CHAPTER I

INTRODUCTION

1.1 General Background of the Study

Nepal is an economically poor country lying between two fast growing countries India and China. Nepal is rich country in natural resources; among many natural resources, water resource is one of the essential and valuable resource. Nepal is a rich country in south Asia and second richest in the world which has about more than six thousand large and small rivers hurling from the Himalayas and mountains towards the plan of terai. Water has multifarious uses, the most important ones being irrigation and drinking water supply including sanitation in addition; one should not forget the industrial needs and other uses like hydropower generation, navigation recreation etc. are basically known as non-consumptive ones. Nepal is endowed with huge theoretical hydropower potential of 83,000 mw, out of which 43,000mw is considered as techno-economically feasible.

The water resources of Nepal are regarded as one of the principle opportunities for future economic development of the country. A study repot shows about 225 billion m^3 of surface water flow through Nepalese territory. Annually this gives a specific run of about 0.12 million m^3/km^2/year, being about four times the world average. Energy or power is the driving factor for the growth and development of the nation. There are various sources of energy and each nation has its own reserve and energy policy to propel the development activities. Among the various countries over the world, Nepal is one of the gifted nations with a vast reserve of natural resources; particularly it is rich in hydropower resources. The history of development of hydropower in Nepal dates back to a century ago which began with successful installation of Pharping hydro-electric power (HEP), a 500 Kilowatt (KW) power plant. Over the last 100 years, the development of hydropower in Nepal has not been as per expectation and the resulting effect has not been the long load-shedding throughout the nation reaching the perplexing figure of 16 hours (hrs.) in a day. The current load shedding did not happen overnight. It did not happen because Nepal electricity authority (NEA) was unable to figure out what the demand will be four years to come or because such data was not available to NEA. The possible occurrence of the Load-shedding had been forecasted by Nepal Electricity Authority NEA few years ago, but the

government, with its top priority on urgent social programs could not diverts the scarce public fund on power sector. The demand for energy and gap in supply and demand increased every consecutive year as Nepal electricity authority (NEA) was financially unable to add new hydro plant to Nepalese power system as planned. Hydropower sector has inherited characteristics of huge capital investment, high-risk, and sand long gestation period, very site specific; huge environmental and social impact in case of shortage and mega projects. All these features have made the private investors reluctant to invest in the hydro sector. The size and nature of the project undertaken and accomplished by private sector and public sectors also show that while the private sector could invest and developed more in small hydropower schemes, the public sector could contribute more in large hydro-projects including shortage schemes which are vital for reducing the large deficit in demand and supply during dry month. Public private partnership is most suited for medium to large projects. All most all of the studies relating to power development in Nepal have been carried out either by NEA or government of Nepal (GON) and most of which are in the hands of private sector. Despite the tremendous hydropower potential, Nepal is still not able to harness the indigenous resources resulting in acute power shortage across the country. Among the many reasons that leads to the slow pace of hydropower development in Nepal. The lack of adequate financial resources stands at top. Even with the liberalization policy of government of Nepal towards development of hydropower plants through private sector, the result is not promising due to large gap in electricity demand and supply, the country is facing acute power shortage (NEA, 2012).

Water is considered a prime natural resource for overall economic development of Nepal. The major policy objective of government of Nepal is to develop the nation's vast hydropower resource potential to serve the electricity needs of the people and to generate export revenue. Development and rational use of water resources would enhance economic growth and sustaining poverty reduction efforts. Service is an important tool for overall development of the nation. Through there is enormous potentiality of hydropower in the nation, only 56% of people have access to electricity services through the means of hydropower, that electricity and alternative energy. Present generation capacity of electricity faces a deficit of 400mw in supply in dry season. Due to the shortage of transmission line; adequate import of electricity and its

distribution could not meet. Through some of the projects have been completed under the arrangement of public private partnership, the production of these projects is very low (NPC, 2010).

The annual peak power demand of the integrated Nepal power system (INPS) in fiscal year 2012/13 is estimated to be 1,094.62mw, out of 1094.62mw of Peack demand, only 719.6mw could be supplied and 375mw was shed. Out of 719.6mw supplied, 433mw was contribute by NEA hydro, 10mw by NEA thermal, 174.1mw by integrated power project (IPP) hydro and 102.5mw by import. Compared to the preceding fiscal year's figures of 1026.65, the annual peack power demand of the INPS registered a growth rate of 9.0% but in the half yearly report of NEA published in August 2013 where NEA estimated peak demand is 1200mw, only 766.510m could supplied out of 766.510mw the grid connection is 477.354mw, small hydro-power is 4.536mw, free energy production ,230.510mw, thermal plant by NEA, 53.410mw and solar by NEA contributed 0.100mw. The department is responsible for operation and maintains of the medium and small power stations with installed capacity less than 30mw. There are 12 hydropower and 1 thermal power stations under this department. The total generation from middle hydropower stations were recorded at 389.24gwh in fiscal year 2012 and 2013 compared to 403.24gwh in fiscal year 2011 and 2012. Key challenges for increasing generation from medium power stations are namely, the enforcements of maintain once schedule, reduction of maintenance outages, imparting skills and operating prudence and deficient skilled work force to name a few. As a part of the government policy to promote community participation in rural electrification, the business group carried out community based electrification in the various part of the country and handed over the facilities to the community for operation. The government provided 90% of the capital cost of electrification, and the remaining 10% of capital cost was borne by the community. NEA is responsible for maintains of HT (hydropower transmission) line where as community/user group is responsible for maintenance of lv distribution system. All tougher, about 73,000 households have been provided with electricity by the end of the fiscal year 2012/13 through 94 community groups. Distribution and consumer services, west is also responsible for operation and maintains of small hydro plants located in the western part of the country. Besides rural electrification, business group also oversaw distribution and consumer services functions of 22 small hydropower plants located at

the different districts. Out of 22 small hydropower plants 18 are in operation. These centers services 221687 consumers in total. A part from these, 9 smaller hydropower plants located to private companies and communities. These listed small hydro power plants serve around 1206 consumers. Following 6 small hydropower plants exist in this region. Among them three small hydropower plants each one in Bhajhang, Bajura and Darchula District was leased out to the private company and community. Other four hydropower plants are operated by concerned distribution centers of the district. Leased out hydropower plants are monitored by NEA the capacity of small hydropower plants is as follows; 300kw capacity Darchula, 200kw Bajhnng, 200kw Baitadi, 100kw Dadeldhura, 200kw Doti, 400 kw Achham, 200kw Bajura. The annual power demand of the integrated Nepal power system (INPS) in fiscal year 2013/14 is estimated to be 1201 mw, with 410 mw power estimated to have been shed. Out of the 791mw of power actually supplied, 436.4mw was contributed by NEA hydro, 22mw by NEA thermal, 216.4mw by IPP hydro and the rest 116.2 mw was import. Compared to the preceding fiscal year's figure of 1094.6mw, the annual peack power demand of the INPS registered a growth rate of 9.7%. (NEA, 2014).

There are four scales of hydropower project in Nepal i.e.; micro, small, medium and large/mega. In spite of having abundant resources for power generation, there are very few hydropower installations that are supplying power in the country. There are also limited so far to some urban centers only. The growing population with modernization of the society demands more and more mechanized and efficient equipment resulting in increased demands of power but different geographical setting and limited economic resources and environmental aspect make it prohibitively expensive to extend national electricity grid to remote areas (Ghimire, 2006).

Micro hydropower plants also known as 'Micro-hydro' and Micro-hydropower Plant (MHP) are installed in Nepal's remote hilly and mountainous areas. These are useful to provide electricity for lighting facility mainly. Agro-processing like grinding, hulling, operating radio, TV, computers and some other end uses are its benefits. Nepal's techno-entrepreneurs have gained immense of expertise in this technology as they are in this trade for around 40 years. They have expertise to carry out all services for feasibility study, survey, design, manufacturing of turbines and other machines and equipment, installation, commissioning, and repair and maintenance required to micro hydropower plants. This technology has been

successful to generate approximately 20 Mega Watt of electricity establishing 2500 MH plants of different size and capacity. Achievement in this technical expertise also have been appreciated abroad as services, materials and know how beyond the country have been extended. Around 65 privately run firms/companies are there in this trade these days to render services to establish micro hydropower projects to generate of 5000 Kilo Watt of electricity annually in the country. The plants up to 100 Kilo Watt capacity are to be known as micro hydropower. The schemes of 5 Kilo Watt or less, now, have to be known as Pico. Nepal Micro-Hydropower Development Association was established, in 1992, by eight privately run micro hydropower development firms/companies to set as an umbrella organization of those dedicated to serve the nation with micro hydropower technology, skill and expertise. The Association is also to support formulating policies, plans and programs to concerned agencies. Likewise, professional welfare is one of its objectives (NMHDA, 2013).

Small hydro power can fulfill the demand of electricity in backward and isolated areas; where disadvantaged group and marginalized people live indeed micro hydropower projects have not been installed in adequate number is targeted area yet. The marginalized people are living in Remote rural areas which lack balance of regional development. To some extent the development can't be promoted in rural areas in the absence of the electricity.

1.2 Statement of the Problem

There are limited research had been done in the field of hydropower sector and still there is a lack of proper information. So this study will be extremely helpful for the policy maker to formulate appropriate policy for the development of hydro power in the urban and rural areas. It will also be helpful to the existing hydropower projects to maintain their sustainability to gain the electricity. The result also will be helpful to other industries and institutions for the implementation of program. It helps to uplift the socio-economic conditions and consciousness through the use of this modality of rural people. Frequent break down of canal and electro-mechanical parts represented another major problem repairing which is very difficult task. Despite of these problems modernization of the isolated hills and mountains of Nepal is possible with the tapping of river which crises-cross the country. In the economics, hydropower is

important component which helps proper attentation in the process of implementing the macro-strategy of development.

However, in economics hydropower is less studied in Nepal. Some of the studied were focused only non-economic objective. So this study fulfills such objectives to some extent by introducing economic analysis of hydro power. Due to the unique geography which scattered settlements, the national grid electricity expansion has difficulties. Electrification through small hydropower is the best option for rural area of Nepal. It is the foundations to raise the living standard of rural people in multiple aspects such as economic, social, health, education, income, technological improvement etc. if it is properly use.

Therefore, this study examines economic analysis of hydropower. This study also play vital role in the field of hydro power in the study area. This is due to still there is lack of research whether the impact of hydro power. This study also contributes by over viewing the current status of different type of hydropower in Nepal. So this study carried out by introducing some research problems such as whether Adhikhola hydropower impact the socio-economically, information and technological progress or improvement of the project surrounding people or not and in addition this research will also find out what is the current status of hydro power development in Nepal?

So some research questions will be relevant as follows:

i) What is the current status of hydropower development in Nepal?
ii) What is the socio-economic impact of hydropower in the study area?
iii) What is the impact of hydropower on household's consumption of electrical goods and technological improvement in the study area?

1.3 Objectives of the Study

The general objective of this study is to assess an economic analysis of MHP development in Nepal.

Besides this, the study has following specific objectives:

i) To study the present status of hydropower development in Nepal.
ii) To examine the socio-economic impact of hydropower in the study area.
iii) To examine the impact of hydropower on households consumption of electrical goods and technological improvement in the study area.

1.4 Limitation of the Study

This research will be conduct to analysis the economic impact of Hydro power project on specific objectives. This study has following limitations: It is a study of Tuslibhangja VDC (3,4,5,7 wards) which may not be applicable on the other VDC of the country. For counting data I have must the VDC which are far away from Kathmandu may present they my guide lives. Present study may require the frequent visit which cannot be approvable due to the lack of budget. The study narrowed only some limited variable and ignores many variables which may effect on study area.

1.5 Significance of the Study

Hydro power technology occupies a very eminent place in the energy sector of Nepal. A technology which helps to lessen the alarming deforestation imports of petroleum and may other bed consequences, plays a vital role an improving socio-economic conditions of Nepal. Rural economic activities and living standard rose through supply of electricity generation from hydropower project. Hydro power can significantly importance in urban and rural activities. Hydro power makes human life easier by providing domestic as well as non-domestic facilities creates employment opportunities. In the presence of electricity, electronic devices may be available. They improved both quality and quaintly of communication and education. Hydro power helps to discover, develop, expand, and promote new techniques and technologies in various sectors. Improve in extra-curricular activities which help to raise the living standard of the people. Hydro power helps to improve overall sectors of the economy. As hydropower plays vital role in rural Socio- economic activity at project surrounding area and isolated rural areas of Nepal.

So the researcher has conducted a research on an economic analysis of hydropower project. This research will be helpful and resourceful in the following ways. Possibly this is a new research about hydropower project, especially for far west region of Nepal, Syangja, Tusibhangja VDC. However many research of middle and large hydropower projects have been already done. Outcomes from this research many be helpful to other individuals and institutions to implement programs effectively in such type of project. Socio- economic impacts of this project inform us the role of project in the socio-economic upliftment of a community. Finding of this research may be

valuable information to those people, institutions that are interested about people of the related area. The compiled study of hydropower can be useful for planner, researcher support organizations, manufactures, donor agencies and government agencies to apply the data for designing and planning of policies and to fulfill the needs of researchers to some extent.

In short, the importance of hydropower projects is increasing in every aspect of the society. Hence, this study has been rounded on the pivot of analysis of hydro power project on economic and sociaL aspect of this area.. Outcomes of this study will help to access the Impact of the hydro power on education, employment information technology, households consumption of electrical goods and Income level of the people who live at Tusibhanjang VDC of Syangja district or project surrounding area and in addition this study also identify the existing status of hydropower development in Nepal. Therefore this study is significant at present.

1.6 Organization of the Study

This study will be divided into five chapters. First chapter deals with the introduction of the study. It includes the general backgrounds of the study, statements of the problems, objectives of the study, rational of study, limitation of the study and organization of the study. Second chapter covers the revenue of literature. Third chapter deals with the research methodology. It includes study area, nature and sources of data, sampling design, tools and techniques of data collection, Forth chapter deals with data analysis and presentation which includes MHP project in accessing education, health, Household consumption on electrical goods, technological improvement, income, employment of the people who live in Tusibhanjang VDC Syangja, It also includes the current status, trend, development region wise development, economic impact of micro-hydropower development in Nepal and Current Energy Consumption Trends and Scenarios of Nepal and the last Fifth chapter "summary, conclusion and recommendation" provides the findings, conclusion and recommendation of this study.

