all the smoke. The more time women spend cooking and collecting fire wood and water,

the less time they have for children care, education, and income generating activities. The household tasks could be more easily done if they had access to electricity. An electrical water pump could reduce the time and ache of walking far with heavy buckets. Electricity used for light in the household makes cooking and other indoor activities proceed much faster and the light would also give women a chance to study or carry out income generating activities. After sunset outdoors streetlights are a base for a more secure environment. Information and contacts are gained very quickly through information technologies. If children in developing countries should have a chance to find information and get themselves heard it is very important that they can have access to modern technologies in school. Electricity from a micro hydro plant makes it possible to use overhead Projectors, Computers, TV, Video and Radio. Small hydropower plants are less cost effective than large plants since they do not give any direct income from power export. The government is nevertheless positive towards the use of micro hydropower since it gains many advantages for the community, like education, health and security. This is good in theory but since money is needed in many sectors, such as road building, agriculture and forestry, the budget for rural electrification is limited.

Small hydropower is increasingly finding wide application in many countries of the world; both developed and developing. Small hydro-plant offers several advantages in today's energy markets. It has little or adverse environmental impact; effects on stream ecology are minor ideally - a small hydro system may serve other purposes in addition to power such as water supply, flood control, irrigation and recreation (UN-1982). The role of small and micro-hydropower schemes is significant in extending the electric

energy consumption to the rural areas. Due to the unique topography with scattered settlements the national grid electricity expansion has difficulties, so the electrification through micro-hydro is suitable. There are more than 6000 rivers and innumerable rivulets crisscrossing the country. So, micro-hydropower has a great potentiality for fulfilling the energy requirements of rural Nepal to a great extent. Till mid July 2011 in Nepal, 999 micro hydro plants have been installed with 18.65 MW covering 59 districts (AEPC, 2011).

1.2 Statement of the Problem

Many developing countries are facing energy problems due to the higher technological advancement in the field of energy generation. The major problems of energy are raising price of fossils fuel, depleting forest resources including environment degradation, blockade and disturbance in boarder areas etc. Nepal is a diverse feature country. Here are innumerable hills, peaks and mountains. Because of the diverse features of hilly and mountains regions, which are sloppy and many rivers and rivulets flow forcibly from mountains to Terai regions. The hydropower energy is most feasible and alternative energy sources. Nepal is developing country, where 35 percent people live in rural area, so the national grids are not suitable due to its high cost and roughed topography. Furthermore, in the context of Nepal, it is difficult to make the large-scale hydropower, either from the economic point or the unstable political conditions.

Micro-hydro is the most, which is cost effective and feasible in many areas in Nepal. Although there isn’t any obstruction for the construction, we are

failing to construct the micro hydro plants in a desired number in a satisfactory way. Some of the plants are running with low efficiency and some are completely failed during the recent random sample survey conducted on about 20 percent sample of the total plants installed in Nepal, it was known that around 32 percent of the totals MHP are completely failed (NPC 2017).

The pattern of energy consumption is based on tradition resources particularly fuel wood dung, etc. The over exploitation of forest creates sensitive environmental problems, petroleum product are utilized for transportation, operation of machines and so on. The use of petroleum products creates environmental problems and large amount of foreign currency is needed to import the petroleum products. Nepal has limited sources of foreign currency exchange. As a result Nepal has been facing the problem of debt trap deficit and unfavourable balance of payment.

The development activities should go ahead together with local people's needs and their attitude. If the development activities cannot meet their needs and attitude, the project will not continue for a long run. Nepalese economy is based on traditional agriculture system. In addition to agriculture other sectors of economy such as industry, trade and commerce, transportation, communication and tourism are yet to be developed. On the other, absences of infrastructures like road and transmission line hydropower development is not possible.

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Rural people especially women have to spend much of their working hours in collecting fuel woods, students study hours in affected due to the lack of lighting facilities. They may suffer from the eye, and trunk infection.

1.4 Objectives of the Study

The main objective of the study is to evaluate the impact of the micro hydropower projects (MHPs) in rural development on socio economic aspects through income, saving and employment generation and specific objectives of the study are as follows:

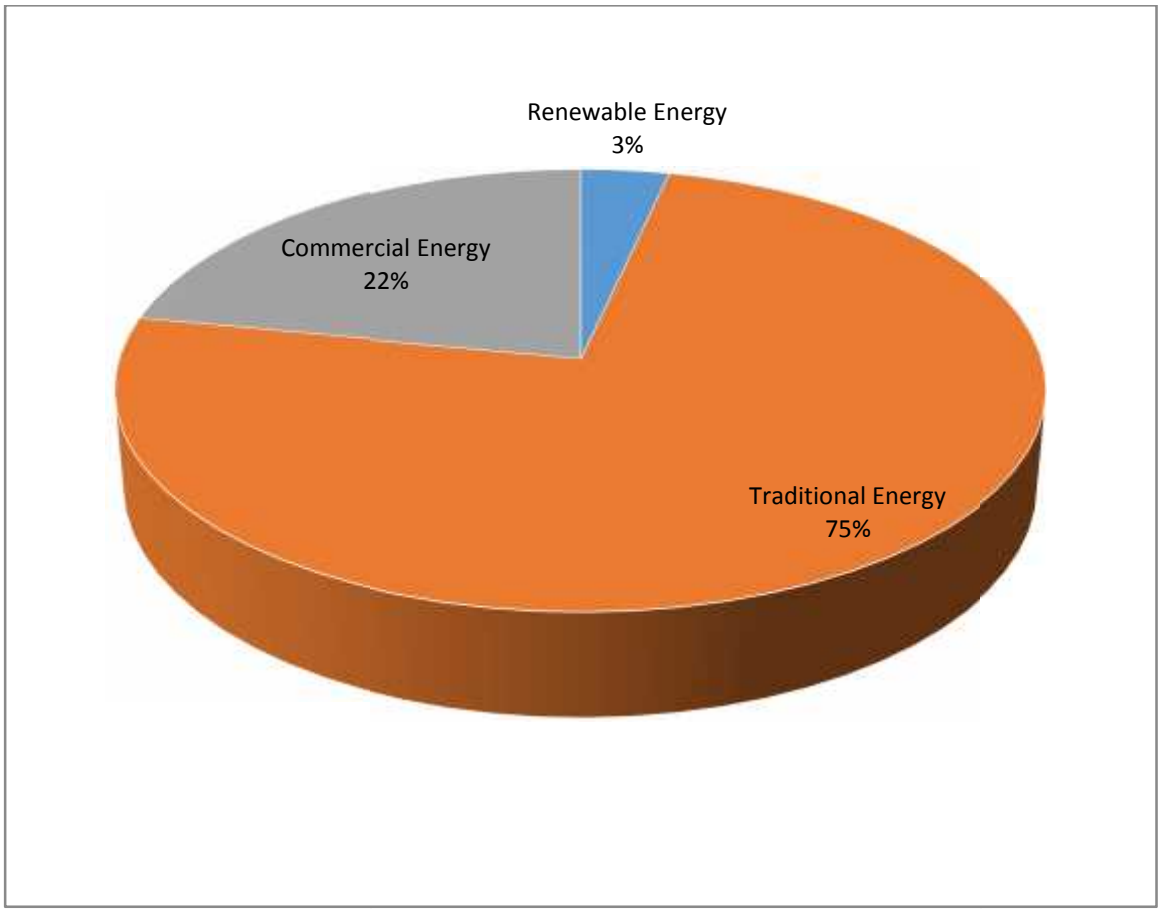
a) To study the increments in the educational level and the technical capacity of the people of Chaunri Deurali Gaupalika -5 of Kavrepalanchowk district.
b) To find out the socio-economic impact of Chaunri Khola Micro - Hydro Project (First) in Chaunri Deurali Gaupalika -5 of Kavrepalanchowk district.
c) To evaluate the problems associated with the MHP and suggest solutions for the sustainable development.
d) To measure the impact of MHE on income and employment generation in Chaunri Deurali Gaupalika Ward No -5 of KavrePalanchowk district.

1.5 Significance of the Study

Micro-hydropower is the most effective and sustainable source of energy in Nepal. It plays a vital role in the overall development of country. In Nepal, there are a lot of water resources. However, due to lack of capital, technical work force and political crisis the mega hydro projects are still not easy and feasible source of energy. In Nepal more than 80 percent population resident in rural area but the mega electricity is focused in only urban area so, more than 80percent of rural population are behind form mega project electricity on the present situation. On this context micro-hydro project will be the remarkable significance to uplift the rural economic by directly and indirectly contributing for employment and income generation.

According to the economic survey of Nepal 2016/2017, the traditional sources of energy shares approximately three fourth of total energy consumption. Likewise, firewood alone shares two-third of total energy consumption. Despite immense potential for generating hydroelectricity, share of electricity to total energy consumption is still very low. The share of electricity to total energy consumption stood at 3.7 percent in FY 2015/16 which grew marginally and reached 4.1 percent by the first eight month of the current FY 2016/17.

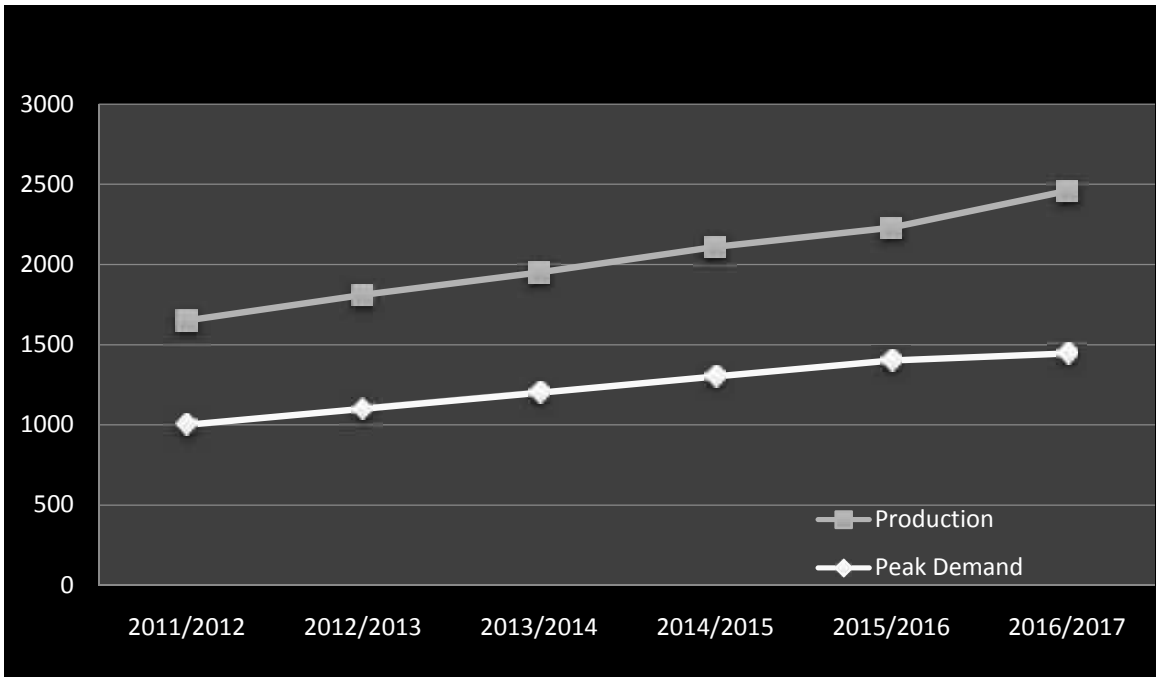
Figure 1.2: Energy Consumption of Nepal



Source:- Economic survey 2016

In the present context of scarcity of fuel wood the other non-renewable energy sources and huge investment of commercial energy sources, the search for alternative energy sources is prominent. In this context, many project have been operated for the project is succeeding in terms of end-use efficiency, how for it effects for the up-lift in the life of rural poor, how far the project is succeeding in the terms of overall socio-economic up-lift of rural people in their perception (ultra poor in particular) are leading issues that have been tried to assess by this study. How the project addresses local people needs and their perception has been significantly studied on it.

Figure 1.3: Gap Between Energy Demand And Supply (In MW)



Source: Ministry Of Energy

Above figure explains the gap between energy demand and supply. The Socio-economic study is undertaken for all hydro projects in order to coordinate with other sectors for the use of electricity. Monitoring and impact study of micro-hydro been under taken to assess the social and economic benefits from electrification such as productivity improvement, employment generation and diversification of products etc. It's often deals with a very broad range of things. Impacts may be felt at the individual level, family level, community level, regional level, national level or even international level.

1.6 Limitation of the Study

This study basically focuses on the socio-economic impacts of the micro-hydro power project in the rural development of Nepal. The budget, manpower, theoretical and methodological limitation during research has

been prevailed for the thesis work. This study has been limited only to micro hydropower, which cannot be generalized especially to other types of plant.

- It is basically based on the socio-economic impact of the micro-hydro power project in the rural development of Chaunri Deurali Deurali Gaupalika Ward No:-5, which may not be applicable on the other Gaupalika of the country.
- The work is based on the academic purposes, so it has certain limitation of budget, time, and skilled manpower.
- This study is particularly based on information from secondary data and field survey suffered from certain limitation.
- This study has been limited only to micro hydropower, which cannot be generalized especially to other types of plant.
- The study narrowed only some limited variables and ignores many variables which may affect on study area.
- The study focused only limited area so the generalization of the study may not reliable to other area.
- It is presented to provide the existing picture of the rural community and help to improve the living standard of the public directly or indirectly.

1.7 Organization of the Study

The first chapter introduces the background of the study. It also addresses the problems, objectives of the study, significance of the study. In chapter second, it focuses on the previous literature relating to the micro-hydropower. In chapter third, it discusses about the methodology which is

going to apply to find out the conclusion of this study. It involves the different tools, techniques, sources of data collection and other analytical tools. Chapter four analyses the data analysis and interpretation. It also discusses the problems and prospect relating to the micro-hydro in rural society of Chauri Deurali Gaupalika-5 of Kavrepalanchowk district. Chapter five concludes the summary of findings, conclusion and recommendations.

