SOCIO-ECONOMIC IMPACT STUDY OF THE USERS OF SOLAR HOME SYSTEM[1]

FINAL REPORT

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Energy Sector Assistance Program (ESAP)
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FIGURES

ACRONYMS

AEPC	Alternative Energy Promotion Center
AHW	Assistant Health Worker
ANM	Auxiliary Nurse Mid Wife
ARI	Acute Respiratory Infection
ASI	Assistant Sub Inspector
ATT	Average Treatment Effect on the Treated
CFL	Compressed Florescent Lamp
CSpro	Census Survey Processing
DANIDA	Danish International Development Agency
DVD	Digital Video Disc
ESAP	Energy Sector Assistance Program
FGD	Focus Group Discussion
FTL	Florescent Tube Lamp
KII	Key Informant Interview
NLSS	Nepal Living Standard Survey
NRS	Nepalese Rupees
PPS	Probability Proportional to Size
PV	Photovoltaic
REF	Rural Electrification Fund
SHS	Solar Home System
SSP	Solar Energy Support Program
VCD	Video Compact Disc
VDC	Village Development Committee
WLED	White Light Emitting Diode

EXECUITIVE SUMMARY

Solar Home System

Despite Nepal's huge potential for hydro electricity, it has not been able to harness its full potential due to various reasons. Currently, only 56 percent of the Nepali population is connected to the national grid while the rest of the population still relies on traditional sources of power. Even in electrified areas, there has been acute power shortage in recent years, with residents forced to live in as much as 16 hours of daily power cuts. In 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.

To promote rural electrification through solar energy, Government of Nepal, in partnership with Danish, Norwegian and German governments, has introduced subsidy program to encourage the adoption of solar home system. The scheme is known as Solar Energy Support Programme (SSP) and is one of the components of Energy Sector Assistance Program (ESAP) which is nested within Alternative Energy Promotion Center (AEPC), a governmental institution. The objective of the second phase of the SSP program is to make quality solar energy systems more accessible to the rural poor and to reinforce national framework for dissemination of quality solar energy systems. For this purpose, Government of Nepal has categorized all Village Development Committees (VDCs) in one of three categories: very remote, remote, and accessible. Under SSP, households in "very remote" VDCs receive subsidy of NRs. 7,000 for solar units of less than 18 watts and NRs. 10,000 for units of more than 18 watts. Similarly, households in "remote" VDCs receive NRs. 6,000 and NRs. 8,000 respectively, while households in "accessible" VDCs receive NRs. 5,000 and NRs. 6,000. Subsidy is only provided for solar home systems installed by the companies that have been verified and approved by AEPC/ESAP and REF. The target of the second phase of SSP is to install 150,000 solar home systems and 50,000 small solar home systems. In addition, KfW has committed to support 100,000 solar home systems.

Evaluation

The purpose of the evaluation was to investigate the socio-economic impact of the SHS disseminated under subsidy of AEPC/ESAP, to investigate the satisfaction level of SHS users, and to identify the possible end use of SHS other than for lighting.

Evaluation Framework

The study evaluates the impact of SHS on income, health, education, access to information, gender equality, security, time use and household expenditure on fuel. Satisfaction level of the user is explored through much they have had to spend on repair and maintenance, how active they are in repair and maintenance of SHS, and whether or not SHS met the expectations of users. Finally, the study identifies possible end use other than lighting by inquiring users and non users of SHS what appliances or equipments they would want to use with Solar Home System.

To measure the impact on access to information of the household, the study uses indicators developed by the World Bank. These include ownership of communication instruments and the households' use of such appliances.

Solar Home System provides lighting even at night, which provides additional time for children to study. Impact of SHS on education is assessed through the educational attainment of the children by comparing the school dropout rate, passing rate, and the scores obtained by students in their exams. This is based on the logical premise that if students study more, they are likely to perform better.

Solar Home System replaces conventional fuel like kerosene and *jharro* used for the purpose of lighting. This may help decrease the incidence of respiratory diseases and eye infection by reducing indoor air pollution. This study quantifies the impact of SHS on health by comparing reported cases of respiratory and eye infection among users and non users of solar home system.

Solar Home System can increase households' farm income as increase in access to information provides information regarding use of pesticides, fertilizers and market information. Such information is helpful in increasing agricultural productivity and eventually income. Similarly, SHS may increase the time available to work by allowing people to engage in economic activities even at night which helps to increase the non farm income. The impact is quantified by comparing the farm and non farm income of users and non users of SHS.

Survey of non users of SHS helps to quantify the average monthly expenditure on fuel used for the purpose of lighting. This information is used to estimate the payback period for the investment in SHS. The survey also collects information on the average amount of fuel use per month. This information is used to calculate the contribution of SHS in reducing greenhouse gases in the environment.

Most crimes are conducted in the cover of darkness. Light from solar home system may prove to be a deterrent to criminal activities like theft and burglary. This section explores if SHS has had any impact on security by measuring the reduction in number of criminal activities.

Methodology

Study is based on both quantitative data (Household survey) and qualitative information (FGD and KII). To explore the impact of SHS, the study relies on quantitative data but effort is also made to verify the results from the findings of qualitative data

When conducting an impact evaluation analysis, the first task is to determine the outcome indicators, which have been discussed above. The next step is to determine whether the outcomes have changed significantly due to the introduction of a policy, subsidy or transfer of technology which, in this case, is the installation of SHS. To estimate the change, this study compared the outcome among user and non user of Solar Home System

Various methods are available to compare the outcomes. A simple comparison yields overestimate of impact because although the government provides subsidy to all households in eligible areas, a huge sum of money should be invested up from. Needless to say, many cannot afford this amount even with the subsidy. Therefore, households who choose to install SHS are different from non user households in at least some dimension. This self selection makes the distribution of SHS non random as households with relatively high income or better educated household heads are more likely to install SHS. If a simple comparison of outcomes between treatment and control groups is made ignoring this bias, two groups will be compared in which one is better off than the other from the beginning. Whatever difference observed between users and non users is then an overestimate of the impact due to SHS alone. So, to make a valid comparison, first off all it is necessary to remove such bias. In other words, to know the impact of SHS, it should be known what would have happened without the SHS.

The study is based on propensity score method of matching outcomes among treatment and control group. The propensity score is a predicted probability of installing SHS for treatment as well as control households based on those factors which are likely to affect the demand for SHS. Under this method a treated household is matched with untreated households with similar characteristics and evaluate the difference in outcome among the matched pair finally the mean of all the differences is evaluated to estimate the impact of the Solar Home System. In this way, bias arising from self selection is removed or lessened.

Impact of Solar Home System

Results show that those households who opt to install SHS have higher landholding, income, and awareness level measured through newspaper readership. Households with better educated household heads are more likely to install SHS. Similarly, the profile of household head's occupation predicts SHS usage. This observation shows that installation of SHS is non random. Further, to validate the results statistically, logistic regression was run which revealed that a number of factors are significant in determining the households' decision to install the solar home system.

Coefficients on a number of variables are statistically significant. SHS users are likely to read newspaper significantly more than non-users and household heads among users are likely to have more years of education than non-users. These are largely expected results because households that read newspaper more often and have better education household heads have better access to information and are probably more confident in dealing with bureaucratic procedures to procure subsidy. Households with larger family size and number of rooms in their dwelling are also more likely to install SHS probably because the variables are positively correlated to income. Not surprisingly, households that own more land and receive remittance income are more likely to be SHS users. Religion does not predict SHS usage, but *dalits* are less likely to install a system.

Based on the logistic regression probability of installing a SHS was predicted for households in the treatment as well as in the control group. This probability is known as propensity score. Difference in outcome between treated and untreated is then calculated among those households which have the same or similar propensity scores. This difference gives the impact of SHS.

Looking at impact estimates of SHS on access to information, it is evident that SHS has had an important role in increasing access to information for rural households where there is no regular supply of electricity. This certainly helps in the empowerment of the rural people.

Education is another sector where SHS has had significant impact. Students with Solar Home System are 15 minutes more likely to study every day than without SHS, with the magnitude of the impact different for male and female students. This figure justifies the 2 more percentage secured by students in their exams. Findings show that with Solar Home System, passing rate increases and school dropout rate decreases. The time spent by the student helping in household work is negative for male but positive for female with Solar Home System.

Surprisingly, findings show that there is no impact of SHS on health outcomes. The reason for this finding could be because firewood is the major source of indoor air pollution and replacement of kerosene for the purpose of lighting may not have had significant effect on health outcomes. A separate analysis for households with and without improved cooking stove also shows no impact on heath. The study focused on estimating the direct and immediate health benefits of SHS. It is possible that due to increase in access to information, households may have made better health choices, invested more in health capital, adopted better sanitation practice, may have taken preventive measures, or their use of health facilities may have increased. Since the interviews were not designed to capture these dimensions of health benefits, the indirect health benefits of SHS cannot be estimated.

Impact on farm income and income through own business is estimated separately. SHS is likely to increase the probability of initiating own business by 3 percent. The income from such business is also likely to increase with SHS but the impact on farm income however is not significant. This is very plausible result because many unpredictable variables affect farm income like weather, rainfall pattern, etc.

Almost 60 percent of the households in control group use kerosene for the purpose of lighting, followed by 32 percent of battery users and 13 percent of *jharro* users. Average kerosene consumption is 0.66 liters per week and average weekly expenditure on kerosene is NRs. 47. This implies that average monthly expenditure on kerosene is NRs. 188. Previous study (TRUST: 2003) reported average monthly expenditure on kerosene to be NRs. 124. This increase is reasonable as the price of kerosene has increased from 2003 to 2009

On the basis of FGD and in depth interview, it can be concluded that SHS has had some positive impact in improving the security situation although SHS alone cannot get rid of the problem completely. Most participants agree that even if crime does take place, with the help of SHS, it is easier to recognize and, in some cases even capture, the culprit.

