

# **CHAPTER-I**

## **INTRODUCTION**

### **1.1 Background of the Study**

Hydropower is a renewable, non-polluting and environmentally benign source of energy. Hydropower is based on simple concepts. Moving water turns a turbine, the turbine spins a generator, and electricity is produced. Many other components may be in a system, but it all begins with the energy in the moving water. The use of water falling through a height has been utilized as a source of energy since a long time.

Generally, a micro-hydro power plant is a system where one can produce as much as a few hundreds of Kilo-Watts of electricity using the run-of-river source. This method is used in the regions where there is availability of different river sources for hydroelectric power, but at low discharges so that one can produce low amount of electricity.

It is perhaps the oldest renewable energy technique known to the mankind for mechanical energy conversion as well as electricity generation. In the ancient times waterwheels were used extensively, but it was only at the beginning of the 19th Century with the invention of the hydro turbines that the use of hydropower got popularized.

Small-scale hydropower was the most common way of electricity generating in the early 20th century. The first commercial use of hydroelectric power to produce electricity was a waterwheel on the Fox River in Wisconsin in 1882 that supplied power for lighting to two paper mills and a house. Within a matter of weeks of this installation, a power plant was also put into commercial service at Minneapolis. India has a century old history of hydropower and the beginning was from small hydro. The first hydro power plant was of 130 KW set up in Darjeeling during 1897, marked the development of hydropower in the country. Similarly, by 1924 Switzerland had nearly 7000 small scale hydropower stations in use (Singh, 2009). Even today, Small hydro is the largest contributor of electricity from renewable energy sources, both at European and world level. With the advancement of technology, and increasing

requirement of electricity, the thrust of electricity generation was shifted to large size hydro and thermal power stations.

However, it is only during the last two decades that there is a renewed interest in the development of small hydro power (SHP) projects mainly due to its benefits particularly concerning environment and ability to produce power in remote areas. Small hydro projects are economically viable and have relatively short gestation period. The major constraints associated with large hydro projects are usually not encountered in small hydro projects. Renewed interest in the technology of small scale hydropower actually started in China which has more than 85,000 small-scale, electricity producing, hydropower plants.

(Micro Hydro.(n.d.).Retrieved August 10. 2016 from <http://www.scribd.com/mobile/document/36918138/Micro-Hydro>).

Hydropower will continue to play important role throughout the 21<sup>st</sup> Century, in world electricity supply. Nepal is not rich in fossil fuel resources but it has plenty of renewable energy resources, in particular water that is running down from the vast Himalayan mountain ranges in over 6,000 rivers. With 365 sunny days a year, the sun's freely available solar energy can also be converted into electricity. In Nepal Pharping micro hydro of 500kw was the first hydro plant established way back in 1911. But after a long interval of 25 to 29 years two other hydro plants namely Sundarijal 900kw (640kw after interchanging of frequently from 50 Hz to 60 Hz) and Panauti 2400kw came in to operation the demand of electricity increased manly on Wards from 60s bigger hydro-power increased almost 20 times (Ghimire, 2007).

Nepal is presently facing an energy crisis of unprecedented proportions. The 706 MW total installed capacity of Nepal Electricity Authority, supplemented by net purchases from India, is inadequate to meet demand (NEA). Load shedding has thus become the rule of the day. In this context renewable energy development continues to be a high priority program of government as it provides a least cost solution to remote, sparsely populated areas unviable considered for the hybrid system.

The compulsion to access electricity via national grid at higher cost due to geographical structure would be eliminated by the establishment of hybrid systems where people of such region can experience a reliable, affordable and continual

supply of power by exploiting the locally available renewable resources. Nepal Electricity Authority is only the organization responsible for the generation, transmission and distribution of electrical energy in Nepal. The major of population in Nepal are deprived of electricity only due to their geographical locations where the extension of national grid line is economically not feasible, thus dependence upon traditional sources of energy has been a compulsion to fulfill energy needs. The current energy crisis in Nepal clearly indicates that the future energy- demand cannot be met by traditional energy-sources. In coming years it would be a necessity as well as requirement to switch from conventional sources to renewable energy resources to fulfill the energy demand.

## **1.2 Statement of Problems**

The major energy resource base in Nepal consists of biomass, hydroelectricity, petroleum products, natural gas and coal reserves. The status of energy consumption in the FY 2015/16 is seen about 50 percent households are using the firewood, 38 percent households are using petroleum products, 3 percent per each household are using renewable source and cow dung, 2 percent per each household are using electricity, coal and agricultural residues (MoF, 2016). Among the entire energy resource base, it is evident that biomass is the dominant resource of the country with respect to its utilization. Nepal has a huge potential for hydropower production, but currently this remains mostly untapped. Other commercial forms of energy are not known to exist in any significant amount.

Nepal's current electricity supply is unreliable, expensive, and insufficient. These supply problems can be attributed to a number of factors, including: "high transmission and distribution losses, piecemeal expansion of the national grid, high cost of power purchase agreements, inefficiencies at the Nepal Electricity Authority (NEA), and underutilization of existing capacity." In particular, this report addresses the inadequate development of Nepal's potential hydroelectric capacity. The insufficient electricity supply imposes a number of costs on society, including equity costs, health and environmental impacts, and economic losses due to unreliable connectivity and productivity losses (Bergner, n.d.).

Despite having one of the world's largest hydropower resources in the world, Nepal lacks reliable and sufficient access to electricity. Overall, of the theoretical hydropower potential of 83,000 MW, about 42,000 MW are technically and economically viable for exploitation. However, the Nepal Electricity Authority (NEA) reports current annual hydropower output of 659 MW. This amount is insufficient to meet domestic energy demand, let alone serve as a potential source of export revenue to bolster Nepal's struggling economy. Despite having among the highest commercially feasible hydropower potential, Nepal has harnessed about 1 percent, far below the level of every other South Asian country.

Approximately 67 percent of the population has access to electricity, and only 5 percent of the rural populace has access to electricity from the national grid. Even residents in Nepal's capital city of Kathmandu experience outages several times a day for up to 16 hours during the dry season. In the FY 2014/15, the total electricity production stood at 829.19 MW while it reached 847.68 MW during the first eight months of the FY 2015/16 with the augmentation of 18.49 MW against the current demand of 1,385 MW. Though about 250 MW is being imported from India, the wide gap between the energy demand and supply is attributable to the persistent long hour-load shedding consequently affecting the life of the people and the overall economy (MoF, 1016).

Providing electricity from national grid to all Nepal is very difficult because of expansion costs, scattered settlement, low electricity production from mega hydro project according to demand, high cost of supply to rural area etc. The micro hydro power projects are the best alternatives to provide electricity to rural area with cheap cost. MHP are helping to rural people by providing electricity with cheap cost and no load shedding on the one side and on the other side it provide the irrigation facility to the nearby people. Where there is impossible to provide electricity from national grid, MHP can easily establish. So, there are many Nepalese households are benefited from the MHPs. But on the other hand there are many difficulties to run the micro hydro smoothly and continuously in remote area due to the external support and other constraints.

Electricity supply by MHP enhances the different impact on socio-economic condition. MHP enables inhabitant to make saving on expenses on kerosene,

firewood, candle etc. so the income will be raised. Further more children have more productive time which can be used for studying and thus education is increased. MHP decreases the Indore air pollution and the risk of fire so the health situation also increased. The inhabitants use different technical equipment, more doctors and teachers are attracted to the mostly remote areas which further improve income, education, health and community life.

Under that background, the study focuses to answer the following questions.

- i) What are the impacts on employment generation, income and expenditure by Lenget Khola Micro-hydro project in Uhiya VDC of Gorkha district?
- ii) What is the sustainability of Lenget Khola Micro-hydro project?

### **1.3 Objectives of the Study**

General objective of the study is to evaluate the socio-economic impact of Micro Hydro Power on its users in Uhiya VDC of Gorkha district. Besides this, the study has following specific objectives.

- i) to analyze the impact on employment generation, income and expenditure by Lenget Khola Micro-hydro project.
- ii) to examine the financial and economic sustainability of Micro-Hydro Project.

### **1.4 Significance of the Study**

Many people around the world live in areas where the water streams and Rivers are potential sources of energy supply for lighting, communication and processing industries (small and big). This has proven to be a very valuable natural resource, which can be exploited even at lower levels through building of small hydro power schemes that can go as low as few kilowatts to assist communities.

This project is to contribute among the existing other projects in rural development planning and improved energy supply through the simplest technology, “micro hydropower” that can be afforded and handled by rural villagers in Nepal like Lenget Khola river taken as the case study in our project.

Electricity is basic pillar of economy which helps to enhance stander of living of people by different angle among which make life style of people easier. There is establishment of large industries to small industries which as used ruler materials. This study has been round on the pivot of impact MHP on the socio economic aspect of the ruler people. Outcomes of this study will help to access the impact of the MHP on income of its client of the Uhiya VDC of Gorkha discript.

To find out the socio economic impact of micro-hydro in Uhiya VDC and to say how it is beneficial for rural villagers is one of the most important parts of this study. So, finding of this study is useful for policy maker, user of MHP as well as those who are interested in the MHPs. This study will also useful for those organizations that are working in the field of economic development and rural electrification, poverty alleviation etc.

### **1.5. Limitations of the Study**

The main limitations of the study are as follows:

- i) This study only depend on users of Lenget Khola MHP of Uhiya VDC of Gorkha district.
- ii) This study is based on the sampling of 60 households.
- iii) The study examines the impact of income, expenditure and employment generation; however it does not examine other dimension of impact.

### **1.6. Organization of the Study**

This study has divided into 5 chapters. Prior to the body of the thesis several pages of preliminary materials such as title page, approval sheet, viva sheet, acknowledgements, table of contents, list of table, abbreviation used etc have been presented.

The first chapter consists of introduction of the study, background of the study, statement of the problems, objectives of the study, and significance of the study, limitation of the study and chapter plan. Second chapter includes review of the literature. Review of literature will be taken into consideration through relevant

books, thesis, articles, journals, reports and other concerned materials. Third chapter deals on study area, research design, nature and source of data, data presentation and analysis, and method of data analysis and interpretation. Fourth chapter encompasses presentation of data, and analysis. Fifth chapter covers summary and conclusion of the research. This chapter also encompasses recommendations made as per the findings of research and analysis.

## **CHAPTER – II**

### **LITERATURE REVIEW**

This chapter contains review of the relevant literature in the available from of published books, journals, articles, theses and previous research works related to the past study. This chapter has been broadly divided in to review of international and national studies.

#### **2.1 Review of International Studies**

Sarfoh (1990) has examined that Africa has the highest potential for hydropower development. It is also behind other regions in developing that potential Sarfoh argue that hydropower was not developed to the required levels in west Africa because of the initial high cost of hydropower plants, low domestic power makes and ignorance of hydro resources and future energy needs.

The authors propose remedies a full assessment of present and future energy needs change in fundamental features of the politics and economics of various countries expansions of electricity to rural populations and regional cooperation in hydropower development. The author's observation that "more availability of resources and the advantages which hydroelectric power offers have not as yet induced any appreciable level of hydro-electricity generation" Concisely illustrates the essence of professor Sarfoh's discussion in this book. The author examines the energy consumption practice of West Africans and the potential of several energy resource endowments of the sub region The further states that only the development of hydropower from West Africa's. river systems can satisfy those needs. As domestic sources of energy, hydroelectricity will be cheaper and more accessible than foreign oil and less damaging to the environment than the depletion of forests for firewood. The author implies a relationship between the obstacles to hydropower development and domestic politics and economics while such a relationship might very well exist, the author does not demonstrate it.

