CHAPTER I

1. INTRODUCTION

1.1 Background

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

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

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

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

unsustainable rate, while the vast potential of other forms of renewable energy remains virtually un used.

Energy sources in Nepal can be broadly categorized into three groups such as traditional biomass energy, commercial non-biomass energy and alternative energy. Traditional energy includes fuel wood, agricultural residue and animal waste. Commercial energy comprises electricity, petroleum products and coal. Alternative energy sources include biomass, geothermal, micro-hydropower, Biogas, Solar and wind energy, the overall energy situation in Nepal indicates that there is a predominant dependence on traditional energy sources. This in fact constitutes about 95 percent of the total energy consumed in the country. Nepal relies to a large extent on traditional energy resources, as no proven significant deposits of fossil fuel are available the total energy consumption in Nepal was 8.505 million TOE in 2002; (about 15 GJ Per capita) and it is expected to increase by 4.5 percent to 8.575 million TOE in the year 2003. Traditional energy provided 85.27 percent, commercial energy provided about 14.24 percent and renewable / others provided only 0.48 percent of the total energy consumption in 2002. The energy consumption in Nepal is estimated at about 75.78 consumption in Nepal is estimated at about 75.78 percent from fuel wood, 5.74 percent from animal waste, 3.75 percent from agricultural residues, 9.24 percent from petroleum products, 3.53 percent from coat, 1.47 percent from electricity and 0.48 percent from renewable/ others sources. Similarly, fuel consumption by sectors i.e. residential, industrial, commercial, transportation, agriculture and others ate 89.05 percent, 1.33 percent, 3.44 percent, 0.79 percent and 0.13 percent respectively (RETRUD 2003).

About 48.5 percent of the total populations has benefited from electricity by current three year plan (three year interim plan 2064/65). The rural population, which comprises about 85 percent of the total population, has very limited access to electricity. Alternative energy is the ideal answer to the present energy crisis of Nepal. The alternative is defined as energy from non-exhaustive natural resources like water, biomass, solar, wind, geo-thermal etc, and technologies that make use of these resources are defined as renewable energy technologies (RET). The most important alternative energy technologies in the context Nepal are related to micro-hydropower, Biomass energy, solar energy, wind energy and Geothermal. The use of AETs have been gradually increasing for the last two decades all over the world. The reasons for rural electrification in Nepal is numerous improving the quality of rural life, expending rural employment opportunities and reducing deforestation are some of them. It will also assist the implementation of rural development programs by meeting energy needs for the development activities and at the same time creating employment and economic activities in rural areas. Alternative energy technologies (RETs) is a synonym for new, renewable and non-conventional forms of energy, i.e., the technologies which use local energy resources other than commercial fuels (petroleum products, gas, coal, etc.) and biomass fuels (fuel wood, agricultural residues, animal wasters) in traditional forms. The main sources of these alternatives are sun, air, water and biomass energy.

Solar and wind energy sources are technically complicated and highly expensive, Bio-gas is suitable only in warm areas. Furthermore, among all the popular renewable energy technology for electricity generation including, hydro, solar, biogas and wind. Hydro electricity is the most

proven, most reliable and potentially cost effective. Micro hydro systems have been in use in the Nepalese hills for centuries in the form of horizontal water wheels which are traditionally known as "Pani Ghattas". Various kinds of micro-hydro technologies such as propeller turbines, cross flow turbines, pelton wheels, multipurpose power units (MPPU) Peltric sets and improvements in traditional ghatta (water wheels) better system efficiency have been developed in the past to tap water resources more effectively.

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

Despite the substantial contribution that micro-hydro technology can provide to the country in meeting its energy needs, on definite plans and programs have been formulated by the government for its development. Even the last 10th five year plan (2002-2007) which envisages government effort in developing alternative and decentralized energy resources, has still to

provide detailed policy and programs including provision for an institutional set up for the development of alternative energy in Nepal. now a days, many of the private sector, governmental and non-governmental organizations are involved in the supply of micro-hydropower and its development activities.

1.2 Statement of the Problem

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

In the Nepalese context the energy consumption pattern is predominated by the traditional source of energy particularly fuel wood. The over exploitation of forest resource has caused serious environmental problems. About 68 percent of the people still depend on fire wood for primary purpose and this

pressure is increasing by 2.3 percent annually. The imbalance between energy demand and sustainable resource management is already a serious one on the other hand commercial sources of energy are not available within the country. The country has to spend a huge amount of foreign exchange in importing this energy. An assured supply of energy is essential not only for sustaining day to day life but also for successfully carrying out development projects. However, the hill region of Nepal is particularly disadvantaged on the energy front lack of transport facilities in this region limits the scope or the use of serial alternative energy sources. This region is also economically poor, hence the people can not afford the use of commercial energy sources. Solar and wind sources are technically and economically complicated. Bio-gas technology is suitable only for terai region.

In 1984, HMG declined micro-hydropower plants up to 100 KW to encourage private participation in rural electrification through micro-hydropower. The provision of subsidies for micro-hydropower in 1958 provided further encouragement. Through the government strategy for carrying out implementation works was not clear and specific enough, the existing infrastructure alone, starting from the availability of facilities for conducting surveys to fabrication, installation etc. was enough to promote the water turbine activities to a certain extent, particularly in the relatively accessible areas around the fabrication sites. It was, however, felt that a modified policy was needed to encourage such activities in more remote areas, including those in the mountains. To meet the increasing demand in the consumption of energy for various 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. As

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

1.3 Objective of the Study

The general objective of the study is to assess the socio-economic impact of micro-hydropower in Shankarpur V.D.C. of Baitadi district. The specific objectives of the study are:

- To identify the role of MHP in rural electrification.
- To assess the present energy situation in Shankapur V.D.C. of Baitadi district.
- To find out the people's participation for the development and promotion of MHP in Shankapur V.D.C.

1.4 Limitation of the Study

There are following limitation of the study:

- This study will only deals the problems, possibility and importance of MHP in Shankapur V.D.C..
- The study was limited to the specific area of Baitadi district, therefore generalization may not be equally applicable to other districts of Nepal.
- This study has considered the socio-economic, health communication. Environmental as well as educational aspect but excluded the technical aspect of MHP technology.
- This study was limited in terms of deeper analysis as only a few variable selected from the numerous factor affecting the MHP energy consumption in the study area.
- The analysis of data were based on simple statistical tools. As more complex and sophisticated tools were be adopted.

CHAPTER II

REVIEW OF LITERATURE

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

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

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

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

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

Rijal, (1999) shows that traditional energy forms predominate in the energy sector in Nepal. About 91 percent of the total final energy consumption (260 million GJ) 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.

WECS (1994/95) Report has analyzed, the main feature of the energy section in Nepal is the growing imbalance between- energy resource endowment and its current use. Heavy reliance on the dwindling forest resources to meet the growing energy needs despite abundant unexploited

hydro-power potential indicates a serious limitation to achieving the increase in the level of energy consumption necessary for higher economic growth and sustainable development. The present deficit in the fuel wood supply (6.6 million tones) is expected to continue given the excessive human and livestock population pressure on the accessible forests. Estimates indicate that the deficit will be concentrated in the terai and middle mountains, home to 85 percent of the population. Report has also found that the present energy situation needs to be rectified to allow the country to achieve its

development targets. To maintain the ecological balance and to make energy resources sustainable, there is a greater need to gradually move away from forest based energy sources. An attractive option, among may others, would be to resort to alternative energy technologies which have the inherent ability to perform effectively under such arduous conditions.

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

Amatya (1993), study focused that the most striking issue is the gap in coordination and inter-organizational communication between the agencies dealing with the planning and implementation of alternative energy in Nepal. Due to the lack of such coordination; most of the problems which require inter institutional coordination have remained unattended to and have adversely affected the production and promotion of AET devices which are already proven under Nepal's socio-economic setup. Probably, a lack of confidence in alternative energy and awareness regarding its potential at the decision making level is one of the reasons which prevented formation of such an institution. It is evident that adequate monitoring and evaluation by appropriate institutions and continuous support from the government and

non-government sectors will prove to be vital in the successful implementation of these programs.

ICIMOD (1991) was prepared for and presented at the seminar on "Rural energy and related technologies" held in Kathmandu - from 26 to 28 March 1991 in collaboration with the ADB/N and WECS of His Majesty's Government of Nepal. This paper assesses the development of the micro hydro systems for the last sixteen years, identifies factors that contributed to the success of this technology and also the factor affecting in its development and also indicates the priority areas for future development and promotional efforts. This paper is based on the information collected from 6 case studies. From these different 6 case studies, the paper presents some recommendations and suggestions. It recommends that the 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. People 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 sheddings. 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.

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

East consult (1990) analyzes the socio-economic impact of MHP plants on rural economy of Nepal. This study is more related to the issues of mill

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

It has been amply demonstrated that decentralized micro-hydro schemes could play an important role as a viable source of energy. !n order to expand this program to a significant scale, more research ad development efforts are required; to lower the investment required for the micro-hydro system by reducing the manufacturing cost of agro-processing equipment, to integrate its use with cottage and rural industries, and to improve the efficiency of traditional *"ghatta"* and increase the scope of their use. A number of other important issues also need to be addressed; How can its operation be expanded? How can private sector capabilities be enhanced to cope with increasing demand? Is the current institutional mechanism appropriate? How can commercial banks and government departments play a more active role? There seems to be a services lack of government interest regarding the development of MHP in Nepal both in terms of policy planning as well as implementation. The quantitative targets in the 10^{th} Five Year Plan is to produce 10 MW from micro hydropower in 47 district and install 4,000 improved ghatta (10^{th} Five Year Plan 2002).

CHAPTER III

RESEARCH METHODOLOGY

3.1 Study Area

Shankappur Village Development Committee (V.D.C.) of Baitadi district mahakali zone in far western development region of Nepal was selected as the study area. Baitadi district lies between $29^0$5' latitude and $80^0$15' to $81^0$45' longitude. This district is situated 390 m to 2950 m high from sea level.