Satisfaction level

Battery is the most repaired part of the Solar Home System and the average cost of repair of battery is also high. Replacement of battery is reported by significant percent of the household. The average cost for replacing the battery is Rs 700, which is only 1 percent of the average annual household income.

Another way to measure the satisfaction level of users is by asking if their expectation was met by SHS. All households expected to have lighting, and the expectation was fulfilled for all households. However, the proportion of household using mobile phone is higher than the proportion that expected it. The same also true for cassette player/radio. On the other hand, the proportion of households using television is lower than proportion that expected it. Findings also show that households are active in repair and maintenance of the system as the proportion of households reporting that they do battery water topping and clean solar panel is high.

FGD and KII revealed the only dissatisfaction that the users had. They complained that technician were unavailable in the village for repair and maintenance of parts.

Identification of possible end use

A large proportion of households want to install more lights. Households would also like to operate television, computer and refrigerator. But the users are aware that to run such equipments, SHS with high capacity is required and the major barrier for households to install a high capacity system is money. To resolve this problem, two options are forwarded by the respondents: the first is to increase the amount of subsidy and the second is for the government to provide easy loan through financial institutions for the installation of SHS.

At institutional leve,l it was common for teachers and principals to report that they would like to have a printer in the school. Respondents in health centers are in favor of subsidy for the installment of high capacity solar systems in health centers. It was frequently mentioned that vital supplies like vaccines and some medicines could not be stored for long in absence of refrigerator

Implication of findings

1. **Health and education institutions are willing to install high capacity systems if proper credit facilities were available.** AEPC/ESAP should partner with financial institutions to make credit facilities available to those who are willing to install high capacity system. Alternatively, arrangements could be made for them to pay the cost in installment.

2. **Provide easy loan to upgrade the system.** Nearly fifty percent of households are willing to upgrade the system while only five percent have in fact done so. It is understandable that subsidy cannot be provided to the same household twice. In such cases, AEPC/ESAP could arrange for soft loans to such households.

3. **Ensure that solar installation companies explain the subsidy scheme properly.** A majority of users said they did not receive subsidy from the government for the installation of SHS. In the future, it should be required of the solar installation companies to explain the subsidy scheme to the users properly and clearly. In addition to this advertisement through radio and Television could be one of the effective means to raise awareness about subsidy and basic maintenance not only among the current users of SHS but also among the non users of SHS.

4. **Train local technicians for onsite repair and maintenance of SHS.** Finding showed that unavailability of technicians for repair is one of the major dissatisfaction over the system. AEPC/ESAP could train some local person in the village on how to repair the components of the system. This could help to reduce the dissatisfaction level of the user.

5. **Recommendations for further study.** Our survey only captured the direct benefits of SHS on health. Future studies could also measure if SHS has had any effect on health indirectly such as by increase in access to information.

ACKNOWLEDGEMENT

Samuhik Abhiyan (SA), a national NGO, has been commissioned by the Alternative Energy Promotion Center (AEPC)/Energy Sector Assistance Programme(ESAP) to carry out a “Socio Economic Impact Study of the User of Solar Home System”. SA has completed this challenging task with the immense cooperation especially of several persons from different organizations, households and use of relevant information from literature.

SA would like to express its acknowledgements and would like to take this opportunity to give heartfelt thanks to the staff of AEPC and ESAP. Thanks are also due to Neils Juhl Thomson, Madhusudhan Adhikari, Resha Piya and all staff of AEPC and ESAP for their invaluable support. We are grateful to Niraj Subedi for his insightful comments.

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Samuhik Abhiyan

CHAPTER: ONE INTRODUCTION

1.1 SOLAR POWER AND SOLAR HOME SYSTEM

Solar energy was first conceived as viable alternative form of power as early as 1860s when coal was expected to be running out of supply. However, 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, industrial countries made concerted effort to develop solar power technologies by creating and maintaining well funded research and development agencies. As a consequence, photovoltaic installation rapidly increased in the late 1970s and 1980s. With increasing evidence of global warming in the 1990s, solar energy was seen to be one of the most viable sources of energy to replace carbon emitting fossil fuels and thus became more "mainstream." More recently, 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 hydro electricity, it has not been able to harness its full potential due to various reasons. Currently, only 56 percent of the Nepali population is connected to the national grid while the rest of the population still relies on traditional sources of power. Even in electrified areas, there has been acute power shortage in recent years, with residents forced to live in as much as 16 hours of daily power cuts. In 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 can be used by households directly, there is no need for investment in expensive infrastructure like power lines. Solar home systems 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 has been actively promoting the use of solar energy, specially in those areas of the country where there is no supply of grid electricity.

The increasing importance that the Government of Nepal is giving to renewable energy and solar PV is reflected in its policies. 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. Soon after the restoration of democracy in 1990, the National Planning Commission prepared the Perspective Energy Plan (1991-2007). The plan envisioned for the government to provide subsidy for the use of solar energy, to make

solar technologies meet rigorous standard, give NGOs and the private sector prominent role in the development and promotion of solar energy, and support research and development activities.

During the Eighth Plan (1992-97), Alternative Energy Promotion Center was established in 1996 under the Ministry of Environment, Science, and Technology with the purpose of promoting and coordinating activities and programmes at the national level. This was an important development because now there is 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 subsidy for the solar PV systems and other RETs. Most importantly, Energy Sector Assistance Program (ESAP) was initiated 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.

In 2006, AEPC prepared a perspective plan for renewable energy which outlined the policies and strategies to be implemented until 2020. They include supporting research and development at academic institutions and manufacturers, produce high quality labor force for installation, monitoring, and development of solar PV systems, and creating a self sufficient commercial structure for the promotion and adoption of solar PV systems.

One of the programmes overseen by AEPC is Energy Sector Assistance Program (ESAP), which was launched in 1999 with the support of DANIDA. The Government of Norway joined the programme in 2003. The objective of ESAP is to “achieve sustainability in the rural/renewable energy section in Nepal” (aepc.gov.np). The first phase of the programme “built a strong foundation for future action and provided benefits to around 1.5 million people in rural Nepal” (aepc.gov.np). The objective of the second phase of the programme (2007-2012) is to “improve the living conditions of the rural

population by enhancing their access and affordability to rural energy solutions that are efficient, environment friendly, and that address social justice" (AEPC/ESAP 2006) The programme "aims to provide energy solutions to more than 1 million households in Nepal." It recognizes that "access to clean, cheap, and reliable energy in remote areas can make an important contribution to improved health, better education and the reduction of poverty" (aepc.gov.np). Under the second phase of ESAP, the target of SSP is to install 150,000 solar home systems and 50,000 small solar home systems. In addition, KfW of Germany has committed to support 100,000 solar home systems.

The component of ESAP that promotes the use of solar energy is the solar energy Support Program (SSP). Under the programme, subsidy is provided to households, institutions, and communities for the installation of photovoltaic systems. For this purpose, Government of Nepal has categorized all Village Development Committees (VDCs) in one of three categories: very remote, remote, and accessible. Under SSP, households in "very remote" VDCs receive subsidy of NRs. 7,000 for solar units of less than 18 watts and NRs. 10,000 for units of more than 18 watts. Similarly, households in "remote" VDCs receive NRs. 6,000 and NRs. 8,000 respectively, while households in "accessible" VDCs receive NRs. 5,000 and NRs. 6,000. However, a number of criteria must be fulfilled before households receive the subsidy. The most important of the criteria is that the solar home system (SHS) must be installed by one of the companies that have been approved and certified by AEPC/ESAP and REF. Solar PV companies all come from the private sector and constitute a key player in the development of solar PV sector in Nepal. By March 2007, there were 53 companies of which 26 were pre qualified by AEPC for the dissemination of SHS.

1.2 RATIONALE OF THE STUDY

The SSP, in partnership with private companies, has benefited households from 2260 VDCs in 73 districts of the country. The second phase of ESAP (2007-2012) seeks to provide subsidy through Rural Energy Fund to install more than 150,000 SHS units. This study is conducted in order to assess the socioeconomic impact of SHS on its users and the community. Furthermore, it will also be valuable in designing programmmes and policies in the future. In line with the practice AEPC/ESAP to conduct impact assessment analyses at regular interval, studies were also conducted in 1999 and 2003. The studies were instrumental in determining the various outcomes that are affected by SHS. However, the studies did not estimate the actual magnitude of the impact. With such a high pace of promotion of the PV technology for rural lighting and other end uses, it is right high time that the concerned authorities know the actual magnitude of the impact of SHS. This study is aimed at quantifying the actual magnitude of impact.

1.3 EVALUATION

This report presents the findings of the impact evaluation of the SSP. The aim of the evaluation was to investigate the socio-economic impact of the SHS disseminated under subsidy of AEPC/ESAP, to investigate the satisfaction level of SHS users, and to identify the possible end use of SHS other than for lighting. The source of the information was Household Interviews (His), Focus Group Discussion (FGD) and Key Informant Interview (KII). Based on the collected data, policy recommendations are made for improved performance of the program.

