CHAPTER ONE
INTRODUCTION

1.1 Country Background

Nepal is a sovereign independent country situated in the foot hills of the Himalayas in South Asia with an area of 147,181 sq. km (IEA 2010). It is located between 26o22'N to 30o27'N latitude and 80o4' to 88o12' E longitude (CIA 2010) .The location of latitude within 35 degree from the equator means it is a favourable environment for solar energy resources, because of low diffuse radiation at higher altitude and increasing albedo factor due to snow (Rijal and Bansal 2000,13). This landlocked country is bordered by India in the east, south and west and by China in the North with about 800 km of Himalayan range as shown in figure 1 below. The altitude varies from 70 meters to almost 8848 meters showing potential for enormous hydropower generation. The country has been divided into 5 development regions containing 14 administrative zones, 75 districts and 3913 village development committees at the ground level (CIA 2010).

1.2 Economic Outlook

The small landlocked country has a population of around 29 million (Nepal CBS 2011) where almost 35% of the population are under the national poverty line defined as US $160 per day (ABD 2011, 165). The same report stated in FY2010, GDP growth rate is around 4% whereas the inflation rate is 10%. As per the data of FY2009 provided by Finance Ministry, Government of Nepal, GDP per capita of the country is just US$ 470 (Nepal Ministry of Finance 2011). In 2008, the electricity consumption per capita was around 90kWh, which is just about 1% of Australia's per capita electricity consumption (IEA 2010).

1.3 Energy Status

More than 80% of the country's population live in rural areas and are meeting their energy needs from traditional resources (87%), such as fuel wood, agricultural residue, cattle dung etc (WECS 2011, 12). Energy supply and balance statistics show

that the major consumption of energy in Nepal is in the domestic sector, whereas the major supply of energy comes from biomass, of which fuel wood is the dominant energy source, as it covers 77 percent of the total biomass energy supply in Nepal. The other energy supply sources like non-renewable (oil and gas) and renewable energy cover 11.76 percent and 0.53 percent respectively of the total energy supply (WECS 2011, 12).

One of the interesting facts is that although Nepal is blessed with natural resources and a steep gradient topography, it has harnessed only 650 MW of 43,000 MW (1.51%) of technically and economically feasible potential of hydropower (Nepal Ministry of Finance 2011, 164-175). It does not have any fossil fuels suitable for power generation.

1.4 Renewable Energy

The large proportion of the population from rural areas and their massive dependence on traditional energy resources show that the rural sector is the most important sector for the implementation of the concentrating development programs to accelerate the country's development index. The low consumption level of imported energy shows that the industrial activity is very low whereas household energy dominates the major energy portion of the market. Due to the geographical terrain, it will cost massive investment and time to link rural areas with the national grid. Based on this fact, the government started to promote locally available environmentally friendly renewable energy resources in Nepal which are more affordable to those rural populations, helping to raise the rural economy. The National Planning Commission (Nepal National Planning Commission 2008) stated in its report that there is technically feasible potential of 50MW micro hydro power, 1132.7 MW of solar energy (considering 5% of the area potentially suitable @ 4-5 kWh/sq.m/day) and 1.9 million biogas plants.

The Government of Nepal (GoN) has established the Alternative Energy Promotion Centre (AEPC) in 1996 for the promotion of renewable energy technologies in Nepal. The main programmes are micro hydro, solar and biomass (bio-diesel, cooking stoves, and biogas). Currently, AEPC is coordinating with Ministries, GOs, donors, INGOs, NGOs, the private sector and stakeholder/user groups to make policy

recommendations to the government. For the small scale RE deployment, it acts as a one door channel for the mobilization of funds. There are different programs under AEPC funded via unilateral, bilateral donor organizations (AEPC 2010) which will be discussed in detail in different journals and booklets.

The GoN has subsidized almost all of these renewable energy technologies through the "Rural Energy Policy 2006" revised in 2006 and 2009. The supporting policies are "Subsidy Policy for Renewable (Rural) Energy" and Renewable (Rural) Energy Subsidy Delivery Mechanism" (AEPC 2010). The Subsidy Policy defines objectives as well as the types, level of subsidy and the delivery mechanism (AEPC 2010). Since the programme is running since last 15 years, there is a need for the evaluation and Analysis of the Impacts of Subsidies on Small Scale Renewable Energy Technologies Dissemination in Nepal (AEPC 2010a).

1.5 Statement of the Problem

The people in the rural area are used to use the conventional form of energy like fuel wood, animal dung and agricultural residue. This conventional method of energy consumption is not suitable for rural people as it has a lot of negative impacts on the life of rural people. Firstly the rural people have little access to the source of energy like hydro electricity. In addition to this, looking at the economical status of the country it is hard to install the plants for the production of the energy. The geographical structure of the country is also seemed to be the burden for the installation of the infrastructure. To enable the rural people to meet the needs of energy, the renewable source of energy which can be installed through fewer budgets and can be afforded by the rural people should be given more importance. Though some of the renewable sources of energy are being developed in the rural area like micro hydro power, wind energy, biomass and solar energy they are only in the reach of the advantaged people. The solar energy is seemed to be very much effective to uplift the life of the rural people however its initial cost of installation is very much high and is far beyond the reach of the rural people who is unable to earn for hand to mouth.

The government seemed to be unable to install the large cost infrastructure of the energy to meet the energy demand of the rural people. However it is providing certain

amount of subsidy for reducing the energy burden among the rural people in the energy devices like solar panel, solar heater etc but they are out of reach of the disadvantaged, marginalized rural people. Elite groups in the villages dominate decision making and they can do neglect the interest of the other people. This raises a question of how democratic is the decision making process when it occurs under social condition of inequality. Many poorer households complained that there is no way they could speak their mind in front of rich people who are taking advantage from the subsidy.

There are some issues and problems still not explored in the field level such as use of user group fund for welfare of poor marginalized people, participation of disadvantage group poor marginalized and women in the decision and planning process for the development and production of community solar energy device, active management of the solar device to derive sustainable yield and impact of solar energy on socio-economic status of user group. These issue require empirical research to explore reliability, if so, it needs detail study researches in these aspects for their validity. This study may give some valid results.

So, in general, this study has attempts to find out the real sequences of study area of energy crisis and people moments accordingly to the energy demand. Specially, the present study has tried to explain following research questions.

i. What is the socio-economic status of solar PV users in the study area?
ii. What are the problems of SHS in the study area?
iii. What is the financial and technical aspect of SHS?

These above and likely so many question are enrolling science then and now but so many school of thought trying to answer it but no one give with satisfaction though the demand and supply of energy increasing as a forth bridge process up to end less energy generation.

1.6 Objectives of the Study

The main objectives of the study are to identifying the possibility and challenges of energy demand and supply which may enhance the economic and social progress in the study area. The specific objectives of the study area as follows:

- To explain the socio-economic status of solar PV users in the study area.
- To examine the problems of SHS in the study area.
- To analyse the financial and technical aspect of SHS in the study area.

1.7 Rationale of the Study

The study is very important for understanding and identifying the changes in the status, way of living and activities of SHS user household in the study area. Assessment of the impacts of SHS users, their activities, their capacities and understanding on utilization of SHS will certainly be helpful informing clean development mechanism (CDM). The outcomes of the study will be of great importance to policy makers to formulate appropriate plan for further development of the appropriate technology that better sots the rural people needs from is and every aspects.

On economic point of view, SHS installation has not just heeled to save kerosene, battery etc, but also opens up new income generating opportunities in rural areas like weaving, photography, running telephone thank painting etc.

Solar PV home system is only option for the rural electrification where due to various reasons such as diverse geological/ structure of land form, the scatter settlement, electricity from national grid is not feasible and costly. Running big hydro electricity requires huge investment and long duration of time, in this contest solar PV home system is highly suitable which also contribute, in small way, to control the migration of people from rural to urban areas in search of better way of life and for other facilities. Solar energy is less costly than micro hydropower and other electricity and can be easily carried out from one place to other.

Solar energy becomes the one of believable and long lasting source of energy. In contest of Nepal, is suffering energy crises not only due to economic condition but also by geographical condition of our country with such scenario we must look towards the solar energy as an energy solution of energy trends.

1.8 Limitations of the Study

Like other type study, this study also will not be free from limitations. For performing any type of research is no doubt a very challenging preposition.

It is obvious that student will have certain limitations in completion of the study. Some of the most common libations which the students anticipate to encounter during understanding of this study can be specified as follows.

i. Lack of sufficient literatures on the topic and secondary sources of information.
ii. The study is being under taken within a modest budget
iii. The study is proposed to be completed within a limited time.
iv. Authenticity of information and substantial reprehensive of sample population.

The study is mainly confined to Dhapa VDC of Jumla district of Nepal. Thus, generalization of the conclusion derived from the study in national/international level may not be relevant to others.

i. The study is very specific case study. It only deals the importance of SHS in Dhapa VDC.
ii. The study is limited in terms of deeper analysis as only a few variables selected from the numerous factor affecting the solar energy consumption in the study area.
iii. This study is limited to the socio-economic, energy, communication as well as educational aspects.
iv. Our research being descriptive, we more conveniently use observation, Questionnaire and interview. The information provided by different households may have limited accuracy that is observed during survey activities.

1.9 Organization of the Study

This Study is divided into five chapters. The first chapter includes introduction, statement of the problem, objective of the study, signification of the study, assumption and limitation of study and organization of study. Likewise, the second

chapter of study includes review of literature. Similarly, the chapter three includes research methodology which deals source of data and information, method of data collection, data processing and method of analysis. The chapter four deals description of study area, Educational Condition of HHS and Problems on Solar Photovoltaic System in the study area. Finally the chapter five deals summary, conclusion and recommendations.

CHAPTER TWO
LITERATURE REVIEW

2.1 Conceptual Literature

In this part researcher has collected different theoretical literature on solar energy system in Nepal. Any study on renewable energy sources like solar energy is primarily is a challenging job in a sense that it requires a wide range of literature during the work. Literature review gives many information and knowledge about the concerned study field which will be very fruitful guidance to the new researcher to make the study systematic, scientific, objective oriented so it is the backbone of the study. In the context of modern solar energy technology in Nepal it is still in its fledging stage, so there is no wider scale.