CHAPTER 2 : LITERATURE REVIEW

Very few researches have been conducted on energy, and socio-economic impacts of micro-hydro power scheme projects. There are many studies in other sector of micro-hydro projects. Generally, the studies on medium and large, small and micro-scale hydropower projects have been conducted to identify various types of impacts created by the rural development of micro-hydropower projects. . Many publications, reports these dissertations articles on journals newspapers which are related to the hydropower are reviewed in the thesis. Those literatures which are closely related to this research have been reviewed.

2.1 Historical Background of MHP in Nepal

In the modern days, it was only in 1882 that the first hydropower plant was built in Wisconsin, USA. This plant made use of a fast flowing river as its source. Some years later, dams were constructed to create artificial water storage area at the most convenient locations. These dams also controlled the water flow rate to the power station turbines. In Nepal, the first hydropower plant was established at Pharping (500-KW) in 1911, 29 years after the world's first plant was established, during Prime Minister Chandra Shamsher Rana's time to meet the energy requirements of the members of the ruling class. Though some 30 percent of Nepal's population remains deprived of electricity while the capital city continues to thirst for drinking water and suffers from regular load-shedding even at the present, it is fascinating to note that Nepal had such an early start in the hydropower generation. The first hydropower plant in India was established in 1898 in Darjeeling and the

first hydropower plant in China was established in 1912. Originally, hydropower stations were of a small size set up at waterfalls in the vicinity of towns because it was not possible at that time to transmit electrical energy over long distance. The main reason why there has been large-scale use of hydropower is because it can now be transmitted inexpensively over hundreds of km. Where it is required, making hydropower economically viable. Transmission over long distances is carried out by means of high voltage, overhead power lines called transmission lines. The electricity can be transmitted as either alternating current (AC) or direct current (DC). Unlike conventional power stations, which take hours to start up, hydropower stations can begin generating electricity very quickly. This makes them particularly useful for responding to sudden increases in demand for electricity by customers, i.e., peak demand. Hydro stations need only a small staff to operate and maintain them. No fuel is needed to operate, as such; fuel prices do not become a problem. Also, a hydropower scheme uses a renewable source of energy that does not pollute the environment. However, the construction of dams to enable hydropower generation may cause significant environmental damage. In the world today, the highest producers of hydropower are Canada, United States, Brazil, China, Russia, and Norway. Among the various countries, Canada ranks first in the production of hydropower as it has abundant water resources and a geography that provides many opportunities to produce low-cost energy. In fact, accessing the energy from flowing water has played an important role in the economic and social development of Canada for the past three centuries.

Pharping Hydropower: Nepal's First Hydro plant

Pharping Hydropower Plant is one of the oldest hydropower plants of Asia and the first hydropower plant of Nepal. The construction of the plant commenced in 1907 and was commissioned in 1911. The plant was inaugurated by His Late Majesty King Prithvi Bir Bikram Shah on May 1911(Jestha 9, 1968 BS, Monday, at 6:30 PM). In total, 900,050 thousand man-days were required to complete the construction of the plant. The plant was equipped with two turbines each of 250 KW. The water for the generation was tapped from Satmule and Shesh Narayan laying steel pipeline with diameter of 44 inch from Satmule and diameters of 10 inch and 9 inch from Shesh Narayan. A reservoir with 200 ft. diameter and 18 ft. depth with the capacity of 528,733 cu. ft. was built. From the reservoir, riveted steel pipes of 20 inch diameter were used as penstock up to the bifurcation point. An overhead transmission line of 6 miles from the plant to the distribution sub-station at Tundikhel was constructed using steel and wooden poles. In the transmission line, there are two major crossings of 600 ft. and 900 ft. on Bagmati River. The equipment of this plant was a grant from the British Government and other expenditures were borne by Nepal Government. The total cost borne by Nepal Government was CRs.713,273.82, out of which CRs.367,984.00 was spent locally inside Nepal. The breakdown of the total cost (CRs. 713,273.82) was: Pipeline/Headwork/Reservoir CRs.196,324.84, Powerhouse/Colony/Tailrace and Widening of Bagmati River CRs. 156,778.31, Substation/Office/Store CRs. 36,175.80, Transmission Line/Street Light/Distribution Line and Telephone Line CRs.111,049.50, London to Kolkata

Transportation/Packing/Commission to Agent CRs. 28,699.26, Kolkata to Bhimphedi Transportation CRs. 40,311.79, Bhimphedi to Site Transportation CRs. 40,372.32, and Salary/Wages CRs. 103,565.00. The plant was constructed under the overall supervision and monitoring of General Padma Sumsher JBR. Executive Engineer Colonel Kishor Narsingh Rana was responsible for planning of the powerplant (NEA, 2005).

Salient Features of the Plant

1. Turbine: Pelton Turbine, 2 Nos.
2. Governor: Milton Oil Governor
3. Penstock: Riveted Steel pipes of 20” dia. (length 2,538 ft.)
4. Reservoir: 200’ dia. and 18’ deep (capacity 528,733 cu. ft.)
5. Conveyance System Pipeline: 44” dia. from Satmule 10” and 9” dia. from Shesh Narayan
6. Water Pressure at Turbine: 288 lb/sq. inch
7. Transmission Line: Length 6 miles, Support - Steel and Wooden Poles (NEA, 2005).

The history of waterpower in Nepal begins with the traditional water mills (Ghatta) used for grinding flour, however, there is a variety of technologies already available or being developed, which come under the mini and micro hydropower category. Nepal's hydropower potential is estimated to be about 83,000 MW, of which about 42,000 MW is assumed to be economically viable. However these figures relates mainly to large scale hydropower development. Study reports show that 63 out of 75 districts have the potential for hydropower generation. The focus on micro-hydropower came

with starting of subsidy on electrical parts by government and through Agricultural Development Bank-Nepal.

Since centuries the traditional wooden water wheels, popularly known as g*hatta* or *Panighatta*, are being widely used for grinding and milling throughout the country and it is estimated and frequently quoted that there are about 16,000 - 30,000 *ghattas* in Nepal (Pandey 1998, Rijal 1997a). Some even say tens of thousands of these *ghattas* are being used for grinding grain into flour for centuries (e.g. deLucia 1997). As the 21.6 percent in 2016/2017 Nepalese are below the absolute poverty, most of the installed micro-hydro powers are being used for agro processing like oil expelling, grinding, milling and husking thereby reducing the human drudgery especially of women. There are different types of applications and definitions of these micro technologies in Nepal ranging from few watts to 100 KW for simple mechanical grain grinding to rural electrification. The impetus behind all modern types of micro hydropower development were certainly traditional types of wooden water wheels slowly developed, installed and operated by the local Nepalese people. The water wheels have been helping to reduce the drudgery of women and children in the agro processing, i.e. grinding and milling millets, wheat and maize in several areas (NLSS, 2016).

Although a 500 KW small turbine was installed in 1911 in Nepal, and there were already existing thousands of wooden-runners, but, because of the dream of “gigantism”, Nepal could not develop hydropower for five decades. Only after almost 50 years, in 1962 a Japanese made micro turbine of 5 KW for electricity generation was installed by a local manufacturing

company at Godavari fishpond in the premise of Kathmandu valley to promote small-scale technology (e.g. REDP 2000a). Even though, gigantism was a dream of then decision-makers but in reality neither such gigantism nor small-scale technology could came into existence during those 50 years. Few interventions of micro hydro plants were also there during this period but as an isolated case. Unfortunately, ‘a long silent period’ until 1960s after the installation of first mini-hydropower in 1911 could have hindered the development of the country in all aspects. The reasons could be several but dream for gigantism must be one that has oppressed the Nepalese dream of prosperity.

Development of MHP came faster when Nepalese government has decided to provide loan and technical assistance to MHP in FY 1981/82 (ICIMOD 1993) and after fiscal year 1985/86 electrical components of MHP were provided with subsidy when add-on electrical system of mechanical power producing turbines are not financially attractive. By the end of FY 1986/87 there were 534 water turbines installed (ADB/N 1987) and increased by more than 800 turbines by 1992 (Pandey 1994,p.185) and most of them are in the range of 5 to 20 KW and are used for agro-processing and small fraction of them for community electrification. The average size of plant was around 8 kW for mainly agro processing mechanical mills (ADB/N, 1987). Up to the end of 1993 about 121 MHP were installed only for rural electrification and producing a capacity of 1.348 MW (ICIMOD, 1993, Pandey, 1994). When a rural energy development programme (REDP) supported by UNDP has been implemented in 1996, by the end of September 2003 about 123 with the capacity of 1.607 MW additional MHP for rural electrification were commissioned and management was looked by

user's committee (REDP 2003). On the other side about 49 nos. of MHP were also installed and handed over to the users committee by Remote Area Development Committee (RADC) since 1993, which is the government agency to look after remote areas of Nepal (Baskota et al 2000). Since 2000, an Energy Sector Assistant Programme supported by DANIDA is also providing subsidy to the private or community owned MHP. MHP development scenario is rather positive than pessimistic at least in numbers, if the present subsidy continues (AEPC, 2002).

2.2 Review at International Level

Nattakul, Boonrod and Roongrojana (2010) studied that this work assesses social impacts of Pico- hydropower applications in the Northern region of Thailand. Six existing Pico hydropower projects were selected based on different characteristics including system capacity, size of user. Normally, Pico-hydro power systems are found in rural or hilly areas. Based on the guidebook, most projects should utilize hilly and mountainous locations to site suitable projects. From a report on electrification technologies by the World Bank Energy Unit, of the options currently available for off-grid generation, Pico-hydro is likely to have the lowest cost. For mini-grid power, it is likely that only biogas plants provide more cost-effective electricity than micro hydro. Northern Thailand is filled with mountains and high level. In areas with high rainfall, there is plenty of water. In terms of economic the results is clear because most the people have the tea gardens and coffee gardens, so they can use electricity at night time to boil tea leaves and pack it for sale. The production cost for each village in the system In

addition, they have home stay service to tourists, which increase incomes. Socially, second range is high percentage of users have satisfaction in the hydropower. According to the light at night time the villager can take time for exchanging ideas with each other, the children read books for longer time and old people understood more Thai language as they can remain watching TV in the night.

Brodman (1981) depicted that the socio-economic impact of Klaten rural hydropower project in Indonesia. This study is mainly based on primary data. This study has found 88 percent of the business in the study area had installed electricity of project, 77percent of the electricity adopters with school children reported that electricity had caused in increase in their study time, more than 80 percent of respondents said that electricity had made the village safer due to lightening of the village paths, more than 70 percent of electricity adopters and non adopters opined that electricity had benefited them by stimulating night time activity. Business work hours had increased 11 percent of the interviewed household increases their income by using electricity in their home industries, 33 percent of the business respondent reported that electricity use had developed their business, 50 percent of the business respondents and 43 percent of household respondents said that employment opportunities had increased due to electrification.

Therefore, his study has thus concluded that rural electrification is the most viable and most benefited source of energy in the rural area. Thus he concluded that Klaten rural hydropower has contributed to enhance the living conditions and expand the capabilities of the people in Java in a clean and sustainable way.

Gonzalez (2007**)** studied that the impact on development and environment due to MHP in Bolivian communities. The study examined nine hydropower projects in Bolivia. The gists of the study are there was significant change on the education, health status, comfort level, self confidence and feeling of own-ness due to the micro-hydro project. Hydropower able to reduce 54 percent of the household expenditure for energy related expenditure such as candles Kerosene, LPG and batteries. There were creation of part time job as well as there is establish and enhance the quality of small business and save the time for travel to buy lighting fuels. Due to the electrification education status of student uplifted and study hours increased. There was continuing of basic literacy for adults in 5 communities additionally. New educational tool have been purchased such as computer rooms, TVs, DVDs, projector etc. The health status of local people improved due to the reduction of smoke generated by firewood at home and there is reduction of risk of fire.

There has been rapid change on communication and social life, so household have TB and radio and more public telephone has been installed in three communities. Public lighting gives security for night for walking and with cheap lighting people stay for productive work more time at night. Hydro-power has contributed to equality between indigenous and non indigenous people in Bolivia. The hydropower has positive effects on local and global environment. The most remarkable aspects are the reduction of the emissions 16.6 tons of CO_2 equivalents every month. The sustainability of project guaranteed in all its dimensions economically, institutionally, technically and environmentally.

Thomas (2012), his study about Concerning renewable energy sources particular attention has to be given to the kind of natural source and the characteristics of the facility. In particular, the environmental and social sustainability of large hydroelectric plants has been severely questioned by a number of studies (e.g. Finley-Brook and Thomas, 2011; Erlewein and Nüsser, 2011; Khennas, 2012). These have highlighted that in many developing countries the building of large-scale dams often co - financed by industrialized countries through the Clean Development Mechanism – further exacerbated social and environmental local inequalities, by adversely affecting indigenous land tenure, disrupting local water-dependent agricultural systems and limiting local access to water –dependent agricultural systems and limiting local access to water resources. Eventually ,those energy-developments may result in form of "hydrologic colonialism"(Finely – Brook and Thomas, 2011) namely the process through which source territories –often rural underdeveloped areas- are burdened with economic environment and social costs, while benefits are exported elsewhere – often to urban industrialized centers.

Kooijman-van(2009) generalised issues, the direction of causality is often difficult to define. Electricity access, for instance, can improve health, as hospitals can work at night too. It can also improve education, by extending the time for studying, and, therefore, reduce inequality. One further implication of greater energy access is welfare improvement as a consequence of a more amenable life, once the time devoted to domestic activities decreases and spare time increases. As a consequence, migration to urban areas - which often regards young productive people – can decrease. This, together with greater availability of energy inputs for local firms and

more time for market activities, can increase productivity and therefore income. Remarkably, Kanagawa and Nakata (2008) used the electrification rate as an explanatory variable for the literacy rate of rural areas in the Indian state of Assam. On the other hand, relatively high income is a condition for high electricity demand that can assure the profitability of its distribution to a given area. At the same time the availability of funds and human capital can foster electricity access, the former ones to buy generation devices and the latter one to install and maintain them. In addition, energy access innovations can work as product innovations rising labor productivity.