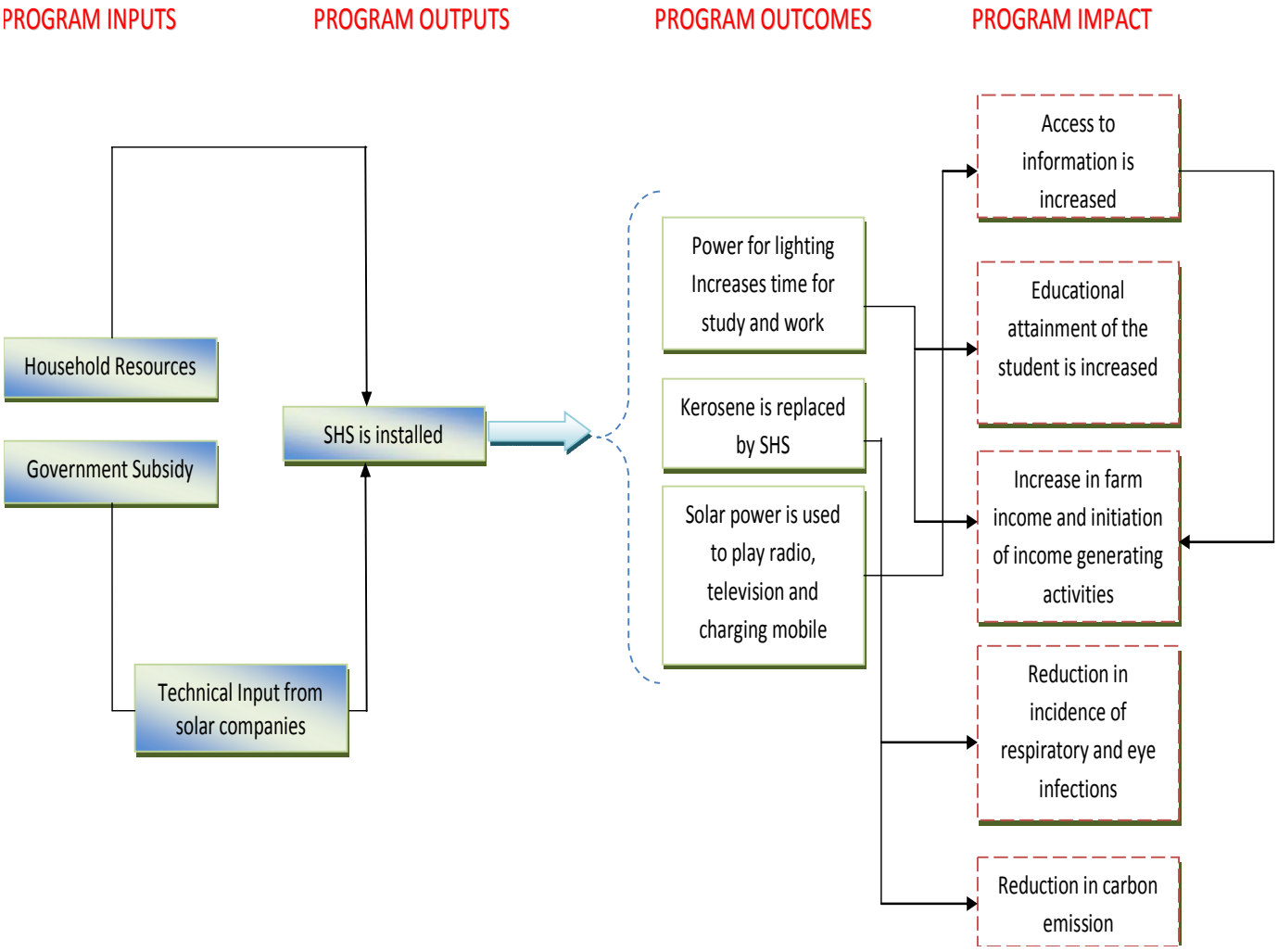
The research was carried out between November 2009 and February 2010 by Samuhik Abhiyan, a non-profit, non governmental social development organization from financial support from Energy Sector Assistance Program.

1.4 STRUCTURE OF THE REPORT

This report consists of five chapters. The first chapter gives a brief introduction to the solar power, its development, and its relevance in Nepal. The second chapter explains framework used for the evaluation. Third chapter describes sampling methodology and methodology for impact evaluation. Those not interested in the technical aspect of the study may skip this chapter. The fourth chapter presents the findings of the study. The fifth chapter provides main conclusions and recommendations of the study.

CHAPTER TWO: EVALUATION FRAMEWORK

Figure 1 Framework for the impact evaluation of Solar Home System



2.1. TO INVESTIGATE THE SOCIO-ECONOMIC IMPACT CAUSED BY SHS DISSEMINATED UNDER SUBSIDY OF AEPC/ESAP

One of the objectives of the evaluation is to investigate what effect SHS has had on socio-economic variables of households. A number of variables that could potentially be influenced by SHS are identified and appropriate survey instruments are designed to measure them. Such components and tools of measurement are discussed below.

2.1.1 Social Capital/Empowerment

Social capital is such an intangible concept that there is hardly any consensus on how to measure it. However, core elements of social capital have been identified and instruments have been proposed to measure and quantify it. The World Bank identifies six dimensions of social capital: groups and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion, and empowerment and political action (Grootaert, Narayan, Jones, and Woolcock 2004). Out of these six categories, solar home system is expected to have tangible impact on information and communication component through increased use of telecommunication devices (AEPC/DANIDA: 1999). In the current study, the impact of solar home system on sources and access to information, means of communication, and use of communication devices among SHS users is evaluated. The World Bank working paper is taken as a guide to select appropriate questions to capture the dimensions of social capital relevant to the study.

2.1.2 Livelihood

In Nepal, subsidy is provided to solar home systems in areas without electricity. In such areas, people derive their livelihood mainly from agriculture. Besides agriculture, people's source of income may be small business or sale of handicraft, all of which are labour intensive activities. In such context, SHS may increase the time available to work by allowing people to engage in economic activities even at night (AEPC/DANIDA: 1999). Previous study has concluded that perceived level of economic activity among male respondents increased after the installation of SHS (AEPC/DANIDA: 1999). In addition, SHS can increase household's access to information on variables like availability of agricultural credit, correct choice and use of pesticides and fertilizers, prices of agricultural products, etc. through channels discussed in the previous section. Such information may have an impact on the livelihood of households as it can increase agriculture production, households can receive higher price for their products, and income from household enterprise may increase.

It is evident from the above discussion that SHS can increase household's farm and non farm income. To quantify the impact on livelihood or poverty, user and non user households are compared on the basis of income generating activities (economic activities), income generated through agriculture (farm income) and income generating activities (non farm income). To estimate farm income, the questionnaire includes detailed questions on amount and price of agricultural products and the cost of production. Subsections on income and expenditure from sale of livestock and livestock products capture net income from livestock. Similarly, subsections on self employment, wage labor, and transfer income collect information on income from those sources. For the income section, the format of Nepal Living Standard Survey (NLSS), a national survey conducted by the Bureau of Statistics, is followed.

2.1.3 Decrease in Investment on Fuel

One of the strategies of the second phase of the SSP is to provide credit to rural households to purchase a solar home system. The strategy stems from the observation that households already spend a substantial sum of money every month on fuel for lighting in absence of solar home system. This study helps to quantify the average monthly expenditure on fuel for the purpose of lighting from the study of control group or non users of solar home system. The amount is the used to estimate the payback period of investment in solar home system.

2.1.4 Health

Along with smoke from firewood, burning kerosene for the purpose of lighting is a major contributor of indoor air pollution. Indoor air pollution could lead to serious health problems such as respiratory diseases and eye infection (TRUST: 2003). Installation of SHS reduces indoor air pollution by decreasing the use of kerosene, which may lead to reduced risk of respiratory problems and eye infections. To see the impact on health, the number of such cases reported among users and non users of SHS is compared. To investigate the severity of such health problems, the number of visits to health centers and use of medicine is also compared to see if it is significantly different among the two groups. SHS may also have indirect benefits on health through increase in access to information. Households with SHS may listen to radio, watch television, and watch educational videos more often which may bring about positive changes in their health choices. However, the current study is designed to measure only the direct benefits so this aspect of SHS is not reported.

2.1.5 Education

SHS may also have an impact on the education of children. With the availability of light, children can study till late night (AEPC/DANIDA: 2003), which may improve their performance in school.

Replacement of *jharro* by SHS will also make more time available for children to study because school aged children may have to spend less time collecting *jharro* in forest nearby. The impact on education is compared by comparing the dropout rates and examination scores of school age children among user and non user households of SHS.

2.1.6 Reduction in Carbon Emission

One of the reasons why solar power is growing in importance as alternative source of energy is because it does not emit carbon like fossil fuels. A more immediate impact of solar home system in the environment comes from its replacement of traditional sources of power for lighting like kerosene, candle, and *jharro*. Estimation of non user households' requirement of kerosene for the purpose of lighting gives us an idea of the contribution of SHS to the environment. The study estimates the amount of kerosene required for the purpose of lighting and secondary sources will be used to obtain information on how much carbon is emitted when a liter of kerosene is combusted. A simple multiplication then gives an estimate of the amount of carbon emission reduced due to the use of SHS.

2.1.7 Gender Perspective

SHS may have differential impact on males and females in the household. If SHS allows households to work longer hours, the burden of extra work may fall disproportionately on females. It is also interesting to know whether it was the household male or female who decided to install SHS in the first place. This study also asks questions related to household's perception on the benefits of SHS in focus group discussions and key informant interviews. From the interviews, opinion of males and females of a household towards SHS will be explored. It will also be relevant to find how the responsibility for repair and maintenance of SHS is distributed within the family. It is likely that males are more knowledgeable about the functioning of SHS and it is their duty to see to the repair and maintenance of the unit. This distribution of roles might shape the attitude and opinion towards SHS.

2.1.8 Security

Most crimes are conducted in the cover of darkness. Light from solar home system may prove to be a deterrent to criminal activities like theft and burglary. This section explores if SHS has had any impact on security by measuring the reduction in number of criminal activities. The focus is at the community level rather than the household level to answer this question because reduction in crime is likely to be felt at a scale larger than a single household.

