CHAPTER I

INTRODUCTION

1.1 Background

Nepal is a landlocked mountainous country, which is sandwiched between India and China; it is 1,127 km far from the nearest point of the sea. It occupies 0.3 percent and 0.03 percent area of Asia and the world respectively. Nepal is located in between the latitude of 26˚22’ N to 30˚27’ N and the longitude of 80˚ 4’ E to 88˚12’ E. The country is approximately rectangular in shape and its average length from east to west is 885 km and the width from north to South is 193 km.

Nepal is divided on the various bases such as ecologically (Mountain, Hill and Terai) river's basis (Koshi, Gandaki, and Karnali) administratively 5 development region 14 zones and 75 districts, 3915 VDCs and 58 municipalities. Out of the total population 86.06 percent people live in rural areas. And 80.77 percent people depend upon agriculture.

The landlocked position, rugged topography with limited arable land (17 percent of total land). Poor resource base and high extent of poverty are major economic vulnerabilities so Nepalese economy is facing in these days. This makes it susceptible to increasing imports and foreign dependents, Nepal has immense stoke of endowed natural resources, unfortunately we are still poor and the least developed because of underutilization of the available resources. On one hand, Nepal's economic growth rate is low. On the other hand, Nepal's economic development is at infant state. However, more or less, all sectors such as agriculture, industry, trade, and commerce and commutation. Social services and tourism are developing smoothly.

Energy is the basis need for all the sectors; likewise, energy is necessary in every step and moment of human life. The world has been modernized through energy. So energy is the basic things for the economic development of a country in modern age. The degree of economic development is largely determined by per capita energy consumption. Energy as an indicator shows the living standard of people. Demand of energy is gradually increasing along with growing population and economic activities. Adequate and

affordable supply of energy is basis pre-requisite for socio economic development of a nation.

The trend of energy consumption is predominated by traditional sources particularly fuel wood. Over utilization of forest creates serious environmental problem. Fossil fuels (petroleum and coal) are imported. It needs a large amount of foreign currency. Nepalese economy however is facing problems like trade deficit debt trap and unfavorable balance of payment on one hand. People's per capita income US$ 400 (World Bank, 2010) and purchasing power is very low. In the other hand, the use of solar energy is negligible and wind energy is still as survey stage.

But the water resource is immensely available in Nepal and hydropower is clean renewable, pollution free, reliable and easily available. It is the best alternative among all the available energy in the context of our country.

Nepal is the first richest country in water resources in Asia and the second richest in the world. Nepal has about 6,300 large and small rivers hurling from the Himalayas and high mountains towards the plain andTerai. The total length of those large and small rivers is about 45,000 KM. The perennial nature of Nepalese rivers and the steep gradient of the country's topography provide ideal conditions for the development of some of the world's largest hydropower projects in Nepal, The total hydropower potential of these rivers is estimated about 83,290 MW and where 45,520 MW (54.69 percent) and 42,133 MW 50.59 percent) are technically and economically feasible. The country's theoretical potentiality occupies 2.27 percent of world's potentiality of hydropower. However, Nepal has generated615.959 MW hydroelectricity up to the end of 2008/09. It is 0.67 percent and 1.33 percent of the theoretical and economic potentialities respectively. Out of the total installed power, 463.136 MW and 152.713 MW power have been installed from public and private sectors respectively. Total installed capacity has reached 615.959 MW including thermal power (NEA, Annual report, 2006/07).

1.1.1 Energy Source of Nepal

Commercial and traditional fuel has remained as two principal source of national energy. 90 percent people are living in rural areas that are consuming traditional energy source. In urban area people areas that are consuming traditional energy. Commercial energy is rarely available in rural areas. Where, they use fired wood Diyalo to light their house.

Commercial energy is available in urban areas. However, Micro-hydro projects, Mini-hydro project, biogas, solar and small scale wind energy are currently; being development in rural areas except biogas other forms of renewable energy contribute to lighting energy.

Traditional Energy Source:

It is clear that sustainable energy is supplied by firewood, animal dung agriculture residue; which cover 90.5 percent of total energy consumption leaving 9.5percentage to commercial source. Supply of fuel wood can't be maintained from uncontrolled destroy of forest which is the main source of traditional energy shared 67.6 percentage. In rural area energy is substituted by agriculture residues and cattle wastage. Human labors and animal draft power is also referred to traditional energy (Economic Survey, 2011).

Forest Resources:

Forest is the major source of traditional energy in rural areas. People are depending on this source. Various programs and project are launched for the promotions and conservation of forest resource, which is one of the most important natural (traditional) resources of the country. Total traditional energy is shared of fuel wood by 67.6 percent. (Economic Survey, 2011).

Agricultural Residues:

Agricultural residues are also traditional source of energy, which is used in Nepal. Such as rice husks and straw are increasingly using for in traditional stoves in houses. At present agriculture residue constitutes 15 percentage of the energy consumption (Economic Survey, 2011).

Animal Dung:

Animal residue is used for cooking either in front of dung cakes or in family scale biogas digests. Dung is mostly dried and burned directly for cooking purpose. Alternatively it is used for biogas plants in which it is used both for energy and organic fertilizer. 7.9 percent of energy contributes to traditional source by animal or cattle wastage sector.

Commercial Energy Source:

In Nepal, commercial energy (petroleum and coal) consumption is very low compared with other countries. It contributed only 9.5 percent of total energy consumption (Economic, Survey, 2008) the demand of most of commercial energy, e.g. coal, petroleum product or mineral oils are fulfilled through import. Commercial energy is mainly supplied in urban areas. Internal product of commercial energy is electricity, which contributed 1 percent of total energy supply. Its contribution is very low because of high project cost and limited capital to invest in this sector. Commercial energy consumption is very low than traditional energy.

Petroleum Product and Coal:

Commercial energy like petroleum product and coal are another option. But they are not available in our country. So they are imported from India and abroad. So they are expensive too. A huge amount of export earning is drained to import petroleum product and coal have been increasing every years. Economic Survey 2008 shows that consumption of traditional commercial source of energy is estimated to grow by 2.2 and 9.7 percent respectively. The causes of that would be rapid increasing urbanization, increase in large number of vehicles and someone also use kerosene for cooking in areas, lighting in rural areas and rapid population growth.

Solar Energy:

The use of solar energy power in the country is at early stage development. Solar energy is used for domestic water heating drying agro products in urban areas. The solar energy products are not only expensive but also technically complicated so it is underutilized. Solar energy potential of Nepal is estimated equivalent 026.6 million M.W. (Economical Survey, 2011). The major solar power station in Nepal in Simikot(Humla) and Gamagadhi (Mugu) have setup capacity 32 K.W. each and generate electricity form solar power (NEA.2003).

Wind Energy:

Utilization of wind energy is still at the research stage in Nepal. But while considering its geographical feature and wind velocity, there is possibility to develop wind energy. Moreover, the only one project is installed at Kagbeni of Mustang district to generate

20KW electricity from wind power(Bhattrai, 2002). To develop this type of technology is technically costly too.

Hydro-Electricity:

It is the main resource, which will ultimately become the dominate source of indigenous energy resource. It has been calculated the size of theoretical hydropower potential based on average flow of six thousand rivers are 83,000 MW where as technically potential 114 major schemes are identified total capacity of those schemes are 45610 MW. Those are economically potential major hydropower schemes whose benefit cost ratio is more than one amount 42330 MW (Mishra S.N., 2000). With such capacity current utilized Hydro electricity is 549.2 MW (NEA,2003). Nepal has 6000 rivers having capacity to generate electricity. So Nepal is rich energy sector if all that resource will be utilized, Hydropower development required high initial investment, infrastructure like road etc. Electricity generated in Nepal essentially consists of both in the interconnected system and remote isolated areas, which is backbone of our economic development and earning foreign currency (Thapa and Pradhan, 1995).

This study was sketched the impact of a SMHP on the socio-economic in the remote village, Jhula- 3, Rukum in Nepal. This mini-hydro scheme provides clean, affordable and sustainable renewable energy both locally and globally. Since, the energy consumption appears to be directly related to the socio-economic impact and living standard of the people as well as the degree of industrialization of country. Therefore, this renewable energy is the basic requirement of development without which the pace of economy cannot be accelerated.

1.2 Statement of Problem

Nepalese economy is based on traditional agriculture. In addition to agriculture other sectors of economy such as industry, trade and commerce, transportation, communication and tourism are not developed yet due to the inadequate electric power and financial resources. The absences of infrastructures like road and transmission line, Hydropower development cannot be achieved moreover infrastructures are required for proper utilization of other available resources in the country. In short, economic development is lacking proper acceleration due to insufficiency of electricity.

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

The demand of petroleum product is growing day-by-day and sometimes we have to face the crisis in their supply in the international price to market as well as wind energy is still of the state of research and survey. Likewise, the price of petrol is Rs 104.50 per liter, diesel Rs96,KeroseneRs 90 (Dec 2015). The solar energy has to been adequately utilized. Similarly, biogas cannot be produced all over the country especially in the cold hilly as well as mountains regions.

All scale of hydropower projects is viable in Nepal. Large dam and reservoirs are needed for large scale hydropower projects life and marine life of the concerned area and its surroundings similarly huge capital investment is required to install large scale hydropower project. For this government should take foreign debt or invite foreign investor to invest. In both cases foreign exports and technicians would be used consequently. The generation cost of large project should found comparatively higher than that of small project. Despite the generation cost of large scale project should be owner than the small one in accordance with the principle of economics in reality. The result is found just opposite. That’s why the large capacity of electricity and ultimately, it has got to bear extra load of debt.

On the other hand, mini-hydropower can fulfill the demand of electricity can fulfill the demand of electricity is backward and isolated areas, where disadvantaged groups and marginalized people live. Indeed micro hydropower projects have not been installed in adequate number is targeted areas yet. The marginalized people are living in remote rural areas which lack balance of regional development. To some extent, the development cannot be promoted in rural areas in the absence of the electricity.

The construction ofSyarpudahamini hydropower project was started in 2041 and accomplished in 2045 B.S. The capacity of this hydropower is 240 KW but it is

producing 200 KW only.The project is currently covering 9 VDCs which was constructed by JICA.The total cost of the project was Rs.3,63,36,000. The hydropower project had been conducted by Nepal Electricity Authority in its initial phase than it was conducted by Company from 2055 BS to 2062 BS but from 2062 BS it has been conducting by User Committee named "RukmeliUrjaBikasUpabhokttaSamiti". Before the conduction of user group, electricity was distributed in 5VDCs. At that time electricity supply was sufficient but when the user committee started to conduct the hydropower, electricity is then distributed in more VDCs even if the electricity production is same. There is a lot of water resources if it is managed. The people of there are facing load seeding problem too much. They cannotuse electricity when they need most.

The objective of the study is to study socio-economic status of Syarpudaha Mini Hydropower Project.This sort of research have not been conducted yet in hydropower sector in Rukum district. Likewise research of socio-economic impact of Syarpudaha Mini Hydropower Project was not conducted from the date of establishment. So, this research is significant for the hydropower project.

The study area was Jhula VDC ward no 3 of Rukum District. Electricity was supplied there two year ago. The aim of this study is to find out socio-economic changes that took place in two years period. The people used dunk, fire wood, kerosene, candle etc before but now they are using electricity. While people were using traditional energy they were facing different types of problem like health, education, income,employment etc. Now the study has found changes in their livelihood by electricity consumption.

1.3 Objectives of the Study

General Objects:

The general objective of the study is to study socio-economic status of Syarpudaha Mini Hydropower Project. This sort of research have not been conducted yet in hydropower sector in Rukum district.Likewise research of socio-economic impact of Syarpudaha Mini Hydropower Project was not conducted from the date of establishment.So, this research is significant for the hydropower project.

There are specific objectives of the study:

- To assessthe socio impacts (Education, health and sanitation) of Syarpudaha Minihydropower project in targeted area.
- To evaluate the economic impact (Income, saving, entrepreneurship, employment) in the study area.
- To analyze the sustainable functioning of Micro hydropower project in study area.

1.4 Significance of the Study

In the view of growing scarcity of fuel wood the other non-renewable energy sources and huge investment of commercial energy sources the search for alternative energy sources is prominent. In this context, many projects have been operated but how far the projects are succeeding in terms of end-use-efficiency, how far it effect for the uplift in the life of rural poor, how far the projects is success ding in terms of overall socio-economic uplift of the rural people in their perception are leading issues that have been tried to access by this study. Moreover there are many studies adopted in MHP sector there are still lack of proper information and show documentation, which will analyze the ground reality of socio-economic, gender and environment aspect of MHP. Hence this impact study will be rounded on the pivot of rural poor and gender in socio-economic aspect.

1.5 Limitation of the Study:

This research has been conducted for academic degree. This study is focused on the socio-economic impacts of the hydropower project in the development of Nepal. It has been taken as a case study. The study primarily focuses the characteristics of the communities and social impacts caused by SMHP at the local area.