WECS (1999) raised more issue for further consideration than it has resolved before due to the initial stage of MHP development. This report also study on the identified and unresolved issues crucial to the successful promotion of MHP. The main objective of the study is to prepare the set of guidelines to increase the economic viability of the MHP. It realizes the necessity that information and ideas should be shared to facilities and foster integrated resources planning. It has suggested that the promotion of MHP in high scale private sector should be encouraged and activated as what is in Thailand but in the context of Nepal, This sector is still at its infancy. They have yet to prove their cost effectiveness. Reason for installation of MHP in private sector for sometimes is better that decision making process in long and commonly underdetermined in community own MHP.

Neston (1999) examined that the socio-economic effects of Micro-hydropower in Nepal, Srilanka, Ethiopia and Uganda. They have concluded that micro-hydropower has proved very successful as a tool to help rural

people develop their economic position and improve their lifestyle. It provides extra energy in the rural area to reduce the drudgery of food processing and it can offer a means of generation electric power in an area away from the grid.

The study has recommended that subsidy should be given to micro-hydropower (MHP) plant in rural Nepal area rather than subsidizing other energy supplies such as kerosene and grid electricity. Since MHP has a very low running cost, loan finance should be available to the rural people. Trainings about their maintenance and operation should be given to the rural people themselves for the sustainability of the project. Since the demand for power during the daytime in the rural area is very low, trainings should be provide to the rural so that people can start new businesses such as food processing mills.

2.3 Review of National Level

Awasti (2010) examined that the socio- economic impacts in Chameliya Hydropower plant in the adjoining area. This study has concluded that the socio- economic impacts of the project are moderate in absolute term and satisfactory in relative term. The project has provided sufficient drinking water and employment opportunities to the local people and electricity supply has extended the social and recreational activities like increase in educational standard, purchase of radios, TV, Tape recorders etc.

This study is a descriptive one based upon qualitative data. It has used primary as well as secondary data. The primary data has been generated from field survey, interview, observation and questionnaire.

Regmi (2012) analyzed that the present condition of Nepalese energy system. The summary conclusions of her findings are there should be need of proper utilization of natural resources like water to achieve the goal of development. By proper harvesting of rest water resources by generating aptly trained man power and investment on water resources. Depending on foreign country could be vanished. One of the alternative ways to increase the energy power not only by the formation of new hydro projects but also by maintaining and optimizing the existing hydropower plants, which may become panacea to control the wave of problem and has been grossly overlooked for these reasons. The development of hydropower in Nepal has always been dictated by many constraints and conditions. projects are selected by planning procedure which are deliberately designed to produce a no option situation in decision making. It is too late to understand the government that private sector is not capable to develop sufficient hydropower projects to satisfy the demand, so, public sector must play a sustainable role for important of hydropower project.

Timalsina (2016) argued that a country with rich of bio-diversity, cultural heritage, majestic Himalayas and immense water, its availability electricity contributes significantly to the overall development of the country on one hand, and its consumption reflects the economic condition of the nation on the other. Therefore, it has become highly important to harness the abundant water resources to generate electricity for development.

Pantha (2017) suggested that the major contribution of the hydropower development in Nepal is not only the financial and technological constraints, but it faces the problems like local communities create the problems, poor

infrastructure, insurgency, lack of skilled manpower, licensing difficulties, inadequate of storage project conservation and environmental problems. In Nepal policy deficiencies and slow making process in electricity sector has resulted in the increased project cost and has reduced the involvement of private sector and entrepreneur. In spite of its high possibilities hydropower has no enough contribution in GDP of Nepal, neither has generated huge amount of revenue in national economy. Thus, restricting and improvement at all policy level is required to overcome various hurdles and then only hydropower development will possible in Nepal.

Karki (1995) argued that the small hydropower development can play a pivotal role in introducing the developing packages. The construction of Mega hydropower projects takes a long time for project preparation and mobilization of external financial resources and its involves a lot of uncertainties as exemplified by Pancheswer, the Karnali high dam Project and Arun III Project. Moreover, without meaningful co-operation from India, it is practically impossible to move ahead for the mega power projects. The writer further writes that ever thought India is having power shortage by 7.1 percent at the national level and 33 percent in Bihar no serious efforts have been made for bilateral development of Nepal's hydropower potential for mutual benefit. Hence, Ministry of Nepal should not pin too much hope on and waste valuable time on its development in the near future, but should proceed with the development of medium, small and micro hydro projects. Because of the poor performance of the small hydropower plants, due to inadequate maintenance and poor utilization of the generated power is showed the negligible portion The program approach has been quite effective in the development of the irrigation sector, it

supports for the establishment of small agro-based industries and so on. So the planned development of small hydropower projects should be carried out to meet its multifarious use and make it economically viable.

Acharya (1983) mentioned that the contribution of hydroelectricity to Nepalese economy. It plays significant role by developing various fields such as agriculture, industries, transportation, social services etc. Water resource is the Nepal's greatest asset but unfortunately very insignificant portion has been harnessed to this date. She says that there is unequal distribution of electricity in different development regions. Nepal is facing many problems with respect to hydropower development. These are: lack of capital, skilled manpower, technical know-how, sufficient market and economic status of people as well as country.

Upadhyaya (1975) said that electricity is a substitute of oil and fuel wood. Electric power installation was started since 1911 A.D. in Nepal but motion of development activities was very slow. If we develop micro hydropower, it can be used in various sectors such as industries, domestic usage and so on. It plays significant role to reduce unemployment and poverty in the village and all country. We can produce more goods having high quality at low cost by using electricity. We can earn more foreign exchange by selling electric power. Definitely, it will help to regain favourable trade balance and balance of payment. Development of electricity really brings economic revolution in the country. Increasing demand of electricity is encouraging to develop micro hydropower.

East Consult (1990) studied that reports to the evaluation of micro-hydro power, its socially acceptance and economic viability. It encompasses many

studies areas of micro-hydropower. But it especially focuses to the investigation especially on such questions like who are the real beneficiaries and to what extent do those get benefit. This study is interested to know the constraints prevailed in rural energy. It also keeps the interest to finding the answer of the question who gets the access to the rural lighting and why? This study was conducted in Turture of Tanahun district Karmasingh of Ghorkha, Buling Arkhala of Nawalparasi, Karputar of Lamjung, Arghali of Dolpa and Karnali of Baglung district.

This study has been centred to the socio-economic evaluation of the impact of private and community owned micro-hydro schemes on members of rural communities who are not the owners of micro-hydro schemes. It focuses to the target groups and aims to enhance the knowledge about relationship between nature and MHP scheme. The objectives of the study are to examine the characteristics and perception of those local people who are benefited by micro-hydro. It especially examines the satisfaction/dissatisfaction ratio of micro-hydro power users and tries to recommend for action to maximize the benefit to the rural poor. It also tries to establish the indicators for monitoring the effects of any such actions.

According to the findings of the study, the viability of this technology under the set of technical and social circumstances, which prevails in perceived benefit, accrues to the mill owner as well as the community. It reveals that; in one hand, agro-processing makes positives impact on community saving the drudgery, especially to women and in other hand, it is not effective to the cash starved people.

It says it is not fully beneficial where the time is consumed by the transportation to mill and waiting, although it depends upon the located area of mill from the settlements. The study indicates that only one or two percent of the customers make payment in kind for the service of the mills who cannot afford the cash payment. But about 3 to 8percent of village inhabitants are poorest, of the poor in most of rural areas of Nepal who do not use, the mills even with payment in kind because they do not have such affordability also. But it is naturally that, the payment in kind is anywhere between (50 and 500) higher than the cash down payment depending upon the local prices of agro-production. It further indicates that except the oil processing kol, the traditional agro-processing mills, such as Dhiki and Janto have not been replaced at all because this turbine mills have not yet been able to reduce the risk reliance of the community vis-à-vis traditional sustainable practices.

ICIMOD (1991) assessed that the development of the micro-hydro systems since the last sixteen years, identifies factors that contributed to the success of this technology, and factors that constrained wider dissemination and promotional efforts. This paper is based on the information collected from six case studies; the paper presents some recommendations and suggestions. It recommends that the success in MHP development is the deli censing of installations below 100 KW capacities.

This paper suggests that, due to the lack of operating knowledge the plants have been facing many difficulties like load shedding. This paper concludes that the government is right in privatizing the installation of micro-hydro units and it has to develop a comprehensive and integrated policy to promote micro-hydro development. This has to be complement by realistic plans of

actions in which people can participate with effectiveness and derive tangible banalities. It suggest that a diverse strategy to be adopted given a physical, cultural and economic condition in the country. The range of activities can be expanded from the provision of expensive construction kits for improving the traditional *'Ghattas'* to the installation of agro processing and improving the facilities to the larger schemes that integrate electrification with various rural industrialization activities.

WECS (1993) carried that outmode advantages to the use of alternative energy. It finds that it is an appropriate scale; these can provide cleaner energy and are comparatively begun as regards their effect on the environment. Moreover, Nepal's rural economy does not provide enough economic basic for large-scale investment for the exploitation of vast hydropower potentials. In this context, alternative energy can play the role of a catalyst in rural development by providing a modern form of energy. It can effectively help in redacting the drudgery of the rural population and cutting down the time required to collect and use traditional form of energy of such as fuel wood, animal wastes etc; provide a cleaner cooking and lighting environmental to rural women; combat the environmental effects of CO_2 emission, forest depletion etc; by redacting and replacing the use of the traditional as well as commercial forms of energy. Save convertible currency, resources by substituting improved fuel and has the potential to create the rural employment and increase productivity.

Jha (1995) argued that one of the major reasons for poverty and backwardness of the Nepalese Economy is power deficit. Shortage of power

creates a problem in the development of agricultural, industrial, trade and other sectors of the economy. With the view to meeting the power shortage, it is needed to generate power not only at the medium or mega level but also at the small and micro level so that each can prove to be complementary rather than competitive to one another.

The small and micro hydropower may play a crucial role in increasing production and productivity of the agricultural sector, including the processing of agricultural produce. The lift irrigation in the hills may also be promoted in a meaningful manner through the development of small and micro hydropower. In addition to this, the food processing and cottage industry might benefit a lot from the development of small hydropower. Electrification is related to productivity, the small hydropower might help increase the working efficiency of rural poor. He concluded that, the small and micro hydropower is also important from the consideration of national welfare in diverse fields, such as conservation of forest, creation of self-employment opportunities and also promotion of the tourist industry. Work on micro hydropower projects can be started by mobilizing local talent, labour and materials, which per se is very important.

Hora (1996) explained that among the alternative energies more popular and available, continuously renewable, non-polluting, efficient widely distributed and based on simple as well as flexible energy sources is micro-hydropower (MHP) in Nepal. It is technically feasible as well as economically viable and the most appropriate technology for Nepal indeed, micro-hydropower projects are not sufficient to meet the national demand of electricity on one hand, we have no economic resources, technology and skilled manpower to install large-scale hydropower project on the other

hand, small scale hydropower projects can play very important role in such context. This technology provides access to electricity and other mechanical forms of energy for agro processing. Furthermore, it is also capable of providing rural electrification to a limited scale.

Hilly topography and enough availability of water resources so the huge potential for micro-hydropower in the country. Micro-hydropower help to reduce the alarming deforestation, import of petroleum products thereby playing a vital role to improve the economic condition of the people. Agriculture Development Bank of Nepal (ADB/N) not only providing loan and subsidies but also providing resources survey, feasibility studies, promotion of manufactures involvement technical assistance and training has financed over 90 percent of the private MHPs in Nepal. It may not generate electricity in dry season. Likewise the skilled manpower may not be available to get it repaired. Sufficient research has not been carried out yet. These are a few problems involved with MHP.

Kumar and Sharma (1999) studied that on “Small Hydropower” it’s mainly focused on the traditional use of water as wheels, Ghattas, water mills, which are very old design and work at very low efficiencies. Water wheels, commonly known as 'Ghattas' have traditionally been used in the mountain areas of the Himalayan and sub-Himalayan regions from ancient times. In the Himalayan region, the main economic activities of the population are still based on agriculture. That why the small-scale hydropower generation is much more effective and efficiency for the energy sources.

Annual Report of Rural Energy (2000)

This is the fairly informative report prepared by REDP and supported by UNDP for the rural energy development program, which has includes about the information of rural energy sectors. The principal aims of this report are to give the message to the people about rural energy related areas; to appraise the impacts of energy and its related components. It tries to demonstrate the development path of rural energy sector, to review on rural energy sector policy and to raise the issues and give the solution of the rural energy sector problems for the sustainable development.

The report mainly focuses on the information of execution of working to increase the level of energy services to poor citizens in the village of Nepal through technological development including micro-hydro, solar, biogas, improved cooking stove etc. This report connotes that the increased population increase the demand of resources that puts further pressure on the forest which is already in determine processes in Nepal. Desertification, ecological instability, loss of biodiversity, drying up of water springs is some of the serious environmental consequences of massive deforestation. So most of the energy needed can be fulfilled by the big hydropower projects but which is focused only one urban area. This effort has largely ignored the rural population. This report raises the majors' issues and focuses on the promotion of rural energy.

This study glimps, the present trend of micro-hydro power, illustrating that most of the MHP schemes have been installed for mechanically driving agro-processing unit like grinder, huller and oil expeller, whereas other end users are few and far from the low cost application and the local resources

utilization through micro-hydro plants. The report concludes that there are inconsistencies in policies support and implementation of micro-hydro, and other, rural energy technology. These inconsistencies are, lack of technical and managerial skills for operation and main finance among the rural population, weak co-operation among the delivery agencies and inadequate information about the technology in rural sector.

Gyawali (2001) examined that the nuanced, sophisticated and the same time engaging, examination of what have happened to Nepal's premier natural resource has a significance that for transcends both the specific experience of the author's own country and the other sector. Water resources development in Nepal is a function of its history. Historical factors and relationships have determined the rate of economic growth and the level of technology and its use.

Issues in water resources development should be looked at form and historical perspective to see how the problems arose and how they are interlinked. Although water management is a burning issue of contemporary public policy, one sees little interaction between water resources planners and historians. An historical analysis would provide insights into the background of various decisions over time, into the evolving nature of present problems as well as the reliance of the past to its solutions. In studying the role of the water in a society, it is conventional to start with the different types of use (i.e., power production, irrigation, domestic uses). In this analysis we take a step further back and look at the source of demand-the various actors, their proclivities, and the genesis of their desire the physical system behave differently to deliver to them goods and services of their linking.

