

CHAPTER I

INTRODUCTION

1.1 Background

More than 85 per cent of Nepal's population live in rural areas and it is the agricultural sector that is the ministry of the rural population. This sector contributes about 39.3 per cent to the real national GDP, even if the trend is downward. However, this sector still provides employment to more than 80 percent of the economically active population (10th five year plan, 2002-2007). Natural resources are the main determining factors for the rural development. The economic growth rate is dependent upon the availability and optimum uses of such resources. Energy is one of the major components of the natural resources. it plays a vital role in the rural development as well as national development because it is essential not only for meeting necessities like cooking and lighting but is also vital for productive sector of the economy like industries, agriculture, services etc. So the energy is an essential ingredient of socio-economic development and economic growth. The production and consumption of energy is often like to other major issues in the society, including poverty alleviation, environmental degradation and security concerns. There is a definite correlation between access to energy on one hand and education attainment and literacy on the other among the rural and urban poor. World energy consumption has been growing at an average rate of two percent per year for nearly two entries. Similar growth is expected to continue in the future. It is likely that the current pattern of rising conventional energy consumption can not be sustained in the future because of environmental consequences of heavy dependence on fossil

fuels, in particular, because of global warming, urban population and acid rain.

In the modern era energy has become not less important than water and food. For a water rich and agriculture based country like Nepal. Located in a unique geo-political situation, energy stands as one of the most important security issues of survival. Energy is vital for achieving the socio-economic development of a country. Self reliance dictates that the problem of providing energy must be solved. for a developing country like Nepal, which consumes at least 50 per cent of its total foreign exchange income in the import of petroleum products, this aspect assumes an specially important dimension.

Nepal's per capital final energy consumption of about 15 GJ is one of the lowest in the world. Only four other countries in the world have a per capita consumption lower than Nepal (RETRUD 2003). Since economic development and living standards of the people of a country is directly proportional to per capital energy consumption, a significant increase in energy consumption will be required to meet the national goal of improved living standards and rapid economic development. the preponderance of a rural sector characterized by a subsistence economy and low economic growth largely explains the low level of energy consumption. Evidence reveals a close association between economic development and per capital energy consumption. Despite this low level of per captain energy consumption, the reviling pattern of energy used and production indicate many elements of unsustainability. The energy problem in Nepal arises not from excessive reliance on non-renewable energy resources, but rather from the fact that one from of energy (fuel wood) is being consumed at an unsustainable rate, while the vast potential of other forms of renewable energy remains virtually un used.

Energy sources in Nepal can be broadly categorized into three groups such as traditional biomass energy, commercial non-biomass energy and alternative energy. Traditional energy includes fuel wood, agricultural residue and animal waste. Commercial energy comprises electricity, petroleum products and coal. Alternative energy sources include biomass, geothermal, micro-hydropower, Biogas, Solar and wind energy, the overall energy situation in Nepal indicates that there is a predominant dependence on traditional energy sources. This in fact constitutes about 95 per cent of the total energy consumed in the country. Nepal relies to a large extent on traditional energy resources, as no proven significant deposits of fossil fuel are available the total energy consumption in Nepal was 5.50 million TOE in 2002; (about 15 GJ per capita) and it is expected to increase by 4.5 per cent to 8.575 million TOE in the year 2003. Traditional energy provided 85.27 per cent, commercial energy provided about 14.24 per cent and renewable/others provided only 0.48 per cent of the total energy consumption in 2002. The energy consumption in Nepal is estimated at about 75.78 consumption in Nepal is estimated at about 75.78 per cent from fuel wood, 5.74 percent from animal waste, 3.75 per cent from agricultural residues, 9.24 per cent from petroleum products, 3.53 per cent from coal, 1.47 per cent from electricity and 0.48 per cent from renewable/ others sources. Similarly, fuel consumption by sectors i.e. residential, industrial, commercial, transportation, agriculture and others ate 89.05 per cent, 1.33 per cent, 3.44 per cent, 0.79 per cent and 0.13 per cent respectively (RETRUD 2003).

About 48.5 per cent of the total population has benefited form electricity by current three year plan (three year interim plan 2064/65). The rural population, which comprises about 85 per cent of the total

population, has very limited access to electricity. Alternative energy is the ideal answer to the present energy crisis of Nepal. The alternative is defined as energy from non-exhaustive natural resources like water, biomass, solar, wind, geo-thermal etc, and technologies that make use of these resources are defined as renewable energy technologies (RET). The most important alternative energy technologies in the context Nepal are related to micro-hydropower. Biomass energy, solar energy, wind energy and Geothermal. The uses of AETs have been gradually increasing for the last two decades all over the world. The reasons for rural electrification in Nepal are numerous improving the quality of rural life, expanding rural employment opportunities and reducing deforestation are some of them. It will also assist the implementation of rural development programs by meeting energy needs for the development activities and at the same time creating employment and economic activities in rural areas. Alternative energy technologies (AETs) is a synonym for new, renewable and non-conventional forms of energy, i.e., the technologies which use local energy resources other than commercial fuels (petroleum products, gas, coal, etc.) and biomass fuels (fuel wood, agricultural residues, animal wastes in traditional forms. The main sources of these alternatives sun, air, water and biomass energy.

Solar and wind energy sources are technically complicated and highly expensive, Bio-gas is suitable only in warm areas. Furthermore, among all the popular renewable energy technology for electricity generation including, hydro, solar, biogas and wind. hydro electricity is the most proven, most reliable and potentially cost effective. Micro hydro systems have been in use in the Nepalese hills for centuries in the form of horizontal water wheels which are traditionally known as "Pani Ghattas". Various kinds of micro-hydro technologies such as propeller turbines,

cross flow turbines, pelton wheels, multipurpose power units (MPPU) Peltric sets and improvements in traditional ghatta (water wheels) better system efficiency have been developed in the past to tap water resources more effectively.

The distribution of micro-hydro units is influenced, among other things by proximity to the manufacture, the extent of development of the region, donor support and the availability of electricity from NEA, with the bitter picture of energy, it is clear that hydroelectric power is suitable sources of energy which is non fossil and non polluted. Hydropower is the major component of the Nepalese energy scenario considering all these obstacles. Nepal Government has reduced the socio-economic disparity by giving the importance in the rural electrification through micro hydropower projects. Micro-hydropower system (MHPs) is increasingly found to be widely adopted in many countries of the world, both developed and developing countries. Hydro-power installation with a total generating capacity of less than 100 KW are classified as micro-hydropower stations which is not necessary to register to the government.

Despite the substantial contribution that micro-hydro technology can provide to the country in meeting its energy needs, no definite plans and programs have been formulated by the government for its development. Even the last 10th five year plan (2002-2007) which envisages government effort in developing alternative and decentralized energy resources, has still to provided detailed policy and programs including provision for an institutional set up for the development of alternative energy in Nepal. Nowadays, many of the private sector, governmental and non-governmental organizations are involved in the supply of micro-hydropower and its development activities.