It is located in the hill and mountain region of the country. The district is connected to the eastern border with Bajhang district, western border with India UP Pardash northern border with Darchula district, and south border with Dadeldhura district. The total area of the district is 1,519sqkms. According to the population census of 2001, total population of the district is 234,418 of which 113,538 are males and 12,880 are females. According to the population census, the economically active (Sixteen year to sixty years) males and females are 57,082 and 67,022 respectively in the district. The density of population per-square kilometer is 154 and 82.88 percent of total population and dependent on agriculture (District profile, 2006).

The electricity service has not sufficiently reached all over in the Baitadi district. Only about 5313 families of 20 V.D.C. have got the electricity services from national gird. (Source, NE Pvt Baltadi). Along with Bajagad (hate) of 20KW, Araid-gad (Kotila) of 15 KW, Jamadi-gad (mathairaj) of 21 KW, Surnaga-gad (Bishalpur) 13 KW, Surhaya-gad (Shankapur) 9 KW, surnaya-gad (Shankarpur) 10 KW, Thalali- gad (Thalakands) 22 KW,

Neulali-gad (Shivling) 18 KW, shalali- Khola (Shivling) 10 KW, Lupun-Khola (Shivling) 8 KW, yanna-gad (Ganjari) 15 KW. Capacity micro-hydro power projects have been lunched through coordination between district development committee (DDC), V.D.C., UNDP, AEPC, REDP, WB and the branch of rural energy development section. Similarly, 215 house have benefited from solar home system and 55 households have benefited from bio-gas and 500 improved cooking stove (ICS) also has been installed with the help if rural energy development section, Baitedi. More than 12 percentage house of the total population of the district has got electricity service in aggregate.

Table No. 3.1 Energy situation of the District

S.N	Details	No	Capacity K.W.	Benefited V.D.C.	Benefited Houses
1	Small hydropower	1	200	5	1520
2	Micro hydropower	11	178	11	1120
3	Solar home systems	215	32	17	806
	Total		410		3446

Sources: Surnaya gad small-hydropower project and rural energy development section Baitadi, 2008

Baitadi district consists of 62 village development committee. Shankarpur village development committee is one of them. The total area of Shankarpur V.D.C. is 183 sq km. This V.D.C. is connected to the eastern border with Shikharpur V.D.C., western border with Rauleshwor V.D.C., northern border with Kataujpani V.D.C. and south border with Shiddheshwar V.D.C.. (V.D.C. profile, 2006).

According to population census of 2001, the total population of Shankarpur V.D.C. is 2149 of which 1039 are males and 1110 are females. There are 437 house holds in the V.D.C. The total area of Shankarpur V.D.C. is covered by agricultural and forest land. The V.D.C. is 12 Kosh far from the district headquarter. As any other V.D.C., this Shankarpur V.D.C. is also regularly divided into nine wards.

3.2 Simple size

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

3.3 Methods of data collection

Relatively few publications were available in central libraries, institutions and department which have link with this study. Therefore the information has been collected from secondary sources but it will not be sufficient to fulfill the objectives of the study. Hence, a field based primary data was also collected. This activity was divided into two parts. The first part was structured interview with the intellectuals chairperson and the members of the V.D.C. and second part was the survey of the selected sample household of each ward which was selected by using probability as well as non-probability sampling method. That may be convenience, sample random and judgmental sampling respectively. All of the households in each ward (Where micro-hydro power is already connected) was numbered, denoted by "N" and 'N' of them was picked out randomly without replacement. The basic purpose of using non-probability sampling was to incorporate typical cases of the population, which has high level of significance, but not

included in the sample. In such circumstances those few cases was selected purposely.

3.4 Method of data Generation

This study needs both primary and secondary data. Primary data was obtained by user's survey and key informant interview using structured and un-structured questionnaire and interview checklist. Secondary data was obtained from published and unpublished literature available in concerned offices, institutions, departments and divisions.

3.5 Data processing.

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

3.6 Tools of analysis.

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

CHAPTER IV

MICRO HYDRO POWER IN NEPAL

4.1 Introduction of MHP

Micro-hydro systems have been in use in the Nepalese hills for centuries in the form of horizontal water wheels which are traditionally known as "pani Ghatta". Some 25,000 of there ghattas are estimated to be in operation. However, they have only limited application and produce about 1 horsepower, just sufficient for grinding maize and millet. With the development of cross flow turbines in 1961 and multipurpose power units (MPPU) during the early 1980s. The available hydropower 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. In Nepal the classification of hydroelectric plants according to their capacity is as follows.

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

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

The major components of MHP are diversion, intake, descending basis, canal, forebay, spillway, penstock, powerhouse, tailrace and transmission distribution system. Disservice structure is a structure designed to raise the water level in the stream in order to enable water to be diverted off the river. In MHP, as a rule, only temporary structures are built for this purpose. These structures are in most cases simply consists of boulder, mud pilling recombining the diversion practiced in traditional water mills. In some cases gabin wires are also used for diverting water. Intake is the point from where water flows off the river channel. Therefore intake is the beginning of the conveyanance of water diverted for MHP. Intake is normally provided with a gate to control the quanity of diverted water. Canal is the structure designed to deliver diverted water to the forebay of the MHP. In MHP sometimes pipes substitute canals. In hydropower the conveyance for delivery of water from river to the forbay is called headrace, penstock is a pipe for delivering water from the forebay to the turbine. It is made of steel or HDPE, and rarely of timber. The conversion of potential every of water in to kinetic energy takes place in the pen stock. The typical velocity of water in the penstock is around 3m/sec. In order to reduce the had loss in penstock it is desirable to make the penstock as short as possible. For this purpose penstock is located in a steep slop, which is very offten over 45^0conversion of mechanical energy of water into electrical energy takes place in the powerhouse. The major components of powerhouse are electrical generator, turbine electronic load controller and control panel. Electrical generator is a device, which converts mechanical energy input to its shaft into the electrical energy. conventional hydropower plants use synchronous generators. MHP use both syschronous and asynchronous generators. Turbine is a divice, which converts kinetic energy of water f 10 w into

kinetic energy of turbine shaft, which drives the generator shaft. The turbine types widely used in MHP in Nepal are pelton and cross flow. If cross flow turbines are used at lower heads the pylon turbines are used at higher heades. In stand - alone MHP pelton wheels are dominant owing to the prevalence of higher heads.

4.2 MHP Development in Nepal

The micro hydropower sector in Nepal has a long histry. The efforts to modernize traditional water mills started in 1960s. The histry of micro hydropower development started with the use of the locally developed water mills which are called "Gnattas" which typically have power of 1 to 3 K.W. ranges. were not suitable for mechanizing agro-processing activities such as husking paddy and expelling oil from oil seeds. The main focus of these efforts was development of indigenous capability to manufacture modern turbines. The success in this endeavor provided the impetus for development of MHP in Nepal.

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

The first MHP were of add-on types. Some of these used simply dc. dynamos. The capacity of add-on type of MHP seldom goes beyond 5 Kw.

These MHP ate by and large, designed to supply power to lighting end uses. Stand-alone MHP appeared in those places, where there was no milling needs or where the MHP site was far a way from the settlement or the power requirements were much higher than that add-on MHP could meet till 1984. The imitative for promotion of MHP was made mainly outside the government sector. During the above period significant contribution for promoting of MHP/turbine technology were made by Kathmandu metal industries, Balaju Yantra Shala, Butwal Engineering works, Development consultancy services (DCS), Research center for applied science and technology (RECAST) Swiss Association for Technical Assistance (SATA) and other organizations. There were basically there players who contributed to development of micro-hydro sector in Nepal at the beginning namely the Agricultural development bank (ADB/N), the private manufacturing companies and rural communities or entrepreneurs.

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

role in promotion of MHP. After the liberalizations of economies, the year 1990 saw a turning point for the development of MHP plants in Nepal.

With is policy introduced by the democratic government 1990 and a technological breakthrough in Micro-hydropower, progresses emerged and may plants come into widespread use that made it possible to generate electricity from the traditional water mills in addition to milling grains. Private sector is attracted due to the smallness and affordable investment opportunities. Since the collapse of Arun-III project in 1995, the necessity and importance of development of micro-hydro future developed. The donors have designed and alternative strategy as power development fund. Act and regulations were and are being rewritten to attract he private sector. The effort for development of MHP are continuing to date. The organizations that have joined later in the development of MHP are Remote Area Development Committee (RADC), Intermediate Technology Development Group (ITDG/N), Centre for Rural Technology (CRN/N), WECS, UNDP, DANIDA, AEPC, Micro-hydropower manufactories Association, REDP, Annapurna conservation area project KMTNC, GTZ, USAID and Canadian Cooperation office (CCO), Institute of Engineering and others. MHP development has received a new dimension despite few hurdles due to the political instability in the country. There are currently more than 2000 MHPs running smoothly in Nepal alone.

4.3 Present status and Potentiality

Nepal's topography is quite unique with high hills scattered settlements. It is estimated that in Nepal more than 6000 rivers and innumerable rivulets cross- crossing the country, whose total length is about 45000 KM. Water

power is the most abundant sources of energy besides the fire wood in the hills. Forest supply nearly 76 percent of the total energy requirement of the country and was provides 50 percent of fodder for livestock. The existence of more than 2500 traditional ghattas indicates the huge potentiality for the micro hydropower installation. The theoretical and economic potential of hydropower in Nepal are about 83000MW and 42000MW respectively. So far, however, only about 548MW (i.e. 1.3 percent of the total commercial potential) has been generated by the various hydropower stations. The contribution of poor generated from the micro-hydro power is only about 0.6 percent of total national power generation including diseur power.

There exists a huge hydropower potential and an ever increasing market, and as of mid July 2006, there have been a total of 5365 micro-hydro schemes, with an installed capacity of over 18683.12 KW, installed in various parts of Nepal since 1962 of them, 188452 KW are peltric micro-hydro schemes and 9297.9 KW mechanical. Table No 1 shows the status and trend of the MHP installations.

