CHAPTER I

INTRODUCTION

1.1 Background

Nepal is a small Himalayan country in between two big countries and has it has it location in the northern margin of South Asia. It has it elongated rectangular shape roughly north west to south east orientation. It has area of 147181 sq. km which is 0.03% of earth and 0.3% of Asia. Its absolute location is $80^0$4'-$88^0$12' east longitude and $26^0$22'-$30^0$27' north altitude. The country has average length of 800 km.

Nepal is an agrarian country with over 80% of its economically active population dependent on agriculture. This sector contributes about 39.3 percent to the real national GDP. Eventhough approximately 31 percent of the total population is leaving below the poverty line (NPC Report, 2007). The total potential power of water in Nepal has been estimated to be 83,000 MW of which 42,750 MW is economically feasible. However, only about 548 MW has been generated by the various hydropower stations. There are approximately 600 rivers totaling about 45,000 km in length and innumerable rivulets flowing from the mountains in the country. Natural resources are the major determining factors for the rural development as well as national development. Energy is one component of the natural resources. Development is the function of energy D=F (E). It is the basic need for all sectors such as agriculture, social services, transportation, communication, industry, trade and commerce. Socio-economic development is largely determined by per capita energy consumption. Therefore quality of life is a question of use of energy. World energy consume has been growing an average rate of two percent for nearly centuries.

Throughout the history of human race, major advances in civilization have been accompanied by increased consumption of energy. Today, energy consumption appears to be directly related to living standard of people. Many developing countries spent a large proportion of their development budgets on energy, till today Nepal has no other sources of energy besides the immense water resources.

Energy sources of Nepal is divided into three categories according to its sources viz traditional biomass energy, commercial no-biomass energy and alter native or renewable energy. Traditional energy includes fuel wood, agricultural residue, animal dung. human labour and animal draft power. commercial non biomass energy comprises electricity, petroleum products and coal. Alternative or renewable energy includes Micro-hydropower, Biogas, Geothermal, (ICS) Improve cooking stove, Solar and wind energy. The consumption pattern of energy in Nepal is pre-dominated by traditional source particularly fuel wood. Electricity, petroleum products and coal are high grade fuels with relatively higher end use efficiencies. But because of their high costs and resource limitations, their consumption is very low then the traditional fuels. Nepal's per capita final energy consumption of about 15GJ. Only four other countries in the world have a per capita consumption lower than Nepal (RETRUD 2006). Consumption of energy is increasing even though the per capital energy consumption is very low in developing countries.

Energy consumption in FY 2004/05 increased by 1.35 percent to 8616 Tons of oil Equivalents (TOE) compared to FY 2003/04. It was expected to increase by 3.34 percent to 8904 TOE in FY 2004/05 in comparison to previous year. Traditional energy, commercial energy and renewable energy occupied 87.7 percent, 11.75 percent, 0.53 percent respectively of the total energy consumption in FY 2004/05. The share of traditional, commercial and renewable energy was expected to remain 86.71 percent , 12.72 percent and 0.56 percent respectively in FY 2005/06. This shows that year too, Nepalese economy heavily relies on traditional sources of energy as in the previous year. Of the total traditional energy consumption in FY 2004/05, share of fuel wood was 89.0 percent, agriculture residue 4.34 percent and cattle residue 6.57 percent, while in FY 2005/06 too the share of agriculture and cattle residue was expected to remain the same. Similarly, of the total commercial energy consumption in FY 2004/05, the share of petroleum products, coal and electricity in total energy consumption was expected to be 63.9, 21.3 and 14.8 percent respectively. Likewise, of the total energy consumption by sector in FY 2004/05, the share of household use was 90.3 percent, industrial use 3.5 percent, commercial use 1.6 percent and agricultural and other use 0.8 percent and 0.2 percent respectively. Whereas in FY

2005/06, household sector was expected to occupy 89.3 percent and industrial, commercial, agricultural and other sectors by 4.5, 1.5, 0.8 and 0.2 percent respectively.

About 40 percent of total population has been benefited from electricity by the end of ninth five year plan. This 40 percent was reported to include consumption of 33 percent from national grid and 7 percent from alternative energy (10th Five year plan, 2002-2007). The rural population, which comprises about 85 percent of total population, has very limited access to electricity. Alternative energy plays the vital role to solve the energy crisis of Nepal. Alternative energy is defined as energy from non exhaustive natural resources like water, biomas, solar, wind, geothermal etc and technologies that make use of these resources and defined as renewable energy technologies (RET). The most important alternative energies or renewable energies of Nepal are related to micro-hydropower, Biogas energy, solar power, wind power and improve cooking stove (ISC).

Among the alternative energies bi-gas, solar power, improved cooking stove (ICS) and micro hydropower are more popular and available in Nepal, is MHP, which is technically and environmental feasible and most appropriate technology for Nepal. Though highly potentiality of solar energy and wind energy sources have not been fully utilized and exploited because these sources are technically and complicated and costly. Bio-gas technology is suitable only in warmer climate are like Terai and it is not suitable for hills and mountains. In order to stop deforestation and to curtail the high consumption of imported petroleum products, a search for an alternate energy has become a must. And MHP is only appropriate technology to fulfill the energy demand of the rural people of mountain and Hill areas. This technology provides access to electricity and other mechanical forms of energy. For agro-processing such as rice hulling, shelling, grinding and oil expelling.

Plants up to 100 KW are called micro hydro plants in Nepal, however the definition is going to change soon and plants up to 500 kw falls under MH (REDP 2005). Micro-hydropower 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 types of MH plants ranging from 1 KW to 100 KW are based on technologies like propeller turbine, cross flow turbine, pelton turbine, multipurpose power unit (MPPU), peltric set, and improved ghatta. Around 2200 such schemes have been developed and installed in the past decades totaling about 14600 kw power output till mi-July 2003 benefiting about 146000 rural households in Nepal. The past 10th National plan aimed to increase the electrification rate to 55% compared to previous rate of 40%. The increment in electrification rate by 15% by the end of tenth plan was attributed to grid (10%) and non-grid including MH. That provided a large market to be served by the technologies like micro hydro. Nowadays, A number of governmental organizations, NGOS, INGOS, international, private companies, research organizations are involved in MHP.

1.2 Statement of the Problem

Energy plays a crucial role in the rural people of hill and mountain areas. The role of energy in our socio-economic is important both from stand point of domestic use and export. Many less developed countries are spending a huge proportion of their development budgets on energy supply. The demand of energy is increasing even though per capita consumption is very low in the country. Many developing countries are facing energy problem due to rising price of fossil fuels, high rate of deplictions of the forest resources. So there is a need to substitute as well as supplement the traditional energy supply system by modern forms of 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. Energy consumption in FY 2004/05 increased by 1.35 percent to 8616 Tons of oil Equivalents (TOE) compared to FY 2003/04. It was expected to increase by 3.34 percent to 8904 TOW in FY 2004/05 in comparison to previous year. This energy consumption growth rate is greater than the population growth rate i.e. 2.25 percent annually.

The energy consumption pattern in Nepal is pre-dominated by traditional source particularly fuel wood. The over exploitation of the forest resources has appeared serious environmental problems. Overwhelming number of people are still dependent on firewood for domestic purpose. The purpose of fuel wood has

been increasing along with the increase of population. As a result the environment and population are being degraded which bring the serious several negative impact. The commercial energy sources like coal and petroleum products are not available because of these energy sources are expensive. The country has already spent a huge amount of foreign exchange in importing for petroleum which results the defict in balance of payment of the country, the cost is very high for the low income economy of Nepal. the hill region of Nepal is physical and economical poor. Nepal is home of poverty. People are poor because they are poor. That's why Nepalese people can not consume commercial energy sources. High potentiality of wind and solar energy have not been fully utilized and exploited because these energy sources are economically complicated. Wind energy is still at the research stage and bio-gas is suitable only in the warmer climate area like Terai region.

The provision of subsidies for micro-hydropower in 1985 provide further encouragement. Though 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 purpose 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. Government must give priority to utilization of this energy on a mass scale wherever this is possible.

Micro-hydro power is comparatively advantageous than other renewable energy sources like bio-gas, solar and wind energy in rural hills and mountain areas. It is only appropriate technology to fulfill the energy demand of hilly people. This energy sources is continuously renewable, non-polluting, efficient and widely distributed and available resources. The modernization of the isolated hills and mountains Nepal is possible with the tapping of river (about 6000) flowing in the country. Nepal's rural economy does not provide enough economic

basis for large scale investment for the exploitation of vast hydro-power potentials. In this context, alternative energy can play the role of a catalyst in rural development by providing a modern form of energy. It can effectively help in reducing the drudgery of the rural population and cutting down the time required to collect and use traditional forms of energy such as fuel wood, animal waste etc. provide a cleaner cooking and lighting environment to rural women, combat the environmental effects of CO2 emission, forest depletion etc. by reducing and replacing the use of the traditional as well as commercial forms of energy, save convertible currency resources by substituting imported fuels; and has the potential to create rural employment and increase productivity. MHP plants installation is one of the most appropriate methods of substitution for other energy sources e.g. fuel wood, animals dung, agricultural waste, petroleum products, for specially hill area. In spite of that possibilities, there is a lack of sufficient information on the existing status and distribution of micro-hydropower in Dangapa VDC of Terhathum district. There has not been studied about the role of MHP in rural electrification as well as its socio-economic impact in this VDC before this research study. So that, it is prominent part of research study in this VDC.

1.3 Objectives of the Study

The general objective of the study is to find out the role of micro-hydropower in Dangapa VDC of Terhathum District. The specific objectives of the study are:

- To find out the energy utilization pattern of Dangapa VDC of Terhathum District.
- To examine contribution of Micro-hydropower in rural electrification.
- To assess the socio-economic impact of MHP in Dangapa VDC of Terhathum district.

1.4 Significance of the Study

Micro-hydropower is a prominent part of rural as well as national development of Nepal. It has high potentiality in the context of Nepal. Although it is costly technology it gives much benefits for hilly people who are deprived from

electricity. It is most proven, most reliable and potentially cost effective technology. It occupies a very eminent place in the energy sector of Nepal. A technology, which helps to lesson the alarming deforestation, imports of petroleum and many other bad consequences, plays crucial role on improving socio-economic condition. But many micro-hydropower users have not fully utilized the that's technology capacity and mostly they are using this energy only for lighting. Rural economic activities and living standard can be raised through supply of electricity generation from MHP.

The definite benefits of this MHP

1. This study of MHP can be useful for planner, researchers, support organization, manufactures, donor and government agencies to apply the data for designing and planning of policies and to fulfill the needs of researcher in some extent.
2. The electricity can be used for lighting, cooking, heating facilities and other related activities.
3. The quality of communication and education will be improved through radio, television which can be made available through electricity.
4. Employment opportunities will be created in the respective area through small cottage industries.
5. Improvement in extra-curricular activities such as women empowerment, cultural programmes, community meeting at night and literacy education etc.

1.5 Limitation of the Study

There are following limitations of the study:

- This study will deal the role of micro hydro power problems and possibility in Dangapa VDC.
- The study was limited to specific area of Terhathum District. Therefore, generalization may not be equally applicable to other district of Nepal.

- Conclusion might be valid to some extent to those areas, which have similar geographic, socio-economic and environmental settings.
- This study has considered the socio-economic, health, communication, environmental as well as educational aspect.
- 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 analysis of data were based on simple statistical tools.