Solar energy was first conceived as available alternative form of power as early as in the 1860s when coal was expected to be running out of supply. The global oil crisis of 1973 brought renewed attention to the potential of solar power as alternative source of energy. Solar PV Home System is the system in which the energy from sunlight is converted into electricity. It is the household electricity supply system with Solar Photo Voltaic panel of capacity of 5Wp to 10 WP and more, and bundled with battery, battery charge controlling mechanism and appropriate number of lights.

Energy

Energy is power that can help in doing some work in our daily life, hence can also be defined as the basic need for us. Energy is evitable to sustain human life, to develop human capabilities and generate income for better living. Therefore energy is considered as one of the basic needs of the people. In Nepal, the demand for energy for various users is increasing with the increase in population and need for the self employment. The poor people are suffering disproportionately than the non poor in terms of energy problems. Though there is enormous potentiality of developing hydroelectricity, only 1.3% of the commercial potential has been exploited (MOF, 2006).

Energy is one of the most important indicators of socio-economic development, and per capita energy consumption is often viewed as a key index of the development. Developed countries have significantly higher per capita energy consumption. Nepal though being reach in water resources possessing around economically exploitable hydropower potential of about 42,000 Megawatts (MW) is facing a severe power shortage up to 12 to 14 hours per day since last 7/8 years. “Electricity is a distant dream for many families in rural area of Nepal, 63% people doesn’t have access on electricity. The discrimination is even higher when it comes to rural area, only 30% of rural people have electricity access while around 90% of urban people are connected with electricity”(Power and People, AEPC 2010). There is continuously increasing demand for electricity for households as well as for industrial and for other many purpose.

Nepal is dominated by rural areas where 85% of the populations living in rural areas are poverty ridden and about 35% of the rural people are poor (CBS 2011). They are living below average life standard without enjoying even the basic amenities. Poverty in rural areas is reflected in low level of income, low level of literacy and poor health status. Poverty is also reflected in low level of energy use. Though total energy consumption is gradually increasing, per capita energy consumption remained more or less constant and it is about 145 Gega joules.

The heavy dependency on biomass energy, especially fuel wood, agriculture waste and cattle dung, particularly in rural areas has given rise not only to environmental degradation and irreversible consequences in the country, but also has caused the social burden on majority of the rural women and the large number of children who have to allot about 20% of the work time for fuel collection (Joshi et al., 2003). Similarly kerosene has given rise to economic burden as well as major health and environmental impacts. Therefore, there is a dire need to substitute as well as supplement the traditional energy supply system by modern forms of sustainable energy in terms of resources and technology. Because of the country’s dependence on imported fossil fuel, high cost of grid connection and low and scattered population density, a decentralized renewable energy supply system becomes the natural and feasible choice which includes micro hydro, solar photovoltaic, biogas, ICS etc. And

fortunately we also have immense opportunities for developing such renewable energy technologies.

Solar technological advancement and rural development are truly related to each other. The development of the rural area depends upon the types of energy being used and level of the technology for the consumption of that energy.

Energy Situation in Nepal

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Conventional Source

The conventional sources of energy are generally non-renewable sources of energy, which are being used since a long time. These sources of energy are being used extensively in such a way that their known reserves have been depleted to a great extent. It is becoming increasingly difficult to discover and exploit their new deposits. It is envisaged at known deposits of petroleum in our country will get exhausted by the few decades and coal reserves are expected to last for another hundred years. The coal, petroleum, natural gas and electricity are conventional sources of energy.

Coal : Coal is one of the most important sources of energy and is being used for various proposes such as heating of housed, as fuel for boilers and steam engines and for generation of electricity by thermal plants.

Oil and Natural Gas : Like coal, petroleum is also derived from plants and also from dead animals that lived in remote past. Natural gas has also been produced in the Earth's curst by the similar process as petroleum and this is also a combustible fuel.

Natural gas is also emerging as an important source of energy in India's commercial energy scene in view of large reserves of gas that have been established in the country, particularly, in South Bassein off west coast of India. Natural gas in also making significant contribution to the household sector.

Financial Calculation : Conventional energy is somehow cheaper to install and it has been a traditional culture in our life but it is going to slow down and deplition. it is more expensive if the total cost of the year per annum. Per house consume 60 ltr kerosene for two lamp and 50 pair cell battery for radio and toourch light. The kerosene cost is Rs 200 per liter and Rs 50 per pair battery. The total cost for nominal energy for light and radio is Rs 9000 for kerosene and 3000 for battery is Rs 12000 for only necessity unit. it is not sufficient energy for the family and it is the basic poor unit.

Non-Conventional Source

It is also known as a renewable energy source because this type of energy can continously give power in the earth and it never end which are as follows:

Wind Energy : Wind power is harnessed by setting up a windmill which is used for pumping water, grinding grain and generating electricity. The gross wind power potential of India is estimated to be about 20,000 MW, wind power projects of 970 MW capacities were installed till March. 1998. Areas with constantly high speed preferably above 20 km per hour are well-suited for harnessing wind energy.

Tidal Energy : Sea water keeps on rising and falling alternatively twice a day under the influence of gravitational pull of moon and sun. This phenomenon is known as tides. It is estimated that India possesses 8000-9000 MW of tidal energy potential. The Gulf of Kuchchh is best suited for tidal energy.

Solar Energy : Sun is the source of all energy on the earth. It is most abundant, inexhaustible and universal source of energy. AH other sources of energy draw their strength from the sun. India is blessed with plenty of solar energy because most parts of the country receive bright sunshine throughout the year except a brief monsoon period. India has developed technology to use solar energy for cooking, water heating, water dissimilation, space heating, crop drying etc.

Geo-Thermal Energy : Geo-thermal energy is the heat of the earth's interior. This energy is manifested in the hot springs. India is not very rich in this source,

Energy from Biomass : Biomass refers to all plant material and animal excreta when considered as an energy source. Some important kinds of biomass are inferior wood, urban waste, bio-gases, farm animal and human waste.

Finance for Non Conventional Energy : Convenentional energy is free for use but it is far expensive to install for us. Government has provided certain grant to the rural people. All people have no more amount of money to invest but if they calculated about the overall benefit and annually charge cost it is cheaper energy than the fuel and other convenentioal energy.

For the solar home system there is different grant fir he rural people in Karnali, far remote and rural people there is average 40 percent grant to the users. All technical support is also free for them but they need to spent for 40 watt solar home system is approximately Rs 20000 and grant is about 16000. People can find cheaper loan from

bank also. People can use solar power for long time duration in a simple maintainance cost.

Introduction to Solar Energy

Solar energy is the radiant light and heat from the Sun that has been harnessed by humans since ancient times using a range of ever-evolving technologies. Solar radiation along with secondary solar resources such as wind and wave power, hydroelectricity and biomass account for most of the available renewable energy on Earth. Only a minuscule fraction of the available solar energy is used.

Solar power technologies provide electrical generation by means of heat engines or photovoltaic. Once converted its uses are only limited by human ingenuity. A partial list of solar applications includes space heating and cooling through solar architecture, potable water via distillation and disinfection, day lighting, hot water, thermal energy for cooking, and high temperature process heat for industrial purposes.

The sun is the big ball of fire. About 70% of the mass of sun is hydrogen with 28% helium and about 2% is composed of heavier elements. The sun is the most abundant and everlasting source of energy on the earth. The energy given by the sun is called solar energy. Sun is the ultimate source of energy and directly and indirectly all the other sources of energy are dependent on the solar energy.

Nuclear fusion is the source of solar energy. The sun is rich in hydrogen gas. At very high temperature and pressure of the sun hydrogen atoms splits up into protons and electrons. Although there is repulsion between protons very high pressure of the sun binds two protons to form a deuteron and a positron. Then a deuteron combines with a proton to give an isotope of helium. The two nuclei of light helium unite to form ordinary helium nucleus. In each step of nuclear fusion a vast amount of energy is released.

Concept of Solar Technology

Photovoltaic cells convert sunlight directly into electricity. Photons in sunlight interact with the outermost electrons of an atom. Photons striking the atoms of a semi conducting solar cell free its electrons creating an electric current. The photovoltaic

effect was first discovered in the 19th century and was used by Bell Labs in 1954 to develop the first electricity to satellites. These early PV cell were produced in small quantities from exotic materials. While early cells were inefficient converting less than 1% of the incident sunlight into electricity, they quickly increased to 6% when researchers experimented with crystalline silicon, the principal component of sand. Current conversion efficiencies have surpassed the previous achievement and about 15% efficiency is achieved in the crystalline silicon cell PV module.

PV is measured in units of 'peak watts' (Wp). A peak watt figure refers to the power output of the module under 'peak sun' conditions considered to be 1000 watts per square meter. The term photovoltaic is derived from the Greek word "phos" meaning light and the word "volt" (named by Alessandro Volta). Photovoltaic is a science, which examines light-electricity conversion, respectively, photon energy-electric current conversion. In other words it stands for light-current conversion. Both direct and diffuse solar radiation takes part of the process. The light to current conversion takes place within solar cells, which can be amorphous, polycrystalline or mono crystalline, according to their structure. In most cases they are made of silicon. Most common application of solar cells applies to pocket calculators power supply, parking meters power supply and similar appliances. Solar-module consists of many solar cells, which are electrically connected and placed between glass and tedlar plate, and framed by an (usually) aluminium frame. A number of solar-modules and other components (batteries, charge regulators, inverters...) can form large photovoltaic systems. Further information on units and symbols used in photovoltaic and in solar energy engineering can be found if you follow the link above.