The generalization derived from this study may not be equally applicable to other sector. Due to the financial, temporal and other constraints the field survey has been conducted in a single season. Some limited aspects of the study area has analyzed here the study area was limited to Jhula VDC ward no 3. Information of other VDCs attached with Jhulawas connected in this study. The limitation of study wasappeared as follows:

1. Lack of money and time boundary.

2. There was not found well managed documentation in hydropower office.
3. It was difficult to collect more information from respondents.

1.6 Organization of the Study:

This study has been organized in to five chapters. The first chapter deals with the introduction. It includes the general information of mini hydro power, statement of problem, objective of the study, significance of the study, limitation of the study, organization of the study. The second chapter presents the review of literature Review. The third chapter deals with the research methodology. It includes rational for the selection of study area, research design, nature and source of data, universe and sampling, data collection technique and tools, household survey, interviewed with key informants, observation, interview, data analysis .The fourth chapter presents the methods of data analysis with profile of the study area. The last chapter of the study offers summary/finding, conclusion and suggestion. Appendices and reference have been kept at the end of this report.

CHAPTER II

LITERATURE REVIEW

2.1 Conceptual Review:

Hydropower is the renewable energy contained in flowing water. Electricity generated using hydropower is known as hydroelectricity and is generally considered to be reliable. Hydroelectric power is the cheapest source of energy,renewable and environmentally benign during running. The potential annual power generation of a hydropower project is proportional to the head and flow of water.

Hydro-electricity is fundamentally the combination of water flow and vertical drop (commonly called “head”). Vertical drop creates pressure, and the continuous flow of water in a hydro system gives us an ongoing source of pressurized liquid energy. Pressurized, flowing water is a very dense resource, and hydro-electric systems convert a very large percentage of the available energy into electricity because the resource is captive in a pipe or flume.

CLASSIFICATION OF HYDROPOWER PLANTS:

Classification of hydropower plants according to capacity, according to head, according to purpose, according to facility types, according to hydrological relation, according to transmission system Large Run-of-River High Single purpose Isolated Medium Reservoirs, Medium Cascade Small Multi Purpose In-stream Mini Micro Pico Low Pumped storage Connected to grid are as follows:

Large >100 MW, Medium 25 – 100 MW, Small 1-25 MW, Mini 100 KW - 1MW, Micro 5 – 100 KW and Pico < 5 KW.

Pokhrel, (2003) in his article, has mentioned that HMG proper policy and long –term plan of hydropower development are essential to fulfill national needs and to export. If national capacity and technology would inadequate then HMG should to offer foreign investors to develop hydropower. Khimti (60 MW) is the first project invested by foreign

companies under the electricity Act – 1992. The mention that foreign companies are investing on hydropower generation by imposing their own terms and condition.

Thapa, (2004) and "DobbarVikas" have defined that development of hydropower has been doubled in twelve years of restoration of democracy in comparison to thirty years of Panchayat. Statistically, existing capacity of hydropower is more than 600 MW now. It was only 281 MW capacities before twelve years. Per capita energy consumption reached around 60 K per year now. However, it was less than 20 KW at that time. Total number of customers as reached 970,000 from 290,000 during that period. Now NEA became capable not only to solve the problem of load shedding but also to export. New liberal hydropower policy facilitated investors in the various cases then private sector has been attracted and it become has developed the local industries which create the employment opportunity. Likewise, it helped to raise the value of goods and services and performed the integrated energy system of Nepal and positive impact on overall economy. National capital, Skills, knowledge technicians and technologies have become capable to apply small hydropower plants after came of the new policy private sector has generated about 145 MW electricity in Nepal in this period.

Dahal, and Gurugharana(1998) has published by NEFAS is also an important publication, which is related with environment and sustainable development. These both aspects are inexorably interlinked with each other. They explain that the vicious circle of poverty and environmental degradation is reinforced. The growth of population, the people use traditional as well as commercial energies, biomass energy accounted for 95 percent of total energy consumption (75.6 percent from fuel wood and the rest from agro residue and dung cakes) the forest alone fulfills 96 percent of the total energy rural households need.

Gurung, (2000), in his thesishas revealed that the total water provides nearly 25 percent of the world's energy. It is estimated that 73,000 TWH can be generated where as today; the world has produced 3,207 TWH of hydroelectricity. Asia consists of 28 percent of the world's hydropower potentiality. High run off potentiality of several rivers and mountainous topology support to raise hydropower development in the context of our country. The study analyzes potentiality and historical perspective of hydropower development in Nepal. Major rivers and small rivers contribute 87 percent and 13 percent in theoretical hydropower potentiality of Nepal respectively. Total technically feasible hydropower potentially is 45,520 MW from 93 project sits of different river basins. He

also analyzes the sustainable development of small hydropower projects in Nepal. He recommends that we should develop the small hydropower projects in the present context of Nepal.

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

2.2 Review of Previous Studies:

Hydroelectricity was first originated form water resources at Rothberg of Northumberland in 1879. Lord Armstrong lighted his house with electric lamp by using current from a dynamo driven by a water turbine. The first hydropower station in Europe for supplying electricity to the public was bolt at Zurich, Switzerland in 1882. It was based as the principle of kinetic energy.

In the context of Nepal, Pharping Hydro plant (500 KW) in 1911 is supplying electricity in Kathmandu. Then 24 years letter second hydropower project Sundarijal (900 KW) was generated in 1935 A.D. Now its capacity is 640 KW. The development of hydropower went ahead in progressive path smoothly. Only 2077 KW power was installed from hydropower at the starting date of economic plan in 1956 AD. Every plan has been making plans and implementing the programs about the development of hydropower in Nepal. Unfortunately first five year plan did not achieve the goal of power installations only preliminary works were completed. But other plans more or less achieved the goal of hydropower development. Even in holiday plan period (Since 1990/1992) we achieved 71000 KW power due to the completion of some projects. Out of five hydropower projects including a major project, Sixty–eight hydropower projects have been installed up to FY 2007/08. Out of them 8 projects are considered as the large scale project.

Government of Nepal (HMG/N) has brought out new liberal policy about the development of hydropower to encourage private sector (foreign as well as local investor, by the implementation of water resources Act 1992. Especially Nepal has adopted this liberal policy to attract private investment for the development of small hydropower projects. Nepal electricity authority has announced its policy to purchase the power generated by its private developers/investors of small hydropower projects up to 5 MW capacity. In order to support the capital requirement for the installation of hydropower project, the government has established a power development fund (PDF) support the private investors. Similarly, domestic commercial banks have been also autonomously investing on hydropower project is priority sector investment. This policy has been encouraged the private investors to install small hydropower projects to much the growing national demand for energy in the country.

The landlocked position of Nepal, rugged, topography with limited arable land, poor resources base and high extent of poverty are major economic vulnerabilities Nepalese economy feeling these days and because of this makes it susceptible to increasing imports and foreign dependents. Nepal has the largest natural resources. Unfortunately, Nepalese people are still poor and least developed because of underutilization of the available resources. Here in one hand, Nepalese economic growth rate is decreasing day by day. On the other hand Nepal's population is growing rapidly.

In the present condition of Nepal, energy plays the vital role of fulfillment of resources. It is the primary need for all economic and social development. Energy itself is not a sustainable used connect to diverse process such as lighting bulbs charging battery is burning fuels and propelling machines.

Usually, the trends of energy consumption is predominated by traditional resources particularly fuel wood. Over utilization of forest create serious environmental problem.

Nepalese people are using 300 kg to 900 kg fuel wood per head per year for cooling and heating. Fuel wood consumption in mountain has been estimated 640 kg/person 1 year while for the Terai it is 479 kg/person per year (Lekhak, H.D., 2003: 2005).

But the water resources is immensely available in Nepal and hydropower is clean renewable among this micro-hydropower is more than more renewable, pollution free,

relievable and easily available in mountain and hillside of Nepal. So micro-hydropower is the best alternative among all the available energy in the context of our country.

Nepal is the second richest country of the world and first richest country in Asia in the context of water resources. Nepal has about 6300 large and Small River hurling from the Himalayas and high mountains towards the plain and Terai. The total length of those large and small rivers is about 45000 km. The perennial nature of Nepalese river and stepped grand of the country topography provided ideal condition for the development of some of the world's largest hydropower project in Nepal. The total hydropower potential of these rivers is estimated about 83,290 MW of and which 45,520 MW (54.69%) and 42,133 MWE 50.59 percent are technically and economically feasible from 93 and 66 sites respectively, the countries theoretical potentiality occupies 2.77 percent of world's at potentiality of hydropower. Nepal has generated 552.201 MW hydropower up to the end up to FY 2003/04 it is 0.67 percent and 1.33 theoretical and economic potentialities respectively. Out of the total installed power 414.188 MW and 144.083 MW power have been installed from public and private sector respectively. Total installed capacity has reached 609.057 MW including thermal power.

So, energy can be generated from falling water through the use of turbine, which can be used as mechanical power. This is known as hydropower. This power can be used directly to run various milling machines or can be converted into electricity by using generator. Electricity generated in this way can be used for lighting, heating and operating machines. Hydro-projects that generated that small amount of mechanical or electrical power up to 100 KW are called micro-hydro power. Generally, this project is classified on the basis of amount of power produced into large, medium, small and micro-hydro. In Nepal, project from 100 KW to 1000 KW capacities are classified as mini-hydro project, (AEPC, Booklet, 2000: 3).

Nepal is facing enormous challenges in the path of economic development. One of the major-infrastructures required for sustainable development of any nation is power sector, (SHD, 1997: IX). Due to the unique topography with scattered settlements the national grid electricity expansion has difficulties, so the electrification through mini-hydro is suitable. There are more than 6000 rivers and innumerable rivulets crisscrossing the country. So, mini-hydropower has a great potentiality for fulfilling the energy requirements of rural Nepal to a great extent (WECS, 1995: 7).

Thapa and Pradhan, (1995) have defined that hydropower is Nepal's major resources endowment. Numerous attractive run-off-river and multipurpose hydro schemes have been identified but remain underdeveloped. They explain the strategy of water resource development that saving in transportation cost environmental benefits, foreign exchange earnings from large power project, agricultural, industrial products and other modern manufacturing output to be stimulated by power supply. Small and micro hydro power remain virtually used in the hilly and mountain area, despite. Nepal's small size only about 10.5 percent of the total population has had the access of electricity (whereas about 40 percent of domestic connections are concentrated in the Kathmandu valley). The installed capacity of hydropower station developed until new worked out less of than one percent of potential identified up to that date. Nepal's energy scenario reflects an imbalance between energy constipation that energy resources endowment development of water resources is essential in order to meet human needs like increasing agricultural and industrial production, meeting energy needs and earning foreign exchange from power export. They have pointed out that high investment requirement for the development of hydropower and lack of financial resources to the major constraints at present.

Bastola, (1990) has said that geographical and geological condition of the country has been rise to such a river system in our country. It surveys that some of the cheapest hydropower station can be developed in the country. 15 million Kilo Watt hydropower potentiality of our country is so much greater compared to our consumption. It can be exhaustible for our economic uplift. We must look for market, external input for isolated hill area, medium size projects to meet national needs in relation to entry, irrigation water supplies and large scale projects primarily for export and securing navigation facilities from lower riparian to ease the difficulties by Nepal's landlocked status.

Paudel, (1996), in his thesis has studied about the development of hydroelectricity during different plan periods and major projects. Harnessing our water resources is cashier to say than to do as the wide topographical variation has created hitch in our development efforts. However, this variation can be turned into nature's gift and ultimately can pave the steps for economic prosperity. Proper utilization of the water resources is essential for generating electricity and reducing the import of expensive petroleum products. Hydropower projects seem to have brought some changes in attitude, behavior, habit, and consciousness of the local people. It has mainly contributed to transportation, market and

communication facilities. The physical characteristics and rivers naturally affect Nepal's hydropower development activities and human interaction. He concludes that small hydropower plants, which may be the only means of rural electrification in the country, are viable at present.

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

Pokharel, (1998), in his thesis has mentioned,A case study of Socio-economic Impact of Jhimruk Hydro Project, Pyuthan", has mentioned that energy is important for economic development. Without it, he pace of economy cannot be accelerated.

2.3 Hydropower Development Policy in Nepal:

The following have been major policy documents guiding energy production, development, utilization and regulation.