2.2 TO INVESTIGATE THE SATISFACTION LEVEL OF SHS USERS

Besides the quantitative impacts of SHS, the study also investigates subjective evaluations of households on their experience of installing SHS. Households who decide to install SHS necessarily have some expectations from the system. To investigate the level of satisfaction of households, the respondents are asked if SHS met their expectations. Households might feel let down if they had high expectation of SHS before installation. The frequency of repair and maintenance of components of SHS is also asked because it could also reflect households' satisfaction level. If a household has had to repair its unit frequently, the household could be dissatisfied, or it could also signal household's satisfaction with the service because of their revealed willingness to repair the unit repeatedly. The study compares the expectation and performance of SHS and the amount spent in its repair and maintenance.

2.3 TO IDENTIFY THE POSSIBLE END USE OF SHS OTHER THAN FOR LIGHTING

The current focus of the solar energy program is to make solar home systems available to rural households for the purpose of lighting. However, solar power could be used for other purposes if rural households and institutions express interest in such uses. Various possible end uses of SHS is explored in this study. SHS can be used not only for lighting but also for other purposes including operating heavier home appliances, medical equipments in health centers, computers in schools, and so on. Previous studies will be used as guide in exploring alternative end use in two categories: consumptive end use and productive end use. Consumptive end use signifies use for consumption purposes, while productive end use

CHAPTER THREE: METHODOLOGY

The study is based on qualitative (FGD, KII or Group Interview) and quantitative (household survey) data. To explore the impact of SHS, the study relies mostly on quantitative data but the results are also verified from the findings of qualitative data. What follows is a detailed description of the objective of impact analysis, various methods available for analysis, and the choice of suitable method for the current study.

3.1 IMPACT ASSESSMENT

In previous sections, it was repeatedly mentioned that comparison will made between user and non user of SHS. In this section various methods of making comparison between two groups is discussed and the appropriate method for our study is chosen.

While conducting an impact study, the first task is to determine an outcome indicator. In the current study the outcomes of interest are social capital, livelihood, etc. which have been determined already. The next step is to determine whether the outcomes have changed significantly due to the introduction of a policy, subsidy or transfer of technology which, in this case, is the installation of SHS. To assess the impact of the policy on outcomes, outcome indicators between users (treatment group) and non users (control) of SHS have to be compared. This difference in outcome indicators between treatment and control group is called the treatment effect on treated or the impact of the treatment.

Various methods are available to make a comparison between two groups. A simple comparison of outcomes between the two groups gives some idea about the impact of the policy, but it is difficult to say if the difference in outcome is only due to the installation of SHS. This ambiguity can be illustrated by examining the demand for SHS. Even though SHS can be installed by any household of those areas in Nepal where electrification is not yet possible, there is something that determines a household's decision to install SHS. Even with subsidy, a SHS unit is unaffordable to many households, so it is reasonable to assume that only those households with relatively high income choose to install SHS. This is why the distribution of SHS is non-random and there is some bias in distribution of SHS. In economics literature, this is known as self selection bias because individuals and households self select to be in the treatment or control group. In this scenario, the outcomes on user households are likely to be better than on non user households even if the use households had not installed SHS. If a simple comparison of outcomes between treatment and control groups is made ignoring this bias, comparison

of two groups will be made in which one is better off than the other from the beginning. Whatever difference observed between users and non users will be an overestimate of the impact due to SHS alone. So, to make a valid comparison, first off all it is necessary to remove such bias. In other words, to know the impact of SHS, what would have happened without the SHS should be known. Various methods are available to remove or reduce such bias arising from simple comparison of treatment and control groups. Each of them is discussed below, and justification is provided for why propensity score matching is the best method in this context.

3.1.1 Construction of Counterfactual

Counterfactual is the answer to the question “what would have happened to a household without solar home system?” In essence, all impact evaluation studies are seeking to answer this question. Policymakers want to know what effect a particular policy has had on its recipients. But obviously observe both the factual and the counterfactual on the same household cannot be observed; a household either installs a system or it does not. Therefore, to assess the impact of solar home system, the best that can be done is find a non user household that is as similar to the user household as possible. A comparison of the outcomes between the two household can then be attributed as the impact of solar home system. In experimental studies where the distribution of policy is random, outcomes on non recipients of the policy is a valid counterfactual for policy recipients. However, when the policy uptake is not random, outcome on non users is not the valid counterfactual because non users differ from users systematically. Therefore other statistical methods must be used to construct a valid counterfactual.

3.1.2 Double Difference Method

In this method the outcome indicator between treatment and control group is compared twice. A comparison is made before the installation of solar and second comparison is made after the policy is implemented. Finally, the difference of the differences is calculated which gives the impact of the policy. To make the first comparison household information before the policy is implemented is needed. Since such baseline survey is not available in this context, so this method cannot be used for impact assessment.

3.1.3 Instrumental Variable

Instrumental variable method is another approach to correct for self selection bias. An instrumental variable is a variable that has an effect on the decision to install SHS but has no effect on

outcomes of interest. It is well known in impact evaluation literature that a suitable and valid instrumental variable is quite difficult to come about so the current study does not rely on this approach.

3.1.4 Propensity Score Matching

Under propensity score matching method, a user household is matched with a non user household with similar characteristics and difference in outcome is evaluated among the matched pair. For example, let us assume that education level of the household head is one of the factors that determine whether a household installs SHS. Under the matching method, a user household is matched with a non user household such that the education level of the household heads is the same. Then the difference in outcome between the user and the matched non user household is evaluated. This procedure is repeated for all households and finally, the mean of all the differences is computed to estimate the impact of the SHS. In this way, the bias arising from the education level of the household head is removed or lessened. Similarly, households can be matched in two dimensions. Let the occupation of the household head be another factor that affects a household's decision to install a SHS. Now a user household is match with a non user household such that the education and occupation of the household heads is the same. Once the procedure describe above is followed, we will have removed the bias in two dimensions. In this way, households can be matched in multiple dimensions and better estimate of the true impact of the treatment can be obtained.

However, it is inconvenient and often impossible to match households in multiple dimensions. Instead, households can be matched on propensity score, which is the probability of a household being a user. This probability can be generated for both user and non user households using logit procedure. Once propensity score for all households is calculated, a user household can be matched with a non user household with the same or the closest propensity score. The difference in outcome between each matched pair of observations can then be calculated and the average difference can be evaluated which is often referred as Average Treatment Effect on Treated (ATT) In this way, bias arising from multiple dimensions can be removed.

The factors that are likely to affect a household's decision to install SHS are income of the household, education level and age of the individual who decided to install SHS, ethnicity and household size. While calculating propensity scores, only those components of income must be chosen that are not affected by SHS. The study hypothesizes that SHS affects two components of income: agricultural productivity and income from household enterprise. These components cannot be used to calculate propensity scores because they are affected by SHS and thus the bias is not removed by

matching on these components. Information on these components is still collected to assess if SHS has had any impact on them. The components of income that are not likely to be affected by SHS are landholding size, type of roof or floor (cement, wood, mud, etc.), etc.

3.1.5 Matching Methods

After calculating propensity scores, a researcher has to choose the appropriate matching method. There are various ways to match propensity scores but the suitable method depends upon the nature of the data. Nearest neighbor matching method matches each treatment observation with the non treated observation whose score is closest to that of the treatment observation. A variant of this method is caliper matching where a treated individual is matched with all untreated individuals who fall within the range of a predefined caliper. These methods reduce bias because each treated individual receives a better match, but it increases the standard error of the estimate. Yet another method of matching is kernel matching where information from all untreated observations are used to construct a match for a treated observation. However, untreated observations that have scores similar to the treated observation receive more weight than those that are dissimilar. The exact weight on each observation depends on the distribution of the kernel and its variance.

3.2 SATISFACTION LEVEL AND END USES

To assess the satisfaction level simple descriptive statistics along with the FGD and KII is used. To explore possible end uses other than lighting, FGD and KII are relied upon, but to know what kinds of household appliances are being used and what appliances households would like to add, household survey is utilized. Involvement in any kind of enterprises which is based on SHS will also be explored through household survey.

3.3 BRIEF REVIEW OF LITERATURE

Propensity score matching is the cutting edge method used in impact evaluation. This method was first proposed by Rosenbaum and Rubin (1983) and has been widely used since. Dehejia and Wahba (2002) provide a neat theoretical explanation and empirical illustration of the technique. Numerous empirical studies have also used this methodology to estimate the impact of a policy. For example, propensity score matching method has been used to estimate the impact of labour market policies on employment and earnings (Bryson, Dorsett, and Purdon 2002), effectiveness of antipoverty programs (Jalan and Ravallion 2003), and the impact of subsidized health insurance on utilization of medical facilities (Portillo and Vernon 2005).

Propensity score matching method has previously been used in impact evaluation in Nepal as well. Jackson et al (2008) evaluate whether Safe Delivery Incentive Program (SDIP) increased health institutional delivery. Under the SDIP scheme, a mother receives cash for delivering in a health institution instead of home. The authors assess the impacts of SDIP by comparing outcomes between those who were aware of the SDIP during pregnancy (treated) and those who were not aware (control). This is based on the logical premise that the behavior of a woman could not have been affected by the SDIP if she was not aware of the cash incentive prior to childbirth. The results showed that a simple comparison between treatment and control gave higher proportion of women delivering in health institution but when propensity score was used the proportion was low. Therefore the result without propensity score matching was misleading as it was only a simple comparison without controlling for the bias.