Solar Home System

It is one of the simple ways to produce the electricity. It converts the solar energy into electricity up to 100 watt. The Renewable Energy in the Rural Market Project supports an innovative approach to rural electrification in Nepal using exclusive concessions to supply dispersed rural homes and public facilities with renewable energy systems on a fee-for-service basis. A solar home system consists of a photovoltaic (PV) solar panel, storage, battery, a battery charging controller, and various end use equipment like fluorescent lamps. Solar home systems can eliminate or reduce the need for candles, kerosene, LPG, and/or battery charging, and provide

increased convenience and safety, improved indoor air quality, a higher quality of light than kerosene lamps for reading, and reduced CO2 emissions. It consists of a solar panel of size according to the necessity of production of the electricity. It is the most important part of the solar home system. The battery, charge indicator, bulb, wires and the switch are the other parts of the system. The solar panel is subjected to sun in such a way that maximum amount of solar energy falls on the panel which is connected to controller through which the battery gets charged. The controller also transfers the energy from the battery to electric load safely.

Solar home systems are also an alternative to grid-based rural electrification. In the early 1990s, the World Bank recognized that solar-home-system technology was maturing, costs were declining, and commercial markets were developing. At the same time, population growth was outpacing the ability of electric utilities to extend rural electricity grids and developing countries were increasingly recognizing the economic difficulties of achieving full grid-based rural electrification. The World Bank and many governments began to perceive that solar home systems could provide least-cost rural electrification and could supplement grid-based electrification policies.

Nepal is one of the poorest countries of the world in terms of its GDP per capita and its fuel use. In rural Nepal households generally rely on kerosene and candles for lighting, dry cell batteries for radios and cassette players and wood for cooking. Solar Home Systems (SHSs) have recently been introduced in Nepal but have generally been available only to the wealthier members of society due to their prohibitively high capital costs. In theory the SHSs provide enough energy to displace the traditional fossil fuel based energy used for lighting and radio/cassettes. The level of displacement is not well documented but this case study endeavors to shed some light on how energy use has changed following installation of SHSs, based on several published.

The Government of Nepal aims to increase the rate of household electricity service over the next 20 years. With a largely rural population living in sparsely populated, remote locations, solar home systems (SHS) will play an important role in meeting the off-grid component of rural electrification.

In 1932, the photovoltaic effect in cadmium selenide was observed. Nowadays, CDS belongs among important materials for solar cells production. The use of solar PV technology for rural electrification in Nepal introduced with 3 mini- grid PV systems installed in 1988 by Nepal Electricity Authority (NEA), with the assistance from the French government. Use of PV power for rural electrification gained momentum only after the successful launching of Pulimarang Village Electrification Projects in late 1993. The success of Pulimarang project played a crucial role in catching the attention of the government towards the PV technology as a means to electrify remote villages and form 1995/96 the government of Nepal started providing subsidy to the decentralized SHS through ADB/N. In 1996, the Alternative Energy Promotion Centre (AEPC) was established under the Ministry of Science and technology with an objective for promoting alternative renewable energy in rural Nepal. AEPC started providing subsidy for Solar PV electrification from 1998/99 but with the establishment of Energy Sector Assistance Program (ESAP) in 1999 for five years as a joint program of the government and Danida, the installation of Solar PV Home System boost up. By 1993/94, there were 3 solar PV companies in Nepal but the prospect of Danida support for the sector surfaced more companies rapidly came to existence.

Solar Home System in Policies and Plans

According to rural energy policy, 2063, rural energy refers to environmentally sustainable forms of energy for the completion of the domestic, economic and social purposes in the rural area. The rural energy basically focuses on the renewable form of energy.

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Poverty reduction is one of the prime objectives development plans of Nepal. Accessibility to better form of energy has been one of the means in addressing poverty reduction since implementation of Eight Five Year Plan (1992 – 97). Ninth Plan (1997 – 2002) further emphases this development thought by focusing coordinated approach for rural energy development with the objective of poverty reduction. Moreover, the current Tenth Plan (2002 -2007) emphasizes on strengthening the integrated energy planning approach through decentralization mechanism like the establishment of rural energy development fund at local and district levels.

Among the different provisions required for addressing the issues for poverty reduction the supply of reliable and sustainable electricity is one of the basic requirements. At the end of the ninth five year plan, around 40 percent of population has accessed to the electricity facility. Thirty three percent of population has been connected with national grid and rest 7 percent have electricity facility from alternative energy sources such as micro hydro, solar and other isolated electricity generation plant. To expedite sustainable rural energy supply in year to come, special emphasis has been given to promote rural energy program to ensure services to the poor people. One of such alternatives is solar home system.

2.2 Review of Related Studies

In this section I have included different thesis and dissertation in related to the solar home system which will be helpful for the further my study. I have reviewed its content, objectives, methods, design, population sampling and findings which are as follows:

Joshi (2010) has studied on solar home system and its impact conducted in Jogimara VDC of Dhading district. The general objective of the study was to find the socio economic impact of Solar Home System and the specific objectives were to find out the accessibility of the rural people towards solar technology, to find out the status of the SHS in the study area, to study the socio-economic characteristics of the SHS users, to find out the extent of utilization of the solar technology by rural people and assess the energy and other benefits from the installed SHS, to identify the obstacles, challenges of local community for the solar technologies, to suggest the possible effective measures so that the obstacles can be reduced, to provide recommendation for possible programs related to the solar technology, and to find out local idea to solve the existing problem and to promote the solar energy technology. Households data were collected from purposively selected 15 user's households form 29 users of solar home systems and 15 non user's household using semi structured interview schedule. Besides, data required was also collected from the installing company especially regarding the installation of system and its socio economic impacts. Focus group discussion was also conducted to collect the common data and to verify the data gathered form household survey. SHS of 20 w were most popular in the study area. Solar Home System has been mainly used for lighting and radio playing in the study area. SHS has been found well functioning in the study area, with good lighting facility.

In this study the researcher found that children were the most benefited group through improvement study environment. Better lighting has prolonged study time and also facilitated the guardians in tutoring the children. It has enabled female members to accomplish more household chores. Chatting and interaction among the family members, which is important developing better understanding, also increased. On the average, SHS has increased wake up duration of the family members approximately by two hours via alternation in bed time and wake up time. Tuki was widely used

lighting device before installation of SHS and distantly followed by lantern and battery. Kerosene was prevalent used fuel for lighting and dry cells for radio and tape recorder. SHS saved monthly fuel expenditure to maximum extent. SHS has been helpful for reducing work load and increasing leisure time of women through better lighting provision in substantial proportion of cases. It has also improved women's level of awareness and knowledge through access to TV and radio.

In another study Panta 2015 has studied title on "A Study on the Socio-Economic Impact of Solar Home System on Community (A Case Study of Maharudra VDC of Baitadi District, Nepal)" was conducted with the objectives of assessing energy scenario, per capita energy consumption, finding socio-economic and other impact of SHS to the users and assess the knowledge and attitude towards SHS in Maharudra VDC (specially in ward no: 1, 2 and 3) of Baitadi District. This study is mainly based in the primary information and the data were collected using the techniques of field survey with the help of questionnaire, field visit and observation.

In this study researcher found that there were 712 households (HHs) in the VDC. Of the total households, there were 186 HHs in ward no.1, 2 and 3, 40 households who have installed and still using Solar Home System and 10 Solar Home System non-users was selected as the sample for the study. During the study it is found that Brahhmin 48% (24) were the main beneficiaries of SHS, Agriculture 58% (29) was the main occupation among 50HHs, the average family size of the sample Households were 6.56 persons per family, average literacy rate 70.12%, Among 50 HHs, 40% (20) sample HHs can support expenditure by their income for 8 to 12 months, 42.43% (14) sample HHs noticed increased study hour of their children by at least one hour after installing SHS. Firewood was the most common sources of energy with highest per capita energy share, 13.15 GJ by SHS users and 12.608 GJ by SHS non-users. Only 52.5% SHS users uses kerosene while 100% SHS non users uses kerosene. The use of kerosene by SHS shares 0.00367 GJ(27.5 l) in per capita energy consumption which is far less than by SHS non-users which was 0.067348 GJ(127 l). By installing SHS a household have saved at least Rs 1309 annually compared to SHS non users from kerosene. This VDC not still connected to national grid; and there were no LPG. The per capita energy share of solar energy is 3.124 GJ. The average Per capita energy consumption of total 50 samples HHs of Maharudra VDC was 13.24GJ, which

is slightly less than national per capita energy consumption by 0.96 GJ. Out of total energy consumption, (4342552.5 MJ) the share of traditional energy (fuelwood 3518505MJ) was 81.02%, commercial energy(kerosene 5810MJ) 0.13% and of solar energy(818640MJ) 18.85% .

Similarly highest no. of SHS 35% was installed in the year 2070 B.S, 22.5% was installed in the year 2067 and rest in different years till Baisakh 2071. Most commonly installed system is of 20WP by 67.5% HHs, 87.5% people has access to radio, 92.5% HHs have access to mobile phones and only 2.5% received all radio, television and phone facilities. Each SHS users have DC to AC inverter as mobile charging systems. About 60% HHs used 1 to 4 no. Of bulbs, 47.5% HHs used CFL and Tube Light, 62.5% HHs used SHS for lighting two hours daily and 37.5% HHs faced the maintenance problem with SHS in the study area.

From this study it was found that all the households were using SHS getting benefit through white and smokeless light, had saved money from buying kerosene significantly, had started various income generating activities at local level by both men and women resulting gender equality and women empowerment. Their access to energy and means of communication has increased, local health post are running facilities at night during emergency, children study hour has increased significantly, no. of accidental fire hazard because of kerosene lighting has decreased. By the use of SHS, the reduction in emission of CO_2 equivalent and motivation for entrepreneurship development at local level has helped positively in reduction of poverty and in holistic development of rural areas. All users were very positive towards SHS installation. They suggested that focus should be given in easy availability of solar components at low price and skilled technicians at local level as well as clear plans and policies for further promotion and sustainable development of solar home system is most.

The another scholar Rupakheti (2014) has studied on improved cook stove (ICS) is a device that is designed to consume less fuel and save cooking time, convenient in cooking process and creates smokeless environment in the kitchen or reduction in the volume of smoke produced during cooking against the traditional stove.