Table No. 4.1 Installation of MHP

year of installation (mid-July)	No-Peltric (KW)	Peltricset (KW)	Mechanical (KW)	Total(KW)
1998	2867.2	857.9	7,052.2	10,777.3
1999	386.5	226.4	14.3	627.2
2000	719.5	213.5	-	933.0
2001	891.0	81.2	10	982.2
2002	434.3	100.4	-	534.7
2003	231.1	25.0	-	256.1
2004	395.8	130.82	609.6	1136.22
2005	681.9	148.9	-	830.8
2006	893.4	100.4	1611.8	2605.6
total	7500.7	1884.52	9297.9	18,683.12

Installation mid July 2006

Source: AEPC/ESAP

4.4 Government Policy and Major Institutions

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

ADB/N, institute in 1981, the rural electrification project provided financial as well as technical assistance to promote rural electrification through micro-hydro power plants.

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

After the establishment of energy support assistance program (ESAP) with the support of DANIDA and NORWAY, the subsidy policy as well as increased investment in the construction of micro-hydro power and to facilitate more homes, a new rate of funding has been decided. This will encourage to include all the homes of the community and therefore this policy is inclusive also.

For the project of micro hydro power the following funding is arranged.

⇒ Total sum of NRs 8000 per house upto 5kw capacity. But total investment should not increase by NRs 65,000 based on per KW installation capacity.

⇒ NRs. 10,000 per house for more than 5kw up to 500kw will be allocated. But total investment should not increase by NRs. 85,000 based on per KW installation capacity.

⇒ If hydro power project is to be operated through improved water mills the project will be receive NRs. 4000 per house. But the total investment should not exceed NRs 40,000 per KW installed capacity.

⇒ NRs 10,000 per the increased number of stakeholders houses is allocated for the rehabilitation of 5kw micro hydro power projects. The total investment should not exceed NRs. 85,000.

⇒ Additional transportation funding will be allocated for the transportation of installation equipments. However, such assistance is based upon the per-day salary of porters from the near by highways to the project site. Projects. According to the geographical condition projects are classified.

Group 'A' All the projects running in NRs 300. Karnali zone and near by districts that are 50 pl 45 Kms. from highway.

Group 'B' Projects that are at the NRs. 1200, distance from 25 km to 50km.

Group 'C' Projects that do not exceed 25km no funding from hear by road.

In the current three year interim plan (2007 - 2010) Government of Nepal plans to install the following.

- The electric service will be provided extra 5 percent rural people by alternative energy. (1500 V.D.C. electricity will be supplied)
- In 54 district 11,500 KW (i.e. 11.5 MW) electricity will be generated by micro and small hydroelectricity.
- In 73 district, 90,000 solar electric system will be connected.

- In 75 district, 1,40,000 solar lamp will be distributed.
- In 30 district, 810 institutional solar electric system will be connected.
- In 40 district 1500 solar dryerl pressure cooker will be connected.
- In 70 district. 1,00000 bio-gas plant will be constructed.
- In 40 district, 4,000 improved water mill will be connected.
- 50 KW electricity will be produced by wind energy.

The maping and research work of wind energy in probability district.

- Mine and high hilly region, 3,00,000 improved cooking stove, bio energy system will be connected.
- In 75 district, energy and environment branch unit will be established under local body DDC, V.D.C. for energy plan formulation, progress, co-ordination, supervision extra activities.

CHAPTER V

DATA ANALYSIS AND PRESENTATION

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

5.1 Socio-Economic Characteristics of the sample population

5.1.1 Age, sex composition and education structure of sample HHs.

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

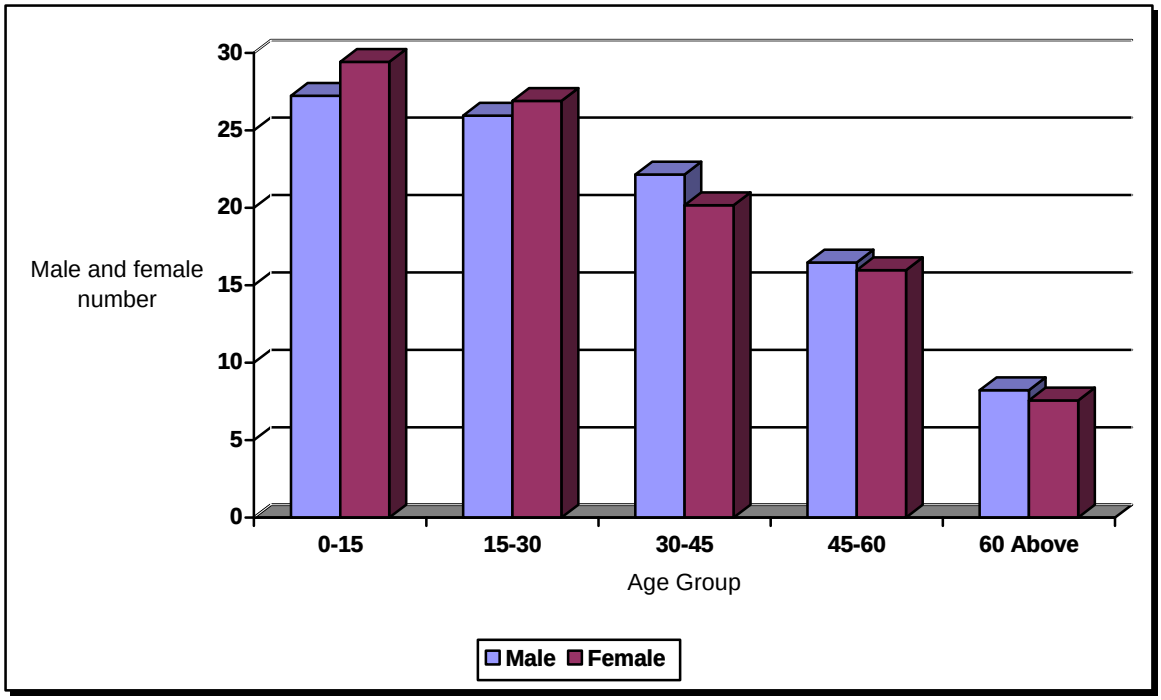
Table No: 5.1 Population Distribution by age and sex

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

Sauce: Field survey, 2008.

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

Figure No: 1 Population Distribution by Age and Sex



Survey has found that people below 15 years and above 60 years fall under economically inactive and are not usually see in the any protective work and job market. Among the dependent population 28.16 percent are children and 7.94 percent are olds. This low percentage viz, 7.94 percent of old age group. i.e. above 60 years, population that denotes the relatively short life expectancy in the study area. The age group of 0-15 and above 60 should re not involved in any income generating activities but our culture is bounded in such way that they are assured to be involved various type of household works, such as rearing of cattle and goat, looking children, fetching water, cleaning house, cooking food, collecting fuel-wood and so on.

Education is the key indicator of the human development It plays a vital role in the efforts of any endeavor to uplilt a society from reptession and scarcity, need less to say it has a society from repression and scarcity, need less to say

it has a positive role in the success of life. Food, shelter, clothing and education are the basic need of the people. Similarly, attention must be paid for the condition of literacy of the rural farmers as well as the schooling children. Even primary education is a principal mechanism of fulfilling the minimum learning needs of the people needed for effective participation in the economic, social, political and civil activities. Towards the survey found that , Shankarppur V.D.C. (Study ares) has a Sahskarpur higher secondary and other 6 primary schools in different wards. Table No. 3 Shows about the educational status of the sample house holds.

Table No 5.2 Educational status of sample households

Level of Education	**No of Persons**	**Percentage (%)**
A. Illiterate	135	84.74
B. Literate	142	51.26
Primary (1-5)	63	22.74
Secondary (6-9)	47	16.97
10 Calss or above	32	11.55
Total (A+B)	277	100.00

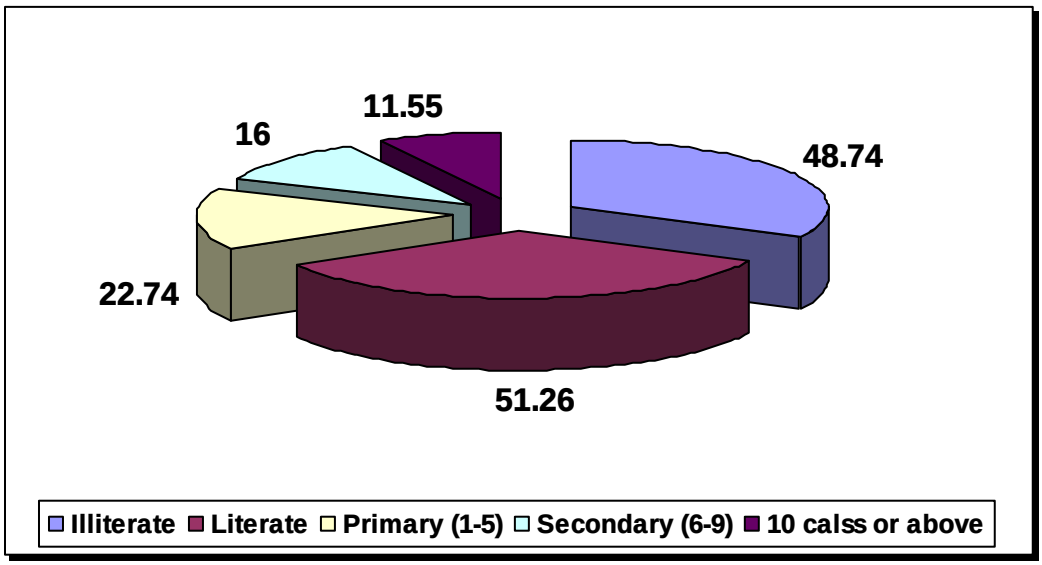
Source: Field survey, 2008.

Above table shows taht 48.74 percent people are illiterate and 51.26 percent are literate of the sample households in the study area. The literate population is greater (i.e 2.52) than illiterate population. It is observed that the literacy rate in the study area is lowar than that of national average rate (i.e. 57 percent). About 48.74 percent of the total population is illitetate and rests of them are literate in the study area. Out of total literate population 22.74 percent are studying in primary level, 16.97 percent in secondary level

and only about 11.55 percent have completed school level education and even more.

Here, standard norms for literate counting is applied which counts only those in population, who can read and write simple sentence of their daily uses in their mother language and also can make simple calculation involving addition, subtraction. multiplication and division. Educational status of the sample house holds can also be shown in pie-chart below.

Figure No. 2 Educational status of sample households pic-chart.



