CHAPTER 1

INTRODUCTION

1.1 Background

Nepal is one of the most favorable countries by nature for the solar energy and receives ample radiation too. It varies from 3.6–6.2 kWh/m2/day. People from rural area of Nepal cannot afford the diesel generators operations cost for electricity, in mountains and cold high altitudes of Nepal. Small hydro turbines need specific topographical conditions that are only found near a small percentage of users' dwellings. (WECS,2010). There is only one solution for it, solar electricity generating systems because it is easy to install and operate.Butit has some limitations and problems which can be overcome with proper planning.

The sun is the largest energy source on the earth. It provides free energy which is significantly more environmental friendly than the traditional energy sources, Radiation from the sun that can produce heat, generate electricity or causes chemical reactions. Solar collector collects solar radiation and transfers it as heat to a carrier fluid.

Solar energy was first conceived as a viable alternative form of power as early as in the 1860s. Due to abundance of coal and petroleum, no major progress was made in solar technologies until the global oil crisis of 1973. The crisis brought renewed attention to the potential of solar power as alternative source of energy. In response, industrialized countries made a concerted effort to develop solar power technologies by creating and maintaining well-funded research and development agencies. Photovoltaic installation rapidly increased in the late 1970s and 1980s. With increasing evidence of global warming in the 1990s, solar energy has been seen to be one of the most sustainable sources of energy to replace carbon emitting fossil fuels and thus became more "mainstreamed". Nowadays, many countries have made solar energy a central part of their energy policy and committed to fulfill substantial portion of their energy demand from solar power. The context for the use of solar power in Nepal is slightly different. Despite Nepal's huge potential for hydroelectricity, it has not been able to harness its full potential due to various reasons. Currently, only

56%Nepali population is connected to the national grid while the rest of the population still relies on traditional sources of energy. Even in electrified areas, there has been an acute power shortage in recent years, with residents forced to live in as much as 16 hours of daily power cuts. In the light of this situation, solar energy has been identified as one of the alternative sources of energy that has the potential to reduce the deficit between demand and supply. Since power from Solar Home System (SHS)can be used by households directly, there is no need for investment in expensive infrastructure like power lines. SHS are also readily available and easy to install, so they can address the short run deficit in energy in Nepal. As such, the Government of Nepal (GoN) has been actively promoting the use of solar energy, especially in those areas of the country where there is no supply of grid electricity. (AEPC, 2010)

The first recorded use of Solar Photovoltaic (PV) in Nepal can be traced back to 1963 when Civil Aviation Authority of Nepal installed a Solar PV system in Bhadrapur Airport to run navigation equipment. Its use for domestic electrification started in 1992/93 and gained momentum from 1996 when Alternative Energy Promotion Centre (AEPC), with the objective of developing and promoting renewable energy in Nepal was established. With respect to the consumption of energy, in 2014, Nepal is in the 142 position with the human development index 0.534 according to World resource institute and world energy organization. Nepal is recognized as a rural country as about more than 80% of the land is covered by the rural area and almost all of the people in rural area seemed to be using the traditional form of energy like firewood, agriculture residue, animal dung in an ineffective way. This has directly affected the development and the living standard of the rural people of Nepal. The consumption of these types of energy not only affects the cost and time but also affects the environment in negative way. Life expectancy rate, literacy rate and income are directly or indirectly related to energy consumption which is the factor of human development index. The alternative form of energy like solar energy can be the best form of energy as a solution of this problem.

Nepal is geographically diverse country. Scattered settlement is one of the prominent characteristics. Nepal is facing energy crisis, 12 to 14 hours of power cuts and high rate of power purchases agreement with neighboring country is evidence of it though.Rural Nepalese people are living under the poverty. Nepal has diverse

geographical area and it is difficult to link the main transmission line to rural area technically and financially as well. Therefore, energy is considered as one of the basic needs of the people. (AEPC, 2070/71)

Energy can be defined as the ability to do work. The energy that is found in the rural area under the rural people is called rural energy. For the complete and the sustainable development of a country there should be the reliable development of energy. The country is seemed to be going to face the problems of the energy crisis in a near future all due to inconvenient and continuous increasing rate of use of energy. People are destroying the forest in the fastest rate. To keep up the interrelationship between the energy and the forest resources, it is necessary to bring the concept of renewable and alternative source of energy. It is important to replace the traditional use of the energy and replace them through the alternative forms i.e. biogas, micro hydro project, solar energy, improved cooking stoves etc.

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. Technological progress improves the quality of existing physical and human resources that increases the quality of the same productive resources likewise; technological progress results from new and improved ways of accomplishing traditional tasks such as growing crops, making clothing building a house etc.

1.2 Statement of the Problem

Due to population growth, the demand for energy is increasing day by day. Major part of energy consumption is met through traditional sources. The renewable energy sources are to be developed and solar energy promotion is a significant one for improving the condition of the rural people. Nepal is reachin water resources.However, it cannot be implemented in all the parts of the country due to lack of policy and its implementation.

Solarenergy is one of the sustainable sources of energy. Many studies conducted in solar energy have drawn the positive impacts on women health and their socio-economic activities. This study would be of importance for investigating the change

in women's status, children's study and other socio-economic activities of solar usinghouseholds(HHs) in the area under study.

The government seemed to be unable to install the huge cost of required infrastructure development to meet the energy demand of the rural people. However, it is providing certain amount of subsidy for reducing the investment burden of the rural people in installing renewable energy technologies but they are out of reach of the disadvantaged &marginalized group of rural people. Elite groups in the villages dominate decision making and they 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 HHs 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 or less explored in the field level such as use of user group fund for welfare of poor and marginalized people, participation of disadvantaged group, and women in decision making and planning process for the development and production of community solar energy technologies, active management of the solar energy technologies to derive sustainable yield and impact of solar energy on socio-economic status of user group. These issues require empirical research to explore reliability, if so, it needs detail study researches in these aspects for their validity. The proposed study is expected to give some valid results in this regard.

After the installation of the SHS, it has created a very positive impact on the HHs environment and life of the people. The SHS is very much successful in fulfillingtheir demands and improving the life style of the people. It has also provided community people with the opportunity to generate the extra income. So despite its high cost, compared to the affordability of people, they are willing to have SHS for lightening.

This study was focused on lighting SHS environment, children study, use of kerosene, battery, health and hygiene, awareness income generation etc. The research questions are as follows:

- What is the existing socio-economic status of HHs in the study area?
- What is the purpose of installing SHS by local People?

1.3 Objectives of the Study

The study is aimed to find out the access of the rural people to solar home system and the role played by it for the upliftmentof the socioeconomic status of the people. Specific objectives are as follows:

- To find out the socio-economic status of the SHS users and non-users.
- To assess uses of SHS system in the study area.

1.4 Importance of the Study

Growing concern for environmental protection and increasing energy crisis demands clean and renewable energy such as solar energy. Given the tremendous potential for harnessing solar energy in Nepal, installation of SHS can be seen as an effective strategy to provide electricity to scattered and isolated rural communities. The establishment of these systems requires considerable initial investment, and therefore, justifies the need to evaluate viability and desirability of the HHs in order to ensure that the resources are utilized.

This study aims to assess the accessibility of the rural people to SHS and role of SHS is considered as in improving the quality of life. The SHS is considered asone of the alternatives to reduce the crisis of the energy in the rural area of Nepal. Our country is suffering from the shortage of the use of modern energy and the use of traditional forms of energy is creating a lot of problems such as economic and environmental. Such condition seems to be affecting the socio economic status of people in the negative direction. Theproposed study attempts to find out the possibility of the SHS in that area. This study might be helpful for the government and the development partners to identify as well as to justify that why the SHS should be given more importance in the context of Nepal for the upliftment of the status of the rural people. The evaluation of these systems was enabling the government to formulate adequate

policies regarding the promotion of SHS in particular and development of rural areas in general. Finding of this may be helpful for the government and development partners whether to invest in the SHS is rational or not.

1.5 Limitation of the Study

Due to the limitation of time, this study covers only 60 households comprising of 50 SHSusers and 10 non users. So the findings are only indicative rather than conclusive. Similarly, the study is limited to the socio-economic status of SHS users and non-users and various uses of SHS. Thus the validity of the data provided by the respondents hinge upon two main constraints found in the way the data was collected, i.e., recall or memory and hiding of information. Most of the primary data collected through the semi structured questionnaires relied on recall or the memory of the respondents as they have not recorded data. The study was mostly focused on the secondary data. Only the operational months was considered to assess operational cost as well as overall benefits brought about through the SHS.

1.6 Organization of the Thesis

The thesis contains six chapters' Introduction, Literature Review, Research Methodology, Data Analysis and Presentations and Conclusion and Recommendation. The first chapter deals with introduction with consist of background, statement of problem, objectives of the study, importance of study, limitation of the study and organization of the thesis. The second chapter deals with literature review which consist of conceptual review, empirical review and policy review. Similarly, the third chapter deals with the research methodology. It consists of research design, selection of study area, sampling procedure, data collection tools and techniques, sample HHs survey, key informant interview/checklist, focus group discussion, analysis of data. The forth chapter deals with profile of the study area with consist overview of kalikot district and Phoimahadev VDC. Likewise, the fifth chapter deals with analysis and interpretation of survey data. Which consists of socio-economic characteristics of study HHs, various user and non-users of SHS and summary of finding is also include here. At last chapter six deals with conclusion and recommendation.References and questionnaires have been attached as annexes at the end of the report.

CHAPTER 2

LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Sources of Renewable Energy

The source of energy, which can be produced in short time and can be used for long time is called renewable source of energy. Renewable energy is a synonymous term used for the alternative energy or non-conventional energy. In a broader sense, clean energy like solar, geothermal, water, wind, etc. are taken as the renewable energy. Renewable energy sources are those energy sources which are not destroyed when their energy is harnessed. Renewable energy sources are distinct from fossil fuel which must be consumed to release energy. Human use of renewable energy require technologies that can harness natural phenomena such as sun light, wind and water flow, biological process such as anaerobic digestion, biological hydrogen production and electricity. Renewable energy sources may be used directly or used to create other non-conventional forms of energy. Example of direct use is solar oven, geothermal heating water mills and wind mills. Example of direct use, which requires energy harvesting, is electricity generation through wind turbines or photo voltaic cell (PV cells) or production of fuels such as biogas from anaerobic digestion or ethanol from biogas.(Pant, 2015)

2.1.2 Potential of Renewable Energy Sources in Nepal

Hydropower has potential of 83,000 MW. Annual daily average of solar insolation in various parts of Nepal is estimated to be between 4-5 kWh per sq. meter per day. Similarly, 200 MW of wind power can be produced in between Jomsom and Chusang in Kaligandalaki region. About one million biogas plants can be installed all over the country. Similarly, there is a large potential of producing biomass through the adoption and development of various biomass conversion technologies.(Dhakal, 2009).

2.1.3 Solar Energy and Photovoltaic Systems

The solar energy is classified into solar thermal and solar photovoltaic (PV). Solar thermals have numerous applications like water heating, vegetable and agricultural products drying, cooking etc. In Nepal, the solar water heaters are beings extensively used in urban areas. The applications of solar dryers and cookers have found moderate use simply because of the low level of dissemination of these technologies. The solar PV, on the other hand, is extensively used not only in developing countries but also in highly developed countries like Germany, Japan and the USA. Developed countries have initiated highly subsidized rooftop programs for solar energy.PV modules are used to produce electricity. The system consists of PV module, batteries, charge controller and lamps along with other accessories like wire and switch. When the light from the sun falls on the active surface in the forms of a steam of photons, the electrons on the surface get energized and thus there is movement of electron. The flow of electrons produces the energy. The photo-voltaic cells act as the active surface which is made of photo sensitive materials like crystalline silicon in either mono or semi crystalline to generate the power as batteries. This is why these are called photo voltaic cells.(Pant, 2015).

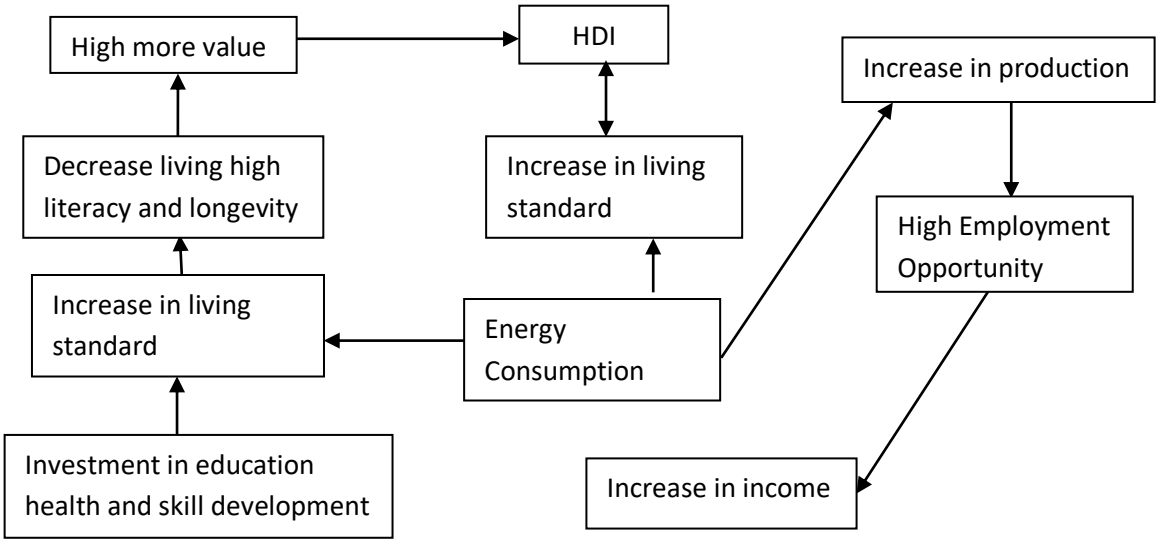
2.1.4 Relationship between Energy Consumption and Human Development Index

In general, there is broad agreement on the links between energy consumption and human development. Improving access and broadening the choices of energy sources for HHs and communities may affect welfare among poor HHs in several ways. Greater use of energy may result in other benefits, particularly, better health and education, higher productivity of labor and easy entry for the poor in labor markets.Poverty is a multi-dimensional problem where one of the determinants is well-being. A famous HDI vs energy consumption curve shows that there is sharp rise in HDI with the increase in the per capita energy consumption for some level, there after the energy consumed is used for luxury so that the curve follows slightly hormonal path. So that activities and for sub sectors to enhanced energy efficiency and energy service could have poverty impact. There is strong relationship between access to modern energy services and development. (NPC, 2014).