Since 1911, when electricity was first generated in Nepal, hydroelectricity development has always been a prerogative of the state. From 1911 to 1951, only two stations with capacities totalling less than 1 MW were commissioned because the socio-system demand was limited to the places of the Rana shoguns. After the advent of democracy, demand for electrical energy has come from a much broader section of the populace, although only 4 percent of Nepal's population at present has access to electricity. This population is today paying about six cents per kWh of electricity, which is what an average North American (With per annual income a hundred times more than the average Nepali) pays. Although the country is described as being rich in water resources, the cost of developing medium-sized hydroelectric projects has been $2000 /kW for the 60MW Kulekhani and $ 3500/KW for the 69-MW Marsyangdi. The small hydro units are costlier at almost $ 5000/ KW. The corresponding figures for hydro development in the Indian Himalaya are less than $ 1000/ KW. This discrepancy can be explained by the existence of a more efficient productive market system in India than in Nepal where the stricture of the state apparatus has a feudal rent-seeking character.

Dhital (2003) presented that in international conference on renewable energy technology for rural development (Returned 03) prepared by Dital, Ram Prasad and et. al. The returned report is published in every four years. It is important information to the energy sector, which combines the present states, past experience and future plan of this energy sector with the view of national and foreign experts. The paper tries to analyze the initial evaluation of investments and optimizes the components to observe on total projects cost. This analysis deals with the approach for financial analysis to calculate

the cost where three scenarios that is, with subsidy, without subsidy and with net economic benefit.

Final Evaluation of Private Rural Electrification Project (367-0162) (1994, is a report prepared by a research team of Ranjitkar**,** under the USAID of Nepal. This report is based on the study of evaluation of three private plants as the private Rural Electrification Projects which are: (1) Purang-25 KW (Muktinath VDC of Mustang), (2 Silkes-100KW (Parche VDC of Kaski) and (3) Seem - 16 KW (Morabang VDC of Rukum). The study shows that the installation of micro-hydropower plants has brought technical revolution in the rural areas where people had not been exposed to modern technology. Micro-hydropower plants give them opportunities to utilize modern technology to improve their living standard. These plants also help them to link their subsistence village life to the modem market through value - added goods produced by micro enterprises e.g. milling cottage industries and so on developed in the course of time. After the establishment of pored plants in villages, there are good changes that micro enterprises will flourish. The study has found that the expected benefits from the projects are firewood and kerosene savings; improvement in education, agricultural productivity, health, and women's working time etc. right sized micro-hydropower plants are economically replicable and sustainable because such plants are within the managerial capacity of the rural people. The team recommends that the micro-hydropower projects should not only be financially and economically viable but should be also on appropriate scale depending upon the needs of villagers' transparency and participation in the decision making, managerial as well as technical back-up support.

Bhadra (2005) defined that the condition of hydro electricity in Nepal. He emphasises that the use of electricity and fuels have been found to be accelerating though the rate of economic growth has remained same in Nepal for decades. This is because Nepal could not adopt the appropriate policy to utilize the water. But it is obvious that in every sectors of development it has vital role. The problem is rather terrifying because of the cheap price of electricity but the lower greeting capacity, and low invests.

Nepal has increase the electricity through small and micro-hydro gainful employment to preserve the environment and develop radically The generation and distribution of hydro- electricity is to be decentralized as the water resource by nature are so that agriculture modernization and industrialization in all the regimes will be possible Nepal has to adopt the strategies of rural electrification initiative industries, for development Micro Hydro-electricity inputs in hills and mountains will promote cottage industries and transportation in Nepal.

Tiwari (1995) analyzed that the role of MHP in rural electrification and also examined the impact of MHP after construction within the influenced area. He has compared the benefits and cost of Bhorletar MHP. Field survey has been used to collect the primary information and the secondary data sources are ICIMOD, East Consult, Ministry of Finance and NEA. This study has concluded that micro hydropower is the most feasible and most efficient alternative source of energy in rural areas.

Mahat (2003**)** reported that about 12 percent of the rural population (from current 7 percent) is expected to be served with alternative energy by the end of Tenth Five-Year Plan (2003-2007). However, considering the current

pace of expansion of rural electrification networks, it would be difficult if not impossible, to expand the reach of the rural people to electricity even for lighting in next 25 years. Which is a sad reality and deserves serious thinking from all concerned agencies promoting renewable energy development, including GOs, I/NGOs, CBOs, POs. Considering the high cost of large hydro-power plant establishment and power transmission line expansion in rugged terrain and rural areas, the use of available electricity has been confined mostly for lighting in the most energy consuming residential sector.

Besides, the present discriminatory electricity tariff for higher consumption does not encourage its use for cooking in the residential sector. Therefore, it would not at all reduce the consumption of traditional biomass for cooking in the near future. Even if there has been a growing concern to overcome the adverse impact of improper biomass fuel use in the residential sector, particularly concerning the quality of life and health of women, children and elderly people in rural households, the reliance of residential sector on traditional fuel would not reduce until their problems receives a high priority for RandD, for promoting sustainable utilization of indigenous (and very low cost) solid biomass fuels.

UNVN (2003) explained that water contains energy. The energy generated by downward movement, of higher place can be converted into dynamic energy with the help up turbine we can run different machines directly and we can produced electricity by joining the shaft of generator. The project in which small amount of electricity's is produced is called micro-hydro project. Generally MHP includes the project of capacity up to 100 KW.

WINROCK (2004) focused that the victimized local people from the hydropower development. The development of a hydropower project has mainly benefits, but also precipitates many adverse consequences in the lives of local people. There are three main groups of people who are affected by the development of hydropower projects. The first group involves communities living in the vicinity of a hydropower project who may have been hurt by land acquisition, pollution and other problems. The second group are communities living downstream of a hydropower project who are subjected to problems such as dewatering, flooding etc. the third group involves communities living upstream of a hydropower project who face problems such as land acquisition by access roads and transmission lines, destruction of natural resources during project construction etc.

This study reviewed the adverse consequences of hydropower development in Nepal as it impacted the lives and livelihoods of local communities. It also discussed the responses of hydropower developers to such adverse impacts.

Karki (2005) reported that 134,570 biogas plants have been installed in the country covering 66 districts by December 2004. Due to straight quality control from material selection to plant construction, installation and operation, a high success rate of 98percent has been documented for operation of the plant and 96percent of the clients satisfied with the overall system.

The estimated technical potential for biogas production in Nepal was 4.36 cubic meter per day, which is based on the number of cattle/buffalo in the country (in 1997/98), or specifically on the quantity of dung that could be available for biogas, and the micro-climatic pockets in different parts of the

country. The estimated technical potential ranges between 1.53 and 2.9 million plants in the country (average plant volume is currently around 7 cubic meter). However, the estimated economic potential is considered to be 600,000 plants. Therefore, early tapping of this vast unutilized source would not only enhance the rate of employment, level of rural income, and open the access to clean, affordable, renewable, indigenous and carbon neutral source of energy, but also to improvement in quality of life and health of the rural people, mostly women, children and elderly people.

Kafle (2005) argued that hydropower has contributed for poverty reduction and economic growth, shown in developing countries. Though, the regional development and expansion of industries encourages even to the undeveloped countries for prioritizing hydropower development. Economic and social development and environmental protection are interdependent and mutually reinforcing pillars for sustainable development. The multiple use benefits of hydropower reliability and quality of fresh energy supply caters to a fundamental sustainability goal of poverty alleviation. In social aspects the development of hydropower enables to make easy access of electricity to all over the country with significant impact to reduce poverty and enhance the quality of life in the communities.

Bhattarai (2005) stated that, we have not yet been able to develop even one percent of the total potentials (83,000 megawatts) and provide electricity to a quarter of the total population. The problems or the challenges of the Hydropower development such as selection of the projects and appropriate managing finance for them have not been given due attention. And there is

dearth of knowledge or information about the Hydropower Development in Nepal.

In this regard, we can get help from his article about the financial estimation of the resources for the development of hydropower for the next 30 years. The development of medium sized hydroelectricity projects in general and micro power projects in particular are recommended for Nepal. Regarding the need of the financial resources, the study has recommended that preferences should be given to mobilize domestic financial resources by encouraging private sector investment.

ICIMOD (1991) prepared that the seminar on Rural Energy and Related Technologies held in Kathmandu from 26 to 28 March 1991 in collaboration with the ADB/N and WECS of His Majestry's Government of Nepal. This paper assesses the development of the micro hydro system for the last sixteen years, identifies factors that contributed to the success of this technology and also the factor affecting in its development and also indicates the priority areas for future development and promotional efforts. This paper is based on the information collected from 6 case studies. From these different 6 case studies, the paper presents some recommendations and suggestions.

It recommends that the success in MHP development is the re-licensing of installations below 100 KW capacities. The study also identifies from the owner's points of view the MHP units constitute a paying proposition except in cases of very bad management, the mill and electric generator (specially with 50percent subsidy) bring sufficient revenue to enable other to repay the

loan instalments in time and make a profit over and above the amount. People are willing to contribute towards the capital cost out of their own pockets. They are ready to pay from Rs 12 to 16 per 40-Watt bulb per month, which is several times higher than the standard NEA rate. This paper suggests that due to the lack of operating knowledge the plants have been facing many difficulties like load shedding. This paper concludes that the government is right in privatizing the installations of Micro Hydro units and it has to develop a comprehensive and integrated policy to promote micro hydro development. This has to be complemented by realistic planes of action in which people can participate with effectiveness and derive tangible benefits. This paper suggests that a diverse has to be adopted given the physical, cultural and economic conditions in the country. The range of activities can be expanded from the provision of inexpensive constructions kits for improving the facilities to the larger schemes that integrate electrification with various rural industrialization activities.

Shrestha (2000) mentioned that the development of the hydroelectricity is possible due to the enormous water resources as well as favourable topographic and climatic condition. Hydroelectricity has tremendous advantages for the people, and it helps to develop energy sector of economy. Electricity is one of the infrastructures of upgrading the socio-economic condition of nation. The proper utilization of electric power accelerates the motion of national development. Our experience shows that the developed countries like Japan. UK, USA, China, France etc. achieved advancement in time through electric power. At present, the stock of non-renewable resources like petroleum products, coal, natural, gas, fuel wood etc. is decreasing. The hydroelectricity has become economically attractive

because it is renewable and environment friendly. He has discussed the role of hydroelectricity in various economic as well as non-economic sectors. Industries, agriculture, transportation, social services and other sectors can be promoted by the utilization of electricity. He has also discussed but the development during the plan periods.

RETSUD (2009) concluded that international conference was organized jointly by Nepal Solar Energy Society and Ecosian Co. Ltd., Republic of Korea in collaboration with centre for Energy studies/ IOE/ TU and School of Engineering/ Kathmandu University (KU). The conference covered themes relating to Bio fuel, Biogas, Biomass, Climate Change, Economy, and Energy from waste, Global Warming, Improved water mill, Nuclear energy, rural issues, Solar PV, wind energy and others. It was concluded with the following remarkable recommendation**:**

- The role of RETs and alternative energy technology in mitigating climate change impact should be taken into consideration.
- For the low population density settlement in the high range land, appropriate energy solution must be developed.
- Decentralized energy system based on the RETs for the socio economic development of rural population must be prioritized and supported.
- Suitable and efficient bio-mass technologies have to be developed to ensure adaptability and reduced level of harmful emission.
- The subsidy in RETs must be only as priming force, sustainable development of RETs can only take place if treated commercially.

Energy Trend in Nepal

Like many developing countries, the energy consumption pattern in Nepal is characterized by the use of biomass as the main source of energy. Commercial sources of energy, such as electricity and petroleum products, are inaccessible or unaffordable to the poorer sections of the society. Hence, the vast majority of people rely on the traditional fuels, wood, crop residues and animal waste. Energy sources have been categorized under three broad types: (i) traditional, (ii) commercial and (iii) alternate or renewable energy sources.

This categorization pertains to the modality of use of the resources in abstracting the inherent energy contents. Commercial sources of energy are fossils fuels (coal and petroleum fuels) and electricity. Alternative energy sources include the micro hydro, solar power, wind power, biogas, briquettes, biomass etc which are the weapons of the modern RE. Hydropower, Biomass and Solar power are the three major indigenous energy resource bases in the country. Though Nepal has a huge potential of hydropower production, its exploitation has been to a very minimal and therefore it is the biomass sector which dominates the overall energy supply and consumption. Government, along with bilateral agencies, non-governmental and private organizations is engaged in the promotion of RE through national and regional programs.

CHAPTER 3 : RESEARCH METHODOLOGY

3.1 Introduction to the Study Site

Project area lies in the Chaunri Deurali Gaupalika ward No-5 of Kavrepalanchowk district, 3 no province of Nepal. It is 33KM far from Dolalghat in the east and is accessible through the gravelled road. The source of the flow for Chaunri Khola First Microhydro Project (CKFMHP) - 22 KW is Chaunri Khola. The altitude of the area is about 900m amsl. The potential load centres of the project comprise Balu, Ramche, Harre, Biruwa and Pokhari of ward no. 5. Most of the load centres lie within the range of 2 km from the power house. The all-weather nearest road head of the project site is Dolalghat.

Chaunri Deurali Gaupalika -5 is still far from the national grid connection and people are relying on the alternative sources of energy such as energy from the micro hydro, bio gas, solar energy etc. Agriculture is main source of income of the people of this ward but the social impact and the change in the life style due to the micro hydro cannot be ignored today. Hence, I'm very much and excited and enthusiastic to study about the social and economic impact imparted by this project.

3.2 Research Design

There are different types of research and it can be classified by its process, purpose, and outcome. Researcher has done both qualitative as well as quantitative research giving more emphasis on the quality albeit the outcome may not apply to the practical manner. Also research is a bit descriptive and explanatory. This research has identified and obtained the information,

characteristics and impacts of the micro hydro project on the ward no.-5. Lastly, my ultimate effort is to give the suggestions and make relevant recommendation to the project developers, stakeholders, and to all the benefited committee members.