CHAPTER – II

REVIEW OF LITERATURE

2.1 Introduction

In the international area small hydropower is often studied as a component for the rural development and rural electrification. Since; the scale of hydropower comparatively small the effects are very often found analyzed in the economic dimension of a society. Some studies have linked hydro power with appropriate technology as well. Limited research has been conducted on economic impact of small hydropower projects. However, there are many studies have been done in other sector of hydropower projects. Generally the studies on medium and large scale hydropower projects have been conducted to identify various types of impacts created by the development of hydropower projects. In order to find out what articles have written or researched, the researcher tried to review all the available literature in this area. Some national and international journals, books, dissertations, newspapers which are related to the hydropower and closely related to this research have been reviewed as follows:

2.1.1 Review of National Studies

Khatri (2010) has conducted a research in the topics economic impact of small hydropower; a case study of Piluwa Khola hydropower project Sankhuwasabha district, Nepal. The main objectives of his research were to identify the potentiality and present status of hydropower and to examine the economic impact of Piluwan khola hydropower project of focus area. He has adopted descriptive and analytical research and this research were based on primary as well as secondary data. Both data were presented in the tables, pie-chart and figures etc.

The main findings of this research were the demand for electricity is higher in comparison to the generated capacity, the Piluwakhola hydropower (3mw) is supplying electricity through national grid to meet the increasing demand of electricity, the level of awareness of the people increased. Nobody has been migrate due to the project despite the project has occupied about 41 ropani land. Some PAFs (project affected field) purchased better cultivatable land by using compensation. Some PAFs used compensation to pay debt, invest on business and so on; the

consumption of the electricity is very low in the study area. There is need to increase the consumption of the electricity. Project helps to increase the living standard, education, health status of the project surrounding people. The recommendations of this research were political domination under hydro-project should be stopped. The clear and supportive policies and program ought to be developed and implemented for the development of small hydropower (SHPs). In various region of the country the private sector should be encouraged to developed hydropower especially small hydropower project like Piluwakhola hydropower project (PKHP). SHPs should be installed in rural, isolated and hilly areas.

Regmi (2013) had conducted a research in the topics Socio-economic impact of Thawakhola Micro-hydropower project in Ilam District. The main objectives of his research were to access the impact of MHP on health and entrepreneurship on the study area and to access the impact of MHP on information technology on the study area. He had adopted systematic sampling and this research based on primary as well as secondary information. The data were presented by traditional method; Bars, Pie-chard and required tables.

The main findings of this research were Thawa Khola MHP project has an upbeat impact on enhancement of education status and awareness on information technology of the people who live in Phuyatappa VDC, partially people gain lighting facilities which helps to increase study hour and decrease disease by reducing indoor pollution, the acquirement and utilize of physical assets such as electric appliances has increased access to information and the impact on education, health, access to information and entrepreneurship is positive in project surrounding area. He had recommended that if we give the ownership of electricity to the community then rural people are very much conscious about any type of damage and loss towards the community assets thus this schemes not only creating real sense of ownership but it also leads to safely and security of national assets. This stops the leakage and theft of electricity which helps to reduce problem of load shedding and communities are motivating their member for 100%. Consumer connection by introducing new domestic electrical appliances on installment bases community shops, deploying local youth's unemployment people as a working group. It increases the annual income of households; it reduces average annual health care expenditure for Housewives, Adult literacy rate, quality of Education and Women socio-economic status.

Dhungel (2009) had introduced that electricity is one of major sources of power for the nation's most economic activities. Nepal's installed electricity generation capacity is 688.24mw only 40% of population has access to electricity with a very low per-capita availability of 71kwh per annum. The main objects of his article were to analysis the role of electricity in the causal relationship between electricity consumption and economic growth in Nepalese economy. Econometric methodology has been adopted and time series data of total commercial energy consumption and real Gross Domestic Product (GDP) over the period 1980-2006 were used to investigate causal relationship between electricity consumption and economic growth. The necessary data were collection from different sources. To estimate the relationship between electricity consumption and economic growth, most of the study he had used Gross Domestic product as measure of economic growth. Unit roof test, Co-integration test and ganger causality test preferred to shows the relationship between electricity consumption and economic growth.

He has concluded that the Nepal possesses 42000mw of economic Hydro-electricity is a prerequisite for enhancing economic growth in Nepal on the one hand. While supplementary other forms of energy such as coal and oil through energy exchange programs in the neighboring countries on the other. Estimates of electricity income and price elasticity from the time series data (1980-1999) have shown that the income elasticity of electricity was highly responsive. It shows that Nepal for the long period of time does not have to arrange demand management. It further implies that more generation will more create its own demand. It suggests that Nepal should accelerate more investment in generating hydro-electricity in order to improve supply management. This present study also suggests that Nepal will need to put more effort into increasing electricity supply investment as a national strategy towards advanced development in the long run.

Kandel (2013) has conducted a study in the topics socio-economic impact of MHP project. The main objectives of his study were to examine the socio-economic impact of Nuntha Khola MHP project and to analysis the problems and management systems of Nuntha Khola MHP project. This study based on primary and secondary data. He has conducted quentative techniques mean, standard deviation and range. It is used to analysis the data.

The main findings of this study were Nunthakhola MHP project has an upbeat impact on enhancement of education status, improvement on health status, awareness on information and entrepreneurship of people live in Dhamga VDC. As a whole people gain lighting facilities which help to decrease deceases by reduce indoor pollution. The equipment and utilize of physical assets such as electronic appliances has increased access to information. He has recommended that if we give the ownership of electricity to the community or rural people then they are very much conscious about any type of damage or losses towards the community assets. Thus, this schemes not only creating real sense of ownership but also leads safely and security of national assets. This stops the leakage and theft of electricity which helps to reduce the problem of load shedding, small industries need to be established in the village so that the MHPs revenue can be increased and further, investment can be made households use electricity for more productive activity, government should increase the amount of subsidy for MHP project. Nepal is rich country in water resources but there are not any specific vision and policy of state therefore, the government should formulate and implement the power policy for development MHP in rural areas.

Awasti (2010) had conducted a research in the topics socio-economic impact of Chameliya hydropower project on the adjoining areas. The main objectives of his research were to review the historical hydropower development in Nepal and to examine the socio economic impact of Chemelia hydropower in the adjoin area. This research was based on qualitative data so this research is a descriptive type of research. To study the objectives both primary as well as secondary data should be collected. In order to analysis both data Bir-digram, Pie-chart, simple and subdivided Bar-diagram have been used.

The main findings of this research were the project imparted the excessive drinking water facilities to the local and employment opportunities to both local and other people from outside. This trend is expected to continue after the project well being implemented. Electricity supply has extended the social and recreational activities i.e., increasing Education, purchase and use of tape records ,TV ,radios etc. physical structure of this project utilize the fertile and hill land, which has impact on potentiality of agricultural productions. Environmental mitigation measures have not been completely followed. In terms, the impact of the project can be judged as moderate in absolute term and satisfactory in real terms, which mean similar in

comparison to other project. He has recommended that there were also negative Socio-economic impact of the project but these negative impacts are fewer than positive impacts. Therefore, it should be tried to enlarge the positive impacts and avoid negative impact which would be beneficial, the clear supportive policies and programs for the development of SHPs in various regions of the country and detail survey & estimation should be concluded to identify and install SHPs which can be invested by domestic private sectors and priority should be given for the development of SHP because it helps to reduce regional imbalance of development ,meet large scale project as export oriented projects.

Joshi (2011) had conducted a research in the topics Socio-Economic Impact of Surma Devi small hydropower project, a case study of Bajhang District. The main objectives of his research were to find the socio economic impact of the project and to introduce the total effects of the project at the study area. He had adopted different techniques and tools as a field survey, interview, observation and structured questionnaire and quantative method is used to find the every kinds of socio-economic and environmental effects in the study area as well as surrounding areas.

He had mentioned that energy is important for economic development. The pace of economic development can't accelerate without hydropower development. The development of productive sector of an economy depends on development of energy sector. In hilly and mountainous areas, all most all the households are found to have consumed traditional sources of energy for cooking, heating, lighting and other necessary activities. Traditional energy sources can't be sustainable to fulfill energy requirement. From the present analysis it has been observed that most of the people depends on forest for energy sources and livestock as a result, the 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 the deterioration of water resources and hampers both electricity generation and drinking water. Hydropower occupies a very eminent place in the energy sector of Nepal. The utilization of energy concentrated on urban areas and most of rural areas have been by-passed -by this power development. The hydropower project has brought changes in socio-economic, cultural and other aspects of the people living in the project located area and its surroundings.

Hora (1996) had examined that among the alternatives energies more popular and available, continuously, non-polluting, efficient widely distributed and based on simple as well as flexible energy sources is MHP in Nepal. The main objectives of her thesis were to depict the current status of MHP in Nepal and identify the issues in MHP development promotion and rural electrification. This study is explanatory type. Secondary data were used to study such objectives.

According to her findings, MHP is technically feasible as well as economically viable and the most appropriate technology for Nepal indeed, MHP project are not sufficient to meet the national demand of electricity on one hand. We have no economic resources, technically and skilled manpower to install large scale of hydropower projects access to electricity and other mechanical forms of energy for agro-processing on the other. Furthermore it is also capable of providing rural electrification to the limited scale. Hilly topography and enough availability of water resources show the huge potential for MHP in the country. MHP helps to reduce the alarming deforestation, import of petroleum products thereby playing a vital role to improve the economic condition of the people. Over 90% of the private MHPs in Nepal have been financed by agricultural development bank of Nepal not only providing loan and subsidies but also providing resources survey feasibility studies, promotion of manufacture involvement, technical assistance and training. It may not generate electricity in dry seasons likewise; the skilled manpower may not be available to get it repaired sufficient research has been carried out yet there are few problems involved with MHPs.

Rai (2014) had studied in the topics socio-economic impact of Thotnekhola mini-hydropower; a case study of Okaldhunga District. The main objectives of his study were to state the potentiality of hydropower electricity generation and present status of Hydropower, To analyze the socio-economic impact of the study areas peoples, To find out the attitude of community towards Thotne khola Mini-HP (Hydropower) and to suggest the sustainable development of Mini-hydropower project in Nepal. This study based on primary as well as secondary information. The primary data has been collected from sample survey, HH (Households) questionnaire and detail observation in concerned area. The collected both data were presented in suitable tables and figures and analyzed the both data according to the objective of the study.

The main findings and conclusion of his study were small and micro hydro power may be most useful in rural and remote area. There is sufficient feasibility of such types of lower scale hydropower, but neither government nor private sectors vision goes there. The conclusion of the study area as follows; the demand for electricity is higher in comparison to the generated capacity. After electricity facility all most of the respondent's family income, standard living, sanitation & health and study hours of the child have been increased. The small hydro power is known as lower scale plan and established in rural hilly areas. Therefore, there is neither higher immigration nor emigration trend. Electricity is major foundation of industrialization so there are some small and domestic industry is established. Hydro power changed social and cultural properties like change in behavior, changing in clothing and thinking he had recommended that electricity energy must be established as a fundamental and basic need of human beings. Nepal is rich in water resources but there is no specific vision and policy of state. Therefore, the government should emphasize the development of infrastructure in remote hilly and mountain district like the Okhaldhunga with support the development of hydropower technology promotion and entrepreneurial development and subsidy program encourage the development of Mhp system. In every opportunity preference should be given to the local people then local people should be also ready and conscious to help the upcoming projects & program and grab advantages.

Gaudel had conducted a research in 2013 in the field of MHP entitled emerging innovative strategies and institutional arrangement to ensure sustainability of MHP development; a case from Baglung district in Nepal. The objectives of this study were to examine roles of various stakeholders in the development of the mini-grid. This paper further, analyzes as to what extent this development of mini-grid has been instrumental in increasing the sustainability of MHPs and to what level the reform relating to a paradigm shift from government led country. Planned energy distribution and development process to community based participatory process has been successful. A field visit was carried out in June 2013 to collect information on different aspect of mini-grid and its sustainability. Interviews and group discussions were carried out with the members of the Mini-grid Co-operatives, grid operators, MHP operators, users and other stakeholders. Secondary data were collected from the literatures, reports and records of the grid operators. This study shows that the micro

level plans and policies for rural electrification are translated into realities. This has been possible with the active involvement of the locals to fulfill the local energy demand. The formulation of the mini grid and its management by a cooperative consisting of people from among the users has put the MHPs in the path of sustainable energy development. The mini-grid can be reliable source of electricity supply to the remote area where the national grid extension is not easily possible. This first Mini-grid through connected with the 6 MHPs at preset is operated in isolation mode and there are possibilities to connect this grid with the national grid in near future. The stake holders are moving ahead in this process. As Nepal electricity authority is the sight energy buyer and owner of the national grid, NEA needs to play a supportive role in facilitating the sustainability of MHPs in rural areas of Nepal. This connection works well, then surplus energy from the mini-grid can be supplied to the national grid and it can contribute electrical energy to some extent in order to mitigate the power shortage in the country (Gaudel, 2013).

Saud (2005) had conducted a research in the topics of development of micro-hydropower in Nepal. The main objectives of the research were to examine the current status of the MHP development on Nepal. To identify the contribution of MHP in rural development and to access the impact of MHP on peoples livelihood and quality of life in remote areas of the country. This research was based on secondary data. The collected data were analyzed by using quantative tools and the data were presented map, chart and diagrams.

The main findings of this research were MHP is considered as best options for providing electricity to hilly and rural mountain villages. The rural village can enhance their livelihood and style of living while preserving environment. Sites sustainable for such MHP installations are abundant for e.g. traditional water mills called ghettos are very common in hilly areas with steams and used for grindings grain hulling rice and expending oil, MHP has fulfilled commodities requirement, such as running agro-processing mills bakery, mechanical workshop, rural enterprises, farming computers training, photo studio and so on in locations of the hills and mountains with low population density and scattered settlement. Hence there is high prospect of MHP development from all rounds, sustained development for all rounds and sustained development in rural Nepal particularly in rural area. Most of the rural people have been heavily dependents on traditional sources of energy. These

traditional sources exploited through MHP. MHP is a major renewable sources and this widely seen as a means of reducing foreign exchange payment for imported energy and fuels in rural areas. He has recommended that the His Majestic the government of Nepal (HMG/N) emphasize on subsidy policy with equity for the development of MHP in rural area all over the country. Priority in rural electrification should be given by using indigenous materials and manpower during implementation and operational processing. The people should be made aware of people Participation, good governance responsibility for the sustainable development of the MHP. And the government should invest much of the finance in building MHPs in rural remote areas of the communities.