WECS (1995) examined the needs of energy in our lives cannot think of survive without energy. Energy is compulsion for the development purposes after the utilization of the energy properly and aptly then the status of education, condition of



health, development of infrastructure, transportation facilities are gear up which leads a country on the prosperous way of development due to which living standard of people automatically sky up and it is vital for economic development and employment, it is also a critical factor for Shortage of biomass fuels has forced urban households and industries to switch from biomass fuel to imported fossils fuels and other commercial form of energy. Deforestation and desertification are threatening or traditional energy supplies and agro-base rural economy. These shortage of biomass fuel in rural sector have energy care and needed to promote rapid economic growth. To meet the basic need of rural families is also plagued by the lack and other resources example farmland technology and capital for investment.

Bose (1997) has mentioned that the construction of such a big dam in mountain leads to great controversial issue. The constructions of such large dam in the mountain environment in seismic zones create a great sensitive issue for further disaster and hazards. For example Tehri Dam project in Uttarparadesh. He further stressed that development must be centered on the people with most conserving to environment. In a democracy, the development process must be participatory in nature. He suggested that in the name of science and technology, development should not become culturally incentive and there should be detailed planning for disaster management, natural disasters as well as manmade is necessary.

Khandker, Barnes and Samad (2009) in his study in Bangladesh, based on cross-sectional household survey data from 2005, found that the incomes of households in electrified areas are 12.2 % higher than those of comparable households in non-electrified areas. The authors found positive effects on both farm and non-farm incomes, but do not explore the actual causes of these effects. Another finding of the study is that the positive impact increases with the duration of electricity access during the first 8 to 9 years, after which it levels off.

ADB (2010) conducted a study in Bhutan and found positive effects of electrification on non-farm income but not on farm income. Non-farm incomes of electrified households were found to be 50-72 % higher than those of unelectrified households, but these accounted for only 21-29 % of household income. According to the authors, this can be explained by the fact that the study area was experiencing a severe drought during the survey and that only one of the four surveyed provinces had irrigation

infrastructure. On average, however, the study found incomes to be significantly higher for home businesses using electricity than those who do not use electricity. Nevertheless, it should be mentioned again that this study does not control for other factors that could have influenced the distribution of incomes.

Tshering and Tamang (2012) concluded that all plans and policies in the hydropower sector are geared towards contributing to achieving economic self-reliance and overall socio-economic development of the country. The sustainable development strategies incorporating the social and environment concerns of hydropower development will lead to successful implementation of hydropower projects. Most of Bhutan's hydropower plants (both already built and proposed to be built in future) are mainly run-of-the river schemes with no impact or minimal impact to the environment. Socially, these planned projects will have no negative impacts. The people will benefit from the project's spin-off effects like the project road access, grid electricity, schools & hospitals built during project construction period and other income generating activities including some employment opportunities with the project. This is over and above the benefit to the national economy.

Saqibi, Khan, Ali and Amir (2013) have concluded that micro hydro power project have significant impact on improvement in family income. The households with improvement in family income had given the reason of employment of their unpaid family workers, involved in subsistence farming before the project in area. That (90.3%) of the respondents were given the same reason as the availability of off-farm employment opportunities due to the project in area. About 47.48% increased was calculated in income and about 46.71% in expenditure of the sampled households due to the availability of jobs from the MHP project. Majority (33.3%) had spent extra money on improving their house structure (constructing new rooms, kitchen, washroom, toilets, replacing wooden gates with steel made gates), about (18%) spent on children education and (17.3%) improved their household intake. It shows that utilizing all the available efficiency of 300-MW in northern areas of Pakistan, for such type of micro hydropower projects can bring positive change in power generation sector as well as capable to solve unemployment problem in rural areas.

Umar and Hussain (2013) conducted a study entitled "Micro hydro power: A source of sustainable energy in rural communities: Economic and environmental

perspective”. This study is mainly based on descriptive analysis which shows the socio economic information like the main source of income, area of agriculture land and the main source of lighting etc. The results indicate that the main source of lighting for MHP households is the electricity generated from the MHP plant. While for WAPDA users the main source of lighting is kerosene oil, generators and mostly DC chargeable lamps. Moreover, the MHP connected households are better up in terms of the monthly electricity bill and the expenditure made on other sources of energy. Thus the MHP households get a saving due to low expenditure on the use of energy items. This consumer surplus may be used for the consumption of other household items resulting into their welfare improvement.

Rao, Agarwal and Wood (2015) conducted a study on “Impact of small-scale electricity systems: A study of rural communities in India and Nepal” with the objective of ‘What are the socio-economic impacts of small-scale electricity (SME) systems on rural communities in South Asia?’. The main Focus of the study is on Service conditions, Income, Women/health, Children/education, Business decisions etc and found that Electricity access reduces the time spend on household chores to leisure, and increases the more time for income generating activities. Reduces the use of kerosene, Increases the living standard of households, and so significant improvement on socio-economic status.

Demissie, and Somano (2016) conducted a research entitled “Socio-economic and environmental impacts of micro-hydro power plants” and claimed that electricity is one of the most important inputs for economic development of a country. While the total population living in rural area is huge, more than 85% of the rural population do not have access to electricity in Ethiopia. Micro-Hydro Power Plant (MHP) is an alternative for rural electrification. Micro-hydropower is considered to be the most feasible, decentralized renewable energy option for providing reliable and affordable electricity to the remote and isolated areas of Ethiopia. The community of Leku Kebele relied mostly on firewood, kerosene and dry cell batteries as a major source of energy before access to the Micro-hydro power. With the implementation of MHP, traditional kerosene lamps like ‘Kerosene lamp’ were completely abandoned, and firewood consumption was reduced. Electric lights in households extended the day providing additional hours for accomplishing different activities, such as reading to

school children and work. The micro-hydro-power was also used to supply power to modern agro-processing mills in the village, which reduced drudgery for women as they no longer have to use ineffective and distant traditional water mills. With the introduction of a micro-hydro power in Leku Woreda in Jimma, Ethiopia, there has been a great positive impact in terms of the community's socio-economic aspect. There has been a shift from traditional to modern way of living, and an efficient way of generating income which in turn increased their savings. As per the geological study conducted, it was seen that there is negligible effect on the environmental aspect. There has been no indication of risk of soil instability that would adversely affect the community and to the environment itself. Thus, micro-hydro power generation scheme provides clean, affordable, sustainable and environmental-friendly renewable energy to remote and isolated areas in Ethiopia.

## **2.2 Review of National Studies**

Acharya (1983) she has mentioned the contribution of hydroelectricity to Nepalese economy. It plays significant role by developing various fields such as agriculture, industries, transportation, social services etc. water resources is the Nepal's greatest asset by unfortunately very significant 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 hydro-power development. There are lack of capital, skilled manpower, technical knowledge sufficient market and economic status of people as well as country.

Jha (1995) he stated that one of the major reasons for poverty and backWardness of the Nepalese economy is due to the power deficit. Shortage of power creates a problem in the development of agriculture, industry, trade and other sector of economy with the view of meting power shortage; it is needed to generate power in small and micro level. The small and micro-hydropower play crucial role in increasing productivity of the agriculture sector and including the processing of agriculture product. The lifting irrigation in the hills area is also promoted by the development of small and micro hydropower. Addition to this the food processing and cottage industry will get benefit from the development of micro-hydropower. By considering the fact of only two percent total rural population has access to electricity, the small hydropower play vital role in providing electricity to the rural areas and

even to isolated pockets areas of the countries. The micro hydropower is also important from the consideration of national welfare in divers fields, such as conservation of forest, creation of self employment opportunities and also promotion of the tourist industry. Since electrification is related to productive the small and micro hydropower helps to increase the efficiency of rural power.

Alastair, Paul, and David (1999) concluded that Micro-hydro power has proved very successful as a tool to help rural people develop their economic position and improve their life-style. It provides extra energy in a rural area to reduce the drudgery of food processing and it can offer a means of generating electric power in areas well away from the grid. The success of any programme using such a technology depends on a wide range of factors that must all be considered and covered effectively. These include the manufacture and installation of the technology itself, but also making sure the technology is used for purposes for which people have a felt need and which are economically viable. The financing of the installation of the technology through loans and subsidies is another area that needs careful planning over a term of several years.

Hamal (2001) explains that rural and hill areas have under gone deforestation due to insufficiency of alternative energy; i.e. electricity and women over working in farm time consuming and non-monitoring and highly backwardness. The author further explains that energy is required to fulfill day - today needs, which includes cooking, heating, lighting and productive activities such as transportation, irrigation, cottage industries, etc. Energy shortage has been recognized as major constraint in economic development and it contributes to further deteriorate the environment, creating a vicious cycle in rural life by deforestation women are the main user of household energy. They are the main persons responsible for collecting fuel wood or the managing of other energy sources such as doing crop residues etc. Deforestation has made the women's work harder. The increasing walking distance to fetch fuel materials has proven to be a work burden. Most of rural women are not yet exposed to the existing and as 'electricity' women are found to fetch and gather fuel materials.

Paish (2002) in his study stated that hydropower on a small scale, in the form of mini or micro-hydropower, thought to be the most low cost energy technologies that can be utilized for rural electrification and industrialization among developing and less developed countries. The micro hydropower can be used as a source for income

generating activities. For example micro hydro potential in Nepal has been used for work that are mechanical in nature such as milling and rice hauling (Paish, 2002).

Win Rock International Nepal (2006) give the argument on the role of energy for poverty alleviation and uplift the living standard of the in terms of education, health, sustainable, environment and women's empowerment. Similarly it measured quantities efforts of different power agencies and the decades towards the national poverty reduction strategy (PRS) reviewed in detail. This study is designed to analysis PRS. The two primary objectives of this study were to undertake comparative analysis of changes before and after REDP intervention. The program REDP achieved the improvement on several targets on the target launched are among them it gets improvement on the way of women empowerment which is the indicator of millennium development goal in which is found to be directly influenced by REDPS initiatives with the approximately half population of the total women interviewed holding higher portion in various community based organizations. This also proved with positive response from community elders recall questions also established the significant role of REDP in achieving greener and sustainable environment (MGDs) and that REDP's holistic approach plays to key role in hitting a number of MDGs targets simultaneously positive changes in many indicators confirmed the prime role of energy in the development process of the rural communities studies. Considering that REDP is providing energy services in an integrated manner, including skills development, enterprise development, information services institutional and capacity building, fuel supply, technology many fracturing operations and maintenance etc. with encouraging outputs it can be considered as a best practice model operating so far in Nepal.

Adhikari (2007) has stated that 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 Shamsheer Rana's time to meet the energy requirements of the members of the ruling class. Though some 60 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.

Dhungel (2009) in his thesis have analysis the financial and economic condition of micro hydro power in Nepal. His thesis started with a background of the economic condition and energy scenario of rural Nepal. this is followed by the introduction of micro-hydro power and it's role in rural development of Nepal. The final portion and the primary objective of his thesis consist of financial and economic analysis if micro hydro systems in rural Nepal. In this regard, relevant data concerning three MH systems had been collected. The financial analysis of all three system show that only one the privately owned system, which are community-owned, is in week financial conditions. Lastly, an economic analysis of one of the those three MH system is conducted which shows that MH system can be a highly effective means to increase the economic welfare of the people in the rural areas, even though they may be in week financial situation. However, bearing in mind the need to ensure the long-term sustainability of these MH systems in daily vering series; the financial viability of a system therefore becomes a crucial consideration.

Singh (2009) has summarized that 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 (in most cases double that of conventional thermal power stations). 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.

He further stated that 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 hydro power 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.