1.6 Organization of the Study

This study has been divided into seven chapters. First chapter is introduction. Background of the study, statement of problem, objectives of the study, significance, limitation and organization of the study has been included in this chapter. Second chapter is literature review. Third chapter includes Micro-hydropower in Nepal. It leads to development of MHP in Nepal and government plan and policy. Fourth chapter leads with methodology which includes research design, sampling procedure, source of data and information. This also includes data collection techniques and tools and data processing and analysis. Fifth chapter discusses description of study area. It consists introduction of Terhathum district and introduction of study area. Sixth chapter describes analysis and discussions about role of lower Parewa Khola Micro-Hydro project in Dangapa VDC., Terhathum district. Seventh chapter provides conclusion and recommendation. This chapter is followed by bibliography and appendixes.

CHAPTER II

LITERATURE REVIEW

Literature review is one of the research works of several literature about MHP of Nepal, only some of them which are relevant of the study have been review.

Hora (1974) has focused "Role of Micro-hydro power in Rural Electrification in Nepal" in her study tapping of small rivers for MHP would help to exploit the available resources of the hills and mountains in the country. If there is the facility of electricity in the villages, the replacement of traditional sources of energy by electricity will be possible. In order to meet rural energy demand, government has given more priority on MHP in Eight plan (1992-97) and with the supply of electricity kerosene can be easily substituted. In the context of end use of electricity, the integration of irrigation with MHP is most viable in the hills and mountains. She added that mills is another major end use integrated in some of the MHP plants for processing grains and expelling oil seeds with promotion of MHPs other end-uses like saw-mill, battery charging, corupelling, fruits and vegetable dying etc can be promoted in rural areas. These will help to improve the load factor of the plant and the revenue of the plants can be raised.

ICIMOD (1991) was prepared for and presented at the seminar on "Rural energy and related technologies" held in Kathmandu from 26 to 28 March 1997 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, identities factors that contributed to the success of this technology and also the factor affecting in its development and also indicates the priority areas for future development and promotional efforts. this paper is based on the information collected from 6 case studies. From these different 6 case studies, the paper presents some recommendations and suggestions. It recommends that the success in MHP development is the delicensing of installations below 100 kw capacity. 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 percent subsidy) bring sufficient

revenue to enable other to repay the loan installments in time and make a profit over and above the amount. are willing to contribute towards the capital cost out of their own pockets. They are ready to pay from Rs. 12 to 16 per 40 watt bulb per month which is several times higher than the standard NEA rate. This paper suggests that, due to the lack of operating knowledge the plants have been facing many difficulties like loan shedding. This paper concludes that the government is right in privatizing the installations of Micro-hydro units and it has to develop a comprehensive and integrated policy to promote micro-hydro development. This has to be complemented by realistic 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 larger schemes that integrate electrification with various rural industrialization activities.

Khennas, and Barnett (1990) reported on "Word Renewable Energy Congress vi, invited paper. They emphasized that MHP is an option for socio-economic development. The lack of energy supplies in rural areas is a chronic problem. In many developing countries less than 10% of the rural population has access to electricity. Rural electrification through conventional means such as grid connection or diesel generators is very costly. Fortunately, abundant water resources for energy production are available in some poor countries. Decnetralized small-scale water power or micro-hydro schemes (defined as plant between 10 kw and 100 kw) are a particularly attractive option in many rural areas. Water is a traditional source of power in some parts of Nepal, Peru, Sri Lanka etc. The paper highlights the importance of Micro-hydro power in the socio-economic development of isolated hilly and mountain areas. The paper is based on cases drawn from Asia. Latin America and Africa. Micro hydro is perhaps the most mature of the modern small-scale decentralised energy supply technologies used in developing countries. There are though to be tens of thousands of plant in the "Micro" range operating successfully in China, and significant numbers are operated in wide ranging countries such as Nepal, Sri Lanka, Pakistan, Vietnam and Peru. This experience shows that in certain

circumstances micro hydro can be profitable in financial terms, while at others, even unprofitable plant can exhibit such strong positive impacts on the lives of poor people.

Micro hydro plant can achieve a wide range of quite different objectives. But much confusion and misunderstanding aries when all micro hydro plant are lumped together. Analytically, it is therefore important to judge the viability of each micro hydro investment in terms of a specific objective. similarly, in the formulation of government or donor policy, it is important not to expect micro hydro to achieve may, often conflicting, objectives. For instance it is probably not possible to provide electricity to very poor people in remote locations through micro hydro and make a high return on capital.

Tack (1991) has highlighted on "Mini-And Micro hydro power in Nepal" that the energy plays a significant role in the economic development and technological advancement of societies and concomitant with these, it plays a crucial role in human welfare. Increased energy demand has not only exerted substantial pressure on Nepal's limited poorest resources but also has a negative effect on its environment and economy. Nepal has no fossil fuel of its own and fall requirements have to be imported. The search for other options, such as biogas, indicates that they have limited application in the more isolated and high altitude mountain areas. Renewable options, such as wind and solar power, are not technologically ready for mass dissemination. The use of micro-hydroelectricity is, therefore, the most promising option for the remote hill communities in Nepal for the foreseeable future.

WECS (1993) Report had been carried out more advantages to the use of alternative energy. It found that it is an appropriate scale, these can provide cleaner energy and are comparatively benign as regards their effect on the environment. Moreover, Nepal's rural economy does not provide enough economic basis for large scale investment for the exploitation of vast hydro-power potentials. In this context, alternative energy can play the role of a catalyst in rural development by providing a modern form of energy. It can effectively help in reducing the drudgery of the rural population and cutting down the time required to collect and use traditional forms of energy such as fuel wool, animal waste etc.

Provide a cleaner cooking and lighting environment to rural women: combat the environmental effects of CO2 emission, forest depletion etc. by reducing and replacing the use of the traditional as well as commercial forms of energy: save convertible currency resources by substituting imported fuels; and has the potential to create rural employment and increase productivity.

Rokaya (1994) has presented on "Mini- and Micro Hydro power for Mountain Development in the Hindu kush Himalayan Region". He remarked that per capita energy usage in Nepal was very low and was characterised by a heavy dependence on traditional biomass fuels which had many ill effects. Therefore, it was necessary to develop indigenous and viable sources such as MMHP, which had been around for centuries, and considerable expertise had been accumulated within the country in developing and installing modern MMHP plants. Rokaya added that, unit the present, about 37 plants had been installed in the government sector in the MMHP range (up to 1,000 kw capacity), and about 900 more were installed in the private sector in the MHP range (up to a 100 kw capacity). These plants were mainly for agro-processing, but about 100 or 50 also generated electricity. The privately installed plants were contributing significantly to meeting the energy needs in many remote areas. His majesty's Government of Nepal (HMG/N), had also contributed significantly towards the development of private MMHP through delicensing plants of up to 100 kw and by providing subsidies for the equipment. Installation rates had declined during the past five years.

He further noted that capital costs, as well as repair costs, for MHP were site-specific and varied considerably. During recent years, the cost per kw was between NRs 77,000 to 100,000 (45$1,530-2,000). Over all, MHP plants for agro-processing were reported to be viable both financially and technically. Some factors affecting the profitability of the plants could be improved through appropriate efforts; e.g., consistent and transparent government policies, effective management and monitoring of loan and subsides, promotional activities, adequate training facilities, and establishment of an independent institute to promote MMHP.

On the technical side, he remarked that lack of standardization and quality control, plus improper installation practices had caused frequent breakdowns and the repairs were not easy to carry out. Therefore, the owners faced considerable hardships in getting repairs done which were difficult, time consuming, and expensive. He stated that political commitment, institutional arrangements, financial support, coordination, training, and improvement of technology would be helpful in enhanced dissemination of MMHP technology.

Rijal (1998) carried out on "Renewable Energy Technologies". He states that the development and management pattern of the Hindu Kush-Himalayans (HKH) region, evaluated that the pace of dissemination of new and renewable energy technologies in the HKH region of china is slower than in the rest of the country. In China, excellent manufacturing capabilities exist for such technologies, but the lack of institutions in the HKH region to promote them as well as their low acceptability in the prevailing socio-economic conditions hamper large-scale diffusion there. The experience with RETs in the hills states of India shows that there are several short comings in are as such as policy and planning implementation procedures, and the institutional framework. There are technology specific barriers as well as problems common to all programs and technologies. Pakistan lacked a clear-cut and comprehensive national policy for development of renewable energy technologies. Because of this, the Director General's office for new and renewable energy resources is non functional. Nepal has made remarkable progress in the development and dissemination of some RETs such as biogas and less so in other cases such as micro hydropower. Some technologies are in the initial phases of dissemination, among the SPV home systems and peltric sets Report find out the principal barriers to the dissemin and promotion of RETs within the HKH region have been high up-front capital costs, inadequate rural credit systems, the lack of a continuous energy supply, an insufficient institutional base, and the sporadic availability of low cost information and services.

Rijal (1990) shows that traditional energy forms predominant in the energy sector in Nepal. About 91 percent of the total final energy consumption (260 million GI) in 1994/95 was met by traditional forms of energy such as fuel wood 81 percent, agricultural residues 4 percent and animal waste 6 percent, the rest

came from commercial sources such as petroleum products 7 percent, coal 1 percent and electricity 1 percent. There has been little change in energy transformation over the last decade. The share of traditional energy has declined only marginally, from about 95 percent in 1984/85 to 91 percent in 1994/95.

Neupane and et al (2002) have studied on "An opportunity of carbon trading through the promotion of Micro-hydro in Nepal. They emphasized that due to the voice raised against global warming and deteriorating ozone layer, the big polluting countries yet to ratify the "Kyoto protocal" on reducing the carbon emission to the 1990 level by 2008 to 2012. Renewable. energy (MHP) has established itself as the best choice for pollution prevention and climate change.

The study described that the carbon saving, which would otherwise be released into the atmoshpher due to the burning of possil fuels (e.g. kerosene and dissel etc.) and the saving of forest resources, due to the use of more efficient heater, lighting for cooking, reading and other domestic activities, certainly contribute to maintain the local environment. In this way, rural (renewable) sources of energy such as micro-hydro (MH) is very promising to act positively for the environment and play vital role in the global arena.

D.P. Adhikari (2003) has reported "Micro-hydro componen of Energy Sector Assistance Programme: A way towards the Future" in Nepal. His paper deals on the MHP development in the past in the context of Dainda supported Energy sector Assistance Programme (ESAP), which is executed by AEPC. This paper illustrates the issues on the MH sector, objectives and approaches of MH component of ESAP. The area centre approach has been wall tested and also emerged as an effective means for providing local support services especially on the issues such as information, dissemination, awareness creation and ensuring facilities supports and some pointers towards the future.

Rizal and et al. (2003) reported on "Micro-hydro Scheme for Rural Development: Environment. Friendly Energy Supply and option for socio-economic development in Nepal. They have explained about development of MHP in Nepal and to investigate the viability of MHPs through comprehensive analysis of cost structure of hydro plants, technical, human perspectives and social aspects in the context of Nepal. The extent of ecology and environmental

degradation through MH projects are very negligible, however there is a need to plan clear development strategies and important them to multiply the positive impacts on agro-processing, water supply and irrigation, community health, community forest, tourism, employment etc. In the context of socio-economic, the people of hill and mountain have opportunities to improve medical care, agriculture produce by irrigation, tourism, business access with media by more television and radio connections, of entertainment and connection to the global community.

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The micro-hydropower sector development started in the late sixties. In order to fill up the gap of the central nodal agency to promote and dissemination the alternative energy in the country, government of Nepal established alternative energy promotion centre (AEPC) under the Development Committee Action 1996. AEPC helps the government to programmes related to use of alternative energy technologies. AEPC works closely with various donors. INGOs, NGOs and private sector in order to implement various program activities.