3.3 Nature and Sources of the Data

This study is basically based on primary data collected from field survey. It was collected from user households (HHs) of the study area by asking different questionnaires and interviews to them. Similarly, the secondary data is also used for the study collected from various published or unpublished documents from individual experts. Data from the several governmental and non- governmental organizations such as AEPC, ESAP, REMREC, REDP, MGSP etc. are also taken into account as required.

Both the primary and secondary data that we have used on the research is more qualitative (words and texts) and less quantitative (numbers, statistics or financial). With these natures of data with a small sample size we are explaining and analysing the direct or indirect impacts of the micro - hydro system on the society.

3.4 Sample Selection

At present 236 households (HHs) at the project area in the VDC are electrified. The power produced by this project is 22 KW, and has met the present demand for lighting in the evening, and other several work during day time. The respondents of this study were people who have been using electricity by this project and this research was conduct among 40 household by random sampling method. For this purpose all of the household were

numbered from 1 to 236 in a sequential manner and noted. Then, all of the numbers from 1 to 236 were written in a small piece of paper and kept into a basket. After that number was picked randomly and the house corresponding to that number was surveyed. The respondents of this study were indigenous people, professional, students, businessmen, male, female and all necessary.

3.5 Questionnaire Design

Questionnaire was prepared by consulting several books, journals and articles and asking different person working in the micro hydro sector for several years. Questionnaire is kept in annex at the end of this report for reference. The questionnaire consisted open-ended as well as closed ended questions including queries' about social, economic, cultural, educational, environmental aspects and the influence of the project on the people's daily life style.

3.6 Methods of Data Collection

For the research of the socio - economic impact of the micro-hydro, data were collected through direct personal interview with help of structured questionnaire adapting random sampling method to those households who were either directly or indirectly benefited by the projects and lies within the boundary of the study area. Data were collected from 2074/03/05 – 2074/03/11. Data was collected by the interview process and by the direct observation method. Particularly, quantitative data were collected by the interview method and qualitative data by both observation and interview methods.

3.7 Data Analysis

All the collected data are presented in a tabular format using different techniques. They are analysed and tabulated according to the objective of the study. Electronic devices such as computer and calculator are used for the data processing and analysis. All the analysed data are shown either in the bar diagrams, pie charts or graphs as required.

CHAPTER 4 : DATA INTERPRETATION AND ANALYSIS

Analysis of data is a process of inspecting, cleaning, transforming, and modelling data with the goal of discovering useful information, suggesting conclusions, and supporting decision making. Data analysis has multiple facets and approaches, encompassing diverse techniques under a variety of names, in different domains. The analysis of data is the most skilled task in the research process. It calls for the researcher's own judgment and skill. Hence, in this chapter an attempt is made to analyse those raw data and draw some reasonable conclusion. Data collected through the random sampling method is tabulated and then is represented either in pie-chart or bar diagram as per necessity. This chapter describes about the social and economic impacts conveyed by the micro hydro on the people lying within the project boundary.

4.1 Basic Information

Kavrepalanchowk is one of the hilly districts located in province no. 3 of Nepal. Total area of the district is 1396 square kilometre with east longitude 85^0 24’ to $85^0$49’ and north latitude $27^0$20’ to $27^0$85’. Total population of the district is 3, 81,937. Kavrepalnchowk district has 6 municipalities and 7 Rural Municipalities with 2 electoral constituencies and wards. But our concern is on the Ward No. - 5 and more specifically on Balu, Ramche, Harre, Biruwa and Pokhari of Ward No. - 5 as our study site (CBS,2011).

Following table gives the figure about the population and household numbers:

Table 4.1 : Population Distribution of a PokhariChaunri VDC

Ward	Household	Population		
		Total	Male	Female
1	48	242	105	137
2	83	440	176	264
3	104	484	205	279
4	22	93	38	55
5	93	468	196	272
6	71	343	138	205
7	81	428	204	224
8	56	243	107	136
9	90	435	175	260
Total	648	3,176	1,344	1,832

Source: CBS 2011

4.2 Analysis of the Primary Data

The researcher has 3,176 populations with 648 households in the pokhari Chaunri VDC. But the total households in our study area of Balu, Ramche, Harre, Biruwa and Pokhari were 202 in 2011 census. Today this data is increased and the number of households has reached to around 236. In the impact areas, settlements of the people are more clustered. Housing patterns are more or less the same. Meanwhile, the economic status and the race/caste of the people are also quiet similar. Therefore, due this type of

settlement pattern, the cluster and judgmental sampling have been used. Hence, for our research we have selected 40 households lying within the boundary of study area.

4.2.1 Population Distribution by Age Group of Sample Households

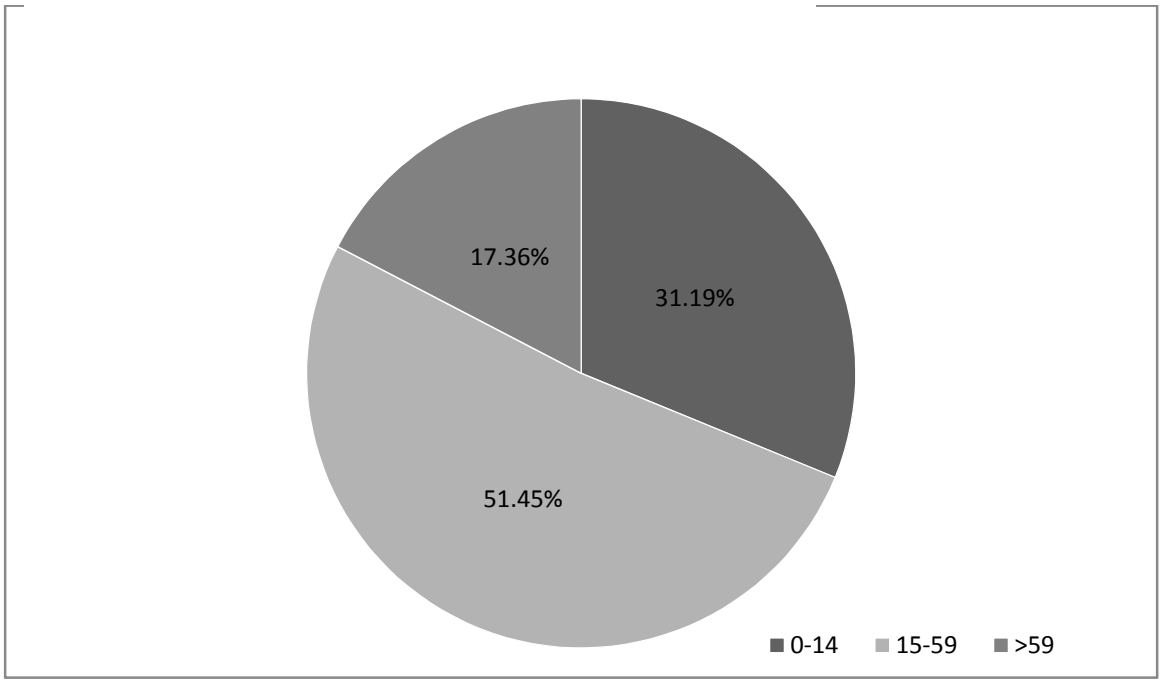
The age and the sex structure of the population are the most important demographic characteristics that are captured during a field survey. Age and sex are two attributes that largely influence an individual's role in society. The age structure of a population, that is; the distribution of the population indifferent age groups, constitutes an important subject of demographic analysis and development planning. Age structural dynamics includes fertility, mortality and as well as related changes in family planning and social arrangements. Table below gives us more information about the demography of the study site:

Table 4.2: Population Distribution by Age Group

S.N.	Age	Male	Female	Total	Percent
1	0-14	47	50	97	31.19
2	15-59	70	90	160	51.45
3	>59	26	28	54	17.36
4	**Percent**	**45.98**	**54.01**	**311**	**100**

Source: Field Survey, 2017

Figure 4.3: Population Distribution by Age Group



source:Field survey

Both above table and figures show that the male population is 45.98 percent and the female population is 54.01, where the female population is greater than male. The economically active human resource is considered to be 15-59 age groups and therefore the percentage of working population of the total sample population is estimated as 51.45 percent. This survey has found that people below 15 years and above 60 years fall under economically inactive and are not usually see in the any protective work and job market.

4.2.2 Population Distribution by Caste of Sample Households

Nepal has been since long known as a multiethnic, multilingual and multicultural country. Various native ethnic groups inhabit scattered in many places of Nepal. They do have their own customs; traditions and culture. Largest ethnic groups are the Chhetri and Brahmins in the study area also these populations are found predominant. Table 4.3 and figure 4.4 below

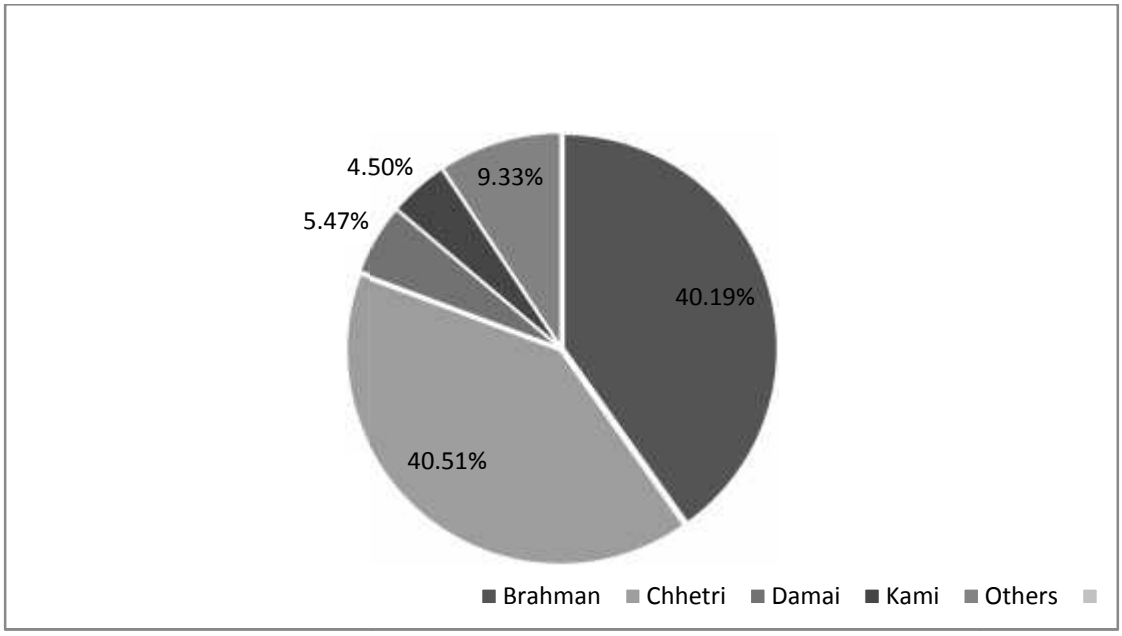
gives us more information about the demography of the study site with respect to caste:

Table 4.3: Population Distribution by Caste

S.N.	Caste	Male	Percent	Female	Percent	Total Percent
1.	Brahmin	57	39.87	68	40.48	40.19
2.	Chhetri	60	41.96	66	39.29	40.51
3.	Damai	8	5.59	9	5.36	5.47
4.	Kami	5	3.49	9	5.36	4.50
5.	Others	13	9.09	16	9.51	9.33
	Total	143	100.00	168	100.00	100.00

Source: Field Survey 2017

Figure 4.4: Population Distribution by Caste



Based on the table 4.3, there are mainly four castes in our study area according to the report of field survey. But some other minor groups also have their presentation. Chhetri is the largest caste/ethnic groups having 40.51 percent of the total population 311 followed by Brahmin 40.19 percent.

4.2.3 Population Distribution by Occupation of Sample Households

Composition helps us to know about how many people are involved in what sort of job or profession. It helps us to know about what the main economic activities of the people are. It shows the data about how many people's are involved in income oriented activities and their contribution to the national economy. In Nepal, majority of the people have agriculture as their profession as trade, industry and services are not developed as per the expectation of the people. Table below gives us more information about the demography of the study site with respect occupation:

Table 4.4: Population Distribution by Occupation

S.N.	Occupation	Male	Percent	Female	Percent	Total Percent
1.	Agriculture	65	45.45	110	65.48	56.27
2.	Service	16	11.19	7	4.17	7.40
3.	Business	14	9.79	8	4.76	7.07
4.	Student	24	16.78	34	20.23	18.65
5.	foreign employment	19	13.29	5	2.98	7.72
6.	Others	5	3.50	4	2.38	2.89
	Total	**143**	**100.00**	**168**	**100.00**	**100.00**

Source: Field Survey 2017

Here, in the study area, about 56.27 percent of the people are involved in the agriculture and rest 43.73 percent in the other profession. Still large numbers of the people are involved in the agriculture but the trend is decreasing year by year.

Without adapting modern agriculture system it is difficult to improve the economic standard and adjust in the changing pattern of economic system. In actual, people are also motivated towards modern, productive and more income generating occupation but due to the lack of infrastructure and other complementary facilities people are bound with the agriculture only. Also 7.40 percent, 7.07 percent and 7.72 percent people are engaged in the service, business and foreign employment respectively with 18.65 percent people studying in the school and colleges.