Adhikari, (2011) summarized that the benefits of rural electrification are incontestable, especially for the enhancement of rural people's livelihood. Evidence from other developing countries reveal that access to electricity in combination with simultaneous access to markets and other infrastructure has contributed to growth of rural areas in clear and compelling ways. The electricity demand for productive uses is insignificant; the power is mainly used for lighting and cooking. Less than 3% of the households in the case study communities are involved in running small grocery shops and hotels.

Further he stated that it can be seen NRs 512,244 is saving after use of electricity. Electricity replaced the kerosene and dry-cell. Due to the geology and soil strata of Nepal, sedimentation and erosion are permanent issue but their effects can be minimized. Hence, sedimentation and erosion do not affect the sustainability parameter as sediments can be flushed off and erosion can be minimized. The discussion and the overall result value of 3.61 out of 5 shows that Nepal's hydropower is at a sustainable level. It is to be considered that the score of Nepal was drawn down only because of the political and the governmental factors. Hydropower is welcomed and supported by the local people as a beneficial project. If Nepal gets good and stable governance with reduction in red tape politics and bureaucracy, the score will surely rise over 4 out of 5. Although the sustainability score is above the accepted level, Nepal needs to develop many sustainability measures and continuous sustainability management so that it can reach a most satisfactory level of sustainability.

Gurung & et. al. (2011) found that a MHP had a significant impact on the consumption of firewood in rural households. It was revealed that children have lesser propensity to go for wood collection once their homes have been connected to the MHP. Similarly, modern electric lights in the households allow more time for students to conduct their study during night time. Access to electricity reduces drudgery for women in the village allowing them to have enough time to be involved in other household related activities including income-generation and social and community development activities. Moreover, the micro-hydro based electricity reduces CO<sub>2</sub> emissions significantly. Thus, this study concluded that the MHP has positive impact on socio-economic conditions of the rural communities.



Joshi (2011) has mentioned that energy is important for economic development. The pace of economic development cannot be accelerated without hydropower development. The development of the productive sector of an economy depends on development of the energy sector in the hilly and mountainous area, almost all the households are found to have consumed traditional sources of energy for cooking, heating, lighting and other necessary activities. Traditional energy sources can not be sustainable to fulfill energy requirements. From the present analysis it has been observed that most of the people depend on forest for energy sources and livestock. As a result, deforestation has brought about ecological and environmental hazards along with shortage of fuel wood, soil erosion, deterioration of the fertility of soil etc. Deforestation leads to deterioration of water resources and hampers both electricity generation and drinking water. The utilization of energy is concentrated on urban areas and most of the rural areas have been bypassed by this power development. The hydropower project has brought about change in socio-economic, cultural and other aspects of people living in the project located area.

K.C., Khanal, Shrestha and Lamsal (2011) summarized that Nepal has a vast number of natural energy resources, but only a small fraction (renewable resources contribute to less than 1.0% of total energy consumption) has been harnessed due to geophysical, technical, economical and political reasons. The majority of the population in rural areas relies on traditional biomass resources for energy; whereas in cities, they are forced to use expensive imported fossil fuels for fulfilling their energy needs. The excessive but poor usage of biomass and increasing use of fossil-based energy sources have promoted negative impacts on public health, the environment and the national economy. Also, under the current state of technologies, infrastructures and policy, the Nepalese people will continue to rely on traditional biomass resources and imported fossil fuels for many years to come. Thus, for developing countries like Nepal, the use of RHE has a large potential, both in terms of available renewable resources and providing clean and reliable energy, to curtail the import of costly fossil fuels, create employment opportunities, preserve the local environment, and improve the quality of life. The realization of the foresaid potentials, however, requires a more systematic and comprehensive study supported by research and development. Moreover, larger quantities and better qualities of energy resources are prerequisites for meeting all of the millennium development goals because of its inherent links to

poverty alleviation, education, gender equality, health, and the protection of the environment. Considering the diversity in both available resources and socioeconomic and geophysical conditions, energy policy should pay due care on the proper hybridization of different energy options to meet both the affordability and acceptability of the local people.

Yuya , Raghuvanshi, and Camarao (2011) concluded that Micro – hydropower plants (MHP) serve as a move to greener environment. MHP use the power of running – water in generating electricity. MHP are introduced and used in developing countries to reduce carbon emissions and other greenhouse gases. Moreover, MHP are the source of electrification in rural areas in countries like Nepal. Their presence develops and improves the socio – economic aspects of every household in rural areas. With electricity in place people start to engage in different economic activities such as business and industries emerge. And, villagers start owning essential household appliances. However, in the case of the Daunekhola micro – hydropower plant, the benefits of having a hydropower plant is hard to recognize because the community cannot sustain the maintenance of the plant. Given that the annual revenues both from residential and industrial usage cannot cover the annual total running cost. And since the demand for the electricity is highly inelastic, increasing the price or tariff on kilowatt per hour would only burden the villagers by making them pay a higher tariff as well as making their agricultural products expensive. Thus, the best way is for the government to give subsidies and grant in order to help the community meets the operational and maintenance cost of the plant.

Regmi (2012) analyzed the present condition of Nepalese energy system. The summary conclusions of her finding 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 resource by generating aptly trained man power and investment on water resources dependency 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 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 is

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.

Bergner (2013) stated that approximately 50 percent of the population has access to electricity, and only 5 percent of the rural populace has access to electricity from the national grid. Even residents in Nepal's capital city of Kathmandu experience outages several times a day for up to 16 hours during the dry season. These electricity shortages have led to a heavy reliance on biomass burning for energy in rural Nepal, which has negative health and environmental impacts, particularly for women and children.

In 2011, peak power demand in Nepal reached 950 MW, and is projected to continue increasing by around 7.5 percent annually until 2020. This analysis considers several alternatives to address the 300 MW imbalance between supply and demand for electricity given feasibility and cost constraints. He suggested the alternatives for increasing hydroelectric capacity include: 1. Letting present trends continue; 2. Developing micro-hydropower projects (<100 kW); 3. Expand capacity using mid-range dams (1-100 MW); and 4. Pursuing large-scale hydroelectric projects (>100 MW)

UNDP (2013) in its report stated that micro- and pico-hydro stations as small as 1 kW continue to be adopted in many countries, providing local communities with affordable electricity. Typically, such hydro systems operate reliably for at least 20 years and require minimal maintenance (other than keeping the intake screen free of debris). Nepal had more than 2,600 micro- and pico-hydro systems installed by the end of 2013, with a total capacity of more than 45 MW.

Dhakal and Shrestha (2014) summarized that since energy is widely needed for almost all human activities, it is necessary to make a balance of pros and cons related with hydropower generation. No universal recipe can be here established, since regional peculiarities will play a striking role in the decision process. In the case of Nepal micro-hydropower is essential in rural area. More than 27 MW power is generating from micro-hydropower of Nepal and going on progress for more MW

power. Higher the generations of electricity but lower the sales because of several factors and failure rate is higher which takes more time in repair and maintenance and more expenses due to weak equipments and natural disasters. Nepalese are socially conscious and know national and international rules and provisions that the project must make to the society and they must contribute to the projects to make the MHP plants more sustainable. Hence, the cooperation of people and society with the hydropower developers is always positive, which is the best factor suggesting the sustainability of the hydropower projects.

MoF (2015) has reported that the total electricity production had stood at 746 MW in FY 2013/14 while this has increased by 4.89 percent to 782.45 percent in the first eight months of current fiscal year. On the transmission line front, it has been extended to 1987.36 Km by the end of review period. The number of electricity consumers has increased significantly reaching 2,789,678. Electricity distribution line has been extended to 116,090 Km by the end of review period. Despite high electricity demand of 1291.1 MW in the current fiscal year, its production has been just 782.45 MW causing supply gap of 508.65 MW which is lower by 40 percent than the current requirement.

Hydropower will continue to play important role throughout the 21st Century, in world electricity supply. Hydropower development does have some challenges besides the technical, economic and environmental advantages it shares above other power generation (fossil fuel based) technologies. At the beginning of the new Millennium hydropower provided almost 20% (2600 TWh/year) of the electricity world consumption (12900 TWh/year). It plays a major role in several countries. According to the study of hydropower resources in 175 countries, more than 150 have hydropower resources. For 65 of them, hydro produces more than 50% of electricity; for 24, more than 90% and 10 countries have almost all their electricity requirements met through hydropower.

(International Sustainable Energy Organization. (n.d.). Retrieved August 10, 2016 from <http://www.uniseo.org/hydropower.html>)

## **CHAPTER-III**

### **RESEARCH METHODOLOGY**

This chapter provides information in the research methodology. This includes study area, research design, nature and source of data, population and sample, data analysis and presentation and method of data analysis and interpretation.

#### **3.1 Study Area**

This study is based on the Lenget Khola Micro-Hydro Power Project, Uhiya of Gorkha district. This MHP is located at Uhiya of Gorkha district. It is about 26 Mile away from Gorkha Bazar, which is inaccessible for vehicle transportation. The MHP was established in 2008 A.D. It started to operate from 2013. This MHP is used by Ward No. 1, 2 and 3's peoples of Uhiya VDC. It has 26 KW capacity of electricity generation. There are 200 households uses electricity from this MHP. They use electric equipment as well as operates business farm from this MHP. Direct and indirect employment opportunity is created by this MHP.

#### **3.2 Research Design**

This study is a case study of Uhiya VDC of Gorkah district. So, it is a micro level study. This is analytical as well as descriptive type of research design. On this basic of the nature of the study, both descriptive as well as exploratory research design has been used in order to analyze and interpret the date.

#### **3.3 Nature and Source of Data**

The nature of this study is descriptive as well as analytical. This study is mainly based on primary. Primary data has collected through the questionnaire and key informant (KII).

##### **3.3.1 Primary Source of Data**

Primary data has collected through the households survey. The sample households were interviewed and relevant information is collected from the field survey through the questionnaire. The researcher took personal interview and the questionnaires were

filled. During the collection of data researcher visit the respondent's house. The respondents provide the questionnaire and collect the answer form respondents. Cross checks, editing and indirect questions were also put sometimes when the answer were thought to be unrealistic and irrelevant. The questionnaire is given in appendix. Besides key informant interview with the president of project consumer committee, social leaders and the expert of the village was also conducted.

### **3.3.2 Population and Sample**

The universe of the study was the Uhiya VDC of Gorkha. Out of total Wards, Ward no 1, 2, 3 of Uhiya VDC were selected purposively . It is because this lenget khola micro hydro project is distributed among these Wards. There are 200 households in three Wards, out of which 60 household chosen randomly for study because selected sample from this method maintain the assumption to represent the whole. The total numbers of respondents are 60 including both male and female. The sample size has been decided based on the viability of resources and time.

### **3.4 Data Presentation and Analysis**

The available data from the various sources has been classified and tabulated to meet the need of the study after completing the field work. All information of the filled up questionnaires are presented in table after editing and cross checking. The data collected from the various sources are tabulated and presented in table and figure. Similarly, simple statistical tools are used in order to interpret the data.

### **3.6 Method of Data Analysis and Interpretation**

This study is mainly based on the descriptive and analytical technique. Obtained data have analyzed by using simple and statistical tools such as percentage, graphs, and charts and so on.

## **CHAPTER- IV**

### **DATA ANALYSIS AND PRESENTATION**

This chapter provides the information about introduction of MHP, Socio-Economic impact, sustainability of MHP in details by using simple statistical tools, graphs and figure.

#### **4.1 Introduction of Lenget Khola Micro-Hydro Power Project**

Lenget khola micro-hydro power project, Uhia-1 Gorkha Nepal is established in 2008. This MHP started producing electricity from 2013. The total cost of this MHP is 68 lakh and users paid Rs. 400 per month for the use of electricity.