In the regard of the study project Celichama MHP, construction of this MHP was started in 2063/9/20 and it takes exactly 2 years time to complete this 19.9 KW project. The total budget for the project was 24,03,666 in which main donor was Poverty Alleviation Fund who contributed 16,05,966, Bhagwati VDC funded 5,00000, Shankarpur VDC contributed 1,50,000 and rest of the budget was managed by the local people of the VDC. This project was accomplished with the technical and social mobilization assistance from Darchula Bikash Sanghatan.

1.2 Statement of the Problem

The supply of energy is often a major constraining factor of rural as well as national development. Deficiency in energy can directly result in physical paralysis of a modern society. Many developing countries spend a large proportion of their development budgets on energy. The working of today's way of life requires energy in different forms of different purpose. However most developing countries are facing energy related problems as the cost of fossil fuels are increasing and resources are decreasing. Historically, Nepal's rural population has been meeting their energy needs from traditional sources like fuel wood and other biomass resources. This neither sustainable not desirable from environmental considerations and the need to improve the quality of life. Therefore there is a need to substitute as well as supplement the traditional energy supply system by modern forms of energy in terms of resource and technology. Because of the country's dependence on imported fossil fuels, the high cost of grid connection and low and scattered population density, a decentralized energy supply system becomes the natural choice.

In the Nepalese context the energy consumption pattern is predominated by the traditional source of energy particularly fuel wood.

The over exploitation of forest resource has caused serious environmental problems. About 68 percent of the people still depend on fire wood for primary purpose and this pressure is increasing by 2.3 per cent annually. The imbalance between energy demand and sustainable resource management is already serious one on the other hand commercial sources of energy are not available within the country. The country has to spend a huge amount of foreign exchange in importing this energy. An assured supply of energy is essential not only for sustaining day to day life but also for successfully carrying out development projects. However, the hill region of Nepal is particularly disadvantaged on the energy front lack of transport facilities in this region is also economically poor, hence the people can not afford the use of commercial energy sources. Solar and wind sources are technically and economically complicated. Bio-gas technology is suitable only for terai region.

In 1984, HMG declined micro-hydropower plants up to 100 KW to encourage private participation in rural electrification through micro-hydropower. The provision of subsidies for micro-hydropower in 1985 provided further encouragement. Through the government strategy for carrying out implementation works was not clear and specific enough, the existing infrastructure alone, starting from the availability of facilities for conducting surveys to fabrication, installation etc. was enough to promote the water turbine activities to a certain extent, particularly in the relatively accessible areas around the fabrication sites. It was, however, felt that a modified policy was needed to encourage such activities in more remote areas, including those in the mountains. To meet the increasing demand in the consumption of energy for various purposes in Nepal and to ease the impact of the fuel crisis, the government must adopt a firm policy on utilization of various sources of renewable energy available in Nepal. As

micro-hydropower is available in abundance throughout the country and the recurring expenses of the devices are almost nil, the government must give priority to the utilization of this energy on a mass scale wherever this is possible. MHP is most appropriate to pirate technology to fulfill the demand of the rural hill areas. It is the most proven, most reliable and potentially cost effective technology. However use of MHP is constantly increasing due to the growing scarcity of other resources of energy as well as more as increase on awareness on its various advantages. Nepal's experience in the use of MHP is based on the import of MHP devices from other countries. This is due to the lack of research and development and manufacturing capability in the country.

1.3 Objectives of the Study

The general objective of the study is to assess the socio-economic impact of Micro-hydropower in Bhagwati VDC of Darchula district. The specific objectives of the study are:

- To identify the role of MHP in rural electrification.
- To assess the present energy situation in Bhagwati VDC of Darchula.
- To find out the people's participation for the development and promotion of MHP in Bhagwati VDC.

1.4 Limitations of the Study

There are following limitations of the study:

- This study will only deal the problems, possibility and importance of MHP in Bhagwati VDC.
- The study was limited to the specific area of Darchula district, therefore generalization may not be equally applicable to other districts of Nepal.

- This study has considered the socio-economic, health communication. Environmental as well as educational aspect but excluded the technical aspect of MHP technology.
- This study was limited in terms of deeper analysis as only a few variable selected from the numerous factor affecting the MHP energy consumption in the study area.
- The analyses of data were based on simple statistical tools, more complex and sophisticated tools are not been used.

1.5 Organizations of the Study

This section deals with how the chapters are organized hereby. Altogether this study is divided into six chapters. The first chapter deals with general background, statement of the problem, objectives, significance, and limitation and organization of the study. The second chapter is about literature review. Third chapter contains study site, nature of data, sample selection, questionnaire design, method of data collection, data processing where as fourth chapter is contains introduction, development, status and potentiality and Government's policy about MHP. The fifth chapter deals with data analysis and presentation. The sixth chapter contains summary, conclusion and recommendations.

CHAPTER II

REVIEW OF LITERATURE

Study in the rural energy source like micro-hydropower system is a very important topic in the sense that, it required a wide range of literature during the work. Basically, study was carried out on the literature related to the micro-hydropower. The extensive study was carried out in various publications and reports also, which provided various important information related to research work. In the context of the research and development of MHP technology, Nepal is still in its fledgling stage, so there is no adequate study about the role of MHP in rural electrification as well as its socio-economic impact in the rural areas. Perhaps certain government, non-government and private institutions carried out its some studies.

Economic survey (2004) found that the energy demand is ever increasing. A large proportion of energy consumption continues to be met from traditional energy source with increasing pressure on forest resources leading to environmental imbalance to rise. Solution to this problem at hand is to commission electricity generation projects under construction in shortest possible time and implement small hydropower projects to supply power at a competitive price given the prevailing situation of peace and security, the problem to meet the impending challenge has compounded. Various type of alternative energy sources are available in the country. Despite the wide scope of their use, proper promotion is lacking. Construction materials are difficult to deliver to the sites due to adverse security situation while the subsidy being provided is not sufficient.

NEA Annual Report 1999/2000 shows that, Nepal with a per capital energy consumption of about 15 GJ is one of the five least energy consuming countries in the world despite the fact that there is 2.27 percent of the total hydropower potential in the world. The preponderance of a rural sector characterized by a subsistence economy and low economic growth largely explains the low level of energy consumption. Evidence reveals a close association between economic development and per capital energy consumption. Despite this low level of per capital energy consumption, the prevailing pattern of energy use and production indicate many elements of unsustainability (Baskota and Sharma, 1997). The energy problem in Nepal arises not from excessive reliance on non renewable energy resources, but rather from the fact that one form of energy (fuel wood) is being consumed at an unsustainable rate, while the vast potential of other forms of renewable energy remains virtually unused.

RETURD (2003) states that, renewable energy sources are indigenous and can contribute towards reduction in dependency of fossil fuels. It also provides national energy security at a time when decreasing global reserves of fossil fuels threatens the long-term sustainability of the economy. Renewable energy serves assume special significance in developing country like Nepal when viewed in the context of the geographic diversity and size of the country, not to mention the size of its rural economy. Since the renewable energy resources are appropriate as local energy sources meeting ever expanding and diversified energy needs. In this perspective they offer numerous possibilities for meeting the basic energy needs of the rural poor. Thus, the increased use of renewable energy sources/technologies is necessitated by the ability of the conventional systems to meet growing energy demands in an

equitable and sustainable/manner, need to efficiently and economically meet the energy needs of all country's citizens, particularly the rural poor, large-scale impact of conventional energy, production and consumption on the physical and human environment.