At the district level, Kathmandu, Lalitpur, Kaski, Bhaktapur, and Manang have the highest HDI values for 2011, whereas Bajura, Bajhang, Kailikot, Humla, and Achham have the lowest one. (NPC, 2014).

Overall, in 2011, there are 10 districts,eight in the mid-western and far western mountains and hills, and two in the eastern Tarai that have very low HDI values of less than 0.4. The next 16 districts including nine in the mid-western hills and mountains, and four in the eastern Tarai-have HDI score between 0.4 and 0.449. Thirty districts, mostly in the hills have scores between 0.45 and o.499. Another 13 districts, mainly in the eastern and central hills, have scores between 0.5 and 0.549. The six districts with the highest HDI values are in the Kathmandu valley, together with Kaski, Manang, and Chitwan.(NPC, 2014).

Figure No. 2.1 Relationship between Energy Consumption and HDI:



Source: (NPC, 2014).

NPC (2010) has mentioned the energy is one of the prime movers of the country and society as a whole Nepal with abundant water resources with high gradient has huge potential of generating hydropower. In the 9th plan government of Nepal had set target to generate 2200 MW electricity by 2017. Recent studies conducted by the government of Nepal the possibility of generating 1000 MW in 10 years and 20000 MW in 20 years.

Table No. 2.1: Key Energy Targets

Indicator/Year	2011	2030
Installation capacity hydro (MW)	705.5	17000
Final energy consumption per capita (in GJ)	16	23
Electricity consumption (in KWH per capita)	80	1070
Share of renewable energy in final total energy consumption (in %)	11.9	22.1
Access to electricity to household (in %)	70	99

Source:(NPC, 2014)

2.1.5 Capacity of Installed Solar Home System in Nepal

In order to calculate the total installed capacity of solar PV in Nepal, forms of energy has been separated into six categories SHS, SSHS, solar PV in communication sector, ISPS and solar PV in government related office. Capacities of installed capacity are summarized in table no 2.2 SHS and SSHS have been further divided into those under government subsidy disseminated through various organizations and without government subsidy. (AEPC, ESAP, 2010).

The categories of SHS distributed under government subsidy has the highest installed capacity of 6,049910 WP followed by solar PV used in the communication sector (124,389WP). SSHS has the installed capacity of 73723 WP. Likewise, SHS disseminated through various organization and SHS installed in urban areas and without government subsidy have total installed capacity of 217,789 and 135,969 WP respectively. Total watt peak of solar PV installed in government related office is 361367 Watt peak, in this way total installed capacity of solar PV in Nepal is more than 9 megawatt (9141933W). (AEPC, ESAP, 2010).

Table No. 2.2: Total no. of System and total Installed Capacity

Indicator/Years	No of System	Installed capacity W.P
SHS		
Installation under govt. subsidy	3,26,111	60,49,910
Disseminated through various origination without govt. subsidy	1,849	2,76,493
Installed in urban area without govt. subsidy	2,210	1,19,280
Sub total	3,36,870	64,45,683
SSHS	5,855	-
Installation under govt. subsidy	82,799	29,275
Disseminated through various origination without govt. subsidy	60,000	4,01,036
KarnaliUjjyalo Programme	6,920	3,00,000
Installed in urban area without govt. subsidy	15,574	6920
Sub total	943*	737231
Solar PV in Communization Sector	402	1243894
Institutional Solar PV System (ISPS)	76	217789
Solar PV Pumping System (PVPS)	17**	135969
Solar PV in govt. Related Offices		361367
Total		9141933

Source: AEPC/ESAP 2010.

* No. of Site,

** No of offices

2.1.6 Status of Solar PV in Nepal

AEPC (2010) has reported that the SHS. The abundance of solar reduction in most part of the world provided premising source of energy. Where, other conventional method is going to be either very expensive or possible only in the far distance future. In Nepal about, 3% of the population install has to live their lives in darkness and poverty without much hope in the way the country has governed in the last 40 years. Nepal's situation for an establishment of hydroelectric power grid is available only in 40% of the country as per the population census 2001 and 10^{th} five year plan. Under this circumstance, PV technology would provide the answer as the second eye in terms of hydropower. So far 277 institutional SHS has generated 1038.78 kWp.

However, it is estimated that 4636kwp of PV power is being utilized in various parts of Nepal for different purpose such as standalone SHS (71.7%), Nepal Telecom. (21.6%) Nepal electricity authority managed centralized rural electrification (2.1%) water supply system (2%) and other (1.0%). For some time to come standalone PV system and PV integrated systems for telecommunication services was continue to grow due to their specific advantage. Efficient and effective operation of PV system depends upon their optimum sizing which in turn also depends on the climate conditions of the place where the PC system are supposed to be installed. (AEPC, 2010)

2.1.7 Subsidy policy for Solar System

Solar energy technology is of the importance and popular renewable energy technologies in Nepal. Presently, GoN is promoting Small Solar Home Systems (SSHS), Solar Home System (SHS), Institutional Solar Photovoltaic Systems and some solar thermal systems like solar dryers and solar cookers.

The following subsidies are being provided for solar home system, small solar home system, institutional solar photovoltaic pumping system, system solar cooker and solar dryer to make the policy more pro poor and inclusive.

Table No. 2.3: Subsidy for Solar Home Systems

Solar PV Systems	Subsidy Amount in R.s.		
	Category "A" VDCs	Category "B" VDCs	Category "C" VDCs
Small solar Home System with 10 Watt Peak (per system)	5,000	48,00	4,500
20 Watt Peak-Watt Peak Solar PV System (per HH per system)	7,000	6,200	6,000
>50 watt Peak Solar PV System (per HH per system)	10,000	9,000	8,000

Source: (AEPC, 2013)

The maximum subsidy amount of 75% of the total systemcost but not exceeding R.s. 1000,000 is provided for institutional solar photovoltaic system cost but not exceeding Rs. 1500,000 per system for Solar Drinking Water Systems. The additional subsidy of Rs. 2500 per household was provided to household with single woman, backward, disaster victim, and poor and endangered ethic group as identified by the GoN. The ministry was preparing the guidance for the management of the lead acid battery to be used in solar energy. (AEPC, 2013)

2.1.8 KarnaliUjjyalo Programme

Geographically remote, absence of adequate infrastructure development, and backward in development have forced the most places of Karnali Zone and adjoining districts to rely on the kerosene lamp, “Jharo” (pine wood rich in latex) and dry cell for lighting. "KarnaliUjjyalo Programme" (KUP) in the annual budget of FY 2063/64 was the effort of Nepalese Government to overcome the situation of severe energy crisis for lighting in those areas. Under this program GoN distributed 31,000 Small Solar Home System (SSHS) called "Solar Tuki" (ST) in five districts of Karnali zone and 29,000 in four adjoining districts of Jajarkot, Bajhang, Achham and Bajura through Alternative Energy Promotion Centre (AEPC) (Table No. 2.4). The cost of

such ST was about Rs 4,500 of which GoN provided Rs 4,275 (95% subsidy) and users paid only Rs 225 under this program. (AEPC, 2012)

The small solar PV system promoted consisted of a 5 Wp solar module, a battery box with switches and indicators, two units of WLED based lamps and wiring accessories. The lamps were plug-in types that could be hanged on any place with the support of attached hook. The success of the KUP is unknown as the quality of the product and delivery modality is heavily debated. While surveying in some of the districts, none of the ST distributed under that programme were found in the houses.(AEPC, 2012)

The main objective of the program was to provide lighting system for the households in Karnali zone and its adjoining districts, where other means of electricity has not yet reached and where the possibility of extension of other system of electricity in near future is low and also where people could not afford for SSHS. Thus, the program was focused on the low income people in remote areas.(AEPC, 2012)

The 18 pre-qualified solar companies were liable to provide warranty (10 years in solar panel, 2 years in battery and 1 year in lamps) as well as one year free after sales service. Similarly, a provision has been made on behalf of the people who keep the ST are eligible to get subsidy for SHS if they want to install it after one year. (AEPC, 2012)

Table No. 2.4 Solar Tuki (ST) Distributed underKarnaliUjjyalo program

S.N.	**District**	**Number of ST Distributed**
1	Dolpa	1590
2	Mugu	5200
3	Jumla	6800
4	Kalikot	13760
5	Humla	3650
Sub-total of Karnali zone districts		31000
6	Jajarkot	6000
7	Bajura	5000
8	Achham	11000
9	Bajhang	7000
Sub-total of adjoining districts of Karnali zone		29000
Total		**60000**

Source: (AEPC, 2012)

2.2Empirical Review

Joshi, (2015) conducted Solar Power as a Rural Energy-Problem and Prospectus A Case Study of Ajayameru VDC Dadeldhura, District. The main objectives of this study were 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 and to identify the obstacles, challenges of local community for the solar technologies. He used both descriptive and exploratory method in his thesis. The universe of the study was the solar home system users as well as the non-users of Ajayameru VDC of Dadeldhura District. Out of total people, about 15 HHs of the users as well as 15 HHs of the non-users was sampled with quota sampling on the basis of caste.

Rural household energy use in the Terai and Mid-Western hill region of Nepal, a research report of WECS (2007), provided the information on energy on situation in this area. This report has mentioned the energy and use pattern, energy resource, energy consumption. According to this report, rural households in the Terai consume on average 171218 MJ of energy on the per capita basic a year. The per capita consumption of individual energy source in the total are: 596 kg of firewood (58%), 80 kg of twigs (71%) 194 kg of agriculture residue (14%) kg of other plant based material (2%) and 8.2 liters of kerosene (2%).

A study carried out by TRUST in 2010, which was outsourced by AEPC shows that most of SHS users are relatively well off families in the rural community. It is also found that financial supports package should be bundled with SHS attention program. The users use SHS for lighting and other use for listing radio, watching TV, tape recording, telephone etc. The data has clearly indicated that the low involvement of respondents in income generating activities slightly more than one tenth fell SHS has induced new rural enterprise in the village. (AEPC, 2010)

Energy resource and consumption profile of mid-western development region of Nepal (2007), a research conducted by WECS, flashes the energy resources, consumption pattern by area (rural urban) and ecological region, fuel type etc. in

mid-western development region, according to this research report, energy consumption by end-use and fuel type in 2005/06 is a as follows.(WECS, 2007)

Table No. 2.5: Energy Consumption by End- Uses MWDR 2005/06

End use	Urban (%)	Rural (%)	MWDR(%)
Lighting	4.4	2.1	2.2
Cooking	83.1	72.1	72.5
Water heating	1.3	0.2	0.2
Animal feeding	2.6	18.1	17.5
Space heating/cooling	7.7	6.6	6.4
Agro processing	0.2	0.5	0.5
Appliances	0.1	0.0	0.0
Rituals	0.5	0.6	0.6
Totals	100	100	100

Source: (WECS, 2006).

Sherestha, (2006) stated that, it is not claimed that solar electricity solar home electric lighting systems can solve rural electrification issues completely. The solar home system too has limitations and problems but these can be overcome with proper planning. There are basic preconditions to be met if rural electrification problems are to be solved with the solar home electric lighting system: proper SHS planning, sufficient and stable solar irradiance over the foreseeable future, proper maintained schedule and active participation of SHS users. SHS was not meet demands where users already have of aspire to having consumer items such as refrigerators, deep freezers and washing machine.These are relatively high energy consuming devices. SHS are basically meant to supply direct current for such things as fluoresced tubes with electric ballast, television sets, radio and cassette of video players. In his studies the socio-economic impact, the rural electrification schemes through Photo voltaic system have reduced the consumption of kerosene form 35 to 10 liters per households per month. Furthermore, they have reduced the consumption of dry cell battery, which have been the main source of energy for powering of solar energy in Nepal both terms of policy planning as well as implementation. (Shrestha, 2006)

He concluded that Installation of SHS has improved indoor environment for most of the respondents. Smoke free environment has brought better health condition especially by reducing respiratory and eye related problems. Other important changes are decrease in incidences of fire and physical injuries. Apparently, unawareness and confusion among the SHS owners regarding disposal of used batteries is the one and only problem concerning environment. This calls proper orientation for SHS owners. Another visible impact is decrease in incidences of fire hazards and physical injuries. However, new incidence of acid burning is emerged causing minor casualty to family members, properties and their belongings. (Shrestha, 2006)

The heavy dependency on biomass energy, especially fuel wood, agriculture was bete 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. 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. (Joshi, 2010).

Appreciable potentialities of solar energy resources are reckoned to exist throughout the country. With the national average sunshine hour of 6.8/ day, and solar insolation intensity of about 4kwh/ m^2/ day, all the parts of the country has a huge potentiality for solar PV and solar thermal technologies. Solar energy potential of Nepal for solar PV is estimated to be about 26 million MW (CRT, 2005). An estimate of 4636 KWP of photovoltaic power is being utilized in various parts of Nepal for different purposes (WECS, 2006).

2.3 Policy Review

2.3.1 Solar PV in Development Plans and Policies

The increasing importance that the GoN is giving to renewable energy and solar PV is reflected in its plans and policies. In this section a brief review of governments' plans and policies related to Solar PV technology is presented.

I. Solar PV in Periodic Plans

The Government's effort towards development and promotion of Solar PV technologies can be seen in Nepal's various five year development plans, starting from Seventh to first three years Interim Development plan and also in perspective RE plan.

II. Development Plans

The Seventh Five Year Plan (1985-90) was the first of national policies to address Renewable Energy Technologies (RETs). The Plan recognized that RETs could replace traditional sources of fuel in rural areas and sought to encourage the development and adoption of alternative sources of energy like biogas, solar and wind. Later AEPC drafted the 20 Yrs. RE Perceive Plan in 2000. The plan envisioned for the government to provide subsidy for the use of solar energy, to make solar technologies meet rigorous standards, to give NGOs and the private sector a prominent role in the development and promotion of solar energy, and to support research and development activities.

During the Eighth Plan (1992-97), Alternative Energy Promotion Center was established in 1996 under then Ministry of Science, and Technology with the objective of promoting and coordinating activities and programmed at the national level. This was an important development that created a central authority that could formulate and enact policies related to renewable energy.

The Ninth Plan (1997-2002) sought to tie the economic development of rural areas with rural electrification. Solar energy was identified as one of the most appropriate source of electricity in rural areas. Interim Rural Energy Fund (IREF) was set up to

administer subsidies for solar PV systems and other RETs. Most importantly, Energy Sector Assistance Program (ESAP) was started during this period.