Government of Nepal with the assistance from the kingdom of Denmark has jointly initiated Energy Sector Assistance Programme (ESAP). ESAP is the sector programme with a long term (10 to 15 years) vision and executed by the alternative energy promotion centre. The energy sector assistance programme aims at improving the living conditions of rural people by easing its access to rural energy technologies with better performance in terms of productivity, use versatility and environmental impacts.

Mini-Grid Support Programme (MGSPO), is a management unit under AEPC/ESAP, MGSP manages the programme activities of the micro-hydro component. Among many programmes ran by AEPC/ESCAP. Mini Grid support programme (MGSP) aims to promote and support the micro-hydro power supply for isolated and scattered settlements which are not connected to the national grid. At present MGSP has institutional linkage with Interim Rural Energy Fund (IREF), which is a functional unit providing subsidy to alternate energy technologies like micro hydro and solar energy.

Ghimire (2004) paper presented at National Training Workshop on the Integration of Energy and Rural Development of Policies and Program in Nepal. His paper deals on Nepal relies heavily on traditional energy resources, as no significant deposits of fossil fuel are available Nepalese use the lowest commercial energy (around 500 kw per capita per year) of all south Asians by far. The total energy consumption in Nepal for the year 2003/04 was 363 million Gj of which the residential sector consumed 90 percent and agriculture sector 1 percent. Based on the fuel type, biomass provided 86 percent of the total energy consumption, petroleum 9 percent, which is mainly consumed by urban areas, electricity only 2 percent and renewable 1 percent of the total energy consumption.

About 40 percent of the total population has benefited from electricity by the end of ninth pan. This 40 percent is reported to include consumption of 33 percent from national grid and 7 percent from alternative energy. About 85 percent of Nepal population lives in rural areas, and agricultural work is mainstay of the rural population. For the year 2003/04, total rural energy consumption is 288 million Gj of which the rural residential consumed 97 percent From end use perspective of the total energy consumed in rural Nepal, 63.9 percent was used for cooking, heating accounted for 8.5 percent lighting 1.31 percent, agro processing 3.4 percent, animal feed preparation 16.5 percent and others such as religious occasions and ceremonies 4.3 percent of total energy consumption of 288 million Gj in rural Nepal, biomass accounts for 98 percent while electricity accounts for only 0.1 percent of the total energy consumes and petroleum products comprise 1.6 percent and renewable source 0.5 percent of the total energy consumed.

Economic survey (2006) found that traditional commercial and renewable energy occupied 87.7 percent, 11.75 percent, 0.53 percent respectively of the total energy consumption in FY 2004/05. The share of traditional, commercial and renewable energy is expected to remain 86.71 percent 12.72 percent and 0.56 percent respectively in FY 2005/06. This shows that this year too, Nepalese economy heavily realies on traditional sources of energy as in the previous year.

Of the total traditional energy consumption in FY 2004/05, share of fuel wood was 89.0 percent, agriculture residue 4.34 percent and cattle residue 6.57

percent while in FY 2005/06 too the share of agriculture and cattle residues is expected to remain the same. Similarly, of the total commercial energy consumption in FY 2004/05, the share of petroleum products was 69.9 percent, coal 15 percent and electricity 15.4 percent. Whereas in FY 2005/06 the share of petroleum products, coal and electricity in total energy consumption is expected to be 63.9, 21.3 and 14.8 percent respectively.

Of the total energy consumption by sector in FY 2004/05 the share of household use was 90.3 percent, industrial use 3.5 percent, commercial use 1.6 percent and agricultural and other use 0.8 percent and 0.2 percent respectively. Whereas in FY 2005/06, household sector is expected to occupy 89.3 percent and industrial, commercial, agricultural and other sectors by 4.5, 1.5, 0.8 and 0.2 percent respectively.

Table No. 2.1: Structure of Energy Consumption:

Energy Sources	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Traditional	5576	5691	5811	5933	6059	6185	6268	6403	6540	6681	6824	7066	7240	7397	7558	7721
Fuelwood	4980	5084	2191	5300	5412	5525	5574	5694	5816	5941	6068	6315	6451	6591	6733	6878
Agri. Waste	224	228	233	238	143	248	273	279	285	292	299	305	312	319	328	336
Animal Dung	372	379	387	395	404	412	421	430	439	448	457	446	477	487	497	507
Commercial	349	419	430	483	581	651	691	769	818	1054	1016	1029	1015	1059	1014	1133
Coal	42	58	26	32	67	72	60	61	68	246	174	152	134	171	152	241
Petroleum	257	306	348	391	448	507	554	625	661	709	734	758	753	747	705	724
Electricity	50	55	56	60	66	72	77	83	89	99	108	119	128	141	157	168
Others	4	5	6	6	7	10	13	16	20	24	29	33	39	45	45	50
Total	5929	6115	6247	6422	6647	6846	6972	7188	7378	7759	7869	8128	8294	8501	8617	8904

* Estimate of first eight months.

Note:

1. Since the fiscal year 1993/94 structure of energy consumption is presented in Tonne of Oil Equivlent (TOE) instead of Tonne of Coal Equivalent (TCE). The basis of conversion is taken as 1 TOE equivalent to 1.454288 TCE.

2. The renewable energy has been included from FY 2004/05 in detail.

3. As data have been adjusted in accordance with the survey recently conducted by Water and Energy Commission it may not verify with the earlier stastistics.

Source: Economy Survey, 2006.

In order to mobilize smoothly efficiently and quickly the financial resources received from government of Nepal, and the governments of Denmark and Norway in Micro-hydro plants and also to coordinate with banks to ensure the availability of loans, an Interim Rural Energy Fund has been established and operated under the Alternative Energy promotion Centre (AEPC) with the setting up of IREF, it is expected that the access to new and sustainable energy systems of the rural people in particular will be increased. It will have very positive impact by providing electricity services in the areas whereas electricity has not connected from the national grid. It will directly contribute in income generation and employment. And through it, there has been improvement in living standard.

There has been population expansion and increase in different developmental activities which has increased dependency on traditional sources of energy. it is realized that there will be ecological imbalances due to increasing trend of forest depletion owing to increasing pressure on natural resources. Therefore, it is challenge to make available the electricity supply to the people easily and at affordable price by completing electricity projects under construction in a shortest possible time so as to minimize risks related natural imbalances.

Both Plant (2002-2007) set target ed alternative energy including rural electrification provide electricity services to 12 percent of rural people (existing 7%) install 4000 improved ghatta and MH capacity equivalent to 10 MW in 47 districts.

Interim Plan for 3 Years (2007-2010)

Access to electricity to additional 4.5 percent population by alternative energy and mainly micro installation of micro hydro power of 10 MW in 54 districts of Nepal set up energy and environment unit in all 75 districts to coordinate RET activities promotion of micro hydro CDM projects.

CHAPTER III

MICRO-HYDROPOWER IN NEPAL

3.1 Development of MHP in Nepal

Micro hydropower has existed in Nepal for centuries in the form of horizontal water wheels which are traditionally known as "paint Ghattas" which typically have power of 1 to 3 kw ranges, were not suitable for mechanizing agro-processing activities such as husking paddy and expelling oil. The institutional development of MHP started date back to 1962 when Swiss assisted to the establishment of a manufacturing company named Balaju Yuntra Shala (BYS) at Lalitpur in Kathmandu. In the beginning of the 1970s there were some private workspaces established primarily to produce and install small water mill units, widely known as "Turbine Mill" in rural Nepal. Multipurpose power units (MPPU) during the early 1980s, the available hydropower in 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. Hydropower up to 100 kw are known as micro-hydropower. In Nepal the classification of hydroelectric plants according to their capacity is as follows:

Type	Size
Micro-hydropower	Upto 500 KW
Mini-hydropower	Above 100 K.W. but not exceeding 1000 KW (1 MW)
Small-hydropower	Above 1 MW but not exceeding 10 MW
Medium-hydropower	Above 10 MW but not exceeding 300 MW
Large-hydropower	Above 300 MW

Likewise, the classification of micro-hydroelectric plants according to their capacity is as follows:

Type	Size
Very small micro hydropower	upto 8 K.W.
Small micro hydropower	8-20 K.W.
Medium micro hydropower	20-50 K.W.
Large micro power	50-100 K.W.

The modern MH was introduced in the country when Japanese propeller turbine was installed to generate electricity. The rapid dissemination of MHP took place through the technical and financial support of ADB/N under its Fourth Agriculture credit programme supported by Asian Development Bank, Manila. Further, impetus of MHP development for electrification started in 1981 with the government subsidy in electrification components and credit assistance of ADB/N. The government provided incentive to the entrepreneurs by waiving income tax on earning from MHP. With a view to improve access to capital for MHP entrepreneurs through the government, started providing loan for MHP under the priority sector interest rate.

During the first four years (1981-1984), only 10 MHPS were installed with total 9 kw electrical capacities, when government introduced subsidy policy. IN the year of 1985, altogether 23 schemes, generating 166 kw were installed. After the liberalization of economy the year 1996 saw a turning point for the development of MHPs in Nepal. Since the collapse of Arun-III project in 1995, the necessity and importance of development of micro-hydro future developed. The donors designed and alternative strategy as power development fund. Act and organization were and are being rewritten to attract the private sector. The efforts for development of MHP are continuing date. The organizations that have joined later in the development of MHP are remote area development committee (RADC), Intermediate Technology Development Group (IT DG/G), Centre for Rural Technology (CRTIN), WECS, UNDP, DANIDA, Interim Rural Energy Fund (IREF) at AEPC, Micro-hydropower manufactories. Association, REDP, Annapurna Area Conservation Project (ACAP)/KMINC, GTZ, USAID, Canadian cooperation office (CCO), Canadian Centre for International Studies (CCIS), Institute of Engineering and Others. MHP development has received an new dimension despite few hurdles due to the political instability in the country. There are currently more than 22,000 MHPs running smarthly in Nepal.

3.2 Government Plan and Policy

The importance of developing water turbines was felt during both the sixth and seven five years plans. The Fifth Five Year Plan (1975/76-1979/80). For the First time, considered the role of micro-hydro plants in rural electrification. The

goal of rural electrification according to the plan was to promote expansion of agriculture, commerce and small-scale industries under the guidance of the plant, the industries. Under the guidance of the plan, the small hydropower development board was established in 1975, which played a crucial role in the electrification of rural hill areas. The sixth five year plan (1980-1985) - Agriculture Development Bank (ADB) launched the rural electrification project: Waived Licensing requirement for micro hyro deregulated microhydro electricity price subsidy of 50-75 percent for add on electrifiction waived income tax for micro hydro projects. In 1984, HMG/N declined MH plants upto 100 kw to encourage the participation of private sector in rural electrification. The development of the energy sector was given special priority in the Eight Five year plan. The existing policy, no-license is required to operate a hydropower scheme of up to 1 MW capacity. 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 DANIDA, the subsidy policy as well as installation process have been revised. The government has approved subsidy policy for MHP in the year 2000. The subsidy policies of MHP are; NRs.55,000 per KW for new MH projects upto 3 KW. capacity (Mainly Peltric Selts), NRs.70000 per KW for new H projects above 3 KW, NRs.35000 per KW or 50% of cost for rehabilitation projects. Subsidy is being provided the transportation of equipment and material of project is being provided on the add on the basis of project located Rs. 21000 per KW if it is more than five days working distance and Rs.7850 per KW if the site is 2 to 5 days walking distance. No subsidy if the side is less than 2 days walking distance.