Dhital R.P. (2003) this is the conference paper presented in international conference on renewable energy technology for rural development (RETRUD 03) prepared by Dhital, Ram Prasad. 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.

Rijal, (1999) shows that traditional energy forms predominate in the energy sector in Nepal. About 91 per cent of the total final energy consumption (260 million GJ) in 1994/95 was met by traditional forms of energy such as fuel wood 81 per cent, agricultural residues 4 per cent and animal waste 6 per cent, the rest came from commercial sources such as petroleum products 7 per cent, coal 1 per cent and electricity 1 per cent. There has been little change-in energy transformation over the last decade. The share of traditional energy has declined only marginally, from about 95 per cent in 1984/85 to 91 per cent in 1994/95.

WECS (1994/95) Report has analyzed, the main feature of the energy section in Nepal is the growing imbalance between energy resources endowment and its current use. Heavy reliance on the forest

resources to meet the growing energy needs despite abundant unexploited hydro-power potential indicates a serious limitation to achieving the increase in the level of energy consumption necessary for higher economic growth and sustainable development. The present deficit in the fuel wood supply (6.66 million tones) is expected to continue given the excessive human and livestock population pressure on the accessible forests. Estimates indicate that the deficit will be concentrated in the Terai and Middle Mountains, home to 85 per cent of the population. Report has also found that the present energy situation needs to be rectified to allow the country to achieve its development targets. To maintain the ecological balance and to make energy resources sustainable, there is a greater need to gradually move away from forest based energy sources. An attractive option, among many others, would be to resort to alternative energy technologies which have the inherent ability to perform effectively under such arduous conditions.

ICIMOD (1999), Report pointed that, in the past, the implementation of alternative energy technologies has not been very encouraging. Despite their attractive economic and financial performance, potential in the overall energy scenario is still unrealized. A number of issues have emerged related to their development. The issues can broadly be classified as social issues (non-acceptance of technologies), planning and policy issues (lack of willingness at the policy level), institutional issues (non-existence of responsible coordinating bodies), financial issues (high initial investment) technical issues (weak infrastructure), and managerial issues (lack of marketing skills).

ICIMOD (1991) was prepared for and presented at the seminar on "Rural energy and related technologies" held in Kathmandu-from 26 to 28 March 1991 in collaboration with the ADB/N and WECS of His Majesty's Government of Nepal. This paper assesses the development of the micro hydro systems for the last sixteen years, identifies factors that contributed to the success of this technology and also the factor affecting in its development and also indicates the priority areas for future development and promotional efforts. This paper is based on the information collected from 6 case studies. From these different 6 case studies, the paper presents some recommendations and suggestions. It recommends that the succession MHP development is the deliquescing of installations below 100 KW capacities. The study also identifies from the owner's points of view, the MHP units constitute a paying proposition except in case of very bad management, the mill and the electric generates (especially with the 50 per cent subsidy) bring sufficient revenue to enable other to repay the loan installments in time and make a profit over and above the amount. People are willing to contribute towards the capital cost out of their own pocket. They are ready to pay from Rs. 12 to 16 per 40 watt bulb per month which is several times higher than the standard NEA rate. This paper suggests that, due to the lack of operating knowledge the plants have been facing many difficulties like loan shedding. This paper concludes that the government is right in privatizing the installations of micro-hydro units and it has to develop comprehensive and integrated policy to promote micro-hydro development. This has to be complemented by realistic plans of action in which people can participate with effectiveness and derive tangible benefits. This paper suggests that a diverse strategy has to be adopted given the physical, cultural and economic conditions in the country. The range of activities can be expanded from the provision of inexpensive

constructions kits for improving the traditional "Ghattas" to the installation of agro-processing and improving the facilities to the large schemes that integrate electrification with various rural industrialization activities.

ICIMOD (1998), Report, has been carried out some case studies on renewable energy technology. Study highlighted the importance of micro-hydropower in terms of reducing drudgery for women, as it reduced the time taken in agro-processing activities and also provided opportunities for women to engage in income-generating activities and literacy classes in the evening. Regarding legislative and regulatory issues, the study highlighted some points. Such as, the water resources act 1996 did not specify the right of prior use of water resources form micro-hydropower projects; the private sector shied away from research activities because of the inadequacy of laws on patent and intellectual property rights lack of formal standardization of procedures and guidelines and resulted in errors in flow measurements and demand estimation at the feasibility study stage of project, as well as negligence regarding safety features in micro-hydropower plants and entrepreneurs often found it difficult to get financial assistance from ADB/N for micro hydro if a diesel mill or other water turbine existed within three kilometers of the vicinity. This has not only affected hydropower development but also created situation of monopolies.

East Consult (1990) analyzes the socio-economic impact of MHP plants on rural economy of Nepal. This study is more related to the issues of mill ownership's and management performance such as mechanical agro-processing and electricity, it impact on both entrepreneur and consumers. According to the findings of the study, the electricity has provided psychic and indirect benefices such as longer hours of study,

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

It has been amply demonstrated that decentralized micro-hydro schemes could play an important role as a viable source of energy. In order to expand this program to a significant scale, more research and development efforts are required to lower the investment required for the micro-hydro system by reducing the manufacturing cost of agro-processing equipment, to integrate its use with cottage and rural industries, and to improve the efficiency of traditional "ghattas" and increase the scope of their use. A number of other important issues also need to be addressed, how can its operation be expanded? How can private sector capabilities be enhanced to cope with increasing demand? Is the current institutional mechanism appropriate? How can commercial banks and government developments play a more active role? There seems to be a services lack of government interest regarding the development of MHP in Nepal both in terms of policy planning as well as implementation. The quantitative targets in the 10th Five year Plan is to produce 10 MW from micro hydropower in 47 distinct and install 4.000 improved ghatta (10th Five Year Plan 2002)

CHAPTER III

RESEARCH METHODOLOGY

3.1 Study Area

Bhagwati Village Development Committee (VDC) of Darchula district Mahakali zone in far western development region of Nepal was selected as the study area. Darchula district lies between $29^{\circ} 36'$ to $30^{\circ} 15'$ latitude and $80^{\circ} 22'$ to $81^{\circ} 09'$ longitude.

It is located in the hill and mountain region of the country. The district is connected in the east with Bajhang district, in west with Utrakhand of India its northern border with Tibet of China and south border with Baitadi district. The total area of the district is 2,322 sq km and its average length is 92.5 km where the average width is 42.5 km. According to the population census of 2001, total population of the district is 121,996 of which 59,791 are males and 62,205 are females.

Darchula district consists of 41 village development committee. Bhagwati VDC is one of them occupying the area 1677195 sq m. This VDC is connected in east with Malikarjun VDC, in west with Mahakali river, north Dattu VDC and south border with Shankarpur VDC.