From the above pie-chart, it is shown that the literacy level of the sample households is smoothly high. The pie-chart also shows that, primary level is higher in proportion as compared to secondary and above secondary level.

5.1.2 Ethnic composition of the Respondents

Ethnicity plays an important role in the social cohesion of people living together. Cast and ethnicity also have influence by occupation, social status,

norms and values to some extent. It may create a social hierarchy and segments division of society.

In the study area, there are different type of ethnic groups such as Brahman (Awasthi), Chhetri (Bist, Kunwar, Khatri). Occupation caste (Luhar, Koli, damai, Bhul etc.) (V.D.C. profile, 2006). The ethnicity structure of the V.D.C. based on sampling households is given below.

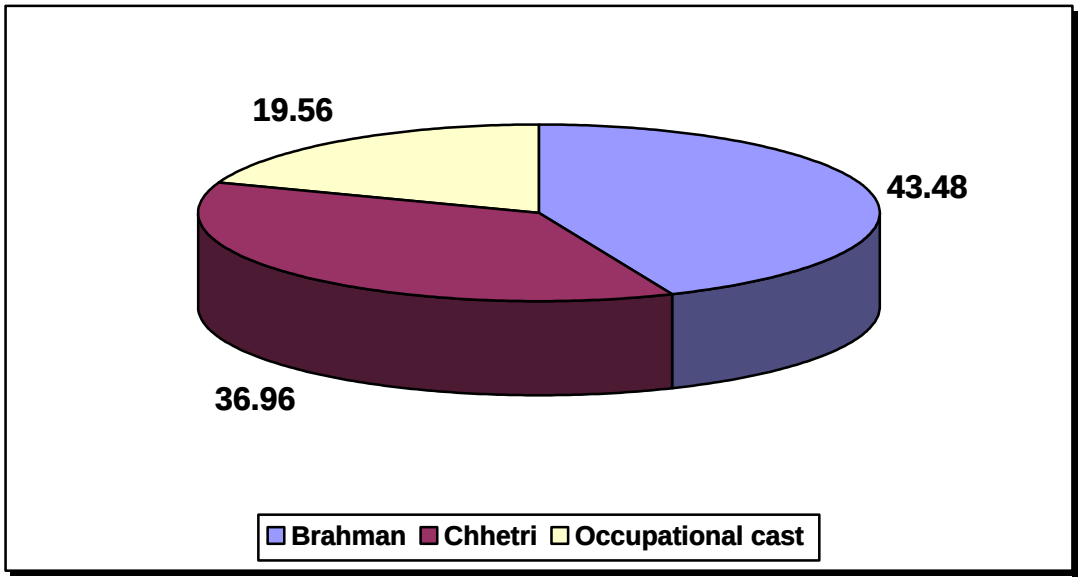
Table 5.3 Distribution of Respondents According to ethnicity.

S.N	Cast	No of Respondents	Percentage (%)
1	Brahman	20	43.48
2	Chhetri	17	36.96
3	Occupational cast	9	19.56
Total		46	100.00

Source: Field survey, 2008.

Above table shows that Brahman are more the other caste. In the study area, 43.48 percent Brahman, 36.96 percent Chherti, 19.56 percent, Occupational caste (Luhar, Koli, Damai, Bhul) are settled. The occupational castes are very low in the sample households. Ethnic structure of the sample population can also be shown in pie-chart below.

Figure No. 3 Ethnic Composition of Respondents



From the survey, it was found that there are only 3 castes, such as Brahman, Chhetri, occupational casts. All these castes belongs to the Hindu religion.

5.1.3 Occupational status of the sample house holds.

Agriculture sector is the main source of the national income. This sector contributes about 40 percent of the real national GDP. Agriculture has been the main sector of employment and for income generating activity the V.D.C. also. Thus it can be regarded that agriculture is the man source of livelihood for this V.D.C.. But this sector is very backward in the study area due to the lack of irrigation agricultural imputs, training and skill development program. Agriculture and the foreign job are the main sources of income in the sample households. On the basis of primary occupation, the dwellers can be divided into four different categorizes such as agriculture, services, foreign job and business. The occupations structure of the population based on sampling households is given below.

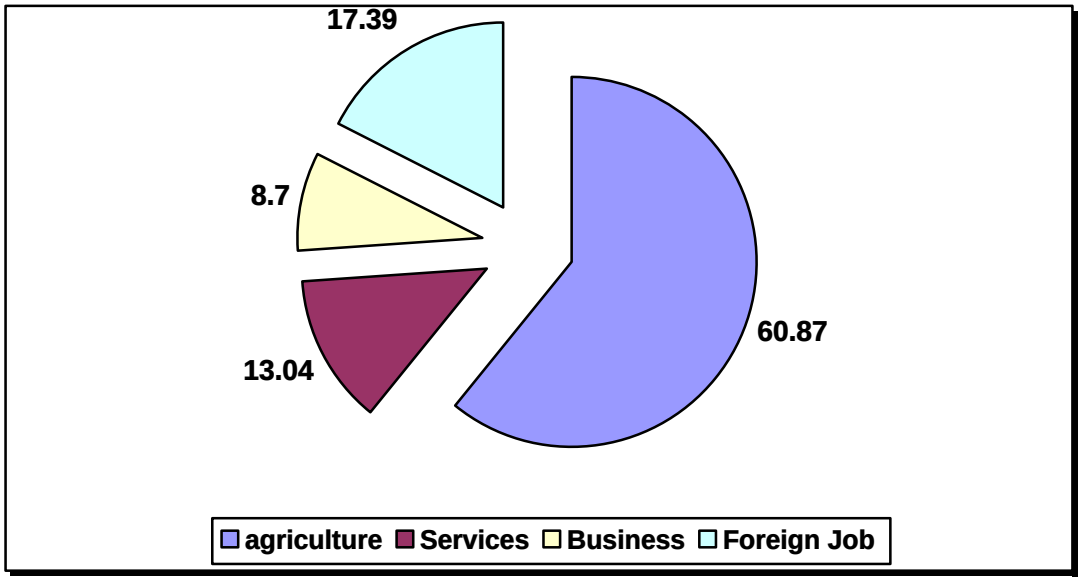
Table No: 5.4 Occupation structure of the sample households

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

Source: Field Survey, 2008.

According to above table, it is clear that the highest number (60.87%) of population are engaged in agriculture and lowest number of population are engaged in business (8.70%) only about 13.04 percent of sample population are employed in service sector where as 17.39 percent are involved in foreign-job. Nowadays, people are encouraged to join the service for their economic security purpose. Our country has still to develop induct. Most of the people are involved in agriculture because 39 percent of total GDP has been contributed by agriculture sector ad 60 percent by non-agriculture sector (Economic survey, 2007), Occupational structure of the sample households can also be shown in pie-chart below.

Figure No 4 Occupation structure of the sample households.



5.1.4 Livestock Situation in sample households

There is no large scale animal husbandry. Since most of people are farmers, they keep buffaloes, cow/Oxes, Sheep/goats, hen/ ducks and others (such as horses, donkeys etc.) main purpose he hind keeping those animals is for getting fertilizer, milk and meat. Milk and meat are main income generating sources of people. Some of the people also keeps the animals for the purpose of bio-gas. The livestock situation of sample households can be analyzed by following table and pie-chart.

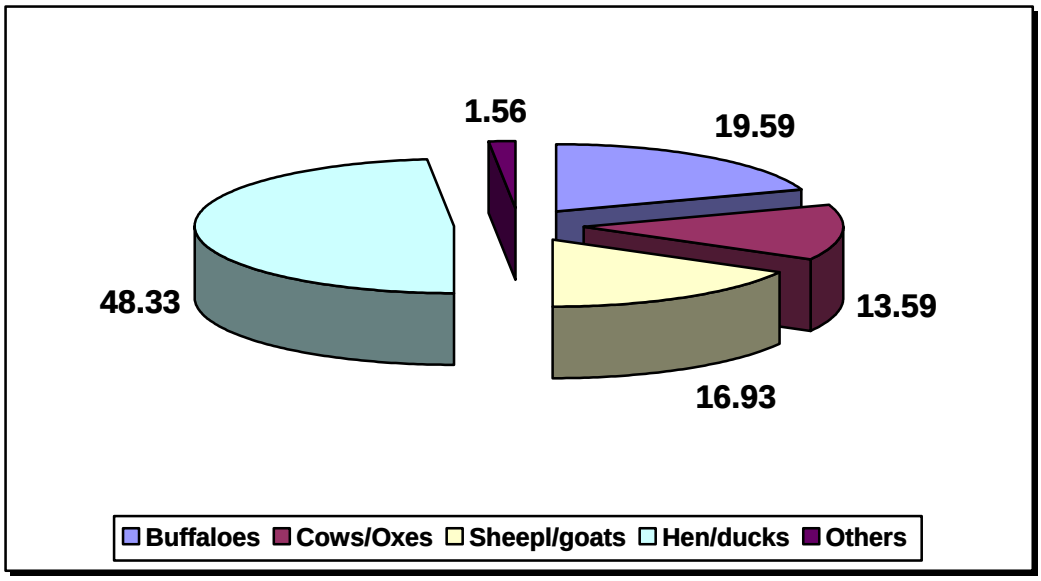
Table No 5.5 Livestock rearing situation in sample households

S.N	Type of livestock	No of Animal	Percentage (%)
1	Buffaloes	88	19.59
2	Cows/Oxes	61	13.59
3	Sheep/goats	76	16.93
4	Hen/ducks	217	48.33
5	Others	7	1.56
	Total	449	100.00

Source: Field Survey, 2008.

Above table states, the highest number of animal birds in the sample households are hen/ducks (48.33%) lowest number of animals are others (1.56%) such as horse and donkeys. There are 19.59 percent of buffalos, 13.59 percent of cow/Oxes and 16.93 percent of Sheep/goats. People in study area use Oxes for ploughing, sheep/goats for meat and buffalos for milk. The livestock situation of the sample households is shown in pie-chart below.