The tenth five year plan (2002-2007) emphasizes on:

- Increasing the consuming capacity of rural families by developing and extending the alternative energy sources, seen as a powerful tool for poverty alleviation.
- Supplying energy for commercialization of the domestic needs and the professions of rural population by developing alternative energy technologies based on local resources and tools.

- Reducing dependency on imported energy sources and reducing negative environmental effects by the proper use of resources and tools of local energy.
- Improving and increasing the access of rural people by reducing the cost of development and installation of alternative sources of energy.

In the Tenth Five Year Plan (2002-2007) HMG/N plans installation of

- 52000 units of solar PV home systems
- 2000000 biogas plants
- 250000 improved cook stoves in 45 districts of Nepal
- Installation of extra 10000 KW (10 MW) of electricity through pico and micro hydro installations in about 47 districts within the plan period.

Interim Plan for 3 years (2007-2010)

Access to electricity to additional 4.5 percent population by alternative energy (Mainly mini/micro, installation of mini/micro hydro power of 10 MW in 54 districts of Nepal Set up Energy and Environment Unit in 75 districts to coordinate RET activities promotion of Micro/Mini hydro CDM projects.

CHAPTER IV

METHODOLOGY

4.1 Research Design

This study has been carried out on the basis of exploratory as well as descriptive research design. The research study emphasized on to investigate the impact of Micro-hydropower users and benefit of them. Moreover the research has studied find out the trend of energy consumption pattern, women workload, time saving, health, educational and effect of MH.

Besides, the study has attempted to describe the things related to MH plants; such as installation capacity, community group, experiences, awareness, existing condition and investigation of explored findings is described.

4.2 Sampling Procedure

The universe of the study is Micro-hydropower users households of Dangapa VDC of Terhathum district. For this study, about 10 percent (31 HHs) of the total population (314) in whole VDC, is sampled, who have used Micro-hydropower with simple random, convenience, purposive and accidental sampling are used for HHs.

4.3 Source of Data and Information

Primary as well as secondary data and qualitative and quantitative data were applied for the research study.

Likewise, secondary data was also used for the study which was obtained from published and unpublished written documents like books, journals, dissertations, research reports, institutions, agencies, DDC, VDC.

4.4 Data Collection Techniques and Tools

a. Household Survey

Structured questionnaire was prepared to collect primary data for MHP user households. The questions were asked to respondents and answers were filled up to generate realistic and actual data.

b. Field Visit and Observation

Each household selected in sampling was visited and present energy scenario, socio-economic status of MHP users in Dangapa VDC were observed walking hours and hours. The photographs show that the pictorial representation of actual status of the local people in the VDC. The researcher visited to field to collect information about energy consumption pattern, rural electrification pattern, time consumption pattern, health, education, housing environment, awareness of MH users were observed very curiously.

c. Focus Group Discussion

The FGD discussion was conducted in separate place with the active participation of men and women who had been used in MHP. The discussion was focused more on men, women, advantages of MHP, drastic changes brought by MHP, education, health of children and their changing activities.

d. Questionnaire

Structured questionnaire was prepared to obtain the realistic and accurate date from household survey of the respondents; to make favourate situation, I had tried to stimulate the people to share information without any hesitation, heartly and humbly requested to fill the questionnaire by them.

4.5 Data Processing and Analysis

Data processing consists editing classification, coding frequency distribution and tabulation.

After collecting data the raw data was edited and coded then the data was put together in same kind of table. The help of computer program was taken and simple statistical tools like table, mean, median, percentage were used.

CHAPTER V

DESCRIPTION OF STUDY AREA

5.1 Introduction of Terhathum District

Terhathum district lies in Koshi zone of eastern development region of Nepal. Geographically this district lies on Middle hill region. This district is situated latitude between 26^{o}66' to 27^{o}30' north and longitude between 87^{o}25' to 87^{o}45' east. According to physiographic division of Nepal, the district is situated 322 m to 3034 m height from the sea level. This district is bored by Taplejung and Panchthar district in the east, Dhankuta district in the west, Taplejung and Sonkhuwasava district in the north and Dhankuta and Panchthar district in the south. The total area of district is 679 sq.km. About 51.05%, 37.96%, 5.5%, 4.14, and 1.35% of the total area covered by agriculture land, forest land, grazing land, shrubs respectively. According to the population census of 2001, total population of district is 1,13,111 of which 58179 (51.4%) are females and 54932 (48.6%) are males. The district consists of 32 village development committee. The density of population per square kilometer is 167. The major occupation of the people in this district is agriculture. Almost 86 percent of the total population are dependent on agriculture. The climate is cool temperate.

Source: DDC profile 2007

The electricity service has not suffently reached all VDC in terhathum district. Only about 1508 households of 10 VDC have got the electricity service from national grid. (NEA 2007). About 1227 HHs of 5 VDC have got electricity from 7 micro-hydropower plants and 3 peltric sets through the co-ordination between district development committee and Rural Energy Development Section (REDS 2007).

Table No 5.1: Present energy scenario of MHP in Terathum district.

S.N	Micro-Hydro project Name	VDC/ Village	KW
1	Khoranga khola MHP	Srijung - 7	25
2	Asine khola MHP	Asine, srijung-2	15
3	Naminta MHP	Ishibu-4	10
4	Sangapu MHP	Samdu-7,8	14
5	Falamesango MHP	Sandu-4,1,5	17.5
6	Lambu khola MHP	Sungam- 4,3,2,majhakhark	27
7	Lowar parewa khola MHP	Dangapa-1,2,3,5/9 of Basantapur VDC	35

Source:- AEPC 2008, ktm and REDS Terhathum, 2008.

Micro Hydropower

5.2 Introduction of Study Area

Dangapa Village Development committee is one among 32 VDC, of Terhathum district According to physiographic division of Nepal, this VDC is situated 1100 m above sea level and catchment area of MHP is 20 sq.km. This VDC lies in the south west part of the district. Sudap VDC in the south east, Sungnam VDC in the north east, Basantalpur VDC in the north, Phalek VDC in the north west and Angdim VDC in the west south bound this VDC and Humarjung VDC just touches the VDC in the south.

The total population of Dangapa VDC is 2741 of which 1405 are females and 1336 are males. There are 457 households in the VDC About 2125.59 hectare area of Danga VDC is covered by agricultural land where as low land (khet) 13.6 percent, upland (pakho) 40.24 percent, forest land 36.23 percent, grazing land

0.57 percent and other (miners/rivers/settlements etc.) 9.36 percent. This study area is not accessible by road for transporting the goods. A blacktop road is available upto Basantapur, Terhathum. From Basantapur, nornal trekker takes about 4 hours and loded porter takes about 7 hours to reach the VDC site. The climate is cool temperate. The average rainfull of the area is about 1,255 mm.

Many people in this VDC depend on agriculture. Major agriculture crops are paddy, Maize, Millet, Potato and Sweet potato. Cardamom is normally grown where these crops can't be grown in same field. Main source of income in this VDC is farming, animal rearing and some foreign jobs. Subsistence agriculture and livestock are the main occupation of the local people. The dominant ethnic groups of the study area comlprise Limbus, Chhetris, Kamis, Damai. Sarkis and Brahmins. The economic condition of the people varies from poor to medium, rich, the living standard of the majority people is average. There are one primary school, one secondary school, one health post, one VDC office and one post office. After using the MHP, Local people have comprised 23 MHUGs in this study area.

CHAPTER VI

ANALYSIS AND DISCUSSIONS

This chapter of the dissertation attempts to analyze the role of MHP on socio-economic chaptereristic of MHP users in Dangpa VDC on the basis of primary data collected by researcher during twenty five days field study. Thirty one households were selected of research based on probability and non-probability sampling in the study area. Structured unstructured questionnaires, observation and informal discussion were applied to achieve the objectives of the study.

6.1 Social Characteristics of the Sample Respondents

6.1.1 Age and Sex Structure of the Sample Population

Age and Sex structure are the basis demographic characteristics, which play crucial role in the population analysis because these traits directly influence the nationality, morality and marriage. Independent and active age group of population has a significant role in the rural development as well as national development. It represents the family size and structure of this VDC. Researcher has identified five group of population interval among sample households. The following table depicts age and sex structure of sampled respondents.

Table No. 6.1 Distribution of Sample Population by Age and Sex

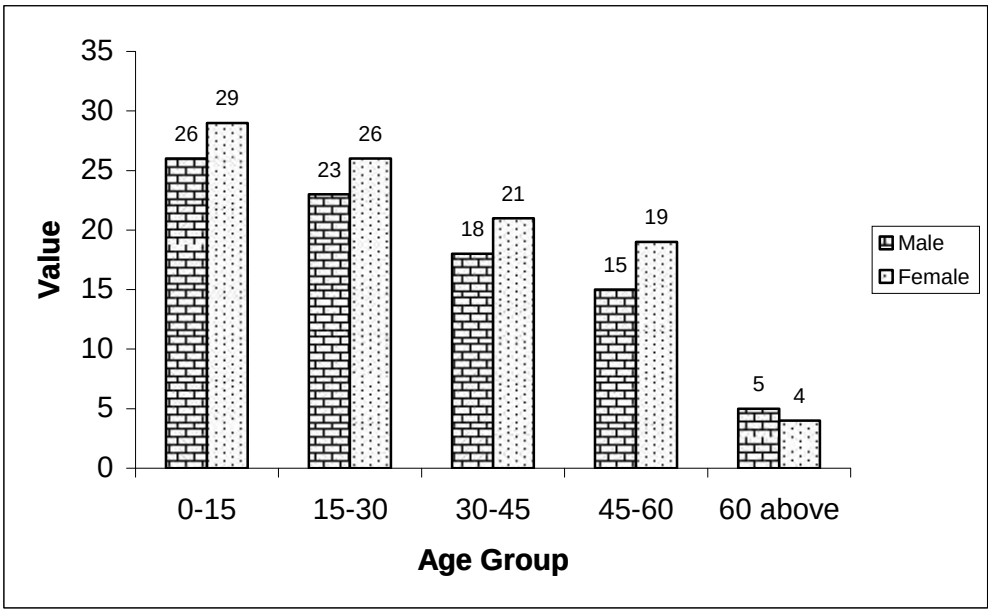
S.N.	Age group	Male		Female		Total	
		No.	Percent	No.	Percent	No.	Percent
1	0-15	26	29.89	29	29.29	55	29.57
2	15-30	23	26.43	26	26.27	49	26.34
3	30-45	18	20.69	21	21.21	39	20.97
4	45-60	15	17.24	19	19.19	34	18.28
5	60 above	5	5.75	4	4.04	9	4.84
Total		87	100.00	99	100.00	186	100.00

Source: Field Survey, 2008

In table no. 6.1, the sample population has been classified into five groups. Above table shows that the population of female (53.22) is greater than (i.e. 6.44)

male 46.78 in the sample population. The economically active human resource is considered to be 15-60 age group. Therefore the percentage of working population of the total sample population is estimated as 65.59 percent where, 30.10 percent of males and 35.49 percent of females are economically active and rest 34.41 percent are dependent on them. Analysis shows that, male population is less i.e. (4.31) than female of the total economically active population. It is also found that, below 15 age group (29.57) is greater than others which shows, the population growth rate is higher in the study are which is shown in bar-diagram below:

Figure No. 1: Distribution of Sample Population 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 any productive work and job. Among the dependent population 29.57 percent are children and 4.84 percent are olds, which are dependent on other, which demographic character, low percentage viz. 4.84 percentage of old age group, i.e. above 60 years, population denotes the relatively short life expectancy in the study area. The age group of 0-15 and above 60 are not involved in any income generating activities but our culture is bounded in such why that they are assured to be involved various type of household works, such as rearing of cattle and goats, looking children, bringing water, clining house, cooking food, fetching fuel-wood around them and so on.