The Tenth Plan (2002-2007) focused on the use of alternative energy for economic development, sought to accelerate the commercialization of alternative energy technologies and to replace traditional sources of energy by modern and renewable sources. As planned, IREF was transformed into Rural Energy Fund (REF) during this period and Rural Energy Policy was promulgated in 2006.

Rural Energy Policy (REP) seeks to link renewable energy to economic development and increase the role of local agencies, NGOs, and private sector in its promotion. With respect to solar PV, REP subscribes to increasing the provision of subsidy and linking solar energy to improvements in health education, irrigation, drinking water, and communication.

The Three years Interim Development Plan has targeted to expand the services of electricity in such a way so as to ensure coverage of an additional 5% of the population through alternative energy sources. The interim plan has also identified a lack of coordinated effort for the development of alternative energy sources in order to provide electricity in the rural areas as one of the major challenges in the sector of electricity and power.

III. Perspective Energy Plan

The national planning commission prepared the Perspective Energy Plan (1991-2017). The plan has made a number of recommendations for the development of solar energy. The recommendations made are as follows:

i. Provide government subsidy for a definite period of time, say 10 years.

ii. Standardize solar technologies and ensure strict quality control.

iii. Give the lead role to NGOs and private sector and the facilitating role to the government.

iv. Support R & D activities in respect to water heating, cooking and cost reduction of solar PV system

IV. Solar PV in National Energy Policies

Solar PV has found its place in following two policies of the Government of Nepal.

1. Rural Energy Policy, 2006

2. Subsidy Policy for Renewable (Rural Energy), 2009

Besides, there is a special Delivery Mechanism developed and under practice for SHS promotion.

V. Rural Energy Policy, 2006

With an overall goal to contribute to rural poverty reduction and environmental conservation by ensuring access to clean, reliable and appropriate energy in the rural areas, the GoN has promulgated "Rural Energy Policy 2006" with the following objectives:

- To reduce dependency on traditional energy and conserve the environment by increasing access to clean and cost effective energy in the rural areas.
- To increase employment and productivity through the development of rural energy resources.
- To increase the living standards of the rural population by integrating rural energy with social and economic activities.
- Listing the overall policies valid for all the Renewable Energy Technologies, the policy document also states the specific policies for different RETs.
  Working Policies Specific to Solar Energy Technology
- Emphasis was given for the necessary study and research for reducing the cost of solar energy technology and its efficient use.
- Arrangement shall be made to operate solar energy technology at the community and institutional level by integrating it with irrigation, health, education and drinking water.
- Development of solar energy technologies was be encouraged by integrating it with technologies for drying and cooking of food, purifying water, lighting and communication systems.

- Necessary public awareness activities were launched to increase the use of solar cookers.
- Solar energy map for the whole of Nepal was prepared.
- Arrangement shall be made to collect the battery used in solar energy production for recycling or proper disposal management.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Research Design

This study was based on the exploratory and descriptive research design. The exploratory information based on interviews, observation and case studies from the field whereas descriptive information attempt to describe the things related to solar energy in specific to solar home system. In fact, this section describes the study site, nature of the data and sources, sample size; data collection tools techniques, data analysis and limitation of the study.

3.2 Rationale of the selection of the Study Area

Various research works have been carried out in different parts of Nepal. Particularly, the hilly area is one of the famous areas for SHS. Different capacity of module has been using in Phoimahadev VDC for longtime. This research areahas selected ward no. 8 and 9 of Phoimahadev VDC in Kalikot district;which does have a significant potentiality. The purpose of selecting this VDC is on the basis of area coverage, diversified, places among the pocket area, easy accessibility for the researcher.

3.3 Sampling Procedure

There are 617 HHs in Phoimahadev VDC. And 149 households in ward no 8 and 9. In the study area ward no 8 and 9,there are 102 households have been benefited from solar energy. Among them, 50 households were selected from users and 10 households from non-users as a sample using simple random sampling method. Altogether 60 respondents were selected for the study purpose.

3.4 Sources of Data

This study aims to find out the socio-economic status of SHSusers and non-users in the study area and various uses of SHS. Thus, the primary data was collected from the SHS users and non-users of the study area. The primary data was collected through

household survey, interviews of key informants interviews, focused group discussion and direct interview with SHS users and non-users. This was helping the researcher comprehend a holistic picture of the study area. During the course of the interview with the local people, the researcher primarily took the reference of some indicator like income, time-saving, impact in the everyday life, social change, and empowerment of women. On the other hand, special focus was given to how the local people respond on the impact of the ongoing change to the social wellbeing, which was also another goal of this study.

The secondary data related with SHS and its development, history, technological features, impacts and its consequences, present condition and future prospects of SHS in the rural context of Nepal was obtained from the published and unpublished materials, journals, books, articles, newspapers and magazines, brochure, websites, thesis report and government publications. Some have been accessed through internet while other has been collected from the relevant libraries. The socio-demographic information regarding study sites were collected from Central Bureau of Statistics (CBS) records.

3.5 Data Collection Tools and Techniques

To collect the primary data, structured questionnaires and semi-structured interviews, observation and focus group discussion methods were used.While secondary information was obtained through review of relevant literatures, books, magazines and published and unpublished materials etc. of VDC, DDC, NGOs/INGOs and other organizations.

3.5.1 Sample Household Survey

Household survey was carried out to collect primary information. The purpose of conducting household survey was to acquire information about age and sex composition, occupation, educational status, livestock holding, different aspects of solar, income, women empowerments, agricultural production, and adaptation. Altogether 60 households were surveyed. Each survey lasted around 45-60 minutes and took in the form of conversation, structured around a written questionnaire

consisting of both fixed-response and open-ended questions. By using household survey method, the researcher collected data of household socio-economic features.

3.5.2 Key Informant Interview/ Checklist

Key informant interviews were conducted during the field work in order to comprehend the status of SHS and how to adaptation to changing condition. Purposive sampling technique was used to obtain general information and to understand the relationship of social processes, communal adaptation and information exchange about solar. This sampling is appropriate for determining the actor who becomes the source of deep knowledge/information on subject matter if situation is dependent on other social factors.

3.5.3 Focus Group Discussion

The qualitative information was collected in the form of discussions. Altogether five focus groups from users (10 people in each group) and 1 focus group from non-users for discussions (FGD) were carried out with different age group and sex. Both discussions were carried out with directly impacted groups. These FGDswere helpful to obtain detailed information about changing dimensions of the society, their occupation, changing pattern of their occupations, economic condition, and adaptation process of local communities.

3.6 Data Analysis

The collected data was first organized into different topics, coding and recoding according to topic. Qualitative data was analyzed in descriptive way and explored the meaning and quantitative data was presented in simple tables, charts and figures. Graphical representation of the data was done in Microsoft Excel.

CHAPTER 4
PROFILE OF THE STUDY AREA

4.1 An Overview of Kalikot District

Kalikot District is located in Karnali Zone of the Mid-western Development Region of Nepal. It borders with Jajarkot and Dailekh district to the South, Achham district to the West, Bajura and Mugu district at North and Jumla district to the East. The district is divided into one electoral constituency level, nine Jurisdiction, and thirty Village Development Committees. The district headquarters, Manma is linked with road network and passenger bus service is available. The total area of the district is 1741 km^2. Geographically the district is divided into three distinct regions from north to south, viz Himalayan, Higher Mountain and Mid Mountains. The elevation of the district ranges from 738 m to 4790m from the mean sea level. The major rivers in the district are Tila and Karnali. (CBS, 2065 B.S.)

Kalikot is a rural mountain district situated in the Karnali Zone of Mid-Western Nepal. Due to a difficult terrain and patchy road networks, it takes about 10-12 hours to reach Manma, the district headquarter from Birendranagar, Surkhet, despite a distance of only about 160 km. The estimated population of the district is 125,930. This district comprises of thirty health facilities including 1 district hospital, 1 Primary Health Care Center (PHCC), 9 health posts, and 19 sub-health posts. The overall health indicators of the district are very low compared to other districts. When Nepal Family Health Program II began, the contraceptive prevalence rate (CPR) in the district was 12.1% and health facilities were providing only pills, condoms and injectable. Long-acting, reversible family planning methods, such as implants were available in the district and Inter Uterine Contraceptive Device(IUCD) was only available at the district hospital. Male sterilization services were being provided only through mobile outreach services. (CBS, 2065 B.S.)

The main occupation of the people of Kalikot district is agriculture. Where, more than 90% of the district population depends on the agriculture. Paddy, maize, millet, wheat and barley are the usual cereal crops and apple, potato, bean, oil seed and herbalproducts are cash crops.(CBS, 2065 B.S.)

The district inventory identified just over 83.5 km of roads, including 78km of strategic roads and 5.5 km of rural roads. In coordination with the Defense Technological and Industrial Cooperation Committee (DTICC) and District Development Committee (DDC), 11 rural roads with a length of 319.5 km were identified as making up the district road core network (DRCN), and the remaining 150km were classified as village roads. The existing SRN roads link passes through 14 VDCs although it serves only for 3 VDC headquarters. All of the DRCN and SRN roads are earthen fair-weather roads.(CBS, 2065 B.S.)

4.1.1 Introduction of Selected Area: Phoimahadev VDC

Phoimadadev VDC is situated at 50 km. east-north from the district headquarter of Kalikot. The VDC covers the 21 km^2 area of district. Phoimahadev VDC situated Jumla District in east, Ranchuli VDC in west, Thirpu VDC in north and Ranchuli VDC in south.(CBS, 2065 B.S.)

According to the (CBS, 2012), the total population of VDC is 3418. Out of which, 1,710 are female and 1,708 are male, the population density is 84 per km and the population growth rate is 3.95%. The main castes of the VDC are Brahamin, Chhetri, Thakuri and Dalit etc. Hinduism is the highly accepted religion in this VDC. Agriculture is the main occupation of this VDC. Almost 80 percent of the households are engaged in this occupation where Apple, Potato, paddy, wheat, maize, and millet are the major crops. (CBS, 2065 B.S.)

CHAPTER 5

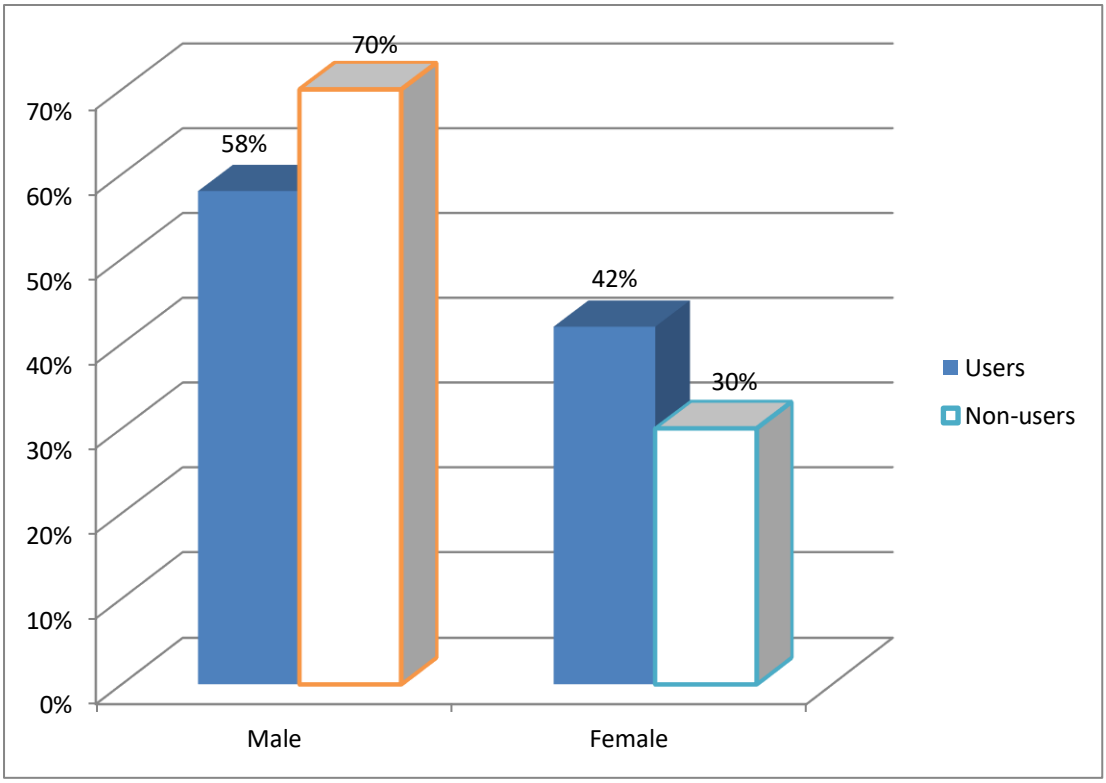
ANALYSIS AND INTERPRETATION OF DATA

This chapter deals with the analysis and interpretation of the data. The data were collected from the respondents of Phoimahadev VDC through questionnaires, semi-structured interviews and observation. On the basis of collected data, the result is derived and displayed in tables, lists, figures and graphs as needed. According to the type of data, the certain techniques and tools are used for data analysis and interpretation of the result. Descriptive and statistical tools are used to analyze the data and based on the analysis. After the analysis of data and interpretation of results, study findings have been presented and summarized.

5.1 Socio Economic Characteristics of the Study Households

5.1.1 Distribution of Respondents by Sex

Chart 5.1: Distribution of Respondents by Sex



The distribution of the respondents by sex is presented in chart 5.1. It indicated that about 58 % of user's population was male while about 42 % was female. Similarly about 70 % of the non-user's population was male and 30 % was female. The average household size among users and non-users are 6.3 and 5.9 respectively.

5.1.2 Distribution of Respondents by Age

Table 5.1: Distribution of Respondents by Age.

S.N	Age	Users		Non users	
		Number	Percent	Number	Percent
1	<6	3	5	2	20
2	6 - 14	10	20	1	10
3	14 - 59	33	65	7	68
4	>59	4	10	0	-
	Total	50	100	10	100

Source: Field Survey, 2015

Among users only about 5 % of the population was below 6 years and 20 % was between the ages of 6 to 14 years. Similarly about 65 % population was between the age of 14 – 59 years (which is considered as economically active population) and about 10 % of population was above 59 years. Among non-users, 17 % of the population was below 5 years and it was only about 12 % between the ages of 6 to 14 years. Similarly about 68 % population had been found between the age of 14 – 59 years and the rest about 3 % had been found above the age of 59.