##### **4.1.1 Project Installation Cost**

The total project installation cost is Rs 68,00,000. Out of total cost of the project, Alternative Energy Promotion centre provided around 33, 00,000, Jadibuti Prabardhan Kosh provided 3,00,000. Community forest provided the fund about 2,00,000, Shed (Goth) Committee provided 2,00,000 and Uhiya VDC provided Rs. 8,00,000 for the establishment of MHP. The total user of the MHP are 200 household and money collected from per household is Rs 10,000 and so the total amount of money collected from households is Rs. 20,00,000.

##### **4.1.2 Project Maintenance Cost**

There is no worth of investment if construction operates only in short term so maintenance is needed for every non living thing things to run for long-run. There is also need of repair and maintenance in MHP too, to operate for a long time. In lenget khola micro hydro project maintenance is done time to time. For the maintenance, maintenance cost is funded from monthly charge from consumer. And the monthly charge of this MHP is Rs. 400 per month.

##### **4.1.3 Electricity Consumption and Monthly Payment for Electricity Used**

The electricity is distributed equally among the all consumers without meter box. The most of the households are seems to using the electricity only for lighting, radio, TV

purpose consumed and very few households are using electricity for the purpose of TV/computer/cooking, etc.

The payment system for the consumption of electricity is equal for all use. All user of MHP paid equal amount of Rs. 400 per month for the use of electricity whether they use more electricity or less electricity.

## **4.2 Socio-Economic Profile of Sample HHS**

The household information includes of age, sex composition, education status, marital status, land holding and caste/ethnic composition in the study area.

### **4.2.1 Ward and Village wise Distribution of Respondent**

**Table No. 4.1: Ward and Village wise distribution of respondent**

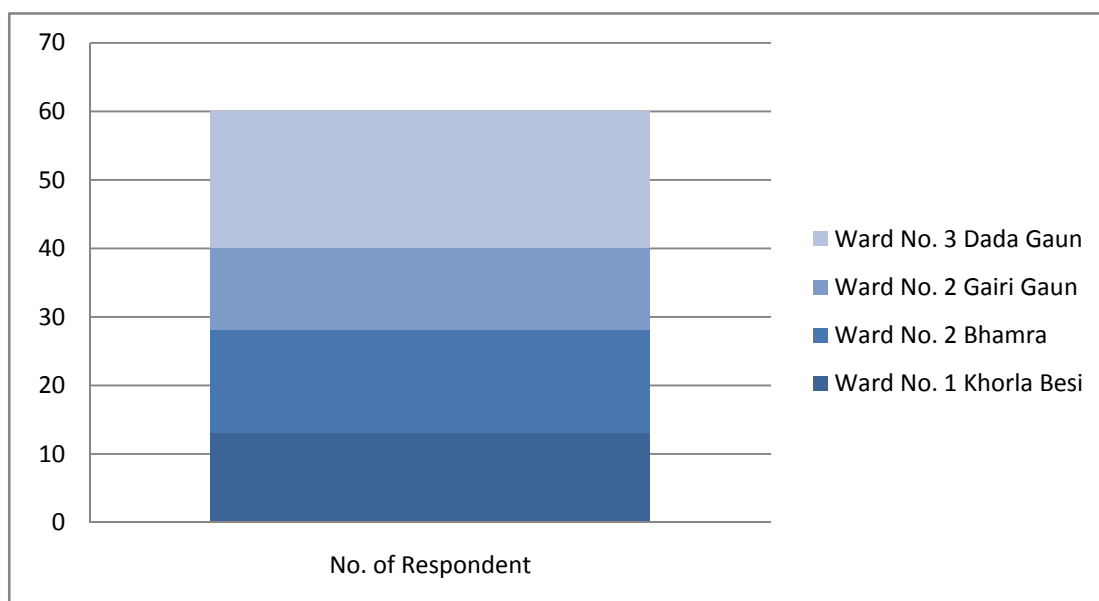
<b>Ward No.</b>	<b>Village (Tole)</b>	<b>No. of Respondent</b>
1	Khorla besi	13
2	Bhamra	15
	Gairi Gaun	12
3	Dada Gaun	20

Sources: Field Survey, 2016

Table No. 4.1 shows that total questionnaire are filled up in Uhiya VDC's Ward No.1,2 and 3. Among these three Wards 13 respondents from Ward No. 1, 27 from Ward No. 2 and 20 from Ward No. 3. Most of the questionnaire are filled in ward No.2 because of dalit settlement.



**Figure No. 4.1: Ward and Village wise distribution of respondent**



Sources: Field Survey, 2016

In the above Figure (Figure No. 4.1) shows that total questionnaire are fill from Ward No. 1, 2, 3 where 13 respondent are live in Khorla Besi, Ward No.1, 15 and 12 respondents are from Bhamra and Gairi Gaun respectively of Ward No. 2 and 20 respondent from Dada Gaun of Ward No. 3. Due to the Dalit and thick settlement more respondent are taken from Ward No. 2 and 3.

#### 4.2.2 Household Information

**Table No. 4.2: Household Demographic Information**

Household Characteristics	Outcome	
Household Size	5.6	
Dependency Ration	2.67	
Sex of household head	Male	Female
	48	12

Sources: Field Survey, 2016

Above table shows that average house hold size micro hydro electricity user family is 5.6, similarly, the dependency ratio is 2.67. Out of total 60 sample household, 48 household's head is male and rest of household's head is female.

### 4.2.3. Age and Sex Composition of the Respondents

**Table No. 4.3: Ages and Sex Composition of the Respondents**

Age group	Male	Female	Total	Percent
Below 30	11	10	21	35.00
30-44	13	7	20	33.33
45-59	8	7	15	25.00
Above 60	4	0	4	6.67
Total	36	24	60	100.00
Percent	60	40	100	

Sources: Field Survey, 2016

In the above table ( table No.4.3 ) shows that out of total respondent 60 percents are male and remaining 40 percents are female. Out of total 35 percentage respondents are the age of below 30 years, 33.33 percentage respondents are the age group of 30-44, 25 percents are the age group of 45-59 and remaining 6.67 percent respondents are the age above 60. Majority of respondents are from the age group of below 30 in this study.

### 4.2.4. Caste/ Ethnicity Composition

**Table No. 4.4: Caste/ Ethnicity Status**

Cast	Total	Percent
Janjati	45	75
Dalit	15	25
Total	60	100.00

Sources: Field Survey, 2016

Table No.4.4 shows that there are only Janajati and Dalit people. Out of 60 Janajati and Dalit respondent 75 percent questionnaire were filled up from Janajati and 25 percent from Dalit.

**Figure No. 4.2 Caste/ Ethnicity Composition**

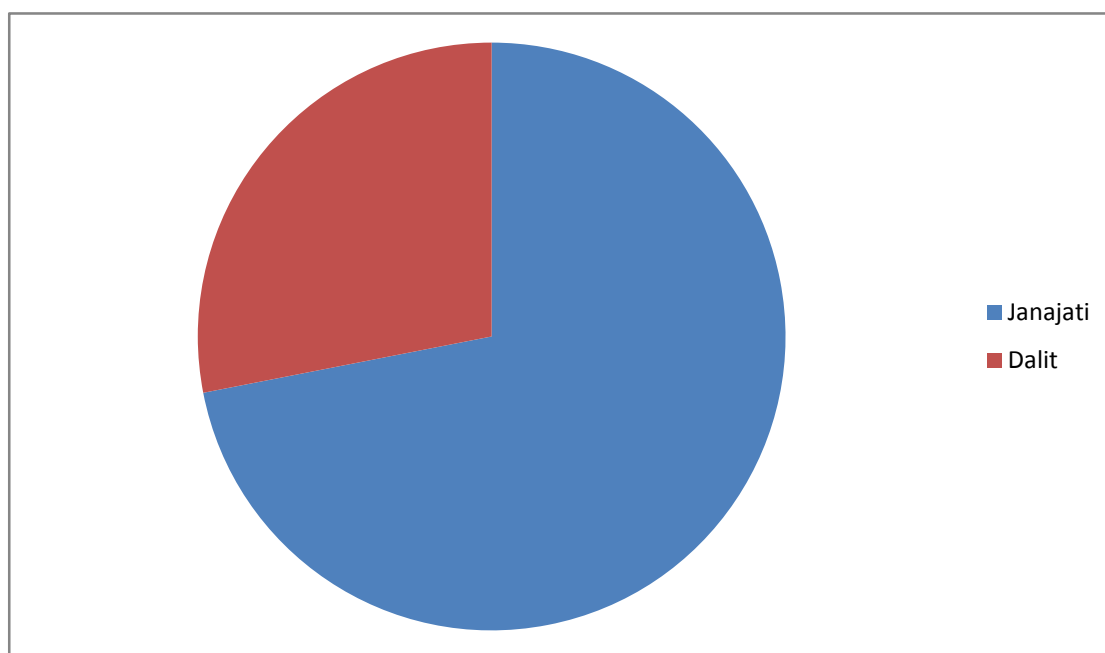


Figure No. 4.4 shows that only two casts are in there, among them 75 percent are from Janjati community and remaining 25 percent respondents are from Dalit community.

#### **4.2.5. Marital Status**

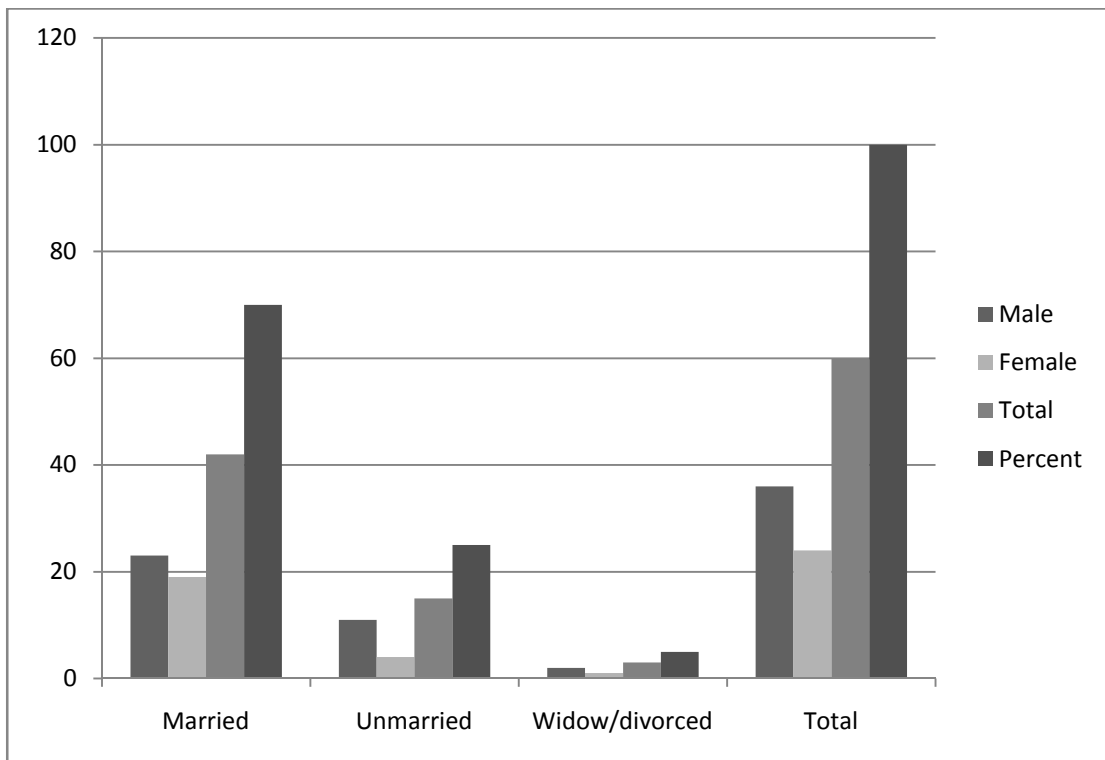
**Table No. 4.5: Marital status of the Respondents**

<b>Marital status</b>	<b>Male</b>	<b>Female</b>	<b>Total</b>	<b>Percent</b>
Married	23	19	42	70
Unmarried	11	4	15	25
Widow/divorced	2	1	3	5
Total	36	24	60	100

Sources: Field Survey, 2016

Table No. 4.5 shows the marital status of respondents. Among 60 respondents 70 percent were married, 25 percent were unmarried and only 5 percent were widow or divorce.