Adhikari had been done a research in 2014 in the field of MHP entitled socio-economic impact of micro-hydropower a case study of Angsarung VDC Panchthar district in Nepal. Main objectives of this research were to study the impact of Nibukhola IV micro-hydropower project in income, information and education of the people and to study the people's participation about sustainability of MHP project. This study based on explanatory research type. This study was based on descriptive, analytical and explanatory. This study also based on qualitative and quantative from questionnaire through household interview. Both primary and secondary data were presented by pie-chart bar-diagrams and tables were generated by using computer program. MHP has positive impact on income, employment by helping in the establishment of new business. MHP reduces expenditure on different energy source of energy in rural area. By the use of MHP the health conduction also gets improved. People who don't have MHP use maximum firewood as light or lamp and cooking but those people who have MHP has reduced which has helped to conserve forest. Electricity is closely related with human life there for all respondents who have use MHP have been changed their living standard. The status of sanitation has improved by the use of MHP. By the use of MHP study hours of students have been improved than non-users. MHP users have improved their education status. MHP reduced the expenditure on different energy sources like firewood, kerosene, bio-gas etc. so it can be a less expensive source of energy in the rural area. To repair, maintains &operation for the MHP management committee is fully responsible. Recommendation can be made by considering the findings and conclusion of this present study. The electricity power generation should be increased by further investment as demand is length than

supply. Lack of timely maintains is another problem technically. So the technicians should be provided by government to maintain MHPs. The sustainability of MHP is another issue. The dam constructed is located at week area as well as 'kulo' is built on sloping area. Household uses electricity for more productive activities. The Small industry need to be established in the village. Government need to formulate appropriate policy and should allocate resources for MHP to maintains and repair (Adhikari, 2014).

Upadhaya (2009) had evaluated the effectiveness of Micro-hydropower project in Nepal. This study investigates the efficacy of community based Micro-hydropower projects in two remote villages, luwang, Ghala and Ghandruk, as well as the role of public participation in these projects. This report employs a case study methodology, with data collection taking the form of interviews, surveys and document reviews. The result of this study shows that Micro-hydropower projects are a temporary salutation at best. Besides on internationally accepted criteria, both the technical performance and the level of public participation at both projects were found to be very low. Gender caste, ethnic group and socio-economic stratification have also seen an unequal distribution of the projects benefits. According to her Nepalese nationals power grid would be expensive and problematic; Micro-hydropower project have proven to be an economical and efficient alternative in the effort to power remote villages deep in the mountains. Her findings indicates that both the Nepalese government and associated non-governmental organizations must make significant policy changes if they hope to achieve success in future development work with community-based micro-hydropower projects.

2.1.2 Review of International Studies

Brodman (1981) had conducted a research in the topics socio-economic impact of rural electrification; a lesson from central java "has depicted the Socio-Economic impact of klaten rural hydropower project in Indonesia. The main objectives of this study were to examine impact of rural electrification and to find out the living conditions of the people in the study area. This study was primarily based on primary data.

The main findings of this study were 88% of the business in the study area had installed electricity of project, 77% of the electricity adopters with school children reported that electricity had caused in increase in their study times, more than 88% of respondents said that electricity had made the village safer due to lighting of the village paths, more than 70% of electricity adopters and non-adopters opined that electricity had beneficial them by stimulating night time activities, Business work hours had increased. 11% of the interviewed household increases there income by using electricity in their home, industries, 33% of the businesses respondent reported that electricity use had developed their business. 50% of the business respondents and 43% of household respondents said that employment opportunities had increased due to electrification. Therefore, this study has thus concluded that rural electrification is the most vital and most benefited source of energy in the rural hydropower has contributed to enhance the living conditions and expand the capabilities of the people in java in a clean and sustainable way.

Cockburn (2005) has studied about the evaluation of social impact of fund for promotion of hydropower station. A project carried out by international technology development group. With the support of Inter-American development bank has examined the major social and economic impact of MHP. The major objectives of the study were to identify the direct and indirect impact of the MHP. To discuss the lessons learned regarding the intervention model and to recommended appropriate policy in the field of rural electrification. The study was carried out through a quick research combining qualitative and quantative data gathering techniques such as interview, sample survey and questionnaire. The study has covered eight micro-hydropower projects. The main findings from the study were the installation of MHP system has generated significant improvements in the livelihoods of beneficiaries. The use of electricity appliances has improved the quality of life. Street lighting has contributed to improve the use of public are as well as with the installation of MHPs income improvements were the results of family business and Self-employment using electricity has reduced the expenditure on other source of energy; e.g. Four times less in Tomborapa MHP area, 2.7 times lass in Lasjuntas MHP area. Women have been benefited as electricity has made it easy to do certain house chores. Children are the most benefited group in education related aspect and terms of entertainment

possibilities at leisure times and the greatest benefits have been produced in health care.

Ramanathan & Abey (2007) stated that Indian's endowed with rich hydropower potential; it ranks in the world in terms of usable potential. However, less than 25% has been developed or taken up for development. Thus hydropower is one of the potential sources of meeting the growing energy needs of the country. The installed generating capacity in Indian (in utilities) as of 31 march 2006 was nearly 0.125 million mw. This included thermal hydro-nuclear and renewable based generation. Hydropower constituted about 32325mw. The demand for power has been growing at the rate of 5.74% in recent years. During 2005-2006 the demand were 632BU in terms of energy and 93210mw in terms of peak power requirements. The country is experiencing power shortages of varying degrees in different parts of the country. The shortages during 2005-2006 were 8.4%. Per-capita consumption of electricity is relatively low, of the oldest of 600 kilowatt-hours.

He mentions some findings in his book Indians endowed with rich hydro potential; it ranks fifth in the world in terms of usable potential. This distributed across six major river systems namely, the Indus, Brahmaputra, Ganga, the central Indians river system, and The East and West flowing river systems of south India. The Indus, Brahmaputra and Ganga together account for nearly 80% of total potential. However, to date about 20% of the country's vast hydropower potential has been harnessed. The share of hydropower in the total installed capacity has also decreased over the years; from over 50% in 1960-1961 to nearly 26% now. Preparation of details project report for hydropower project takes relatively longer period than for thermal project because reliable hydrological, geological, seismological and environmental studies have to be carried out for a longer period. In addition to this, these project are comparatively capital intensive. Development of small hydropower floors suffered due to in accessibility the site lack of power accusation infrastructures, investigation and construction difficulties, land acquisition and financing difficulties, inadequacies in institutional support and in some cases law and older problem. Based on the above findings the recommendations given by the book were: India has an assessed hydropower potential to the tune of 8400mw at 60% load factor, out of this only about 20% has been developed so far considering the large untapped potential and the intrinsic characteristics of hydropower is promotion the countries energy security and

flexibility in system operation, the government is giving a trust to accelerate hydropower development. Further he recommended that India has been cooperating with Bhutan and Nepal in hydropower development for over a decade. There are prospects of further enhancement for the benefit of all the countries and in the larger interest of energy security of the region some prospect of hydropower cooperation with Myanmar are also indicated.

East Consult (1990) analyzes the socio-economic impact of MHP plants on rural economy of Nepal. This study is more related to the issues of mill ownership's and management performance such as mechanical agro-processing and electricity, it impact on both entrepreneur and consumers. This study was based on the information collected from the seven sites, which were visited by research termand studied. The study examines the technical performance such as mechanical agro-processing and electricity.

According to the findings of the study, the electricity has provided psychic and indirect benefices such as longer hours of study, improvement of health, some wicker work's etc. and has been made be community more attractive for transient such as trekking but the economic productivity can't be expected since the sue of electricity is not predictive. Tariff collection problems, lack of knowledge in operating and maintenance and authorized use of electricity are identified in the problems side. The rural people have no cash income to pay the electricity change. So, it is very much difficult for them.

The report makes some important recommendation regarding further development and dissemination of this technology. It suggest that, the poor should be integrated with income generating programs, that manufactures should reduce the operation and maintenance service cost to assist the mill owners properly operating their machines, that private entrepreneurs from within the community has provided chapter and better service than private owner from out sides of the community so they should further encouraged to expand in areas of the country which do not have such facilities and lastly it suggest that the government should examine the possibility of allowing the small turbine owners to connect to the national grid and to sell electricity to the Nepal electricity authority(NEA) at avoided costs to avoid limbo in a turbine generated electricity.

Sarfoh (1990)Stated that Africa has the highest potential for hydropower development; it is also behind other reasons in developing that potential. He had argued that hydropower was not developed to the required levels in West Africa because of the initial high cost of hydropower plants, low domestic power markets and ignorance of hydro resources and future energy needs. The author's purpose remedies a full assessment of present and future energy needs change in fundamental features and future of the politics and economics of varies countries expansions of electricity to rural populations and regional cooperation in hydropower development.

The author's observation that mere availability of resources and the advantages which hydroelectric power offers have not as yet induced any applicable level of hydroelectricity generation. Consciously illustrates the essence of professor Sarfoh discussion in this book.

The author examined the energy consumption practice of West Africans and the potential of several energy resource endowment 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 chapter and more accessible than foreign oil and less damaging to the environment then 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.

Sarfoh is less than convincing in his conclusion that hydropower represents the best alternative sources of energy for West African, especially when one conditions the formidable obstacles that outlines. The net result of the obstacles is a significance reduction is hydropower generated, necessitating the closing of some hydropower plants and the purchase of private generators by industries and individuals West Africans hydropower projects thus become un reliable, inefficient and costly sources of energy.

Nafziger (1990) had conducted a research on impacts and implications of rural electrification ideology in Nepal's domestic sector were based on the information collected from five sites. The study has general presented an overview of each of the research site at Khaireni, Butwal, Baglung, Salleri and Andhi Khola. It also contains a description of each sites electrification ideology and system physical infrastructure.

The study processed to consider electricity tariff outlining the primary facts of the domestic tariff at each site sites. The study also discussed about the impact of electrification on lighting and other issues such as dry-cell battery utilization, low wattage cooking etc. it also describes about social impact of electrification.

The study compares the impacts of convenitalverses non-convenital rural electrification ideologies in electrified household across geographical regions. And also compares electrified versus non-electrified households co-existing within the same geographical region in order to identify commodities and divergences between the two.

The study makes some important recommendations it recommended that the electrification is one of an extremely scarce service in many service. So to effectively utilize this scarce resource in the most equitable manner, the paramount area that should be addressed using very simple and non-convenital tariffs and technologies are the constraint of domestic peak.

Khan (1998) Stated that provision of electricity is a pre-condition for the advancement of other services to accelerate economic development of the total consumption, households is 44 percentage, agriculture 15 percent ,industry 17 percentage and other 12 percentage includes railway traction.

He further states that Pakistan has made a great stride to build a Self-sustained and viable power system. The overall financial constraint in Pakistan and consequently, inadequate availability of funds for new power generation facilities etc. was the major constraints. His recommendation indicated that the electrification of village manifests transformation of the rural economy in checking the influx of rural workforce in which of work to the already populous cities and towns where the essential services supplied by utilities are already over capacities.

DFID (1999) published an article community Micro-hydro in (Least Developed Countries) (LDCs): Adoption, Management and poverty Impact. Energy is an important factor in rural development. Lack of energy is often a constraint that holds people back from achieving a better life style. Many routine jobs that rural people need to do to provide for their basic needs, demand energy. This energy can be provided manually, which demands hard work from the people involve and takes large time. An external source of energy releases people from this drudgery and

allows them to be far more productive in their use time. In hilly areas of the world, one sources of energy is that from moving water. Small turbine technology has been developed in many countries that can allow both shaft power and electricity to be generated from small streams flowing down hillsides cheaply and efficiently. Shaft power can be used directly to drive machinery that can do many of the tasks that have been traditionally done by hand. The classic example is food processing, rice hulling, the grinding of grains to flour and pressing of food oils from seeds are very laborious tasks if done by hand. The use of energy allows these tasks to be done much more quickly. The availability of energy also allows a range of productive tasks that would not otherwise possible. New village industries can be set up that can be used to earn income for villagers. Alternative, high value crops and other produce can be grown and processed for sale to towns and even for export. This includes products such as tea of coffee fruit juices of spices.

hydropower 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 rural areas to reduce the drudgery of food processing and it can offer a means of generating electric power in areas as well away from the grid. The success of any programs using such technology depends on a wide range of factors that must all be considered and covered effectively. These includes the manufacture and installation of the technology itself ,but also making sure the technology used for purpose for which people have a felt need and which are economically viable. The financing of the installation of the technology through loans and subsides is another area that needs careful planning over a term of several years.

Barnes et al. (2002) they presented a paper the role and importance of small hydropower and rural electrification case-study Uttaranchal, India. This technical paper deals with the areas supplied with electricity from small hydropower are mostly mountainous area, which are hard to reach with large national grids and which have suffered from the lack of or shortage of electricity. This has severely restrained the economic development in these areas. The exploitation rural small hydropower not only solves the problems of water supply to mountainous agriculture, but also solves that of electricity supply for pumping water for agricultural use including irrigation. It accelerates the constriction of infrastructure, improves the development, agriculture in mountainous areas, and guarantees a stable and high output of grain. Small

hydropower eliminates electricity shortages in rural areas and this supports the rapid growth local industry, township and village enterprises and agro-industry. It promotes the exploitation the mountainous resources and turns a resources advantage into an economic advantage. This creates employment opportunities for rural residents, and reduces the migration of the rural population to urban areas.

The future of development of small hydropower projects in Uttaranchal state is bright and in view many power stations shall come up in future which will facilitate the development of far off areas of the state and will provide quality power to the people of area. It is the need of time that the small hydropower development should take place keeping all parameters of safety and quality management in place so that the problems which are hampering the operation and maintenance of existence of existing power stations may not re-occur.

Actually hydro power planning is very necessary for Nepal as well as rural areas where the national projects can't cover electrification, in such places the small project known as micro-hydropower plant may be very useful. The micro-hydropower project conducted in district head quitter as well as another places can't cover the whole district. So the hydro project of Adhikhola Khola must be suitable and usable or it has significant role in study area.

All the above studies love mainly related with the study of hydro power project. Actually small hydro power project is very necessary for rural area. Most of these studies try to analyses the problem, prospects, socio-economic evaluation and technical assistance of hydro power. Some limited study has analyzed the impact of hydro power to assess education; health, information, income, and Employment of people live in the rural area. However this study is focused on economic analyses of hydro power in order to fulfill research gap by adding some new objectives like to identify the present status of hydro power development in Nepal and to examine the impact of hydro power on household consumption of electrical goods and information technology. So this study will contribute to fulfill the gap which makes our research better in the field of hydro power..