5.1.3. Distribution of Respondents by literacy.

Table 5.2: Distribution of Respondents by Literacy

SN	Literacy Level	Users		Non-Users	
		Number	Percent	Number	percent
1	Illiterate	0	0	1	10
2	literate	3	6	1	10
3	School	6	12	3	30
4	S.L.C.	11	22	3	30
5	Intermediate	15	30	2	20
6	Bachelor Degree	13	26	0	0
7	Master Degree	2	4	0	0
8	Above Master Degree	0	0	0	0
Total		**50**	**100**	**10**	**100**

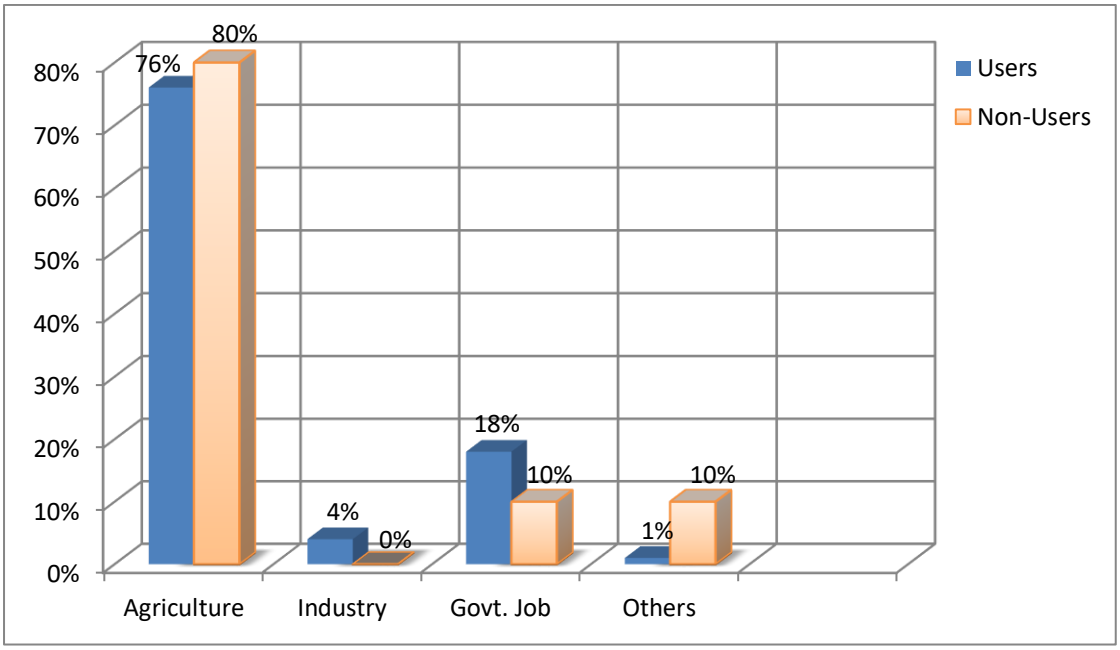
Source: Field Survey, 2015

Given table 5.2 shows that literacy rate that are using SHS which is given below; users 0% Illiterate, 6% literate, 12% school education, 22% passed SLC, 30% are intermediate, 26% are graduated and 4% are master's holders. In case of non-users 10% Illiterate and general literate, 30% School education and SLC, 20% are intermediate and none of them are graduate or above.

It concludes that difference between users and non-users according to literacy, where education play vital role in solar home system using. Somehow people are civilized by coping. And on the other hand skill also needed. Only 4% master holding using it where 10% illiterate person not applying it. It means most of people are uneducated and they are ignoring using it. All are literate who are using it. So at first make people literate and skillful and they use SHS.

5.1.4. Distribution of Respondents byOccupation

Figure 5.2: Distribution of population by Occupation



This research which is based on occupation shows following result: Houses who uses SHS are 76% on agriculture, 4% are involve in industry, none of users occupy trade, private job and foreign employ, government job holders are 18% and 2% are involving other kind of occupation which is not introduce. Secondly houses that are not using SHS mainly involve in agriculture it percentage is 80, government job holders are 10%, others none introduce occupation are 10%. Non users have not access to trade, industry, private job and foreign employ.

Though here's main occupation is agriculture and government job but the policy of SHS is not working properly and agriculture is not blockage of some infrastructure of development and this remote are need some attractive policy of government which can remove from darkness.

5.1.5. Total Description of Land. (In Ropani)

Table 5.3: Total Description of Land in Ropani

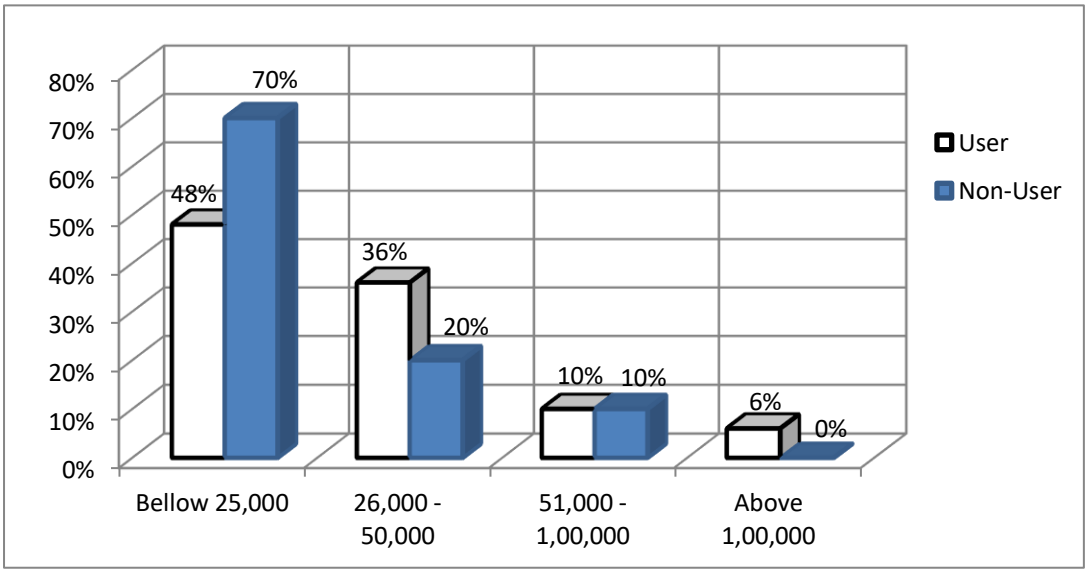
SN	Description *(In Ropani)*	Users		Non-Users	
		Number	Percent	Number	Percent
1	0-5	22	44	8	80
2	5-10	18	36	1	10
3	10-15	9	18	1	10
4	15 Above	1	2	0	0
Total		**50**	**100**	**10**	**100**

Source: Field Survey, 2015

Above table 5.3 has told us about the situation of people and difference of land among SHS users and non-users. Basically survey goes on selected people and they haven't enough land but they are interested on alternative energy. 44% users have up to 5 ropani likewise 36% have up to 10 ropani and 18% users have less than 15 ropani and 2% have above 15 ropani land. All are from medium class. In case of non-users 80% have 5 ropani or less it. And both 5-10 and 10-15 ropani belongs to 10 % people. It shows interest also plays the role on it. People who have more than 10 ropani they are not using SHS. So at first people have to interest than they act.

5.1.6. Annual Income of SHS Users and Non-users

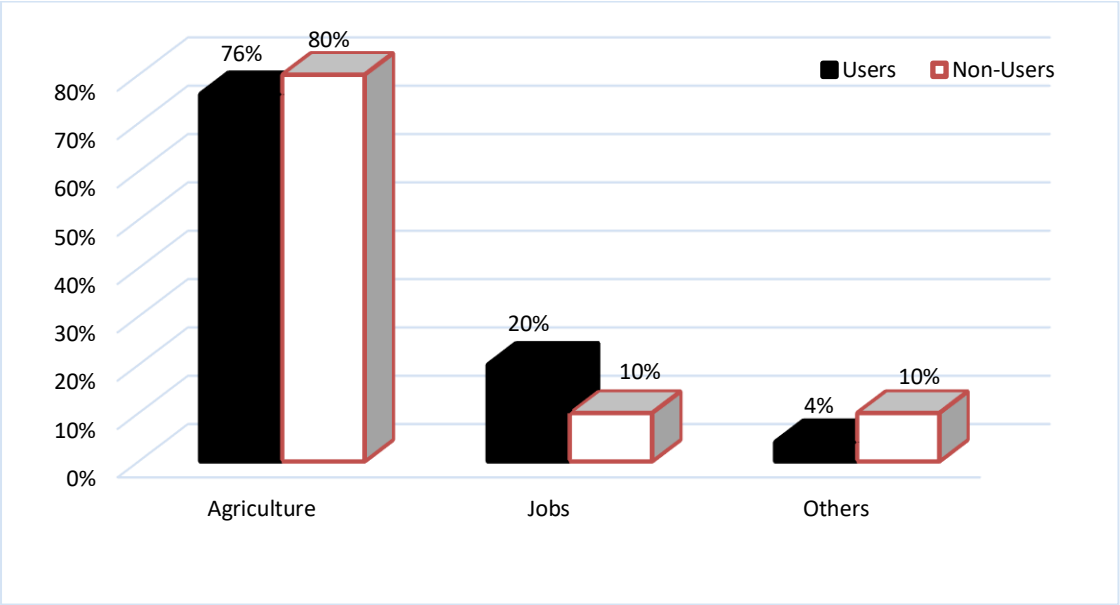
Chart 5.3: Annual Income of SHS Users and Non-Users



Economic factor is the one of the essential element of every purpose. 70% of people who are not users of SHS have below Rs. 2500 income in a year, 20% of non-users earns Rs. 26,000 – Rs. 50,000 in a year and 10% income of non-users is Rs. 51,000 – Rs. 1,00,000. Non-users cannot earn more than one hundred thousand rupee in a year. So they are unable use SHS. However, people who are using SHS they are also not too much wealthy. Their income is respectively below Rs. 2,500, Rs. 2,600 - Rs. 50,000, Rs. 51,000 – Rs. 1,00,000 and above Rs. 1,00,000; 48%, 36%, 10% and 6% income rate. So here, rich to poor people are applying SHS. Therefore, it is fit for not every corner of people in Nepal who are from rich and middle class.

5.1.7. Income Sources of SHS Users and Non-Users.

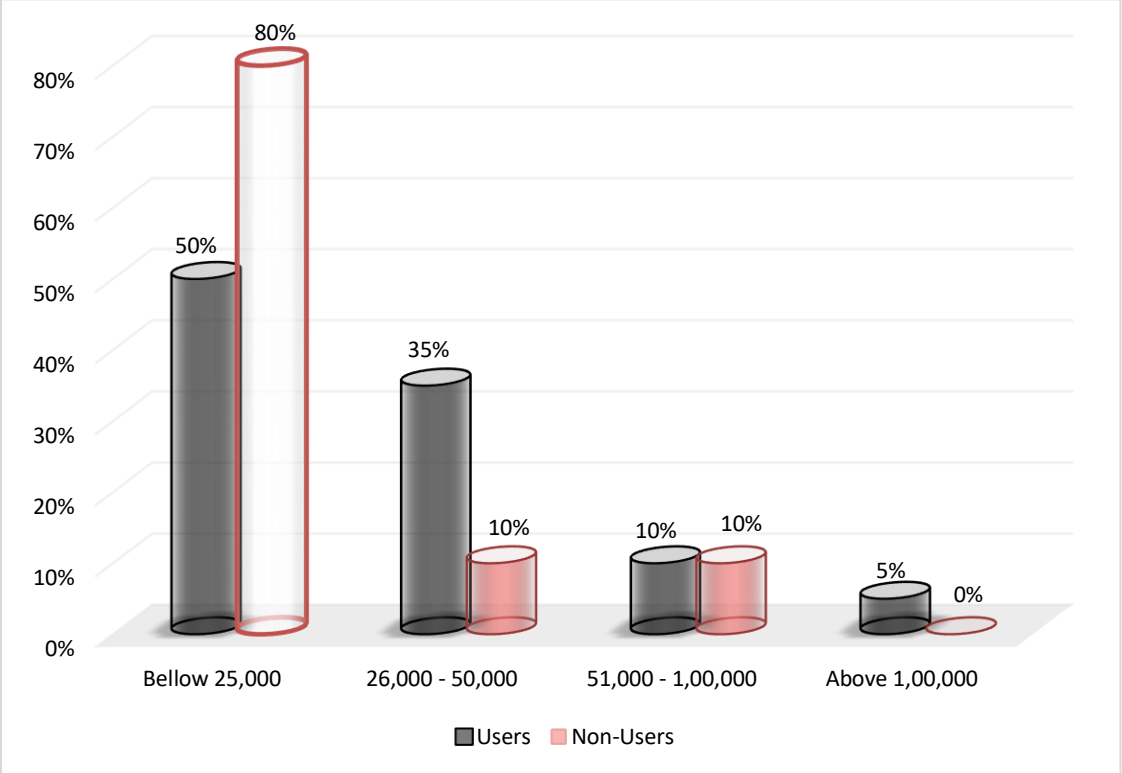
Chart 5.4: Income Sources of SHS Users and Non-Users



76% and 80% have agriculture as the income sources that are using SHS and non-users. Same as jobholders 20% are user and 10% non-user. Others are 4% are users and 10% are non-users. None of them has foreign employ. Their income sources also depend either use SHS or not.

5.1.8. Annual Expenditure of SHS Users and Non-Users

Chart 5.5: Annual Expenditure of SHS Users and Non-Users.