Development Plan:

- Until 1990, hydropower development was under the domain of government utility
- From 1992, hydropower development was opened for private sector
- New policy seek investment by private sector and expand electrification within the country and export
- Hydropower Development Policies 1992 and 2001, Water Resources Act 1992, and Electricity Act 1992
- Water Resources Strategy 2002 and National Water Plan 2005
- National Electricity Crisis Resolution Action Plan 2008
- Rural Energy Policy 2006

- Foreign Investment and Technology Transfer Act - 1992
- Environment Protection Act - 1996 (Regulation-1997)
- Nepal Government's policy and plan of 10,000 MW in 10 years (2010-2020) and 25,000 MW in 20 years (2010-2030)

Limited research has been conducted on energy, socio-economic and environmental impacts of micro-hydro power scheme projects. There are many studies in other sector of micro-hydro projects. Generally, the studies on medium and large, small and micro-scale hydropower projects have been conducted to identify various types of impacts created by the rural development of micro-hydropower projects.

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

East Consult P. Ltd. 1990 socio-economic impact evaluation of the MHP schemes in rural communities of Nepal.

This is the final report prepared by East Consult P. Ltd. under the study sponsorship of ITDG Nepal. This study especially reports to the evaluation of micro-hydro power, its socially acceptance and economic viability. It encompasses many studies areas of micro-hydropower. But it especially focuses to the investigation especially on such questions like who are the real beneficiaries and to what extent do that get benefit. This study is interested to know the constraints prevailed in rural energy. It also keeps the interest to finding the answer of the question who gets the access to the rural lighting and why? This study was conducted in Turture of Tanahun district Karmasingh of Ghorkha, BulingArkhala of Nawalparasi, Karputar of Lamjung, Arghali of Dolpa and Karnali of Baglung district.

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

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

Dhital(2003), this is the conference paper has presented in international conference on renewable energy technology for rural development (RETREWD 03) prepared by Dital. The Retrud report is published in every four years. It is important information to the energy sector, which combines the present states, past experience and future plan of this energy sector with the view of national and foreign experts. The paper tries to analyze the initial evaluation of investments and optimizes the components to observe on total

projects cost. This analysis deals with the approach for financial analysis to calculate the cost where three scenarios that is, with subsidy, without subsidy and with net economic benefit.

Jha, (1995),has said that one of the major reasons for poverty and backwardness of the Nepalese economy is power due to deficit. Shortage of power creates a problem in the development of agricultural industrial, trade and other sectors of the economy. With a view of meet the power shortage, there is need to generate power from not only the medium or mega projects but also small scale hydropower projects. The small hydropower projects might contribute significantly by providing electricity in isolated pocket area as well as to the grid since the electrification is related to productivity. Small hydropower might help to increasing working efficiency of the rural families. For the sustainable development of small hydropower, he has emphasized the implementation of small and micro hydro projects by adopting the program approach instead of providing subsidy, comprehensive institutional base is required it provide supporting services such as agriculture extension input supply. Marketing services credit facility etc and development of capability of the farmers

Bastola, (1990),has analyzed that geographical and geological condition of the country has been rise to such a river system in our country. It surveys that some of the cheapest hydropower station can be developed in the country. 15 million Kilo Watt hydropower potentiality of our country is so much greater compared to our consumption. It can be exhaustible for our economic uplift. We must look for market, external input for isolated hill area, medium size projects to meet national needs in relation to entry, irrigation water supplies and large scale projects primarily for export and securing navigation facilities from lower riparian to ease the difficulties by Nepal's landlocked status. River are not only the ornaments of eth country but also diamonds if they are properly utilized by involving a long term plan for its development. Fifth development plan has (NPC, 1970)

Sapkota, (2012), has mentioned, Rural energy means energy that is environmental friendly and use for rural households, economic and social purpose such as; micro and mini hydro, solar energy, wind energy, biomass energy etc. Rural energy is also known as renewable energy. Energy is essential to economic and social development and improved quality of life. Similarly renewable energy is a key element of sustainable rural development.

In Nepal, there are a lot of possibilities to produce energy. Theoretically, hydro-power has a potential of 83000MW hydropower, but among them only 43000MW can be produced from the prospective of economic and technical point of view. Up to now there is only 563 MW hydropower is produced and the produced hydropower is mostly used in urban areas than the remote rural areas. Because of this condition, the remote areas are directly affected, in which, they are not getting clean and applicable energy. Thus, in Nepal, there is lots of possibilities of micro hydro project in remote rural areas; which is very much, environment friendly and economically bearable. (Recent Rural Energy Policy of Nepal-2063)

- Only the 12% people are getting service of electricity from the alternative source of energy, where the national transmission line is not assessable to reach in the geographically remote areas. From the MHP 23 MW, Solar Power energy 12 MW, Wind energy 20 KW and Bio-gas 11 KW all together 35.03 MW electricity is produced upto now in Nepal.(NPC,2013)
- "Renewable is a key elements of sustainable development, providing clean, affordable, and reliable energy, a valuable resource in the world's energy portfolio." (G8 Renewable Energy Task Force 2001, final report)
- Micro hydropower plants also known as 'micro hydro', 'mh' and '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 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 1000 Kilo Watt capacity are to be known as micro hydropower as defined recently where as it was limited to 100 Kilo

Watt in the past. 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 programmers to concerned agencies. Likewise, professional welfare is one of it's objectives. (NMHDA)

- The micro hydro is primarily used for lighting purposes in rural area. The average load factor of a typical micro hydro project is less than 30 percent. Biomass, fuel wood in particular is still the most dominant form of energy for rural households regardless of their access to MH electricity. Micro hydro plants in Nepal are playing important role for enhancing the rural livelihood. It reduces or replaces the use of kerosene. Micro hydro can also run agro processing units and some other small enterprises. The average electricity consumption of Micro hydro users is only about 1.9[1] kg/month, which is roughly equivalent to 4 hours of daily use of three 60-watt bulbs.
- Electricity provides luminance that is hundreds of times brighter and at the same time cheaper than kerosene- based lighting. People enjoy this consumer surplus because better illumination qualities can be obtained from micro hydro electricity at a far cheaper rate than kerosene fed electricity. This allows business activities in the rural communities to extend well beyond daylight hours, which has the potential for employment and income growth. The productive use of micro hydro electricity like agro processing, carpentry, communication centers etc. has given the opportunities of employment to the rural people resulting in a source of income. Similarly people can also engage themselves in operating and maintaining the micro hydro plants and enhancing their skill. It has also enabled women to be involved in productive activities in the evening, and increases their exposure to the outside world and education through electronic media such as TV powered by electricity.
- The gender and social inclusion concept in micro hydro has prioritized women empowerment in this sector. Better lighting facility also increases study hours for school-going children and impact on results. Micro hydro plants have been a very good worth for promoting the Clean Delivery Mechanism (CDM) by reducing carbon emission. About 10 million kg of CO_2 is saved every year by MH households in Nepal. Selling that carbon can also be listed as income generating way from micro

hydro. Studies show that, household's benefit from MH exceeds its cost by about 3 times. Nepal's micro hydro projects are already registered in the CDM. **(AEPC-WB Survey, 2009).**

- Micro hydro is a type of hydroelectric power that typically produce up to 100 kW of electricity using the natural flow of water. These installations can provide power to an isolated home or small community, or are sometimes connected to electric power networks. There are many of these installations around the world, particularly in developing nations as they can provide an economical source of energy without the purchase of fuel.[1] Micro hydro systems complement photovoltaic solar energy systems because in many areas, water flow, and thus available hydro power, is highest in the winter when solar energy is at a minimum. Micro hydro is frequently accomplished with a peloton wheel for high head, low flow water supply. The installation is often just a small dammed pool, at the top of a waterfall, with several hundred feet of pipe leading to a small generator housing.(Wikipedia)
- A large section of the Nepalese population is deprived of electricity coverage despite huge hydropower potential, particularly in rural areas. About 63 percent of Nepalese households lack access to electricity and depend on oil-based or renewable energy alternatives. The disparity in access is stark, with almost 90 percent of the urban population connected, but less than 30 percent of the rural population. Nepal has about 83,000 MW of economically exploitable resources, but only 650 MW have been developed so far. This study has been designated to organize an evaluation system that measures the impact of micro-hydro installations on rural livelihoods and to establish a monitoring system for Alternative Energy Promotion Center (AEPC) to continually measure the results of the results of the renewable energy programs against the targets. (TWB) Hamal, (2001), Explain that rural and hill areas have undergone deforestation due to insufficiency of alternative energy, i.e. electricity and women over working in farm time-consuming and non-monitoring and highly backwardness. The author further explain that energy is required to fulfill day-today needs, which included cooking, heating, lighting and productive activities such as transportation, irrigation, cottage industries, etc. Energy shortage has been recognized as a major constraint in the economic development and it contributes to further deteriorate the environment, creating a vicious cycle in rural life by the deforestations. Women are the main user of household energy. They are the main person responsible for collecting fuel wood or managing of other energy source such as doing crop

residues etc. Deforestation has made of women work harder. The increasing walking distance to fetch and gather fuel materials.UNDP,(2005) has defined on new and renewable energy source to study the situation of new and renewable sources in Nepal. In this context the research problem of this dissertation is to assess the socio-economic benefit of Kulekhani first hydropower which a view to prepare recommendation to augment the positive benefited and minimize negative benefits. This study is based on the survey covered in some district in the central and western development region areas namely hills and mountains. This study depicts the status of new and renewable energy source via small, micro, hydropower. Water turbines, biogas solar and wind power. The study has assessed the potentiality of this resource and also identified the area; which need further development. The study covers out with the conclusion that most hydropower installations are either operating under capacity or generating. In adequate electricity to meet local demand due to insufficient water resource during the dry season to generate electricity in full capacity and in some areas colder operation of the plan is often hampered by the formation of ice in the intake and frequent break down of the electro mechanical part. Thus the study concluded that the hydro projects run effectively only for about 9 months in a year. According to study the main establish effective linkage and co-operation between affiliated organizations and to monitor and evaluate programmed and preference the lack of adequate database related to micro-hydro project resource and the high cost of water turbines. It also suggests that the government should provide facilities to setup New and Renewable Energy Subsidy (NRES) and there should be provision of financial support thought subsidy in initial investment back financing on working capital, canalization of donor, resources to promote healthy growth of (NRCES) technologies further their need to be the integration of cottage industries, ropeways and other income generating activities, as a means 01 improving load factors and viability of isolated hydro electricity.

- WECS(1988), has Carried out Rural Electrification Impact in Nepal, Volume I. This final report of the task force on rural electrification and impacts on Nepal. The main objective in this report was to investigate impact of rural circulation in trader to create a database for future forecasting and to provide police direction for future development. Rural areas Nepal served from a various generation sources were studied in this report. There included Nepal Electricity Authority grid sides and there are remote from the gird served by diesel, the Indian grid NEA. Investigations were

made of small hydro and private micro hydro. The study gathered and analyzed demand date from NEA. Investigations were made of small hydro to determine operating characteristics. The major finding of this reports that is the impact of rural electrification have been minimal. But this is not meant that there is no future for rural electrification. Rather it means that development of rural grid must be under taken in a planned, reasonable ways so that systematic development of it in rural areas can be possible.

Dongol, (1999) has explained that power is the most important things for make country industrialization and in modern era industrialization of any country plays an important and role in economic development of Nepal. Exploitation, utilization, and utilization of energy resources have contributed so much to the development of industry, agriculture, transport etc. Per capital energy consumption is the basic factor; not only for the comparison of living standard of the people of Nepal but also for the measurement the role of economic growth of the country. Nature has been kind enough to favors Nepal with waterpower resources. The potentiality is quite Hugh and it plays a leading role in the economic development of Nepal. Actually Nepal started to utilize this resource from year 1911 but the study about the extent of the assets of waterpower potentiality was just recently during the years 1963-66. Though waterpower development of Nepal has considerably long history but due to several reasons only about 0.04 percent of the waterpower resources is utilized so far. Till this time other power resources like coal, gas, liquid fuel is not available. So only waterpower plays positive role in economic development of Nepal. At present the country's hydroelectric power generating capacity is limited and very few areas. If we see the unbalanced nature of tiller development, the central region of the country is facing the problem of utilization of energy from the development power plants. Again industrially position area in the eastern and western region are not getting power is the main problem for industrialization of the country. For to protect forest which are rapidly being depleted it became necessary of energy. To give irrigation facilities in hilly areas has become essential to utilize water resource as far as possible.

WECS, (2002) has analyzed on socio-economic issues in energy development that energy is basic necessary for survival. It is necessary for development activities to promote education, health care, transportation and infrastructure for attaining a reasonable

standard of living and it is also a critical factor for economic development and employment. Shortage of biomass fuels has forced urban households and industries to switch from biomass fuels to imported fossil fuels and other commercial form of energy. Deforestation and desertification are threatening to traditional energy supplies and agro-based rural economy. These shortages of biomass fuel in rural sector have energy sources are needed to promote rapid growth- of the rural economy. The aim of achieving rapid rural economic growth to meet the basic needs of rural families is also plagued by the lack of energy and other resources e.g. farm land, technology and capital for investment.