CHAPTER III

RESEARCH METHODOLOGY

Research Methodology is one of the most important parts of our research work. In the chapter of methodology should include the different methods of our research work, like as research design nature of data, source of data, techniques of data collection.

3.1 Study Area

The government of Nepal has divided into five development of regions, 14 zones, 75 districts, 217 municipalities, 3137 VDCs for the adequate or equal development of the country. Among them western development region is one which includes three zones Gandaki,lumbini and dhaulagiri. For this study Gandaki zone has been chosen which has six districts: Syangja, kaski, Tanhau, lamjung,manang,gorkha.And total covered area of this district is 1164 square kilometer .The Adhikhola small hydropower is located syangja district Jagartradevi vdc waed no .8.This hydropower product 5100 kw and distributed about 20 vdc and one municipality area. But study area is Tulsibhajang vdc (ward n.3,4,5,7)which areas people were consumed electricity and water supply for irrigation purpose.

3.2 Research Design

The research design is the detail and scientific plan of the investigation for the good research work and reliability. I will apply the scientific method. This study based on explanatory research design. This study was investigating the socio-economic impact of micro-hydropower in rural sector. This study find out how people benefitted by project and its impact on people besides the study an attempt to describe the benefits experienced by household of the project affected area after the installation of micro-hydropower project such as economic activities, income, information technology ,education, employment, households consumption on electric goods and current status of Micro-hydropower development in Nepal. This study was focus on the investigation of impact of micro hydropower project.

3.3 Nature and Sources of Data

The nature of data were quantative and qualitative both. The present study was using both the primary and secondary data.

3.3.1 Primary Sources

This research work is mainly based on primary data. Primary data were collected from the field study using different techniques and tools like field survey, interviews, observation and structured questionnaire.

3.3.2 Secondary Sources

The secondary data were helped to make the study more relevant and comprehensive. The secondary data were obtained from the various sources, which are specified; Economic survey, Central Bureau of Statistics(CBS) report and publication of Nepal Electricity Authority (NEA), Ministry of finance (MOF), Journals, Alternative Energy promotion Centers and internet.

3.4 Sampling Design

In the study area, there were total 538 households affected by the MHP project in the field survey out of 538 household 54 households were selected by using simple random sampling method. The sample is about 10% of the population and lottery method were applied to select household and to fulfill the purpose/objective of the study.

3.5 Tools and Techniques of Data Collection

For this study data were collected from the field survey. The study was mainly based on primary data. The data were used to analyze economic impact of MHP on Tusibhajang VDC of Syangja District. The questionnaire was designed to access the impact of micro-hydropower project on education, health and technological improvement, household consumption on electrical goods, employment and income of the people. The study will be conducted through the formal method of interview, observation, structured questionnaire and secondary data were collected through varies sources like major publications of the governmental and non-governmental agencies/organizations and its various organizations in order to examine the current status of Micro-hydropower development in Nepal.

3.6 Data Analysis and Presentation Methods

After classification and editing of the collected data another important work for the fulfillment of the objectives of the study is data analysis and presentation, different statistical tools were used for data analysis like average, percentage, and ratio. Descriptive method was applied for qualitative data. The data were presented by using simple methods like as Bar-diagram, Pie-chart and required tables.

CHAPTER IV

DATA PRESENTATION AND ANALYSIS

This chapter deals with data presentation and analysis, which includes current status of small hydropower development in Nepal, it's social and economic impact analysis of hydropower project in accessing education, health, Households consumption on electrical goods, technological improvement, income, employment and entrepreneurship of the people who live in Tulsibhajang VDC(ward no3,4,5,7), Syangja district. This chapter presents the analysis of data and their interpretation with the help of table. Section 4.1 presents history and trend of small-hydropower development in Nepal, 4.2 presents current energy consumption trend or scenario in Nepal, 4.3 presents current status of small-hydropower development in Nepal, 4.4 presents district and development region wise development of hydropower and section 4.5 presents socio and economc analysis of hydropower development in Nepal. Section 4.6 presents the socio- economic Impact of small hydropower project on surrounding people, 4.7 presents the household consumption of electrical goods and 4.8 presents technological improvement in the study area.

Socio-economic feature of the study area depicts the development status of the village with the aspect of sociologically and economically. The sociological and economic characteristics such as General information of sample households (religion, age, cast, gender etc.), household's participation by ward, education, employment, health, entrepreneurship, rural electrification and level of income have a significance influence in the economy of the village and the living standard of the people. Similarly electrical goods consumed by sample household and their technological improvement deals with the household consumed number of electrical goods and technological improvement due to consumption of electrical goods after hydropower project such as improvement in communication , skill development etc.

4.1 Trend of small Hydropower Development in Nepal

The Hydropower development in Nepal has a long history. The institutional development of hydropower started date back to 1962 when Swiss assisted to the establishment of manufacturing company named Balaju Yantra Shala (BYS) at Lalitpur Kathmandu. However, the history of micro-hydropower exploitation with the

help of water wheels started from countries when some Nakarmis visited Tibet and transferred the technology of water wheels locally named as "Pani Ghatta". They are still being used to gained food grains in hills and mountains region. It is estimate that more than 25000 such Ghatta are still locally manufactured and used all over the country. The modern micro-hydropower was introduced in the country when Japanese propeller turbine was installed to generate electricity. The development of MHP started with the improvement of local water wheels as Multi-Purpose Power Unit (MPPU) for agro-processing. Further, the cross flow turbine was promoted for agro-processing and generating electricity. Generating electricity along with the establishment of numbers of turbine manufacturing companies since 1970s. The rapid dissemination of MHP took place through the technical and financial support of ADB/N (Agriculture Development Bank/Nepal) under fourth agricultural credit program supported by Asian development bank, Manila. Further, impetus of MHP development for electrification started in 1981 with the government subsidy in electrification component and credit assistance of ADV/N.

During the first four years (1981-1984), only 10 MHPs were installed with total 9kw, electrical companies, when government introduced subsidy policy in the year of 1985, all tougher 23 schemes generating 166kw electricity. After the liberalization of economy, the year 1996 saw a turning point for the development of MHP in Nepal. The government of Nepal has also placed emphasis on MHP. The eighth plan (1992-1997) set a target to develop 5 mw of MHP project. For last two decades, the government has been providing subsidies for MHP through the ADB/N first and then the AEPC fund. The water resources act, 1992 and the electricity act, 1992 were enacted to provide the legal framework to allow the private sector to enter into MHP development. The ninth plan (1997-2002) set a target on reduction of rural urban disparities through rural electricity supply and linkage with rural economic activities among other things. The ongoing tenth plan (2002-2007) also envisages the same kinds of goal poverty reduction. His majesty's government of Nepal (HMG/N) established AEPC under the development committee act 1996. AEPC works closely with various donors International Non-Government Organization (INGOs), Non-Government Organizations (NGOs) and private sectors in order to implement various programme activities. HMG/N with the Energy Support Assistance Program (ESAP). The former implementation of the ESAP began on 15th April 1999 with long term

(10-15 years) vision. Currently AEPC is providing government subsidy and technical support with the assistance of DANIDA.

The total 360 peltric and Non-peltric MHP plant were installed up to 2011, which generate 28.308kw electricity. Similarly, Rural Energy technologies (RET's) installed data up to mid-July, 2012 shows that the total 2921 MHP plant (peltric and non peltric) were installed, which generates 28.308 k w electricity. However, the year wise installed MHP plant up to 2013 shows that, the total 2778 MHP plant were generate 26534.46kw electricity. This implies that the development of MHP plant in Nepal at present is increasing rate. Therefore the current status of MHP plant was to some extent satisfactory. However, the development of MHP in Nepal is not free from problem. The main problems of the development of MHP project were policy making, implementation, lack of government subsidy, investment and awareness etc. The highest power house of the world Cho-Rolpa Micro-hydropower project which is located in Dolakha, Gaurishankar village. The height of this project is 4580m and it generates 15kw electricity. This project is completed in 2003.

The small hydropower has operating in Nepal since the constriction of Godavari fish farm plant with 6kw back in 1962 in Godawary VDC in Lalitpur district of the country. The development of MHP has been continuous since 1975. However, development of MHP has increased drastically since 1995 during 42 years, between 1962 and 2013. During the period of 1996-2013, the total MHP plant is 1152 with an installed capacity of 22830.62kw and Pico-hydro installed during this period is 1626 with an installed capacity of 3704.46kw.

If we analysis the year wise installed data of small hydropower plant in Nepal the highest small hydropower plant (140) were installed in 2011, which generates 4016.2kw .similarly, the highest Pico-hydropower 130 were install in 1996, which generates 203.3kw electricity. However, the highest electricity 368kw were generate from 103 Pico- hydropower schemes in 2011.

The trend of total small hydropower installation in number was fluctuating in different period between 1962-2013. Even though, from 2001 there has some overall declining in number of each year as compared to early annual basis. But cumulative frequency of maps in number was constantly increasing from 1962-1977. Although contentiously increasing between 1978 to 2003. The trend of total installed capacity

Kw was fluctuating in different periods during 1962-2013. But the trend of cumulative installed capacity was increasing constantly between 1962-1976. However gradually increasing between 1978-2013.

4.2 Energy Consumption Trends and Scenarios of Nepal

NCEESD (2014) has displayed Lack of access to modern and clean energy services is considered as one aspect of the energy poverty. The two major challenges of energy poverty are lack of access to electricity and reliance on biomass sources of energy for cooking. Nepal has the highest energy poverty in the South Asia with just 120kwh of electricity and 15 Giga joule (GJ) of primary energy consumptions per-capita in a year in 2012.

Besides, Nepal is facing energy supply crises frequently in the recent time. The traditional energy source such as fuel-wood has become scarce everyday with the growing population and people's migration from hilly region to southern plains. The forests are eventually becoming denuded. Overall, the demand for energy is growing at a rapid pace but the supply side is facing a lot of bottlenecks. There is a lack of proper planning and comprehensive policies related to energy sector. Individual and disaggregated approaches in dealing with Sub-sectorial problems from the concerned government agencies are lacking coherence and making the energy crisis more acute. Imports of petroleum products in 2014 are expected to reach 150% of total exports from the country. Nepal, being in the high vulnerable group of countries, because of its poor economic performance compared to other South Asian countries and its total dependence on imports of oil products, has to seriously take certain policy/strategy steps for its energy security and sustainability.

Against this back drop, it has become very essential to have an integrated energy model in the present context for proper planning and policy analysis so that the policymakers can be timely updated and given various policy options to take necessary energy related policies and decisions. An end-use approach modeling framework on the basis of Model for Analysis of Energy Demand (MAED) was developed for a period from 2010 to 2030. Consequently, Nepal markal energy modeling framework was developed and inputs of the useful energy demands from the end-use approach MAED were exogenously incorporated in Nepal consumes 410,000 TJ of final energy in 2010 with 85% of traditional biomass, 12% of fossil

fuels, 2% of electricity and 1% of modern renewable energy. The final energy consumption scenarios were calculated at the three different cases of Gross Domestic Product (GDP) growth rate 4.4%, 5.6% and 6.3% respectively. With the policy of promoting renewable energy and energy efficiency the final energy scenario at the reference case of GDP growth rate indicates 23% of energy supplied by indigenous renewable energy resources. By 2030, Nepal has a carbon abatement potential of 42% and 43% at the GDP growth rates of 6% and 9.2% respectively provided that the country focuses on implementation of the aforesaid technology and policy interventions.

With the implementation of the above strategic options, Nepal can achieve carbon abatement of 42% to 43% from the BAU case in 2030, if Nepal takes concrete policy path ways for accessing modern energy to the people, improving energy efficiency measures in all sectors, and developing indigenous hydropower and renewable energy resources for low carbon energy supply. This abatement is also in the range of the expected carbon abatement in the neighboring South Asian countries.

The analysis of the scenarios developed indicates that Nepal's energy consumption is becoming highly dependent on totally imported fossil fuels which put Nepal's economy at jeopardy in the long run. The analysis from the markal modeling framework highlights that Nepal needs to develop its indigenous renewable energy resources to meet the growing energy demands for sustainable energy development and energy security.

4.3 Present Status of small -Hydropower Development in Nepal

The rural energy development programme (REDP) has operated from 16 August 1996 to 31 March 2011 adopting a holistic approach of development for the promotion of rural energy technology; primarily community managed small- hydro systems in Nepal. Over the period of around 14 years of operation, the programme has passed through three phases completing the programme cycle of pilot operation, expansion, replication, main streaming and institutionalization. During the first phase from 1996 to 2003, the programme expanded from initial 5 districts to 10 districts in 1999 and to 15 districts in 2000. In its second phase from 2003 to 2007, the programme was operated in 25 districts. Likewise, the programme was operational in 40 districts in its third phases panning from 2007 to 2011.

Table No 4.1: Present Status of small hydropower Schemes Installation in Nepal

SN	Hydropower schemes	Electrification schemes		House hold served
		Number	KW	
1	small-hydropower(non-peltric schemes)	317	5814.2	5749
2	Pico-hydropower(peltc- schemes)	53	171.2	2027
Total Number		360	5985.4	7776

Sources: Alternative energy promotion center Lalitpur, khumaltar, achievement of Rural energy development program (REDP), 2011. year review of 16th August, 1996-31st March, 2011.

The above table depicts that During 16th August, 1996 to 31 March, 2011, with the support of Rural electricity development program (REDP), the community people have commissioned a total of 317 community managed Micro-hydro systems with the total power out put 5814.2kW benefiting more than 3, 46,494 rural people living in rural areas that were not likely to be connected by the national grid at least in the next five years. However, during the period, 53 Pico- hydropower schemes generating 171.2kw which served 2027 households. To sum up, the total 360 electrification schemes (non-peltric and peltric) were generating 5985.4Kw electricity and which served 7,776 households.