According to population census of 2001 the total population of Bhagwati VDC is 3036 of which 1490 are males and 1546 are females. There are 546 house holds in the VDC. The VDC is 8.5 Kosh far from the district headquarter. As any other VDC, this Bhagwati VDC is also regularly divided into 9 wards.

3.2 Sample size

The sample size for this study is 20 percent of the total population (230) in the whole VDC, who has used micro-hydropower. Therefore, the total sample is 46 households, which is equally divided in the wards.

3.3 Method of data collection

Some publications were available in central libraries, institutions and department which have link with this study. Therefore the information has been collected from secondary sources but it will not be sufficient to fulfill the objectives of the study. Hence, a field based primary data was also collected. This task was divided into two parts. The first part was structured interview with the intellectuals, chairperson and the members of the VDC and second part was the survey of the selected sample household of each ward which was selected by using probability as well as non-probability sampling method. That may be convenience, sample random and judgmental sampling respectively. All of the households in each ward connected with micro-hydropower was numbered, denoted by “N” and ‘N’ of them was picked out randomly without replacement. The basic purpose of using non-probability sampling \was to incorporate typical cases of the population, which has nigh level of significance but not included in the sample. In such circumstances those few cases was selected purposely.

3.4 Method of the data Generation

This study needs both primary and secondary data. Primary data was obtained by user’s survey and key informant interview using structured and un-structured questionnaire and interview checklist.

Secondary data was obtained from published and unpublished literature available in concerned offices, institutions, departments and divisions.

3.5 Data processing

With the completion of field part of the survey, the processing of finding part began. Therefore, all the materials collected during the field work was properly coded by giving code number to each response with the help of code manual. After collecting data, the raw data was edited and coded then the data was put together in same kinds of tables. Tabulation process was done manually.

3.6 Tools of analysis

For the purpose of interpreting and analyzing the tabulated data simple statistical tools like percentage, mean, median and correlation were used.

CHAPTER IV

MICRO HYDRO POWER IN NEPAL

4.1 Introduction of MHP

Micro-hydro systems have been in use in the Nepalese hills for centuries in the form of horizontal water wheels which are traditionally known as “pani Ghatta”. Some 25,000 of these ghattas are estimated to be in operation. However, they have only limited application and produce about 1 horsepower, just sufficient for grinding maize and millet. With the development of cross flow turbines in 1961 and multipurpose power units (MPPU) during the early 1980s. The available hydropower is increasingly used for rural application. Because of the rapid increase in the price of fossil fuels and the problems of distribution in the hills and mountains, the efficient use of water turbines and MPPUS became the focus of attention in rural communities. In Nepal the classification of hydroelectric plants according to their capacity is as follows.

Categorization of Hydropower

Type	Size
Micro-hydropower	Up to 100 KW
Mini- hydropower	Above 100 KW But not exceeding 1000 KW (1 MW)
Small- hydropower	Above 1MW But not exceeding 10 MW
Medium- hydropower	Above 10 MW But not exceeding 300 MW
Large- hydropower	Above 300 MW

Hydropowers up to 100 KW are known as micro- hydropower. Water power can be converted into mechanical energy by using water turbines and into electrical energy by using electricity generating equipment.

The major components of MHP re diversion, intake, descending basis, canal, fore bay, spillway, penstock, powerhouse, tailrace and transmission distribution system. Disservice structure is a structure designed to raise the water level in the stream in order to enable water to be diverted off the river. In MHP, as a rule, only temporary structures are built for this purpose. These structure are in most cases simply consists of boulder, mud pilling recombining he diversion practiced in traditional water mills. In some cases gabin wires are also used for diverting water. Intake is the point from where water flows off the river channel. Therefore intake is the beginning of the conveyance of water diverted for MPH. Intake is normally provided with a gate to control the quality of diverted water. Canal is the structure designed to deliver diverted water to the fore bay of the MHP. In MHP sometimes pipes substitute canals. In hydropower the conveyance for deliver of water from river to the fore bay is called headrace, penstock is a pipe for delivering water from the fore bay to the turbine. It is made of steel, rarely of timber. The conversion of potential energy of water in to kinetic energy takes place in the penstock. The typical velocity of water in the penstock is around 3m/sec. The order to reduce the head loss in penstock it is desirable to make the penstock as short as possible. For this purpose penstock is located in a steep slope, which is very often over 45 degree conversion of mechanical energy of water into electrical energy takes place in the powerhouse. The major components are electrical generator, turbine electronic load controller and control panel. Electrical generator is a device, which converts mechanical energy input to its shaft into the electrical energy. Conventional pants use synchronous generators. MHP use both synchronous and asynchronous generators. Turbine is a device, which converts kinetic energy of water into kinetic energy of turbine shaft, which drives the generator shaft. The turbine types widely used in MHP in Nepal are pelton and cross flow. If

cross flow turbines are used as lower heads the pylon turbines are used at higher heads. In stand-alone MHP pelton wheels are dominant owing to the prevalence of higher heads.

4.2 MHP Development in Nepal

The micro hydropower sector in Nepal has a long history. The efforts to modernize traditional water mills started in 1960s. The history of micro hydropower development started with the use of the locally developed water mills which are called “ghattas” which typically have power of 1 to 3 K. W.

The institutional development of the MHP sector started dates back to 1960s when Swiss assisted the establishment of a manufacturing company named Balaju yantra shala in Kathmandu. United Mission to Nepal (UMN) initiated establishment of institution to support rural technology development. Mostly locating in western part of the country in the beginning of the 1970s. There were some other private workshops established primarily to product and install small units, widely known as “turbine mill” in rural Nepal.

The first MHP were of add-on types. Some of these used simply dc dynamos. The capacity of add-on type of MHP seldom goes beyond 5 KW. These MHP are by and large,

Designed to supply power to lighting end uses. Stand-alone MHP appeared in those places, where there was no milling need or where the MHP site was far away from the settlement or the power requirements were much higher than that add-on MHP could meet till 1984. The imitative for promotion for MHP was made mainly outside the government sector. During the above period significant contribution for

promoting the MPH/turbine technology were made by Kathmandu metal industries, Balaju Yantrashala, Butwal Engineering Works, Development Consultancy Services (DCS), Research Center for Applied Science and Technology (RECAST), Swiss Association for Technical Assistance (SATA) and other organizations. There were basically three players who contributed to development of micro-hydro sector in Nepal at the beginning namely the Agricultural Development Bank (ADB), the private manufacturing companies and rural communities or entrepreneurs.

In 1984 the government with a view to promote MHP waived the license requirement for it. The electrification from the micro-hydro structure after 1985 when government announced a providing for the subsidy primarily on adding generator to existing turbine mills and also some new schemes were built for the stand-alone electrification purpose. A quick progress was witnessed in a short period of time. The government further provided incentive to the entrepreneurs by waiving income tax on earning from MHP, with a view to improve access to capital for MHP entrepreneurs the government, through the ADB/N, started providing loan for MHP under the priority sector interest rate. After this arrangement the ADB/N played a key role in promotion of MHP. After the liberalizations of economies, the year 1990 saw a turning point for the development of MHP plants in Nepal.