In the current study, propensity score matching is used to assess the impact on following variables:

1. Social Capital/Access to information
2. Farm and Non Farm Income
3. Health
4. Change in Time Available for Work
5. Educational Performance

Other factors besides these have been explored through simple descriptive statistics obtained from qualitative portions of the survey. Volume of carbon reduction has been estimated through simple multiplication of average liters of kerosene used per month and amount of carbon released when a liter of kerosene is burned. Gender perspective have also been explored through the use of frequency count, graphs etc.

3.4 ANALYSIS OF QUALITATIVE INFORMATION

Focus group discussion and group interview of household members gives their perception on different issues (social capital, health, gender disparity, satisfaction level, etc). Content analysis of the qualitative data is used to obtain the main theme under each issue. In content analysis, data is categorized under topic headings and all responses related to each topic are kept under the topic heading. Finally the main theme emerging from the data is agreed upon. To increase the credibility of information obtained from qualitative section of the interview, results of the quantitative methods will be triangulated with the theme of qualitative data.

Table 1 Summary of data and analysis

OBJECTIVE	HYPOTHESIS	METHOD OF ANALYSIS	DATA SOURCE
Social Capital/ Empowerment	Access to information has increased	Propensity Score Matching Thematic	Household Survey FGD and KII
Livelihood	Economic activities has increased Income has increased Poverty has decreased	Propensity Score Matching Thematic	Household Survey FGD and KII
Health	Incidence of respiratory and eye infection has decreased	Propensity Score Matching Thematic	Household Survey FGD and KII
Education	School age children perform better in school School dropout rate has decreased	Propensity Score Matching Thematic	Household Survey FGD and KII
Time	Working hour has increased	Propensity Score Matching Thematic	Household Survey FGD and KII
Security	Crime has decreased	Thematic	FGD and KII
Environment	Less carbon emission	Descriptive	Household Survey
Gender		Descriptive	Household Survey
Satisfaction level of SHS users	Solar home system has met users' expectation Households are active in repair and maintenance of SHS	Descriptive Thematic	Household Survey FGD and KII
Identifying possible end use		Descriptive Thematic	Household Survey FGD and KII

3.5 SAMPLING METHOD

3.5.1 Sample Districts

Ten districts are selected purposively for the study keeping three factors in mind: ecological belts, development regions and level of subsidy. Sixty six percent of SHS was installed in hilly districts, twenty seven in mountain and only seven in Terai. Therefore the sample consists of seven districts from hill (70% of sample), two from mountain (20% of sample) and one from Terai (10% of sample). Similarly, thirty three percent of SHS was installed in Western Development Region, twenty four percent in Mid Western, twenty one percent in Eastern, fifteen percent in Central and seven percent in Far Western. The sample reflects this distribution as well: three districts are from Western Region (30% of sample), two each from Eastern, Central, and Mid Western (20% each) and one from Far Western Development Regions were selected (10% each).

According to data from AEPC/ESAP, in fifty three districts, all VDCs are categorized as "accessible" while in six districts, all VDCs are categorized as "highly remote". In the remaining sixteen districts, VDCs are of mixed categories. To represent this distribution, the sample contains six districts where all VDCs are "accessible," one district with where all VDCs are "very remote," and three districts with mixture of highly remote, accessible and remote VDCs. The list of sample districts can be seen in Table 2.

Table 2 Sample Districts

S.N	Name of the District	Development Region	Ecological Belt	Subsidy category
1	Achham	Far-Western	Hill	53%-A, 11%-B & 36 %-C
2	Chitwan	Central	Terai	100 % C
3	Gulmi	Western	Hill	100 % C
4	Humla	Mid-Western	Mountain	100 % A
5	Ilam	Eastern	Hill	100 % C
6	Kavre	Central	Hill	100% C
7	Lamjung	Western	Hill	100% C
8	Myagdi	Western	Hill	100% C
9	Rukum	Mid-Western	Hill	63%-A & 37-% B
10	Taplejung	Eastern	Mountain	8%-A, 4 %-B & 88%-C

3.5.2 Sample Size for Users (Treatment)

Population=78472 (Number of SHS installed until 2063/64).

Assumed Proportion=0.250

Level of acceptable error=0.028

Level of significance=0.05

On the basis of above information, the required sample size is 909. However, due to time and resource constraints, sample size of users was reduced to 800.

3.5.3 Sample Size for Non-User (Control)

For the propensity score matching method to yield valid and credible results, sample size of non users should be as high as possible so that good matches for users can be found. For example, in the study by Dehejia and Wahba (2001), the authors use almost 16000 control observations to match 185 treatment subjects. However, owing to time and resource constraints, it was decided to interview user and non user households in a ratio of 1:3. This ratio was thought to be reasonable because the SDIP study by Jackson et al. (2008) also collected information on treatment and control group in a 1:3 ratio. Therefore, 2400 non user households are sampled, 48 from each ward.

3.5.4 Identification of the Sample

The sample for the survey was based on two-stage sampling method of households. In the first stage, 5 primary sampling units (PSUs) in each district were selected using probabilities proportional to size method. In the study, wards are taken to be the primary sampling unit. In the second stage, households within each selected PSU were selected using systematic sampling method.

3.5.5 Primary Sampling Unit

As mentioned earlier a probability proportional to size method was applied to select the PSU. In this method SHS users were listed according to ward for each VDC of every district. The data provided by ESAP/AEPC was used to construct the list. To allow for SHS to have a tangible impact, the list include only those households that have been using SHS for 3 years or more. So from the data sets only those households were selected that had installed SHS before the end of year 2006.

Once the households were listed, a cumulative frequency of number of SHS installed in each ward was calculated. Cumulative frequency was then divided by 5 (number of PSUs). This gives the sample interval (SI). A random number was generated in Excel to determine the random start (RS). The PSUs corresponding to the random start value then becomes the first sample. The second sample is

the PSU corresponding to the random start value plus the sample interval (RS + SI); the third sample is the PSU corresponding to the random start value plus twice the sample interval (RS + 2 SI). In this manner, five PSUs from each district were selected. Since the PSUs are listed according to the cumulative frequency of SHS users, PSUs with higher number of user are more likely to be sampled under this methodology.

16 user households were interviewed from each PSU. In some cases, there were less than 16 user households in a ward. In such cases, more than 1 ward was combined to construct a PSU. In yet other cases, two VDCs had to be combined to have sufficient sample. Please refer the Annex for detailed information on the selection of PSU.

3.5.6 Sample Households (Treatment Group)

Once PSUs are determined, sampling is done to select the user households. Systematic sampling was conducted in the second stage using the same data set. In this sampling technique interval (n) is determined by dividing the total number of SHS installed in a PSU by number of the number of required samples (16). Random number was generated in Excel to select the first sample while subsequent sample was the households that corresponded to every nth interval. It should be noted that households that installed SHS after 2006 were excluded from this group. For the households selected in treatment group, the name and address of the SHS owner was provided to the enumerators and they were instructed to make a visit in the household for interview.

3.5.7 Sample Households (Control Group)

For households in control group it was impossible to determine the sample in Kathmandu. However, some general instruction was provided to all enumerators. As per our methodology, three non users had to be interviewed for each user. Non user households are those households that are not connected to national grid, do not have a generator, are not connected to micro hydro, or do not have any other source of power. Households that installed SHS after 2006 are also not regarded as control households. To maintain randomness, enumerators were instructed to find three non user households in three different directions to a user household.

3.5.8 Sample Size for FGD & Group Interviews

One focus group discussion in each district was conducted. Participants of FGD were school teachers, health personnel, security personnel, representative from VDC office, solar user group representatives (if any), user and nonuser of SHS, etc. Similarly, two or three group interviews or key

informant interview (KII) in each district was conducted. Participants of group interview included household head and few other family members.

3.5.9 Development of survey tools

Study is based on both quantitative and qualitative methods. A structured questionnaire was developed for household survey and checklist for group interview and focus group discussion. Structured questionnaire for household survey was developed in English and translated into Nepali. It contained the following sections

- Household member's information: Demographic information of the household members (name, sex, age, marital status, level of education).
- Health and education information: Educational attainment of the members between the ages of five and twenty; information on incidence of respiratory problems and eye infection.
- Access to information: Household's ownership of different kinds of appliances (radio, television, mobile phone, fixed line phone, VCD or DVD player), frequency of listening to radio or watching television, availability of telephone, use of telephone, newspaper readership etc.
- Household characteristics: Socio economic information of the household (religion, caste, type of fuel for cooking, use of improved stove, type of floor, type of roof, number of rooms in dwelling, landholding, livestock holding)
- Income: Farm income, wage income, income from own business and transfer income
- Information about solar some system (for users only): capacity of the system, usage pattern, installation details, loan on installation
- Satisfaction level (for users only): expectation from solar home system, repair, additional end uses, overall satisfaction level
- Source of lighting for non user (for non users only): Source of power for lighting, availability of the source, uses of light, possible adoption of other sources of power.

3.5.10 Data Entry and Statistical Analysis

Data was entered using CSPRO 3.3. This software enabled the creation of a data entry format which is exactly similar to the questionnaire where skips and add value sets could be maintained. This helped in reducing data entry errors. Statistical analysis was conducted in STATA 10.