The main features of the energy sector are the imbalance between energy resource endowment and its current use. There is an excessive dependence on forest to meet energy needs while hydropower, which has vast potential has remained virtually not so utilized. Biogas is not an important energy, which is technically limitation in hills and mountain even in Terai. Nepal's hill and mountain areas occupied under development infrastructure make life hard for rural population. Women generally hear the full responsibility of household chores and share work in the farm and also fuel collection for energy requirement. This increases workload for the women. This makes women's daily life more difficult. The report mainly concentrated on women who are responsible for reproduction and bring up all the time spent to the next generation and care on a daily basis of all family members. Moreover they generally work hard but paid low wages and offer security low valuation of women's work, few legal rights, and also non-wages.

Energy supply program should also include generating activities for rural people either men or women. Women are handicapped by their skills, materials and technology and extension services. Energy supplied could increase both productivity as well as decrease in hardship if men or women in such activities like shorter processing hour on agricultural sector and less physical work. It reduces time and hardship, i.e. cutting, grinding, stirring as a result more time has gone for productive work. So that energy helps women to improve income-generating activities. In conclusion; this report talks stainable development as the keyword for need oriented, self reliant and environmentally sound development and says that increased economic activities will require more energy input. Nepal relies excessively on the form of renewable energy, i.e. NV 00d obtained from forest and its role in balancing ecosystem has been decreasing. We have large amount of water resources, which could be exploited for hydropower, hydro-based energy (also all

sector of energy) used in the domestic and industrial sector. It contributes development of the country as a whole.

Environmental impacts if they are not designed consciously to protect the environment ITDG. (1999) concludes that MHP can cause unacceptable negative or these impacts are not mitigated properly. The scale of MHP impacts is small enough to reasonably mitigate them without any significant adverse environmental impacts at affordable costs. Landslides or land erosion ranks highest among the possible negative impacts of MHP. The universal positive environmental impact from MHP is reduction of green house gas emission through substitution of kerosene used for lighting. MHP geared towards electric cooking can conserve forest as well as reduce green house gas emission. As already mentioned earlier MHP has positive gender impact. The involvement of women in MHP promotion is still at the low profile. In this connection the participation of woman community organizations in MHP promotion is appreciable initiative. Efforts in this direction will be at the interest for the MHP promotion.

Pandey (2009),has defined, In Nepal, the installation of MHP has been supported by bilateral donors and banks who have not been effective in providing reliable and affordable energy to poor rural areas .In addition, due to poor planning and execution, most of the existing MHP plants were not functioning in many rural parts of the country. Also, there is a lack of data regarding rural energy supply and consumption patterns since energy planners overlook rural enterprises as less-productive members of the economy. Moreover, rural electrification follows a top down approach in Nepal. However, primarily rural energy sector has to be improved in order to improve the economic status of the country. Because more than 80% of the Nepalese people still live in rural parts of the country. Therefore, more attention should be given towards the rural household who are deprived of electricity especially, in mountainous region like “Sikles”. The objective of the current paper was to investigate the impact of decentralized small-scale renewable energy technologies in a rural community, Nepal. A case study was carried in order to assess the socio-economic conditions of a village impacted by the MHP plant using qualitative as well as quantitative.

Karki, (2004) has mentioned Nepal’s rural electrification through the national grid is dwindling. This is because the extension of the national grid to rural areas is unrealistic both technically and economically due to the rugged mountainous terrain, and the sparse

nature of human settlement. Also, rural electrifications often awarded as a political favor in Nepal, which ultimately put major portions of poor rural population in darkness if the areas are not within the interest of political leaders. Nepal is one of the poorest countries in the world with a per capita income of $447/year, where about 25% of the population lives below the poverty line (NPC, 2010). Nepal's energy sector is small, inefficient, unreliable, poorly managed, and hugely dominated by traditional energy sources including firewood, agricultural residues, and animal dung. During the 2009/2010 87% of the country's energy demand had been met through traditional sources whereas commercial (petroleum, coal, and electricity) and renewable energy sources contributed 12.2 and 0.7%, respectively. The heavy reliance on traditional biomass for energy results in a poor quality of life, makes local resources scarce, reduces agricultural productivity since nutrient rich agricultural residues are transferred from the farm to the fireplace, and damages the fragile hill ecosystem.

Koirala, (2007) has defined, despite having limited access, the numbers of electricity consumers are growing annually in Nepal. During the year 2008/2009, the total number of customers reached 1,677,000 (represents a growth of 10%) and in the year 2009/2010 it was estimated to be 1,879,000 (12% growth) (MOF, 2010). With the given economic condition of the country, the task of providing electricity to all through capital intensive large hydropower projects seems daunting to meet the existing power demand. Therefore, to meet the challenge of ever-increasing energy demand, small-scale renewable energy technologies have been adopted throughout the country. Rural areas are electrified using decentralized renewable energy technologies such as photo voltaic, wind, geothermal, and MHP, and are competitive with electricity delivered via the national grid. MHP has turned into one of the most promising indigenous technologies to satisfy rural electrification because of their simple design, simple manufacturing processes, low price per kilo watt, easy maintenance, and no dam has to be built. Additionally, many researchers have reported that HP not only provides lighting for rural communities but also helps to accelerate rural economic development if the power is integrated with agricultural production and other income generating businesses; plus less fuel wood is consumed. Overall, MHP can fulfill the technological, environmental, economic and social sustainability criteria in remote and isolated areas in developing countries like Nepal.

Energy Trend in Nepal:

Modern RE options that are considered technically proven and socially viable in Nepal include micro-hydro, solar photovoltaic systems, Improved Ghatta, biogas plants, solar thermal units and improved cook stoves. The government, along with bilateral agencies, non-governmental and private organizations is engaged in the promotion of RE through national and regional programs.

Solar Home System:

The system of transforming the energy come from sun in to electric, heat and light energy by the help of collector is viable and feasible in the context of Nepal. At present, there are about 30 manufacturers of solar system and the total installed capacity in the country is estimated at 10,000 sq meters of solar panels. About 14 companies have been involved in the installation and there are 42,500 solar home systems in 74 districts except Bhaktapur district. The total installed capacity of solar home system in Nepal is 1,584.5 KW peak power. Among them Eastern Development Region carries 11,761 pants with 467.0 KWp, Central Development Region occupies 6,465 plants having 232.1 KWp and Western Development Region has 16,723 plants with 645.9 KWp. Similarly Mid-Western Development Region has 2,670 plants with 69.11 KWp and 3,470 plants having 116.1 KWp have been installed in Far-Western Region (CADEC, 2004: 18).

Analyzing above data, the trend of installing the solar home system is not dissatisfactory. Solar home system was introduced in 9992 but it had slow growth rate up to 1998, when below 5,000 pants had been cumulatively installed in Nepal at the mid of 1999. Incredibly at the end of 2003 there were 42,500 plants in total, which indicates that the growth rate of solar home system has been highly increased since 1999, (CADEC, 2004: 18). However, due to the high initial investment (required 31,500 – 33,000 per unit of 36 W module), the rural people of low-income level have deprived from it. Thus there are least solar home systems in Far Western Development Region while it is least developed region of Nepal. It is impossible to practice in cooperative way due to scattered settlement pattern and lack of cooperative sense in Nepal. Another system, the solar water heater technology has not yet been proud appropriate for Himalayan regions.

Biogas:

Biogas is a by-product of "anaerobic digestions" of organic wastes such as plants and crops residues, wood and bark residues and human and animal manure. It is an important and viable energy resources thus have expanded throughout the globe in the past two decades. Biogas at first was introduced in Nepal after the demonstration of it as modal in 1955, (Hora P. 1991: 45). Latter on 250 biogas plants were installed during the fiscal year of 1975/76.

With the establishment of Biogas support program (BSP) in 1992 with the financial support from the Netherland Development Organization (SNV/Nepal), the pace of biogas development increased rapidly. Currently 49 biogas construction companies have been recognized for the installation of biogas plants. By the mid July of 2003, a total of 111,395 biogas plants have been installed in 65 districts having total installed capacity 776,146.9 cubic meters. Among them, 21,274 plants have been installed in Eastern Develop Region with 149,968.9 m3 installed capacity, 32,826 plants have been installed in Central Development Region with 209786.7 m3 installed capacity and 41,269 plants have been spread in Western Development Region with 283815.1 m3. Likewise 8,855 plants have been penetrated in Mid-Western Development Region with total 66154.0 m3-installed capacity and 7,171 plants having 56422.2 m3 capacities are in Far-Western Develop Region, (CADEC, 2004: 19).

In Nepal 3,318 Biogas plants were installed in 1992/93 and reached the no. 37,354 cumulatively at the end of 1997/98, Then, due to the viability of this plant the installation trend was speeded swiftly and at the end of fiscal year 2001/02 the plants were installed in number of 95,055 in total, (CADEC, 2004: 19). It is reported that about 90 percent of the plants installed in Nepal have a provision of toilet connection and more than 50 percent households have already connected toilet to their plants.

Due to the well proven, design and quality control mechanism, recognition of local manufactures/installer, provision of all seasonal subsides, accessibility of masonry and technical work by local people and employment possibility the biogas program has been successfully increased in arithmetic series in Nepal. But biogas plants have not been installed parallel in numbers compared to their effective demands. It is due to less effectiveness of slurry utilization program, inadequate research and development and

ineffective and inadequate monitoring and evaluation mechanism. Along these constraints, biogas is not viable in all places of Nepal due to geographically and climatologically uneven regions.

Turbine Mills:

The development of hydro electricity turbines was initiated around the middle of 19th century. Its subsequent improvement in efficiency and flexibility of utilization and finally coupling of turbines with electricity generation started enable the waterpower to produce electricity energy. It was famous all over Nepal and is still used widely where there is not accessibly of electricity handled agro-processing mills. It has no environmental impact and, effect on stream ecology is minor. Beneficially hydro electrical turbines system may serve other propose in addition to power such as water supply, flood control, irrigation and recreation.

In Nepal, there are 804 schemes of turbine mills on total and its installed capacity is 7106.9 KW as a whole. Among all, 92 plants with 1013.0 KW installed capacity have been installed in Eastern Development Region, likewise 197 plants have been operated in Central Development Region with 1749.7 KW total installed capacities. Similarly, 301 turbine mills have been installed in Western Development Region with 2573.5 KW installed capacity and Mid Western Development Region has 173 schemes with 1407.25 KW capacities. And Far Western Development Region owes only 36 schemes with 3161.1 KW installed capacity. Likely, 5 plants with 47 KW installed capacity are not region wise know, (CADEC, 2004 30).

Far Western Development Region is in poor status in turbine owing like other technology. Western Development Region is rich in turbine installation which region owes the developed status in Nepal. Though the turbine mills were notably operated in back years, most of them are not sustained ably because they are not used in multipurpose connection.

Improved Ghatta:

Ghatta, a spinning device to crossing the cereals and grains using kinetic power of water started to operate from time immemorial. The devices used two hard stone slates knotting with a long modern churning stick are still seen operating at the bank of river mostly.

These were operated traditionally and handled by local technology, later on; the technological investigation towards the local indigenous and traditional technology has progressively modernized the devices. In this process these traditional *Ghatta*were changed the figure to improved *Ghatta*joining or fixing iron churning stick stone/iron devices are fixed with it according to the geographical location of plant installed area and speed and volume of water.

Presently in Nepal, total 872 schemes of improved Ghattas have been installed in total. Out of these schemes, 147 plants have been installed in Eastern Development Region. Similarly, 392 plants have been operated in Central Development Region which comparatively almost 3 times more than the plants of Eastern Development Region. Likewise 80,147 and 103 plants have been installed in Western, Mid-Western and Far-Western Development Region respectively where 3 plants have not regionally known, (CADEC, 2004: 21). These improved Ghattas have been used only for grinding purpose so its usefulness is comparatively less than MHP. Besides these, different books, reports, previous studies, articles, plans, policies, journals, other published and unpublished documents related to this research work will be studied.

2.4 Current Status of Electricity in Nepal:

By the end of FY2007/08, various hydropower projects generated 650 MW of electricity in Nepal. Of the total hydropower so generated, 645 MW is connected to the national grid, while rest of the energy generated from small hydropower stations and not connected to the national grid have been providing electricity services at local levels. The total electricity generated has reached 703 MW including 53.41 MW from thermal power stations and 100 KW from solar plants.

By first eight months period of FY 2008/09, (79 MW) Middle Marsyangdi Hydropower Project built under the German Government assistance has been commissioned, started commercial production, and connected to national grid. Construction of other two projects, i.e., (30 MW) Chameliya Hydropower Project in Darchula of Far-West Region, and (14 MW), Kulekhani III in Makwanpur are underway. Domestic investment has been garnered to carry out construction of Upper Tamakoshi Hydropower Project, the project is transformed into a company, and construction of access road and other works have started. Htunla and Mugu, where solar energy has been only source of electricity,

construction of (500 KW) - Heldung under construction has been completed, while construction of (400 KW) Gamgad is underway for dependable electricity services in those two districts.