The direct and indirect benefits of ICS includes were: increased thermal efficiency, the conservation of forests by cutback in firewood consumption, reduction in

women's labour, reduction in indoor air pollution and hence smoke-released health disorders, prevention of fire hazards, reduction of cooking time.

His study was conducted in Dhading District with specially focused to Jiwanpur VDC. The main objective of the study was to acces the present situation of ICS in Dhading district , to analyze the potentiality of improved cooking stove in Dhading District and find out problems and challenges of Improved cooking stove in Jiwanpur VDC. For this study descriptive and analytical research design have been adopted to obtain necessary information .

In Nepal, biomass energy: fuel wood, agri-residue and animal dung is used for cooking and heating purposes. Use of traditional stoves such as "agenu" (open fireplace) and "chulo" (rudimentary stoves) consumes more fuel wood and increases the burden on women. Women are mainly responsible for cooking and collection of biomass, mainly fuel wood from the forest. Use of biomass energy and low-grade biomass fuels lead to excessive levels of indoor smoke/air pollution. Women and children in particular are exposed to the smoke emission. This is one of the reasons for higher rates of infant mortality and morbidity and other unhealthy living conditions. Release of incomplete monoxide and other harmful particles in the atmosphere due to poor combustion of biomass fuels in rudimentary stoves results in the emission of Green House Gas (GHG). More than 80% of the energy needs are met by fuelwood thus exerting immense pressure on the forest resources of the country with negative impacts on environment.

The another researcher Pandit (2013) has studied on "A Study on the Energy Impact of Solar Home System to the Users (A Case Study of Belkot VDC of Nuwakot District, Nepal)" was conducted with the objectives of assessing energy scenario and per capita energy consumption, finding socio-economic and other impact of SHS to the users and assess the knowledge and attitude towards SHS in Belkot VDC (specially in ward no: 4, 8 and 9) of Nuwakot District. This study was mainly based in the primary information and the data were collected using the techniques of field survey with the help of questionnaire, field visit, observation.

In the result there were 1549 households (HHs) in the VDC. Of the total households, 40 households who have installed and still using Solar Home System and 10 Solar

Home System non-users was selected as the sample for the study. During the study it is found that Brahhmin (50%) were the main beneficiaries of SHS, Agriculture (58%) was the main occupation, the average family size of the sample Households were 6.98 persons per family, average literacy rate 66.19%, 60% sample HHs can support expenditure by their income for 8 to 12 months, 52% sample HHs noticed increased study hour of their children by at least a hour after installing SHS. Firewood was the most common sources of energy with highest per capita energy share, 9.46 GJ/ year/person by SHS users and 9.74 GJ/ year/person by SHS non-users. Only 37.5% SHS users uses kerosene while 100% SHS non users uses kerosene. The use of kerosene by SHS shares 0.00445 GJ/year/person in per capita energy consumption which is far less than by SHS non-users which was 0.09227 GJ/year/person. By installing SHS a household have saved at least Rs 1725 annually compared to SHS non users from kerosene. There was almost equality in consumption of LPG between SHS users and non users, 50% sample HHs uses LPG in the study area. The per capita energy consumption of PLG by SHS installed households was 0.09706 GJ/ person/year and by Non users 0.08537 GJ/person/year. The per capita energy share of solar energy is 4.81GJ/person/year. The average Per capita energy consumption of total 50 samples HHs of Belkot VDC was 13.62 GJ /person/years which is slightly less than national per capita energy consumption by 0.58 GJ /person/year. Out of total energy consumption, the Share of traditional energy was 69.85%, commercial energy 1.49% and of solar energy 28.65%. Similarly highest no of SHS 37.5% was installed in the year 2060B.S, most commonly installed system is of 20WP by 37.5% HHs, 92% people has access to radio, 50% HHs have received radio, television and phone facilities, 55% HHs used 5 to 8 no. of bulbs, 40% HHs used CFL and T.L, 50% HHs used SHS for lighting two hours daily and 45% HHs faced the maintenance problem with SHS in the study area. This case study has focused towards the positive impact of energy system in the users household people.

2.3 Conclusion of the Literature Review

During my study I was interested to study solar system and its impact on daily life of the users because there was happy where solar home system in the house. I studied different journal, reports, books, dissertation and articles for the purpose to study my

concern. I found different ideas and knowledge for the further study and I studied and continue I will study until my this thesis completion.

For the purpose of the study on "Impact of solar home system in household users" I have searched different libraries, books, journals and report and thesis and I studied those literature. I found different theoretical ideas and empirical ideas about solar system at home. I found mirror to look my face for the shave my bared as I found many guideline and ideas from the above literature. Now I have been literate on solar energy on home system and I will follow the theoretical ideas and empirical ideas from the literature. I will completely follow the different ideas for my future study. Empirical study has given me for the study method and theoretical literature has made me conform about the solar energy system and its policy in our country. Finally I have been ready to study with the help of these literature.

CHAPTERTHREE

RESEARCH DESIGN AND METHODOLOGY

Methodology is the backbone of the study. So, it needs to be well defined to conduct the study. Therefore in this study the following methodology has been adopted to fulfill the objectives.

3.1 Research Design

It is the blueprint for the collection of data. It is a work plan owing to the objective of the research. For this study, a descriptive and exploratory research design was followed. The purpose of the study is to describe the Home application of PV system on SHS made by the use of SHS in the household level of Dhapa VDC of jumla district. The descriptive method was used for the qualitative data obtained during the study. The data's that are not quantifiable was explained literally. On the other hand Researcher had analyzed and discover degree of interdependence between various characteristics/activities that are influenced by SHSs in such cases the exploratory research design has been used. Researcher have also looked into the problem by exploring the views of different set of respondents, as well as by exploring different literatures related with the study.

3.2 Rationale of the Selection of Study Area

Since last decade SHS has emerged as an important source of alternative energy in Dhapa VDC of jumla district. So the present study has been carried out in Jumla VDC. This VDC lies in the North part of Surketh and is attached with RARA lake, a famous tourist destination of jumla.

The researcher himself is the local inhabitant of the same district, so he is familiar with the local culture and practices. The another reason is, it is easily accessible for me because of he is accessible for all wards of DHAPA VDC .All in all the researcher was well convinced that by the selection of this VDC, it could get more accurate information to fulfill his objectives easily and effectively under any circumstance than any other study area.

3.3 Nature and Sources of Data

Data is a set of fact, sheets the wholesome aggregate of which gives the information. This information in fact contributes to the inquiry of truth and approaches towards the reality. Both primary and secondary data were used in this study. Data gathered are both qualitative and quantitative in their nature.

3.3.1 Primary Data

In the due course of my research, primary data were collected viz. observation, interview, and through structured and semi structured questionnaire as per the convenience to aid to the study. Questionnaire was the main tool for collecting information in the field survey.

3.3.2 Secondary Data

Since, this research is mounted on the base of description and analysis, secondary data plays the vital role. The various internal and external sources were used for acquiring the secondary data. The various sources consist of village development committee central bureau of statistics, alternative energy promotion center, various solar system providing system companies Google bulletins reports, and NGOs/INGOs etc.

3.4 Universe Population and Sample

In census of 2011 there were 675 individual households in Dhapa VDC of Jumla districts. Out of 675 households there is the population of 3746. The Researcher select 90 houses from each ward then 10 houses out of 9 wards. Where there is population 375 out of them 176 were male and 196 were female. In this population the Researcher has found 211 households use solar SHS and 173 were non-users. The researcher had taken 42.65 percentages sample size out of 211 SHS user households. In this sampled all the races had collected.

3.5 Sampling Procedure

Convenience was applied sampling to select 10 households from each wards while selecting the sample unit, the diverse cast such as Chhetri, Brahmin, Dalit, etc was also considered.

3.6 Techniques and Tools of Data Collection

This research has been conducted by employing various methods for data collection. Both primary and secondary data has been collected. The researcher himself collects the primary data from the respondents by conducting the questionnaire survey with the SHS users. For the collection of primary data following data collection techniques were adopted:

3.6.1 Households Survey

The name list of the household head was obtained from the VDC office and house to house survey was conducted. The questionnaire forms were filled up by the researcher interviewing with household heads. In the absence of household head, another senior person present at the home was taken as the respondent.

3.6.2 Observation

To explore energy related problems and prospects in the study area, visual observation by the researcher was also conducted. General problems, kitchen and study room environment, the probable remedies were observed. The data's were collected observing the households environment, solar home system wiring, condition of panel, elevation of panel setup, battery conditions, types of bulbs etc were closely monitored by the researcher.

3.6.3 Key Informant Interview

A key informant interview is loosely structured conversations with the people who have specialized knowledge about the topic. To dig out its major key informant's interview were conducted within the study area. The key informants were teacher, local political leader, VDC staffs, businessman and local SHS technician. By interviewing them on the basis of prepared set of questionnaire allowing the respondents enough leeway to provide the information, the information was recorded.

3.6.4 Focus Group Discussion

The focus group discussion was held in separate group with the participation of solar home system user. This discussion was based on the home application of SHS. It was

the systematic organized to the selected household member in the village of Pyakurebada. Altogether two FGD were conducted during my study among them one of the male and other female group of participant.

3.7 Data Processing and Analysis

The collected raw data was modified as per the requirement and objectives of the research. The various steps that were followed are:

3.7.1 Data Processing

a. Editing: The collected raw data were edited to detect error and omissions. So to overcome the possible error in our research editing was done carefully.

b. Coding: In order to make the research more systematic and scientific, assigning of numerals or symbols to answer has been carried out, so that it helped to allocate the answer whenever necessary.

c. Classification: The result of research study is at large volume in the form of raw data. So in order to simplify it has been classified into homogeneous groups, so a meaningful relationship can be profoundly studied.

d. Tabulation: After the necessary classification of data the next step taken was arranging the data in respective tables/ charts. The tabulation is essential in order to systematize and logical arrangement of data for further manipulation.