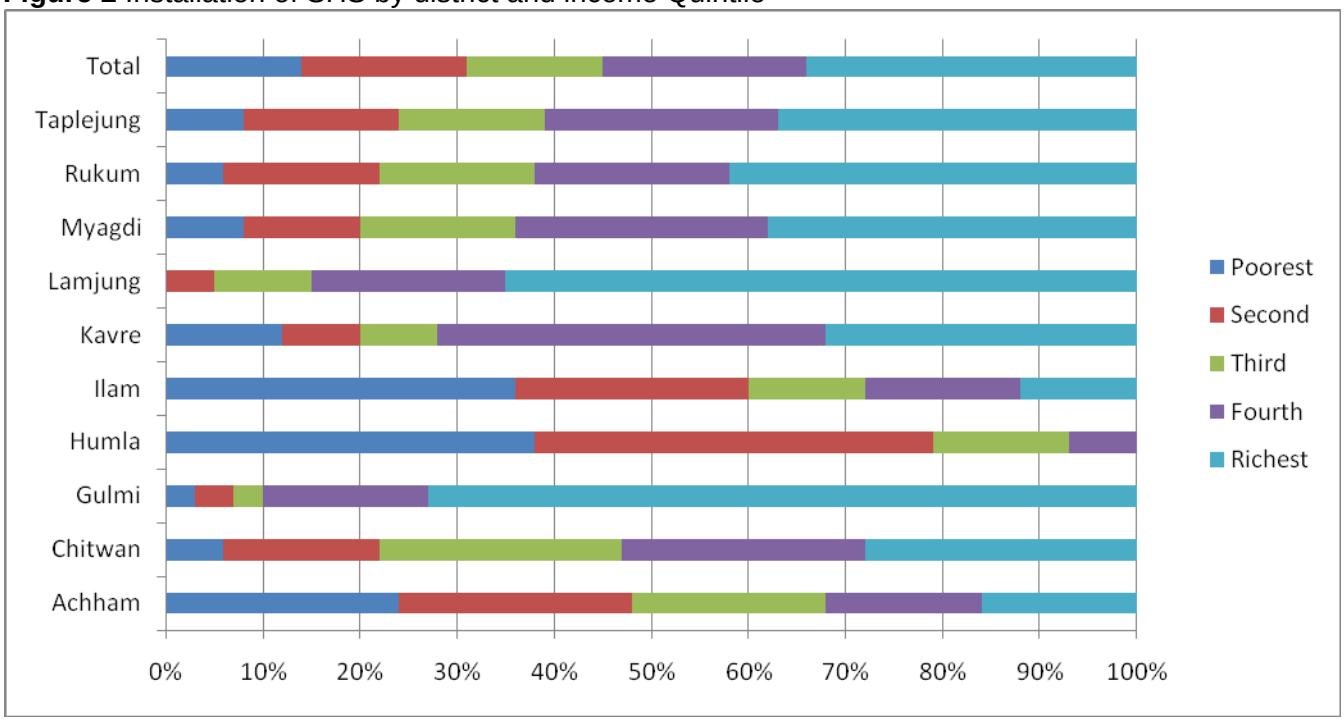
CHAPTER FOUR: FINDINGS

4.1 IMPACT OF SOLAR HOME SYSTEM

A total of 3196 sample was collected from 10 districts, out of which 799 are users of solar home system and remaining 2397 are non users. In each district, 80 users and 240 non users were supposed to be interviewed from five randomly selected clusters. This condition was satisfied in all but two districts – Rukum and Taplejung. For some reason, enumerators in Rukum interviewed only 79 users and 238 non users whereas in Taplejung 239 non users were interviewed. Since one user and three non users could not be interviewed, the 1:3 ratio between users and non users is still maintained.

Figure 2 gives a snapshot of the distribution of SHS installation by district and total income quintile. The distribution of SHS is about evenly distributed in Achham and Ilam among all income quintiles. Distribution is well targeted among the poorest in Humla with 79 percent of SHS installed in households in the poorest two quintiles. SHS usage is skewed in favor of the rich in Gulmi, Kavre, Lamjung, Myagdi, Rukum, and Taplegunj. 90, 72, 85, 64, 62, and 61 percent of SHS is installed by households in the richest two quintiles in those districts respectively. In aggregate, SHS usage by the poorest is satisfactory as 14 and 17 percent of SHS is installed by households in the poorest and the second poorest quintiles respectively.

Figure 2 Installation of SHS by district and income Quintile



4.1.1 Factors Affecting the Installation of Solar Home System

The purpose of using matching method is to reduce any bias due to self selection into the program. Since investment in SHS is substantial even with government subsidy, households with higher farm income and larger landholding are more likely to install a system. It is also plausible that households that have better access to information or with relatively better educated household heads are more likely to install SHS. Here we explore if there is any significant difference in household characteristics between SHS treated and untreated.

Table 3 Household characteristics

	SHS Treated	SHS non Treated	Statistical Significance
Average Landholding Size (ropani)	15.91	8.65	Significantly different at less than 1% level
Average Annual Income (Rupees)	1,13,222	54,847	Significantly different at less than 1%
Average Newspaper Readership (times per month)	4.74	2.04	Significantly different at less than 1%

Source: Survey, 2009

As expected, Table 3 shows that treated and untreated households are significantly different from each other in terms of wealth, income, and access to information or level of awareness.

Table 4 Education of household head

	SHS treated (%)	SHS non treated (%)
Primary or Some Primary (1-5)	42.30	59.01
Secondary or Some Secondary (6-10)	30.54	18.47
Above Secondary (>10)	9.26	2.55
Informal Education	15.14	14.63
Don't Know	2.75	5.18

Source: Survey, 2009

The profile of education for household head reveals that household heads that are relatively more educated are more likely to install SHS. Table 4 shows that non user household heads have relatively less years of education than user household heads.

Table 5 Occupation of household head

	SHS treated	SHS non treated
Agriculture	76.35%	85.65%
Government Service or Other Salaried Job	10.76%	1.92%
Self Employment	6.51%	2.46%
Daily Laborer	0.88%	5.67%

Foreign Employment	1.25%	1.13%
Unemployed	1.25%	1.38%
Other	2.88%	1.67%

Source: Survey, 2009

The profile of household head's occupation is yet another dimension where user and non-user households differ from each other significantly. While 85 percent of household heads among non-users are involved in agriculture, the figure among users is 75 percent. On the other hand, almost 11 percent of household heads among users are employed in government service or other salaried jobs whereas only 2 percent of household heads among non-users are employed in this sector. These observations justify the choice of the methodology employed in the study. A simple comparison of outcomes between user and non-user households would yield biased result in presence of such pre-existing differences.

The first step for propensity score matching method is to construct propensity scores for the sample. Propensity score is the probability that a household is a user of SHS. To construct the scores, standard logistic regression is run with variables like development region, ecological belt, ethnicity, religion, type of roof and floor of dwelling, education and occupation of household head, household size, landholding size, and household's access to information as proxied by newspaper readership. The complete list of variables can be found in Table 4.

As can be seen in Table 6, coefficients on a number of variables are statistically significant. SHS users are likely to read newspaper significantly more than non-users and household heads among users are likely to have more years of education than non-users. These are largely expected results because households that read newspaper more often and have better education household heads have better access to information and are probably more confident in dealing with bureaucratic procedures to procure subsidy. Households with larger family size and number of rooms in their dwelling are also more likely to install SHS probably because the variables are positively correlated to income. Not surprisingly, households that own more land and receive remittance income are more likely to be SHS users. Religion does not predict SHS usage, but *dalits* are less likely to install a system. The probability that households using firewood for fuel have SHS is less than the probability for households using other sources of fuel like kerosene, LPG. The same is true of households that have improved cooking stove relative to households without. What is somewhat puzzling is households in western and mid-western regions are less likely than households in central region to install SHS, but households in far western region are more likely than central region households. On the other hand, as expected, households in hill and mountain districts are more likely than households in Terai to have SHS probably because

areas in Terai are better connected to the national grid. Occupation of household head is also significant in explaining SHS usage. If a household head is employed in government service or other salaried jobs, or if he or she is self-employed, the household is more likely to take advantage of the subsidy program. These results further support the expectation that user and non-user households are not identical and justify the methodology.

Table 6 Logit results for determinants of solar home system

Variables	Coef	Z
Socio Economic Status: Proxy for income		
Number of person in household	0.111	1.97
Total land	0.008	3.48
Number of livestock	0.001	0.33
Remittance income in last year	0.440	3.47
Uses firewood for cooking	-1.256	-4.83
Uses improved cooking gas	0.601	4.29
Has simple floor in the dwelling	-0.658	-2.12
Has advanced floor in the dwelling	1.305	4.68
Has simple roof in the dwelling	1.257	3.18
Has advanced roof in the dwelling	1.503	8.50
Has natural roof in the dwelling	1.018	3.18
Number of rooms in the dwelling	0.288	8.63
Awareness		
Newspaper readership (per month)	0.013	1.97
HH head has completed primary education	0.170	0.61
HH head has completed secondary education	0.730	2.58
HH head has completed above secondary education	1.076	3.20
HH head has some informal education	0.410	1.43
HH head woks in agriculture sector	0.186	0.39
HH head has salaried job	1.583	3.04
HH is self employed	1.267	2.38
HH is daily wage earner	-0.807	-1.28
HH is unemployed	0.273	0.44
HH is has some other occupation	0.372	0.65
Development Region		
Eastern	-0.412	-1.67
Western	-0.522	-2.41
Mid western	-0.973	-3.69
Far western	0.967	3.03
Ecological Belt		
Hill	0.664	2.19
Mountain	1.061	2.99
Others		
Distance to nearest electrified village	5.79	0.02
Nearest village was electrified less than 3 years ago	0.401	1.72
Nearest village was electrified 3 to 5 years	0.770	2.96
Nearest village was electrified more than 5 years ago	0.440	3.47
Ethnicity		
Upper caste (Brahmin, chettri, thakuri)	-0.167	-0.52

Janajati	0.180	0.58
Dalit	-0.851	-2.30
Religion		
Hindu	0.291	0.34
Buddhist	0.368	0.42
Kirati	-0.123	-0.14
Other religion	1.385	1.26
Constant	-4.616	-4.12
Pseudo R^2	0.224	
Number of Observations	3196	

4.1.2 Impact on Access to Information

Table 7 provides estimates of the impact of SHS on various indicators of access to information. The table reports the outcomes among SHS treated and untreated and differences without matching and differences after matching with kernel weights.