Private sector enthusiasm in electricity generation has been satisfactory in FY2008/09 like in previous years. Hydropower projects under construction in the private sector are being completed and brought in operation one after another. In the process, construction of two projects namely (0.996 MW) PatiKhola, and (0.979 MW) Seti II have been completed this year and generating electricity. Hydropower projects under construction and expected to be completed by the end of this fiscal year are: 2.4 MW RidiKhola; 0.991 MW Upper HandiKhola; 0.99 MW Lower PiluwaKhola; and 2.4 MW Mai Khola. Likewise, Power Purchase Agreements (PPAs) have been completed for 0.980 MW Charanawati, 0.580 MW Gohna Gad, 1.850 MW BhairabKunda, 9.658 MW SipringKhola, 9.900 MW Lower Modi I, 0.990 MW Jiri Khola, 0.990 1\I1V ChakeyKhola, 5.0 MW DapchaRoslli, and 0.985 MW Upper Puwa I (Economic Survey, 2009).

In the process of electrification, 2044.66 Km circuits Km. of 132 KV high voltage transmission lines, 357.96 circuits Km. of 66 KV lines, 9.7 Km. circuits Km. of 66 kV underground lines, and 2550.5 Km. of 33 kV lines are in operation by the end of FY2007/08. In the process of construction of 132 kV 'Rhlgmen' transmission line for capacity enhancement in Kathmandu valley to cope with ever-growing urbanization, construction of 132 kV Thankot-Chapagaun-Bhaktapur transmission line under the ADB assistance is near its completion. Construction of a (75 Km) 220 KV transmission line is underway under the WB assistance for transmission of electrical energy from the existing Khunti hydropower station and future projects in the periphery. Construction of various 33 kV transmission lines are underway including 90 Km Iiam-Phidim-Taplejung, 50 Kin SitalpatiMusikot, 33 Km Buipa-Okhaldhunga, 70 Km. Chinchu-Rakam-Jajarkot, 45 Km Ghorahi-Holeri, 90 Kin Udipur-Besisah.ar-Manang -Marana-Jumla, and 40 Km Dhar-kuta-Hile-Leguwa-Bhojpur. Studies and preparatory works are underway for construction of 400 kV (75 Km) transmission lines between Duhabi-Jogbatu, Butwal-Sunauli, and Dhalkebar-Bhittanlod based on principally agreed power exchange capacity enhancement agreement concluded between Nepal and India. The construction work will be carried out in pursuance of planned construction of transmission lines at three separate points

between Nepal and India. Out of these three, works are underway for construction of Dhalkebar - Birttamod transmission to start in FY2009; 10 and complete by FY2010/11 (Economic Survey, 2009).

The Government of Nepal and Nepal Electricity Authority (NEA) are carrying out electricity distribution works in all electricity accessible districts from their own sources. Both Phase I and II of Electrification in Kailali and Kanchanpur has been completed under the assistance of the Government of Denmark. In addition, electrification is completed in additional locations of 27 districts under the assistance of Asian Development Bank (ADB). Electrification started in additional locations of Bhaktapur, Lalitpur, Nuwakot, Dhading, and Kavrepalanchok districts through the World Bank assistance is continued with the target of completion in FY 2009/10.

Rural electrification work is in progress in participation of 149 community based institutions with a target of providing access of electricity to 135,000 household. This is an activity carried out under the community-based rural electrification expansion program (Economic Survey, 2009).

A number of activities are underway for hydropower feasibility studies and preparing detailed study reports. Studies for identification of other feasible projects towards meeting the energy demand are also continued. Efforts are underway for garnering resources for detailed study of storage type-127 MW Upper Seti Hydropower project, as immediate execution of such a project is felt necessary to remove the present demand and supply imbalance in national electricity supply system caused by seasonal variation. Bids are invited for construction of Upper Trishuli (A), while feasibility study is continued on Upper Trishuli (B) hydropower project. An updating study is being carried out on Rahughat Hydropower Project proposed for construction through Indian assistance. Detailed studies initiated on some other attractive storage-type projects like Nalsiaugad, Madiishaneshwor, and Seti-Trishuli.

A total of 3,180.66 Gaga Watt Hours (GWH) of electricity was supplied in FY2007/08 comprising 1,798.61 GWH from hydro-electricity, 9.17 GWH from thermal, 960.47 GWH purchased from the private sector, and 412.41 GWH imported from India. Of the total electricity thus supplied in the same year, 2287.41 GWH was consumed domestically while 61.5 GV-TH was exported to India. According to estimates for

FY2008/09, available electricity will total 3,537.41 GWH comprising 2,828.934 GWH from hydropower plants, 14.5 GWH from thermal plants, and 684.0 GWH import from India. Of the total availability, 2,666.6988 will be consumed domestically and 54.0 GWH export to India (Economic Survey, 2012).

In FY 2007/08, consumption of electricity on sector basis industries consumed 39.2 percent, household 40.4 percent, commerce 6.6 percent, no commerce 4.6 percent and miscellaneous 9.2 percent. Such ratios in FY 2008/09 estimated. for industry, household, commerce, non-concurrence, and miscellaneous sectors are 38.1 percent, 41.7 percent, 6.8 percent, and 13.4 percent respectively.

The numbers of electricity consumers are growing annually. By the end of FY2007/08, the number of customers grew by 9.1 percent totaling 1 million, 524 thousand 610. In FY2008/09 total number of electricity customers is estimated to reach to 1 million 677 thousand by recording 10 percent growth (Economic Survey, 2012).

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Design:

This study has been carried out on the basis of description and analytical in nature. The main focus isgiven on the social and economic impact of micro hydro project of Syarpudaha inRukum district. The purpose of this research isto find out the social and economic impact of SMHP areas mainly Jhula VDC ward no 3 Rukum district.

3.2 Nature and sources of Data:

The quantitative data has been obtained from questionnaire whichareanalyzed using statistical tools. The collected qualitative information ispresented in a descriptive way. The information obtained ispresented in appropriate tables and figures.They have been categorized and tabulated according to the objective of the research.

The study has been conducted on the basis of both primary as well as secondary data. The source of primary data was obtained from field work through observation, questionnaire and interview of some key informants applying some additional questions where needed. Similarly information wasobtained through secondary sources. The sources of secondary data are collected from Department of Energy,SMHP office Rukum, Library, District development committee and VDC of Jhula and Banphikot, Rukum.

3.3 The Study Area:

The construction ofSyarpudaha mini hydropower project was started in 2041 and accomplished in 2045 B.S. The capacity of this hydropower is 240 KW but it is producing 200 KW only. The project is currently covering 9 VDCs which was constructed by JICA. The total cost of the project was Rs.3,63,36,000. The hydropower project had been conducted by Nepal Electricity Authority in its initial phase than it was conducted by Company from 2055 BS to 2062 BS but from 2062 BS it has been conducting by User Committee named "RukmeliUrjaBikasUpabhokttaSamiti". Before the conduction of user group, electricity was distributed in 5 VDCs. At that time electricity supply was sufficient but when the user committee started to conduct the hydropower,

electricity is then distributed in more VDCs even if the electricity production is same. There is a lot of water resources if it is managed. The people of there are facing load seeding problem too much. They cannotuse electricity when they need most.

The objective of the study is to study socio-economic status of Syarpudaha Mini Hydropower Project.This sort of research have not been conducted yet in hydropower sector in Rukum district. Likewise research of socio-economic impact of Syarpudaha Mini Hydropower Project was not conducted from the date of establishment. So, this research is significant for the hydropower project.

The study area was Jhula VDC ward no 3 of Rukum District. Electricity was supplied there two year ago. The aim of this study is to find out socio-economic changes that took place in two years period. The people used dunk, fire wood, kerosene, candle etc before but now they are using electricity. While people were using traditional energy they were facing different types of problem like health, education, income, employment etc. Now the study has found changes in their livelihood by electricity consumption.

3.4 Universe Sampling procedure and sample size:

The universe of the study was the mini hydropower user households of Jhula VDC of Rukum district. There are total 90 households in ward no 3. Out of hydro power users in this VDC, this study has been done 35 households of ward no 3 through random sampling has been applied to take household survey.

3.5 Data Collection Techniques and Tools:

The study has been dependent both on primary and secondary data. The primary data were collected from the fieldwork conducted during household survey, key informant interview and observation using following techniques.

3.5.1 Household Survey:

A set of questionnaire has been used as a tool to collect primary data in order to achieve the research objectives. Sex, ethnicity, education, family size, marital status, attitude and practices through household's survey. Head of households were interviewed in order to get relevant information of their respective households.

3.5.2 Key Information Interview:

Key informant interview was applied to obtain information from the knowledgeable persons of the community (User committee, secretary of VDC, teachers, government officers, elder persons, institutions etc) who have known the aspect of the JhulaVDC's social and economic condition. They were provided the information in details about their knowledgeable and experience in mini-hydro project. To generate the accurate data from HHs survey of hydropower users, structured questionnaire will be prepared. The respondents were requested to fill up questionnaire.

3.5.3 Observation:

Observation wascarriedout number of times during field visit. Observation was made about present condition of mini hydro and its interrelationship with local people. The cultural, social and linguistics values also were under spotlight of research of further the level use of the local people also include the circle of research. Important information is observed through questionnaire and check list method during fieldwork.

3.5.4 Data Analysis and Interpretation:

Data collection wasused to describe a process of preparing and collecting data. The purpose of data collection is to obtain information to keep on record to make decision about important issues, to pass information onto others. Primarily data was collected to provide information regarding a specific topic. Various techniques like table, graph, charts, statistical tools,computer software etc was employed during the research study.

CHAPTER IV

DATA PRESENTATION AND ANALYSIS

4.1General Background of Rukum District and the Study Area:

This section deals with the overall analysis of the field that the researcher had acquired through the field study. In the process of analysis, research highlights socio-economic impact of micro-hydro project. To justify the statement the researcher has analyzed both qualitative and quantitative data Micro-Hydro is the leading sector for the development of Nepal, It's being a comparative advantage of Nepal has important role in Nepalese economy.

Rukum district is much popular from its natural beauties, the district widely known as the district of "*BaunnaPokhariTripannaTakuri*" lies in northern part of Rapti zone of Mid - Western development regions and extended in the area of 2,877 sq.km. It is located in northern west approximately 550 KM far from Kathmandu the capital city of Nepal .This hilly district is important for its historical, cultural and geographical prospective. It has the great potentiality for hydropower development. Rukum is extended from 754 meter to 6000 meter altitude from the sea level. It is administratively divided into 43 VDCs, 11Ilakas (sub areas) and 2 electoral areas. It is extended between 28° 29' to 29° 0' northern latitude and 82° 12' to 82° 53' eastern longitude. The district headquarters MusikotKhalanga lies at the altitude of 1448 from the sea level, the average rainfall is recorded 1600 m.m. to 2400 m.m. The minimum temperature is 0.4° c to maximum temperature is 34°c. It has subtropical monsoon type of climate. This district is surrounded by Baglung and Myagdi in the east, Jagarkot in the west, Dolpa in the North and Salyan as well as Rolpa in the south. Rukum is rich its natural beauty, rare wild animals, valuable herbs, dense forest, tiny hills and valleys.Sanibheri and Thulibheri are originated from this district. Rivers, ponds, lakes, waterfalls, moderate types of temperature, magar culture, tamples, different, human civilization, yarshagumba, the medical herbs are the main identities of this district. Dhorpatan hunting reserve which is legally opened for hunting lies in this district. The five powerful and prosperous states like Musikot, Rukumkot, Gotamkot, Banphikot and Jaharikot of the medieval age are prevalent there. (DDC profile)

Syarpudaha Micro-Hydro project is situated in BanphikotVDC of Rukum district. Banphikot VDC is culturally and historically famous in Rukum. It is also very important for tourist area. There are a lot of scene and historical place which can attract the tourist. Banphikothas a potentiality of hydro project because of its geographical status. Brahaman, Chhetri, Thakuri, Damai, Kami live in the study area. The project hadstarted to build in fiscal year 2041/042 and completed in 2045Chaitra.

4.2 Socio – Economic Impact:

4.2.1 Population Distribution of the Study Area by Caste Group and Sex:

The total of 242 population and 35 households are recorded in the study area at ward No.3 JhulaVDCRukum District. Out of the total population the share of male and female are 53:4 percent and 46.5 percent respectively five caste groups such as Braman, Thakuri, Chhetri, Kami, Damai, are found in the study area. Out of the total caste group Chettri households are in the highest while other caste groups have the least number of households. Out of the total households number of Thakuries, Chettri, Bramin, Kami and Dami are 46, 95,55,26, 20 respectively in the study area similarly out of the total population those caste group consist 11.20 percent 40.94 percent 23.70 percent 11.20 percent, 4.31 percent correspondingly total number of households population and sex ratio of the overall study area have been presented in the following table.