3.7.2 Data Analysis

All the data's has been analyzed systematically and scientifically by using different statistical tools. Primary data has been analyzed according to its nature, so as to address the objectives of the study. Quantitative data has been analyzed using simple statistical tools like frequency and percentage distribution. Qualitative data has been analyzed descriptively and to the extent possible with use of tables and frequency distribution.

CHAPTER FOUR
INTERPRETATION AND ANALYSIS OF DATA

This chapter is based on analysis and data generation through questionnaire, observations, discussion and personal study of the consumers were done. The data taken from field visit are presented in tabular forms and they are analyzed in different point of view in order to find the objectivity of study work. Since all field visits were done on rural area thus the study and interpretation all are in rural based.

4.1 Study Area

Jumla District

Jumla district lies in the Karnali zone of mid- Western Developmental Region with its headquarter at Khalanga. It is located at 29°05' to 30°31' Northern longitude and from 81°17’ to 81°30’Eastern latitude. This hilly district is situated at western part of capital Kathmandu. Its total area is 1,692 sq. km. And its altitude varies from 400 m to 6000 m. It shares its boundaries with Kalikot and Bajura district in East, Dolpa in West, Mugu and Humla in North and Surkhet in South. There are all together wards 27, 30 VDC, 1 Municipality.

According to National Population and Housing Census 2011, the total population of the district is 2,35423with male 1,28,567 and female 1,6856. The average household size is 6.11 and population density 141 persons/km^2. There is total 50,440 households With an average household size of 5.11, among which 39,720 HHs use firewood for cooking, 206 HHs use kerosene, 1,131 HHs uses LPG, cow dung by 55 HHs, biogas by 33 and 6 HHs depends on electricity for cooking.

Similarly 12,498 HHs uses electricity as a source of lighting, 4,185 HHs uses kerosene, biogas by 148 HHs and 4,984 HHs use solar as source of lighting.

This district is famous for historical places like Sinja valley Palace and Kanakasundari Temple. The major occupation of people is Agriculture (54%) beside this it is a regional headquarters of mid western Development Region.

Dhapa VDC

The study was undertaken at Dhapa VDC of Jumla district. This VDC lies in constituency no.1of Jumla district. Total area of this VDC is 28.77 sq. km. It lies between the altitude of 480 m to 1960 m. Total population of Jumla VDC is 3746 having 1877 male and 1869 female populations. There are all together 675 households with an average household size of 5.26.

Among which 578 HHs use firewood for cooking 2 HHs use kerosene for cooking. Similarly 211 HHs uses solar as a source of lighting and 42 HHs uses kerosene as source of lighting (National Population and Housing Census 2011).

Within the VDC, our study is mainly focused in ward no 1 - 2 which is composed of different ethnic groups; largest population in the Dhapa is Chettri and Dalit respectively. Besides, the other castes and ethnicities like Dalit, Chhetri and Brahmin have their considerable presence.

Most of the houses have tile/slate roof houses followed by thatch/straw roof house. The wall of the house was made by mud and stone. The villagers are getting drinking water supply from different sources like 285 were benefiting from tap/piped water, 70 HHs form covered well/kuwa, 85 HHs form uncovered well/kuwa, 122 HHs form spout water and 18 HHs form river. They get health services from a health post and private clinic.

As far as social organizations are concerned, mainly four types of organizations are found namely community forest users group, Mahila Samuha and Political Parties and Schools. There are one higher secondary, two secondary and three primary schools in the VDC. The governmental representation was limited with public schools, health posts and police bits.

Most economic activity revolves around agriculture, livestock and trade of agro products. The climatic condition is suitable for the horticulture. Most household used to sell fruits, vegetables, milk of cows and buffalos which is collected and transported to Gothijiula. No. of households are also found involved in poultry farming. Some people are found involved in business and government job, as well as gone abroad for labor.

There was no grid electricity connection till Magh 2071. All together installed SHS in 211 HHs has been taking significant advantage from Solar Home System. People generally use Firewood as sources of cooking fuel. The kerosene was used for lighting but after Solar was installed it is used as the alternative source of lighting.

4.2 Structure of Sampled Population

Here the structure of population means the spatial distribution of population on study area through which researcher may obtain the actual distribution of population accordingly to cast, age, education, profession, economic conditions, ethnicity, family size, and etc.

The study mainly focused on the solar home system because most of Nepalese women's are spending their most of time to collect fire wood. Similarly most of rural women's are also suffering from chronic effect on their lung even though they are not smoking and rural environment is also healthy. On the name of energy collection and suffering such chronic diseases the economic status of rural life also lay down, that wise to enhance the rural economic, researcher realized without overcoming the issue of energy problem and application methods of energy the rural economic development could not be achieved.

While study on field, researcher equally given the emphasis on women, low income family, local indigenous people including both literature and ill-literature. No one can imagine the goal of development could be success without education there for to provide better education for our children light is also play vital role. Consequently the prosperity of the country and community will be easier to achieve. Realizing this importance of education among the rural people of Nepal, researcher collected the information regarding the education status of the study population which is expressed as follows.

4.3 Respondents by Caste/Ethnicity

The segregation system makes Brahmin in the position of higher rank but for the prosperity of technological utilization also Brahmin becomes the 1st position, it is because most of indigenous people of Nepal working on service and business

similarly they are also involve on panditye activities on working religious as well cultural activities.

Table 4.1

Caste Distribution of the sample HHS

S.N.	Cast	Nos. of household	Percentage
1	Brahmin	52	57.78
2	Chhetri	28	31.11
3	Dalit	10	11.11
Total		90	100.00

Source: - Field Study, 2016

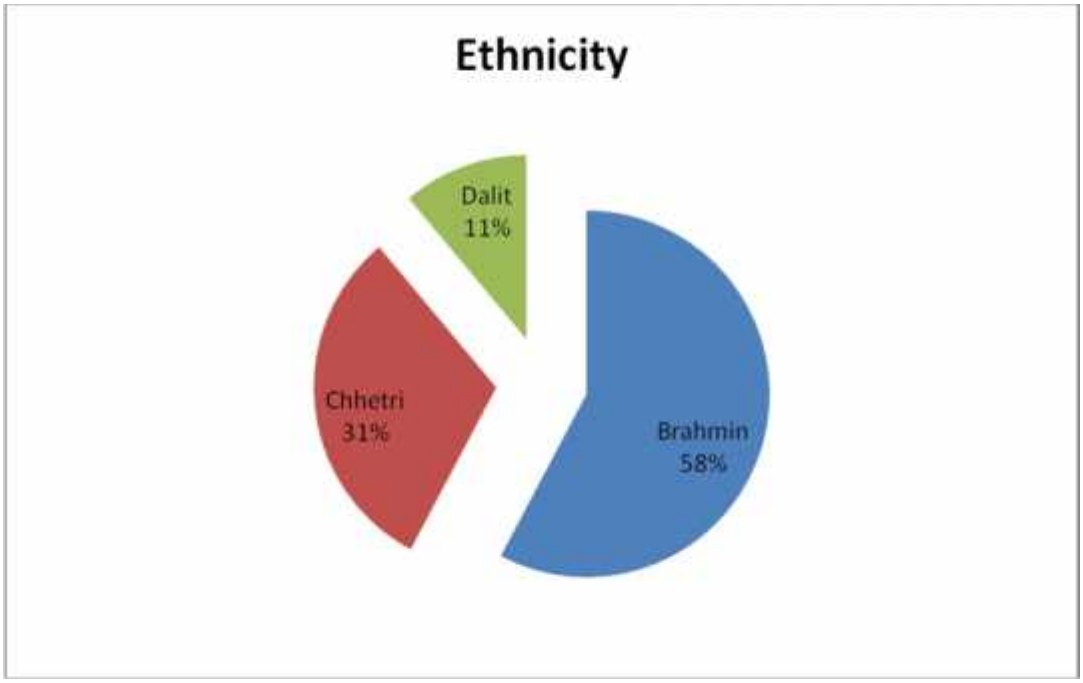

Fig 4.1 : Caste Distribution of Study Area

It can be seen from above figure the population of Brahmin are nearly about 57.78% where as Chhetri in 31.11% and rest of 11.11% are Dalit. This indicates that all three different types of cast are accounting as respondents on study area. In the study VDC majority of Brahmin are higher and then followed by Chhetri and Dalit household are less in ethnic composition according to VDC profile.

4.4 Educational Distribution of Respondent

Each and every respondent have variety in educational status. So, family education in any house-hold holds the key information of the awareness towards life supporting factors. We could hear a proverb in some uneducated families that "what is the role of education we should hard work for food". But in case of educated family the using of new-technology always takes 1st credit, so far as energy consumption educated family wants pursuit their life on technological way which makes their life cozy and confirmative.