**Figure No. 4.3 Marital status of the Respondents**



Sources: Field Survey, 2016

Figure No. 4.3, shows that out of total respondents, 70 percent of the respondents are married. Then it is followed by 25 percentage respondent unmarried and 5 percentage respondents are widow or divorced.

#### 4.2.6. Educational Status

**Table No. 4.6: Educational Status of the Respondents**

Literacy Status	Male	Female	Total	Percent
Illiterate	5	4	9	15.00
Literate	31	20	51	85.00
Level of Education( Distribution of literate )				
Up to Primary	9	8	17	28.33
Up to Secondary	16	9	25	41.67
Up to Higher secondary	6	3	9	15.00

Sources: Field Survey, 2016

Table No. 4.6 shows that out of total respondent 85.00 percent are literate and remaining 15.00 percent are illiterate.

Out of total respondent 28.33 percent respondent have read up to primary level, 41.67 percent read up to secondary level and remaining 15.00 percent have read the higher secondary level.

The statistics shows that the literacy rate of study area (85%) is relatively high in comparison to the national literacy which is about (65.9%).

#### 4.2.7. Main Income Sources of Households

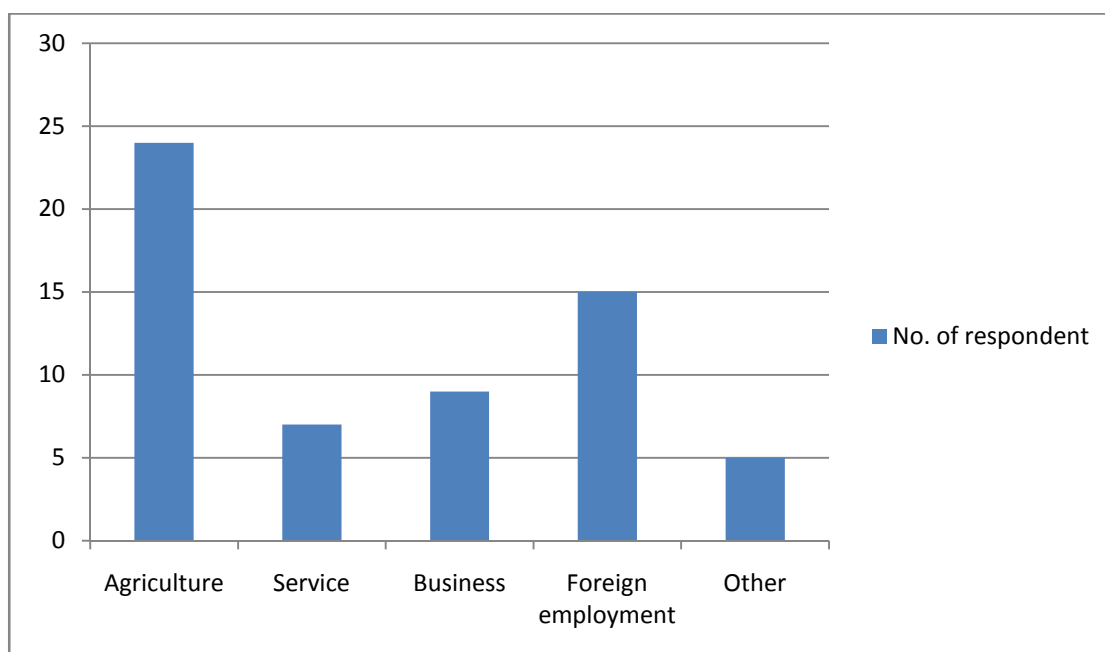
**Table No. 4.7: Main Income Sources of Households**

Income Source	No. of respondent	Percent
Agriculture	24	40.00
Service	7	11.67
Business	9	15.00
Foreign Employment	15	25.00
Other	5	8.33
Total	60	100.00

Sources: Field Survey, 2016

Table No. 4.7 shows the main income source of households. Out of 60 households 40 percentage of respondent's main income source is agriculture, 11.67 percentage were depends on service, 15 percentage on business, 25 percentage on foreign employment and 8.33 percentage were depends on other for their household income.

**Figure No. 4.4 : Main Income Sources of Households**



Source: Field Survey, 2016

In the Figure 4.6, 40.00 percent of the respondent's main source of income is agriculture, 11.67 percent respondent's main source of income is service like hotel, 15.00 percent of respondent's main source of income is business, 25.00 percent of respondent's main source of income is foreign employment and remaining 8.33 percent of respondents main source of income is other including daily wage labor, public service etc. So, most of respondent's main source of income is agriculture and remittance sends back by migrants.

#### 4.2.8. Land Holding Size

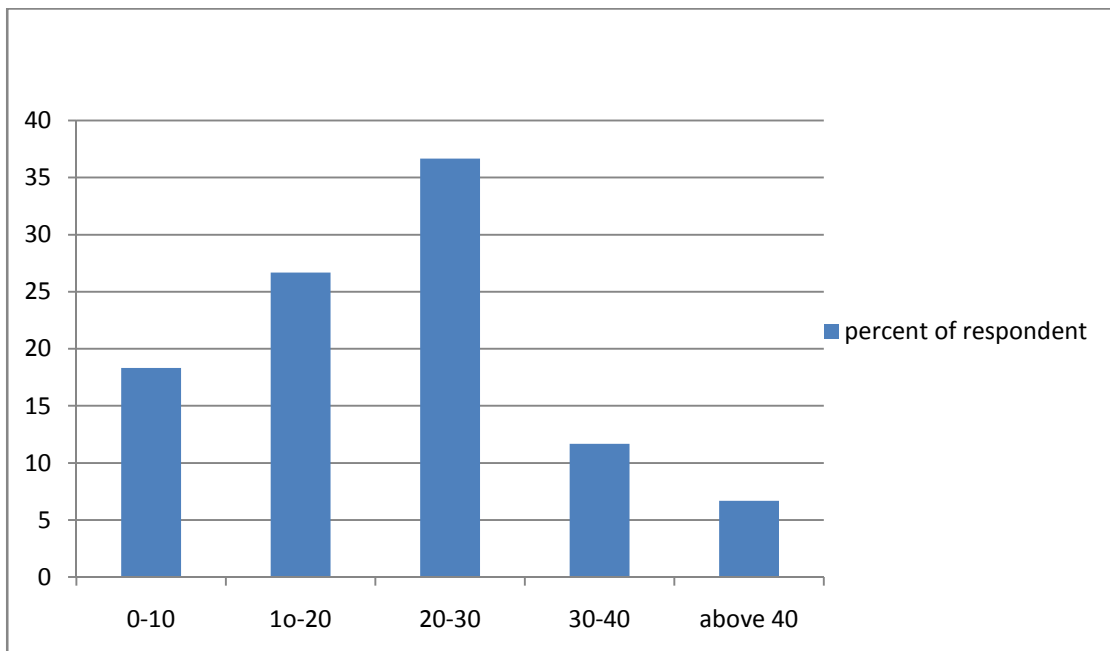
**Table No. 4.8: The Land Holding Size of the Respondents**

Land holding size (Ropani)	No of Respondent	Percent
0-10	11	18.33
10-20	16	26.67
20-30	22	36.67
30-40	7	11.67
Above 40	4	6.67
Total	60	100.00

Source: Field Survey, 2016

Table No. 4.8 shows that out of 60 respondent's 18.33 percent respondents have 0-10 Ropani land, 26.67 percent respondents have 10-20 ropani land, 36.67 respondents have 20-30 ropani land, 11.67 respondents have 30-40 and 6.67 percent respondents have above 40 ropani land.

**Figure No. 4.5 The Land Holding Size of the Respondents**



Source: Field Survey, 2016

On the figure 4.7, out of total respondents, 18.33 percent have 0-10 Ropani land, 26.67 percent respondents have 10-20 Ropani land, 36.67 percent of respondent have 20-30 Ropani land, 11.67 percent respondents have 30-40 Ropani land and remaining 6.67 percent respondents have land above 40 Ropani. Most of respondents have land size of 20-30 ropani in the study area. This indicates that most of the people are dependent upon agriculture and the main source of income of respondent is agriculture.

### **4.3 Economic Impact of MHP in the Study Area**

Economic impact of MHP means the effect on economic activities derived by micro hydro project in the study area. The economic impact of micro hydro project includes of effect on income, employment and so on. Under this topic researcher have analyzed and interpreted the economic impact of micro hydro project with the help of table, bar-diagram and pie charts.

### 4.3.1 Creation of Employment Opportunity by MHP

**Table No. 4.9: Creation of Employment Opportunity by MHP**

<b>Established Firm after MHP</b>	<b>No. of Firm</b>	<b>No. of Employment</b>
Poultry Firm	2	4
Furniture	1	3
Agro mill	1	2
Dairy	1	1
Electric Shop	3	3
Electric Repairing Center	2	2
Photo Studio	1	1
Employment in MHP		2
Cold Drinks Center	3	3
Medical	1	1
Total	15	22

Source: Field Survey, 2016

Table No. 4.9 shows that after the establishment of MHP 15 new firms in which electricity used were established in the study area. And the number of direct employment created by MHP is for 22 individual. Most of the employment opportunities were created by poultry farm which is for 4 individuals by 2 firms. So, the direct employment created by MHP in study area is for 22 individual but there are many indirect employment opportunities also increased after the establishment of MHP. As we know the root cause of poverty in developing countries like Nepal is unemployment, increase in employment opportunity leads to increase in level of income and hence reduction in poverty. So, MHP helps to not only increase in employment opportunity but also reduces the poverty.

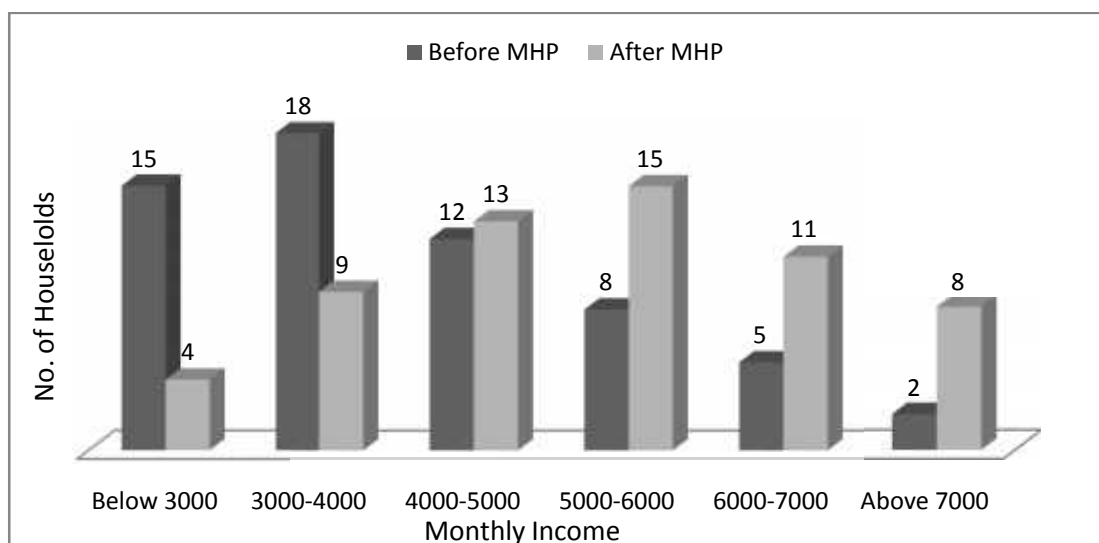
### 4.3.2 Role of MHP in Income Generation

MHP helps to increase in the level of income of households by providing employment opportunities as well as the creating the markets for their product in the local area. The role of MHP in income generation can be known by analyzing monthly earning before and after MHP of households and the increase in the level of income of households.