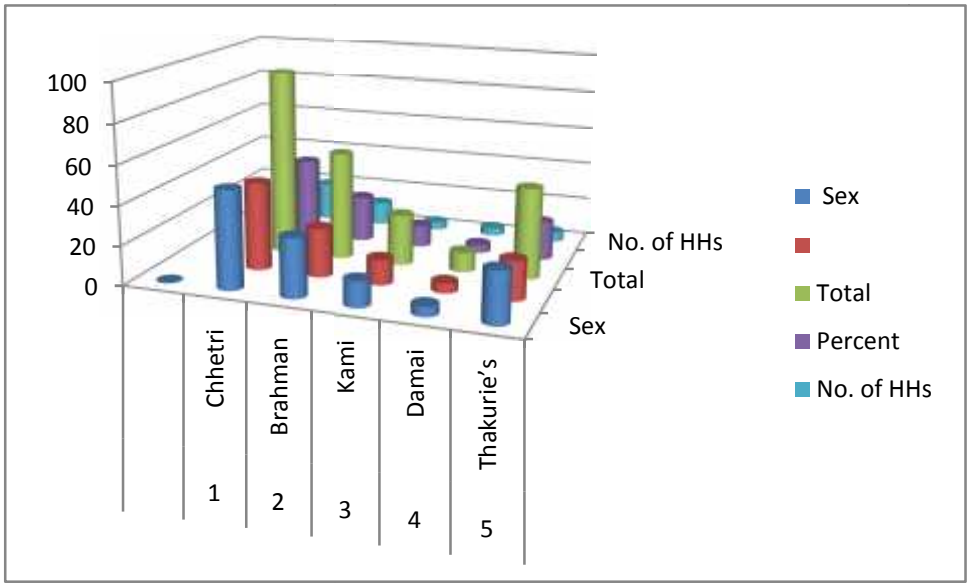
Table 4.2.1

Demographic Study of Project Area

S.N.	Caste Group	Sex		Total	Percent	No. of HHs
		Male	Female			
1.	Chhetri	53	49	102	40.94	16
2.	Brahman	30	25	55	23.70	9
3.	Kami	13	13	26	11.20	3
4.	Damai	5	5	10	4.31	3
5.	Thakurie’s	26	23	49	19.82	4
Total		127	115	242	100.00	35

Source: Field Survey 2015.

Demographic Study of Project Area



Source: Table 4.2.1

4.2.2 Population Distribution of PAFs by Caste Group and Sex.

Those households whose lands have been occupied by the project are categorized under project affected families (PAFs). Out of the total 35 households of the study area, direct impact of the implementation of this project is on 35 families where the total PAFs population is 242, the male consists 53.44 percent and female occupies 46.55 percent. Brahman, Chhetri, Kami and Thakuri are the dominant four caste group of PAFs. Chhetri were found in majority among PAFs, Household and Population of PAFs. Chhetri are 16, Brahman 9, Thakuri 3, Kami 3and Damai 4 respectively.

4.2.3 Literary Status of the Study Area:

Literacy is one of the most significant indicators to measure people's living standard. Out of total population 45.40 percent people are literate in the study area. Literate male and female are 60 percent and 40 percent respectively. By caste group literacy rate is different. Literacy rate of Chhetri, Braman, Kami, Damai and Thakuri is 55.30 percent, 89.60 percent. 20.25 percent. 16.15 percent 8.60 percent respectively. It is found that the literacy rate of male is higher than female in every caste group.

Table 4.2.3

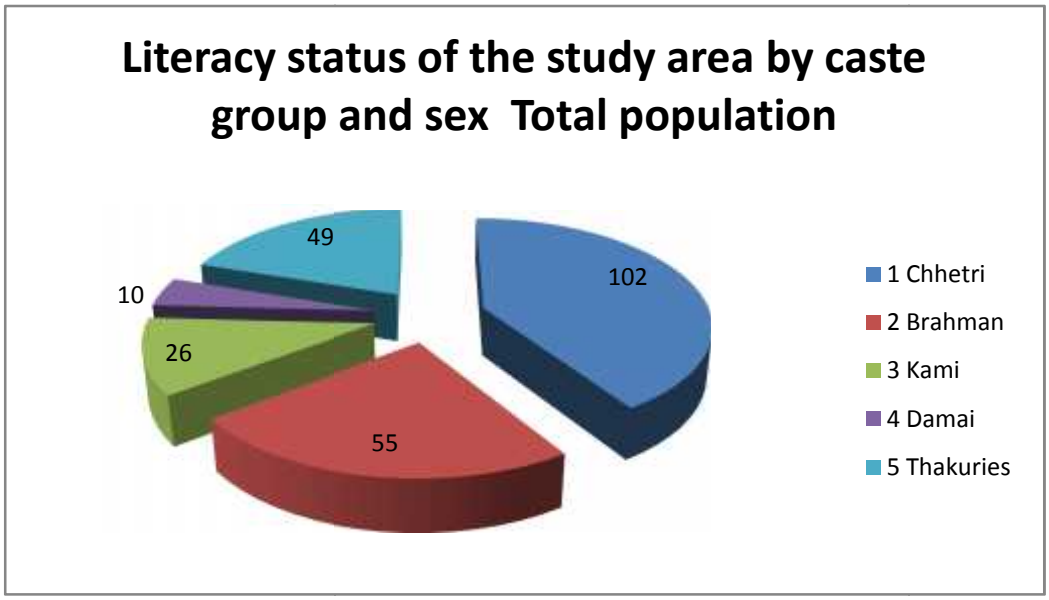
Literacy status of the study area by caste group and sex

S.N.	Caste Group	Total population	No. of Literate people		
			Male	Female	Total
1.	Chhetri	102	53	49	102
2.	Brahman	55	30	25	55
3.	Kami	26	13	13	26
4.	Damai	10	5	5	10
5.	Thakuries	46	26	23	49
Total		242	127	115	242

. Source: Field Survey, 2015

Figure 4.2.3

Literarystatus of the study area by caste group



Source:4.2.3

4.2.4 Educational Status of the PAFs:

The literacy rate of the PAFs is 45.40 percent in aggregate, out of others the literacy rate of male and female is 60 percent and 40 percent respectively in aggregate. The literacy rate of male is higher than female in the whole PAFs and every caste group also. There is only one primary school in the study area. The nearest lower secondary and high

schoolsare situated in Jhula VDC and campuses are at Banphikot and district headquarters about two hour far from the study area. The total number of 95 (Chhettry) 55 (Brahmin); 26(Kami) 26 (Damai) 20 (Thakuri) 46 people from PAFs have found the primary school, Lower secondary and high school level respectively. Out of them the share of male and female in primary and lower secondary level is equal. How every the share of male is higher than female in the case of secondary as well as higher level.

Number of male is found higher than female in primary as well as lower secondary level in Chhetri and Brahman communities of PAFs out of the whole PAFs. Only one male and one female are involved in teaching profession.

The students used not study in night time properly before the project starting. At that time students fail ratio is much but now they study more times at night and they pass. So student pass ratio is decreased.

4.3 Health and Sanitation:

4.3.1 Drinking Water:

The people of the PAFs as well as whole study area drink taps (piped) as well as stream water. But the pipeline water and improved stone taps are increasing day by day. Before the project started PAFs used to drink water of pipe, tap and well sources respectively. But now quality of pipe water has improved in comparison of past.At the completion of the project, 18.4 and 11 PAFs are using drinking water of pipe. Tap and well sources respectively. The pipe water users are increasing.

4.3.2 Use of Toilet:

Sanitation is one of the indicators of living standard of the people. Before the project start there were only 5 Kachchi toilets in all PAFs. But after starting project, they improved their behavior and gradually started to build toilet. But due to their poor economic condition, they haven't built modern toilets yet. They have made Kachchi and improved (with pan sit) toilets in all HHs now. They use light in their toilets so that they are safe from snakes and insects at night time. By the help of electricity people pull water from SaniBheri River and use in toilets properly so that they always clean their toilets.

People pull water from SaniBheri River by the help of electricity and which water use in farm (vegetables and other so on), toilets, washing pots etc.

4.3.3 General Treatment:

Before the project start, people of the PAFs used to follow domestic as well as traditional approaches like, witch-doctor (*DhamiJaharki*) for general treatment. However, they follow witch doctor for no longer. They use domestic approach and some people go to health post. Frequently repeated diseases are diarrhea, cold-cough, dysentery etc. Health post was only one the health institution for medical treatment of all PAFs before the project start. Nowadays, health centre and private clinics are availability. Before the project started people used to lamp for light. Due to the smokes of lamp they were facing eye, lung and heart problems. At that time health problems are more but now days these types of problems have decreased. We have found impacts ofhydro project there.

4.3.4 Occupational Status of the Study Area:

Before started the project about all people were involved in farming. At that time people were cultivated traditional farm and they were faced food problem but now they have changed their farming style. They cultivate a little professional farm so they grow vegetables and buy in market and earn money. Such as they have been solvedtheir food problems now.Although most of the respondents are involved in agriculture and student now days. Some respondents have been involving in business, job service and others in the study area. The occupation status is presented in table below:

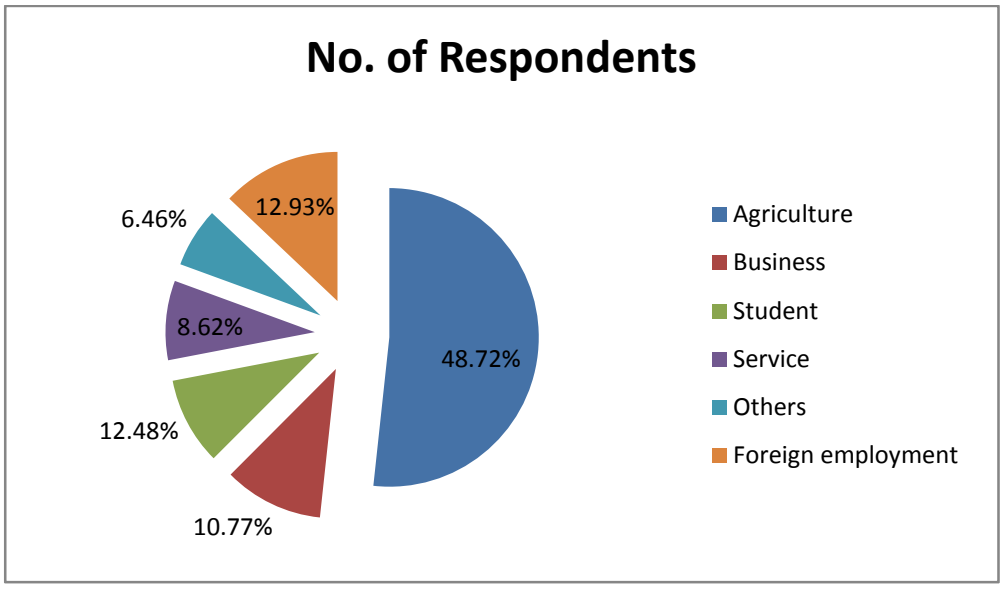
Table 4.2.4Main as well as Secondary Occupation of the Study Area of PAFs:

Occupation	No. of Respondents	Percentage
Agriculture	120	48.72
Business	25	10.77
Student	32	12.48
Service	20	8.62
Others	15	6.46
Foreign employment	30	12.93
Total	242	100

Source: Field Survey, 2015.

The table above shows that most of the local respondents are farmers and business man both is found 48.72 and 10.77 respectively. Students, service, foreign employment and in others are 12.48, 8.62 .12.93 and 6.46 % respectively. The least number of respondents are in service and others. It can also be shown in pie chart too.

The above table can be shown in the pie chart



Source Table 4.2.7

4.3.5 Irrigation :

Rivulet canal is the main source of irrigation. Large area of cultivatable land is available in the study area but there is shortage of irrigation. There is possibility of Canal of TilchaKhola and SimtaruKhola for irrigation in the study area. SimtaruKhola is using for irrigation in Chhinkhet and BherakhetJiulanow.

4.3.6 Agricultural Production:

Agricultural products are major sources of food for PAFs. Irrigation is one of the major problems for farming system in the study area, PAFs grow food crops such as Paddy, Maize, millet, etc. cash crops like vegetable production also starting now. Total PAFs used to produce 981 muripaddy 354 muri maize and 154 muri paddy millet before the project started. However, they produce 673, muri paddy, 343 muri, mazi 15 muri wheat and 154 muri millet after the completion of the project. Before the project, average production of paddy, maize millet was 1.20 1.13 and 0.5 muri per Ropani however it is

1.27, 1.21 and 0.5 muri per Ropnai after the completion of the project. The productivity of cereal crops has decreased due to the decrease in the cultivated land at the completion of the project.