Table 4.2

Distribution of Respondent by Educational Status

Education	No. of population				Total (Male+Female)	Percentage
	Male	Percentage	Female	Percentage		
Illiterate	30	33.33	22	24.44	52	57.77
Under SLC	12	13.34	9	10.00	21	23.34
Under Graduate	9	10.00	3	3.34	12	13.34
Graduated	5	5.55	-		5	5.55
Total	56		34		90	100.00

Source: - Field Study, 2016

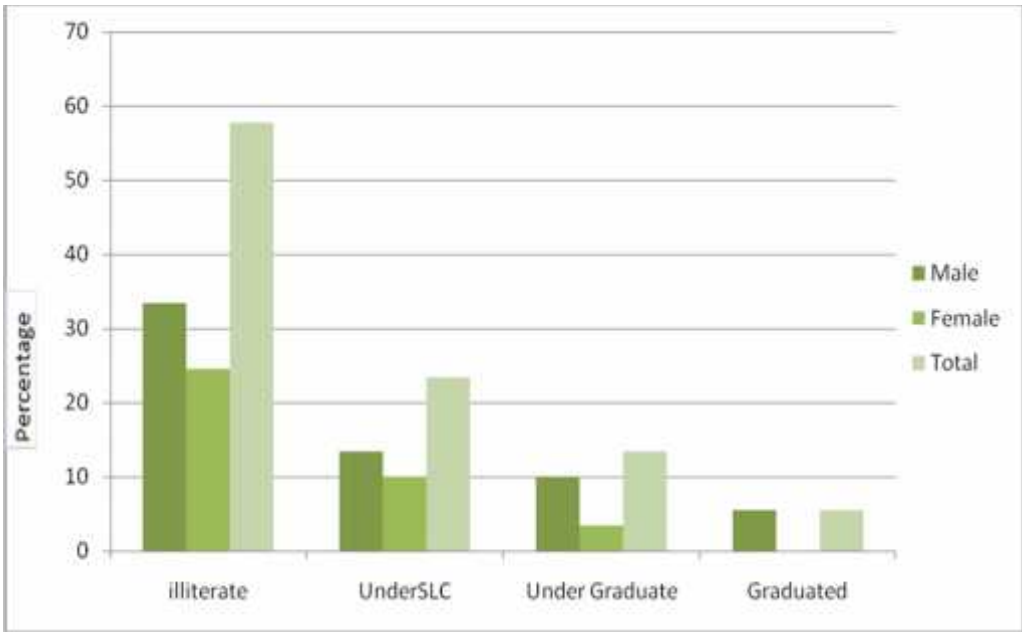

Fig 4.2: Distribution of Study Population by Educational Status

It can be seen from above table that the female educational status is relatively lower than that of male. Out of 90 respondents only 38 are literate but population of educated female respondents is only 12. There were no female respondents having graduated.

The researcher found 57.77 % of population is illiterate among of them 24.44% female are illiterate. Beside this 23.34% respondents are simple literature it means they are under SLC. But some hope full and significant results based on there are 13.34% of populations are SLC passed and among of them 3.34% population is carried-out by female population. Here 5.55% male respondents are graduate where as 0% female respondent.

4.5 Family Size of Sample Population

The researcher considered the sample population under the field study where all respondents equally take participated under studied period. On that time they filled up the family size as required to researcher. The rate of energy consumption depends up the equipments used by household. We simply argue on the fact that those persons who have high economic can use more energy rather than poor person but sometimes the family sizes also affect the energy patter of utilization. We simply take an example that if a house contains large family size, in that kitchen s/he must cook more food, there may have numbers of school students in this way the rate of energy consumption must increase.

Table 4.3

Distribution of sampled Household by Family Size

Family size in Number	No. of House Holds	Percentage
1 – 4 members	11	12.22
5- 7 members	51	56.66
8 – 10 members	25	27.78
10 + Members	3	3.34
Total	90	100.00

Source: - Field Survey, 2016

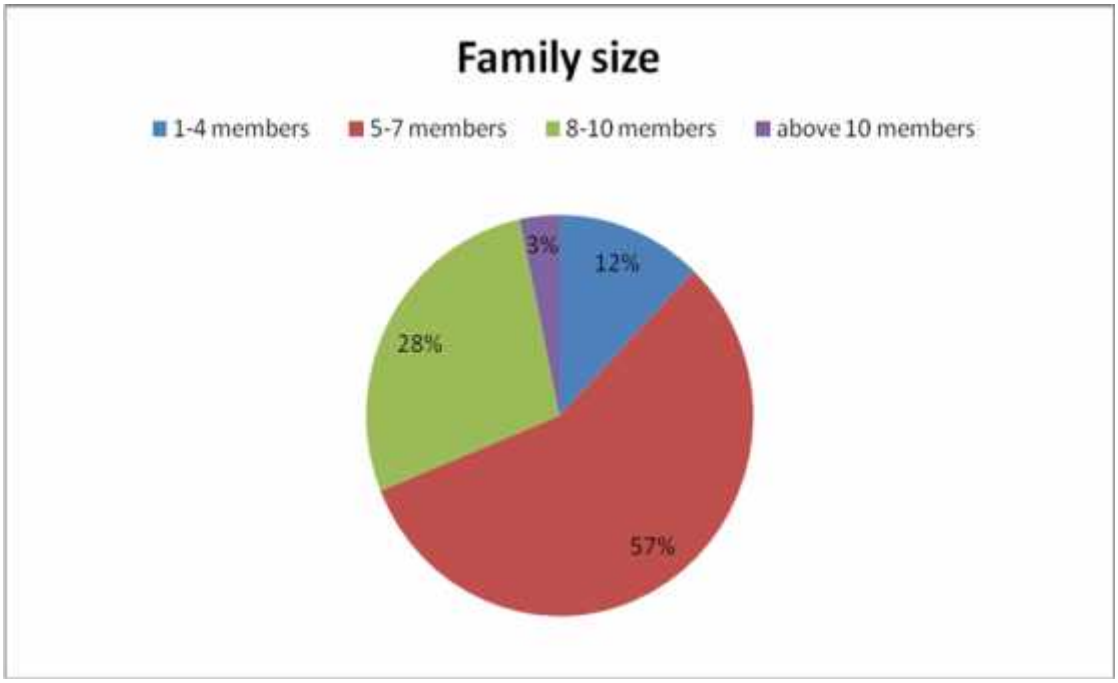

Fig 4.3: Family Size of Respondent in form of Chat

Above the table shows that maximum family size contained 1-7, after 8-10 family size similarly,1-4family size was less respectively.

4.6 Occupation of the Respondent

Occupation play a vital role in the technology installation and the informal utilization of any new treands of technology depends up on the occupation. In a general view is found that, those persons who are in the farmer business are mostly prefermering the installation of Solar Home Photovoltic Sistem.those persons who involving on service or trasde are more o\inclined to education than other occupation class becaise they are well knewn the importasnt of education and are more aware as well. The followig table indicates the number of house holds by occupation.

Table 4.4

Distribution of sampled House-holds by Occupation

Occupation	No. of HHs	Percentage
Farmer	60	66.67
Teacher	12	13.33
Business	13	14.44
Other	5	5.56
Total	90	100.00

Source: - Field Survey; 2016

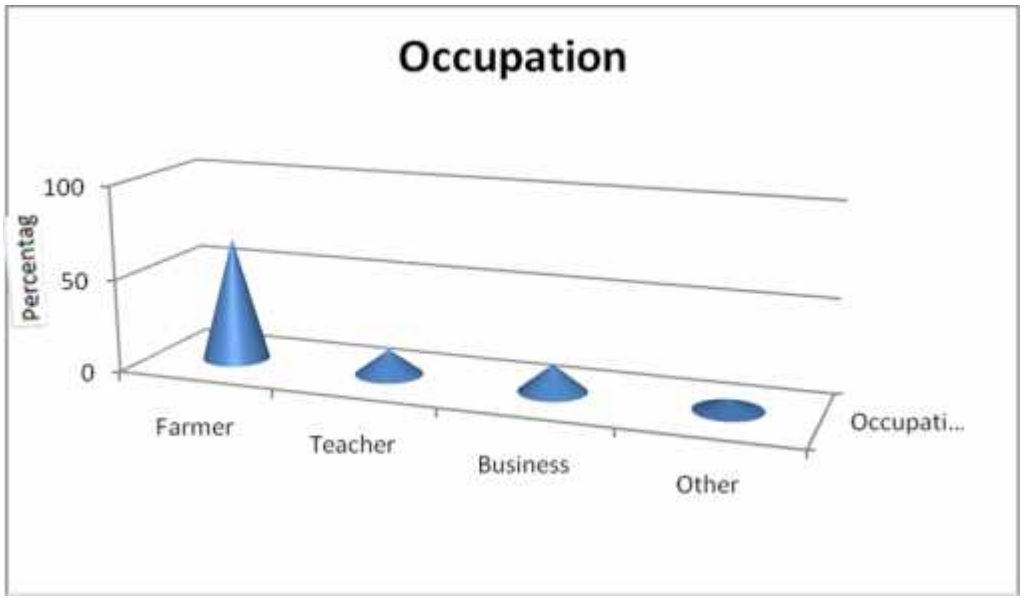

Fig 4.4: Occupational Status of the respondents

From the field survey it is found that there is a majority of farmer, 57.7% of respondents are involving on agricultural activities, on other aspect there are 23.1 5 of population involving on both agriculture and service, the most power full and strong identification of income generating activities holding on our society is business there are 7.7% respondents are engaging on this sectors. There the researcher found that 11.5% service holders who are in private and public enterprises. Most of service holders are in the field of teacher and Nepal Army.

4.7 Annual Income and Source of Income

Prosperity of the house-hold depends upon the source of income and its extent. Higher the income better will be the household status. The annual income of most Nepalese people based on the agro product. The economic based upon the agro product which can't be considered as the sustainable because Nepalese agriculture based upon the monsoon movement. If the monsoon occurs in a time, the annual crop production of Nepal also good otherwise loose. The power purchasing capacity also depends up the income of family. The efficacy of the Solar PV system is based up on the capacity of solar panel and power load system.

Table 4.5

Source Income Distribution of sampled House-hold

Average annual income	No. of House-holds
Below 50 Thousand	22
50-70 Thousand	39
70-90 Thousand	12
Above 90 Thousand	17
Total	90

Source: Field Survey, 2016

The data presented on above table shows that the majority of house-hold income is 50-70 thousand per year, below 50 thousand income family is second no so few family has better income above 90 thousand it shows that maximum HHS income is low.

4.8 Educational Condition of HHS

4.8.1 Increased Study Hour after Installation of SHS

In rural areas of Nepal where there is no electricity (grid and non grid) mostly people use Diyalo as source of lighting. Students are forced to study under dim light of Diyalo fuled by Diyalo or torch lights that uses dry cell. the efficiency of these lights is low and students finds difficulty in studying in those environments .Solar home

system provide efficient cleaner and brighter lights which helps student to study in brighter light as well as help the family .Respondent of SHS users has found increased study hours of their children has been shown in below table:

Table 4.6

Respondents by Increased in Study Hour after SHS Installation

S.N	Increased Study hours daily	No of HHS	Percentages (%)
1	Increased by 1 hour	28	58.33
2	Increased by 2 hour	12	25.00
3	Increased by 3hour	8	16.67
	Total	48	100.00

Source: Field Survey, 2016

48 households out of 90 SHS installed households have their school going children.about58.33% HHS admit that after installing SHS their children studying hours have been increased by 1 hour at night daily. 25% HHS admit increased in night study by 2 hours and 16.7% HHS admit 3 hours increased in study hour at night daily after SHS was installed the fact is to increase or decreased in study hours not only the solar light but various variables like studying environment household work to be done to be done by children etc are also crucial in determining the study hour of students.