Figure No 5 Animal rearing situation in the sample households



5.1.6 Annual Income Level of Sample Population

Income level determines the resource mobilization, living standard, education level and health also. Generally, it is believe that high level of income increases the quality of life. In the study area, there are many sources of income such as agriculture, government job (services), foreigh job, business, laboring and others. it is usually difficult to figure out individual households income because the numbers of the household do not record their income requlary and they do not like respond to this question for the fear of publicity of their economic status. Especially, it is difficult in a society like ours where material wealth is used as a tool to place a family or an individual in the hierarchy of society. As a result, respondents give reply with caution. To estimate the household income, the probable source of a household income has to be considered, such as sales of agricultural

products, animal products, salary, labor income. The annual income level of the sample households is shown in table below.

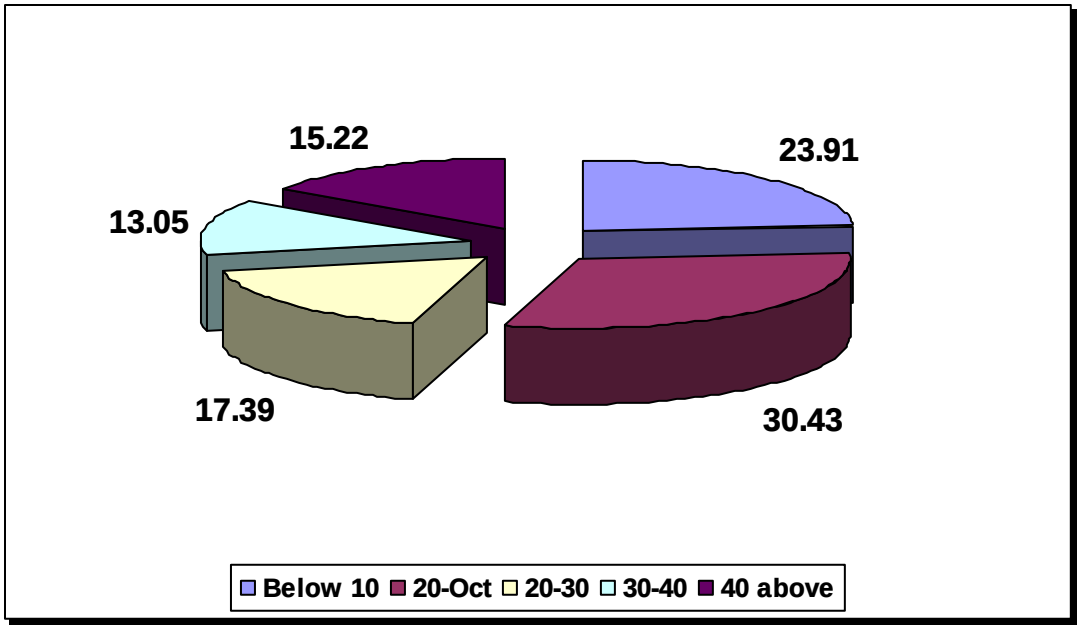
Table No 5.6 Distribution of Respondents by annual income.

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

Source: Field Survey, 2008.

Above table states that most of the respondents, i.e. 30.43 percent have annual income level Rs 10,000 to Rs. 20,000 and above 23.91 percent of sample households have less than Rs. 10,000. Survey found than the house holds, who have low level of income are engaged in agriculture sector, than is substance sector due to the lack of knowledge, agricultural inputs and market. Similarly, 17.39 percent of the respondents have annual income level Rs. 20,000 to 30,000 and 13.05 percent have annual income level Rs. 30,000 to 40,000 only 15.22 percent house holds have the high level of annual income i.e. more than Rs. 40,000. Survey also found that the households who have high level of annual income are involved in business, foreign job, and service. The annual income level of the sample households can be presented in pie chart below.

Figure No: 6 Distribution of sample population by annual income.



5.2 Energy Using Situation in Study Area.

5.2.1 Main Energy for Cooking

The main energy used for cooking food are fuel -wood, agricultural wastes, animal dung biogas, electricity, kerosene etc. In the study area, more than 45.74 percent 1 and is occupied by jungle. Most of the middle class family uses biogas for cooking purpose and poor people use animal dung agriculture wastes and fuel-wood as energy for cooking food. Table no 11 will show the main energy to cooking food in sample households.

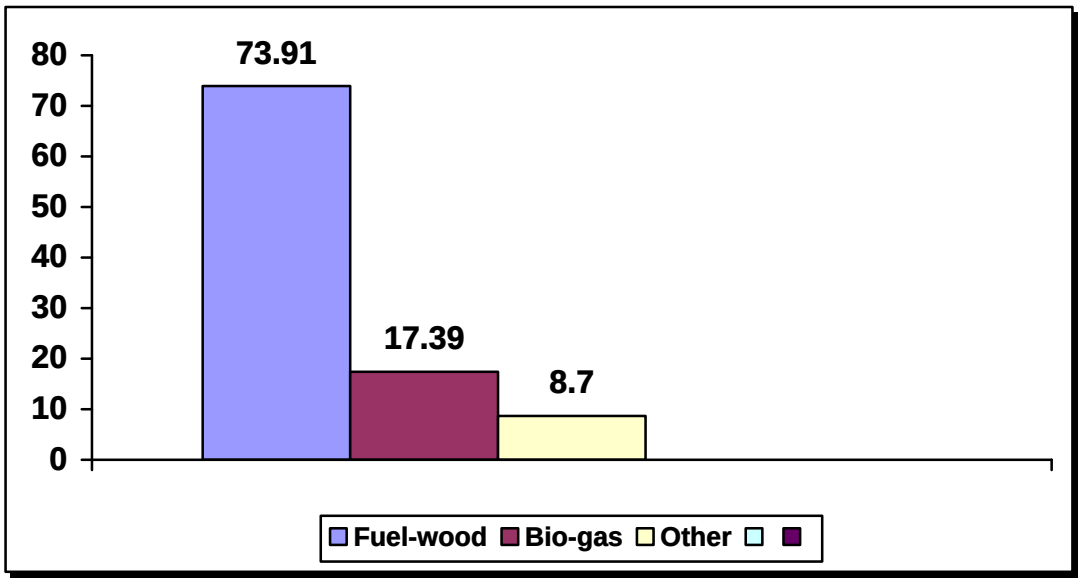
Table No. 5.7: Main energy for cooking food.

S.N.	Source of Energy	No. of House-holds	Percentage (%)
1	Fuel-wood	34	73.91
2	Bio-gas	8	17.39
3	Others	4	8.70
	Total	46	100.00

Source : Field Survey, 2008.

Above table shows that, most of the households i.e. 73.91 percent use fuel wood for cooking purpose. In the study area 17.39 percent sample households uses bio-gas and only 8.70 percent uses other sources of energy such as kerosene, agricultural wastes and animal dung, which can be shown in bar- diagram below.

Figure No. 7: Main energy for cooking food of the sample Households.



5.2.1.1 Type of cooking store.

Survey found that, 73.91 percent sample households use fuel wood for cooking purpose. Greater percent of fuel-wood using pattern in V.D.C. is a jungle that has occupied more than 45.74 percent land in Shankarpur V.D.C.. In the study are, only about 36.96 percent households uses improved cooking stove (ICS) and 63.04 percent of the sample households uses traditional cooking stove. The uses of ICS has decreased the consumption of fuel wood which can be shown in table below.

Table No.5.8: Type of cooking Stove of the sample Households.

S.N.	Type of stove	No. of House-holds	Percentage (%)
1	Improved cooking stove (ICS)	17	36.96
2	Traditional C.S	29	63.04
	Total	46	100.00

Source : Field Survey, 2008

Forest is the main source for the supplement of fuel-wood in V.D.C. which has been one of the main season for the forest depletion. Most of the forest covered area lies in the western part of the V.D.C.. Supply of fuel-wood from their own resources is directly related with land occupied by each household supply of fuel-wood depends upon land. The people with more land have access on more fuel-wood. While having less land produce less fuel-wood. Main energy source at home was found fuel-wood. In the study areas 73.91 percent of same house holds use fuel-wood. There is a trend on planting trees for fuel-wood and animal protection now in the study area.

Survey found that, most of the sample household (i.e73.91%) uses fuel-wood and only about 26.09 percent of the sample households uses another sources of energy like, biogas animal dung, agricultural bedsides and kerosene. The main source of the fuel-wood is forest (involves community and private forest). In the study area, only about 32.35 percent sample households collect the fuel-wood from the private forest and most of them i.e. 67.65 percent of the households fetch fuel wood from community forest, which can be represented table below.

Table No. 5.9: Main source of fuel wood.

S.N.	Source	No. of House-holds	Percentage (%)
1	Community forest	23	67.65
2	Private forest	11	32.35
	Total	34	100.00

Source: Field Survey, 2008

5.2.1.2 Time spent for collecting fuel- wood (by sex)

Shankar VCD has forest coverage about 45.74 percent and most of the forest lies in the eastern part of the V.D.C.. Most of the people of V.D.C. go to jungle to bring fuel- wood while some of them uses biogas and other sources of energy for cooking purpose. The households who uses fuel-wood, they spent much time to fetch the fuel-wood, which is shown in the table below.