6.1.2 Caste/Ethnicity of the Sample Respondents

Classification of population by caste and ethnicity is only tentative. The caste system of Nepal is basically rooted in Hindu religion; on the other hand, the ethnic system has been rooted mainly in mutually exclusive origin myths, historical mutual seclusion and occasional state intervention. Caste and ethnicity are most important component in rural development process in developing country like Nepal. This analysis has been taken into consideration in order to recognize the social conditions and cast comparison in the study area. Caste and ethnicity composition can be shown through the following table.

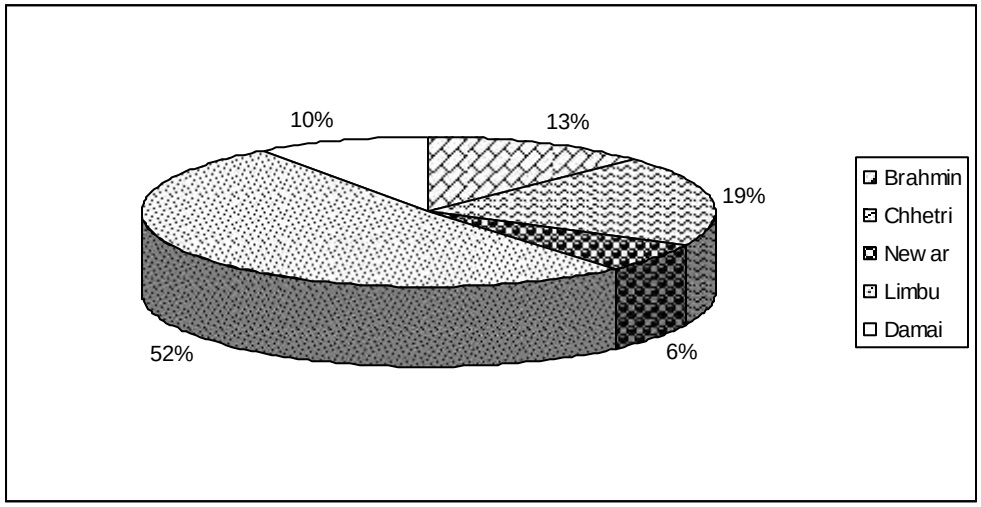
Table 6.2: Distribution of the Sample Respondents by Caste/Ethnicity.

S.N.	Caste	No. of Respondents	Percent
1	Brahmin	4	12.90
2	Chhetri	6	19.36
3	Newar	2	6.45
4	Limbu	16	51.61
5	Damai	3	9.68
Total		31	100.00

Source: Field Survey, 2008

Table No. 6.2 shows that Limbu is the dominant cast at the Dangapa VDC. Brahmain is a few than the others caste. The major caste/ethnic groups identified by the researcher in the study area are Brahmin (12.9%), Chhetri (19.36%), Newar (6.45%), Limbu (51.61%) and Damai (9.68%) respectively. All these castes belong to Hindu religion. Caste/Ethnicity of the sample respondents can also be shown in pie-chart below.

Figure No. 2: Caste/Ethnicity of the sample Respondents



6.1.3 Educational States of the Sample Respondents

Education empowers the human beings; it increases status of human life. Education provides people with the knowledge and skills to contribute and benefit from development efforts. It is a key indicator of human development. It has a positive role in the success of life. Primary education is a principle mechanism of fulfilling the minimum learning needs of the people needed for effective participation in the economic, social, political and civil activities.

Dangapa VDC has one primary school and one secondary school, survey found. These two schools have been spreading, light of knowledge for some years. Educational status of the sample respondents is shown by table no. 6.3.

Table No. 6.3: Educational Status of the Respondents

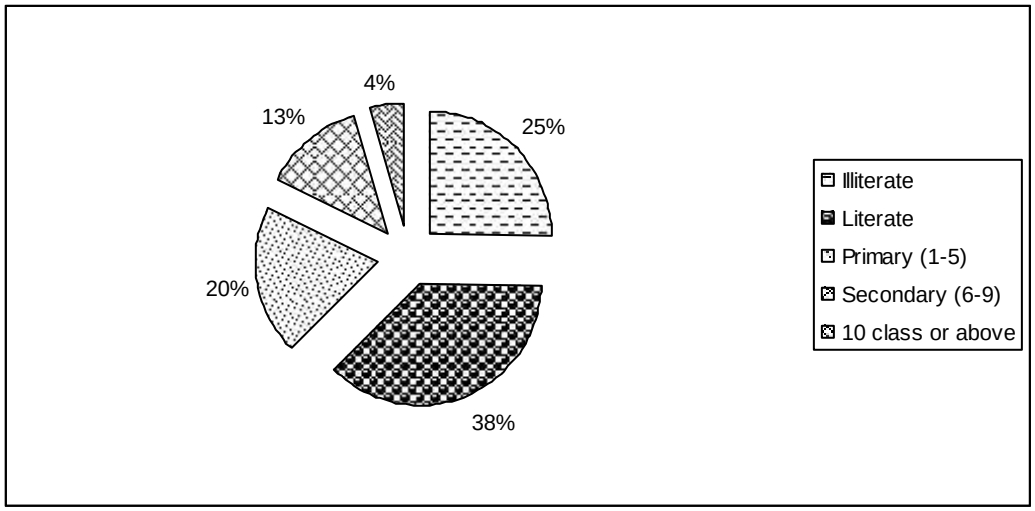
Education Level	No. of Persons	Percentage
A. Illiterate	75	40.32
B. Literate	111	59.68
C. Primary (1-5)	58	31.18
D. Secondary (6-9)	40	21.50
E. 10 class or above	13	6.99
Total (A + B)	186	100.00

Source: Field Survey, 2008

Above table has shown that 40.32 percent are illiterate and 59.68 percent are literate of the sample respondents in this VDC. Out of total literate population

31.18 percent are studying in primary level, 21.50 percent in secondary level and only about 6.99 percent have completed school level education. Educational status of the sample respondents is shown in pie-chart below.

Figure No. 3: Educational Status of Sample Respondents



6.2 Economic Characteristics

6.2.1 Land Holding Pattern of the Sample Respondents

Land is the most important source of wealth of a nation. Without abundant land, it is very difficult for the development of any country. It is argued that landholding is considered as the major indicator for the identification of poor in Nepal. It is an important factor of rural income and partly for employment generation. The following table illustrates the average landholding size of the VDC.

Table No. 6.4: Land Distribution of the VDC

S.N.	Type of Land	Area (Hectare)	Percentage
1	Agricultural Land	1144.42	53.84
	i. Low Land (Khet)	289.08	13.6
	ii. Up land (Pakho)	855.34	4.24
2	Forest Land	770.10	36.23
3	Grazing Land	12.10	0.53
4	Others	198.96	9.36
5	Total	2125.59	100.00

Source: VDC Profile, 2005

Dangapa VDC consists of the Land about 2125.59 hectare on the basis of land using pattern, there are four types of land (i) Agricultural Land, which is dived into two parts: Low land (khet) and up land (pakho) (ii) forest land (iii) Grazing land and (iv) others.

The size of landholding of farmers in Dangapa VDC is unequally distributed. Most of the families have their own hand but relatively some of them have not sufficient land. Land holding pattern of the sample respondents is shown by the table no. 6.5.

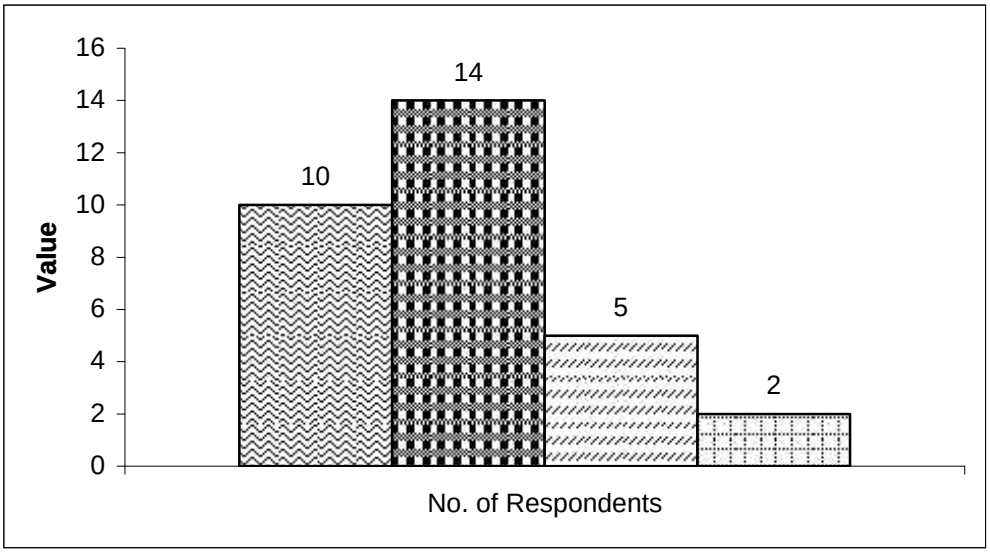
Table No. 6.5: Distribution of the Respondents by Size of Land Holding

S.N.	Size of landholding (in ropani)	No. of Respondents	Percentage (%)
1	below 5	10	32.26
2	5-10	14	45.16
3	10-15	5	16.13
4	15 above	2	6.45
Total		31	100.00

Source: Field Survey, 2008

Above table shows that, most of the respondents i.e. 45.16 percent have hold the land between 5-10 ropani. Similarly 32.26 percent respondents have less than 5 ropani land. Only a few percent i.e. 6.45 percent respondents are found who have more than 15 ropani and 16.13 percent of respondents have hold the land between 10-15 ropani, which can also be shown in bar-daigram below.

Figure No. 4: Landholding Pattern of Sample Respondents



6.2.2 Occupational Status

Occupational structure is a good indicator of employment both for men and women. Income sources depend on occupational status. Nepal is agrarian country so most of the villagers depend on agriculture. It is the way of life. It contributes 39.3 percent to the GDP. But this sector is very backward in the study area due to the lack of irrigation, agriculture inputs, training, awareness. The following table shows the occupation of the respondents in the study area.

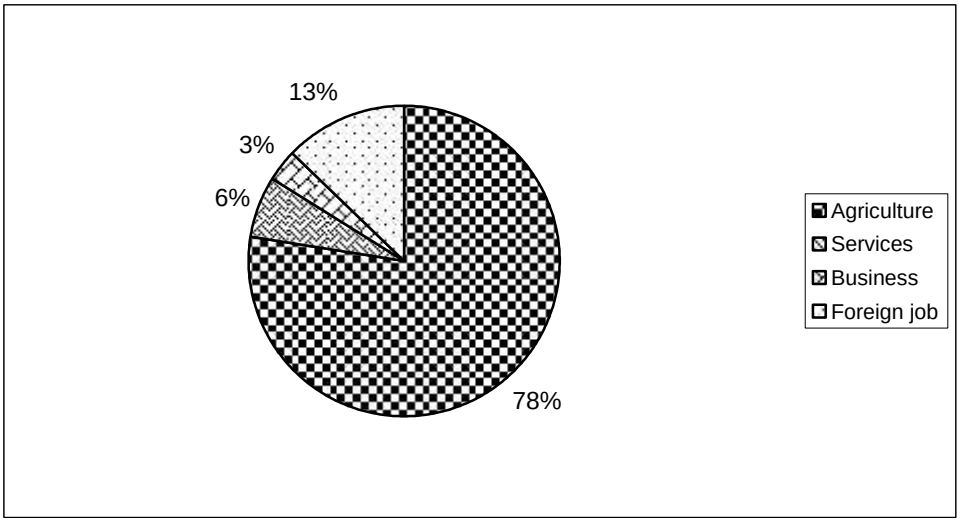
Table No. 6.6: Distribution of Respondents according to occupation

S.N.	Occupation	No. of Respondents	Percent
1	Agriculture	24	77.42
2	Services	2	6.45
3	Business	1	3.23
4	Foreign job	4	12.90
Total		31	100.00

Source: Field Survey, 2008

Above table states that, the agriculture and foreign job are the main sources of income in sample respondents. On the basis of occupation, the respondents can be divided into four catagorizes such as agriculture, foreign job, services, and business, survey found that the highest number (77.42%) of population are dependent on agriculture and lowest number of population are engaged in business (3.23%). Only about 6.45 percent of sample population are employed in service sectors where as 12.90 percent are involved in foreign job. Occupational status of the sample respondents can also be shown in pie-chart below.