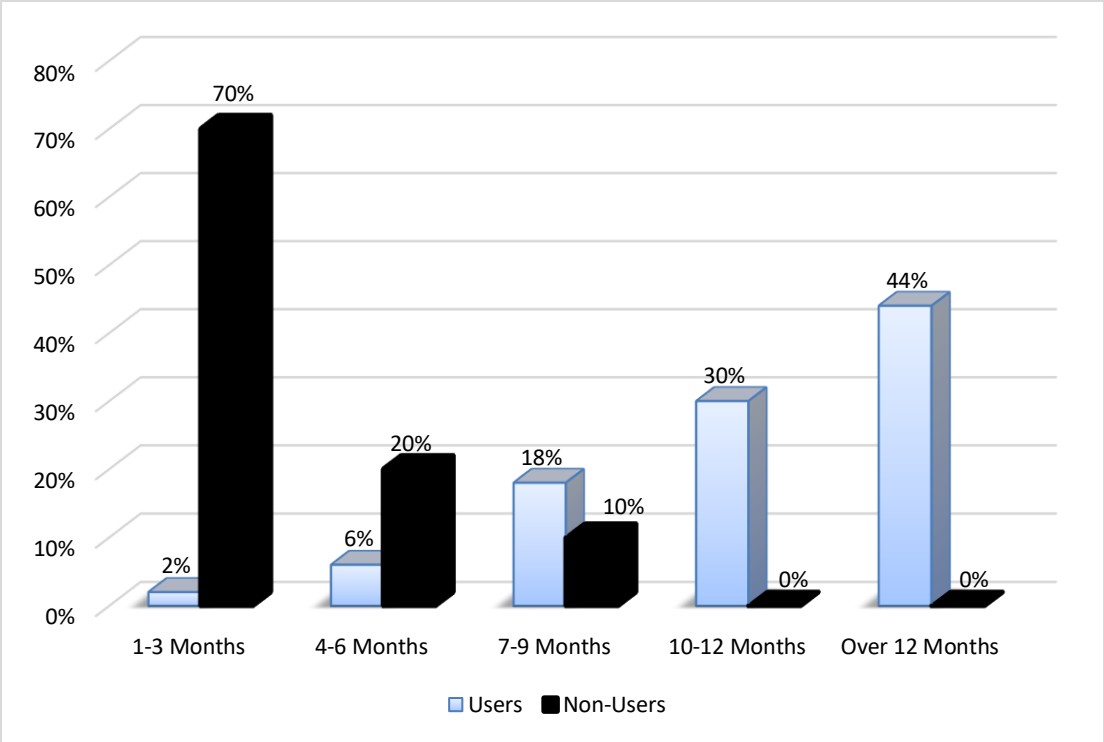


This chart 5.5 shows the annual expenditure of people who users of SHS and non-users. It also shows people have habit of saving which can make their life easier in future. 50% of people who are users expend less than Rs. 2,500 and 80% people expend same amount of money who are not users. 35% of people expend Rs. 26,000 – Rs. 50,000 who used SHS and 10% of people expend same amount of money who are non-users. 10% of people both users and non-users expend Rs. 51,000 – Rs. 1,00,000 amount of money and 5% of people who used SHS they expend more than Rs. 1,00,000 amount of money in a year.

It argues somehow it may costly for poor people but it makes life easier; though people not using because they cannot save money as they need. If they put it shows they may be loan. Money should save for other purpose. If government gives some economic comfort user number may be increased.

5.1.9. Support of HHs Expenditure by Annual Income of SHS User and Non-Users.

Chart 5.6: Support of HHs Expenditure by Annual Income of SHS User and Non-Users



Research shows that people whose house is hold by annual income they put the SHS and save money too. These 70% people's house cannot hold 3 months by their annual income. It is dream for them to put SHS. At first, they are thinking about their basic needs and then only secondary wants. Sometime people are too interested for their wants. Our data also shows 2% people who are using SHS their house also cannot hold by their annual income more than 3 months. If people's income is increasing they use facilities, for e.g. 6% user's house is hold 4-6 months by their annual income and 20% non-users house is also hold 4-6 months by their annual income. 7-9 months hold their houses by 18% users and 10% non-users. 30% user's houses are 10-12 months hold by their annual income and 44% user's houses are over 12 months holding by their annual income. Therefore, we conclude that if people have sufficient income they use SHS.

5.2 Various uses of SHS and Energy Consumption analysis of thestudy Households

5.2.1. Total HHs Annual Energy Consumption of SHS Users and Non-Users.

Table 5.4: Total HHs Annual Energy Consumption of SHS users and non-users

SN	Purpose	Types of energy sources	Users			Non-Users		
			Quantity (Kg/Lt./kWh)	Cost (inRs)	Energy (MJ)	Quantity (Kg/Lt./Kwh)	Cost (in Rs)	Energy (MJ)
1	Lighting	1. Fuel Wood	720 Kg.*	10,440	12060	1800 Kg.^	26,100	30150
		2. Agro Residue	96 Kg.**	288	1214.4	300 Kg.^^	900	3795
		3. Other Biomass	24Kg.***	72	327.60	45 Kg.^^^	135	614.25
		4. Kerosene Oil	24Lt.****	2400	864	48 lt.^^^^	4800	1728
		5. Battery	0	0		0	0	
		6. Other Fuels	0	0		0	0	
		7. Candle	0	0		0	0	
2	Cooking	1. Fuel Wood	4200 Kg.#	60,900	70350	4200 Kg.#	60,900	70350
		2. Agro Residue	1800 kg.##	5400	22770	1800 kg.##	5400	22770
		3. Other Biomass	24 kg.###	72	327.60	24 kg.###	72	327.60
		4. Kerosene Oil	0	0		0	0	
		5. Others……	0	0		0	0	
3	Electric Equipment's	1. Battery	0	0				
		2. Others…….	0	0				

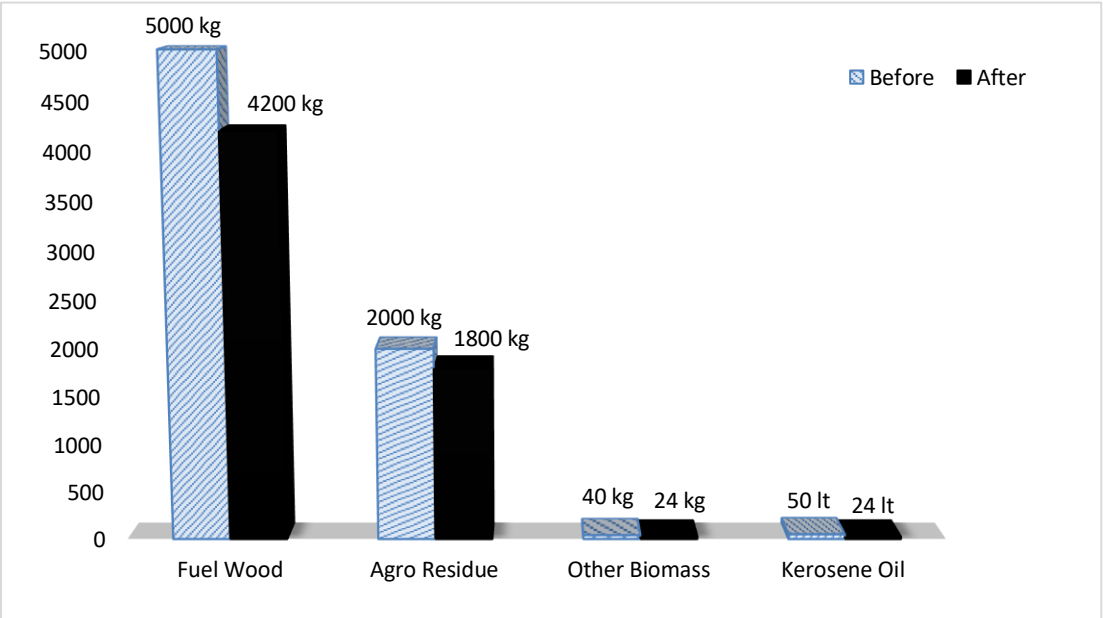
** 2kg/day = 720 kg/year,** 2kg/week = 96kg/year,*** 0.5 kg/week = 24 kg/year,****0.5lt/week = 48 lt/year,*
 # 35 kg/3days = 4200 kg/year, ## 5 kg/day = 1800 kg/year,### 0.5 kg/week = 24 kg/year,
Rs.14.50/kg Fuel Wood,Rs.3/kg Agro Residue and Other Biomass, Rs.100/lt. Kerosene Oil.
^ 5 kg/day = 1800 kg/year, ^^ 5 kg/week = 300 kg/year, ^^^ 1 kg/week = 45 kg/year, ^^^^1 lt/week = 48 lt/year
i) Fuel wood /kg = 16.75MJ, ii) Agro residue / kg = 12.65 MJ, iii) Other biomass / kg = 13.65 MJ, iv) Kerosene Oil / kg = 36 MJ.

House that uses SHS consumes 720 kg “Jharo” (pine wood that use for lighting) per year. It cost Rs. 10,440 but non-users used 1800 kg “Jharo” per year and it cost Rs. 26,100 only for lighting purpose. In same case, users use 96 kg agro residue per year and it cost Rs. 288 and 300 kg agro residue used by non-users. It cost Rs. 900. Other biomass 24 kg, Rs 72 used by user and 45 kg, Rs. 135 used by non-users per year. Kerosene oil 24 lt, Rs. 2,400 and 48 lt, Rs. 4,800 used by user and non-users. All given items used only for lighting purpose. Both users and non-users do not use battery, candle and other fuel because these items are not easily available in this area. Most of people using indigenous items for lighting purpose.Though they have SHS in their home. Sometimes environment also could not help. Therefore, they are compulsion to use these materials for lighting, cooking and extra purpose.

In cooking purpose non-users take fuel wood 4,200 kg cost Rs. 60,900 and user take also 4,200 kg cost Rs. 60,900. Agro residue both are used in same quantity 1,800 kg cost 5,400. Other biomass also same in quantity 24 kg cost Rs. 72. Finally, this survey shows that solar equipment used only for lighting they are side liked from other sources of energy like LP gas, electricity etc.

5.2.2. Annual Consumption of Energy Sources and Saving Pattern after Using SHS.

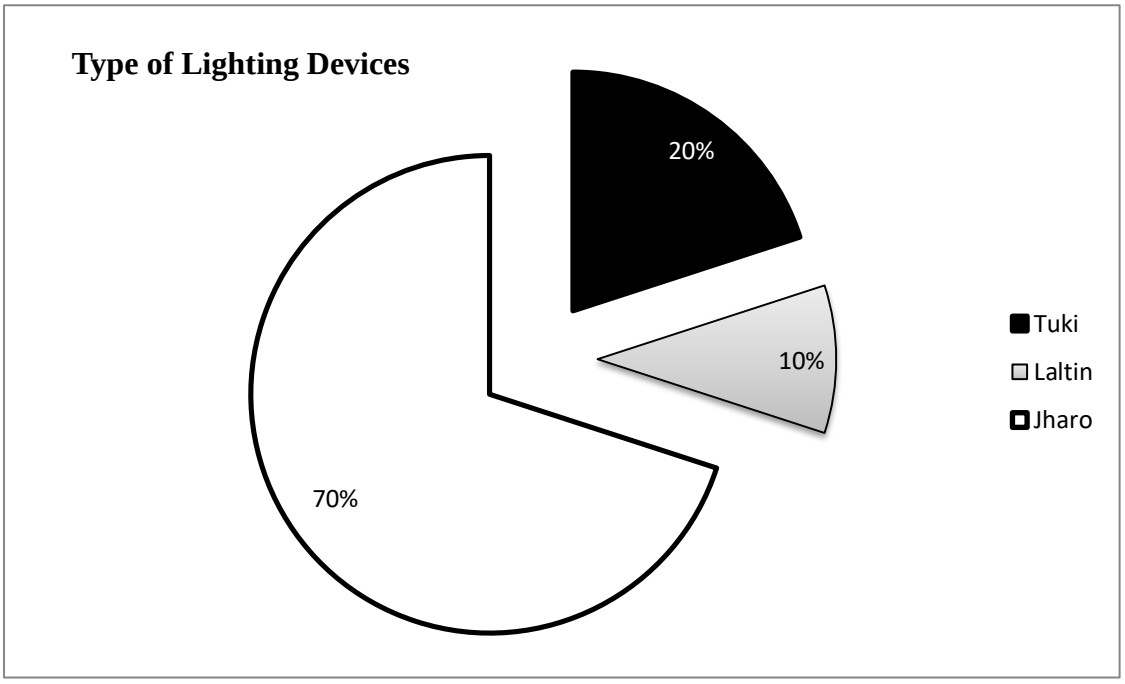
Chart 5.7: Annual consumption of energy sources and saving pattern after using SHS



In previous data, it mentioned that SHS used only for lighting purpose. So people who have SHS in their home they reduce only “Jharo” but firewood needed for cooking and other needed energy. In given chart 5.9 showscondition of before and after using SHS. Before using SHS they used 5,000 kg fuel wood for lighting and cooking purpose but when they used SHS they used 4,200 kg fuel wood for this purpose per year. Before using SHS they used 2000 kg agro residue but now they used only 1,800 kg per year. Similarly before using SHS they used 40 kg bio-mass but now they used 24 kg per year, before used SHS they used 50 lt. kerosene oil for lighting purpose but when they using SHS they used only 24 lt. kerosene oil per year. Other sources like batteries and candles are not access on them so they deny.

5.2.3. Types of Lighting Devices Used Before InstallationSHS.

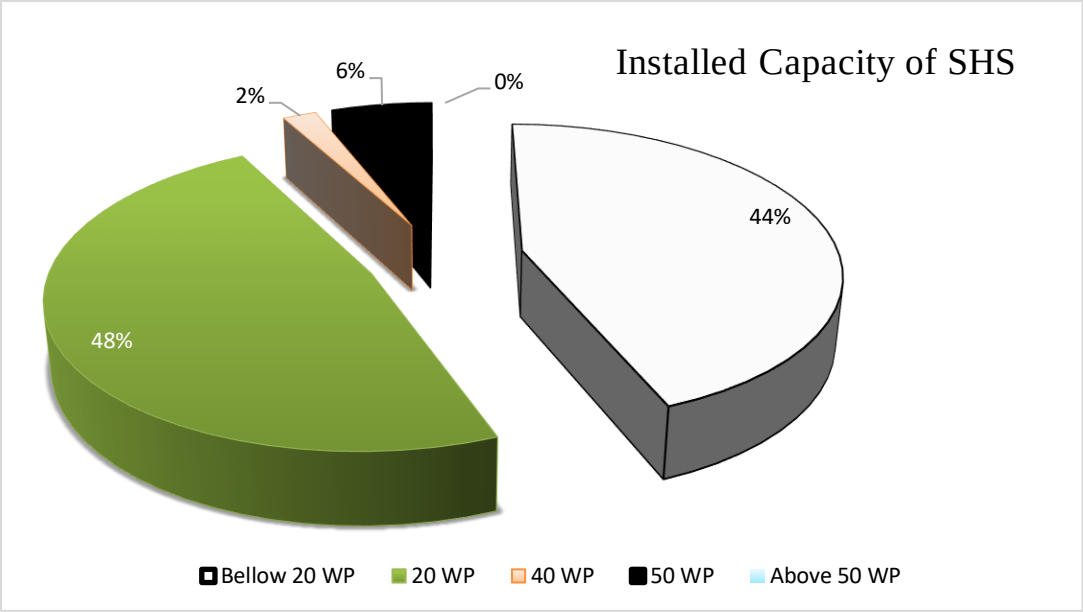
Chart 5.8: Types of Lighting Devices Used Before InstallationSHS.