4.8.2 Sources of Entertainment by SHS in Study Area

Energy plays vital role in making access to information and technology. Different electronic means like television, radio, mobile, etc are used as source of information in the study area is shown below in table. The SHS helped to solar users for information, communication and entertainment. Those status had given below:

Table 4.7

Sources of Information got by Sampled Household

S.N.	Types of sources	No of HHS	Percentage%
1	Radio	45	50.00
2	Phone	33	36.67
3	T.V, radio, phone	15	16.67

Source: Field Survey, 2016

Out of 90 SHS installed households 50% households have at least a Radio in their home. Similarly 36.67%households had atleast a mobile phone with anyone of their family member. Around half of SHS installed household 17 % has radio, Television and mobile phone.

4.8.3 Fire Wood Consumption By HHS in the Study Area

Among the traditional energy resources fuel wood is the largest energy resources in Nepal providing about 77% of the total energy demand in the year 2008/09 in Dhapa VDC also fuel wood is the primary sources of energy used for cooking purposes. in Dhapa VDC average cost of one Bhari fire wood of about 40 KG is 400 Rs. VDC one KG fire wood is equivalent to 10Rs .the Annual fuel wood consumption by the respondent HHS of Dhapa VDC is shown in below:

Per BHARI fuel wood = 40 KG, per HHS per month average fuel wood = 40 KGP per KG Rs. = 10
Per month fuel wood KG = 1600
Per year amount of fuel wood Rs. = 1600 × 10 = 16000

There is almost same amount of fire wood energy is consumed by SHS users and non users. Economically, 1600kg fire wood is used by 90 HHS equivalence to Rs 16000 annually.

4.9 Health Condition of the Respondent

Distribution of the health related problem among the study population has been presented in only about 20 % were suffered with such problem during last year and this figure was higher for non user's population. Among the diyalo user before SHS installation sufferers from 23 % each had infected with cough, 51 % with eye pain, 25% with asthma.

Table 4.9

Distribution of Population by Smoke Related Problem

S.N	Health problems	Users	Percentage %
1	Eye pain	46	51.11
2	Asthma	23	25.56
3	Cough	21	23.33
	Total	90	100.00

Source: Field Survey, 2016

Above this table shows that before installation SHS varies disease has been seen. After installation SHS reduce health related problems by SHS. We concluded that SHS helps to the human health and environmental sanitation.

The researcher also aimed to find out the relation of technology using pattern changes on human social attitude. The researcher found that none of lower cast people want to isolate to take advantage of solar system. All solar PV system makes people feeling given new status on their society. They uniquely said that “since the utilization of Solar Home Photovoltaic system, it makes our life get new respectable position on our society”.

Here peoples give the positive response towards solar system, they also made unique voice on satisfaction of using solar PV system, they collectively said, even if NEA (Nepal Electricity Authority) provides sufficient amounts of energy we never want to isolate to take solar advantage through solar panel. They advice to all those who are not take any advantage please don’t be isolate to take technological advantage of solar PV system it makes evolutionary change our life also. They also agree on common problem that government give huge substitution to kerosene which not only burrow our money to foreign country but also harmful effect our environment that’s wise it is better to give more and more substitution on solar PV system which makes adverse effect on our daily life and pursued to our healthy environment.

4.10 Technical Aspect of Solar Home System

For maintaining and monitoring both male and female were involved in SHS where they monitor out of them battery, solar panel, charge controller, distill water etc. Male user were more responsible then female.

Table 4.10

Gender in Maintenance

Gender/Care	No. of Household	Percentage
Male	65	72.22
Female	25	27.78
Total	90	100.00

Source: Field Survey, 2016

Above this table showed that among the 90 HHS male and female participation in maintenance of technical part of SHS was different. Highly no of male were involved in put distill water maintenance batteries and monitoring cable etc. No. of female were low participation in technical maintains.

Table4.11

Time Duration to Put Distil water in Battery taken by Respondent

Time Duration	No. of Household	Percentage
1 month	25	27.78
1-3 month	23	25.55
3-5 month	27	30.00
Above 5 month	15	16.67
Total	90	100.00

Source: Field Survey, 2016

Above this table shows that 30%of respondent put in distil water in battery after 3-5 month,27.78% respondent put in distil water in battery after 1 month,25.55% respondent put in distil water after 1-3 month and 16.67% respondent put in distil water in battery after above 5 month respectively.

4.10.1 No of Bulbs Used by Households in the Study Area

No of bulbs used for lighting by households in the study area varies as per system capacity types of bulbs used no. of family size etc, which is shown in the table below

Table 4.12

Distribution of Bulbs for Lightning

S.N	No of bulbs	No of HHS	Percentage
1	1-5	47	52.22
2	5-8	35	38.89
3	Above8	8	8.89
4	Total	90	100.00

Source: Field Survey, 2016

the above table shows that more than half of the solar home system instilled HHS(52.22%)in Dhapa VDC has 1-5 bulbs used for lighting 38.89% HHS has bulbs between 5-8 and 8.89%HHShas bulbs more than eight. the no of bulbs depends upon the system capacity, requirements of the house and on types of bulbs used for lightening .During the study it is found that all bulbs are not used at the time by household, they are used alternatively .appropriate no. of bulbs as per system capacity helps in longevity of battery and panel.

4.10.2 Major Problems Faced with SHS

Using solar energy technology requires proper knowledge and understanding from its beginning installing phase to its use operation and maintenance. The initial cost of SHS is quite high in compare to traditional source of energy so many people fiend it unaffordable. Beside this proper guidelines are required for its operation and maintenance. Some major problems faced by SHS users of Dhapa VDC is shown below in table no:

Table 4.13

Major Problems Faced by SHS Users

S.N	Types of problems	No of HHS	Percentage(%)
1	Cost	32	35.555
2	Operation/maintenance	46	51.111
3	Both cost and maintenance	6	6.67
4	low efficient during bad weather	6	6.67
	Total	90	100.00

Source: Field Survey, 2016

The above table shows that 35%HHS take SHS cost is high for them while 51%HHS faced problem of operation and maintenance like battery fuse, changing distil water level in battery etc.6.67% HHS complains that during rainy season when weather is cloudy the energy produced by their SHS is not enough for them ,so the cost of SHS should be reduced by giving more incentives to rural low income HHS as well as there should be aweaness programs on SHS and skilled technician available in village for its maintenance.

4.11 Subsidy

Government provided subsidy policy system to those people whose economic condition is very poor. The subsidy policy system lunched by governments for the Karnali zone, remote areas and also for Dalit whose economic status was very low.

Table 4.14

Subsidy of SHS by Install HHS

S.N.	Subsidy amount	No of HHS	Percentage(%)
1	5-6 thousand	43	47.78
2	6-8 thousand	20	22.22
3	Above 8 thousand	27	30.00
	Total	90	100.00

Source: Field Survey, 2016

The above table shows that highest no of HHS (47.78%) has receive 5-6 thousand subsidy. the reason for its maximum no of HHS poor and low income. similarly 30% HHS receive 6-8 thousand subsidy the reason for middle class HHS and 22% HHS receive above 8 thousand subsidy the reasons for its maximum rich class HHS lies in this rank. we conclude that poor dalit, and low class family receive maximum subsidy, middle class and high class HHS receive low subsidy.

Table 4.15

Respondents give their Respond on few objective questions about subsidy

S.N.	Question	Answer	No.
1	Who do you think provides the subsidy?	NGOs	75
2	What is your agreement with the company?	None	90
3	What is the necessary document to provide SHS?	All of above	85

Source: Field Survey, 2016

The above table shows that no of HHS 75 out 0f 90 who says that NGOs provides subsidy others (15)HHS says that not only NGOs, similarly next question shows that maximum HHS has not any agreement with company. Respectively 85 HHS provides necessary documents other (5)HHS has not knows about the document.

4.12 Problems on Solar Photovoltaic System

Even solar system provides lot of positive attitude for human society through naturally or artificial way, It does not have any environmental Impact, people still do not able to utilize its benefits because of it high cost of installation. The households who are using the solar technological system getting constraints due to non viable of technician on the sport at the time of requirements similarly they do not have simple technological knowledge for solve normal problems associate SPS, Due to this they are paying high cost at a time of acid change and water change. The household using SHS must depend on technician for repair and Dhapa who is in 40 K.M. a part of their resident, and 5and half hour journey by foot.

Some problems faced with SHS in Dhapa VDC are as follows:

1) Cost: though there is subsidy the initial installing cost of SHS is high .it is really difficult for low income people to install SHS. About 35.55%respondents of Dhapa find the cost of SHS as a major problem during its installation and for further promotion and development.

2) Maintenance: Maintenance problem like fuse problems, changing distilled water in battery, low durability of battery and charge controller etc are problem frequently faced by SHS users of Dhapa VDC. more than 51.15% HHs of the study are finds maintenance as major problems lack of skilled manpower and repairing centre is also another problem for them.

3) low efficiency during bad weathers : about 6.67%HHS of the study area finds low efficiency of SHS during cloudy, rainy humid day. The light were not brighter enough and even all load don’t work during such time.