Table4.3.6

Agricultural production of PAFs (BP and AP)

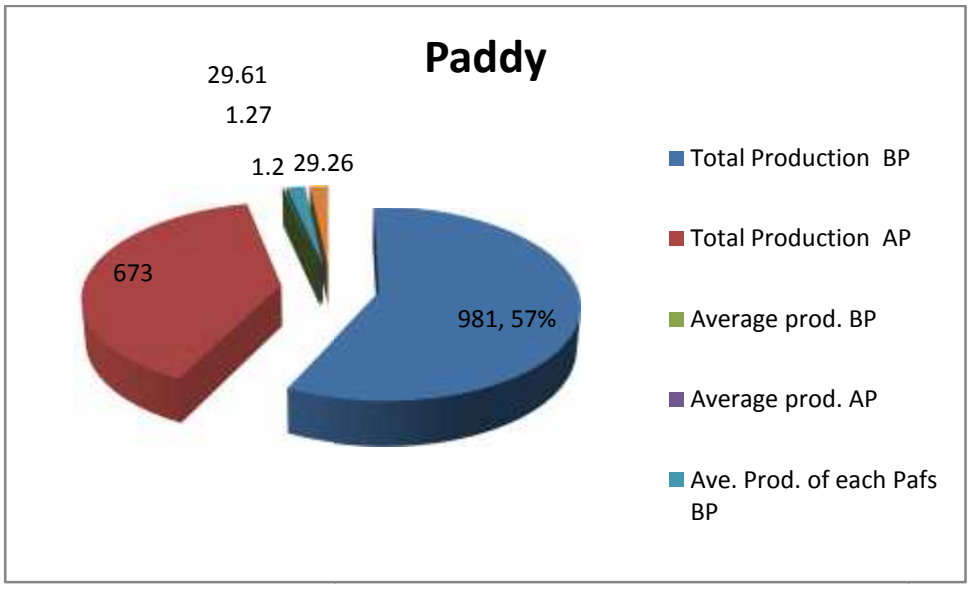
Cereal Crops	Total Production		Average production		Ave. Prod. of each Pafs	
	BP	AP	BP	AP	BP	AP
Paddy	981	673	1.20	1.27	29.61	29.26
Maize	354	343	1.13	1.21	15.39	14.91
Wheat	-	15	-	-	-	0.65
Millet	154	154	0.5	0.5	6.69	6.69

Source: Field Survey, 2014.

BP = Before project started

AP = After project started

The above table show in pie chart below



Source: Table 4.3.6

4.3.7 Additional Sources to fulfill food inefficiency:

Wage - labor porter sale of cattle, business and services are sources to fulfill food deficit of some poor families. Wage labor, porter and sale of cattle were major sources to fulfill

food deficit before the project started however sale of cattle and foreign employment became major sources after the completion of the project. It indicates that major sources to fulfill food deficit of PAFs are changing.

4.3.8Source of Income:

Agriculture, livestock husbandry, wage labor, business services and foreign employment were/are major sources of income of PAFs people and the study area before as well as after the completion of the project. Agriculture and livestock husbandry were the key sources of income of PAFs and the study area before the project started. Agriculture and livestock husbandry, service, foreign employment, business are main sources of income of PAFs and the study area now. It seems that order of income sources are changing.

4.3.9 Expenditure Pattern:

PAFs and people of study area spend their income on food, clothing social activities, festivals, education and health. Few households spend for food. Before the project started, PAFs used to spend the largest amount on food and clothing. Then they spent on social activities on festivals.However expenditure on education and health has increased now. 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.

4.3.10. Entrepreneurship Development:

Before the project started most of the respondents were involved in agricultureand rest of the main power used to go India and foreign for the employment. At that time there was not any energy to operate entrepreneur and they had no ideas about entrepreneurship and occupation also. While project was started by the help of electricity, people were started to do business, hotels and so on. When there got electricity energy they were started other entrepreneur like wooden factory, rice and oil mill, hand paper industry etc. So that such types of small industries and mills are operating now.

4.3.11. Development of the Employment:

Before the project started most of the respondents were involved in agriculture and rest of the main power used to go India and foreign countries for the employment. At that

time,there was more disguised employment. But after the project started some entrepreneur were operated there. The respondents have involved in these industries so the project has created a little employment there now. After the project started some respondents are involved in individual occupation, they have created self employment now. So it has found changes in employments there.

4.3.12. Sustainable Functioning:

The Syarpudaha mini hydropower project is established in 2045 B.S. The capacity of this project is 240 KW but it is producing 200KW now. The project has been covered in 9 VDCs which is made by JICA. The hydropower project had been conducted from Nepal Electricity Authority in initial phase than it had been conducted by Company from 2055 BS to 2062 BS but from 2062 BS it has been conducting by User Committee named "RukmeliUrjaBikasUpabhokttaSamiti". Before the conduction of user group, electricity is distributed in 5 VDCs. At that time electricity supply was sufficient but when the user committee started to conduct the hydropower, electricity was distributed in more VDCs although the electricity production is same. There is a lot of water resources if it managed. The people of there are facing load seeding problem too much. They are not using light in right time.

So it has found that, the hydropower has not conducted efficiently because there have many technically and economically problems. So it is not working sustainable functioning now. If the User Committee can manage the problem, the hydropower will conduct smoothly. If the user committee couldn't manage the problems, NEA should terminate agreement with user committee and should operate itself. There is a lot of water resource if hydropower project wants to increase its capacity. If thehydropower project can manage such kinds of problems, it will conduct sustainable functioning.

4.4. Electricity:

4.4.1 Electrocution in the Study area and PAFs:

The facility of electricity was not available in the study area before initiation of the project.

Out of total households of the study area not any one households were electrified at the beginning of the project construction. Up to the study period total households are benefited from electricity. And also all PAFs are benefited from electricity now.

Almost all the household the bill of electricity i.e. are most rate of government. Mostly people use electricity for lighting and playing radio, T.V. etc. In Conclusion the consumption of electricity of the PAFs and whole study area is low. There is a need to increase the consumption of electricity that helps to uplift the living standard of the people of the study area.

At the completion of the project, it helped to electrify the project area and its surrounding areas. However, there is still increasing the demand of electricity in the study area.

4.4.2 Energy Sources and User Household:

People of the study area use fuel wood for cooking and kerosene and electricity for light. Electricity is used to play radio, T.V., computer and so on. Kerosene has been radically replaced by electricity in the study area. Those households, which have no access to electricity is still use kerosene for light.

4.4.3 Fuel wood consumption by PAFs:

People of the study area and PAFs used public forest and their own forest before the project started. They however are using ministry forest and their own forest for various purposes after the completion of the project.

Before the project started total PAFs used to consume approximately 645 quintal fuel wood over a year, price of fuel wood was Rs. 110 per quintal before the project started. Total PAFs used to consume fuel wood equivalent to Rs. 70,950 and average consumption of PAFs was equivalent to Rs. 3,080. After the completion of the project those PAFs consume 580 quintal (equivalent to Rs 92,800) and average consumption is equivalent to Rs. 4,035 (25.22 qw.) over a year. Real consumption of fuel wood of PAFs has decreased but monetary volume increased due to price rise (from Rs 110 to Rs. 160 per bundle).

The price of wood is raise because the community has got money by working in the project and the value of money is going high actually they know the value of money

and the society change in economic field or the forest is saving by different community so that people got wood easily from the forest.

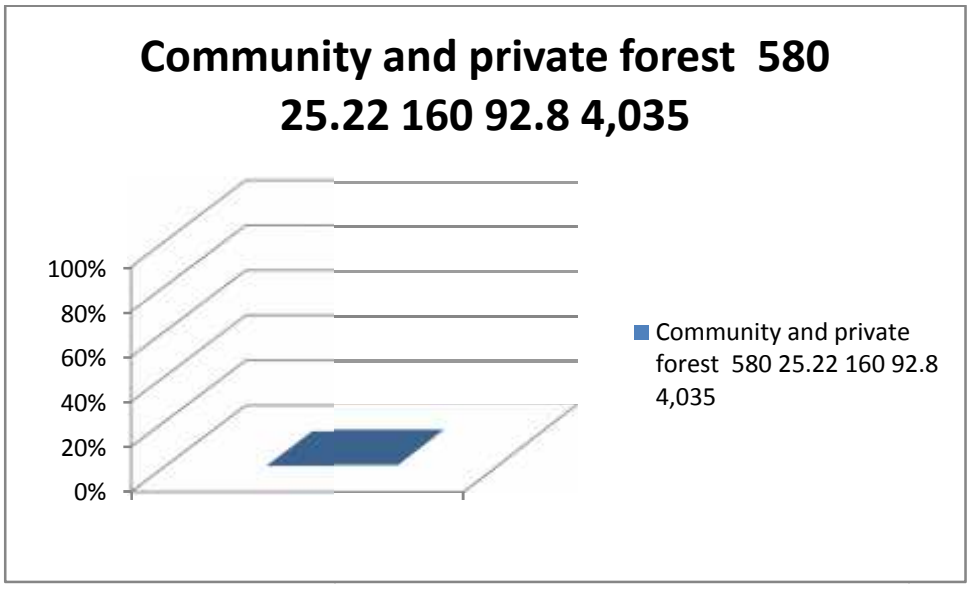
Table 4.4.3

Kind of used forest and consumed fuel wood by PAFs

Kinds f Forest	Quantity of consumed fuel wood by PAFs		Monetary Value of Fuel Wood			
	Total in kg	Average in Quintal	Price per quintal	Total price	Average Price	
Public and Private forest	645	28.04	116	70,950	3080	BP
Community and private forest	580	25.22	160	92.800	4,035	AP

Source: Field Survey, 2014.

The above table show in pie chart below



Source Table 4.4.3

4.4.4 Use of firewood before project and After the project:

In the remote parts of Nepal people mostly use firewood for cooking purpose.

Excessive use of firewood causes the destruction of forest resources as a result many environmental problem can be created in aggregate 1kg of firewood gives 16.75MJ energy and 1kwh gives 3.6mj energy .

1kg firewood =16.75MJ

1kwh = 3.6MJ

BeforeSyarpudahahydro project single house hold uses 25 kg firewood which is 418.75MJ(25×16.75) per d ay . per month a single house hold uses 418.75×30= 12562.5 MJ In this research searcher haveselected 45 house hold then they uses 12562.5×45=565312.5MJ per month likewise per annum the total consumption of firewood in the research are is 565312.5×12=6783750 MJ which is 1884350 kwh (1kwh =3.6MJ)

After the implementation of Syarpudaha hydro project the uses of fire wood is somewhat reduced but now a single house hold uses 18 kg of firewood which is 301.5MJ(18×16.75) per day/per month single house hold uses 9045MJ(3o1,5×30) likewise per year 108540MJ(9045×12). Now 45 house hold uses 4884300MJ which is1356750kwh.

From this we can clearly say that the uses of firewood is reduced by (6783750MJ - 4884300MJ) which is equal to 1899450MJ . It means 1899450MJ energy is saved after the implementation of Syarpudaha mini hydro project. The less consummation of fire wood havehelped to preserve natural environment of the study area.

4.4.5 Use of electrical/electronic goods:

PAFs use various kinds of electronic goods such as radio Tape, T.V. iron, emergency light etc. For the electricity, cell and acid battery as energy were used before. Only 10 radio/Tape were there in overall PAFs before completion the project whereas total number of radio, T.V. tape recorder emergency light, iron in overall PAFs are 21, 5, 2 and 5 respectively now. But before the completion of the project there were not any mill. But

now there are 2 mills (1 rice and oil mill & 1 wooden mill).For the millselectricity has been key fuel there.

4.5 Women and Children:

4. 5.1 Time spending on fuel collection and agriculture:

Most of the females collect fuel wood instead of male in the study area. Before the project started, they used to spend around 40 day on fuel wood collection for a year. Around 7 hours on agriculture daily. Syarpudaha micro hydropower helped to increase a number of consumers to enjoy more facilities now, women spend nearly 30 days to collect fuel wood for a year. The save an hour daily on household activities and utilize it in agriculture activities.

Socio-economic Impact of Syarpudaha Mini Hydropower Project

4.6 Introduction:

It has been known that every hydropower project has positive and negative impacts on social, cultural and economic aspects of the concerned area and its surroundings, environmental impacts of small hydropower are limited. Syaruudahamini hydropower project has influenced various aspects of physical and social, Economic and Environmental aspects of human being in the project site JhulaVDC ward no3 and its surroundings. It has indirect and positive as well as negative impacts. It has following socio-economic impacts.

4.6.1 Impact on infrastructural development:

Project has positive impact on the development of infrastructures. Telephone and mobile service available at Jhula 3 and surrounding area is the outcome of the project. There is also road facility in project area.Electricity has been available in the project area due to the project. Local market was set up at the project site.