Figure No. 5: Occupational status of the Sample Respondents



6.2.3 Livestock Situation of the Sample Respondents

There is no large scale of animal husbandry in the study area. Almost of all people are farmers. They keep buffaloes, cows/Oxes, sheep. goats, Hen/ducks, pigs for getting fertilizer, milk and meat. Milk and mean are the main income generating source of the local people. Livestock situation of sample respondents is shown through the following table.

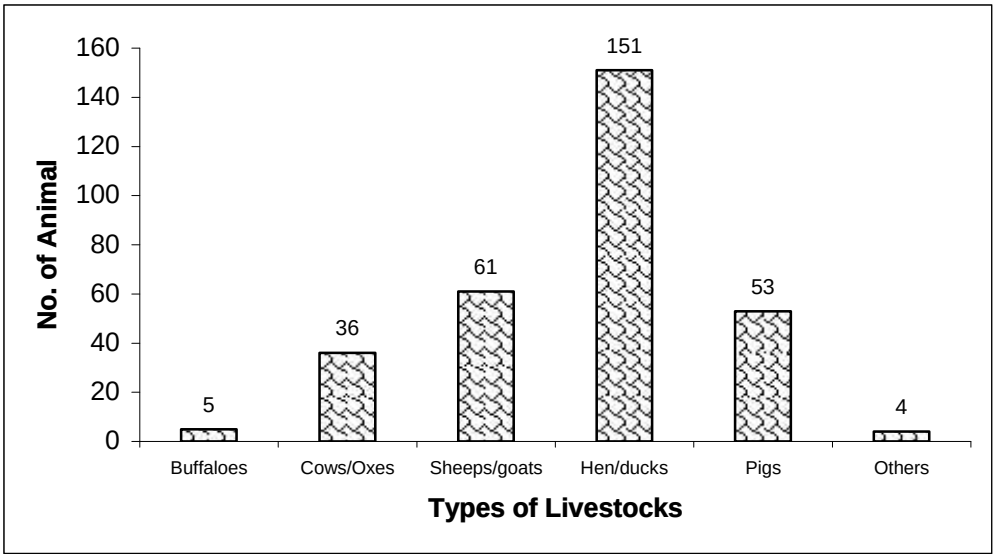
Table No. 6.7: Livestock Situation of the Sample Respondents

S.N.	Type of Livestocks	No. of Animal	Percentage (%)
1	Buffaloes	5	1.62
2	Cows/Oxes	36	11.61
3	Sheeps/goats	61	19.68
4	Hen/ducks	151	48.71
5	Pigs	53	17.09
6	Others	4	1.29
Total		310	100.00

Source: Field Survey, 2008

Above table shows that, there are 1.62%, 11.61%, 19.68%, 48.71%, 17.09% and 1.29% of buffaloes, cows/oxes, sheeps/goats, hen/ducks and pigs in the study area respectively. The highest percentage of animals are hen/ducks and lowest percent of animals are others. In the study area. People keep buffaloes and cows for milk, oxes for ploughing, hen, ducks, pigs for meat and for selling. Livestock situation of the sample respondents can also be shown in bar-diagram below.

Figure No. 6: Livestock Situation in the Sample Respondents



6.2.4 Annual Income Level of Sample respondents

Income level determines the resource mobilization, living standard, education level and health also. Generally, it is found that high level of income increases the quality of life. In the study area, there are many source of income such as agriculture, government job (services), foreign job, business, labouring and others. It is very difficult to find out the actual income of the sample respondents because they don't have their income records and they don't like to answer about their economic status because of the fear of publicity of their properties. To estimate the respondents income, the probable source of a respondents income has to be considered, such as sales of agricultural products, animal products, salary, labour income. The following table depicts annual income level of the sample respondents.

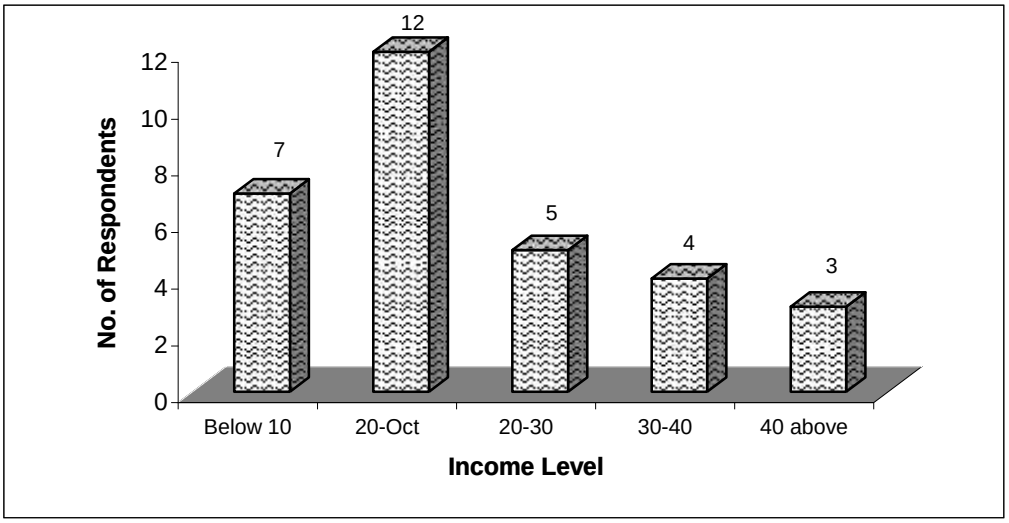
Table No. 6.8: Annual Income Distribution among Sample Respondents

S.N.	Income level (in Rs.: 000)	No. of Respondents	Percentage (%)
1	Below 10	7	22.58
2	10-20	12	38.71
3	20-30	5	16.13
4	30-40	4	12.90
5	40 above	3	9.68
Total		31	100.00

Source: Field Survey, 2008

Above table shows that the sample respondents, i.e. 22.58 percent have annual income level less than Rs. 10,000 and 38.71 percent have annual income level Rs. 10,000 to Rs 20,000. Researcher found that the households, who have low level of income are engaged in agriculture sector, that is substance sector due to the lack of agriculture inputs and market. 16.13 percent of the respondents have annual income level Rs. 20,000 to 30,000 and 12.90 percent have annual income level Rs. 30,000 to Rs. 40,000 only 9.68 percent households have the high level of annual income i.e. more than Rs. 40,000. Survey is found that the respondents who have high level of annual income are involved in business, foreign job, and service. Annual income level of the sample respondents can also be shown in bar-diagram below.

Figure No. 7: Annual Income Level of the Sample Respondents



6.3 Present Energy using Pattern in Study Area

6.3.1 Main Energy for Cooking Purpose

Fuel-wood, agriculture residues, animal dung are the main sources of energy for cooking purpose survey found. Forest land covers more than 36.23 percent in the study area. All HHs use fuel wood, agriculture residue and animal dung as a energy for cooking.

The following table reflects the main energy for cooking purpose of sample respondents.

Table No. 6.9: Main Energy for Cooking Purpose in Sample HHs

S.N.	Source of Energy	No. of Respondents	Percentage (%)
1	Fuel wood	29	93.55
2	Agriculture Residues/Animal dung	2	6.45
Total		31	100.00

Source: Field Survey, 2008

It is clearly seen from the above table only 6.45% respondents use agriculture residue and animal dung. Many sample respondents i.e. 93.55 percent sample respondents use fuel wood for cooking food.

6.3.2 Fuel wood using Pattern for Cooking Food

It is found that 93.55 percent samples respondents use fuel wood for cooking food of local people and animals. forest is the major source for the supplement of fuel wood in the VDC which has become one of the main cause for the forest depletion. Most of the forest covered area lies in the northern part of the VDC. Supply of fuel wood from their own resources is directly with land occupied by each households. Supply of the fuel wood depends upon land. The people with more land have access on more fuel wood. While having less land produces less fuel wood. There is a trend on planting tree for fuel wood and animal protection in the study area. The main source of fuel wood is forest involving community and private forest. It can be shown in the table.

Table No. 6.10: Fuel wood Source in Sample respondents

S.N.	Source	No. of Respondents	Percent
1	Private Forest	20	68.97
2	Community Forest	9	31.03
Total		29	100.00

Source: Field Survey, 2008

Above table reflects that the respondents have two types of forest. Most of the people have their own forest on their land. About 68.97 percent of the respondents bring fuel wood from their won forest or private forest. Only about 31.03 percent of the respondents fetch fuel wood from community forest.

6.3.3 Time Spent for Collecting Fuel wood (by sex)

Forest has covered about 36.23 percent in Dangapa VDC. Most of the forest lies in the southern part of the VDC. Most of the people in the VDC have own forest on their land, some of them go to community forest to fetch fuel-wood and some of them use others for cooking purpose. The respondents spent much time to bring fuel wood. This can be reflected in the table below.

Table No. 6.11: Time Spent for Collecting Fuel wood (by Sex)

S.N.	Time Consumption (In hrs.)	Male		Female		Total	
		No.	Percent	No.	Percent	No.	Percent
1	0-1	4	36.37	5	27.78	9	31.03
2	1-2	4	36.36	8	44.44	12	41.38
3	2-3	3	27.27	5	27.78	8	27.59
Total		11	100.00	18	100.00	29	100.00

Source: Field Survey, 2008

Above table depicts that all sample respondents who use fuel wood spent average 2 hours to fetch the fuel wood from the forest. It is clearly seen that only about 37.93 percent males and 62.07 percent females of the sample respondents involve to fetch the fuel wood. Survey is found that the respondents use the fuel wood in average. 7-8 bhari (300kg) per month/households. Most of the fetchers are women who spent their own time for collecting fuel wood.

6.3.4 Main Energy for Lighting Purpose

Main energy for lighting purpose is Micro-Hydropower in Dangapa VDC, which is implemented for lighting purpose, listening radio. Playing cassette player, C.D. Exactly. Total households of Dangapa VDC are 457, where as 314 households are users for using MHP. That's why, it is found that 68.70 percent of total households are benefited from MHP. Lower Parewa Khola Micro-hydropower was installed in the year 2064-12-15 B.S. through the joint investment of AEPC/REDP, District Development Committee Terhathum, Dangapa VDC Banks and local community. The MHP was constructed by Ag. power company in the VDC and it produces 35 Kw electricity. All of the sample respondents replied that MHP project is sufficient for lighting purpose. The present energy situation for lighting purpose can be shown through the table below.