CHAPTER FIVE
MAJOR FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Major Findings

Following are some of the highlights of the key findings:

- Dhapa VDC of Jumla district is the study area.
- The VDC has 675 households with total population3746, male 1877 and female1869.
- It is found that out of total households, 90 households has been taking advantage from solar energy.
- All these 90 HHs who are the users of SHS taken as sample HHs (100%) taken from every ward.
- The total population of sample households is 372persons, male 176 (47.31%) and female 196 (52.68%).
- In the study area average HHs size is found to be 6.98.
- The total area of Dhapa Vdc is 28.77 sq km.
- Highest no of households in the study area are Brahmin (57.78%) followed by Dalit (11.11%).
- The average literacy rate of sample HHs is 42.23%, Male literacy 13.34% and female literacy rate 10%.
- Major occupation status of the sample HHs, Agriculture 66.67 service in Teacher 13.33% , business 14.44% and others 5.56%.
- 60% sample households agreed that their income supports expenditure for 8-12 months while 30% sample HHs for 12+ months and 10% for 4- 7 months.
- After the installation of SHS, 58.33% sample HHs noticed the increased of study hours of their children by 1 hour, 25% HHs by 2 hours and about 16.67% households by 3 hours per day.
- Fire wood is the most common and highly used sources of energy by both SHS users. Annually 1600 bhari used by 90samples HHs annually in the study area equivalence to NRs 16000.

In the study area 50% HHs takes radio as major source of information while 36.67%household has at least a member with phone (mobile/land line) and 16.67% HHs uses all TV, radio and phone.

- 38.88% sample households in the study area had installed 5 - 8 no. of bulbs, 52.22% HHs has 1-5 Bulbs while 8.88% HHs has no. of bulbs more than eight.
- 100% sample HHs agreed that SHS helped them to keep home environment clean and healthy compared to Diyalo.
- 51.11% SHS users faced problems with its maintenance while 35.55% HHs find it costly and 6.67% HHs complain about its low efficiency during bad weathers.
- The no of HHS 75 out 0f 90 who says that NGOs provides subsidy others (15) HHS says that not only NGOs, similarly next question shows that maximum HHS has not any agreement with company. Respectively 85 HHS provides necessary documents other (5) HHS has not knows about the document.
- The highest no of HHS (47.78%) has receive 5-6 thousand subsidy. the reason for its maximum no of HHS poor and low income. similarly 30% HHS receive 6-8 thousand subsidy the reason for middle class HHS and 22% HHS receive above 8 thousand subsidy the reasons for its maximum rich class HHS lies in this rank. we conclude that poor dalit and low class family receive maximum subsidy, middle class and high class HHS receive low subsidy.
- No of 30% of respondent put in distil water in battery after 3-5 month,27.78% respondent put in distil water in battery after 1 month,25.55% respondent put in distil water after 1-3 month and 16.67% respondent put in distil water in battery after above 5 month respectively.
- Among the 90 HHS male and female participation in maintenance of technical part of SHS was different. Highly no of male were participate in put distil water maintenance batteries and monitoring cable. No of female low participation in technical function of maintenance.
- It can be seen from above table that the female educational status is relatively lower than that of male. Out of 90 respondents only 38 are literate but population of educated female respondents is only 12. There were no female respondents having graduated.

- The researcher found 57.77% of population is illiterate among of them 24.44% female are illiterate. Beside this 23.34% respondents are simple literature it means they are under SLC. But some hope full and significant results based on there are 13.34% of populations are SLC passed and among of them 3.34% population is carried-out by female population. Here 5.55% male respondents are Graduate where as 0% female respondent.

The data presented on the majority of house-hold income is 50-70 thousand per year, below 50 thousand income family is second no so few family has better income above 90 thousand it shows that maximum HHS income is low than the fewer HHS has high.

5.2 Conclusion

In conclusion the researcher finds the positive impact of using solar power/energy Dhapa V.D.C especially in social, economical, educational, and environmental sectors. In the process of researching the researcher uses tools and technique to collect data in Dhapa V.D.C. researcher finds the many changes in people's lifestyle. It is mostly which helps to social change of Dhapa V.D.C and peoples life becomes easier than before , likewise in economical factor using solar energy means reducing bills and saving money which helps Dhapa V.D.C. people' lifestyle. Similarly, another sector is educational, in which children's reading and writing have become better than before children' reading hours is increasing day by day by using it. On the other hand environmental sector solar power system drive clean, pure energy which helps in decreasing indoor and outdoor pollution by not used firewood. So that solar power impact on Dhapa V.D.C. is mostly it has changed the lifestyle of peoples.

From the study it was found that all the households using SHS are getting benefit through white and smokeless light, had saved money from replacing kerosene significantly, had started various income generating activities at local level by both men and women resulting gender equality and women empowerment. Their access to energy and means of communication has increased, local health post are running facilities at night during emergency , children study hour has increased significantly, no. of accidental fire hazard because of kerosene lighting has decreased. By the use of SHS, the reduction in emission of CO_2 equivalent and motivation for entrepreneurship

development at local level has helped positively in reduction of poverty and in holistic development of rural areas. All users were very positive towards SHS installation. They suggested that focus should be given in easy availability of solar components at low price and skilled technicians at local level as well as clear plans and policies for further promotion and sustainable development of solar home system is most.

5.3 Recommendations

As already mentioned above that SHS is a wiser and most appropriate solution for lighting not only remote areas but also urban areas where shortage of electricity is common problem. Based on the study following recommendations are made for its wider applications throughout the nation.

1) Low access of Dalit, though government provide subsidy to them but Dalit really use SHS. So government should provide public awareness, more subsidy to Dalit.
2) According to data analysis the researcher find out that literate were more than illiterate to use solar home system. Although SHS was necessary to all rural people, so that to participate them in counseling program, awareness, and those program which encourage them in SHS.
3) By using SHS increase to information communication technology so it should be sustainable from government.
4) Though SHS brings improve in respondent health status to increase the access of non–user people.
5) The initial cost of installing SHS is high such that all people can't support it. So subsidy should be increased for the rural areas while there should be also provision of subsidy to urban areas people who are willing to install it.
6) Beside subsidy government should provide incentives in imports and transportation of components of solar energy system rather than providing incentives to kerosene.
7) The cost of installation of same capacity in the same locality also differed as per the installing company. So cost of installation according to its capacity and geographical region should be fixed by concerned government authorities.
8) SHS installation should be made as much possible as free for those poorest people of remote areas where grid electricity infrastructure seems costly.

9) Government should run campaign to make people aware about SHS, its use and impact on the users.

10) Repairing centers and shops for buying and repairing different components of SHS should be made available within the locality.

11) People's easy access to skilled technicians on SHS should be made available at local level.

12) Primarily research is foundation for making any kind of policy, so research centers on solar energy with involvement of experts should be run in different part of the nation.

13) There should be long term (about 20 years) perspective plan on solar energy with clear objectives and fixed targets on installing SHS throughout the nation.

14) Government should make policy on commercial production of solar energy and provision of selling it to the grid connection.

15) Effective implementation of clean development mechanism (C.D.M) for solar energy should be ensured.

16) Effective monitoring and evaluation of various institutions and programs on solar energy should be donated regular basis.

Though government lunched SHS in rural area it also provide related technician in local area. Researcher found many positive impact in Dhapa VDC and Some kind of negative impact also seen in that system.

SHS is necessary for all people, so that the government considerably in maintained and manage in the above recommended point as well as local body should be involved in implementation.

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Appendix - I

Application of Solar Home System

Respondent Name : District : Ward :

Education : Sex : Caste :

1. What are the changes come after using solar system.
2. How much fuel were consuming before using solar energy.
3. How much does it have spent of your family ?

S.N.	Goods	Per Unit Price	Technical Expenditure	Transportation Expenditure	
				Price	Time

4. What is your family's educational status ?

Sex/Level	1-5	6-10	SLC	+2	Bachelor	Master	Literate
Female							
Male							
Total							

5. What is your family member occupation ?

Sex/Occupation	Students	Farmer	Teacher	Business	Services	Others
Female						
Male						
Total						

6. How much do your annually income ?
7. What type of energy do you use in your daily life ?

   a) Solar energy b) Biogas c) Fuel wood

   If you use firewood, how much do you use abstractor in month ?

Bhari	Kg	Per kg (Rs.)	Total kg	Total (Rs.)

Technical Aspect

8. Who does participate using distill water ?

   a) male b) female c) Other

9. Is electricity used directly on Battery ?

10. What are problem there shown by using other electrical materials ?

Electrical Materials

11. How long time cleaning panel ?

12. Why is need panel cleaning ?

13. How much bulbs do you use ?

14. How do you protect using wire ?

15. What is function of charge control ?

16. What did you use before using solar energy ?

17. What are advantages in your health by using solar energy ?

18. What are difference come in children studies after using solar energy ?

Before	After	Difference

Entertainment and Information

19. What advantages have been supported after using solar energy ?

20. Did you have Radio and TV ?

21. What have been supported after using solar energy ?

Maintenance/Care

22. Whats relation between repairing company and suppliers ?

    a) Written agreement b) Oral argument c) No

23. How many times does it repair ?

24. Is there any technical problem ? If you have how is that ?

25. How do you resolve these problem ? Is any support there of local resident ?

26. Is there any training given you ?

27. Who do respire and maintenance solar ?

Subsidy

28. To whom subsidy is given ?

    a) Remote area b) Over all country

    c) Karnali zone d) Don't know

29. How much did you get subsidy amount ?

30. How did you collect money when purchased solar ?

31. How did get subsidy receiving solar PV ?

32. What process were done when getting subsidy ?

33. What documents were included when purchasing solar ?

Appendix - II

Name of Respondent Participation FGD in Pyakurebada

1. Ram Krishna Upadhaya
2. Santosh Neupane
3. Ramita Acharya
4. Puran Khatri
5. Man Bahadur Khatri
6. Maya Hamal
7. Sangita Jaishi
8. Puspa Rawol
9. Jaga Prasad Acharya
10. Nirmala Dhital
11. Laxmi Acharya
12. Muna Bhandari
13. Chandra Bahadur Khatri
14. Min Bahadur Neupane
15. Saroj Pyakurel
16. Tika Prasad padhaya
17. Bhanu Pariyar
18. Sandesh Sarki
19. Mayalal Sarki
20. Vidya Pariyar