With its policy introduction by the democratic government 1990 and a technological breakthrough in Micro-hydropower, progresses emerged and many plants came into widespread use that made it possible to generate electricity from the traditional water mills in addition to milling grains. Private sector is attracted due to the affordable investment opportunities. Since the collapse of Arun-III project in 1995, the necessity and importance of development of micro-hydro further developed. The

donors have designed an alternative strategy as power development fund. Act and regulations were and are being rewritten to attract the private sector. The effort for development of MHP is continuing to date. The organizations that have joined later in the development of MHP are Remote Area Development Committee (RADC), Intermediate Technology Development Group (ITDG/N), Centre for Rural Technology (CRN/N), WECS, UNDP, DANIDA, AEPC, Micro-hydropower manufacturers Association, REDP, Annapurna conservation area project KMTNC, GTZ, USAID and Canada Cooperation Office (CCO) Institute of Engineering and others. MHP development has received a new dimension despite few hurdles due to the political instability in the country.

4.3 Present Status and Potentiality

Nepal's topography is quite unique with high hills scattered settlements. It is estimated that in Nepal more than 6000 rivers and innumerable rivulets cross- crossing the country, whose total length is about 45000 K.W. Water power is the most abundant sources of energy besides the firewood in the hills. Forest supply nearly 76 percent of total energy requirement of the country and was provides 50 percent of fodder for livestock.

4.4 Government Policy and Major Institutions

The importance of developing water turbine was felt during both the sixth and seventh five year plans. The fifth five year plan (1975/76-1979/80). For the first time, considered the role of micro-hydro plants in rural electrification according to the plan was to promote expansion of agriculture, commerce and small-scale industries under the guidance of the plan, the small hydro-power development board was established in

1975, which played a crucial role in the electrification of rural hill areas. Under the sixth five year plan period ADB/N, institute in 1981, the rural electrification through micro-hydro power plants.

In 1984, HMG/N delivered MHP up to 100 KW to encourage the participation of private sector in rural electrification. The development of the energy sector was given special priority in the eighth five year plan. The existing policy, no-license is required to operate a hydropower of up to 10 MW capacity, this scheme plays significant role for development of MHP. The owners are given liberty to fix tariff rates of their schemes. HMG/N formulated a hydropower development policy in 1992.

After the establishment of Energy Support Assistance Program (ESAP) with the support of DAINIDA and NORWAY, the subsidy policy as well as increased investment in the construction of micro-hydropower and to facilitate more homes, a new rate of funding has been decided. This encourage to include all the homes of the community and therefore this policy is inclusive also.

Subsidy Mechanism of Government of Nepal for MHPs:

Feasible Mini-Grid Schemes will be eligible for the government subsidy which is channelled through the REF in accordance with the GoN subsidy policy. The GoN has recently approved the new subsidy policy for Mini-Grid projects/schemes which sates the following provisions:-

- J Rs. 12,000 per household but not exceeding Rs. 97,500 per KW of installed capacity for projects up to 5kW.
- J Rs. 6,000 per household but not exceeding Rs. 60,000 per kW for the electrification from improved Water Mills.
- J Rs. 15,000 per household for new plants between 5kW to 500 kW but not exceeding Rs. 125,000 per kW of installed capacity.

-) For rehabilitation projects above 5 kW, subsidy equal to 50% of rehabilitation cost will be provided but not exceeding Rs. 62,500 of verified per kW.
-) Rs. 97,500 per kW for projects up to 5 kW for institutional establishment.
-) Additional transport subsidy of Rs. 500 per kW but not exceeding Rs. 30,000 per kW for projects situated at more than 10km from the nearest road head.
-) Rehabilitation projects will receive 50% for transportation subsidy.
-) Rs. 30,000 per km will be provided to the karnali Zone and the prescribed adjoining areas of Achham, Bahang, Bajura, Dailekh, Darchula, Dolpa, Humla, Jajarkot, Jumla, Kalikot, Mugu, Rolpa and Rukum districts.

Subsidy Delivery Modality:

Depending on the size of the project, the project cycle shall entail identification, verification, feasibility study by qualified companies and appraisal of the project by MGSP and TRC. If the outcome of the appraisal is positive, the Mimi- Grid developer will be eligible to apply for the subsidy as in the standard REF Application Form. After commissioning of the project, MGSP verifies the commissioning and power output test reports.

Other Supports from Government level:

Other supports from Government of Nepal can be summarized as follows:-

-) Technical Human Resource Development through different technical trainings

-) Encouraging Private Sector through the provisions of Pre-Qualifying process for installation of MHPs.
-) Appointment of Facilitator Organizations (NGOs/Companies) for facilitating the community about government efforts including subsidy mechanism.
-) Coordinating efforts from different private sector, NGOs, INGOs, giant bilateral and multi-lateral donor agencies and UN and its associates and gathering sufficient fund for the promotion of MHP countrywide, etc.

CHAPTER V

DATA ANALYSIS AND PRESENTATION

This chapter attempts to analyze information received from the structural as well as unstructural questionnaires, observation and informal discussion. Analysis will be basically focused on the examinations of the basic parameters, which are directly or indirectly related to the objectives of the study.

5.1 Socio-Economic Characteristics of the Sample Population

5.1.1 Age, sex composition and education structure of sample HHs

Age, sex composition are the basic demographic characteristics, which play an important role in the population analysis because these traits directly influence the nationality morality and marriage. Similarly, other population parameters such as occupation, education are also influenced by age and sex composition in the context of our country. It also represents the family size and structure of the VDC. The age and sex composition of the sample is presented below.

Table No. 5.1
Population Distribution by Age and Sex

S.N.	Age Group	Male		Female		Total	
		No.	Percent	No.	Percent	No.	Percent
1	0-15	43	27.22	35	29.41	78	28.16
2	15-30	41	25.95	32	26.89	73	26.35
3	30-45	35	22.15	24	20.17	59	21.29
4	45-60	26	16.46	19	15.97	45	16.26
5	60 above	13	8.22	9	7.56	22	7.94
	Total	158	100.00	119	100.00	277	100.00

Source: Field survey, 2011

Above table shows that the population of the male (57.04) is higher than female (42.96) in the sample households. The economically active human resource is considered to be 15-60 age groups. Therefore the percentage of working population of the total sample population is 63.90 percent where, 36.82 percent of male and 27.08 percent of female are economically active and rest 36.10 percent are dependent on them. Analysis shows that, male population is greater (i.e. 13.26 percent) than female of the total economically active population. It is also found that, the population growth rate is higher in the study area which is shown in the bar-diagram below.

Figure No. 1
Population Distribution by Age and Sex

Survey has found that people below 15 years and above 60 years fall under economically inactive and are not usually seen in the any productive work and job market. Among the dependent population 28.16 percent are children and 7.94 percent are olds. This low percentage via, 7.94 percent of old age group i.e. above 60 years, population that denotes the relatively short life expectancy in the study area. The age group of 0-

15 and above 60 should not be involved in any income generating activities but our culture is bounded in such way that they are assured to be involved in various types of household works, such as rearing of cattle and goat, looking after children, fetching water, cleaning house, cooking food, collecting fuel wood and so on.