### 4.3.2.1 Monthly Earning Before and After MHP

**Figure No. 4.6: Monthly Earning Before and After the establishment of MHP**



Source: Field Survey, 2016

Figure No. 4.6 shows the monthly income of households before and after the MHP. Before establishment of MHP 15 households monthly income was below 3000, but after MHP the level of income having below 3000 remains only 4 households. Similarly, before MHP 18 household's monthly income was between 3000-4000, but after MHP that level of income remains with 8 households. Households with level of income between 4000-5000 before MHP were 12 and after MHP households with that level of income increased and become 13 households. Similarly, households with 5000-6000 income before MHP were only 8 but MHP households with that level of income reaches 15. The households having income between Rs. 6000-7000 were 5 before MHP, which reaches 11 after establishment of MHP. And the income having above 7000 before MHP were 2 households and reaches 8 after establishment of MHP in the study.

The data presented above shows that the number of households with having low level of income decreases and the number of households with relatively high income level increases after establishment of MHP. So, it can be concluded that MHP play vital role in generating level of income of households.

#### 4.3.2.2 Calculation of Median Income Before and After MHP

Calculation of median income helps to analyze effect of MHP on the level of income of household in rural area. By what amount the level of income of households increase after the establishment of MHP in the study area can be obtained by calculating median. The median is calculated instead of other statistical tools because it is generally used for income, employment etc. and other tools may be affected by outliers and skewed data but it is not. The calculation of the median income of households before and after MHP is shown in the following table.

**Table No. 4.10: Calculation of Median Income Before and After MHP**

Monthly Income	Before MHP	CF	Monthly Income	After MHP	CF
Below 3000	15	15	Below 3000	4	4
3000-4000	18	33	3000-4000	9	13
4000-5000	12	45	4000-5000	13	26
5000-6000	8	53	5000-6000	15	41
6000-7000	5	58	6000-7000	11	52
Above 7000	2	60	Above 7000	8	60

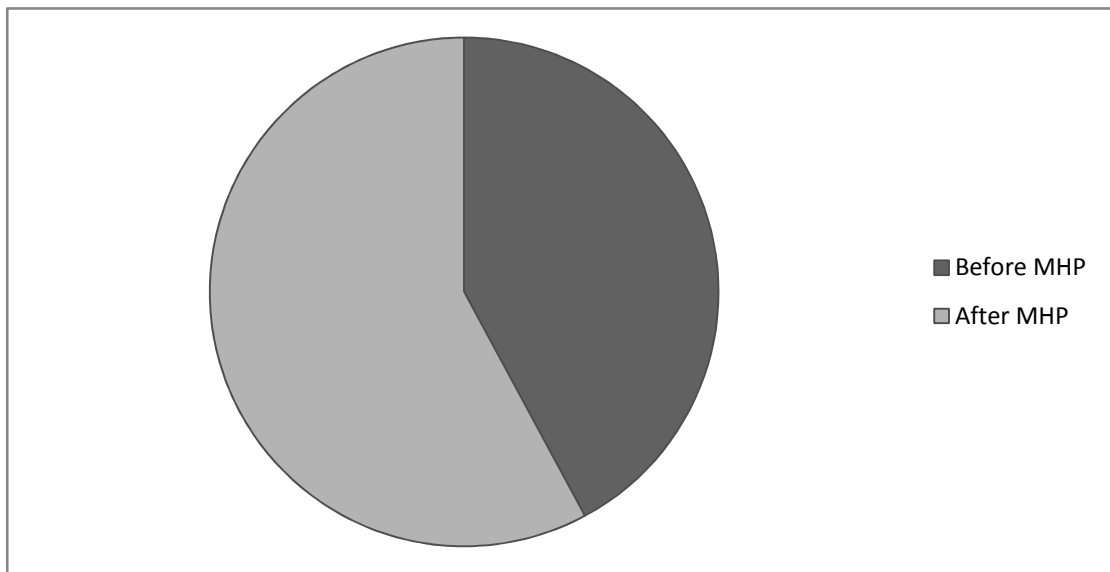
Source: Field Survey, 2016

Median before MHP= 3833.33

Median after MHP= 5266.67

The Median income before establishment of MHP is Rs. 3833.33, after the establishment of MHP the level of income of households increased by Rs. 1433.34 per month and reaches Rs. 5266.67. The amount of money to manage the household expenditure in rural area is nearly sufficient. People can fulfill their basic needs like food, cloths, education, health and so on. So, it can be said that MHP in rural area not only help to increase in the level of income but also help to reduce the poverty in the rural area. This before and after monthly income medians are also shown in following pie chart.

**Figure No. 4.7 Median income before and after MHP**



Source: Field Survey, 2016

#### 4.3.2.3 Increase in Income after MHP

The increase in income after establishment of MHP is shown in the following table:

**Table No. 4.11: Increase in Income after MHP**

S.N.	Increase in Income	No. of Clients	Percent
1	Up to 1000	6	10.00
2	1000-2000	10	16.67
3	2000-3000	17	28.33
4	3000-4000	14	23.33
5	4000-5000	9	15.00
6	Above 5000	4	6.67
Total		60	100.00

Source: Field Survey, 2016

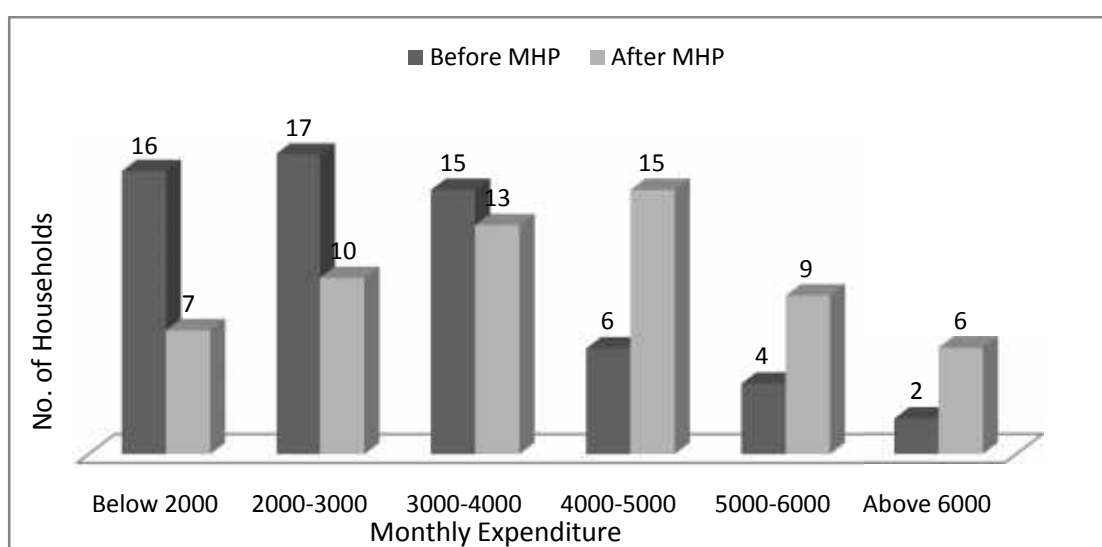
Table 4.11 shows the increase in household income after establishment of MHP in the study area. After the establishment of MHP all clients level of income seems to increased. The households with increased in income by 1000 or below are 10.00 percent, increased by 1000-2000 are 16.67 percent, increased by 2000-3000 are 28.33 percent, increased by 3000-4000 are 23.33 percent, income increased by 4000-5000 are 15.00 percent and income increased above 5000 are 6.67 percent. Most of the

households income seems to increased by 2000-3000 per month after the establishment of MHP in the study area. This shows that MHP play significant role in generating income level in rural area.

### 4.3.3 Expenditure of Households Before and After MHP

Does MHP increases only the level of income of households or it also increases the expenditure of household is most curious question. The Expenditure of households before and after the MHP is shown in the following figure.

**Figure No. 4.8: Expenditure of Households Before and After MHP**



The households having monthly expenditure below 2000 before MHP were 16 and after MHP households with that expenditure decreases and remains only 7. Similarly the households with monthly expenditure between 2000-3000 were 17 before MPH and remains only 10 after MHP, expenditure between 3000-4000 before MHP were 15 and remains only 13 after MHP. Similarly, the households having monthly expenditure between 4000-5000 were 6 before MHP and reaches 15 after MHP, expenditure between 5000-6000 were 4 before MHP and reaches 9 after MHP and monthly expenditure above 6000 were only 2 households before MHP and reaches 6 after establishment of MHP in the study area.

### 4.3.4 Calculation of Median Expenditure Before and After MHP

Calculation of median expenditure helps to analyze effect of MHP on the household in rural area. By what amount the expenditure of households increase after the

establishment of MHP in the study area can be obtained by calculating median. The calculation of the median expenditure of households before and after MHP is shown in the following table.

**Table No. 4.12 : Calculation of Median Expenditure Before and After MHP**

Monthly Expenditure	Before MHP	CF	Monthly Expenditure	After MHP	CF
Below 2000	16	16	Below 2000	7	7
2000-3000	17	33	2000-3000	10	17
3000-4000	15	48	3000-4000	13	30
4000-5000	6	54	4000-5000	15	45
5000-6000	4	58	5000-6000	9	54
Above 6000	2	60	Above 6000	6	60

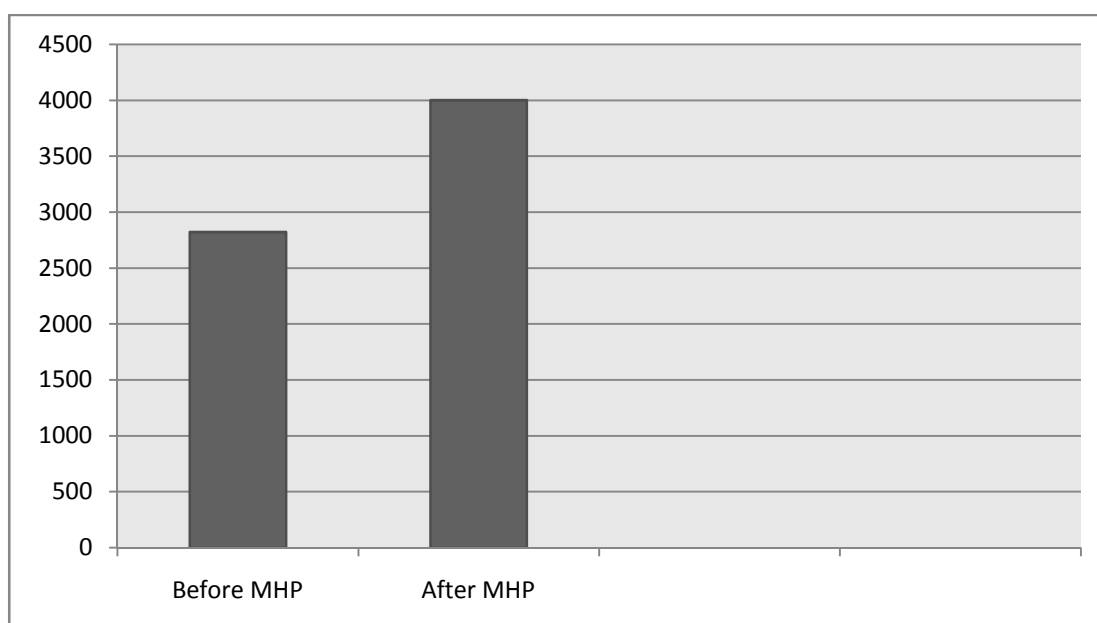
Source: Field Survey, 2016

Table No. 4.12 shows monthly expenditure before and after establishment of MHP with their frequency and cumulative frequency. From this table median results can be found after calculating.