Table No 4.2: RETs installation schemes of micro-hydropower and Pico-hydropower

SN	RE Technologies	Installed under AEPC support		Installed out of AEPC support		Total	
		No.	Capacity	No.	Capacity	Nos.	Capacity
2	small-hydropower power Plants	815	17.79MW	472	6.82MW	1,287	24.61MW
3	Pico-hydropower plants	862	2.34MW	772	1.36MW	1,634	3.70MW
Grand total		1677	20.13MW	1244	8.18MW	2921	28.31

Source: Alternative energy promotion center, Khumaltar, Lalitpur, RET, 2012. (Cumulative up to mid July2012)

The abve tabe illustrate that the hydropower schemes installed with the support of APEC and out of APEC support . The table depicts that up to 2012 mid july 815 small-hydrpower plants generates 17.79 Megawatt(MW) under APEC support. However out of APEC support 472 Micro-hydropower plant generates 6.82 MW electricity. Similarly under the support of APEC up to 2012 mid july 862 pico-hydropower plant generates 2.34MW electricity. However out of the support of APEC 1244 pico-hydropower plant generates 8.18MW electricity.

Table No 4.3: Present status of Micro-hydropower and Pico-hydropower

SN	Hydropower schemes	Electrification Schemes	
		Number	KW
1	small-hydropower(Non-Peltric schemes)	1152	22830
2	Pico-hydro (Peltric-schemes)	1626	3704.46
Grand total		2778	26534.46

Source: Alternative energy promotion center, Khumaltar, Lalitpur, 2013.

The table illustrate that the cumulative of hydropower schemes installed up to 2013. Table shows that 1152 number of micro-hydropower schemes generates 22830kw electricity. Similarly 1626 number of Pico-hydropower schemes generates 3704.46kw electricity. The table also depicts that the total cumulative MHP and PHP data which is 2778 MHP and PHP plants generates 26534kw electricity.

4.4 District and Development Region Wise Development of small hydropower in Nepal

Nepal has divided in to 75 administrative districts in 2018 BS. Due to its Physiographic and climatic variation, Nepal is divided in to three ecological zones namely terai, hilly and mountain. The hill and mountains people's livelihood is very poor and income is very low to consumption renewable energy and deprived their basic needs. So that MHP development is the best option to improve life style of rural people. The first MHPs named Godavari fish farm as installed at Godavari VDC Lalitpur district with capacity 6kw manufactured by BYS Balaju Yantra Shala in 1962. The MHP installations are 59 districts out of 75 districts during the period 1962-Mid-July 2012 in Nepal. The total number of micro-hydropower schemes and

their installed capacity (KW) of each development region and district has given in below.The kingdom of Nepal has divided into five development regions aligned in an east-west direction in 2029 BS and 2037 BS. Each development region is composed of Three major ecological regions; Hill, Mountain and Teri. Terai region has low installed capacity k w of MHP in the comparison of hill and mountain region. The main objectives to form these development regions are to eliminate the extreme economic disparity and to bring about balanced and integrated development in all of them. Installed capacity (kW) of MHP schemes by development region and their distribution can give in Annex 1. Annex one show that total installed capacity of all MHP schemes in Development Region and District during the period(1962-Mid-July 2012).That is 1287 MHP plant whose total capacity is 24604.57kw. In addition, total Pico-hydro install number is 1634 whose total capacity is 3702.61.

Table No 4.4: Development region wise Development of MHP and PHP plants.

Development regions	**Pico-hydro (up-to5kW)**		**Micro-hydro(5to100kw)**	
	No.	**Capacity (KW)**	**No.**	**Capacity(KW)**
FWDR	15	55	138	3048
MWDR	85	197	133	2113.70
WDR	294	719.80	407	8762.40
CDR	314	872.25	214	3516
EDR	808	1502.50	230	4832
Grand total(NEPAL)	1634	3702.61	1287	24604.57

Source: Alternative energy promotion center, khumaltar, Lalitpur, 2012

The table shows that the development of Pico-hydro and Micro-hydro in five development regions. The MHP plant rapidly grows in western development region in comparison to other development regions, which is 407 plants, generate 8762.4kw electricity. However, the status of MHP development in mid -western region is very low in comparison to other region that is 133 generate 2113.7 KW. However, the development of Pico-micro-hydro in development region is little bit different that is the high installed region is central development region which consists 808 Pico-hydro and generate 1502.5kw electricity. However, the low developed Pico-hydro

development region is far western development region. Furthermore the development of MHP and Pico-hydropower can be illustrated in the annex.

4.5 Economic Impact of hydropower Development in Nepal

Over of 50% of the population lives in hill and mountain regions of the country. They scatter over several mountain and these lands are vulnerable and less productive for cultivation. Rural villages have been left behind: no electricity, no toilet, no paved roads, no gas, no health services and better education and no chance to spend better life. Due to the lack of electricity, they have to walk up with sunrise and sleep with the sunset. The use of kerosene to light up when necessary, However, due to the installation ofsmall hydropower that plays crucial role for the standard life of the rural people in remote areas. Small hydropower is a major renewable resource and this widely seen as a means of reducing foreign exchange payments for imported energy and fuels. By providing investment opportunities for local entrepreneurs and communities, private sector hydropower installation can contribute to the local economy, to rural institution building and to the dissemination of technical and managerial skills. It is also possible that the ongoing migration from the hills to the town and the terai may be slowed down by upgrading the locally perceived quality of life through the availability of electricity and other related facilities.

Smallhydropower generation is one of the Nepal's major renewable resources and considered as a means of reducing foreign exchange payments for imported energy and fuels. At the local level small hydropower can reduce import dependency and increase energy sustainability by using local source of energy under the concept of "one household one enterprise." The following economic impacts of small hydropower are noticed in Nepal: The people of rural areas can be their household activities during the evening due to the supply of electricity. The people of rural area can improve agriculture practices (commercial vegetable production and increase in productivity) due to the availability of water for irrigation from the canal built to divert water for running small hydropower system these activities have helped to improve life of rural people in remote areas. Rural people can begin production and marketing of traditional skill-based crafts such as Tanka painting and increase sticks due to the availability of bright electric light to work in the evening. Establishment of agro-processing mills and other rural industries such as bakery, photo studio, poultry

farming , off season vegetable farming ,pig and goat rearing, nursery management, computer training center and saw mills, which are powered by the electricity by MHP. These income generating activities supplement people income's in substantial amount. These activities have shown impact on livelihood of poor as well as lower and middle level rural people.

4.6 Socio-Economic Impact of Hydropower

Socio-economic feature of the study area depicts the development status of the village with the aspect of sociologically and economically. The sociological and economic characteristics such as general information of sample household (religion, age, cast, gender etc.), house hold participation by ward, education, employment, health, entrepreneurship, rural electrification and level of income have a significance influence in the economy of the village and the living standard of the people.

4.6.1 Households participation by ward

Small hydropower has played the vital role for electrification in rural areas of Nepal. This Adhikhola hydropower project electrify areas are about 20 vdc and municipality , This study area is ward number , 3,4,5,7 of Tulsibhajayang VDC. To make the study more effective and reliable, the questionnaire was asked equally according to the population ratio of wards with the help of simple random sampling by adaptive lottery method. The ward wise distribution of respondents of this research is shown the table number 5.1 below.

Table No 4.5: Household participation by ward wise

WN	Total households participation by ward wise	Sample Households	%	C f %
1	160	16	29.63	29.63
4	130	13	24.07	53.70
5	140	14	25.93	79.63
6	110	11	20.37	100
Total	540	54	100	100

Source: Field survey, 2015

The above table 4.5 depicts that, the total house hold in the study areas are 535, out of the total 54 respondents were taken with the help of simple random sampling. Out of total number of respondents in each ward only 10% respondents were taken for the fulfillment of the study. The higher number of respondents (16) were from ward number 1 because large number of household live in this ward. Whereas least number of the respondents were 4 from ward number 5. Likewise, 6,10,8 and 10 respondents were selected from ward number 4, 5, 7 and 8 respectively.

4.6.2 Cast and Religion of Sample Households

Nepalese people are categories in to a different cast and ethnic groups. Cast system is fundamentally based on Hindu religion whereas vertical relationship among the cast exist. Brahmin, Chhettri, are in the apex whereas Dalit Group is the bottom of the socio economic class at the study areas.

Table No 4.6: cast of the respondents

S.N	Cast	Respondents no	Percentage	C f %
1	chetteri	6	11.11	11.11
2	brahamin	35	64.82	75.93
3	Dalit	13	24.07	100
4	Janjati	0	0	100
5	Other	0	0	100
Total		54	100	100

Source: Field survey, 2015

The above table depicts that the distribution of respondents by cast and ethnicity of the sample household. The highest portion 35(64.81%) respondents are brahamin and lowest portion 6(11%) respondents are chetteri. Likewise, the moderate number of respondents 13(24.07) are Dalit. In the study areas Janjati and other cast portion are nil or zero. However the situation of religion in the study areas is 100% Hinduism.

4.6.3 Gender of the Respondents

There was significance imbalance in the participant respondents regarding gender. The population ratio of male and female are nearly 50-50 but female respondents were fewer in numbers than male numbers in this research because in many house

hold male were head of the family and the society is patriarchal so male participation was larger number in compares to female number in this sampling process. Out of the total sample 79.62% were male respondents whereas only 20.37% were female. The gender wise participation of respondents of the study area has presented in table below.

Table No 4.7: Gender of respondents

SN	Sample household	Percentage	C f %
Male	43	79.63	79.63
Female	11	20.37	100
Total	54	100	100

Source: Field survey, 2015

The above table shows that the gender of respondents of the sample households. Out of the total (43)79.63% were male respondents whereas (11)20.37% female. In the table cumulative frequencies also can be presented.

4.6.4 hydropower and Rural Electrification

81% respondents accepted that small hydropower plays the vital role to electrification in the rural areas. Before this project they compiled to live under the kerosene lamp light. If villagers were waiting to central grid, they may still in dark night. They have no easy access to get central grid due to the scatted settlement and topographical difficulties. Hence, small hydropower is the best energy sources for rural areas electrification. Thousands of big rivers and small rivers falling from mountain to plain areas, micro hydro project can easily lunch in low and reasonable cost in needed areas. Hence, it is the easy and chief way to provide electricity in remote areas of Nepal.

Small hydropower effects on villagers in multidimensional ways like light, education, income, sanitation, health, employment, communication and technological improvement in the study areas. Most of the people use it for the purpose of lighting, which makes their night life easier, people get easy communication access and children's reading habits, life style have changed. Many small scale industries like agro -mill, furniture, saw mill, shop etc. makes people's life style easier than before. People's attitude and behavior have changed by using the electrical instruments like

radio, TV, internet and other various sources of media. Smallhydropower help to rural electrification or not can be shown below following tables and figure.

Table No 4.8: small hydropower help in rural electrification

SN	Small hydropower help in rural electrification	Observation	Percentage	C f %
1	Strongly agree	25	46. 30	46.30
2	Neutral	0	0	46. 30
3	Disagree	3	5.56	51.85
4	Difficult to say	7	12.96	64.81
5	Agree	19	35.19	100
Total		54	100	100

Source: Field survey, 2015

The above table illustrates that how small hydropower help in rural electrification. Above table shows that the 25(46.30%) respondents were strongly agree as MHP help in rural electrification. Similarly, 0(0%), 3(5.56%), 7(12, 96%) and 19(35.19) sample households were netural, disagree, difficult to say and agree respectively. The highest portion of the respondents is agree MHP help in rural electrification.

4.6.5 Electricity Consumption for Various Purposes

People use the electricity mainly for lighting purpose; very nominal number of households used it for productive purpose like installation of small -scale industries /firms. Due to the insufficient of power as public demand from small hydropower and so they are unable to lunch cottage industries as well as economic instruments, as they want to use. Even, they are compelled to run the installed firms in alternative time due to the in sufficient of power. Mainly, households used small hydropower for lighting purpose minimum 2 hrs. to maximum 10 hrs. from 54 sample households, 34 house hold use the electricity for the purpose of business at the mean hours 5.7. They used electricity this purposes minimum 3 to maximum 15 hours per-day. For TV and Radio purposes, they used 1 to 7 hours at the mean hours 3.64 and 1 to 2 hours for personal used whereas in average 0.33 hours. They used for the purpose of cooking 1 to 4 hours at the mean 1.04 hours.

Table No 4.9: Electricity consumption per-day for various purposes

SN	Uses of small hydropower	Sample Household	Mean Hrs.	Std. Dev.	Min.Hrs.	Max. Hrs.
1	Lighting	54	4.96	1.5	2	10
2	TV/Radio	51	3.64	1.70	1	7
3	Business	34	5.27	4.12	3	15
4	Personal uses	14	0.33	0.54	1	2
5	Cooking	37	1.04	0.99	1	4
Total		190	15.24	8.87	8	38

Source: Field survey, 2015

The above table presents the electricity consumption per-per day for various purposes. In the above table 54 sample households are consume electricity per day for lighting purposes at the 4.96 mean hours and their standard deviation ,minimum hours and maximum hours are 1.5,2 and 10 hours respectively. Similarly electricity consumption per-day for TV/Radio, Business, Personal uses and cooking purposes sample households are 51,34,14 and 37 respectively and these sample households using electricity for TV/Radio, Business, personal uses and cooking purposes at the mean hours per-day 3.64,5.27,0.33,1.04, standard deviation are 1.70,4.12,0.54,0.99, minimum hours are 1,3,1,1, and maximum hours are 7,15,2,4 respectively.

4.6.6 Impact on Education

The hydropower project may have vital on the education of the children as well as adult. With the availability of light, children can study additional time hours, which may improve their performance in school. Similarly, parents are more aware to their children's education which also helps to uplift the academic performance of the children. By asking the improvement of their performance at Scholl, participation on any type of literacy class at night and study hours of the children after MHP are taken as the measuring rod of impact of MHP project on education sector. People are aware of the importance of education for women because of the use of TV and other instruction. Now girl go to Scholl in the large number But as far as higher education is concerned local people are still backward. Some people are started to send their children to boarding school. Some women have taken skill oriented training.

4.6.7 Effect on Children's Study Habits after small hydropower

After small hydropower, the study habits of the children have raised. 88% household agreed (strongly, to some extent and agree) that the performance of the children has improved in the school than before. In the rural sector, in the absence of electricity, the student or children are obliged to use kerosene lamp while studying in evening and night time. By this situation schooling aged generation is mostly affected. They cannot study for long time due to the deficiency of enough kerosene and deem light.