4.2.4 Population Distribution by The Educational Status of The Sampled Households

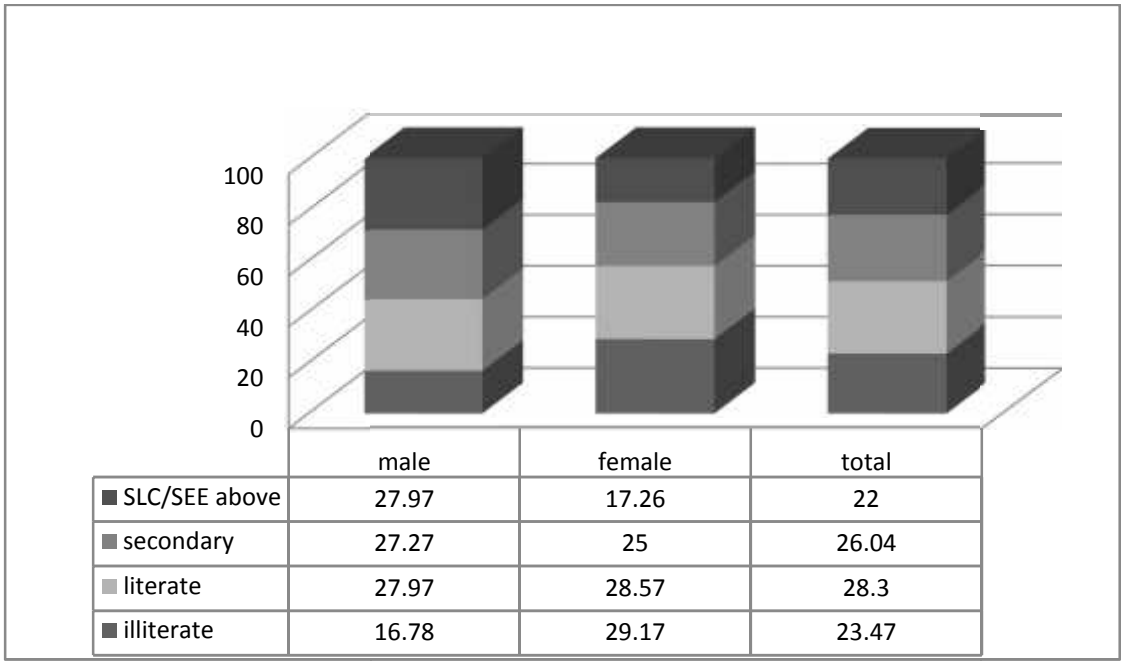
Education is one of the major socio-economic factors that influence a person's behaviour and attitude. In general, the higher the level of education of a people, more the society or country is developed. It is primarily the key indicator of the human development. It plays a vital role in the efforts of any endeavour to uplift a society from repression and scarcity, needs less to say it has a positive role in the success of life. Even primary education is a principal mechanism of fulfilling the minimum learning needs of people needed for effective participation in the economic, social, political and civil activities. Following tables displays the level of the education of the people residing in the study area.

Table 4.5: Population Distribution by Education

S.N.	Education Level	Male	Percent	Female	Percent	Total Percent
1.	Illiterate	24	16.78	49	29.17	23.47
2.	Literate Primary	40	27.97	48	28.57	28.30
3.	Secondary	39	27.27	42	25	26.04
4.	S.L.C. /S.E.E Above	40	27.97	29	17.26	22.
	Total	**143**	**100.00**	**168**	**100.00**	**100.00**

Source: Field Survey 2017

Figure 4.5: Population Distribution by Education



Source: Field Survey 2017

From the above table 4.5 and figure 4.5 can be inferred that, still 23.47 percent of the sample population are illiterate but is lesser than the literate

people. The literacy percent 76.34 is greater than the national literacy rate 65.9 percent (CBS 2011) and it is very positive because the more literate people we have in the society, we can develop our community in a faster rate. Around 48 percent of the population has passed at least SLC/SEE. This figure of literacy rate supports us to claim that we have completed achieving the slogan “Education for all”, up to 2015 especially for the woman and the marginalized group and is also going to complete the Sustainable Development Goal (SDG) of education that all girls and boys complete free primary and secondary schooling by 2030 and also providing equal access to affordable vocational training, to eliminate gender and wealth disparities, and achieve universal access to a quality education. This micro hydro project has also enhanced the quality of education in the WARD NO-5 as schools and colleges are using electricity for operating the electronics teaching devices such as computers, lab equipment etc. Furthermore, children are also using electricity for the reading purpose at home during nights. Hence, this project has made great impact on the education status of people.

4.3 Social and Economic Impacts

Compared to large hydropower projects, micro hydropower (MHP) schemes have relatively low negative environmental and socio-economic impacts. As recent evaluation studies on MHP projects and the along going electricity supply suggest, particularly socio-economic impacts of the plants are to be considered positive. Just like other off-grid renewable energy applications, MHP schemes have a variety of direct and indirect positive impacts, which are often interrelated.

The Social Impact Evaluation is the process of identifying, analyzing and making explicit the changes and modifications that have been produced in the social conditions of people as a result of the implementation of a Project. It is therefore understood that the execution of a project generates changes both in terms of the direct beneficiaries or stakeholders. A key issue in impact evaluation is to be able to determine that the changes produced are the result of project activities and not the result of other actions external to the Project. Social impact assessment is concerned with the human dimension of environments. It balances social, economic and environmental objectives, and seeks to predict, anticipate and understand the potential impacts of development.

With the installation of the Chaunri Khola First Micro Hydro Project, Chauri Deurali Gaupalika Ward No-5 not having the energy services before, and therefore it is feasible to assume that the pertinent changes actually resulted from the project intervention, or that these changes were due to social and economic initiatives that were promoted by the project.

4.3.1 Impact on Education

Nepal is stated is second position with reference to water resource in the world. Most of the rural areas of Nepal have been dark at the night. People have been using kerosene and burning firewood for light. By this situation schooling aged generation is mostly affected. It is attempted to find out that what the education improvement of students' after electricity is.

Table 4.6: Impact on Education

S.N.	Status	Number of HHs	Percent
1.	Improved	33	82.5
2.	Not improved	3	7.5
3.	Same as Before	4	10
	Total	40	100.00

Source: Field Survey 2017

During field survey, researcher managed to ask the question to the respondents about the educational status after launching the project.Table 4.7 shows out of the 40 HHs respondents, 33 HHs respondents told educational status has improved, 3 told it is not improved and rest 4 respondents said it is same as before. Especially, the impact of the micro hydro can be seen in the school and colleges as they are now able to use the modern teaching equipment's. Shree Jagriti Secondary School of Keureni, Araniko Secondary School of Pokhari etc. have now started using computers, printers and various other electronic devices so that students are now more exposed to the modern teaching materials and methods. Also, students are able to study during night with the help of light. This has helped to a great extend to improve the educational status of the Chauri Deurali Gaupalika.

With the availability of electricity, people have also started using radios and television, a means of communication by which they are more aware on every heading day by day and gain more knowledge by listening and watching news, documentary, informative programs and others shows. Very few people also use internet either on a computer or a mobile phone, which

has helped a lot to increase their awareness. So, micro hydro has a great role in improving an educational status of the people.

4.3.2 Impact on Cooking System

In almost all of the rural area of Nepal total energy consumption for cooking is met through firewood and only a small numbers of the families cook using a renewable energy source. They are typically dependent on the traditional method of cooking. Concept of improved *chulo* has just been initiated but it hasn't gained the required momentum.

Table 4.7: Impact on Cooking System

S.N.	Energy Source	HHs(Before project)	Percent	HHs(After project)	Percent
1	Firewood	34	85	30	75
2	Bio-gas	4	10	4	10
3	Kerosene	0	0.00	0	0.00
4	LP Gas	2	5	2	5
5	Heater	0	0.00	4	10
	Total	40	100.00	40	100.00

Source: Field Survey 2017

Table 4.7 explain that biogas is used by very few people in the sample households. Only 4 percent HHs use heater after the development of the project. 85 percent people of the sample household used firewood as a primary source of energy for cooking before the project which is the main reason of the deforestation in the rural area prevailing till today. This is the reason why government has to take seriously for the development of RET (Renewable Energy Technology) in the cooking system at rural areas. Table below gives an overview of the energy consumption for cooking purpose.

4.3.3 Status of Drinking Water and Sanitation

Water resources are valued for human health and for sustaining food production, the energy contained in moving water such as rivers or tides can also be harnessed to create energy through hydropower or mechanical uses. Water has always been an important and life-sustaining drink to humans and is essential to the survival of most other organisms. About 70percent of the human body is composed of water. So, drinking water consumed by the humans must be safe enough to ensure good human health. In our study area, water from the streams is taken through the pipe at the houses. But it has not covered all of the houses. Around 9 houses take water from the single pipe established nearby their house. Furthermore, people do not use filter for the filtration process which causes *diarrhoea* and other communicable diseases time and again especially when the streams are subjected to flood. Hence, sufficient amount of water is available in the Chauri Deurali Gaupalika Ward No-5 but the appropriate management is required for the supply of safe drinking water to every house.

Likewise, without the essential infrastructure, sanitation cannot be maintained at any place. Toilets, safe drinking water, proper management of cow and buffalo dung etc. only ensures the sanitation in the rural areas. We also cannot ignore the level of education in people for the sanitation. It has not been a long time that people are well educated about their health and sanitation. So, at a very slow rate environment is being clean. Moreover, CKFMHP has implemented the programme of improvement of foot trails, local *chautaras,* maintenance of water taps etc. which has the positive

impact about sanitation on the village. Women's and children's work load has decreased with the introduction of electricity, since they spend less time on energy related household tasks such as the collection of fire wood and water gathering rather they give more time on their cleanliness of their house, environment and community.

4.3.4 Impact on Lighting System

The trend of energy using is growing towards the renewable and commercial sources known as electricity. It is also the most reliable and effective source of energy for lighting purpose. But in those areas where electricity is not accessible, kerosene has served as an energy source.

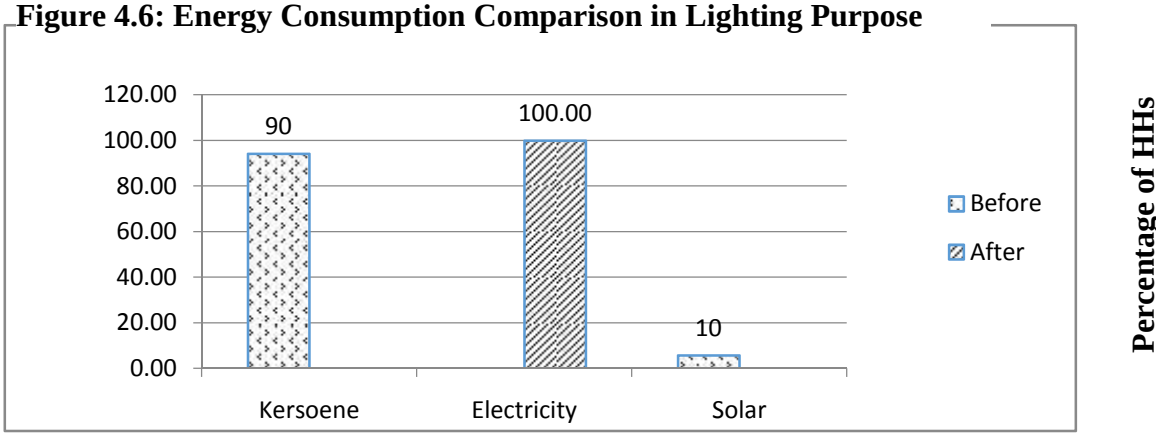
Table 4.7 : Impact on Lighting System

S.N.	Energy source	HHs (Before Project)	Percent	HHs(After Project)	Percent
1	Kerosene	36	90	0	0.00
2	Electricity	0	0.00	40	100.00
3	Solar	4	10	0	0.00
	Total	40	100.00	40	100.00

Source: Field Survey 2017

Chauri Deurali Gaupalika Ward No-5 was isolated from the national grid lines, people were obliged to use kerosene lamp for the lighting purpose.

Figure 4.6: Energy Consumption Comparison in Lighting Purpose



But with the establishment of the micro hydro the scenario has been changed. People are motivated towards the electricity and all of the households in the sample area have started using electricity. Households which used solar previously have not dismantled it; but now they regard electricity as a primary source for energy. Those houses fitted with solar previously use it for lighting purpose and use other electrical appliances such as fan and heater with the help of electricity. Electricity has changed the life style of the people and has helped in their daily work. For e.g. it has helped children to study, women to work inside the house easily during night etc.

In the views of local people, electricity also helps to conserve the forest, control soil erosion process that aggravates the flood and land slide hazard. Hence, people are motivated towards the hydropower development too. With this positive change it is sure that the several health related problems also are going to be reduced to some extent.

4.3.5 Impact on Health

Health care needs of the rural population are always unmet and neglected with the lack of the adequate number of health post and hospitals. Due to the lack of education and increasing number of pollutions, people of rural area are severely affected with numerous diseases. Because of the negligence, minor problems are developed into the major ones. But with the development of micro hydro project, people have drowned up the use of kerosene and firewood for lighting purpose. With the use of electricity indoor air pollution has reduced. Following table shows the peoples view on the health status imparted by the project:

Table 4.8: Impact on Health

S.N.	Status	HHs numbers	Percent
1	Positive	37	92.5
2	Negative	0	0
3	No Change	3	7.5
	Total	40	100.00

Source: Field Survey 2017

From the above table 4.9, it is found that respondents from the 37 households told project has a positive influence on human health whereas none of the people said it has negative impact and finally, 3 HHs respondents said health status has remained same as before. Now, in the Chauri Deurali Gaupalika Ward NO-5, people has started using the CFL bulb and other fluorescent lamp as a lighting equipment, whereas a very few family with small family size also use small heaters for the cooking purpose. Before this project it is found that many people as well as children suffered from the respiratory tract infection, asthma and other several respiratory diseases but with the development of the project, all these problems have been reduced to few in numbers. This is the strong fact which supports the status has been changed in a positive aspect. Lastly, as a whole use of electrical appliance and rise in education level has improved their health status.

4.3.6 Impact on Industries and Job Creations

Micro hydropower plants have to some degree been successful in creating some jobs, like those who manage the pumps, and engineers and mechanists who manufacture and maintain the plants. Since management committee

members of the plants work on a voluntary basis, they receive no compensation. Therefore, it is necessary to study to what degree micro hydropower stations have in increasing or creating jobs. It is also necessary to study enterprises that have come up after electricity was introduced.

Electricity is the foundation of any socio-economic activities. The life is very difficult as well as being backward due to in ability to use to modern technology in the absence of power. After MHP, people lunched varies industries in the study area, which help to raise the income level of the people as well as make the villagers way of living much easier. The firms that lunched after MHP in village are presented as below:

Table 4.9: Impact on Industries and job creations

Firms	Observations	Number of industries
Saw mill	40	1
Rice mill	40	2
Poultry firm	40	2
Spice mill	40	1
Oil expeller	40	1
Bakery	40	1
milk cooling	40	1
Furniture	40	1

Source: Field Survey 2017

From the table 4.10, It is observed that villagers installed 10 small industries where around 40 villagers have partially/fully involved in job. The villagers life become easier after installation of Rice mill, Saw mill, Oil expeller and

Spice mill and able to generate income from these firms. People generate income after installation of Bakery, Furniture and Poultry. The other business such as: Hotel, Stationary, Photo Studio and Medical have been run which generate the income as well as make the social life easier too.