Education is the key indicator of human development. It plays a vital role in the efforts of any endeavor to uplift a society from repression and scarcity, needless to say it has a positive role in the success of life. Food, shelter, clothing and education are the basic needs of the people. Similarly, attention must be paid for the condition of literacy of the rural farmers as well as the schooling children. Even primary education is a principal mechanism of fulfilling the minimum learning needs of the people needed for effective participation in economic, social and political activities. Towards the survey found that, Bhagwati VDC (Study area) has a Celichama secondary school and 3 other lower secondary schools in different wards. Table No. 5.2 shows about the education status of the sample households.

Table No. 5.2

Education status of sample households

Level of Education	No of Persons	Percentage
A. Illiterate	135	48.74
B. Literate	142	51.26
Primary(1-5)	63	22.74
Secondary(6-9)	47	16.97
10 class or above	32	11.55
Total (A+B)	277	100.00

Source: Field Survey, 2011

Above table shows that 48.74 percent people are illiterate and 51.26 percent are literate of the sample households in the study area. The literate population is greater (i.e. 2.52) than illiterate population. It is observed that the literacy rate in the study area is lower than of national average literacy rate (i.e. 57 percent). Above 48.74 percent of the total population is illiterate and rests of them are literate in the study area. Out of total literate population 22.74 percent are studying in primary level, 16.97 percent in secondary level and only about 11.55 percent have completed school level education. It is found that for higher study students of the Bhagwati VDC have to travel to Shankarpur VDC and district headquarter.

5.1.2 Ethnic Composition of the Respondents

Ethnicity plays an important role in the social cohesion of people living together. Cast and ethnicity also have influence by occupation, social status, norms and values to some extent. It may create a social hierarchy and segments division of society.

In the study area, there are different types of ethnic groups such as Brahman (Bhatta, Bista), Chhetri (Dhami, Karki, Kuwar), Occupational Caste (Tamata, Luhar, Damai etc.). The ethnicity structure of the VDC based on sampling households is given below.

Table No. 5.3
Distribution of Respondents According to ethnicity

S.N.	Cast	No. of Respondents	Percentage
1	Brahman	10	21.74
2	Chhetri	23	50.00
3	Occupational Caste	13	28.26
Total		46	100.00

Source Field Survey, 2011

Above table shows that Chhetri are more than other caste. In the study 50 percent Chhherti, 21.74 percent Chhetri, 28.26 percent Occupational cast. The Brahmans are low in the sample households. Ethnic structure of the sample population can also be shown in pie-chart below.

Figure no. 2
Ethnic Composition of Respondents

From the survey, it was found that there are only 3 castes, such as Brahman, Chhetri and occupational cast which all belongs to the Hindu religion.

5.1.3 Occupational status of the sample households

Agriculture sector is the main source of the national income. Agriculture has been the main sector of employment and for income generating activity in this VDC as well like in most in our country. Thus it can be regarded that agriculture is the main source of livelihood for this VDC. But this sector is very backward in the study area due to the lack of irrigation agricultural inputs, training and skill development program. Agriculture and the foreign job are the main sources of income in the sample households. On the basis of primary occupation, the dwellers can be divided into four different categorizes such as agriculture, services,

foreign job and business. The occupation structure of the population based on sampling households is given below.

Table No. 5.4

Occupation Structure of the Sample Households

S.N.	Occupation	No. of Respondent	Percentage
1	Agriculture	28	60.87
2	Services	6	13.04
3	Business	4	8.70
4	Foreign job	8	17.39
Total		46	100.00

Source: Field Survey, 2011

According to above table, it is clear that the highest number (60.87%) of population are engaged in agriculture and lower number of population are engaged in business. The number of people involved in foreign job is slightly more than the people are in service sector. Nowadays, people are encouraged to join the service for their economic security and sustainability. In this area there was a tradition to go different parts of India for foreign job. Occupational structure of the sample households can also be shown in pie- chart below.

Figure No. 3

Occupation Structure of the Sample Households

5.1.4 Livestock Situation in Sample Households

There is no large scale of animal husbandry. Since most of people are farmers, they keep buffaloes, cow/Oxes, Goats, Hen etc. Farmers keep those animals for getting fertilizer, milk and meat. Milk and meat are one of the income generating sources of people. The livestock situation of sample households can be analyzed by following table.

Table No. 5.5

Livestock rearing situation in sample households

S.N.	Type of livestock	No of Animal	Percentage
1	Buffaloes	88	19.59
2	Cow/Oxes	217	48.33
3	Goat	76	16.93
4	Hen	61	13.59
5	Others	7	01.56
	Total	449	100.00

Source Field Survey, 2011

Above table states, the highest number of animal are Cow and Oxes (48.33) in the sample households where lowest number of animal are others (1.56%) such as horse and ducks. People in study area use Oxes to plough, goats for meat and buffalos for milk.

5.1.4 Annual income Level of Sample Population

Income level determines the resource mobilization, living standard, education level and health also. Generally, it is believe that high level of income increases the quality of life. In the study area, there are many sources of income such as agriculture, government job (service), foreign job, business, laboring and others. It is generally difficult to figure out the individual household income because the numbers of households do not

like to respond to question about their income because of the fear of publicity of their economic status. Specially, it is difficult in a society like our where material wealth is used as a tool to place a family or an individual in the hierarchy of society. As a result, respondent answers this question with caution. To estimate the household income, the probable source of a household income has to be considered, such as sales of agricultural products, animal products, salary, labor wage. The annual income level of the sample households is shown in table below.

Table No. 5.6
Distribution of Respondents by Annual Income

S.N.	Income Level (in Rs.'000')	No. of Respondents	Percentage
1	Below 10	11	23.91
2	10-20	14	30.43
3	20-30	8	17.39
4	30-40	6	13.05
5	Above 40	7	15.22
	Total	46	100.00

Source: Field Survey,2011

Above table states that most of the respondents, i.e. 30.43 percent have annual income level Rs 10,000 to 20,000 and second largest number of respondent have less than Rs.10,000 annual income (i.e. 23.91%). Survey found that the households, who have low level of income are those who are engaged in agriculture sector due to lack of knowledge about modern techniques of farming. Survey also found that the households who have higher annual income are involved in business and foreign job.

5.2 Energy Using Situation in Study Area

5.2.1 Main Energy Sources for Cooking

The main sources of energy used for cooking food are fuel wood, agricultural wastes, animal dung, electricity, kerosene etc. In the study area fuel wood is main source of energy for cooking all of the households depend on fuel wood to some extent.

5.2.1.1 Types of Cooking Stove

Survey found that almost 100% sample households use fuel wood for cooking purpose to some extent. The source for the fuel wood is the forest around the Bhagwati VDC. In the study area, only about 36.96 percent households uses improved cooking stove (ICS) and 63.04 percent of the sample households uses traditional cooking stove. The use of ICS has decreased the consumption of fuel wood which can be shown in table below.