Research is done on remote area of Nepal where hardly people have got kerosene oil and other lighting equipment. Before using SHS 30% people were used kerosene, among them 20% were used “Tuki” and 10% were used “Laltin”. 70% people were depended on “Jharo” (pinewood that use for lighting purpose). So it shows most of people were suffering from poverty and darkness.

5.2.4. Installed Capacity of SHS.

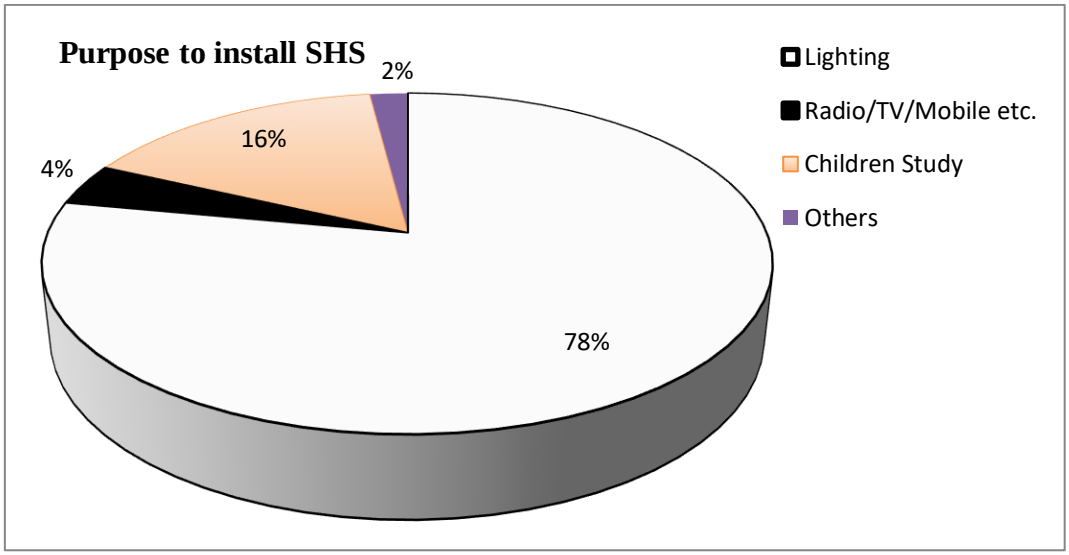
Chart 5.9: Installed Capacity of SHS.



Solar, which is allowed in house, are too cheap. Nobody has electricity equipment above 50 WP. And the capacity of SHS to low where 50 WP confirm by 6%, 40 WP by 2%, 20 WP is used by 48% and below 20 WP are 44%. It assumes less people are confirming high voltage of electricity products by SHS. The main cause of using 20 WP is not expensive to buy and they use it only for lighting purpose.

5.2.5. Purpose to Install SHS.

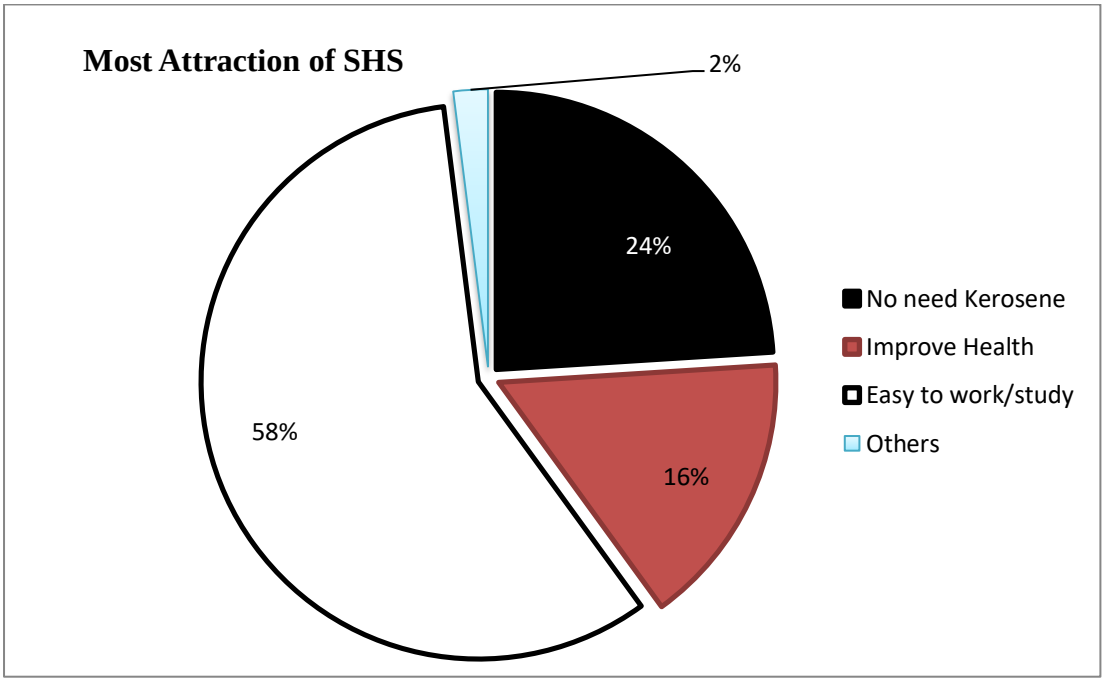
Chart 5.10: Purpose to Install of SHS.



The major purpose of install SHS is lighting which save the pinewood and smoke. Secondly for study, 78% people reply as lighting and 16% are using for study purpose. 4% people used SHS for Radio/TV/Mobile and 2% says as others. We know people watch TV listen radio and mobile though it is remote but it communicate easily because many people of them have mobile though 4% support it.

5.2.6. Most attraction of SHS

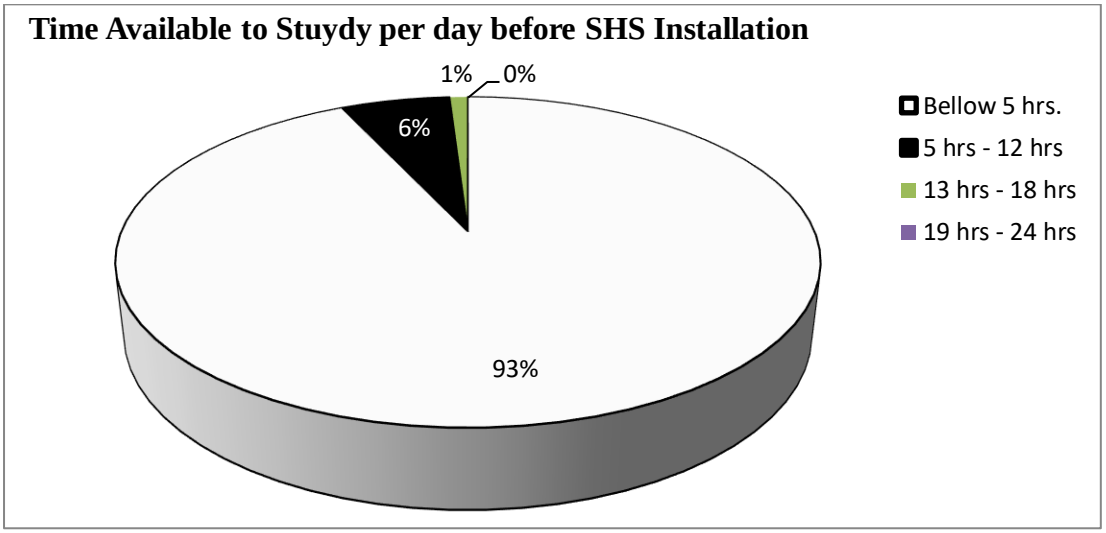
Chart 5.11: Most Attraction of SHS.



The most attraction part of SHS is free from smoke, out from darkness, improving health and support their kids in study. In the research 58% attracted by lighting purpose which makes their life easier to do work and study. 24% people are feeling bore with kerosene oil sent and smoke so they attracted in SHS. 16% people seem aware of their health because they attract in SHS to make them healthy. And 2% of people argue for others things.

5.2.7. Time available to study per day beforeInstallationSHS.

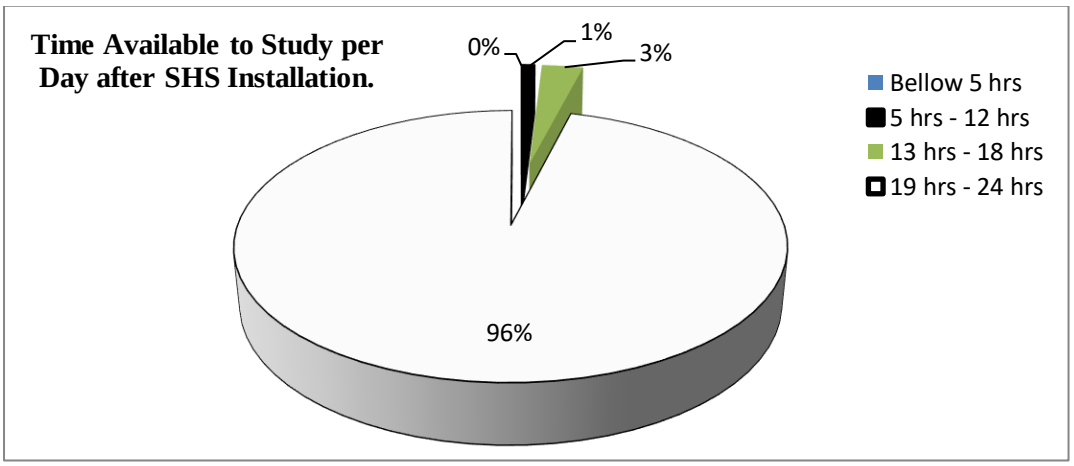
Chart 5.12:Time available to study per day beforeInstallationSHS.



Before installed SHS many people were suffering from lack of time to study and work. They didn't have their private time for their family and society. Whole day they were busy in domestic work. Which was not fruitful and in night it was hard to study. Sometimes "Jharo" caught fire and it was possible to brunt house. People didn't study at night. Among them, 93% of people had less than 5 hrs. to study and work. 6% of people had 5 hrs. – 12 hrs., 1% had 13 hrs. – 18 hrs. for study and work. Nobody had time to study and work 19 hrs. – 24 hrs.

5.2.8. Time Available to Study per Day after InstallationSHS.

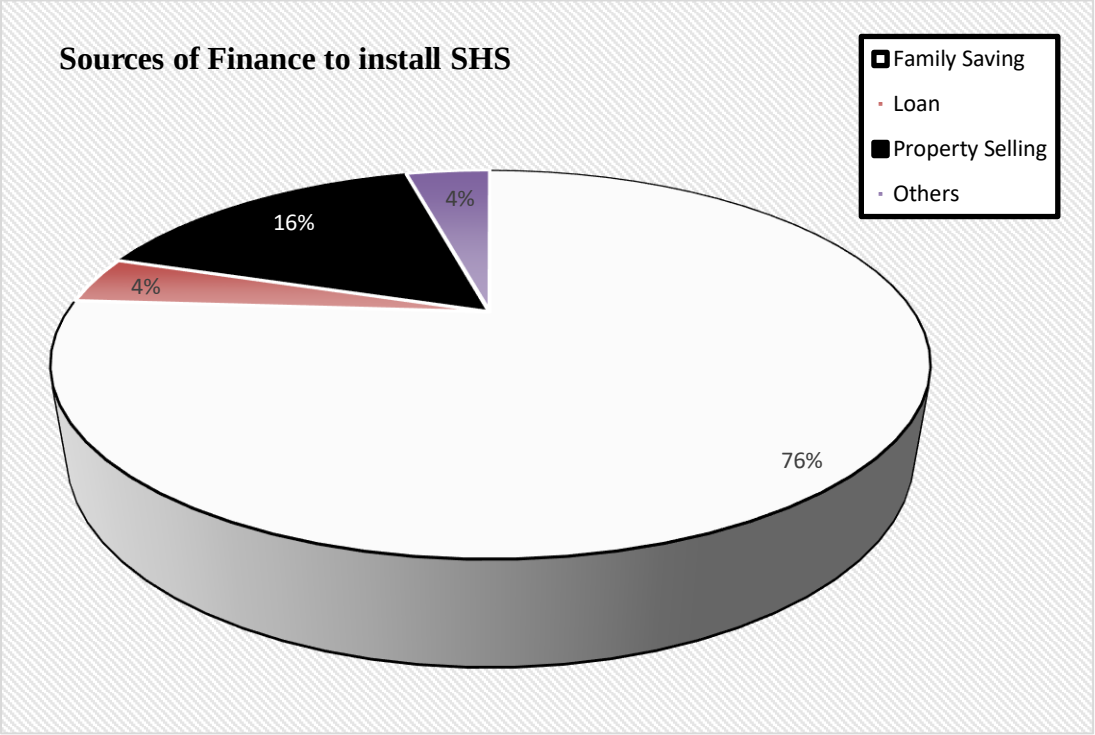
Chart 5.13: Time Available to Study per Day after InstallationSHS.



After installed SHS many people feel relief. They have enough time to reading and enjoy with their families. Probability of danger also reduces because Jharo is totally removed. Among them 96% of people have sufficient time to reading and working. They have 19 hrs. – 24 hrs., 3% of people have 13 hrs. – 18 hrs. and 1% have 5 hrs. – 12 hrs. for reading and working. It shows that SHS is important for them from every corner.

5.2.9. Sources of Finance to Install SHS.

Chart 5.14: Sources of Finance to Install SHS.



Most of houses save money to install SHS they are 76%, 16% of house's sources of finance to install SHS is property selling, 4% of house's sources of finance to install SHS is loan and also 4% sources is others. So we can assume that most of people save their money to install SHS.

5.2.10 Subsidy and Grant Received to Install SHS.

Chart 5.5: Subsidy and Grant Received to Install SHS.