Table No 4.10: small hydropower Effect on Children's Study

SN	Increased hours(in a day)	Household	Percentages	C f %
1	Less than one Hours	12	22.22	22.22
2	One to two hours	6	11.11	33.33
3	Two to three hours	4	7.41	40.74
4	More than three hours	22	40.74	81.48
5	Un known	4	7.41	88.89
6	Decreased	6	11.11	100
Total		54	100	100

Source: Field survey, 2015

The above table illustrate that the out of total 54 sample, 12(22.22%) households children raised their study time less than one hours, 6(11.11%) households children study hours raised 1 to 2 hours, 4(7.41%) households children's study hours increased 2 to 3hours, similarly 22(40.74%), 4(7.41%) and 6(11.11%) households children's study hours are increased more than three hours, unknown and decreased respectively. Hence, most of the guardian of the schooling children found that their children have been studying at the night time using electricity by this situation, it can be said that most of the students educational status is improved after electricity.

4.6.8 Educational Status of Family Member

The literacy rate of the project affected families is 59.71% male and female. However after the project only 40% male and female are literate. This means project help to promote the educational status in the project affected areas.

Table No 4.11: Educational status of family member

SN	Educational status	After project Literate				
		Male	Female	Total	%	C f %
1	After project	152	100	252	59.71564	59.71564
2	Before Project	103	67	170	40.28436	100
Total		255	167	422	100	100

Source: Field survey, 2015

The above table depicts that the educational status of the respondents family. After the project install 9.70% male and female are literate in comparing to before the project. It means we can say that, the rate of literacy at the project affected areas is increasing gradually. After the project 152 and 100 male and female are literate respectively. Before the project the male and female literate are 103 and 67 respectively.

Table No 4.12 Peoples participation on any literacy class at night

SN	Literacy class	Observation	Percentage	C f %
1	Not conduct	21	38.89	38.89
2	Adult	12	22.22	61.11
3	Women	21	38.89	100
Total		54	100	100

Source: Field survey, 2015

The Above table shows that after the small hydropower project 12(22.22%) households participation on Adult literacy class at night and 21(38.88%) households are participate on women literacy class at night. However 21(38.88%) household are not conducting or participate on any literacy class at night. This means large number of sample households is participate at literacy class at night. Therefore the MHP plays the vital role to uplift literacy rate by providing electricity.

4.6.9 Impact in Health and Sanitation

People are conscious of their health and sanitation. They started to visit clinics and hospitals instead consulting with witch doctor (Dhami, Jotish, and Jhankari). Mothers have learnt how to take care their child. Most of the people make a puckki toilet. Smoke from firewood and kerosene had made the health condition of the people poor

in village. Staying in front of firewood for long time caused the housekeepers health worse and children's health also damaged by kerosene used as a means of light to read. Indoor air pollution could lead the serious health problem such as respiratory diseases and eye inflection. Having micro hydro electricity supply at home reduces indoor air pollution by decreasing the use of kerosene and firewood, which lessen the risk of respiratory diseases and eye inflection. By using electrical instrument, people have been listening and watching about health tips and educational programs, which help to change their health condition and they tend to use fresh and healthy things. The expenditure on treatment has reduced and the saving amount can use in others productive purposes. Thus, small hydropower has impact on multi-dimensional ways; it helps to uplift the living standard of the people in village.

People must be careful about indoor and outdoor sanitation. In the negligence of sanitation there may happen different kinds of problems. Human health has been risky without sanitation after using modern electrical instruments. During the survey time of the project the aid organization has lunch the awareness programs about sanitation in the village and every household had compulsion to build toilet before the completion of the project. Tusibhangja VDC also declared as the 'Khula Disa Muktha VDC'. By using electrical instruments of the people have changed and they began to care indoor and outdoor sanitation. In the negligence of sanitation there may happen different kinds of problems. After this small hydropower, 100% said that the village become neat and clean than before.

4.6.10 Improvement in Following Diseases after Installs small hydropower

To estimate the impact of Adhikhola small hydropower on health outcomes, each individual of a household was asked whether they had suffered they had suffered from diseases such Asthma, Bronchitis, ENT irritation, eye infection other diseases after and before the project. A list of these diseases along with the percentage of individual participation about these diseases after and before the project installs have been presented in the following table .

Table No 4.13: Sample Households suffer diseases

SN	Diseases	AP suffered household	AP %	BP suffered household	BP %	Cf% AP	Cf % BP
1	Asthma	3	5.56	5	9.26	5.56	9.26
2	Bronchitis	0	0	4	7.41	5.56	16.67
3	ENT irritation	3	5.56	10	18.52	11.11	35.19
4	Not suffer	29	53.70	14	25.93	64.81	61.11
5	Eye infection	4	7.41	5	9.26	72.22	70.37
6	Other	15	27.78	16	29.63	100	100
Total		54	100	54	100	100	100

Source: Field survey, 2015

The above table depicts that, the impact of Adhikhola hydropower on health of the people of Tulsibhajang VDC. After lunch the hydropower project the ratio of suffering from any type of diseases were decreases. Out of the total sample, only 3(5.5%) households are suffering from Asthma, but suffering from Bronchitis is almost nil or zero in the sample households. Likewise, 3(5.56%), 29(53.70%), 4(7.41%) and 15(27.78%) were suffered from ENT irritation, eye inflection and other diseases respectively. However, before the project suffering ratio from any kinds of diseases household were higher in comparing to after the project suffered household. The above table depicts that before the project 5(9.26%), 4(7.41), 10(18.52%), 14(25.93%), 5(9.26) and 16(29.62%) households were suffered from Asthma, Bronchitis, ENT irritation, Not suffer, Eye inflection and other diseases respectively.

4.6.11 Changes in Children Daily Activities by using Electronic Instrument (TV, Computer, Radio)

The uses of electrical instruments have caused multiple changes on children's behaviors. Almost all the children of the project effected area and got positive changes and learn many things by watching TV or using computer except some negative outcomes such as watching TV for long time, play game in computer/mobile for long time etc. We asked to the respondents in a different ways to know about what is the condition of the children's activities after small hydropower project.

Table No 4.14: Changes the activity of the children after the small hydropower install

SN	Changes Activity	Sample households	%	C f %
1	Talking Style	11	20.37	20.37
2	Dress up	10	18.52	38.89
3	Sports	9	16.67	55.56
4	Health Behavior	14	25.93	81.49
5	Dance	10	18.52	100
Total		54	100	100

Source: Field survey, 2015

The above table illustrates that, the activity of the children after the MHP install. Out of total sample, 11 (20.37%), 10 (18.52%), 9 (16.67%), 14 (25.93%) and 10 (18.52%) respondents were reported that after MHP the children talking style, Dress up, sports, health behavior and dance activities was changed respectively

4.6.12 Impact on Income, Employment and Expenditure

Agriculture, livestock husbandry, wage labor business, services, industries/firms and foreign employment are major sources of income of project affected people before and after the project install. However, the income earnings from these sources after the project completion is comparatively higher than before the project install. After the project install , the firms /industries ,intuitions , medical, shops etc. are install in the village where the many people are directly or indirectly involved in various working activities. It certainly help to raise their income level of the household have increased (to some extent, increase) their income level after the project lunched. The average income from these sources of sample household is shown in the following table and figure below.

Table No 4.15: Monthly income of the sample household after and before MPH Project

SN	Sources of income from	Average income AP	Average income BP	AP %	BP%
1	Agriculture	2481.48	1407	19.29	13.69
2	Services	4654	3833	36.17	37.30
3	Industries	2157	1759.26	16.76	17.12
4	Foreign employment	3574.074	3277.78	27.78	31.90
Total		12866.55	10277.04	100	100

Source: Field survey, 2015

The above table shows that, the sources of income from different sources after and before the project install. After the project the average income of the sample households from agricultural, services, industries, foreign employments were 2481.48,4654, 2157 and 3574 respectively. However, the income sources of sample households before the project from agricultural, services, industries and foreign employment were 1407, 3833, 1759.26 and 3277.78 respectively. Hence, monthly average income of the sample household from these sources after the project install was higher than before the project install. This implies that, the MHP plays the vital role to increase the income of the sample households.

The above table illustrate that the sample households average monthly income from different sources after MHP project install. Figure shows that sample households average monthly income from agriculture, services, industries and foreign employment were 2481.48,4654,2157 and 3574.07 Rs respectively.

4.6.13 Impact on Expenditure

Project affected families and people of the study area spend their income on food crops, clothing, social activities, festivals, education, and health, miscellaneous. Few households spend for food. Before the project started, project affected families used to spend the lowest amount of on clothing in comprising to after the project. It means there is demonstration effect in clothing by watching TV and using other information technology the sample household's fashion/dress up were changed. Although order of expenditure pattern is changing and amount is increasing over a time due to the

increasing of market price and growth of population after the completion of the project. The expenditure on health, education and miscellaneous of the sample households also increasing after the project in comprising to before the project.

Table 4.16: Monthly expenditure of Sample household

SN	Monthly Expenditure on	Average Expenditure (AP Rs)	Average Expenditure (BP Rs)	AP %	BP %
1	Food crops	399	418.52	10.11	12.69
2	Clothing	765	601	19.39	18.22
3	Health education	2128.70	1744.40	53.94	52.89
4	Miscellaneous	654	534.26	16.57	16.20
total		3946.70	3298.18	100	100

Source: Field survey, 2015

The table shows that, the expenditure pattern of the sample households after and before the small hydropower project install. The sample households expenditure after the project on food crops, clothing, health/education and miscellaneous were 399(10.10971%), 765(19.38%), 2128.7(53.9%) and 654(16.57%) respectively. However before the project the expenditure on food crops, clothing, health/education and miscellaneous were 418.52(%), 601(%), 1744.4(%) and 534.26(%). The expenditure after the project on these items increasing in comprising to after the project it implies that value of money, awareness on health /education , demonstration effect lead to increase the expenditure pattern of the sample household after the project , which improve the health, education, technology and other positive impact.

4.6.14 Impact on Entrepreneurship and Employment

After the construction of small-hydropower project people involve on different kinds of business. Before the hydropower project there are lack of any kinds of electrical and electronic shop and little bit productive work like poultry firm, mills, furniture industries, computer institute, tea shop, cloth shop and electronic shop were there, so, after the construction of small-hydropower project it brings revolution on the entrepreneur behavior of the people. After the installation of the project, the

employment opportunities in the village have raised directly and indirectly. Two operator and one electricity consumption change collector are employed in this project. By installing the industries and running business run in the village where the people are able to create fulltime or partial job.

Table No 4.17: Kind of business after small hydropower

S.N	Kinds of business or firms	Observation Households(HHs)	Percentages	C f%
1	Poultry	3	5.56	5.56
2	Milling	2	3.70	9.26
3	Not	19	35.19	44.44
4	Saw mill	3	5.56	50
5	Furniture	6	11.11	61.11
6	Dairy	2	3.70	64.81
7	Computer instuate	3	5.56	70.37
8	Shop	16	29.63	100
Total		54	100	100

Source: Field survey, 2015

The table illustrates that, the impact of hydropower project on entrepreneurship and employment. Out of total sample, 3 (5.56%), 2 (3.70%) and 16 (29.63%) sample household were involved in poultry firms, milling (agro and other), not, saw mill, furniture, dairy, computer institute and shop after hydropower project respectively. Finally we can conclude that, after hydropower project 65 percent, households were involved in different kinds of business in the project affected area.

4.7 Households Consumption of Electrical Goods before and after small hydropower

Before electrification, the people in the study area used few electrical instruments like radio, tape recorder using batter in very limited hours TV and computers run by using solar light. After electrification, the possession of the electrical instruments has increased significantly people have now access different information and entertaining facilities. The table below shows that the sample household consumed different

electrical goods such as Radio/TV, Computer/Laptop, Referigator, Iron/Fan, Bulb and Other after and before the project.

Table No 4.18: Various Electrical goods/ Instruments Consumed by sample households before and After small hydropower

SN	Electronic goods	Possession AP		possession BP		AP EG %	BP EG %
		No. of EG	HH NO	No. of EG	HH No		
1	Radio/TV	79	54	56	46	13.19	28.43
2	Referigator	68	23	29	2	11.36	14.72
3	Computer/laptop	23	39	2	20	3.84	1.02
4	Iron/Fan	24	22	10	10	4.01	5.08
5	Bulb and other	405	54	100	34	67.61	50.76
Total		599	192	197	112	100	100

Source: Field survey, 2015

The above table and figure illustrate that sample household posed electrical goods after and before the hydropower project install. The figure and table shows that, the 54, 23, 39, 22 and 54 sample households have 79, 68, 23, 24 and 405 electrical goods after the hydropower project install respectively. Thus we can conclude that after the project number of electrical goods and user households were increased than before due to the hydropower project help to provide power or electricity at lowest cost in comprising to other sources of energy. In the study area, people consumed different kinds of electrical goods and it has positive impact on sample households life style, education, health/sanitation, technological improvement, income, employment etc.

4.8 Technological Improvement

small-hydropower is boon to people because it provides electricity to run electrical and electric equipment's such as TV, radio, mobile phone, refrigerator, washing machine, computer/laptop, heater and other. Impact of small hydropower project on access to information has been assessed through the ownership of a number of communication devise, radio listening, T.V. watching habits, using trend of internet services. General awareness of various aspects of life is sky up, even in rural lives by

information technology; information technology jumps large steps in the present decade. Rural people also updated them by the revolution of information technology.

4.8.1 Advantages of hydropower

Survey found that all the sample households i.e., 100 percent fell relaxed or enjoy using hydropower system for lighting all of them agree that it is completely smokeless, many of the sample households are influenced from its various advantages like improvement health, time saving, easy to work at night, increased reading habits and so on which is shown in table and figure below.

Table No 4.19: Advantages of small hydropower

SN	Advantages of hydropower	Sample Household	%	C f %
1	Improvement health	16	29.63	29.63
2	Time Saving	10	18.52	48.15
3	Easy to Work at Night	14	25.93	74.07
4	Increased reading Habits	9	16.67	90.74
5	Agricultural production	5	9.26	100
Total		54	100	100

Source: Field survey, 2015

The above table depicts that the advantage of small hydrpower project in the sample Households (HHs). Out of total samples, 16 (29.63%) respondent health condition were improved after the project install. Similarly, 10 (18.52%), 14 (25.93%), 9 (16.67%), 5 (9.26%) and 5 (9.26%) sample households were saving time, easy to work at night, improved reading habits and promoted agricultural production after the MHP project installant,.