4.6.2 Impact on Heath and Sanitation:

People are conscious of their health and sanitation. They started to visit clinics and hospitals instead consulting with witch doctor (Dhami, Jotish, Jhankri). Mothers have learnt how to take their child. Most of the people made improved (with pan sit)toilet.

Quality of drinking water has improved but all households have not access of clean drinking water. During the construction period local people were benefited from the medicines and health service from the project site. However, it has been stopped after operation.

Sanitation is one of the indicators of living standard of the people. Before the project start there were only 5 *Kachchi*toilets in all PAFs. But after started project, they improved their behavior and gradually started to build toilet. But due to their poor economic condition, they haven't built modern toilets yet. They have made Kachchi and improved (with pan sit) toilets in all HHs now. They use light in their toilets so that they are safe from snakes and insects at night time. By the help of electricity people pull water from SaniBheri River and use in toilets properly so that they always clean their toilets.

4.6.3 Impact on Education:

People are aware of the importance of education for women because of the use of T.V and other educational institution. Now girl go to school in a large number, but as far as higher education is concerned. Some people have started to send their children to boarding school. Some women have taken skill oriented training.

The students used not study in night time properly before the project started. At that time students fail ratio is much but now they study more times at night and they pass. So student pass ratio is decreased.

4.6.4 Impact of Employment:

The project has created a significance employment opportunity to the local people. Many people were benefited by the project during the construction period. After operation of the project, it has provided 27 people with permanent job and about 14 people with seasonal job. Similarly, more than 500 got employment opportunity during the construction period of the project some local people are getting temporary employment. There was also opportunity for seasonal employment in the project inaccordance with their desire, skill and capacity.

On the other hand, Before the project started most of the respondents were involved in agriculture and rest of the main power used to go India and foreign countries for the employment. But after the project started some small industries were opened there. The

respondents have involved in these industries so the project has created a little employment there now. After the project started some respondents are involved in individual occupation, they have created self employment now. So it has found changes in employments there.

4.6.5 Impact of skill Development:

People of the local area involved and saw the project construction method during the construction period. It helped them to develop technical skill of construction methods. Some youth had explored their skills such as civil works. Welding metal works electric wiring etc. developed during the construction period in other places.

4.6.6 Impact on Population:

The project has influenced the individuals due to the construction activities and land occupying. 209 (51.30 percent male and 45.70 percent female) of total 23 PAFs are directly influenced due to the occupying land by the project. Most of the households of JhulaVDC consumers of community forest of Jhula) have been directly influenced by the project. But the people of site's surroundings are also influenced indirectly. Due to the construction of the project number of households in Jhula increased. No. life style of the people has become well than before.

4.6.7 Impact on Land Holding:

About 70 percent of land is community land which is used by the hydropower and 30 percent land is public land. 50 ropaniland was effected by lockage of water. 15 PAFs obtained compensation in cash for their lost land. Most of the share of the land isKhet (63 percent) then Pakho Bari (27 percent) and Bari (10 percent). The land owned by joint families is lost more than the individually owned land. Some PAFs bought cultivatable land by investing cash compensation. So, only 50 Ropnai of all the PAFs has decreased in aggregate due to the project. Now, Hence the project affected landholding of the PAFs negatively.

4.6.8 Impact on Agricultural Products and Its Market:

The total agricultural projects have not decreased by large amount because some PAFs bought land by spending composition. In aggregate production of paddy and maize of

PAFs has decreased by 18 muri and 35 muri respectively. But millet has neither decreased nor increased because its farming land is in same area. Some family has started wheat farming, off season vegetable farming.

Garaghaat and Chinkhet bazaar are developed as a local market where local production used to exchange. Throughout the projects construction period the producers sold their products form their own house. That's why the project has positive impact on local product and on market.

4.6.9 Impact on Livestock:

Livestock of all PAFs have increased by 11.45 percent. People have known the advantage of livestock husbandry. They earned large amount of money by selling livestockduring construction period of the project. The people were attracted to livestock husbandry due to the rise of price of cattle. In short the project impact is positive in livestock husbandry.

4. 6.10 Impact on Market Price:

Some nature gifted goods like stones, sand, pebble etc. become money-making goods, due to the project. Now wage rate of different kinds of labor has increased by more than 90 percent in comparison before completion the project. Market price of construction materials has increased by 100 percent and market price of food crops and meats have increased by around 50 percent. In conclusion, market price of the commodities have increased due to the installation of the project. It means that market is being expanded.

4.6.11 Impact on Income Sources:

Traditional income sources have improved. Now, people have started vegetable farming and increased livestock husbandry. Business has been expanding day by day. The project has provided employment opportunity to the wage labor time to time. Service and foreign employment as the sources of income have attracted the people. Hence, the income of the people, themselves have consumed most of the agricultural production. So that average agricultural cash income is limited, wage labor porter, service and foreign employment are sources of cash income of the local people.

4.6.12 Impact on Expenditure Pattern:

The average expenditure has increased by 49.23 percent now in comparison to before the completion of the project. People's total spending has increased due to the rise in market price of commodity high consumption growth of child, increase population etc. Now, people spend the largest amount of money on clothing, on education, health, festivals, foods, social activities. Such as expenditure pattern of the people have changed.

4.6.13 Impact on Electrification and Consumption of Energy:

In comparison of before the completion of the project, number of electrified households of the study areas and PAFs has increased by 40 percent 9 (HHs) and 42 percent (5 HHs) respectively. Electricity user households have increased. Braman,Chettri electricity user household have increased but other groups are still far away from this facility.

Total PAFs have 2/2 TV, radio and decks now. Electricity has substituted the cell and acid battery in electrified households. As an industrial use of electricity numbers of rice/flour mill, oil mill and saw mill, operated by electric power in the electrified area of Jhula has increased by 42.65 percent 20 percent and 30 percent respectively. In comparison before the completion of the project, Electricity has substituted the dies for this purpose at the electrified access areas of Rukum.

Some people become experts in wiring and repairing the electric line consumption of Kerosene and battery has decreased heavily by more than 90 percent in the project areas. Public forest has become community forest. Total consumption of fuel wood of PAFs has decreased by 10 percent however, price of fuel wood has increased by 45percent per quintal.

4.6.14 Role of Compensation:

The composition is used to fulfill various needs of PAFs. 17.39 percent PAFs used their compensation to purchase land (Khet) which is better for productive quality than their lost land. Some PAFs have became free form debt-load. Some PAFs invested their compensation on business. Indeed project become very fruitful for those PAFs who obtained large amount of compensation. Inversely, the project became bad for those PAFs who obtained little amount of compensation instead of their lands.

CHAPTER V

CONCLUSION AND RECECOMANTITION

5.1 Conclusion :

The demand for electricity is higher in comparison to the generated capacity. During this decade, hydropower projects are being installed rapidly in our country. 1,749 to 859 GWH power has been generated from 58 larges as well as small scale projects up to the end of FY 2006/07. Out of the total investment, the contribution of the private sector emerges to be significant due to the liberal as well as privatization policies of Nepal Government.

The Syarpudaha mini hydropower project (200 kw) is supplying electric power through its own capacity. Besides its impact can be noticed in the Rukumdistrict particularly.

The study area is dominated by ChhetriThakurie'sand Brahman about various impacts on the life style of local people of the project area and its surrounding.

The socio-cultural norms and values have changed due to the concentration of large flood of people from divers place background. The level of awareness has increased in people. Opportunity, knowledge, skill etc. are available in the area and their economic status has become better than before. People are attracted towards service foreign employment and business instead of traditional occupations such as agriculture livestock husbandry etc.

Nobody has been forced to migrate due to the project. Some PAFs purchased better cultivatable land by using compensation. Some PAFs used compensation to pay debt invest on business and so on. Women of the study area are still backward. But their status is improving smoothly with time. Now they are aware of sanitation health, nutrition, child care and family planning. Their role in economic decision and overall decision about family is increasing day by day.

The supply of the electricity is very low in the study area. There is a need to increase the supply of the electricity. Out of the total population, 20 percent people are still living in darkness. In conclusion the installation of mini hydropower projects like SMHP is rather than significant from various angles in the present context of Nepal.

As for the impacts of Syarpudaha mini hydro project environment are concerned, they are almost ignorable. Likewise it does not affect the human settlement as much as the large projects do. Obviously it helps to raise the living standard of people living in the surroundings area of the project. It helps to fulfill the demand of electricity in the rural area.

5.2 Recommendations and Suggestions:

1. Government should emphasize the development of infrastructures in remote, hilly and mountainous districts which support the development of hydropower.

2. Detail survey and estimation should be conducted for identity and install Syarpudaha mini hydro project which can be invested by Govt. and Donor Agencies.

3. The multipurpose hydropower project should be installed to promote industries especially cottage and small scale industries and irrigation facilities.

4. Strong financial agencies should be established to facilitate the investment on the development of small hydropower project.

5. The environmental friendly, technically feasible and economically profitable hydropower plants like Syarpudaha micro hydro project should be installed.

6. Small hydropower project should be installed in rural, isolated and hilly areas.

7. Priority should be given for the development of small hydropower project because it helps to reduce regional imbalance of development.

8. Syarpudaha mini hydropower has not conducted efficiently because there have many technically and economically problems. So it is not working sustainable functioning now. If the User Committee can manage the problem, the hydropower will conduct smoothly. If the user committee couldn't manage the problems, NEA should terminate agreement with user committee and should operate itself. There is a lot of water resource if hydropower project wants to increase its capacity. If the hydropower project can manage such kinds of problems, it will conduct sustainable functioning.

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APPENDIX I

Socio-Economic Impact of Syarpudaha Mini Hydropower Project in Rukum District

User's Group

1. Personal Details:

a) Name of the Respondent…….

b) VDC…….. C) Ward No…….

d) Age…… e) Sex…….....

f) Caste…… g) Education…….....

h) Religion …….. i) Occupation……..

2. Your annual income can support your family?

a) 1-3 month b) 4-6 month c) 7-9 month d) 10-12 month e) more than 12 month

3. Annual income of your family Rs……..?

Annual expenditure of your family Rs ……..?

4. How was the housing condition before lunching the project?

a) Kachhi-Stone b) Pakki – Cement/Brick c) Others

5. Have you taken facility of electricity?

a) Yes b) No

6. How is your housing condition when completed the project?

a) Kachhi-Stone b) Pakki – Cement/ Brick c) Others

7. How was the hygienic condition before the project?

a) Poor b) Medium c) Good d) Others

8. How is the hygienic condition after the project?

a) Poor b) Medium c) Good d) Others

9. For what purpose are you using micro-hydro electricity?

a) Lighting and cooking b) cottage Industry c) Business

d) Others / T V, Radio, Fridge, Iron, Micro oven etc.

10. How was the condition of toilet using before the project?

a) Open (without cover) b) Deep hole (cover) c) Modern

11. How is the condition of toilet using after the project?

a) Open (without cover) b) Deep hole (cover)

c) Modern d) Others

12. What was the main occupation of head of the family before the project?

a) Agriculture b) Business c) Teaching d) Service e) Others

13. What is the main occupation of head of the family after the project?

a) Agriculture b) Business c) Teaching d) Service e) Others

14. After the establishment of the SDMHP what do you think?

a) Income generates opportunity improved. b) Education status improved.

c) Commutation level improved. d) Living standard improved.

15. How do you meet your expenditure?

a) Labors b) business c) Job/Service d) Loans e) Others

16. How much money do you spend on lighting the following energy in one month?

Sources of energy	**Amount RS**	**Before**	**After**
Kerosene Liter			
Electricity KWH			
Battery			
Others			

17. What types of energy do you use for cooking food/ in one year?

a) Fuel wood……kg/mt Rs/Kg

b) Electricity Kwh Rs/kwh

c) Biogas m3 cost of biogas plant

d) dung cake kg/mt Rs /kg

18. What positive impact of the following have you found after the project?

Impact	**Yes**	**No**
Road Access		
Agro-Processing		
Forest Conservation		
Drinking water availability		
Business opportunities		
Health service		
Education facilities		
Others		

19. What negative impact of the following have you found after the project?

Impact	**Total no. of Respondents**	**Percentage**
Positive		
Negative		
Total		

20. Are you satisfied with the rural electricity service delivery by SDMHP?

a) Yes b) No

21. If you have any complain about the electricity supply by the rural micro hydro power (SDMHP) plant?

Ans ……..

APPENDIX II

Key Informant Interview

1. When did this hydro project establish ?

2. What is the electricity producing capacity of this mini hydro power ?

3. What sorts of plan and policy have you made for the sustainability of this hydro project ?

4. What challenges have you faced for the sustainability of this hydro project ?

5. What many people are facilitated by this hydro power project ?

6. Who encouraged you to establish this mini hydro power project ?

7. Where do you use the money collected from the consumers ?