The difference without matching overestimates the impact of SHS on ownership of radio, and mobile phone but when matched with kernel weights the biased is reduced but the impact is still significant. SHS is likely to increase the ownership of radio and mobile phone by 8 and 25 percent respectively against 17 and 41 percent without matching. There is not much difference in ownership of television and VCD/DVD player before and after matching. The reason for this could be the very few matching sample as only 9 and 2 households in control group reported the ownership of television and VCD/DVD respectively. This indicates that television and DVD/VDC player are owned mostly by the user of SHS and this doesn't require the matching with propensity score. Even simple comparison gives the estimate of the impact of SHS.

Similarly, SHS has positive and significant impact on other indicators of access to information. Households with SHS are 9 percent more likely to listen to the radio daily and are likely to make 30 more telephones calls per month. SHS is likely to increase the access to information compared to 5 years back by 5 percent. The proportion of SHS users who report radio and television as their primary source of information is 10 percent higher than non users. SHS has also had a positive impact on daily television watching habit but this figure is not much different from the figure without matching as we have the information on only 23 households in control group reporting daily television watching habit.

Looking at impact estimates of SHS on access to information, it is evident that SHS has had an important role in increasing access to information for rural households where there is no regular supply of electricity. This certainly helps in the empowerment of the rural people.

Table 7 **Estimates of impact of SHS on access to information**

Outcome	Outcome among SHS treated	Outcome among SHS untreated	Differences without matching	Differences with matching using kernel weights	
Ownership of	Coeff	Coeff	Coeff	Coeff	t-stat*
Radio	0.901	0.725	0.175	0.082	3.34
Television	0.390	0.003	0.387	0.386	22.03
Mobile phone	0.651	0.236	0.415	0.255	9.41
VCD/DVD	0.093	0.0008	0.093	0.091	8.75
Daily radio listening habit	0.887	0.696	0.191	0.093	3.68
Daily TV watching habit	0.250	0.009	0.240	0.237	14.75
No of phone calls made per month	53.41	12.77	40.64	29.98	6.21
Radio or television as first source of information about major events	0.856	0.711	0.144	0.103	4.03
Access to information has increased	0.954	0.877	0.077	0.059	3.33

*t-stat > 1.96 is significant at 5 percent level of significance

Table 8 breaks down the estimates of the impact of SHS on access to information according to the size of the panel. The result indicates that a unit of 18 watt or less has very little impact on access to information. Coefficients on all variables except for television are insignificant. Access to information for the households using SHS with less than 18 watt panel has not increased. But for the households with 19 to 50 watt panel, access to information has increased and all the coefficients are significant and magnitude of the impact is higher compared to the households with less than 18 watt panel. Similarly for households with more than 50 watt panel the impact is even large and coefficients are significant. For example, number of phone calls made per month is -2, 33 and 49 for SHS with less than 18, 19 to 50 and more than 50 watt panels respectively. Likewise ownership of radio is likely to increase by 3 percent for households with less than 18 watt panel but it is likely to increase by 8.7 percent for households with 19 to 50 watt panel and by 9.7 percent for households with more than 50 watt panel respectively. Ownership of mobile phone is also likely to increase by just 1.9 percent for households using less than 18 watt panel but this figures goes up to 27.7 and 44.4 percent for households with 19 to 50 and more than 50 watt panel respectively. Interestingly, the proportion of household reporting that the access to information has increased compared to before the installation of SHS is negative though not significant for households with less than 18 watt panel. However, the proportion of households who report that their access to information has increased is 7.3 and 10.4 percent more than non user households among users of 19 to 50 watt panel and more than 50 watt panel respectively.

Table 8 Estimates of impact of SHS on access to information by panel size

Panel Size	Outcome	Outcome among SHS treated	Outcome among SHS untreated	Differences without matching	Differences with matching using kernel weights	
	Ownership of	**Coeff**	**Coeff**	**Coeff**	**Coeff**	**t-stat***
	Radio	0.796	0.725	0.071	0.030	0.79
	Television	0.048	0.003	0.045	0.044	2.26
	Mobile phone	0.341	0.236	0.105	0.019	0.43
	VCD/DVD	0.008	0.0008	0.007	0.006	0.80
	Daily radio listening habit	0.756	0.696	0.059	0.015	0.37
<18	Daily TV watching habit	0.105	0.009	0.096	0.092	3.30
N=123	No of phone calls made per month	16	12	4	-2	-0.49
	Radio or television as first source of information about major events	0.674	0.711	-0.036	-0.066	-1.51
	Access to information has increased	0.861	0.877	-0.015	-0.027	-0.86
	Radio	0.909	0.725	0.183	0.087	3.46
	Television	0.420	0.003	0.416	0.416	19.96
	Mobile phone	0.680	0.236	0.444	0.277	9.67
	VCD/DVD	0.097	0.0008	0.096	0.094	7.60
	Daily radio listening habit	0.904	0.696	0.208	0.106	4.13
19 to 50	Daily TV watching habit	0.270	0.009	0.260	0.256	13.39
N=606	No of phone calls made per month	57	13	44	33	5.34
	Radio or television as first source of information about major events	0.878	0.711	0.166	0.120	4.60
	Access to information has increased	0.968	0.877	0.091	0.073	4.15
	Radio	0.971	0.725	0.246	0.097	1.98
	Television	0.628	0.003	0.624	0.624	10.67
	Mobile phone	0.885	0.236	0.649	0.444	7.50
	VCD/DVD	0.242	0.000	0.242	0.239	4.63
	Daily radio listening habit	0.957	0.696	0.260	0.108	2.08
>50	Daily TV watching habit	0.3	0.009	0.290	0.290	5.16
N=70	No of phone calls made per month	78	13	65	49	4.09
	Radio or television as first source of information about major events	0.942	0.711	0.231	0.212	3.96
	Access to information has increased	1	0.877	0.122	0.104	3.22

*t-stat > 1.96 is significant at 5 percent level of significance

4.1.3 Impact on Education

Table 9 presents estimates of the impact of SHS in educational attainment. Average percent secured by students is likely to increase by 2 percent when matched by propensity score, against the 3 percent without matching. The probability of students passing the exam with SHS is five percent higher. School dropout rate has also been affected by SHS; students with SHS are 2 percent less likely to drop out from school.

This subtle increase in percentage secured by the students in treated group can be attributed to the additional time they spend studying. Average study time per day is 15 minutes higher for children in treated households compared to children in non user households, which represents a 16 percent increase. This should be enough to justify the 2 more percent secured by students in the treated group. This is also true for the 5 percent increase in transition rate and 2 percent decrease in dropout rate among students in the treated group. Impact on average percent secured, passing rates and school dropout rates are all statistically significant which suggests that SHS has had positive impact on education of children aged between 5 and 20 years.

Table 9 Estimates of impact on education

Outcomes	Outcome among SHS treated	Outcome among SHS untreated	Differences without matching	Differences with matching using kernel weights	
	Coeff	Coeff	Coeff	Coeff	t-stat*
Average percentage secured by the students	51.20	47.57	3.626	2.208	3.98
Passing rates	0.827	0.777	0.054	0.051	2.66
School dropout rates	0.053	0.097	-0.045	-0.026	-2.03
Average study time of the student (In minutes)	118.983	95.361	23.621	15.553	6.47

*the absolute value of t-stat greater than 1.96 is significant at 5 percent level of significance

Table 10 breaks down the impact of SHS on educational performance by age group. Average percent secured by students aged 6 to 10 and 11 to 15 are likely to increase by 2.99 and 2.49 percent respectively. The increase in percent is not statistically significant for students between the ages of 16 and 20. Though the impact of SHS on dropout rate is negative for all 3 age groups, the coefficient is not statistically significant. This indicates that SHS has no impact on dropout rate of the students on various age groups. .Average study time is higher for students between 11 to 15 and 16 to 20 years old. As expected, students in higher grades spend more time studying than students in lower grades. The

coefficient on average working time is not significant for all age groups. However, the sign is positive for 6 to 10 age group and negative for 11 to 20 age group.

Table 10 Estimates of impact on education by age group

Outcome		Outcome among SHS treated	Outcome among SHS untreated	Differences without matching	Differences with matching using kernel weights	
	Age group	Coeff	Coeff	Coeff	Coeff	t-stat*
Average percentage secured by students	6-10	51.946	47.059	4.886	2.991	2.59
	11-15	50.987	47.202	3.785	2.499	2.83
	16-20	50.183	47.524	2.659	1.132	1.16
School dropout rates	6-10	0.005	0.033	-0.028	-0.018	-1.37
	11-15	0.018	0.0489	-0.301	-0.016	-1.15
	16-20	0.152	0.265	-0.112	-0.060	-1.55
Average study time of the student (In minutes)	6-10	103	84	18	11	3
	11-15	126	99	26	18	5.19
	16-20	136	112	24	18	3.82
Working time	6-10	101.11	101.82	-0.706	3.723	0.48
	11-15	102	108	-5	-7	-1.15
	16-20	111	109	1.97	-7	-0.86

*the absolute value of t-stat greater than 1.96 is significant at 5 percent level of significance

Table 11 presents the impact of SHS on educational attainment of male and female students separately. With SHS, male students are likely to secure more percent than female. Male students in user households are likely to secure 2.5 more percent compared to male students in non user households. Similarly, female students in user households score 1.8 more percent than female students in non user households. Both these figures are statistically significant. Females in user households are 6 percent more likely to pass an exam than females in non user households, but no such effect can be seen among males. On the other hand, there is no impact on school dropout rate for females but males in user households are 4 percent less likely to drop than males in non user households. Average study time is 18 and 15 minutes higher for males and females respectively in user households and the coefficients are statistically significant. There is no significant difference in working time for both male and female students in user and non user households.