Table No. 6.12: Present Energy Situation for Lighting Purpose in Study Area

S.N.	Type of Energy	Capacity	Benefited HHs	Percentage (%)
1	Lower Parewa Khola MHP	35 KW	314	68.71
2	Kerosene	3.5 lts/month/HHs	143	31.29
	Total		457	100.00

Source: DDC/REDP, Terhathum, 2008

It is clearly seen above the table the Micro-hydropower is the major source of energy in the study are for lighting purpose. It plays a crucial role in the study area. 68.17% sample respondents are benefited from MHP system. Only about 31.30 percent of the study area use kerosene for lighting purpose. It was found that, in average single households consume 3.5 liters kerosene per month.

6.4 Role of Micro-Hydropower

6.4.1 Time Spent for the Purchase of Kerosene before the Installation of MHP (by Sex)

Survey found that, all of the sample household in the study area used to kerosene for lighting purpose before the installation of MHP. In the past, most of the households used to kerosene and they spent much time to fetch it but after the installation FMHP system, this problem has found to be decreased, which can be shown in table below.

Table No. 6.13: Time Spent for the Purchase of Kerosene (by sex)

S.N.	Time consumption (in hrs/month)	Male		Female		Total	
		No.	Percent	No.	Percent	No.	Percent
1	0-3	2	14.29	2	11.77	4	12.90
2	3-6	7	50.00	9	52.94	16	51.61
3	6-9	5	35.71	6	35.29	11	35.49
Total		14	100.00	17	100.00	31	100.00

Source: Field Survey, 2008.

Above table shows that, all of the sample households spent average 6 hours/month for purchasing kerosene from the market. A survey as also found that they used to kerosene in average 3.5 liters per month/households. Only about 45.16 percent males and 54.84 percent females are involved for purchasing kerosene. It is clear that most of the females spent their own time for fetching kerosene before the installation of MHP system in the VDC. It is also found that all of the sample households have saved their time after the installation of MHP system where females have saved more time.

6.4.2 Surplus Time Utilization by the Sample Households

Survey found that all of sample household spent average 6 hours for fetching the kerosene before the installation of MHP system. Now a days they save their own time after the installation of MHP system and utilize surplus time for household activities, agricultural work, productive work, income generating activities and other social activities with neighbours and friends. Surplus time utilization pattern of the sample households are shown in the table below.

Table No. 6.14: Surplus Time Utilization in Sample HHs

S.N.	**Activities**	**No. of Households**	**Percentage (%)**
1	Agricultural Work	8	25.81
2	Household Chores	11	35.48
3	Productive Work	3	9.68
4	Income generating activities	4	12.90
5	Social Activities with neighbours/friends	5	16.13
Total		31	100.00

Source: Field Survey, 2008

According to above table, most of the sample households (i.e. 35.48) utilizes their surplus time on households chores and 25.81 percent households utilizes surplus time on agricultural work (vegetable/fruits/seeds production). About 9.68 percent and 12.90 percent households utilizes surplus time on productive work and income generating activities respectively 16.13 percent households spend their surplus time on social activities with neighbours and friends.

6.4.3 Advantages of MHP in the Study Area

In the study area, all people agree that, it is completely smokeless. Many of the sample households are influenced from its various advantages like, improvement in health, time saving, no need o kerosene, easy to work at night, most efficient on productive work and so on which is shown in table below.

Table No. 6.15: Impact of MHP System in Sample Households

S.N.	Impact	No. of Households	Percentage (%)
1	Improvement in health	4	12.90
2	Time saving	6	19.36
3	Easy to work at night	12	38.70
4	No-need of kerosene	6	19.36
5	Efficient on productive work	3	9.68
Total		31	100.00

Source: Field Survey, 2008

From the above table, it has been found that more than 38 percent of sample households are influenced from MHP system because it makes them easier to work at night. About 12.90 percent, 19.36 percent, 19.36 percent households are influenced by its advantages like improvement in health, time saving and no need of kerosene. Only about 9.68 percent of the sample households accepts that it increased their efficiency on productive work.

6.4.4 Involvement on Productive Work by Using MHP System

Most of the sample households accept 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. It is found that only a few

percent of the households are engaged on productive work 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. 6.16: Involvement of Sample HHs on Productive Work by Using MHP System.

S.N.	Productive Work	No. of Households	Percentage (%)
1	Furniture Industry	1	3.23
2	Knitting	7	22.58
3	Agro-processing Mill	2	6.45
4	Not involvement	21	67.74
Total		31	100.00

Source: Field Survey, 2008

Above table shows that, only about 3.23 percent of sample households involve in furniture industry and 6.45 percent households are engaged in agro-processing mill. A survey has found that 22.58 percent households are involved in knitting. About 67.74 percent households are not involving themselves in any productive work.

Women Knitting at night

6.4.5 Increase in Income Level of the Involved Household

The survey has found that the villagers have been able to increase their income level substantially from the various on farm and off farm activities only about 32.26 percent of the sample households are involving in productive work. All of them accept 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. 6.17: Increase in Income Level of Sample Respondents

S.N.	Increase Level (Monthly/Rs "00")	No. of Households	Percentage (%)
1	0-10	3	30
2	10-20	2	20
3	20-30	3	30
4	30-40	2	20
Total		10	100.00

Source: Field Survey, 2008

From the above table, it is clear that, most of the sample households who are involved in productive work i.e. 3 percent have increased their monthly income level in between 0 to 1000 and same percent of the sample households have increased income level in between Rs. 2000-3000. Likewise, about 20 percent have increased their monthly income level in between Rs. 1000 to 2000 and same percent of sample households have increased income level in between Rs. 3000-4000 after involving in the productive work.

6.4.6 Improvement in Health Condition after Using of Electric Bulbs

The use of clean energy produced by the MHP system has immensely improved the health of rural peoples 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 smoky kerosene lamp. Improvement in health of sample households after using the MHP system is shown in table below.

Table No. 6.18: Improvement in Health of the Sample HHs

S.N.	Age Group	No. of Households	Percentage (%)
1	Below 20	7	22.59
2	20-40	12	38.71
3	Above 40	4	12.90
4	Can not say	8	25.80
Total		31	100.00

Source: Field Survey, 2008

Above table shows that most of the sample households i.e. 38.71 percent, agreed that their health has been improved 20 to 40 age group after using the MHP system. Similarly, 22.59 percent of the sample households feel that their halth has been improved less than 20 age group. Likewise, 12.90 percent households have been improved their health above 40 age group. Only about 25.80 percent households can not say anything about it.

6.4.7 Increase in Better Education and Awareness Level

Education is the key indicator of human resource development. Survey found that, only about 59.68 percent people are literate in the study area. Most of the respondents replied that availability of bright light produced by electric bulbs for students to study longer hour in the evening. In average students study 1 hour more per day during evening by using electric bulbs. Incidences of better result of the students in the studies exam are reported after the use of electric bulbs.

6.5 Financial Analysis

Financial analysis of lower Parewakhola Micro hydro Demonstration Scheme Dangapa VDC, Terhathum.

a) Power output 35 kw

S.N.	Particulars	Amount (Rs.)
1	Mechanical Works	500,900
2	Electrical Works	2,417,150
3	Transmission/Distribution Works	1,337,664
4	Transportation	140,000
5	Tools/Spare parts	50,000
6	Installation/commissioning	119,000
7	VAT for non local items	351,902
8	Contingencies	228,236
	Total	5,144,851

b) Mobilization of Resources

S.N.	Source of Fund
1	Subsidy from AEPC/REDP
2	Investment from DDC
3	Investment from VDC
4	Cash Contribution from Community
5	Loan from ADB/N
6	Community Equity

c) Annual Expenses

Components	
Salary-manager	Rs. 30,000
Salary-operator	Rs. 54,000
Repair and Maintenance	Rs. 154,345.53
Office expenses	Rs. 8,000
Miscellaneous	Rs. 5,000
Annuity payment	Rs. 155,369
Depreciation	Rs. 179,656.73
Total Annual Cost	Rs. 586,371

d) Annual Income from HHs lighting

Households	314
Total power consumption	31,400 watts
Annual income	Rs. 471,000

e) Incomes from productive End use/Enterprises from

Agroprossing = Rs, 209,952

Total Income = Rs. 680,952

Net Annual Saving = Annual Income - Annual cost

= Rs. 680,952 - Rs. 586,371 = Rs. 94,581 per year

6.6 Institutionalization at Community Level and Resource Mobilization

As regards the promoting alternative energy resource in this VDC, district based program like alternative energy support program, DDC program, and other local NGOs activities are frequently lunched. Dangapa VDC is not getting adequate attention from the government in terms of development funds for the VDC.

People in the area, during study expressed their view that merely project implementation does mean anything. It is very important that the project selected is a sustainable one. Respondents also expressed their option that alternative energy source should be provided for the villagers in order to reduce pressure on forest.

The REDP is carrying out the CM process in the area since Nov 2000 in the VDC. So far, 21 community organizations (11 male and 10 female) have been formed and are operational in the project area.

These organizations play as a role of catalyst for decision making, fund mobilization, information sharing, coordination and capacity building. Similarly, lower Parewa Khola Micr. Hydro functional group has been formed with equal representation from the entire participating COs to forge ahead the implementation of the MHVEP in the area. These COs have mobilized 377,302 (Female COs-Rs. 13769) and male (COs-Rs 239.661) in the weekly savings and invested Rs. 991,622 cumulatively (female COs-Rs. 453,625 and male COs-Rs 537,997) amongst the members to carry out various income generating activities. Besides these, the COs are carrying out various socio-economic activities in the community, especially through the mobilization of local resources as well as resources from different agencies.

CHAPTER VII

CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

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. The today's issue in the rural areas of Nepal is in fact rising above the subsistence economy. Therefore energy should to be included in the list of basic needs. It is important to disseminate this concept through energy education.

The importance of the energy as one of the prime movers in the process of the economic development and its per capita consumption has been regarded some times as one of the indices of economic development. Nepal is regarded as a poor country because per capita consumption of energy is low as compared to other nations. Nepal's per capita energy consumption stands 15 GJ but it has been increasing every year. Energy consuming pattern is also regarded as one of the important indicators on measuring development status of the country. In the Nepalese context important energy source, especially in the rural sector should never be neglected.

Micro-hydropower (MHP) has been able to bring about profound socio-economic changes. The implications of MHP for rural development are: introduction of a modern technology in rural context. This develops technical capabilities in the village needed for rural industrial development, introduction of industrial management concept. This prepares rural community for undertaking rural industrial activities, nurturing of entrepreneurship in rural areas and retention of entrepreneurs in rural areas. Report reflects the over view of Nepalese rural energy sources status and discusses various energy issues through a case study of Dangapa VDC of Terhathum. The study analyzed the socio-economic characteristics of the study area. The study was based on the role of lower Parewa Khola MHP in Dangapa of Terhathum District. The study revealed various merits

of MHP system. It not only provided energy for lighting but also helped in improved health conduction, save time, easy to work at night and more efficient on income generating as well as productive work.

From the study the general conclusions are as follows:

- Population of the male was less than female in the VDC, the economically active population was 65.59 percent where, 30.10 percent of males and 35.49 percent of females and rest 34.41 percent are dependent on them.
- Educational status of sample households is found to be higher (i.e. 59.68%) than that of national average rate (55%).
- Ethnic composition of the study area shows that Limbus are more (i.e. 51.61%) than other caste and the Newar is very low (i.e. 6.45%) in the VDC.
- Agriculture is found to be main occupation and the source of income. Most of the households i.e. 77.42 percent are dependent on agriculture sector which is lower than that national average (i.e. 81%).
- Forest land of the VDC is 36.23 percent which is less than national scenario (i.e. 39.6%).
- The high land holding households of the study area are only about 6.45 percent who have more than 15 ropani. All of the people of the VDC have their own land.
- Most of the respondents i.e. 38.71 percent of the sample households have annual income level Rs. 10,000 to 20,000.