Being more specific, rice mill, flour mill and oil expeller are established in the village after the availability of electricity. Milk cooling centre is also good example of small scale industry which has even gave an employment opportunity to the two skilled people. Saw Millis another example of the established industry in this ward. These industries have now inspired other people to do some creative work and be independent. Hence, there is a huge impact on the industrial sector after the villages being electrified.

4.3.7 Impact on Forest

A forest, a dense growth of trees and underbrush covering a large tract, also referred as a wood, is an area with a high density of trees. Various herbs, shrubs and trees are its composition. The importance of forest cannot be underestimated. We depend on forests for our survival, from the air we breathe to the wood we use, besides providing habitats for animals and livelihoods for humans, forests also offer watershed protection, prevent soil erosion and mitigate climate change.

Forest has a great role in balancing the ecology as well. Deforestation leads to the various natural disaster and imbalance in ecology. But due to our traditional system of cooking with the firewood in the rural areas, forests are degraded day by day in a large number even the total area covered by the forest in Nepal is increased up to 44 percent over. Table given below

displays the result about the impact of the micro hydro development on the forest.

Table 4.10: Impact on Forest

S.N.	Impact	HHs numbers	Percent
1	Destroyed	5	12.5
2	Reformed	7	17.5
3	No Change	28	70
	Total	40	100.00

Source: Field Survey 2017

From the table 4.11, Out of the 40 HHs respondents, 5 respondents told forest has been destroyed even launching the micro hydro project where as 7 of the respondents answered forest has been reformed and finally 54 respondents' i.e. 70 percent said there is no change in the forest destruction as before. 5 respondent replied that forest is still been destroyed because of the establishment of the saw mill which requires wood at a larger quantities to produce different furniture. To sum up, most of the people have been using the firewood as fuel for cooking in the house and cooking *kudo*/*Kholae* for the domestic animals in the rural area. After launching the project almost all people have been using the electricity as main lighting source and very few people has started using heater for cooking. Hence, there is no more change in the forest destruction pattern even after the development of the micro hydro. Still a lot of projects have to be introduced to preserve the forest and implement a forestation program.

4.3.8 Impact on the Environment

Conventional energy sources based on oil, coal, and natural gas have proven to be highly effective drivers of economic progress, but at the same time damaging to the environment and to human health. Keeping in mind, the social, economical and environmental effects of renewable energy system have been analyzed the micro hydro plant. The uses of renewable energy system, instead of, conventional energy system, to control the social, economical and environmental problems are main isues.

The results show that the trends of total emission reduction in different years, which is exponentially increasing after the installation of renewable energy system in remote areas. The clean development mechanism (CDM) is one of the ‘‘flexible mechanisms’’ under the Kyoto Protocol. It provides for industrialized countries to invest in emission-reducing plants in developing countries and to use the resulting ‘‘certified emissions reductions (CER)’’ towards their own compliance with the emission limitation targets set by the Kyoto Protocol. The certified emissions reductions (CERs) would then be calculated as the difference in emissions between the baseline (thermal or gas-fired power plant) and the plants (MHP, SPV, and wind-based electricity). This CDM enables develop countries to meet their emission reduction commitments in a flexible and cost-effective manner, and assists developing countries in meeting their sustainable development objectives. These are also involved in investors to benefit by obtaining certificates of emissions reductions program. CDM is eligible for power plant and depends upon following points: (i) renewable energy, (ii) fuel switching, (iii) end-use energy efficiency improvements, (iv) supply-side energy efficiency improvement, (v) agriculture (reduction of CH4 and NO2 emissions), (vi)

industrial processes (CO2 from cement) and (vii) sink projects. The following risks are in CDM financing: (i) renewable energy plants are connected risk by financing institutions, (ii) multitude of risks could reduce the value of the plant to zero and (iii) measures are needed to mitigate risks at different stages of the plant.

Hydropower systems are a source of clean energy with little or no environmental problems which is driving the growing interest in mini, micro, and Pico hydro systems that generate from less than 5 kilowatts up to 100 kilowatts of energy. There are no environmental problems concerning the use of water sources for MHS purposes In general, there is enough water to both operate the micro hydro and to supply the water service either collectively to the communities or to the individual houses. In environmental terms, the MHP project raises the awareness of proper watershed management and reforestation to secure the sustainable use of water resources. Moreover the plants contribute to protect the environment and combat climate change through reduced use of kerosene/gasoline and small batteries. CKFMHP has also the positive impact on the environment. People have now ignored the use of kerosene and firewood for the lighting purpose. Awareness has been increased among the people, which have helped to maintain good health and environment in the community. There are no any environmental impacts such as dewatering of the riverbed from the intake, potential ground or soil erosion caused by flushing flows discharge from sedimentation basins and overflow of the fore bay, potential ground instabilities caused by canal construction and leakage from canal etc. as proper mitigation measures were adopted during the project construction. Likewise, appropriate means of mitigation such as maintenance of at least 10

percent residual flow in the dewatering section of the river for the aquatic life is also considered for the ecological balance. Finally, it is important to note that impacts not only depend on the MHP itself, but also on what training and campaigns go along with its implementation and in what way the communities tap the full potential of the electricity supply.

4.3.9 Impact on Family Income

Source of the family income are mainly agriculture, business, service etc. Majority of the people have agriculture as their profession but with the developments of the project and the village being electrified they are now motivated towards more in trade and business. Villages are somehow being industrialized but in a very slow rate. The establishment of the small scale industry also has helped to some family to raise their income. Especially, saw mills, oil expeller, milk cooling system etc. are more income generating profession in my study area.

Table 4.11: Impact on Family Income

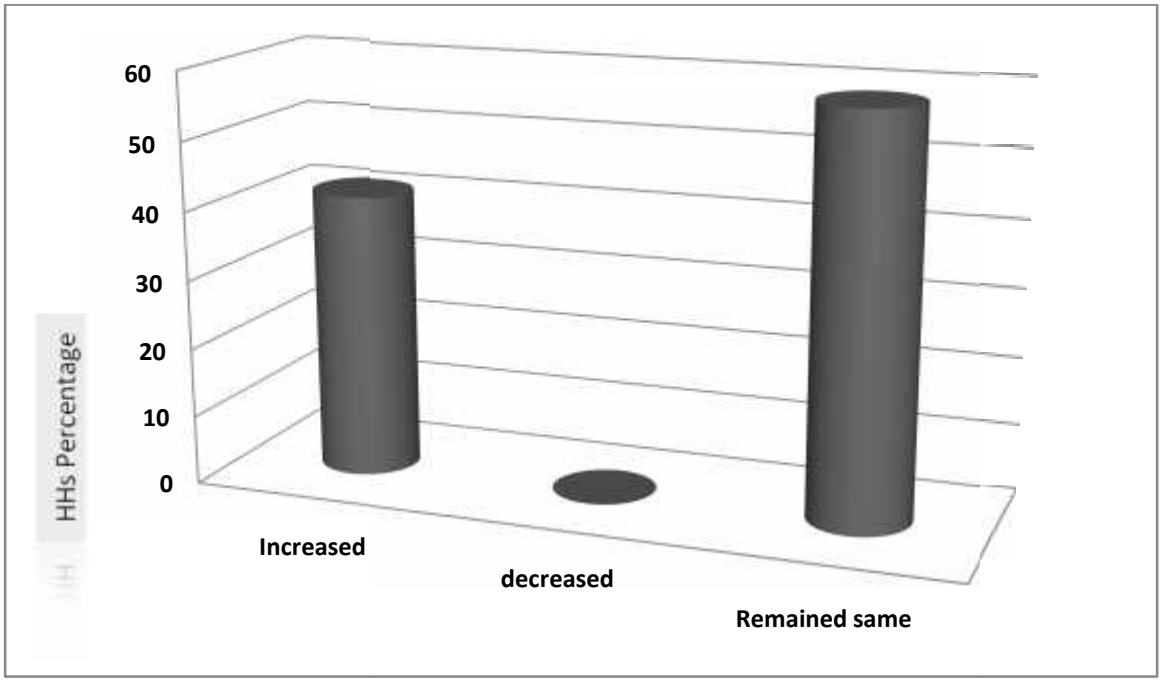
S.N.	Status	Household No.	Percent
1	Increased	17	42.5
2	Decreased	0	0.00
3	Remained same	23	57.5
	Total	40	100.00

Source: Field Survey 2017

From the table 4.12, field survey result suggests us that 17 households income has increased due to the impact of project whereas 23 households income has remained constant as before. Income is being increasing in a low

rate. However, this is the positive sign of being commercialized and it is also the need of present context too.

Figure 4.7: Status of Family Income



Above figure also helps us to correlate the status of the family income.

4.3.10: Impact on Living Standard

Living standard of the people depends on the various factors such as health, sanitation, education, infrastructures, income, market etc. With the development of these factors, living standards of the people are automatically upgraded. By the development of the micro hydro all of the factors have the positive influence on them, which can be also be concluded from the information provided above in this report. Following table gives us an idea about the impact of micro hydro on the living standard:

Table 4.12: Impact on Living Standard

S.N.	Indicator	Number	Percent
1	Increased	32	80
2	Decreased	0	0.00
3	No Change	8	20
	Total	40	100.00

Source: Field Survey 2017

The table 4.13 shows that about 80 percent household told that their living standard increased due to the project whereas 20 percent respondent said that there is no any change in their living standard and none of them said that the living standard has decreased. Even though, income of the only 42.5 percent household respondent has increased but living standard of 80 percent is found to be increased. This is all due to the positive change in other aspect of quality of life such as education, health, sanitation etc.

4.3.11 Impacts on Cultural Heritage

Cultural heritages are the assets of the society. They are linked to the environment, human and social development activities. They are passed from one generation to another. Almost all the human activities such as life-styles, economic activities, and social activities are related to the culture of the people. Here in our case the total length of the project is about 1350m and there are no any kinds social or the cultural heritages situated in between

the intake and powerhouse. Its construction has not affected any heritages such as temple, *patipauwa*, *dhungaedhara*, religion, belief, traditional practices and others. Hence, there is no conflict at present and also there is no any possibility of conflict to be created due to this project in future. In contrast to this people of the numerous ethnic groups have active participation during the construction phase and in the implementation phase at present. People of every religious group, marginalized group and from every profession are included in the functional group of the project. Rather project has initiated the development activities like construction and maintenance of the *foot trails, local chautaras*, and drinking water taps which have uplifted the enthusiasm of local people.

4.3.12 Impact on Skill Development

People of the local areas were involved with very interestingly about the project construction methods during the construction period. It helped them to develop technical skills of construction methods. Some youths had explored their skills such as civil works, welding, metal works, panting electric wiring etc. Similarly, construction workers acquire valuable skills while working for the hydropower project. Project also trained company staff and local people about various sectors. SSHP has provided various training in skill development like basic plumbing, masonry, scaffolding, basic carpentry etc.

4.3.13 Status of Irrigation

Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, during periods of inadequate rainfall. Irrigation is a key factor for farming.

There is no chance of maximum production of crops in the absence of irrigation. Nepal has a cultivated area of 2,642,000 ha (18 percent of its land area), of which two thirds (1,766,000 ha) is potentially irrigable. WECS (2011) reports 42 percent of the cultivated area has irrigation of some sort, but only 17 percent of cultivated area has year round irrigation. An estimate shows that less than 8 percent of the country's water potential is used for irrigation. As our study area is located in hilly region there is neither there provision of regular irrigation in the field nor the proper management. Farmers are particularly dependent on the rainfall. Due to the lack of management, people are demotivated towards agriculture and are interested to invest in the other sectors like business and services.

4.3.14 Status of the Toilet Use

Few years back, people of the Chauri Deurali Gaupalika used to defecate in the open areas. But with the increase in educational status of the people they are now aware and concerned about their health and sanitation problem caused due to open defecation. The scenario has been changed due to the joint effort from the government and various non-governmental organizations. These organizations have ensured the provision of toilet and its proper use in every home and have made the rural areas free of open defecation. In our study site, out of 40 HHs, all of the houses have now modern toilets. So, people have also realized the impacts made by it and they say that their life has become easier by the constructions of toilets. Project also has conducted different awareness program about sanitation and environment conservation at a local levels.

4.3.15 Impact on Women's Participation

Women are backward in our society with reference to every issue. They have not courage and proper knowledge about every subject matter. Men and women are known as two cards of a wheel but it is limited only in saying not in reality. It is attempted to find out the status of women's participation in maintenance and use of electricity by a question high, low or zero as shown in below:

Status of Women's Participation in Maintenance and Use of Electricity

Table 4.13: Impact on Women Participation

Status	Number	Percent
High	12	30
Low	15	37.5
No	13	32.5
Total	40	100.00

Source: Field Survey 2017

The table shows that status of women participation in maintenance and use of electricity. Out of the total 40 respondents highest proportion i.e. 15 (37.5 percent) reported that women's participation is low in maintenance and use of electricity. Likewise lowest proportion 12 (30 percent) reported high and remaining 13 (32.5 percent) reported there is not women's participation in maintenance and use of electricity.

To sum up it is known that "Men and women are two cards of wheel." So equal opportunity and participation is necessary in maintenance and use of electricity. Due to lack of awareness and traditional thinking women's participation is constituted low proportion.

4.3.16 Impact On Saving/Cooperative

The social and economic benefits of cooperatives can have far reaching impact. Due to the democratic organisation and the economic orientation, cooperative contribute significantly to social integration, job creation and the reduction of poverty. Cooperatives are thus stabilising regional economic cycles and can generate regional employment.

There was no any cooperative in this area were lunched before this micro hydro project. At the time of finishing the project 2057 BS, the Chauri Khola Micro Hydro cooperative was established. There is total share member is 475 and its capital share is around 17 lakhs over. This cooperative is providing job, loan, and lot of entrepreneurship training in this area.