Table No. 5.7
Type of Cooking Stove

S.N.	Type of stove	No. of Households	Percentage
1	Improved Cooking Stove (ICS)	17	36.96
2	Traditional Cooking Stove	29	63.04
Total		46	100.00

Source: Field Survey, 2011

Forest is the main source for the supplement of fuel wood in VDC which has been one of the main reasons for the forest depletion. Most of the forest covered area lies in the eastern and southern part of the VDC. Supply of fuel wood from their own resources is directly related with land occupied by each household. The people with more land have access on

more fuel wood. While having less land produce less fuel wood. There is a trend of planting trees for fuel-wood and to feed animals. In the study area, only about 32.35 percent sample households collect the fuel-wood from the private forest and most of them i.e. 67.65 percent of the households fetch fuel-wood from community forest, which can be represented table below.

Table No. 5.8
Main Source of Fuel Wood

S.N	Source	No. of households	Percentage
1	Community forest	23	67.65
2	Private forest	11	32.35
Total		34	100.00

Source: Field Survey, 2011

5.3 Socio-economic Impact of MHP

5.3.1 Advantage of MHP in the Study Area

Survey found that most of the sample household i.e. 82.61 percent feel relaxed or enjoy using MHP system for lighting and only about 17.39 percent feel relaxed to some extent. All of them agree that, it is completely smokeless. Many of the sample households are influenced from its various advantage like sample households are influenced from its various advantage like improvement in health, time saving, save in kerosene, easy to work at night, most efficient on productive work improve children's education and so on which is shown in table below.

Table No. 5.9
Impact of MHP System in Sample Households

S.N.	Impact	No. of Households	Percentage
1	Improvement in Health	7	15.22
2	Time Saving	11	23.91
3	Easy to work at night	14	30.43
4	Save to kerosene	9	19.57
5	Efficient on productive work	3	6.52
6	Improve children's education	2	4.35
Total		46	100.100

Source: Field Survey, 2011.

From the above table, it has been found that more than 30 percent of the sample households are influenced from MHP system because it makes them easier to work at night only about 6.52 percent of the sample households accepts that it has increased their efficiency on productive work and 15.22 percent, 23.19 percent and 19.57 percent households are influenced by its advantages like improvement in health, time saving improve children's education and save in kerosene respectively. Impact of MHP system in sample households can also be presented in pie-chart below.

Figure No. 4
Impact of MHP System in Sample HHs

5.3.2 Involvement on Productive Work by Using MHP System

Most of the sample households are agree that MHP system makes them easy to work at night. They are also benefited from MHP system for studying, doing household chores and income generating activities. But through field visit it is known that only a few percent of the households are engaged on productive activities due to the lack of skill, training, awareness, capital and program opportunities. Involvement of sample households on productive work by using MHP system is shown in table below.

Table No. 5.10
Involvement of Sample HHs on Productive work by
Using MHP System

S.N.	Productive Work	No. of Households	Percentage
1	Poultry farm	2	4.36
2	Furniture industry	1	2.17
3	Bakery industry	1	2.17
4	Knitting	4	8.70
5	Agro-processing mill	1	2.147
6	Saw mill	1	2.14
7	Not involvement	36	78.26
Total		46	100.100

Source: Field Survey, 2011.

Above table shows that, only about 4.36 percent of sample households starts poultry farming and 8.70 percent households involves in knitting. Similarly 2.17 percent households are involves in furniture industry and same percent in bakery industry, agro-processing mill and saw mill. In aggregate, only about 21.74 percent of sample households are involving on productive work by using MHP system and 78.26

percent are not involving themselves in any productive work which can be shown below in figure.

Figure No. 5

Involvement on Productive Work by Using MHP System

5.3.2.1 Increase in Income Level of the Households Involved

The villagers have been able to increase their income level substantially from the various on farm and off farm activities. Survey found that, only about 21.74 percent of the sample households are involving in productive work. All of them agreed that, the income level of the sample households is quite increased after involving in productive work by using MHP system. Increase in income level of the sample households is presented below.

Table No. 5.11
Increase in Income Level

S.N.	Increase level (monthly/Rs. 00)	No. of Households	Percentage
1	0-10	2	20
2	10-20	3	30
3	20-30	2	20
4	30-40	3	30
Total		10	100.100

Source: Field Survey, 2011.

From the above table, it is clear that, most of the sample households who are involved in productive work i.e. 30 percent have increased their monthly income level in between Rs. 1000 to 2000 and same percent households have increased in between Rs. 3000 to 4000. Only about 30 percent household have increased their monthly income level is between Rs. 0 to 1000. Similarly same percent of the sample households have increased income level in between Rs. 2000 to 3000 after being involving in the productive work.

5.3.3 Improvement in Health Condition After the Use of Electric Bulbs

It is estimated that before the installation of MHP, one kerosene wick lamp produce 218.64×10^{-3} tom GHG emission 1 year (CO₂ equivalent) and after the installation of MHP system, one 25 watt incandescent bulb produce only 0.5475×10^{-3} to GHG emission 1 year. It can be concluded that after the installation of MHP in the VDC about 33.23 liter of fossil fuel and about 20.4 pair of dry -cell battery is saved per HH annually. Those saving have resulted ecological benefit of about

0.108 tone CO₂ per HH each year even after reducing the CO₂ invested in MHP plant manufacturing. Moreover, about 52.264 of CO₂ emission will be saved by the community of 437 HH in the village each year. The economic value of such saving ranges differently. The CO₂ avoidance cost of renewable energy technology for lighting is about NRs. 1187 for biogas to NRs. 8543 for solar per ton of CO₂ emission in Nepal. Considering cheaper option then about NRs. 49567 will be the gained value of ecological capital. There is also saving of about 9915 pairs of dry cell each year by the community, thus, reducing hazardous effects of chemical of dry cell and health impacts to the community as dry cells are thrown openly, generally in the agricultural fields. Water pollution due to dry cell indoor air pollution due to kerosene is also avoided or reduced (RETRUD, 2003).

The use of clean energy produced by the MHP system has immensely improved the health of rural people, specially the women, health is the key indicator of human resource development. In the study area, all of the sample households agree that their health has improved after using the electric bulbs in comparison working in the environment with smokey kerosene lamp. Improvement in health of sample households after using the MHP system is shown in table below.

Table No. 5.12
Improvement in Health of the Sample HHS

S.N.	Improving Percentage	No. of Households	Percentage
1	Below 20	12	26.08
2	20-40	17	36.96
3	Above 40	8	17.39
4	Can not say	9	19.57
Total		46	100.100

Source: Field Survey, 2011

Above table shows that most of the sample household i.e. 36.96 percent, agreed that their health has been improved 20 to 40 percent after using the MHP system and it has been note that these percent of households constituted more number of children and old members. Similarly, 26.08 percent of the sample households feel that their health has been improved less than 20 percent and only about 19.57 percent households' states that they cannot say anything about it. Survey found that 80.43 percent sample households agree that the health expenditure of the households decrease after the use of eclectic bulbs. Improvement in health condition of the sample households is presented in the pie-chart below.