However, the specific conclusions are:

- Fuel-wood is main energy source for cooking food, which contributes 93.55 percent.
- Most of the females (i.e. 54.84%) are involves for fetching fuel-wood and they spent 2 hours/day in average.

- Survey found that, more than 67.67 percent of the total households are benefited from Lower Parewa Khola MHP system.
- All of the sample household agreed that MHP system is sufficient for lighting purpose.
- Most of the females (i.e. 54.84%) are involved for purchasing kerosene before the installation of MHP system and they spent average 6 hours/month for purchasing kerosene.
- Most of the sample households (i.e. 35.48%) utilizes their surplus time on households activities and only about 9.68 percent households utilizes surplus time on productive work.
- More than 22 percent of the sample households were influenced by MHP system because it provided light for them to work at night.
- Students study one an hour more per day during evening by using electric bulbs.
- Consumption of kerosene has been reduced by 3.5 liters per month in each family.
- Only about 9.68 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. 2500/month in average) after introducing MHP in the VDC.
- Most of the sample households i.e. 38.7 percent agreed that their health has been improved 20 to 40 ages after using the electric bulbs.
- Various type 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.

7.2 Recommendations

- Rural energy development program will help for rural electrification, environment management and poverty alleviation to some extant in the rural part of the county; 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 felt 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 on pricing, market arrangement and energy quality regulation needs to be developed for the sustainable energy development in the rural part of the country.

- An integrated approach to promoting 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 procedrues for laon sanctioning should be developed and institutionalized.
- Promotion of smaller units such as the improved ghatta, to replace traditional ones 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 needed in both public and private sectors particularly at the operative level to improve present standards.
- Product warranty should be made mandatory for manufacturers 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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APPENDIX A

Household Survey Questionnaire

A. Structure Questionnaire

1. Personal Information

   a) Name of the household head: ……

   b) Sex: [ ] Male [ ] Female

   c) Age: …….

   d) VDC:……,Village: ……

   Ward No.: ……

2. Name of the respondent:

   a) Sex: [ ] Male [ ] Female

   b) Age: .....

   c) Caste: [ ] Brahmin, [ ] Chhetri, [ ] Magar,

   [ ] Gurung, [ ] Chhantyal, Others…….

   d) Religion: [ ] Hindu, [ ] Buddhist, [ ] Islam,

   [ ] Christian, Others ……

   e) Education Level: …….

   f) Relationship with household head: ……..

3. Family structure by age, sex and education:

Age group	**Male**	**Female**	**Education**	**No. of persons**
0-15			A. Illiterate	
15-30			B. Literate	
30-45			Primary (1-5)	
45-60			Secondary (6-9)	
60 above			10 class or above	
Total				

4. Main occupation of family:

   a) Agriculture [ ] b) Business [ ]

   c) Service [ ] d) Foreign job [ ]

   e) Labouring [ ] f) Others …….

5. Annual income of the family Rs. …….

6. Land ownership of the family (in ropani) ……..

7. Total number of livestock:

S.N.	Type of livestock	Number
1	Buffalo	
2	Cows/Oxes	
3	Sheep/Goats	
4	Hen/Ducks	
5	Pigs	
6	Others	
	Total	

8. Which is the main source of energy in your family?

a) Traditional energy:

Fuel-wood [ ] Animal wastes [ ]

Agricultural residues [ ] Others ……

b) Alternative energy:

Biogas [ ] Micro-hydropower [ ]

Solar Home System [ ] Improved cooking stove [ ]

Others …….

c) Commercial energy:

Petroleum products [ ] Coal [ ]

Electricity [ ] Others …….

9. Per month fuel-wood using and collecting pattern of the family by sex, quantity, source, cost and time cost.

Sex	Quantity (In Bhari)	Time cost (in Mins/hrs)	Total cost (In Rs.)	Source
Male				
Female				

10. What kind of energy do you use to cook food?

a) Fuel-wood [ ] b) Biogas [ ]

c) Animal wastes [ ] d) Agricultural residue [ ]

e) Kerosene [ ] f) Electricity [ ]

g) Others ……

11. What type of energy do you use to lighting?

a) Biogas [ ] b) Electricity [ ]

c) Kerosene [ ] d) Solar Home System [ ]

e) Micro-hydropower [ ] f) Others .....

12. Details of MHP installation

a) Installation year: …….

b) Total capacity:

c) Constriction company/institution:

d) Total individual contribution:

e) Subsidy level:

f) Loan provided institutions:

13. For what purpose do you use MHP?

a) Lighting [ ] b) Pumping [ ]

c) Cooking food [ ] d) Others …….

If "lighting", is the system sufficient for your lighting purpose?

a) Yes [ ] b) No [ ]

c) To some extant [ ] d) Can not say [ ]

14. What kind of energy do you use to lighting before the use of MHP system?

a) Biogas [ ] b) Electricity [ ]

c) Kerosene [ ] d) Others …….

If "Kerosene" per month kerosene using and collecting pattern of the family be sex, quantity, cost and time cost.

Sex	Quantity (In Bhari)	Time cost (in Mins/hrs)	Total cost (In Rs.)	Source
Male				
Female				

15. How do you utilize your leaser time?

a) Agricultural work [ ]

b) Household activities [ ]

c) Productive work [ ]

d) Income generating activities [ ]

e) Chatting with neighbours/friend [ ]

f) Others …….

16. What advantages of MHP attracted you most?

a) Improve health [ ] b) Time saving [ ]

c) Easy to work at night [ ] d) no-need of kerosene [ ]

e) Effective on productive work [ ]

f) Others …….

17. Do you feel relax in lighting after the installation of MHP system?

a) Yes [ ] b) No [ ]

c) To some extant [ ] d) Can not say [ ]

18. Do you feel that lighting with MHP system is smokeless?

a) Yes [ ] b) No [ ]

c) To some extant [ ] d) Can not say [ ]

19. How many electric bulb do you have used for lighting? ……

20. Do you think that its easy to work at night using electric bulb?

a) Yes [ ] b) No [ ]

c) To some extant [ ] d) Can not say [ ]

If 'Yes' which work do you favour:

a) Study [ ] b) Income generating work [ ]

c) Gambling [ ] d) Households [ ]

e) Others…….

21. Have you done any productive work by using MHP system?

a) Yes [ ] b) No [ ]

If 'Yes' which those work are?

a) Poultry firm [ ] b) Knitting [ ]

c) Furniture Industry [ ] d) Bakery industry [ ]

e) Saw-mill [ ] f) Agro-processing mill [ ]

g) Others ……..

22. Did you find that after the involving on productive work it help to increase your income level?

a) Yes [ ] b) No [ ]

c) To some extant [ ] d) Difficult to say [ ]

If 'Yes' how much? Rs. …….

23. In your opinion are there any adverse effects of MHP system? Has if any disadvantages? If 'Yes' specify ……

24. MHP system has played vital role for rural electrification. Do you agree?

a) Yes [ ] b) No [ ]

If 'Yes' specify …….

B. Unstructural Questionnaire

1. How much time was available in home per day to study your children before the use of electric bulb? …… hrs/day.
2. How much time was available in home per day to study your children after the use of electric bulb? ……. Hrs./day.
3. Which type of training/ programme have you joined under this programme?

……

4. Did you find that after using the electric bulb help to your family member's health?

a) Yes [ ] b) No [ ]

c) To some extant [ ] d) Can not say [ ]

If 'Yes' what percentage? ……..%

5. Do you have any specific organized group to manage and promote of energy?

a) Yes [ ] b) No [ ]

If 'Yes' in which do your belongs to?

……

6. What type of contribution are your providing to your group?

a) Labour [ ] b) Financial [ ]

c) Technical [ ] d) As advisor [ ]

e) Others .....

7. What type of activities are starting in your group?

……..

8. Who are more benefited in your family after the use of MHP system and why?

……

9. What is your suggestion for the rapid expansion of MHP in the district?

……

10. What type of help and incentive do you expect from governmental, non-governmental and private institutions?

…….

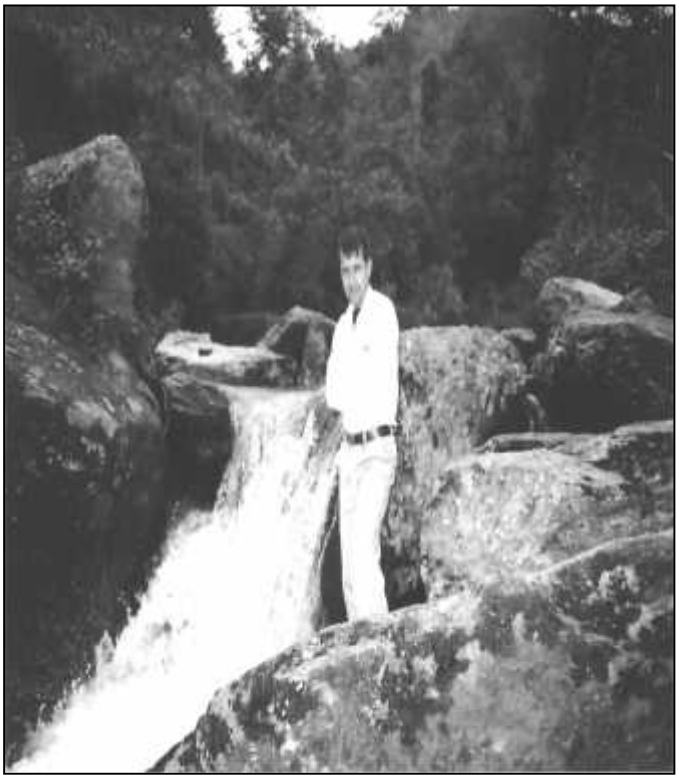
APPENDIX V

Penstock Pipe of MHP

Researcher asking questions for focus group.

Researcher having a meal among Limbu's family.

Porter carrying old patient from long distance.



Lower Parewa Khola of Dangapa VDC.

Introduction

Natural resources are major factors for development. Energy is one component of the natural resources which is determining factor for the rural development as well as national development. Development is the function of energy D = F (E). It is basic need for all sectors such as agriculture, social services, transportation, communication, industry, trade and commerce. Development of country depends on per capita energy consumption of people. Therefore quality of life is a question of use of energy. Energy sources in Nepal can be broadly categorized into three groups such as tradition biomass energy, commercial non-biomass energy and renewable or alternative energy. Alternative or renewable energy is defined as energy for non exhaustive natural resources like water, biomass, solar, wind, geothermal etc. and technologies that makes use of these resources and defined as renewable or alternative energy technologies (RET).

Micro-Hydro power is an alternative or renewable energy technology. Plants up to looked are called micro hydro plants in Nepal. Micro-hydropower plays a crucial role in the rural people of hill and mountain areas where people are deprived from electricity. Micro-hydro power is not only used for lighting but also used for heating, cooking, listening radio, watching T.V. In developing country like Nepal. People can not consume commercial energy petroleum product like coal, oil, L.P. Gas because of energy crisis and expensive. Micro hydro power is the ideal answer to present energy crisis of Nepal. MPH is most reliable and potentially cost effective.

Nepal's per capita final energy consumption of about 15 GJ. Only four other countries in the world have a per capita consumption lower than Nepal.