4.3.16 Negative Impacts on Environment

Since no large reservoirs are required, no resettlement programs and the along going negative impacts for the population occur. Nonetheless some scientist argue that particularly the environmental impacts of small-scale hydropower, when widely used, would be no less serious per KW generated than those from large scale hydropower plants. The impacts of hydropower schemes depend on the way they are designed. Since MHP schemes do not require a reservoir and divert only part of the stream water away from a portion of the river to power the turbine, they only have little impact on the flora and fauna of the vicinity. However they tend to create small, shallow pools which can cause problems such as sedimentation can thus affect water quality and lead to greenhouse gas emission. Particularly a decrease of water

quality can furthermore cause water borne diseases and thus affect the health situation of the population. Moreover aquatic species can be affected negatively in terms of migration and change of habitat condition. Due to the MHP and the along going electricity supply, a population growth close to the powerhouse is likely to occur. Thus the pressure on natural resources and the risk of erosion in areas close to the powerhouse is increased. The increased degradation rate can lead to an increase of sediment load of the river as well as to a reduction of the soil's retention capacity, which can in turn result in an alternation of the discharge rate, showing in longer dry periods and an increased risk of flash floods. Consequences might be that a sustainable use of the MHP cannot be provided. Further environmental impacts might be deforestation due to the construction of access roads and grid connection power lines.

CHAPTER 5 : SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1.1 Summary of Findings

Hydropower is a clean source of energy. It does not consume but only uses the water, and after use the water is available for other purposes (although on a lower horizontal level). The conversion of the potential energy of water into mechanical energy is a technology with a high efficiency. The use of hydropower can make a contribution to savings on exhaustible energy sources (fossil fuels). MHP contributes to sustainable development by being economically feasible, respecting the environment (avoiding greenhouse gas emissions) and allowing decentralized production for the development of dispersed populations. MHP plants create local jobs for the monitoring of the operation of the plant.

Results obtained from our field survey conducted in 2017 in the Chaunri Deurali Gaupalika Ward No.-5 Balu, Ramche, Harre, Biruwa and Pokhari of Kavrepalanchowk district can be summarized as follows:

- Total population in our study area is 1360 comprising male 563 and female 797 people. But considering only 40 HHs through a random sampling process, total male population was found 143 and female population was found 168.
- Population of female is found greater than males in our sample population.

- People with Chhetri ethnic groups were found large in number with 40.51 percent followed by bramhan 40.19 percent.
- 56.27 percent of the people have followed agriculture as their professions while other minor percentage has regarded their profession as students, foreign employment, service and business.
- About 83.22 percentage of our sample population are literate which is much greater than the national literacy rate i.e. 65.9percent.(CBS-2011)
- People have started teaching to the females as well. 70.83percent females are literate while total of 17.26percent population have attained higher school education.
- There is no change in the energy consumption pattern for cooking purpose. 30 (75 percent) HHs use firewood as a main source of energy for cooking either before or after the construction of the project. Only 4 HHs are using a biogas technology and 4 HHs are using heater.
- There is noteworthy improvement in the lighting system of the village. All of the households have started using the light from the micro hydropower.
- Micro hydro has a great influence on the economic status of the people. Out of 40 HHs 17 (42.5 percent) households economic status has been increased while 23 (57.5 percent) HHs remained same.
- With the availability of several facilities with the development of micro hydro, living standard of 80 percent HHs has increased.
- Deforestation rate is same as that of before. Only 7 (17.5 percent) HHs responded that forest is being reformed. 5 (12.5 percent) HHs

respondents said the forest is still being destroyed while 28 (70 percent) HHs respondents replied that there is no change in the forest destruction pattern.

- The educational status of the people has been improved. 31 (82.5 percent) HHs respondent have the positive influence of electricity on their education.
- Different 10 industries have been established by the introduction of electricity on the village. Which are helping to increase the income as well as living standard of the households.
- Majority of the population felt they have positive impact on their health. About 92.5 percent HHs replied the status of the health has improved.
- People have now improved sanitation status slowly. With the rise in educational status and health status people are more concerned and aware about it.
- *Foot trails*, local *chautaras* are maintained by the CKFMHP. Also, drinking water taps are maintained in some cases.
- Project has the positive impact on the skill development of the people. During the construction period several construction training were given to the people with the mobilization of local materials and manpower for the project construction.
- We are well known to the fact that micro hydro projects are the pollution free projects. So, there is no any effect of project on the environment rather it has reduced the use of kerosene and dry cell batteries. Also, it has released enough water at downstream for the ecological balance.

Energy is a basic requirement for development. The development of all the productive sector of an economy depends on development of the energy sector. In general there are two types of energy sources viz. traditional and commercial. Electrification creates various opportunities of development activities in rural area. Traditional source of energy are not sufficient to meet the energy demanded. The use of fossil fuel is also costly and it negatively pressurizes on the balance of payment in the economy. Over pressure on forest creates various problems.

This study attempts to appease the importance of electricity in economic development. It also discusses about hydropower potentiality and its present status in Nepal and impacts of CKFMHP on socio-economic condition of people in the area around the project.

Nepal has great potentiality of hydropower. The theoretical potentiality of hydropower is estimated to be 83,290 MW on the basis of hydrology and topography the technical hydropower potential is accounted 45,520 MW and the economically exploitable capacity of the kingdom, however, is 42,000 MW.

The hydropower development in Nepal has long history starting from the local water mill known as Ghatta. The first hydropower plant was Pharping hydro project (500 KW) which was built in 1911. The government has been lunching the development programmes in accordance with economic plan. Every plan has given to priority to hydropower development for national development.

Before introducing of the development plans, only 207 KW hydropower was generated in Nepal. Then first five year plan failed to generate power, 2,400 kw: 13000 kw 16.040 kw 16220 kw, 77.577 kw, 90,172 kw, 25,500 kw and 274,514 kw hydropower were generated during the second ,third, forth, fifth, sixth, seventh, eight ninth and tenth five year plans period from large as well as small scale projects respectively. Small-scale micro hydro power is both an efficient and reliable form of energy, most of the time. However, there are certain disadvantages that should be considered before constructing a small hydropower system. It is crucial to have a grasp of the potential energy benefits as well as the limitations of hydro technology. There are some common misconceptions about micro-hydro power that need to be addressed. With the right research and skills, micro hydro can be an excellent method of harnessing renewable energy from small streams.

5.1.2 Conslusion

Reference of this study, researcher found about the attitude of the local people toward development is increasing. After the project they are very much aware about the local development activities and are aware about small hydropower development, but before this project they were totally unknown about hydropower development. However, additional thorough investigation is needed to evaluate the impacts of the project on social equity at a local level.

Overall we can conclude that Chaunri Khola First Micro Hydro Project (CKFMHP) has been successful in the Chauri Deurali Gaupalika -5 of Kavrepalanchowk district. It has numerous positive impacts on the people life either directly or indirectly. It can also be proved by the active

participation of the people during construction and the people's involvement in the several income generating activities after the project implementation. In addition to this, educational status, industries establishments' rate, status of the heath and sanitation, increase in income and living standard clearly directs us to a conclusion that social and economic status of the people has been raised.

5.1.3 Recommendations

After the study of the socio-economic impacts imparted by the CKFMHP, following recommendations is made to the government, policy makers, NGOs, INGOs and all other developers who are working on this sector either directly or indirectly:

- Nepal is rich in water resource but there is not specific vision and policy of state. Therefore the government should formulate and implement the appropriate policy.
- Government of Nepal should emphasize in the development of Renewable Energy Technology (RET).
- Government is frosted and quiet in the sector of small as well as large scale MHP. Government should increase the amount of subsidy for these projects
- Local communities should be empowered by creating awareness of individual's rights and responsibilities in the project.
- Affected people by a project should be encouraged to participate or take ownership, as appropriate.

- Developers should be accountability and transparent to the local people about project cost and benefits.

- Local stakeholders should have active participation for share distribution of the project. This ensures the fundamental rights of utilization of local natural resources and help to increase of the local stakeholder's income.

- Community must be sensitive to demand necessary facilities.
- Social equity and justice mustn't be excluded in a development of micro hydro project.
- Project-induced resettlement should be avoided or minimized; if resettlement is required, adequate and timely compensation and rehabilitation measured must be provided to fully offset social and economic losses.
- Detail survey and estimation should be conducted the identity and install CKFMHP which can which can be invested by foreign Donor Agencies.
- The multipurpose micro hydropower project should be installed to promote industries especially cottage and small scale industries and irrigation facilities. Strong financial agencies should be established to facilitate the investment on the development of small hydropower project.
- The environmental friendly, technically feasible and economically profitable hydropower plants like CKFMHP should be installed.
- Small hydropower project should be installed in rural, isolated and hilly areas.
- Priority should be given for the development of small hydropower project because it helps to reduce regional imbalance of development,

meet the local and national demand for electricity and implement, large scale project as export oriented project.

- The private sector should be encouraged to develop hydropower especially small hydropower project like – CKFMHP. Efficient plants and equipments like that CKFMHP should be sued in hydropower project, which many help to generate high power at low cost.
- Electricity duty should be reduced to encourage small and cottage industries in rural areas e.g. saw mill, herbal product industry. Cold storage, cheese and ice cream factory etc.
- Siren or any other alternative system should be kept in the project site to save people from any kind of possible dangers.
- Participatory approach should be adopted to involve local people in the developmental activities as far as possible.
- In every opportunity preference should be given to the local people.
- A portion of project's revenue should be invested to launch various programs for raising the living standard of the people.
- Income generation programs should be launched by project in the study area.

In short it is recommended that mitigation measures must be closely monitored and upcoming hydropower project should avoid the short comings of the CKFMHP. This is the lesson we must learn from the Chaunri Khola First Micro Hydro Project to develop other hydropower project to develop other small hydropower projects throughout the hilly areas of our country.

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ANNEX-1

Study of Socio-Economic Impact of Chauri Khola First Micro-Hydro Project

Date:

General Information

Household No. :

Name of the household head:

Respondent Name:

1) Gauplika: Ward:
   Village/Tole:
2) Caste/Ethnicity:
3) Sex: M\F Age:
4) Religion:
5) Main occupation:
6) Marital status: Married\Unmarried
7) Education: Literate [ ] Illiterate [ ]
8) Family details:

S.N.	Name	Relation with HH	Sex M\F	Age	Education	Occupation	Marital status

Education: 1-Illiterate, 2-non formal, 3-primary education, 4-lower secondary, 5-secondary, 6-intermidate, 7-higher

Occupation: 1-Agriculture, 2-Business, 3-Service, 4-Student, 5-Others

9) Before implementation of this project, did you use electricity?

(a)Yes [ ] (b) No [ ]

10) After of this project are you using electricity?

(a)Yes [ ] (b) No [ ]

11) If no, why?

12) Energy use for housing purpose

	Cooking	Lighting	Using Radio\Television(Y/N)	Others
Before				
After				

1-Firewood, 2-Kerosene, 3-Electricity, 4-Biogas, 5-Solar, 6-Others

13) Is electricity use more effective and easy for housing purpose?

(a) Yes [ ] (b) No [ ]

14) Has your lifestyle changed due to electricity?

(a) Yes [ ] (b) No [ ]

15) If yes, what types of changed has occurred?

16) What is the status of your family income after project implementation?

(a) Increased [ ] (b) Decreased [ ] (c) Remained same [ ]

17) What is the condition of forest after launching this project?

(a) Destroyed (b) Improved (c) No change

18) What is the status of sanitation in the village after electricity?

(a) Improved (b) Same as before

19) What kind of change occurred on your health after the project being implemented?

(a) Positive (b) Negative (c) No change

20) Does the production of crops and livestock meet the annual food demand of your family?

(a) Yes (b) No

21) Is there irrigation facility in your land?

(a) Yes (b) No

22) If yes, what is the status of irrigation of facility?

a) Regular b) Irregular (c) Sometimes

23) Has the project affected to drinking water supply?

(a) Yes (b) No (c) Unknown

24) Are there any kinds of industry established after project implementation?

(a) Yes (b) No

25) If yes what kinds of industry has been established?

Name and types of industries	Function of industries

26) Are your family members employed in the industries?

a) Yes (b) No

27) Has the project contributed to the local development activities?

(a) Yes [ ] (b) No [ ]

28) If yes, in which sectors?

29) What is the educational status of your children after electricity facility?

(a) Improved (b) No improved (c) Unknown

30) Has the education system changed after the project implementation?

(a) Yes (b) No (c) Unknown

31) Is there environmental pollution after this project?

(a) Yes (b) No

32) Is there any increase in migrated people after this project?

(a) Yes (b) No

33) If yes how many people?

34) Has the project affected your any social and cultural properties?

(a) Yes (b) No

35) What is the impact of project in infrastructural development?

(a) Positive (b) Negative

……. …….

……. …….

……. …….

……. …….

36) Do you have the continuous power supply from the powerhouse?

(a) Yes (b) No

37) Is there any maximum limit (or boundary) of the electricity use for housing purpose?

(a) Yes b) No

38) Who is responsible for maintenance of the powerhouse and other components?

(a) User committee (b) The plant owner

39) What is the women's participation in this project?

(a) High (b) Low (c) No change

40) Are you satisfied about the electricity facility provided by the project?

(a) Satisfied(b) Unsatisfied

41) Do you have you any relation with project?

(a) Yes [ ] (b) No [ ]

42) If yes, what types of relation?

43) Did the project affect on your property?

(a) Yes [ ] (b) No [ ]

44) If yes, how did it affect?

45) Did you get compensation of affected property?

(a) Yes [ ] (b) No [ ]

46) If yes, what did they give to you?

47) If not, why?

48) Do community people have conflict or contradiction with the project?

(a) Yes [ ] b) No [ ]

49) If yes, what types of conflict do they have?

50) Are you interested to establish any kinds of income generating local industries after this project(Y/N)?

51) If yes, what industry?

52) What kinds of changes do you have in your living standard after the project?

a) Increased (b) Decreased (c) No Change

53) What types of toilet do you use?

a) Pakki (b) Kachhi (c) No any toilet

54) Did you get any training during the project construction?

a) Yes[ ] (b) No [ ]

55) What type of activities should be done for sustainability of the project? Give your suggestion.