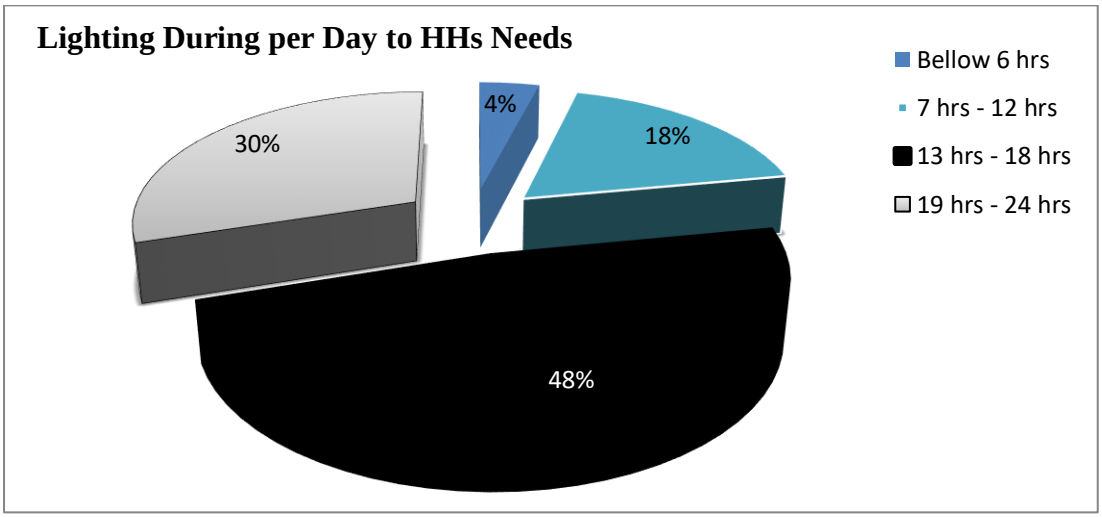
SN	Amount of Subsidy	Users	
		Number	Percent
1	Bellow Rs. 1000	45	90
2	Rs. 1001 - Rs. 2000	4	8
3	Rs. 2001 – Rs. 5000	1	2
Total		**50**	**100**
SN	**Amount of Grant**		
1	Bellow Rs. 1000	48	96
2	Rs. 1001 - Rs. 2000	2	4
Total		**50**	**100**

Source: Field Survey, 2015

Although booth seems same meaning but here subsidy means money that given by government or organizations to SHS. 90 % houses take below Rs. 1,000, 8% houses take Rs. 1,001 – Rs. 2,000 and 2% houses take Rs. 2,001 – Rs. 5,000 as the form of subsidy. Where 96% houses take below Rs. 1,000 and 4% houses take Rs. 1,001 – Rs. 2,000 as the form of grant. It shows that government also helps the rural people to develop their society and themselves.

5.2.11. Lighting Duration per Day to HHs Need.

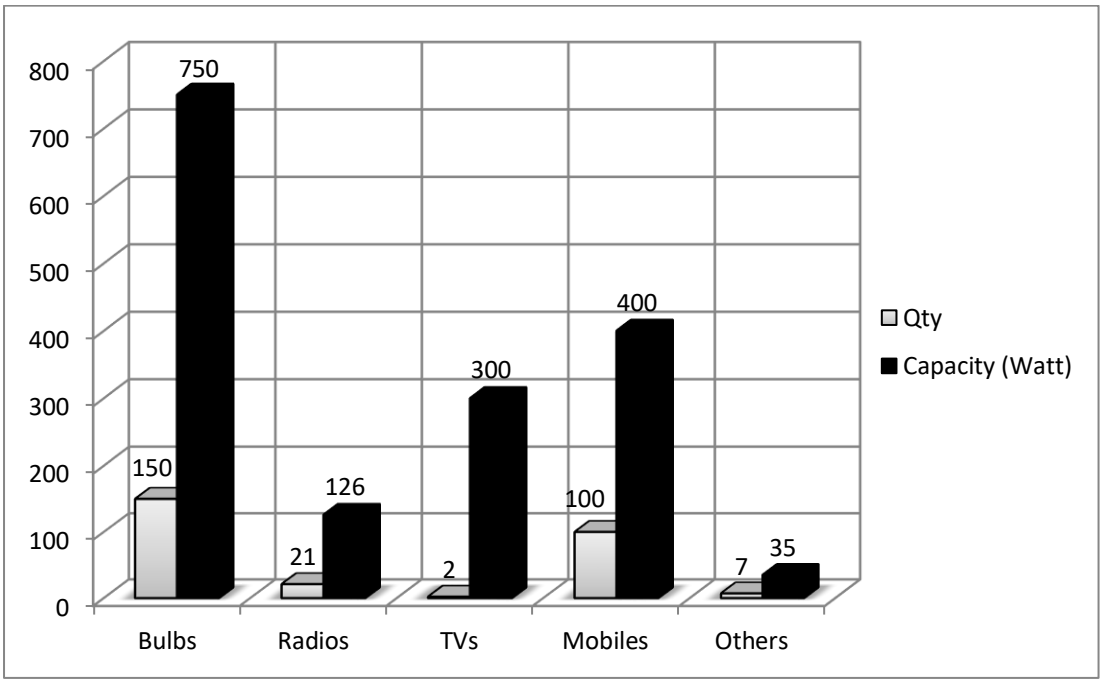
Chart 5.15: Lighting Duration per Day to HHs Needs.



Most of people enjoying the lighting after install SHS. 48% houses have 13 hrs. – 18 hrs. lighting duration, 30% have 19 hrs. – 24 hrs., 18% have 7 hrs. – 12 hrs. and only 4 % houses have below 6 hrs. lighting duration. People's dark days are removed by SHS. That way SHS is boon for villages.

5.2.12. Total Number of Electric Equipment's and Capacity They Are Using.

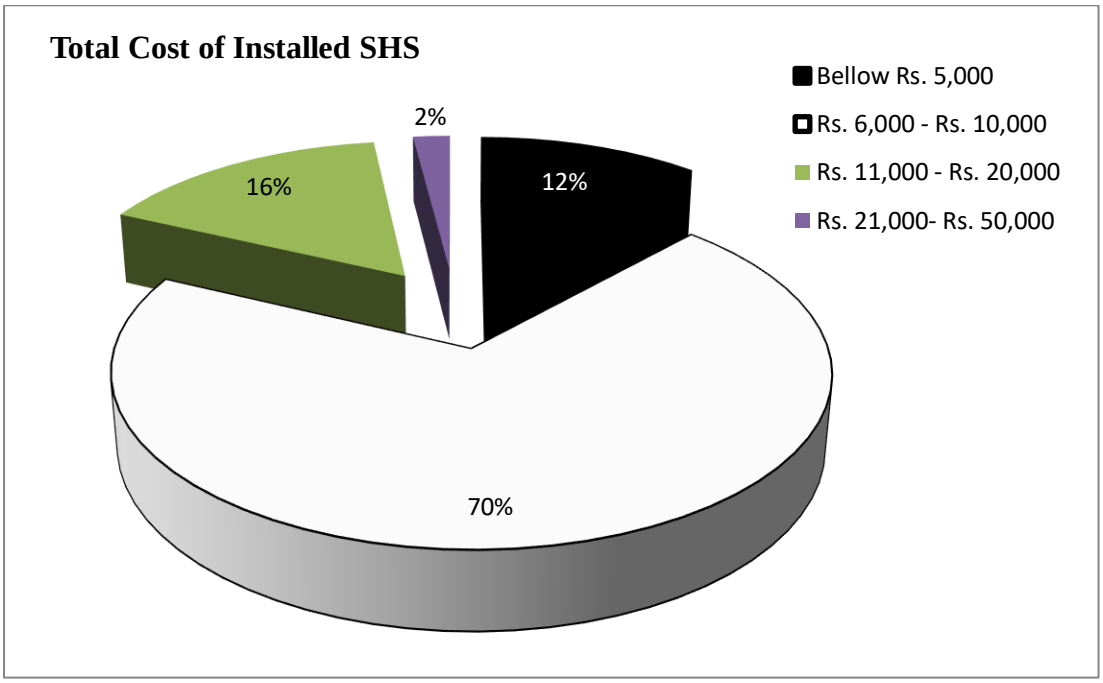
Chart 5.16: Total Number of Electric Equipment's and Capacity They Are Using.



Electricity equipment are using by many houses when they installed SHS. Total number of bulbs 150 and it need around 750 watt capacity, radio 21, it need around 126 watt, TV 2, it need around 300 watt to use, similarly, mobiles 100, it need around 400 watt energy to charge and other things are 7 which need around 35 watt of electricity. Houses are happy and bright with almost 1700 watt of electricity.

5.2.13. Total Cost of Installed SHS.

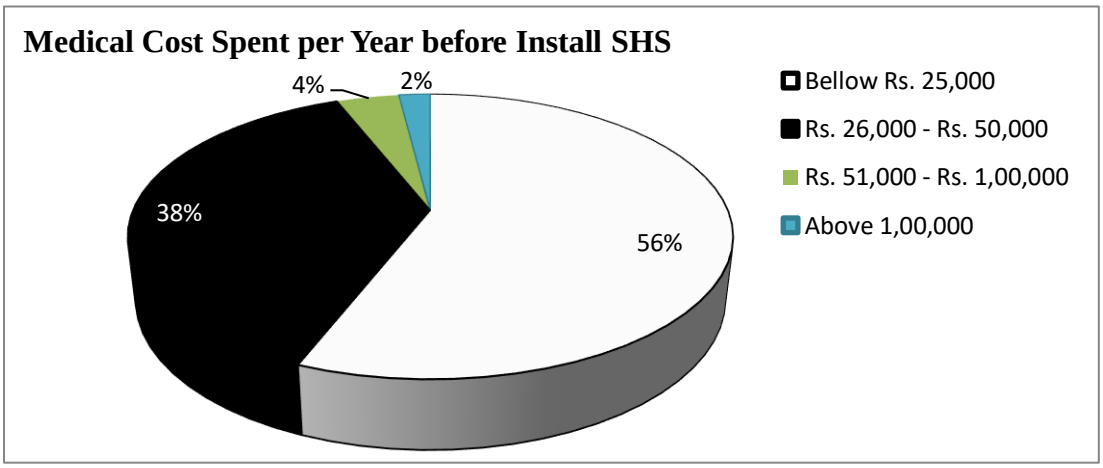
Chart 5.17: Total Cost to Installed SHS.



Given diagram 5.17 shows that the purchase power of houses and their civilization. Now people are aware about SHS and they put it in any of cost. By the study 12% houses spend below Rs. 5,000 to install SHS. Likewise, 70% houses spend Rs. 6,000- Rs. 10,000, 16% houses spend Rs. 11,000 – Rs. 20,000 and 2% of houses spend Rs. 21,000 – Rs. 50,000 to installed SHS. People need light (bulbs) rather than others and also slowly and gradually their purchasing power also increasing way.

5.2.14. Medical Cost Spent per Year before Install SHS.

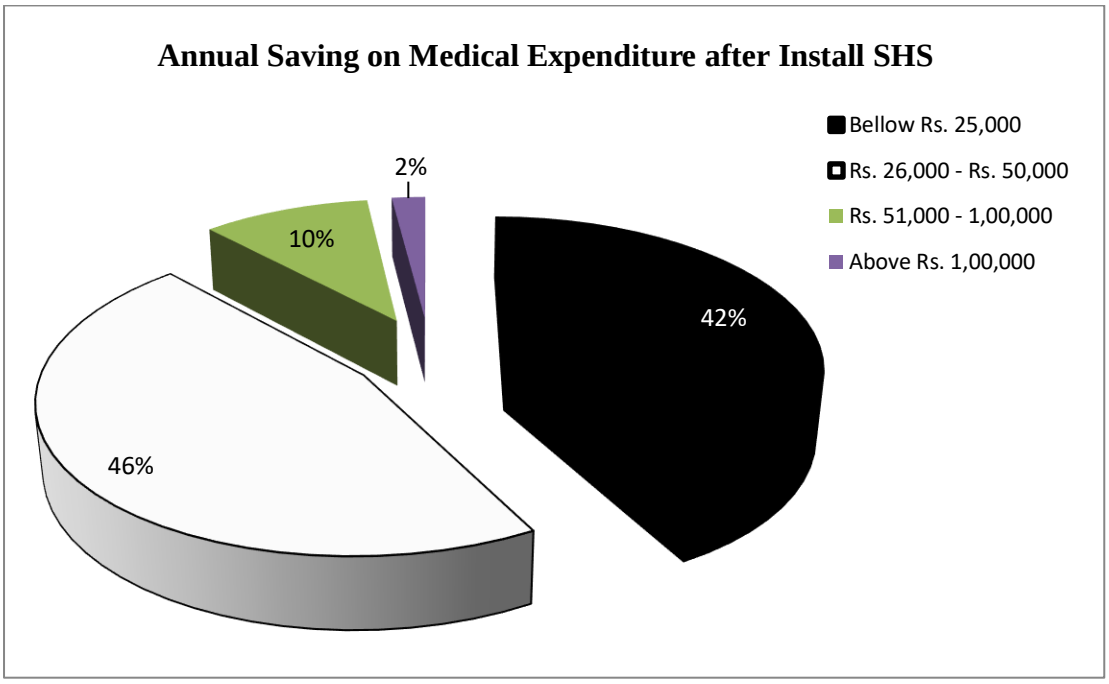
Chart 5.18: Medical Cost Spent per Year before Install SHS.



Directly or indirectly SHS play major role in health of people. Before using it 56% of houses paid below Rs. 25,000 in medical cost per year. Likewise, 38% houses paid Rs. 26,000 – Rs. 50,000, 4% houses paid Rs. 51,000 – Rs. 1, 00,000 and 2% of houses paid above Rs. 1, 00,000 in medical cost per year. Many of economic is spending on medicine so people have low punching power and they suffered from various king of fatal disease which is caused by dust and smoke.

5.2.15. Annual Saving on Medical Expenditure after Install SHS.

Chart 5.19: Annual Saving on Medical Expenditure after Install SHS



After installing SHS people save a lot of riches and their health also good because they are way from smoke and those fatal diseases which basically invite by smoke. Chart shows that their credibility 2% houses save more than Rs. 1, 00,000 in medical cost after using SHS per year. Likewise, 10% save Rs. 51,000 – Rs. 1, 00,000, 46% save Rs. 26,000 – Rs. 50,000 and 42% houses save below Rs. 25,000 in medical expenditure after install SHS per year. This progress report shows life is easier and healthy than before.

5.3 Summary of Findings

The present study is based on both primary and secondary data. The secondary data were collected from different publications, Report of Institutions, District and VDC Profile and so on. Likewise, the primary data were collected by administering the questionnaire, observation, discussion on people of Phoimahadev VDC. The major conclusions of the study are described here under.

From the study it is found that larger proportions of the respondents are male (users and non-users of SHS) in Phoimahadev VDC. Agriculture is predominant occupation of but not the sufficient one in terms of income. Behind agriculture, labor, government job, small industry, business, service are the other occupation followed by the people of study area. Almost half of the respondents could not meet the SHS cost from their annual savings.