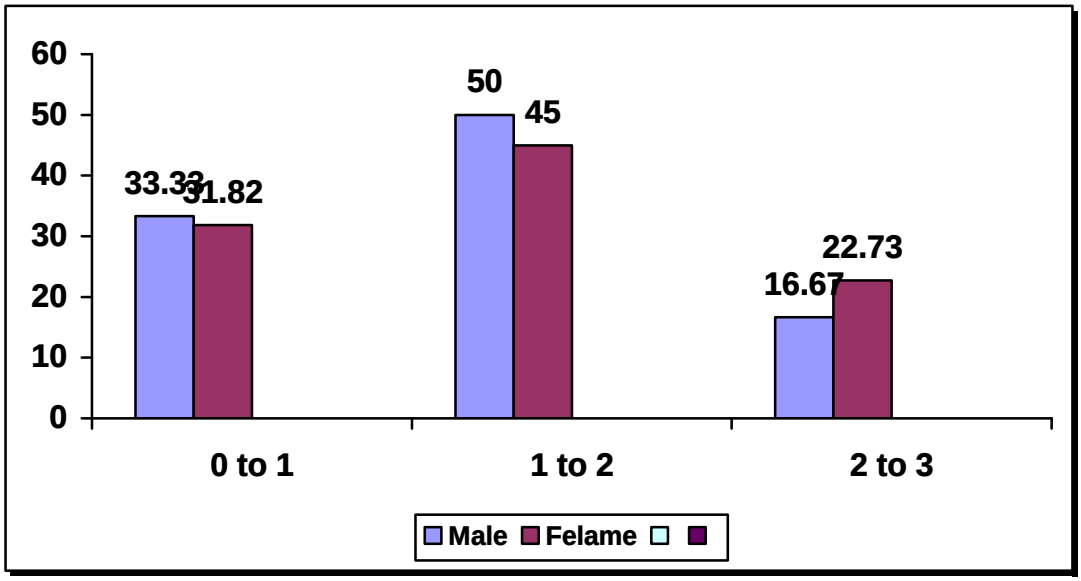
Table No. 5.10: Time Spent for collecting Fuel- wood (by sex)

S.N.	Time consumption (in hrs)	**Male**		**Female**		**Total**	
		No	Percent	No	Percent	No	Percent
1	0-1	4	33.33	7	31.82	11	32.35
2	1-2	6	50.00	10	45.45	16	47.06
3	2-3	2	16.67	5	22.73	7	20.59
	Total	12	100.00	22	100.00	34	100.00

Source: Field Survey, 2008

Above table states that all of the sample household who use fuel-wood, spent average 2 hours a day for bringing fuel-wood from the forest. A survey also found that they used the fuel-wood in average 10 Bhari Per month /households. Only about 35.29 percent male and 64.71 percent females of the sample households are involved for bringing fuel-wood. It is clear that most of the females spent their own time for bringing fuel-wood. Time spent situation on bringing fuel- wood by sex can also be presented bar- diagram on bringing fuel-wood by sex can also be presented bar-diagram below.

Figure No. 9: Time spent for bringing fuel- wood (by sex)



5.2.1.3 Cooking food by using Biogas.

Biogas is used mostly for cooking food and some times also for lighting purpose. The trend of biogas is increasing but it is a bit costly and suitable only for warmest area. In the study area, only about 17.39 percent of sample households uses biogas for cooking purpose. Most of the households who uses biogas have toilet attached biogas and some of them have not attached, which is shown in table below.

Table No. 5.11 Biogas Type in Sample HHS.

S.N.	Biogas Type	No. of House-holds	Percentage (%)
1	With toilet	5	62.5
2	Without toilet	3	37.5
	Total	8	100.00

Source: Field Survey 2008

Above table shows that most of the biogas users i.e. 62.5 percent have toilet attached biogas plants and only about 37.5 percent have biogas plants without attached toilets.

Survey also found that, most of households replied that biogas is sufficient for cooking food. The status on the amount of biogas in sample households can be presented in table below.

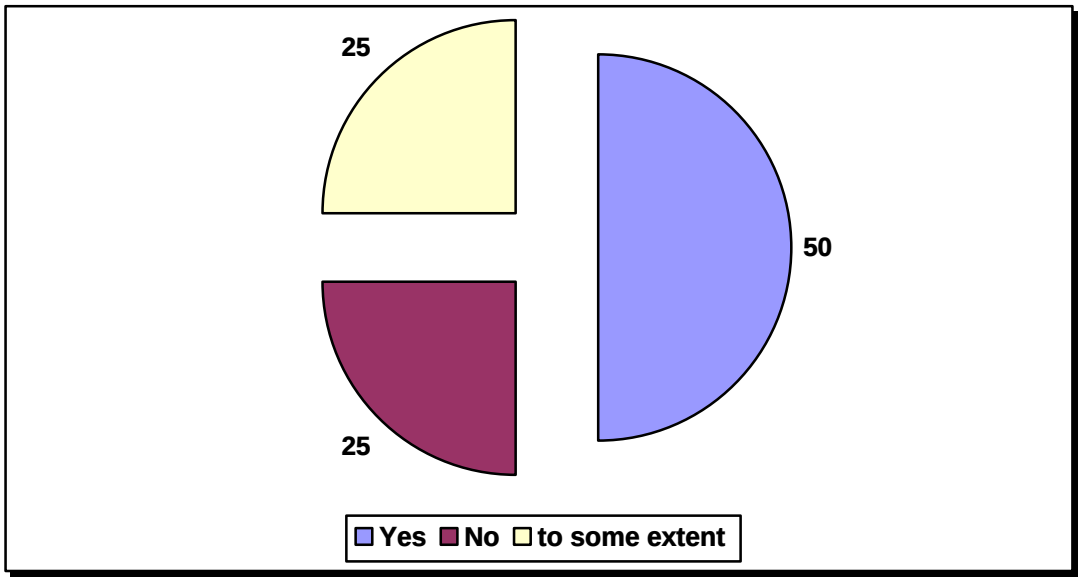
Table No. 5.12: Status of Biogas is Sample Households

S.N.	Sufficient	No. of House-holds	Percentage (%)
1	Yes	4	50.00
2	No	2	25.00
3	To some extent	2	25.00
	Total	8	100.00

Source : Field Survey, 2008

From above table, it is clear that 50 percent households have sufficient biogas to cook food. And remaining 25 percent have enough to some extent. From the study, this both type of problem is seen in households which have little number of animal and who were living in joint family. Which is also presented in pie-chart below.

Figure No. 10 Status of Biogas in Sample Households.



5.3 Socio- Economic Impact of MHP.

5.3.1. Time Spent for the purchase of Kerosene before the installation of MHP (by sex)

Survey found that, all of the sample households in the study area used Kerosene for lighting purpose before the installation of MHP. At present, 17 households used solar home system and 66 households are benefited from surnaya GAD micro-hydro Power project. In the past, most the households used kerosene and they spend much time to fetch it but after the installation of MHP system, this problem has found to be decreased, which can be shown in table below.

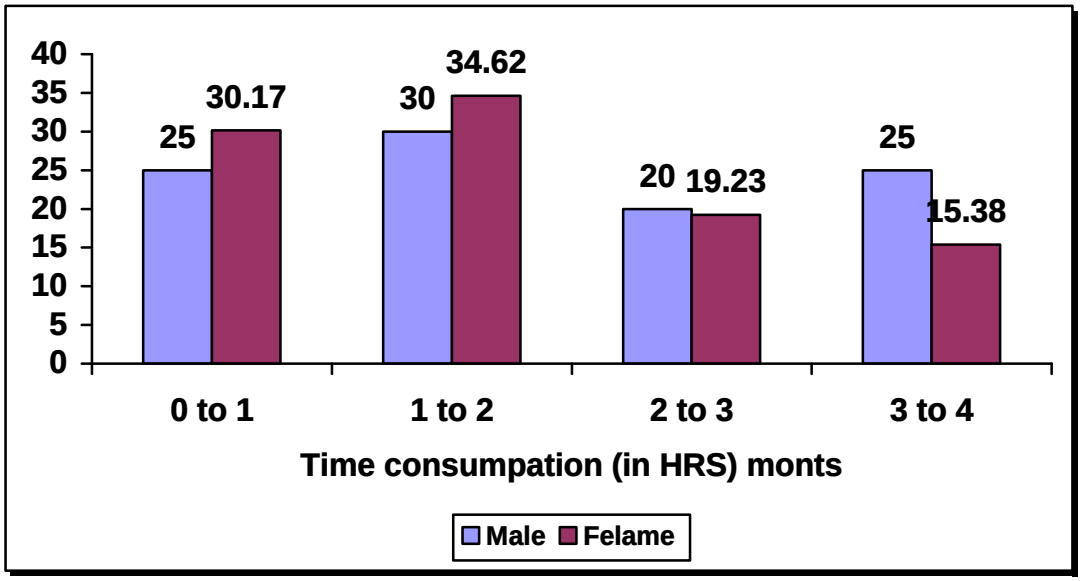
Table No 5.13: Time Spent for the purchase of Kerosene before the installation of MHP (by sex)

S.N.	Time Consumption (in hrs/month)	**Male**		**Female**		**Total**	
		No	Percent	No	Percent	No	Percent
1	0-1	5	25.00	8	30.17	13	28.26
2	1-2	6	30.00	9	34.62	15	32.60
3	2-3	4	20.00	5	19.23	9	19.57
4	3-4	5	25.00	4	15.38	9	19.57
	Total	20	100.00	26	100.00	46	100.00

Source: Field Survey, 2008

Above table states that, all of the sample households spent average 2.5 hours/ month for purchasing kerosene from the market. A survey has also found that, they used kerosene in average 4liters per month/ households. Only about 43.48 percent males and more than 56 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 V.D.C.. It is also found that, all of the sample households have save their time after the installation of MHP system where females have saved more time, It is presented in the bar-diagram below.