Median expenditure before MHP= Rs. 2823.53

Median expenditure after MHP= Rs. 4000

**Figure No.4.9 Median expenditure of before and after MHP**



Source: Field Survey, 2016

The Median expenditure before MHP is Rs. 2823.53 per month, after the establishment of MHP the expenditure of households increased by Rs. 1176.47 per month and reaches Rs. 4000 per month. The data presented and figure No. 4.4 shows that the establishment of MHP in rural area not only increases the level of income of households but also increases the expenditure of households. It is because MHP create the environment of establishment of new business firms and the establishment of new business firms increases the expenditure habit of individual. The median expenditure is also shown in simple bar graphs.

#### 4.3.5 Comparison between Increase in Income and Increase in Expenditure

From the above both table about increase in income and increase in expenditure, we can compare between increase in income and increase in expenditure of households. The median increase in household's monthly income is Rs. 1433.34, and the increase in household's monthly expenditure is Rs 1176.47. So, the saving of household from the increase in income is (Rs. 1433.34 – Rs. 1176.47 =) Rs. 256.87 per month.

This shows that MHP increases the household's income as well as it's expenditure but even after the increase in expenditure they are able to save more money by Rs. 256.87 per month from the increase in income.

#### 4.3.6 Possession of Various Electric Instruments Before and After MHP

**Table No. 4.13: Possession of Various Electric Instruments Before and After MHP**

S.N.	Electric Instruments	Before		After	
		Number	Percent	Number	Percent
1	Radio/tape recorder	55	91.66	54	90.00
2	TV	0	0.00	47	78.33
3	Compute/Laptop	0	0.00	15	25
4	Mobile phone	48	80.00	57	95.00
5	Chargeable battery	2	3.33	58	96.66
6	Refrigerator	0	0.00	12	20
7	Other instruments	0	0.00	50	83.33

Sources: Field Survey, 2016

In the study area, the possession of electric instruments before MHP was seems weaker than after establishment of MHP. Before MHP the radio/tape recorder user were only 91.66 percent, mobile phone users were 80 percent and chargeable battery user were 3.33 percent. They seem to use these instruments by solar system. But the use of TV, Computer/Laptop, Refrigerator and other instruments were not found before MHP. After the establishment of MHP in the study area the user of radio/tape recorder reduced to 90percent, TV user reached 78.33 percent, computer/laptop user reached 25 percent, chargeable battery user reached 96.66 percent, refrigerator user reached 20 percent and other instruments user like rice cooker, Iron, electric judge, heater etc reached 83.33 percent.

Before MHP, the people in the study area were using few electrical instruments like Radio/Tape recorder using battery and mobile phone. But after the establishment of MHP the access on electrical instruments like radio/tape recorder, TV, computer/laptop, chargeable battery, mobile phone, refrigerator and other like iron etc increased significantly of most of households in the study area.

## **4.4 Social Impact of MHP**

### **4.4.1 MHP's Role in Rural Electrification**

According to respondents MHP brings happiness in rural area by making rural life easier. Before this project, they compelled to live under the kerosene lamp light. The electrification from central grid is not possible in this area because of geographical difficulties. The rivers and rivulets of Nepal flow from higher altitude to lower altitude; due to this reason small scale hydro project can easily launched in low and reasonable cost where the distribution from national grid is impossible. So it is the best alternative source of energy in remote areas.

### **4.4.2 Convenience Form MHP to Rural People**

In project affected areas, villagers were benefited from MHP in multi dimensional ways like light, health, technology, use of electronic equipment etc. Mainly villagers use electricity for lighting purpose, which makes night life easier. On the other hand children reading habit, use of electronic equipment, level of knowledge is increased. Along with grocery shop, poultry farm, agro mill, furniture, dairy, medical etc. were

established and standardization of hotel was also maintained. Due to this peoples fashion, behavior and thinking about their life style have become modernized.

#### 4.4.3 Effect of Children Study Hours Using MHP

**Table No. 4.14: Effects on Children Study Hours Using MHP**

Increased Hours	Frequency	Percentage
Up to 1 Hour Per Day	21	42
1 to 2 Hour per Day	16	32
2 to 3 Hour Per Day	9	18
More than 3 Hour Per Day	4	8
Total	50	100.00

Source: Field Survey, 2016

Out of total 60 respondents only 50 respondents' children are studying in school level. Among these 50 respondents 42% of respondents children increased their study hour up to 1 hour per day after MHP, 32% of respondents children increased their study hour by 1 to 2 hour per day, 18% of respondents children increased their study hour by 2 to 3 hour per day and 8% of respondents children increased their study hour by more than 3 hours per day. This result shows that establishment of MHP was found to be significant in the children's study.

#### 4.4.4 Change in Children's Daily Activities Using Electronic Instruments

**Table No. 4.15: Change on Children's Daily Activities Using Electronic Instruments**

S.N.	Child's Daily Activities	Improved		Not Improved	
		Number	Percent	Number	Percent
1	Talking style	45	75	15	25
2	Dress up	40	66.67	20	33.33
3	Sport	42	70	18	30
4	Reading Habits	50	83.33	11	16.66
5	Dance	30	50	30	50
6	Other	33	55	27	45

Source: Field Survey, 2016



Table shows that out of 60 respondents 75, 66.67, 70, 83.33, 50 and 55 respondents' children have improved their talking style, dress up, sports, reading habits, dance and other respectively.

#### 4.4.5 Improvement on Household Member's Daily Activities Using Electronic Instruments

**Table No. 4.16: Improvement on Household Member's Daily Activities Using Electronic Instruments**

S.N.	Households Daily Activities	Improved		Not Improved	
		Number	Percent	Number	Percent
1	In fashion	55	91.66	5	08.33
2	In behavior	54	90	6	10
3	In thinking	50	83.33	10	16.67
6	Others	60	100	0	00

Source: Field Survey, 2016

Of the total sample households, 91.66 percent households member's activities in fashion increased by using electronic instruments, 90 percent's household members' behavior was improved, 83.33 percent member's thinking was improved, cent percent member's other behaviors like watching knowledgeable program, knowledge about politics, science etc. were found to be improved by using electronic instruments.

#### 4.4.6 Effects of MHP Operation in Health Condition

Before establishment of MHP people depend upon firewood, kerosene and small size of solar energy. So they have to spend more time in front of firewood, kerosene lamp means in the smoky atmosphere. Due to this reason people suffered from many respiratory diseases, eyes problems etc. and on the other hand children's health was also affected due to kerosene lamp which was used as light energy during night for reading.

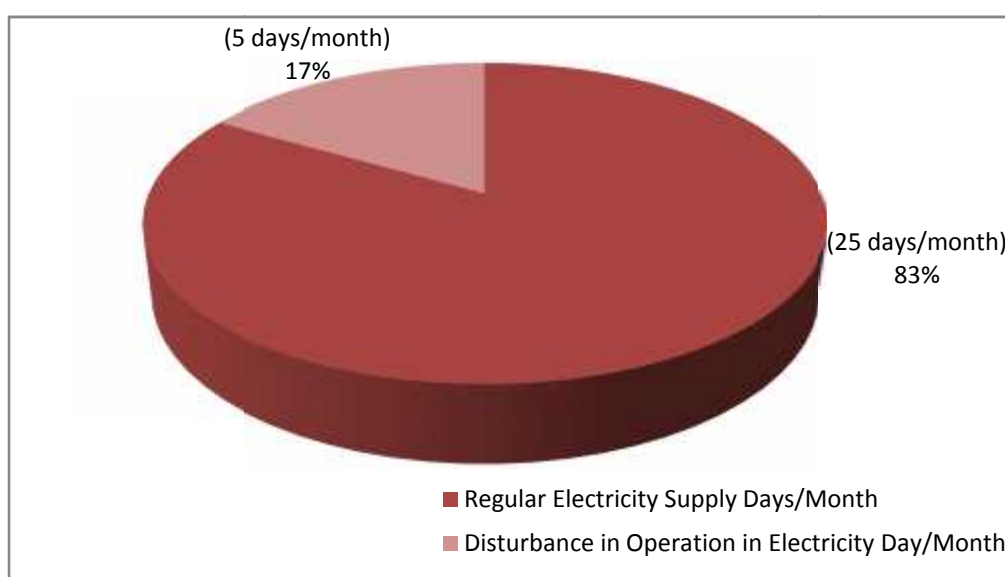
As we know that hydro electricity is eco-friendly renewable and non-polluting source of energy, it helps to reduce indoor air pollution. By the use of electrical instrument such as TV, radio, computer, cell phone etc. People have become more aware of their own as well as their children's health condition, they tend to use fresh fruits,

vegetables, and they have become more concerned about drinking water, started to clean cooking dishes every day. They started to go medical instead of witch doctor ( Dhami, Jhakri ). These all reasons their health expenses is not more increase in comparison to expenses of other heading.

## 4.5 Sustainability of MHP

### 4.5.1 Regularity in Electricity Supply

**Figure No. 4.10: Average Electricity Supply Days/Per Month**



Source: Field Survey, 2016

Figure No.4.10 shows the average electricity supply day per month by MHP. The average regularity in electricity supply is 25 days (83 %) per month by MHP and the disturbance in operations in electricity is 5 days (17 %) per month in the study area. That means, to keep MHP sustainable is challenging in the rural area.

### 4.5.2 Respondents Perception about Sustainability of Project

Using of different electronic equipment, creation of employment opportunity, increase the sanitation and health aspect, these all increase the level of standard of rural areas if the MHP project run for long time. But there are various difficulties to run for long time after establishment of MHP. About this problem respondent suggest various ideas demands which as are follows:

- From government side, government should provide money support, training etc.
- From users side users should involve in activities of MHP, they have to plant trees in barren areas, time to time sanitation of kulo and so on
- From management side, management body should keep proper and transparent account, conduct different program about way of using electricity etc.

#### 4.5.3 Willingness to Pay of Households for Sustainability of the MHP

The establishment of MHP in rural area is not sufficient rather the sustainability of MHP is the most important to improve the living standard of rural people. The sustainability of MHP in rural area is very challenging because of geographical difficulties like landslides, flood and problems in machine of MHP. For the regularity of MHP villagers or it's users can play the significant role. User of MHP should able to pay some amount of money for regularity of MHP. The willingness to pay of households for sustainability of the MHP is shown in the table below.

**Table No. 4.17: Willingness to Pay of Households for Sustainability of the MHP**

S.N.	Amount of Money	Number of HHs	Percent
1	Up to 1000	10	16.67
2	1000-2000	14	23.33
3	2000-3000	16	26.67
4	3000-4000	10	16.67
5	4000-5000	7	11.67
6	More than 5000	3	5.00
	Total	60	100.00

For the sustainability of MHP, 16.67 percent households in the study are ready to pay up to Rs. 1000, 23.33 percent households are ready to pay Between Rs. 1000-2000, 26.67 percent are willing to pay 2000-3000, 16.67 percent households are willing to pay 3000-4000, 11.67 percent households are willing to pay Rs. 4000-5000 and 5 percent of households are willing to pay more than Rs. 5000 for the sustainability of MHP in the study area. Household's willingness to pay for the sustainability of MHP

seems relatively high. And so, there is the possibility to run the hydro project regularly as well as for long time.