There are some difference between users and non-users according to literacy, where education play vital role in solar home system using. Somehow people are civilized by coping. And on the other hand skill also needed. Most of people are uneducated and they are ignoring using it. All are literate who are using it. So at first make people literate and skillful and they use SHS.

Houses who uses SHS are 76% on agriculture, 4% are involve in industry, none of users occupy trade, private job and foreign employ, government job holders are 18% and 2% are involving other kind of occupation which is not introduce. Secondly houses that are not using SHS mainly involve in agriculture it percentage is 80, government job holders are 10%, others none introduce occupation are 10%. Non users have not access to trade, industry, private job and foreign employ. Though here's main occupation is agriculture and government job but the policy of SHS is not working properly and agriculture is not blockage of some infrastructure of development and this remote are need some attractive policy of government which can remove from darkness.

Basically survey goes on selected people and they haven't enough land but they are interested on alternative energy. Interest also plays the role on it. People who have more than 10 ropani they are not using SHS. So at first people have to interest than they act. Economic factor is the one of the essential element of every purpose. So

here, rich to poor people are applying SHS. Therefore, it is fit for not every corner of people in Nepal who are from rich and middle class.

Annual expenditure of people who users of SHS and non-users. It also finds people have habit of saving which can make their life easier in future. It argues somehow it may costly for poor people but it makes life easier; though people not using because they cannot save money as they need. If they put it shows they may be loan. Money should save for other purpose. If government gives some economic comfort user number may be increased.

People whose house is hold by annual income they put the SHS and save money too. In this VDC people used SHS for lighting purpose. So people who have SHS in their home they reduce only "Jharo" but firewood needed for cooking and other needed energy.

Research is done on remote area of Nepal where hardly people have got kerosene oil and other lighting equipment. Before using SHS 30% people were used kerosene, among them 20% were used "Tuki" and 10% were used "Laltin". 70% people were depended on "Jharo". So it shows most of people were suffering from poverty and darkness. The major purpose of install SHS is lighting which save the pinewood and smoke.

The most attraction part of SHS is free from smoke, out from darkness, improving health and support their kids in study. Before installed SHS many people were suffering from lack of time to study and work. They didn't have their private time for their family and society. Whole day they were busy in domestic work. Which was not fruitful and in night it was hard to study. Sometimes "Jharo" caught fire and it was possible to brunt house. People didn't study at night. After installed SHS many people feel relief. They have enough time to reading and enjoy with their families. Probability of danger also reduces because "Jharo" is totally removed. It shows that SHS is important for them from every corner. Most of people save their money to install SHS. Although booth seems same meaning but here subsidy means money that given by government or organizations to SHS. Government also helps the rural people to develop their society and themselves. Most of people enjoying the lighting after install SHS. That way SHS is boon for villages.

Now people are aware about SHS and they put it in any of cost. People need light (bulbs) rather than others and also slowly and gradually their purchasing power also increasing way. Many of economic is spending on medicine so people have low punching power and they suffered from various king of fatal disease which is caused by dust and smoke. After installing SHS people save a lot of riches and their health also good because they are way from smoke and those fatal diseases which basically invite by smoke. Existing SHS distribution policy has succeeded in covering only richer and middle class income groups. The subsidy reduction policy has further led to deprivation of SHS access to poor and ultra-poor section of the society. Taking into consideration of the disadvantage group, special provision should be made in policy to accommodate such sections.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Male members are the primary source of survey information in the rural community. It could be mainly because the male generally entertains the outsider and females do not do so. The SHS users have possessed relatively good level of education from primary to secondary level. Economically SHS users are relatively well off families in the rural community. Agriculture is predominant occupation of but not the sufficient one in terms of income. Behind agriculture, labor, government job, small industry, business, service are the other occupation followed by the people of study area. The investment in SHS is also one of the reasons of high expenditure against household income. It appears almost half of the respondents could not meet the SHS cost from their annual savings

SHS are mainly used for lighting, and then for radio, mobile and TV too, in the same order. In the HHs, utilization of SHS exclusively for productive end use has been rare. Lighting bulbs, mobiles, radio etc. are consumptive end uses of SHS. It is observed that lighting is main end use of all the SHS followed distantly by radio, mobile and TV connection. Operational hours of SHS reflect the intensity of effects in daily household activities. An average number of bulbs in use for lighting are four. Bulb has been placed in common room and kitchen. This shows almost all owners prefer to light the common room than specific room than specific room such as study room. Nevertheless, the productive end use is the most desired end uses of the SHS program. Provision of longer working hour and better lighting quality has created some opportunity in breaking inertia of emerging some rural enterprises. SHS has created the rural employment opportunity to the local community in repairing and maintaining SHS sets. Around half of the respondents perceive that local people are capable to run SHS repairing workshop in the village and two fifth are doubtful about this statement.

Comparatively, children are the main beneficiaries and improvement in study environment is the major gain. Better lighting has provided longer study time and facilitated guardians in coaching their school going children at night. SHS has also increased female members' ability to accomplish more household chores because of better lighting and longer working hours. Another change is chatting/ interacting among the family members. Interactions are good for building the understanding among the family members.

"Jharo" and "Tuki" are commonly and widely use prevalent and widely use prevalent lighting device before installation of SHS. This is distantly followed by lantern. Kerosene is widely used fuel for lighting and dry cells for radio and tape recorder. Study reveals that SHS has helped in monthly fuel saving. The study points out majority of the respondents have installed SHS for the sake of better lighting followed by kerosene expenditure saving and social prestige. Access to information is another important impact of SHS. Easy access to audio visual devices such as radio/ cassettes and TV have made the households better informed and enhanced their knowledge and skills.

Installation of SHS has also improved indoor environment for most of the respondents. Smoke free environment has brought better health condition especially by reducing respiratory and eye related problems. other important changes are decrease in incidences of fire and physical injuries. Apparently, lack of awareness and confusion among the SHS owners regarding disposal of used batteries is the one and only problem concerning environment. This calls proper orientation for SHS owners. Another visible impact is decrease in incidences of fire hazards and physical injuries. However, new incidence of acid burning is emerged causing minor casualty to family members, properties and their belongings.

6.2 Recommendations:

Based on this study, the following recommendations have been made:

- Users are deprived of getting post installation service of repair and maintenance. In some of the cases they have to wait for even one to two months to get repaired their ill SHS set. Service center should be made available locally to promote SHS and strengthen the post installation service accordingly. It is also suggested that distributor of SHS should have provision of technical support and training to the local people including women.
- Existing SHS distribution policy has succeeded in covering only richer and middle class income groups. The subsidy reduction policy has further led to deprivation of SHS access to poor and ultra-poor section of the society. Taking into consideration of the disadvantage group, special provision should be made in policy to accommodate such sections.
- Training local technicians should be made integral part of SHS dissemination process for the successful adoption. The local radio/ TV repairing technicians could be appropriate persons for the SHS maintenance and repair activities as SHS adds synergy in their current work. Technicians working for one company in the same area do not provide service to another company's SHS set. Because of this users are suffering from even simple maintenance problem. To overcome these problems arrangement should be made to provide after sales services by the available technicians irrespective of their company brand.
- Initiation should be taken to establish working understanding among the companies to provide services to the SHS users through solar electric manufactures association Nepal.
- Most of the SHS users lack experience regarding the availability of the subsidy. They thought whatever they paid to SHS Company that is the total cost of SHS. Finding shows most of the users do not know subsidy provider and exact amount of subsidy. Hence it is suggested that amount of subsidy be clearly mentioned in the price list and subsidy provider widely advertise it through appropriate channel.
- Institutional support plays important role to reach poor through group formation, loan distribution, SHS distribution in installment basis and secured

after sales services. It has already been successful income of the sample VDCs. Cooperative society; NGOs and the individual members are promoting SHS. Therefore, institutional support should be availed to facilitate the poor people.

- Solar plays a pivotal role in augmenting the awareness and healthy living of the children through watching TV and listening radio. Such access to information generates effective awareness to children regarding harmful effect of cigarette, alcohol, drugs, and the importance of healthy habit e.g. washing hands before taking food. Therefore, it is recommended that the promotional program of alternative energy including solar component should be regularly broadcast. This effort could be further strengthened by including renewable energy resources in the curriculum and school text book mainly in the social studies and science book.
- SHS is accessible to the income groups having annual income more than 50,000. It is clearly depicted from the study that only handful of the poor and ultra-poor section of society have access to SHS. Present price index is too high to be afforded by the poor and ultra-poor. In order to reach SHS facility to this section following provisions should be arranged.
- Education is most beneficial parameter of the SHS installation. Almost all users express satisfaction over educational performance of their children after installation of SHS. It is recommended that SHS promotional activities should be tied up with different donor agencies related to non-formal education, girl child education and adult education. Those who send girls to school regularly and attend adult education should be provided SHS in subsidized rate by the donors.
- Subsidy should be based according to the economic status of the people especially identified by different poverty alleviation program implementing agencies e.g. Small Farmers Development Program (SFDP), Production Credit for Rural Women (PCRW), NGOs, Participatory District Development Program, Local Governance Program, INGOs etc. Easy installments program provision could be one of the solutions to reach down to the poor and ultra-poor group. Necessary action should be initiated to establish installment system.

- SHS model with capacity adjustable should be developed and promoted at cheaper price. This could provide user more flexible to adjust their energy need with initial cost of SHS.
- Soft loan facility should be extended to needy and willing poor in group liability basis and low interest rate. Distribution of SHS on monthly service charge basis is another means of targeting low income group. It is reported that respondents are ready to pay their present expenses on kerosene for lighting.

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STATUS OF SOLAR HOME SYSTEM IN RURALCOMMUNITY:

A Case Study of PhoimahadevVDC, Kalikot, Nepal

Questionnaire

Name of Respondent: **Occupation:**

Age: **Sex:** **Education Status:**

"Section A"

A. Demographic Information:

i. General information of the family members of the sample Households.

S.N.	Name of the household member	Age	Sex	Education Status	Occupation
1.					
2.					
3.					
4.					
5.					

ii. Literacy of the Respondents Families.

S.N	Level of Education	No. of Family Member	Percentage
1	Illiterate		
2	literate		
3	School		
4	S.L.C		
5	Intermediate		
6	Bachelor Degree		
7	Master Degree		
Total			

Iii. What is the occupational structure of your family member?

Occupation Gender	Agriculture	Industry	Trade	Govt. job	Private Job	Foreign employment	Other
Male							
Female							
Total							

"Section B"

A. Socio-economic Questions:

i. Total land description of your possession. (Ropani/Ha).

a. 0-5 b. 5-10 c. 10-15 d. 15 over

ii. Total food grain production in last year. (Muri/Pathi/quintal)

a. Maize……. b. Wheat……

c. Miller…… d. Other…….

iii. How much Rs. your annual income?

a. Bellow 25,000 b. 26,000 - 50,000

c. 51,000 –1, 00,000 d. Above 1, 00,000

iv. What are your income sources?

a. Agriculture b. Jobs c. Foreign employment

d. Others…….

v. How much Rs. your annual expenditure?

a. Bellow 25,000 b. 26,000 – 50,000

c. 51,000 –1, 00,000 d. Above 1, 00,000

vi. Annual income can support your HHs expenditure?

a. 1-3 M b. 4-6 Mc. 7-9 M d. 10-12 M e. Over 12 M

"Section C"

A. HHs Annual energy consumption.

S.N.	Purpose	Types of energy sources	Quantity (kg/litter/Kwh)	Cost (in Rs.)	Energy (MJ)
1.	Lighting	1.Fuel Wood 2. Agro Residue 3. Other Biomass 4. Kerosene Oil 5. Battery 6. Other Fuels 7. Candle			
2.	Cooking	1. Fuel Wood 2. Agro Residue 3. Other Biomass 4. Kerosene Oil 5. Others…….			
3.	Electric Equipment's	1. Battery 2. Others……..			

B. Annual consumption of energy sources and saving pattern after using HHS.

S.N.	Consumption of Energy Sources	Before (kg/litter/kwh)	After (kg/litter/kwh)
1	Fuel Wood		
2	Agro Residue		
3	Other Biomass		
4	Kerosene Oil		
5	Batteries		
6	Candle		
7	Others Fuels		
8	Others Sources		

"Section D"

A. SHS and its Impacts Information:

i. What type of lamp did you use before installed Solar Home System?

a. Tuki b. Laltin c. Jharo d. Candle

e. Other…….

ii. When did you install Solar Home System in your home?

a. …….(YYYY/MM/DD)

iii. What is your purpose to install of Solar Home System?

a. Lighting b. Radio/TV/Mobile c. Children Study

d. Others…….

iv. What advantage of SHS attracts you most?

a. No need kerosene b. Improve Health c. Easy to work

d. Others…..

v. How much time was available in home per day to study children before the install of SHS?

a. Bellow 5 hrs. b. 6-12 hrs. c. 13-18 hrs. d. 19-24 hrs.

vi. How much time is available in home per day to study children after install SHS?

a. Bellow 5 hrs. b. 6-12 hrs. c. 13-18 hrs. d. 19-24 hrs.

vii. What the sources of finance are for install Solar Home System?

a. Family Saving b. Loan c. Property selling

d. Others…….

viii. Did you get any subsidy and grant for installing SHS at your home?

a. Subsidy Rs…… b. Grant Rs…….

ix. Is the lighting duration sufficient per day for your household need?

a. Bellow 6 hrs. b. 7 - 12 hrs. c. 13 – 18 hrs. d. 19 – 14 hrs.

x. How much electric equipment's are you using? Mention the number, capacity and average lighting hrs. /day?

Electric equipment's	No.	Capacity (Watt)	Average lighting hours a day		
			Summer	Rainy	Winter
Bulbs					
Radio					
TV					
Mobile					
Others…….					

xi. How frequently did you replace, repair or maintain the electric accessories at household level during last year? Mention the cost of replacement, repair and maintenance?

S.N	Components	Quantity	Unit cost	Charge for technicians	Travel cost		Who bearded the cost
					Cost	Days lost	
1							
2							
3							
4							
5							
6							

xii. How much cost to install the SHS in your home (in Rs.)?

a. Bellow 5,000 b. 6,000 – 10,000 c. 11,000 – 20,000

d. 21,000 – 50,000

xiii. How much medical cost spent per year before installed SHS?

a. Bellow 25,000 b. 26,000 – 50,000

c. 51,000 – 1,00,000d. Above 1,00,000

xiv.How much annual saving on medical expenditure after installSHS?

a. Bellow 25,000 b. 26,000 – 50,000

c. 51,000 – 1,00,000d. Above 1,00,000