Figure No. 11 Time spent for the purchase of kerosene



5.3.2 Surplus Time Utilization by the Sample Households.

Survey found that, all of the sample households pent average 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 utilizes surplus time for household activities, agricultural work, productive work, income generating activities and some other social activities with neighbors and friends. Surplus time utilization pattern of the sample households are shown in table below:

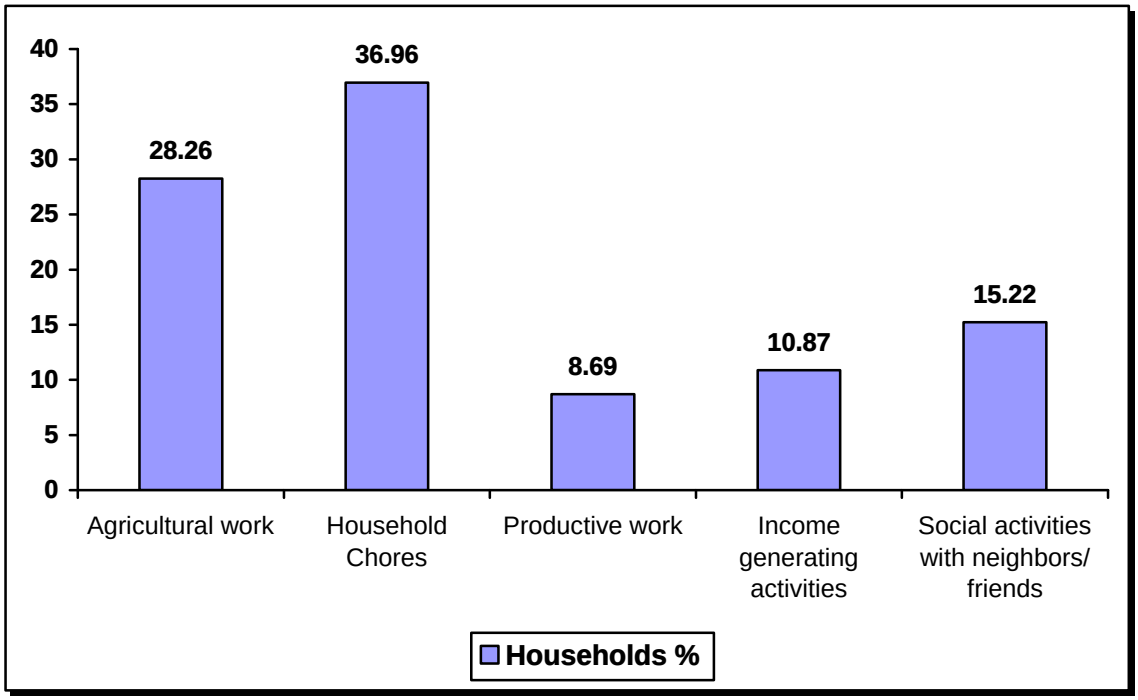
Table No 5.14: Surplus time utilization in sample HHs

S.N.	Activities	No. of House-holds	Percentage (%)
1	Agricultural work	13	28.26
2	House hold chores	17	36.96
3	productive work	4	8.69
4	Income generating activities	5	10.87
5	Social activities with neighbors/friends	7	15.22
	Total	46	100.00

Source: Field Survey 2008

According to above table, most of the sample households (i.e. 36.96% utilizes surplus time on agricultural work (vegetable/fruit/ seeds production) only about 8.69 percent and 10.87 percent households utilizes surplus time on productive work and income generating activities respectively. 15.22 percent households spend their surplus time on social activities with neighbors and friends which can be shown in pie-chart below.

Figure No. 12: Surplus time Utilization Pattern



5.3.3 Advantages of MHP in the study Area.

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

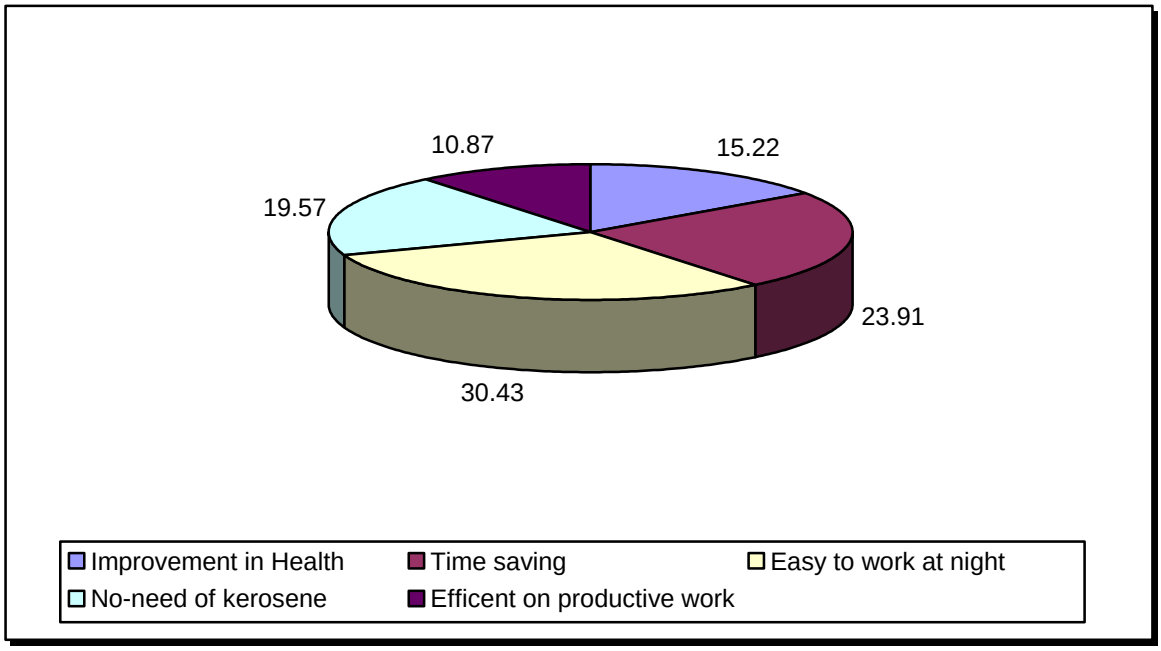
Table 5.15: Impact of MHP system in sample House holds

S.N.	Impact	No. of House-holds	Percentage (%)
1	Improvement in Health	7	15.22
2	Time saving	11	23.91
3	Easy to work at night	14	30.43
4	Save of kerosene	9	19.57
5	Efficient on productive work	3	6.52
6	Improve children's education	2	4.35
	Total	46	100.00

Source: Field Survey 2008

From the above table, it has been found that more than 30 Percent of the sample households are influenced from MHP system because it makes than easier to work at night only about 6.52 percent of the sample households accepts that it has increased their efficiency on productive work and 15.22 percent, 23-91 percent and 19.57 percent households are influenced by its advantages like improvement in healt, time saving improve children's education and save in kerosene respectively. Impact of MHP system in sample households can also be presented in pie-chart below.

Figure No. 13: Impact of MHP system in sample HHS.



5.3.4. Involvement on Productive work by using MHP system

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

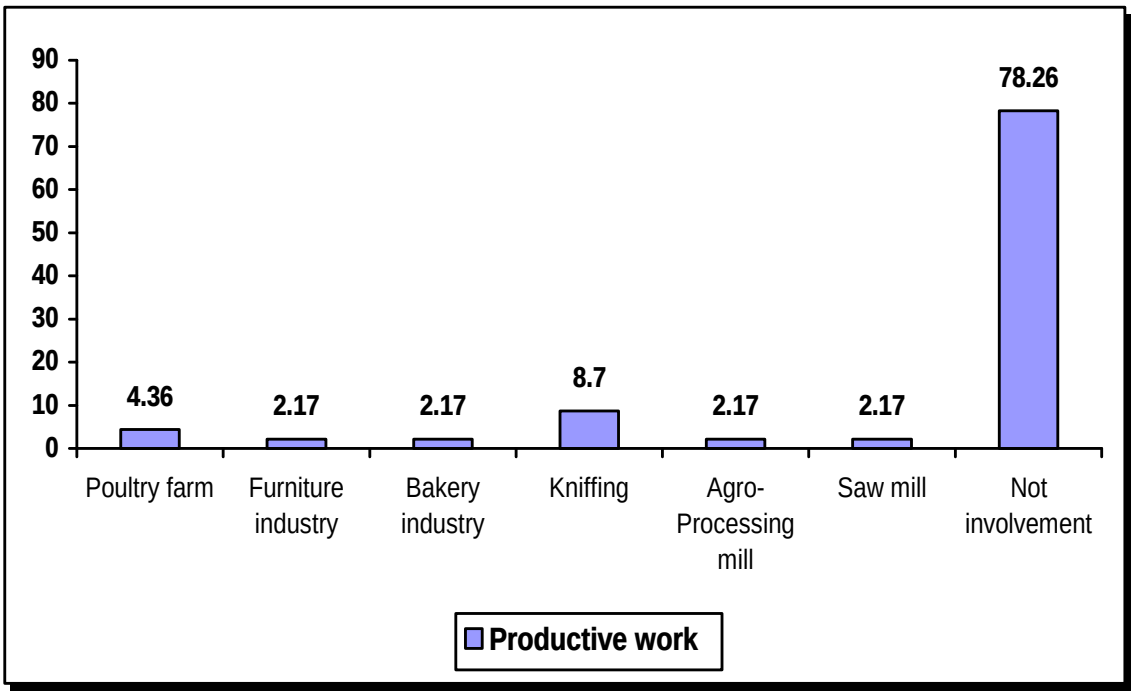
Table No. 5.16: Involvement of sample HHS on productive work by using MHP system.

S.N.	Productive work	No. of House-holds	Percentage (%)
1	Poultry farm	2	4.36
2	Furniture industry	1	2.17
3	Bakery industry	1	2.17
4	Knitfing	4	8.70
5	Agro-Processing mill	1	2.14
6	Saw mill	1	2.14
7	Not involvement	36	78.26
	Total	46	100.00

Source: Field Survey 2008

Above Table shows that, only about 4.36 percent of sample households starts poultry farming and 8.70 percent households involves in knitting. Similarly 2.17 percent households are involves in furniture industry and same percent in bakery industry, agro-processing mill and saw mill. In aggregate, only about 21.74 percent of sample households are involving on productive work by using MHP system and 78.26 percent are not involving themselves in any productive work which can be shown below in pie-chart.

Figure No. 14: Involvement on Productive work by using MHP System.



5.3.4.1 Increase in Income in Income Level of the Involved Household.

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

Table No. 5.17: Increase in Income Level

S.N.	Increase level (monthly /Rs.00)	No. of House-holds	Percentage (%)
1	0-10	2	20
2	10-20	2	30
3	20-30	2	20
4	30-40	3	30
	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. 30 percent have increased their monthly income level in between Rs. 1000 to 2000 and same percent households have increased in between Rs. 3000 to 4000. Only about 30 percent house-holds have increased their monthly income level in between Rs. 0 to 1000. Similarly same percent of the sample households have increased income level in between Rs. 2000 to 3000 after being involving in the productive work.