#### **4.5.4 Willingness to Provide Labour for Sustainability of the Project**

For the sustainability of MHP there is not always the need of money but sometimes it can be maintained by contributing labour. The problem of disturbance in electricity supply by because of landslide or disturbance in Kulo can be solved by contributing labour by its user. Cent percent sample households told that they are ready contribute labour for the sustainability of MHP. In the previous time they all have contributed labour when the Kulo was destroyed by landslides. So, for the sustainability of MHP, the participation of its user is found cent percent.

# **CHAPTER - V**

## **SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

### **5.1. Summary of Findings**

The present study focuses on Micro-Hydro Project and its sustainability. This is the case study of Uhiya VDC of Gorkha district. The main objective of this study is to find out the impact on income, expenditure and employment generation by Lenget Khola Micro-hydro project. Moreover, this study also identifies the people participation about sustainability of Micro-Hydro Project.

This is a descriptive as well as analytical study, so random sampling and purposive sampling technique was used in this study. The present study is based on a structured questionnaire used in the survey. Mainly primary data has been used and various research techniques like interview and observation were applied to collect the required data for the study in field survey. The data and information are presented in simple percentage basis. Table, charts, graphs and average, median are used to analyze and interpreted the data.

The major findings of the study are summarized as follows:

Main source of income of nearly 40.00 percent of the respondents is agriculture, 11.67 percent respondent's main source of income is service, 15.00 percent of respondent's main source of income is business, 25.00 percent of respondent's main source of income is foreign employment and remaining 8.33 percent of respondents main source of income is other including daily wage labour, public service etc in the study area.

The direct employment created by MHP in study area is for 22 individual but there are many indirect employment opportunities also increased after the establishment of MHP. MHP helps to not only increase in employment opportunity but also reduces the poverty by increase the level of income of rural households.

The finding of this study shows that the number of households with having low level of income decreases and the number of households with relatively high income level increases after establishment of MHP. So, it can be concluded that MHP play vital role in generating level of income of households.

The Median income before establishment of MHP is Rs. 3833.33, after the establishment of MHP the level of income of households increased by Rs. 1433.34 per month and reaches Rs. 5266.67. The amount of money to manage the household expenditure in rural area is nearly sufficient. People can fulfill their basic needs like food, cloths, education, health and so on. So, it can be said that MHP in rural area not only help to increase in the level of income but also help to reduce the poverty in the rural area.

The establishment of MHP in rural area not only increases the level of income of households but also increases the expenditure of households. The Median expenditure before MHP is Rs. 2823.53 per month, after the establishment of MHP the expenditure of households increased by Rs. 1176.47 per month and reaches Rs. 4000 per month.

The median increase in household's monthly income is by Rs. 1433.34, and the increase in household's monthly expenditure is by Rs 1176.47. So, the saving of household from the increase in income is (Rs. 1433.34 – Rs. 1176.47 =) Rs. 256.87 per month. This shows that MHP increases the household's income as well as it's expenditure but even after the increase in expenditure they are able to save more money by Rs. 556.87 per month from the increase in income.

The average regularity in electricity supply is 25 days (83 %) per month by MHP and the disturbance in operations in electricity is 5 days (17 %) per month in the study area. That means, to keep MHP sustainable is challenging in the rural area.

For the sustainability of MHP, 16.67 percent households in the study are ready to pay up to Rs. 1000, 23.33 percent households are ready to pay Between Rs. 1000-2000, 26.67 percent are willing to pay 2000-3000, 16.67 percent households are willing to pay 3000-4000, 11.67 percent households are willing to pay Rs. 4000-5000 and 5 percent of households are willing to pay more than Rs. 5000 for the sustainability of MHP in the study area.

Cent percent sample households told that they are ready contribute labour for the sustainability of MHP. In the previous time they all have contributed labour when the Kulo was destroyed by landslides. So, for the sustainability of MHP, the participation of its user is found cent percent.

## **5.2 Conclusion**

Electricity is the basic prerequisite of development. For the development of rural area MHP is essential. MHP in rural area is not helping in lighting but also it play the significant role in employment and income generation and studding behavior also justify the fact. It helps to rise in income and employment by helping in the establishment of new businesses. Similarly, increase in level of income leads to increase in the expenditure of households as well. That means, MHP make the business environment in the rural area by increasing level of income, demand for goods and services as well as increase in business firms.

The main source of energy before MHP in rural area is the firewood which has adverse impact on human health, and MHP helps to improve the health condition by providing the means energy for cooking. MHP helps to keep the environment clean, improve the habit of children, habit of household member and so it helps to improve the standard of living of rural people.

The establishment of MHP once is not sufficient for the electrification in rural area. Due to the geographical difficulties, lack of external support, and other many obstacles it is very difficult to operate the MHP regular in rural area. So, the sustainability of MHP is most challenging in rural area. If we are able to operate the MHP regularly in the rural area, then it should be the most significant infrastructure for the overall development of rural area.

## **5.3 Recommendations**

The following recommendation can be made by considering the findings and conclusions of this present study.

- i. The impact of MHP is positive; it increases the level of income, employment and living standard of rural people. Large portion of

Nepali people are living in the rural area and so, replicate that project in other rural area.

- ii. For sustainability there is still need for external support like economic fund, training, maintenance etc. from government side, regular involvement from users' side and transparent account from management side.



**Questionnaire for Household Survey**  
**SOCIO-ECONOMIC IMPACT OF MICRO-HYDRO PROJECT**  
(A Case study of lenget khola micro hydro project, Uhiya VDC Gorkha Distric)

<b>1. .General information of respondents</b>						
Address:- VDC:				Ward No.:		Tole:
Name of Respondent:				Age:		Gender:
Cast/Ethnic:    i) Brahmin    ii) Chettri iii) Janajati    iv) Dalit    v) Others.....				Education:		Marital status:
<b>How many members are in your family?</b>						
Male <input type="text"/> Female <input type="text"/> 15-60 years <input type="text"/>						
<b>Household member list and occupation (including you)</b> (Cod – Occupation : Agriculture=1, Business=2, Public service=3, Private service=4, Industry=5, Wage labor=6, Student=7, Foreign Employment=8, Other=9)						
S.N	HH member	Age	Education	Marital status	Occupation	Remarks
1						
2						
3						
4						
5						
6						
7						
8						
<b>Land holding size by the family.( In Ropani )</b> .....						

**2. MHP and Rural Electrification**

**2.1 Does MHP help in rural electrification? How?**

.....

**2.2 How much units of electricity do you consume in general? (per month)**

**2.2.1 How many hours per day you do access to electricity for the following purpose?(Write in complete hours)**

1. lighting.....
2. Cooking.....
3. TV/Radio.....
4. For business purpose.....
5. For agriculture.....
6. Personal use.....
7. Other specify.....

**2.4 How much money do you pay for electricity per month? (in general)**  
.....

**2.5 What is your contribution for this MHP ?**

Cash  labor

**2.6 How much did you self fund to install MHP?**

Rs.....

**2.7 From where you maintain the maintenance cost of the project?**  
.....

**3. Socio- Economic Impact**

**3.1 Do you think participation in the project has improved the status of village?**

1. Yes 2. No

**3.2 Have you done the productive work by using MHP system?**

1. poultry farming  
2. Furniture  
3. Sawmill  
4. Dairy  
5. Agro mill  
6. Computer  
7. Other specifies.....

**3.3 Do you find that after involving on productive work it helped to increase your income level?**

1. Yes 2. No 3. To the same extant 4. Difficult to say

**3.4 Does the project helps to promote the agriculture product?**

1. Yes 2. No

**3.5 In your opinion, how it helped?**

1. Regularly 2. Sometimes 3. Irregularly

**3.6 What type of industry is installed in your village?**

1. Milling  
2. Furniture  
3. irrigation  
4. Drinking water  
5. Knitting  
6. Other specify

**3.7 How many electrical instruments do your household posses before and after MHP?**

Instruments	before	after
1. Radio	.....	.....
2. TV	.....	.....
3. Refrigerator	.....	.....
4. Computer	.....	.....
5. Cell phone	.....	.....
6. Chargeable battery	.....	.....
7. Other Specify	.....	.....
8. Other specify	.....	.....

**3.8 Specify the monthly income of the family. Total in Rs.**  
 Before..... After.....

**3.9 What is the status of your family income using MHP?**

1. Increase
2. Decrease
3. No change

**3.10 How much money do you spend on these heading? (Monthly)**

	Before	After
1. Energy	.....	.....
2. Education	.....	.....
3. Health	.....	.....
4. Food	.....	.....
5. Clothes	.....	.....
6. Electronic appliances	.....	.....
7. Others	.....	.....
Total	.....	.....

**3.10 Which instruments are used as energy sources ?**

	Before	After
1.	.....	.....
2.	.....	.....
3.	.....	.....
4.	.....	.....

**3.11 What is the main source of energy in your family? (Non- users of MHP)**

- |             |             |
|-------------|-------------|
| 1. Firewood | 2. Bio-Gas  |
| 3. Solar    | 4. Kerosene |
| 5. Others   |             |

**3.12 Using MHP, is your children study hours increased?**

- |        |       |
|--------|-------|
| 1. Yes | 2. No |
|--------|-------|

**3.13 How much time has been increased?**

- |                 |                      |
|-----------------|----------------------|
| 1. Up to 1 hour | 2. 1 to 2 hours      |
| 3. 2 to 3 hours | 4. More than 3 hours |

**3.14 Has their performance at school increased?**

- |        |       |                 |
|--------|-------|-----------------|
| 1. Yes | 2. No | 3. I don't know |
|--------|-------|-----------------|

**3.15 Have you seen the following changes in the activities of your children due to watching TV, using computer?**

1. Talking style	1. Yes	2. No
2. Dress up	1. Yes	2. No
3. Sport	1. Yes	2. No
4. Reading habit	1. Yes	2. No
5. Dance	1. Yes	2. No
6. Others	1. Yes	2. No

**3.16 Have you seen any changes in following activities to household members using electrification?**

- |                |        |       |
|----------------|--------|-------|
| 1. In fashion  | 1. Yes | 2. No |
| 2. In behavior | 1. Yes | 2. No |
| 3. In thinking | 1. Yes | 2. No |
| 4. Others      | 1. Yes | 2. No |

**3.17 What is the impact of project in infrastructure development?**

Positive

.....

Negative

.....

**3.18 Is there regularity in the electricity distribution?**

- |        |       |
|--------|-------|
| 1. Yes | 2. No |
|--------|-------|

**3.19 Are you satisfied with the way MHP working?**

- |                   |                  |
|-------------------|------------------|
| 1. Very satisfied | 2. Satisfied     |
| 3. Neutral        | 4. Non-satisfied |

**3.20 What should be done for the sustainability of the project?**

From government side

.....

From user side

.....

From management side

.....

**3.21 How do you contribution for the sustainability for the project?**

- |                        |                         |
|------------------------|-------------------------|
| 1. Providing labor     | 2. Providing money      |
| 3. Regular involvement | 4. Providing leadership |
| 5. Other.....          |                         |

**3.23 How much money you can pay for this MHP? (if needed)**

Rs.....

.....

Signature of respondent

*Thanks for your time, Consideration and hospitality*

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