Figure No. 6
Improvement in Health of the Sample HHs

5.3.4 Increase in Education and Awareness Level

Education is the key indicator of human resource development. Survey found that, only about 45.55 percent people are literate in the study area. Most of the respondents (i.e. 84.78%) reply that availability of bright light produced by electrical bulbs for students to study longer hour in the evening. In average students study 1.5 hour more per day during

evening by using electric bulbs. Incidences of better results of the students in the students/exam are reported after the use of electric bulbs. Survey also found that, literacy class was started with improved environment due to bring light in the evening in study area; where as only 35 members are involved in the literacy class. It has been analyzed that it will be help to increase in literacy rate of the VDC.

- It is better to analyze problem of MHP
- Participation strategy/mode
- Contribution/terrific

5.3.5 Problems of Micro-Hydro Power

According to the field survey, sometimes problems take place, like the beginning post of canal being damaged by the overflow of flood during the rainy season. As a result the MHP cannot operate. Similarly, another problem is having no technician facilities to maintain and repair the turbine and the generator in local market when it doesn't function properly. If not in proper condition the hydropower is completely stopped and peoples compelled to relay on kerosene at that time.

5.3.6 Participation and Contribution of People

There is the respected participation and contribution of people to establish the MHP in their local place. They provide labor voluntarily to supply the equipments, device, tools and raw materials to construct MHP. It happened so because people want to have the electricity facilities. However, a sadness mentioning is that no prescience of expert in village it may take long time to repaired the MHP. Although, people are more conscious and active to conserve the MHP avoiding various risky problems on solution. From the beginning phase of this project female

participation is very high in the 12 member development and execution committee 7 are women.

5.3.7 End use of Micro-Hydro Power

According to the field survey, the MHP established in Bhagwati VDC lack of good knowledge and awareness and market facilities. As far as possible people are not getting the facilities and use of MHP regarding the productive works like, Sawmill, wheat and rice mill and other small industries except light. Here, present data is 78.26 percent is using for light and remain 21.74 percent only use for productive function as well.

CHAPTER VI

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary

Energy is not included in the list of basic needs of the population. For subsistence economy that might be a right approach because the life of human being has been sustained for long time through the use of renewable energy resources, which is being taken for granted. A society can not rise above the subsistence economy unless there is abundance of energy. At present the issue in the rural areas of Nepal is how to raise the subsistence economy with in crease quality of the lives of the people. Since energy has not been included in the list of basic needs, it is important to disseminate this concept thorough energy education.

The development of the MHP is one of the prime move in the process of the economic development and it's per capital consumption has been regarded some times as one of the indices of economic development. Nepal is regarded as a poor country because per capita energy consumption stands 15 GJ but it has been increasing every year. Energy consumption pattern is also regarded as one of the important indicators on measuring development status of the country. In the Nepalese context many rural people have no access to clean energy source that should never be neglected. MHP is providing clean energy access to same parts of the rural areas.

Micro-Hydro Progress (MHP) has been able to bring about profound socio-economic changes. The implications of MHP for rural micro-enterprise development are introduction of modern technology in

rural context. This develops technical capabilities in the village needed for rural industrial development, introduction of industrial management concept. This MHP provides basis for undertaking rural industrial activities, nurturing of entrepreneurship in rural areas. The study tries to reflect the over view of Nepalese rural energy sources and discusses various energy issues through a case study of Bhagwati VDC of Darchula. The study analyzed the socio-economic impact of Celichama MHP of Bhagwati VDC of Darchula. The study revealed various advantages and improves of MHP system. It not only provides energy for lighting but also helped in improved health condition, save time, easy to work at night and more efficient on income generate as well as productive work.

6.2 Conclusion

From the study the general findings are as follows:

- Population of the female was higher than male in the VDC.
- Educational status of sample households is found to be lower (i.e. 45.26%) than that of national average rate (57%).
- Ethnic composition of the study area showed that Chhhetri are higher (i.e. 50%) in the sample household where as only 21.74% are Brahman.
- Agriculture is found to be main occupation and the source of income. Most of the household i.e. 60.87 percent and dependent on agricultural sector which is lower than that national average (i.e. 81%).
- Most of the respondents i.e. 30.43 percent of the sample household have annual income level Rs. 10000 to 20000.

However, the specific findings are:

- Fuel wood is main energy source for cooking purpose in this VDC.
- The use of improved cooking stove (ICS) has played a vital role for reducing the consumption of fuel wood.
- All of the sample household agreed that MHP system is sufficient for lighting purpose.
- More than 30 percent of the sample households were influenced by MHP system because it provided light for them to work at night.
- Survey found that, literacy class was started after the installation of MHP system literacy rate has been increase in the study area after the installation of MHP system.
- Students study one and half hour more per day during evening by using electric bulbs.
- Only about 21.74 percent of households are involved in productive work by using MHP system and all of them agreed that, the income level was increase (i.e. Rs. 2300 month in average) after introducing MHP in the VDC.
- Most of the sample households i.e. 36.96 percent agreed that their health has been improved 20 to 40 percent after using the electric bulbs.
- Evening literacy class has been started after installation of MHP.
- Higher level of female participation in the whole process of MHP project.
- Various types of functional group have been formulated in the VDC, which play a vital role for resource mobilization decision making, information sharing, coordination and capacity building.

6.3 Recommendations

Rural energy development program has been providing rural electrification, environmental management and poverty alleviation to

some extent in the rural part of the country. With an unprecedented success on economic development through the rural energy development program. The development efforts needs to be reviewed and more progress based on the use of alternative energy should be implemented. Appropriate policy on pricing, market arrangement and energy quality regulation needs to be developed for the sustainable growth of rural energy. The micro-hydropower deserves the high priority in view of its role in the socio-economic development of Nepal. It is fact that unless the micro-hydropower sector is provided with adequate technical, financial and management support, it will not be able to contribute to national development to the extent one can expect from it. Hence, the specific recommendations are as follows:

- Alternative energy resource should be made available to minimize the pressure on forest.
- A holistic energy sector development policy should be developed and the implementation of REDP's rural energy development with integration of environment management model in the time to come by internalizing it in the local government.
- Appropriate policy pricing, market arrangement and energy quality regulation needs to be developed for the sustainable energy development in the rural part of the country.
- An integrative approach to promote micro-hydropower development needs to be adopted.
- The subsidy program encourages the development of MHP system. Government has done right thing by providing subsidy. But subsidy should be provided according to the structure of the cost not by the district wise.
- The participation of women in planning and implementation of micro hydro plants needs to be ensured.

- Simple and transparent procedures for loan sanctioning should be developed and institutionalized.
- Promotion of smaller units such as the improved ghatta to replace traditional one should be given priority. Since this will ensure the participation of low-income groups.
- Technology promotion and entrepreneurial development programs should be organized.
- Proper evaluation of the socio-economic setting, technical and managerial capabilities and adequate survey and design must be ensured while carrying out feasibility studies.
- Technical training is need in both public and private sectors particularly at the operative level to improve present standards.
- Produce warranty should be made mandatory for manufactures and service provides.
- Capabilities should be built up at village level for operation, maintenance and repairing.
- There is a need to integrate MHP system promotion with income generation and social development activities in order to justify the subsidy scheme.
- Community-owned and managed micro-hydropower plants should be promoted.

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