To sum up, when electricity facility is available there is increases the use of audio and visual media. By using these types of media new generation can imitate or copy of every things that they have heard or saw, so it is proved that project has affected in social and cultural properties education is the key indicator of the human development, it plays a vital role in the efforts of any endeavor to uplift a society fresh representation an scarcity, needless to say it has a society from repression and scarcity and needless to say it has positive role in the success of life. Agriculture

sector is the main source of the national income. Agriculture has been the main sector of employment and for income generating activity in this VDC as well like in most in our country. Thus it can be regarded that agriculture is the main source of livelihood for this VDC. But this sector is very backward before the project installed due to the lack of irrigation, agricultural inputs, training and skill development program. However, effect the project there were improvement on agriculture production to some extent. Thus we can conclude that, small hydropower played the vital role to uplift the human drudgery in the village after this project, people are able to live in light at night, which made the night life easier. Before small hydropower, people compiled to use Wokhal, Jato, Ghatta to grain, this consumed more time of villagers as well as make villagers' life complicate. Now by lunching the agro-mill villagers life become easy and it help to reduce the drudgery of women. By lunching the poultry firms, knitting, dairy computer institutes, medical and other business help to generate economic activity and improve the economic condition of the villager. Small hydropower help to raise the social condition, improvement in the health, increased in reading habits of the sample households.

4.8.2 After Install small hydropower the Receiving Main Program on TV, Radio and Other Various Sources of Information Technology

Hydroelectricity is boon to people because it provides electricity to run electrical and electronic instrument such as, T.V., mobile phone, computer/laptop etc. Impact of the small hydropower on access information has been assessed through the ownership of a number of communication devices, radio listening and T.V. watching habit. General awareness of various aspects of life is sky up; even in rural lives by information technology information technology jumps large steps in the present decade. Rural people also up dated them by revolution of information technology we asked to the respondents in a different ways to know about the trend of receiving main program or information from various sources of media or information technology after small hydropower.

Table No 4.20: after install small hydropower the program on TV, Radio and Other various sources of information technology

SN	Type of Program	Observation	Percentage	C f %
1	Entertainment	12	22.22	22.22
2	News	14	25.93	48.15
3	Health	11	20.37	68.52
4	Educational	11	20.37	88.89
5	Agricultural	6	11.11	100
6	Other	0	0	100
Total		54	100	100

Source: Field survey, 2015

The above table and figure shows that the receiving main program on TV/Radio and other various sources of media/information technology. Out of the total, 12 (22.22%) sample household receive the entertainment program as a major program on sources of media after smallhydropower. Similarly, 14 (25.93%), 11 (20.37%), 11 (20.37%), 6 (11.11%) and 0 (0%) sample households receive the news, health, education, agricultural and other program after small hydropower respectively.

4.8.3 Situation of Communication after hydropower Project

This is the era of science and technology so the internet, communication are the basic need of the people. Most the people of this study area introduced with mobile phone and youths are familiar with internet in mobile. The communication of this area is significantly improved than before the hydropower. Ncell built, network communication tower in the top of the village which makes the entire villages communication better if there was no small hydropower, Ncell tower would not built then communication will be still in poor conditions because 10kw electricity power is need to run this tower, now this insufficiency was fulfilled by the installation of this hydropower . we asked to the respondents in a different ways to know about what is condition of communication after small hydropower.

Table No 4.21: Situation of Communication after small hydropower

SN	Status	Sample Household	%	C f %
1	Improved	27	50	50
2	Little Bit	9	16.67	66.67
3	Not improved	2	3.70	70.37
4	Strongly Improved	9	16.67	87.03
5	Difficult to say	5	9.26	96.30
6	To some extent	2	3.70	100
Total		54	100	100

Source: Field survey, 2015

The table depicts that the condition of communication after small hydropower installation. Out of total sample households, 27 (50%), 9 (16.67%), 2 (3.70%), 9 (16.67%), 5 (9.26%) an 2 (3.70%) households report that, the condition of communication after small hydropower project were improved, little bit, not improved strongly improved, difficult to say and to some extent respectively.

4.8.4 Impact on Skill Development

People of the local area involved and same the project construction method during the construction period. It helps them to develop technical skill of construction methods. Some youth had explored their skill such as civil works. Welding metal works electronic wiring etc. developed during the construction period in other places in the study area hydropower help to develop the technical and mechanical skills by providing electricity, which leads to improve infrastructural development of the study area and nation.

Table No 4.22: Skill developments of Sample household after install small hydropower

SN	Skill of HHs	Observation	%	C f %
1	Skilled	47	47	47
2	Semi-Skilled	53	53	100
Total		100	100	100

Source: Field survey, 2015

The table depicts that the skill development of the sample households. Out of total skilled manpower in the sample household 47 (47%) and 53 (53%) people are skilled and semi-skilled respectively. The total population of the sample households is 305, out of total population 15.41 percent population was skilled after small hydropower project and out of total population of sample household's 17.38 percent population was semiskilled after small hydropower project install. Finally we can conclude that small hydropower project help to develop the skill of the study area gradually.

CHAPTER - V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This study is focuses on the socio and economic analysis of small hydropower project. This study is based on primary as well as secondary data. Primary data were collected through the field survey and secondary data were from different sources like, alternative energy promotion center, Nepal Electricity Authority and various public and private organizations which are related to hydropower project. It is expected that the result from this study will provide valuable information to the policy makers to utilize the resources in the most productive sector for energy generation. The main objectives of the study are to examine the socio-economic impact of Adhikhola Khola hydropower project, to examine the household consumption on electrical goods, technological improvement and to examine the current status of micro-hydropower development in Nepal. This chapter is the concluding chapter of the present study. The first chapter summaries the finding from the study, the second part draws some conclusions and third part lists some recommendations that can be from the conclusion of the study.

5.1 Summary

Among the alternative energy (bio-gas, solar power wind power, Improved Cooking Stove) more popular and available in Nepal is small hydropower, which is technically and environmentally feasible and most appropriate technology for Nepal. MHP has considered up to capacity of 1000 KW to 10,000 . Small hydropower provides access to electricity and other mechanical forms of energy for agro-processing such as rice hulling, shelling, grinding and oil expelling. Various kinds of MHP devices e.g. propeller turbines, cross flow turbines, pelton wheels MPPU, Peltric sets, improved Ghatta have been developed in the past two decades.

The advent of modern development of hydropower in Nepal dates back to only 1 962s in Lalitpur district at Godawary VDC named “Godawary Fish Farm MHPs” with installed capacity 6 KW manufactured by BYS. However, the history of hydropower started from centuries when some Nakarmis visited Tibet and transferred the technology of water wheels locally named as ‘Pani Ghatta’. More than 25,000 such

Ghatta are still being used to grind food grains in hilly and mountains rural areas of the country.

The cross-flow turbine manufacturing companies were established in 1970s. For last two decades, HMG/N has providing subsidy for MHP through ADB/N and then the AEPC'S fund from 1996. Currently AEPC is providing government subsidy and technical support with the assistance of Danida In addition, Remote Area Development Committee (RADC) is another key player in promotion of MHP of HMG/N. Additionally, a number of NGOs and INGOs are involved in the development of MHP.

Hydropower has been able to bring about profound socio-economic and technological changes. The implication of MHP for rural development is an introduction of a modern technology in rural context. There prepare rural community for undertaking rural industrial activities, nurturing of entrepreneurship in a rural areas and pretention of entrepreneurs in rural areas. This study reflects the overview of Nepalese rural energies sources status and discusses various energy issues through a case study of Adhikhola hydropower, Tulsibhanjga, VDC syangja. The study has discussed various merits of hydropower system, it not only provides energy for lighting but also helps in improving health condition, saves time, makes easy to work at night, technological improvement, standard of living, income, employment, infrastructural development as well as productive work.

This study is the descriptive study designed to find out socio-economic and technological impact of Adhikhola hydropower project of Tulsibhangja VDC,(ward no 3,4,5) syangja and to find out the present status of hydropower in Nepal. This study has been conduct from the direct interview method with 54 respondents. There respondents were selected by simple random sampling. The major findings of the study are pointed as follows:

i) The main castes in the study area are Brahmin (90.81%), indiginious caste (6.11%) and Dalit 3 percent peoples practice Hindu religion. Agriculture, foreign employment services and business are the main income sources of sample households.

ii) The main sources of energy of the sample household before hydropower were firewood, biogas for cooking and for lighting kerosene and solar. New hydropower, firewood, solar and biogas is the main sources of energy. In which, hydropower is used all the sample households for lighting purpose and most of the households used hydropower for cooking. It reduces the over expenditure on traditional energy sources. 57 percent respondents are agreed that hydropower help to improve the health condition of the people and it minimizes the different kinds of diseases.

iii) After hydropower project people installed industries such as furniture, agro-milling, saw mill computer institute, poultry firms etc. and create the employment opportunities whereas 35 (64.81%) sample households has raided their income.

iv) Agro-mill make the especially women life easy and the living standard of the respondent has changed after electricity.

v) Agricultural production has increased than before by getting irrigation and other facilities. Other business such as grocery, small medical center and photo studio, rice mill shop and furniture also raise the villager's income level.

vi) Possession of various electric instruments has increased after hydropower, which make the villagers life easy and help to change the life of the people.

vii) The study habits of the children have been increased. 87.03 percent (447) households Said their children's performance in the school has improved in holistic ways.

viii) The entire households (100%) is ready to pay more amount than prevailing rate to maintain the project and make it sustainable.

5.2 Conclusion

i) Small Hydropower (100kw-10000 k w) is considered as the best options for providing electricity to hilly and mountain rural villages. The rural villages can enhance their livelihood and style of living while pressuring environment. Sites suitable for such hydropower installations are abundant for e.g. traditional water mills, called Ghatta are very common in hilly areas with streams and used for grinding grain, hulling rice and expelling oil. Hydropower has fulfilled community's requirements, such as running agro-

processing mills, bakery, mechanical workshop, rural enterprises (saw mills, poultry farming, computer training, photo studio etc.) and so on in locations of the hills and mountains with low population density and scattered settlement. Hence, there is a high prospect of hydropower development for all round and sustained development in rural Nepal, particularly in rural areas wind and solar energy have not been fully utilized because wind energy is still research stage and biogas is suitable only warmer climate. In this sense, hydropower has great potential contributor towards a reduction in demand of traditional fuels for meeting rural energy in isolated rural areas of the country. But the development of hydropower has not been equal among sixty-one districts, five development regions and three ecological regions in terms of installed capacity (k w) and number because of power generated could concentrate in a few places among them. So, that in average, the development of hydropower (micro hydro) schemes with installed capacity (k w) and is overall in terms of numbed households in the country.

ii) The topographical feature provides huge potentialities for hydropower development; however hydropower development faces wide range of challenges towards efficiency enhancement, management system development, institutionalization and arranging sustainable financial support. The world has commitment against global warming and deteriorating ozone layer and deforestation. About 136 countries have ratify the "Kyoto protocol" on reducing the carbon emission to the 1990 level by 2002 to 2012 a new concept on pollution prevention has emerged as the tradition of carbon. In this regard, hydropower has a plays inevitable role to reduce carbon for improve health and environment management.

iii) Hydropower has positive impacts on income and employment. It helps to rise in income and employment by helping to establishment of new businesses.

iv) It reduces the expenditure on different energy sources like firewood, kerosene, biogas etc. So, it can be less expensive source of energy in the rural area. Due to the installation of hydropower, the health condition also gets improved.

v) The expenditure on health education increasing due to the awareness about health and education after hydropower project. Therefore, there is positive impact as health education.

vi) Before electricity, people have been using maximum firewood as light or cooking and lamp have been using as light but when MHP established the need of firewood has reduced which has helped to converse forest. Electricity is closely related with human life therefore all respondent's living standard has been changed after hydropower.

vii) Electricity supply has extended the social and recreation activities i.e., purchase and use of tape recorders, radio, TV, refrigerator, iron, computer, rice cooker etc. The status of health and sanitation how improved after electricity facility. After electricity facility, studying hours of students have been increased.

viii) It has been found that education status of student has improved. To build the hydropower sustainable, repair, maintenance and operation schedule should be necessary therefore there is operation schedule in powerhouse for their purpose users and management committee is fully responsible. The result of the analysis is positive so, the project is economically feasible.

ix) Over all there is positive impact on health, education, communication, skill development, income, employment, expenditure infrastructural development, technological improvement as well as productive work.

5.3 Recommendations

Rural energy development program (establishment of hydropower project) will help for rural electrification, environment management and poverty alleviation to some extent in the rural part of the country, with unprecedented success on economic development through the rural energy development program. The development efforts needs to be the use of alternative energy should be improvement. Appropriate policy on pricing, market arrangement and energy quality regulation needs to be developed for sustainable growth of rural energy. The hydropower deserves the high priority in view of its role in the socio-economic development of Nepal. It is filet that on less the micro-hydropower sector is provided with adequate technical, and management support, it will not able to contribute to national development to the extent one can expect from it. Hence, the specific recommendations are as follows.

i) The participation of women in planning and implementation of hydropower plant needs to be ensured.

ii) The HMG/N emphasize on subsidy policy with equity for the development of hydropower in rural areas all over of the country.

iii) Preliminary studies and detailed feasibility studies (data base information) of all possible sites of different streams of the country should be done and kept in record for ready to use when required.

iv) The people should be made aware of people participation, good governance, and responsibility for the sustainable development of hydropower.

v) The government should invest much of fiancé in building hydropower in remote areas of the country.

vi) There exists a wide gap between policy makers and implementation. So much of the funds should be set out side for the task leaks out which in the channel between policy formulation and project implementation.

vii) Hydropower project should be developed timely to meet the present growing needs in remote rural areas of the country.

viii) Information technology particularly GIS should be taken for adequate identification to the development of hydropower.

ix) Mutual bilateral relationship should be developed to attract the foreign aid and investment on hydropower sector.

x) Lack of timely maintenance is another problem technically. So, the technicians should be provided by government to maintenance hydropower.

xi) The sustainability of hydropower is another issue. The dam constructed is located at the week area as well as 'Kulo' is built on supply areas so there is fear of landslide. So the dam and 'Kulo' should be required for more securely.

xii) House should use electricity for more productive activities.

xiii) Small industries need to be established in the village. So that the hydropower revenue can be increased and further investment can be made. A manual in Nepali is to be prepared and on the basis of it the operation of the plant is to be carried.

xiv) The gap between demand and supply of electricity is increasing adversely day by day. So the government should play vital role to solve this complex problem.