5.3.5 Improvement in Health Condition After the Use of Electric Bulbs.

It is estimated that before the installation of MHP, one kerosene wick lamp produce 218.64 X 10^{-3} tom GHG emission 1 year (co_2 equivalent) and after the installation of MHP systems, one 25 watt incandescent bulb produce only 0.5475 X 10^{-3} ton GHG emission 1 year. It can be concluded that after the installation of MHP in the V.D.C. about 33.23 liter of fossil fuel and about 20.4 pair of dry-cell battery is saved per HH annually. Those savings

have resulted ecological benefit of about 0.108 tone co_2 per HH each year even after reducing the co_2 invested in MHP plant manufacturing. Moreover, about 52.264 ton of co_2 emission will be saved by the community of 437 HH in the village each year. The economic value of such saving ranges differently. The co_2 avoidance cost of renewable energy technology for lighting is about NRs. 1187 for biogas to NRs. 8543 for soar per ton of co_2 emission in Nepal. Considering cheaper option then about NRs. 49567 will be the gained value of ecological capital. there is also saving of about 9915 pairs of dry cell each year by the community, thus, reducing hazardous effects of chemical of dry cell and health impacts to the community as dry cells are thrown openly, generally in the agriculture fields. Water pollution due to dry cell indoor air pollution due to kerosene are also avoided or reduced (RETRUD, 2003).

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

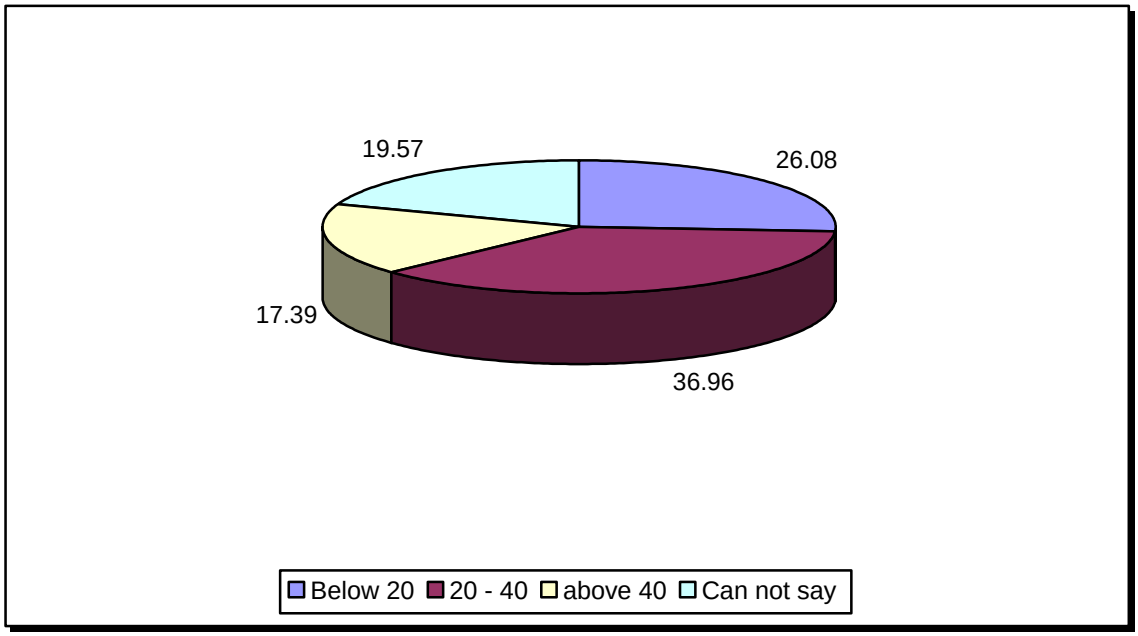
Table No 5.18 Improvement in Health of the sample HHS.

S.N.	Improving Percentage	No. of House-holds	Percentage (%)
1	Below 20	12	26.08
2	20-40	17	36.96
3	Above 40	8	17.39
4	Can not say	9	19.57
	Total	45	100.00

Source: Field Survey 2008

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

Figure No. 15 Improve in Health of the Sample HHs



5.3.6 Increase in Better Education and Awareness level.

Education is the key indicator of human resource development. Survey found that, only abut 45.55 percent people are literate in the study area. Most of the respondents (i.e. 84.78%) reply that availability of bright light produced by electrical bulbs for students to study longer hour in the evening. In average students study 1.5 hour more per day during evening by using electric bulbs. Incidences of better results of the students in the studies/exam are reported after the use of electric bulbs. Survey also found that, literacy class was started with improved environment due to bright light in the evening in study area, where as only 35 members are involved in the literacy class. It has been analyzed that it will be help to increase in literacy rate of the V.D.C..

- It is better to analyse problem of MHP
- Participation strategy/ mode

- Contribution /terrific

5.3.7 Problems of Micro-Hydro Power

According to the field survey, sometimes problems take place, because the beginning post of canal being damaged by the overflow of flood during the rainy season. As a result the MPH can't operate without water sources. Similarly, the another problem is , having no technician facilities to maintained and repaired the Turbine and the generator in local market when it doesn't function properly it not in conditioning the hydropower is completely stopped and people use to kerosene lamp in. that time.

5.3.8 Participation and Contribution of People

There is the respected participation and contribution of people to establish the MPH in their local place. They provide the free cost labour to supply the equipments, device, tools and raw material to construct MPH. It happened so because people want to have the electricity facilities. However, a sadness mentioning is that no prescience of expert in village it may take long time to repaire the MPH. Although, people are more conscious and active to conserve the MPH avoiding various risky problems on solution.

5.3.9 End use of Micro-Hydro Power

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

CHAPTER VI

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary

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

The 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 consumption pattern is also regarded as one of the important indicators on measuring development status of the country. In the Nepalese context many rural people have no access to clean energy source, that should never be neglected. MHP is providing clean energy access to same parts of the rural areas.

Micro-hydro progress (MHP) has been able to bring about profound socio-economic changes. The implication of MHP for rural micro-enterprise

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 MHP provides basis for undertaking rural industrial activities, nurturing of entrepreneurship in rural areas and retention of entrepreneurs in rural areas. The study tries to reflects the over view of Nepalese rural energy sources and discusses various energy issues through a case study of Shankapur V.D.C. of Baitadi. The study analyzed the socio-economic impact of Surnaya -gad MHP of Shankapur V.D.C. of Baitadi. The study revealed various advantages and improve of MHP system. It not only provides energy for lighting but also helped in improved health condition, save time, easy to work at night ad more efficient on income generate as well as productive work.

6.2 Conclusion

From the study the general findings are as follows.

- Population of the female was higher than male in the V.D.C.
- Educational status of sample households is found to be lower (i.e. 45.26%) than that of national average rate (57%).
- Ethnic composition of the study area showed that Brahmans are higher (i.e. 43.48%) than other caste and the occupational cast, is very low (i.e. 19.56%) in the V.D.C..
- Agriculture is found to be main occupation and the source of income. Most of the households i.e. 60.87 percent are dependent on agricultural sector which is lower than that national average (i.e 81%)

- Most of the respondents i.e. 30.43% of the sample households have annual income level Rs. 10,000 to 20,000.

However, the specific findings are:

- Fuel-wood is main energy source for cooking food, which contributes 73.91% and next to this is the place comes for biogas energy.
- The use of improved cooking stove (ICS) have played a vital role for reducing the consumption of fuel-wood.
- Most of the females (i.e. 64.71%) are involves for collecting fuel-wood and they spent 2 hours/day in average.
- In the study area, only about 17.39 percent of sample households use biogas for cooking food, where 62.5 percent of the biogas users have toilet attached biogas.
- Survey found that, more than 55 percent of the total households are benefited from surnaya-gad MHP system.
- All of the sample household agreed that MHP system is sufficient for lighting purpose.
- Most of the females (i.e. 56.52%) are involved for purchasing kerosene before the installation of MHP system and they spent average 2.5 hours/month for purchasing kerosene.
- Most of the sample house holds (i.e. 36.96%) utilize their surplus time on households activities and only about 8.69 percent households utilizes surplus time on productive work.

- More than 30 percent of the sample households were influenced by MHP system because it provided light for them to work at night.
- Survey found that, literacy class was started after the installation of MHP system literacy rate has been increase with study area after the installation of MHP system.
- Students study one and half hour more perday during evening by using eletric bulbs.
- Consumption of kerosene has been reduced by 3 to 5 liters per month in each family.
- Only about 21.74 percent of households are involved in productive work by using MHP system and all of them agreed that, the income level was increase (i.e. Rs. 2300 month in average) after introducing MHP in the V.D.C..
- Most of the sample households i.e. 36.96 percent agreed that their health has been improved 20 to 40 percent after using the electric bulbs.
- Various types of functional group have been formulated in the V.D.C., which play a vital role for resource mobilization decision making, information sharing, coordination and capacity building.

6.3 Recommendations

Rural energy development program has been providing rural electrification, environmental management and poverty all evaluation to some extent in the rural part of the country. With an unprecedented success on economic

development through the rural energy development program. The development efforts needs to be reviewed and more progress based on the use of alter native 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 it's role in the socio-economic development of Nepal. It is fact that unless the micro-hydropower sector is provided with adequate technical, financial and management support, it will not be able to contribute to national development to the extent one can expect from it. Hence, the specific recommendations are as follows:

- More than 17 percent of the sample households used biogas for cooking purpose it decrease the fuel-wood consumption and dependency on forest so as a further improvement on biogas extension pattern, low cost biogas plants should be promoted through easy access to credit facilities for low income households through community loan schemes friendless and women's groups.

- 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 integrative approach to promoting micro-hydropower development needs to be adopted.
- The subsidy program encourage 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 mot by the district-wise.
- The participation of women in planning and implementation of micro-hydro plants needs to be ensured.
- Simple and transparent procedures for loan sanctioning should be developed and institutionalized.
- Promotion of smaller units such as the improved ghatta to replace traditional one should be given priority. Since this will ensure the participation of low-income groups.
- Technology promotion and entrepreneurial development programs should be organized.
- Proper evaluation of the socio-economic setting, technical and managerial capabilities and adequate survey and design must be ensured while carrying out feasibility studies.
- Technical training is need in both public and private sectors particularly at the operative level to improve present standards.
- Produce warranty should be made mandatory for manufactures and service provides.

- Capabilities should be built up at village level for operation, maintenance and repairing.
- There is a need to integrate MHP system promotion with income generation and social development activities in order to justify the subsidy scheme.
- Community - owned and managed micro-hydropower plants should be promoted.

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