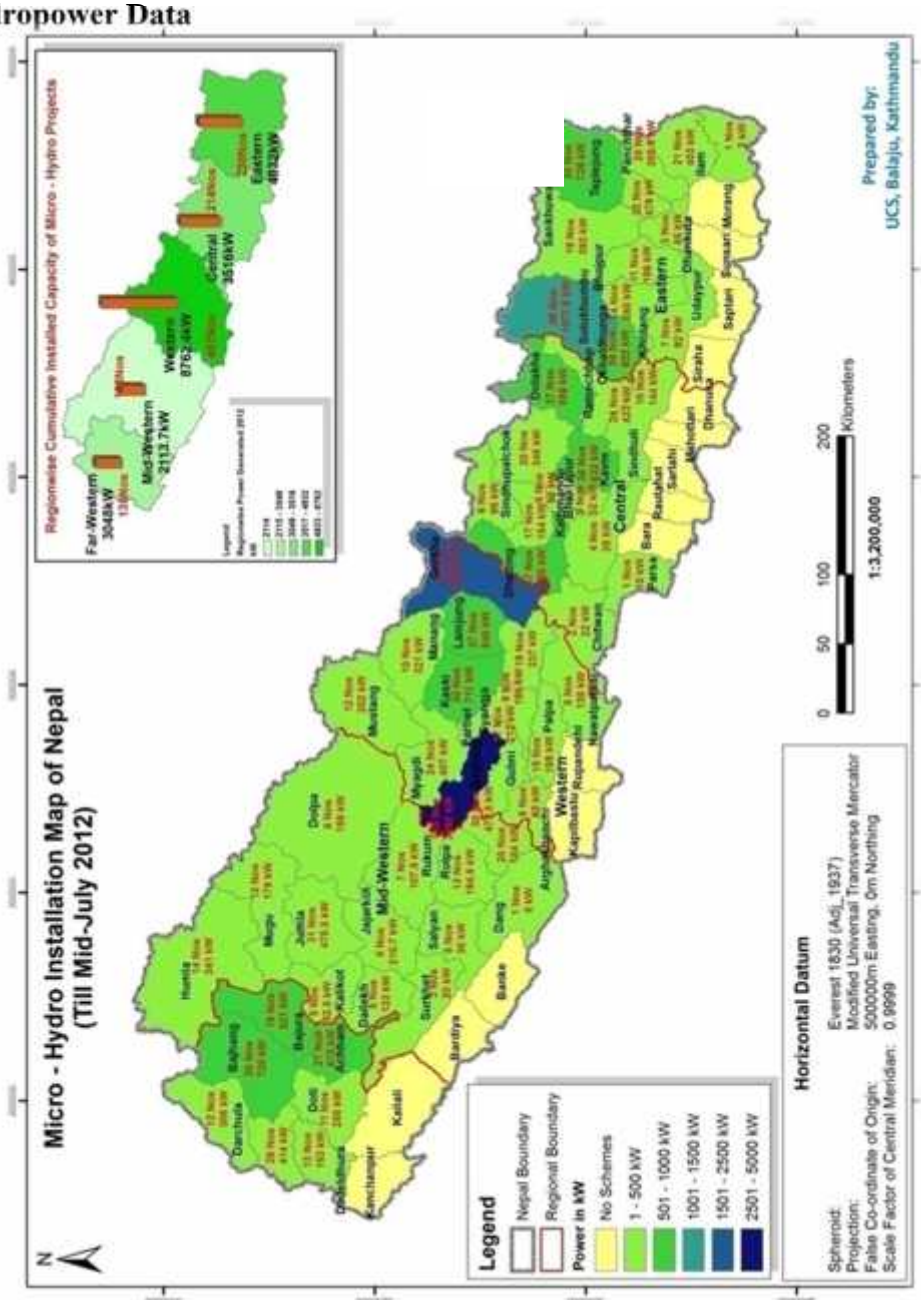
Annex: 1 Year-wise data of small-hydropower during 1962-2013

Year of installation	Pico-hydro (up to 5kw)		Micro-hydro(5-100kw)		Total	
	No.	Kw	No.	Kw	No	KW
1962-1985	0	0	68	593.45	68	593.4
1986	0	0	20	203.8	20	203.8
1987	0	0	17	190.5	17	190.5
1988	0	0	11	109.8	11	109.8
1989	0	0	17	183	17	183
1990	0	0	11	97.8	11	97.8
1991	46	43	7	125.1	53	168.1
1992	13	12	6	106.5	19	118.5
1993	0	0	3	26.5	3	26.5
1994	79	100.3	5	125.7	84	226
1995	115	170.9	13	145.3	128	316.2
1996	130	203.3	14	174.2	144	377.5
1997	84	143.4	16	262.7	100	406.1
1998	97	185	28	430.5	125	615.5
1999	123	226.4	25	386.5	148	612.9
2000	112	213.45	40	719.5	152	932.9
2001	36	81.2	50	891	86	972.2
2002	61	140.5	34	364.5	95	505
2003	80	184.32	53	749.5	133	933.8
2004	66	140.85	35	420.75	101	561.6
2005	48	100.7	38	661.6	86	762.3
2006	46	100.5	42	893.4	88	993.9
2007	70	202.24	98	1,879.05	168	2,081.20
2008	32	95.6	86	1,995.50	118	2,091.10
2009	36	111	60	1,413.50	96	1,524.50
2010	115	392.9	62	1,544.60	177	1,937.50
2011	103	368	140	4,016.20	243	4,384.20

2012	57	207.4	77	2236.67	134	2444.07
2013	77	281.5	69	1791.2	146	2072.7
Year Unknown	0	0	7	92.3	47	15,040.30
Grand total	1626	3704.46	1152	22830.62	2818	41482.87

Source: Alternative Energy promotion center khumaltar, Lalitpur. Year wise micro-hydropower development in Nepal from 1996 to 2013.

Annex two: Rural Energy Technologies Installed Cumulative Data of micro-Hydropower Data



Source: Alternative energy promotion center, khumaltar, Lalitpur. RET's installed Cumulative data of Micro-hydropower up to mid July 2012

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QUESTIONNAIRE

CENTRAL DEPARTMENT OF SOCIOLOGY

Tribhuvan University, Kirtipur

Survey of an Socio and Economic Analysis of AdhiKhola

Small-Hydropower Project Tulsibhajang VDC ward (3,4,5,7,)Syangja-2015

Namaste,

I'm Mr. Yubaraj gyawali from Central Department of Sociology, TU, Kirtipur and doing research on whether the Small- hydropower project Impact socio- economically to the project surrounding people. I need your support and cooperation in the course of interview. All the information collected in this questionnaire, which you provide for the survey I will kept confidential and will used for the purpose of survey only. Please select the appropriate choices in case of multiple choices or specify if necessary.

1. General information of respondents

SN	Question	Code	Answer
1.1	Name of the village:		…….
1.2	Ward no:		……
1.3	Name of the house hold head:		.....
1.4	Name of the respondents:		……
1.5	Gender:	01-Male	…….
		02-Female	
1.6	Age:		……
1.7	Cast:	01-Brahmin	
		02-Chetteri	
		03-Jajati	
		04-Dalit	……
		05-Other	
1.8	Religion:	1-Hindu	

		2-Buddhist	
		3-Cheristian	
		4-Kirat	
		5-Other	……

2. Small-hydropower and rural electrification

SN	Question
2.1	When was Micro-hydropower installed?
2.2	Do you agree Micro-hydropower help in rural electrification?
2.3	How much units of electricity do you consume per- Month?
2.4	How many hours per-day you Access to Electricity for the following purpose?
	1.Lighting
	2. Cooking
	2.TV/Radio
	4. For Business Purpose
	5. Personal use
	6. Other (specify
2.5	What is the condition of the forest after this project?
2.6	How much money do you pay for electricity per- month? (in RS)

2.7	What was the installed cost of the project?(IN RS)
2.8	how much did you self-fund to install Micro-hydropower ?(in RS)
2.9	Such Small-hydropower project is sustainable or not?
2.10	Where you maintain the maintained cost of the project?
2.11	For the sustainability of the Micro-hydropower project what should you done personally?
2.12	What should be doing for the sustainability of the project?
	1. From Government Side
	3.From Users Side
	4.From Management Side

3. Socio-economic Impact of Small-Hydropower

A. Education

SN	Questions	Code	Answer	Skip
3.1	After electrification, do your children study hours have been increased?	1-Increased	.....	If 3 go to QN 3.3
		2-Decreased		
		3-Same as before		
		4-Difficult to say		
3.2	How much time has been increase after micro-hydropower install?	01-Less than 1 hour	……	
		02-1 to 2 hour		
		03-2 to 3 hour		
		04-More than 3 hours		
		05-Un known		
3.3	Has their children's preference at school improved?	1-Strongly improved	……	
		2-Improved		
		3-To some extent		
		4-Not improved		

3.4	Do you conduct or participates any literacy class after install micro-hydropower?	1-Yes 2-No	…….	If 2 go to QN 3.6
3.5	What type of literacy class do you conducted or participated?	1-Adult 2-Pre-primary 3-Other (Specify)	…….	
3.6	What is the number of family member literate in your family?		AP: M.... F.... / BP: F.... M....	
3.7	Have your family member	1-Yes 2-No	……	If 2 go to

	dropout from school or not?			QN 3.9
3.8	What is the cause of dropout?	1-Unwillingness to study 2-Due to their job 3-Other (specify)	.....	
3.9	What is the educational status of your family after install plant?	01-improved 02-strongly improved 03-same as before 04-difficult to say 05-not improved	.....	

B. Health

SN	Questions	Code	Answer	Skip
3.10	Did Any of family members suffer From illness after micro-hydropower?	1-Yes 2-No	.....	If 2go to QN 3.12
3.11	If yes, what type of diseases?	1-Asthma 2-Bronchitis 3-ENT irritations 4-Eye inflection 5-Other(specify)	.....	
3.12	Sources of drinking	Well	……	

	water and distance?(in meter)	Spring water tapes	……	
		Stream	……	
3.13	Did any of your family suffer from Water borne disease past one year?	1-Yes 2-No	.....	
3.14	Does your family have a toilet?	1-yes 2-No	.....	If 2 go to QN 3.16
3.15	When it is build?	1-After Electricity 2-Before Electricity	.....	
3.14	What type of it is?	1-Kachhi 2-Pakki	.....	
3.16	Does any family member suffer from Any kinds of disease before micro-hydropower?	1-Yes 2-No	.....	
3.17	If yes what kinds?		.....	
3.18	Any of family member dead after install Small-hydropower or not?	1-Yes 2-No	.....	If 2go to QN 3.20
3.19	What is the main cause of death?		.....	
3.20	How often your family member listen / watching Health programs on Radio and TV?	1-Every day 2-Few times in a weak 3-Once in a week 4-Never 5-Some times in a month	.....	
3.21	What is the status of health and sanitation after install Small-hydropower?	1-Improved 2-Worse 3-Same as before 4-Difficult to say	.....	

C. Income, employment and entrepreneurship

SN	Question	Code	Answer	Skip
3.22	Have you done the productive work by Using micro-hydropower system?	1-Poultry farming 2-Milling 3-Knitting 4-Saw mill 5-Furniture 6-Dairy 7-Computer trainingcenter 8-Other (specify) 9-No	.....	If 9 go to QN 3.23
3.23	Does the project help to promote the Agricultural product?	01-Promote 02-Not promote 03-To some extent 04-Neutral	.....	If 2 go to QN 3.25
3.24	Is your opinion how it is help?	10-Regularly 20-Some time 30-Irregularly 40-Never	.....	
3.25	Do you find that after involving on Productive work it is help to increase Your income level?	1-Increase 2-Same as before 3-To some extent 4-Difficult to say	.....	If 2 go to QN3.27
3.26	How much income increases monthly? (in RS)		……	
3.27	No of people employed in your family At the project affected areas?		……	

3.28	What is the average monthly income of the family? (In RS)		AP	BP	
	1.Agricult		.....	.....	
	2.Business		.....	.....	
	3.Services		.....	.....	
	4. industries		.....	.....	
	5.Other (specify)				
3.29	What is average monthly expenditure of your Family? (in RS)		AP	BP	
	1.Food Crops		.....	.....	
	2.Clothing		.....	.....	
	3.Health /education		.....	.....	
	4.Festival		.....	.....	
	5. Miscellaneous		.....	.....	

4. Households Consumption of Electrical Goods and Benefits of Hydropower

A. Electric Goods Consumed by Households

SN	Question	Answer	
4.1	How many electrical goods or instrument Does your family possess before and after Micro-hydropower ?(write in number)	BP	AP
	1.Radio/TV	.....	.....
	2.Referigator	.....	.....
	3.Computer /Laptop	.....	.....
	4.Iron/Fan	.....	.....
	5.Other (specify)	.....	.....

B. Benefits of MHP

SN	Question	Code	Answer		Skip
4.2	What was the main source of energy In your family after Small-Hydropower installed?	1-Fire wood			
		2-Bio-gas			
		3-Solar			
		4-Kerosene			
		5-Electricity	.....		
4.3	After install micro-hydropower, it helped to save time or not?	1-Saved			If 2 go to QN4.5
		2-Consumed			
		3-To some extent			
		4-Difficult to say	.....		
4.4	How much time it saved? (in hour)		.....		
4.5	Small-hydropower can be helpful to develop the skill of your family or not?	1-helped			
		2-to some extent			
		3-difficult to say			
		4-not helped	.....		
4.6	How many family members are following type?		AP	BP	
	1.Skilled				
	2.Semi-Skilled				
4.7	What type of program does your family member listen on radio, watching TV and uses other various sources of information?(number family of members)		AP	BP	
	1.Entertrainmet				
	2.News				
	3.health				
	4.educationa				

	5.agricultural related				
	6.other (specify)				

4.8	Have you seen the following changes in the Activities of your children due to Watching TV, Using Internet and using other sources of information?	01-Talking style			
		02-Dress up			
		03-Sports			
		04-Dance			
		05-Other(specify)	.....		
4.9	Has Small-Hydropower improved the communication and information in Efficient way?	1-Improved			
		2-little bit			
		3-Difficult to say			
		4-Not improved	.....		
4.10	If your family have not access the following technology then what time it take to get such sources ofinformation? (in hours)		AP	BP	
	1.Phone				
	2.Internet				
	3.Other (specify)				
4.11	What advantage of Small-Hydropower attracted you must?	1-Improvement in health			
		2-Time saving			
		3-Easy to work at night			
		4 Increased reading habits			
		5-Agricultural production			
		6-Other (specify)	.....		

Please comment on this questionnaire…… Thank you.