Table 11 Estimates of impact on education by gender

Outcome	Gender	Outcome among SHS treated Coeff	Outcome among SHS untreated Coeff	Differences without matching Coeff	Differences with matching using kernel weights Coeff	t-stat*
Average percentage secured by the students.	Male	51.856	47.735	4.121	2.596	3.14
	Female	50.620	47.387	3.232	1.887	2.49
Passing rates	Male	0.819	0.784	0.034	0.027	1.00
	Female	0.834	0.768	0.066	0.064	2.39
School dropout rates	Male	0.033	0.099	-0.658	-0.044	-2.51
	Female	0.070	0.096	-0.026	-0.010	-0.59
Average study time	Male	121.132	96.137	24.994	17.817	5.15
	Female	116.702	94.170	22.53	14.941	4.64
Average work time	Male	89.329	99.976	-10.647	-1.537	-0.26
	Female	115.523	112.728	2.795	4.758	0.77

*the absolute value of t-stat greater than 1.96 is significant at 5 percent level of significance

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4.1.4 Impact on Health

Table 12 presents impact of SHS on health outcomes. There is no discernible impact of SHS on health outcome of household members. Since smoke from firewood is the major source of indoor air pollution, we also estimated the health impact of SHS for households with and without improved cooking stove. When a separate comparison was done for household with and without improved stove the result is opposite to our expectation. Those household using improved stove are likely to suffer more from diseases by the installation of SHS while households without improved stove gas are less likely to suffer.

Table 12 Estimates of impact on health

Outcome	Improved stove	Outcome among SHS treated Coeff	Outcome among SHS untreated Coeff	Differences without matching Coeff	Differences with matching using kernel weights Coeff	t-stat*
Reduction in health problems	Both	0.355	0.358	-0.002	0.022	0.77
	YES	0.394	0.302	0.092	0.126	2.27
	NO	0.345	0.364	-0.187	0.002	0.09

*the absolute value of t-stat greater than 1.96 is significant at 5 percent level of significance

4.1.5 Impact on Income and Income Generating Activities

Table 13 presents results on impact of SHS on income and other income generating activities. SHS is likely to increase the probability of initiating own business by 3 percent. Difference without matching suggests 8 percent more probability, but after controlling the bias the figure reduces to 3

percent. This is also in line with the observation that 19 households initiated own business after installation of SHS. The activities mainly included small retail shop and tea shops (See Annex for detail). Monthly income from small business is NRs. 1,533 higher for households with SHS, which is more than 60 percent higher than the average income from small business for non users of SHS. The impact of SHS in farm income is not statistically significant. The increased incidence of income generating activities and income from such activities among the users of SHS can probably be attributed to the increase in access to information; better informed households are more likely to start the business and also earn more from it.

Table 13 Estimates of impact on income

Outcome	Outcome among SHS treated	Outcome among SHS untreated	Differences without matching	Differences with matching using kernel weights	
	Coeff	Coeff	Coeff	Coeff	t-stat*
Initiation of own business	0.163	0.077	0.086	0.039	2.10
Income from own business	4972	2476	2495	1533	1.97
Farm Income (agriculture and livestock)	34,468	22,278	12,189	3,821	1.92

*the absolute value of t-stat greater than 1.96 is significant at 5 percent level of significance

Farm income includes the money value of total agriculture production the household had in last one year, including self consumption and net income from the trade of livestock and income through the sale of livestock products (please refer to the annex for detail). Average farm income for the sample is NRs. 25,287 per year. This figure compares well with the average farm income obtained in the second round of Nepal Living Standard Survey (NLSS II) where the average farm income was NRs. 38,453 for total sample and NRs. 35,808 for rural households it was NRs. 35,808. Since the current survey was concentrated mainly in rural area the result is compared with the average farm income of rural areas. Still the difference between the figure the current survey and that of NLSS II is NRs. 13,166. This difference could be due to the omission of four items in this study but which were included in NLSS under farm income. The four components are the value of by-products, net income from renting farm assets (draft animals, tractor, etc), value of home produced non crop consumption, and total cash or kind received from tenants on land leased out.

4.1.6 Discussion

An issue arising from the analysis is the observation that SHS has had no positive impact on health outcomes. One possible reason for this is that the major source of indoor air pollution is smoke

from firewood, and the reduction in smoke due to SHS is not significant to improve the health outcomes of household members. The current survey focused on estimating the direct and immediate health benefits of SHS. It is possible that due to increase in access to information, households may have made better health choices, invested more in health capital, adopted better sanitation practice, may have taken preventive measures, or their use of health facilities may have increased. Since the interviews were not designed to capture these dimensions of health benefits, the indirect health benefits of SHS cannot be estimated.

It is noteworthy that solar home system has had positive impact on income from own business but has had no effect on farm income. This is very plausible result because many unpredictable variables affect farm income like weather, rainfall pattern, etc. On the other hand, it is likely that SHS has helped to increase income from own business because now shops can be opened until late and households can work even at night.

4.1.7 Replacement of Alternative Sources of Fuel for Lighting

It is also instructive to measure the impact of SHS on household's monthly expenditure. Although installation of solar home system entails a one-time lump sum cost, it reduces household's monthly expenses by reducing its expenditure on alternative sources of fuel for lighting. Non users were asked what fuel they are currently using for the purpose of lighting. 57.9 percent of non users of SHS burn kerosene, 31.4 percent of use battery, and 13.4 percent use *jharro* for the purpose of lighting. Table 14 gives the information by district. Most of the kerosene users live in Ilam, Lamgunj, Kavre, and Myagdi. On the other hand, *jharro* users are concentrated in remote districts of Humla, Achham, and Rukum. Residents in Achham and Rukum also tend to be frequent battery users while there are no battery users in Humla.

Table 14 Source of energy other than SHS by district

District	Source of energy other than SHS		
	Kerosene	*Jharro*	Battery
	%	%	%
Achham	0.29	13	25.82
Chitwan	10.79	0	11.59
Gulmi	13.45	3.41	16.47
Humla	0.22	71.52	0
Ilam	16.98	0	0.53
Kavre	13.81	0	6.19
Lamjung	15.25	0	3.82
Myagdi	13.53	0.62	6.59
Rukum	1.44	11.46	23.58
Taplejung	14.24	0	5.40

Source: Survey, 2009

Average kerosene consumption is 0.66 liters per week and average weekly expenditure on kerosene is NRs. 47. This implies that average monthly expenditure on kerosene is NRs. 188. Previous study (TRUST: 2003) reported average monthly expenditure on kerosene to be NRs. 124. This increase is reasonable as the price of kerosene has increased from 2003 to 2009.

This information allows as estimate of the payback period of solar home system. With monthly expenditure of NRs. 188 on kerosene, an average household spends NRs. 2,256 per year on kerosene. The average cost of installation is NRs. 24,459. This implies the average payback period of SHS is about eleven years.

4.2 IMPACT OF SHS: FINDINGS FROM QUALITATIVE INFORMATION

4.2.1 Increase in Study Time and Completion of Homework on Time

Most of the respondents felt that after installation of SHS, study hours for their children increased and the children were more keen and interested in doing their homework. It was also revealed from focus group discussions (FGDs) in schools that students from households with SHS do their homework more regularly compared to students from non user households. Children from user households are also neater and cleaner when they come to school. Explaining the importance of SHS, Pratap Sing Bista the principal of Ambika Secondary school in Kalikasthan VDC in Achham said:

"Average passing rate is 5 to 6 percent higher among students who have SHS in their home in comparison to those who don't have SHS, with some exception. Students who don't have SHS don't do their homework regularly and when asked why, they say that there is no facility of lighting in their home. On the other hand, students with SHS in their home are regular with their homework".

Describing the impact of solar home system on education, FGD participants of Saraswoti Primary School in Puwakhola VDC in Taplejung say

"There is an intimate relation between solar and education."

In some parts of the country, SHS has played an instrumental role to run informal education classes. Women in rural areas are unable to join literacy classes during the day because they are occupied with household work. After installation of SHS in some households of the village, literacy classes could be run at night which helped women to fulfill their dreams of being literate. In some

villages, after school coaching classes for students could be organized after the installation of SHS. This helped academically weak students to improve their performance in school.

4.2.2 Improvement in Health Outcomes

Respondent felt that installation of SHS had, in general, positive impact in their health status because they are no longer exposed to smoke from kerosene or *jharro*. They felt that the incidence of acute respiratory infection (ARI) and eye related infection has decreased. However, some felt that solar home system alone cannot do much to reduce incidences of ARI and eye infection as long as the main source of fuel for cooking is firewood. Explaining the positive impact of SHS on health, Yammati Roka, an Auxiliary Nurse Midwife (ANM) in a Primary Health Center in Taplejung said:

"The frequency of eye related problems and ARI has decreased as SHS is installed in most of the households in the village".

Emphasizing the positive side of SHS, an Assistant Health Worker (AHW) of *ilaka* health post in Kaalikasthan VDC in Achham said:

"I think it is due to SHS that the incidence of ARI has decreased from 10 cases per month to about 6 or 7 cases".

In hilly districts, due to the geographical difficulties, the chance of being injured at night is quite high. It was found in key informant interview (KII) in health centers that SHS has helped to reduced injuries and cases of burn. Most respondents felt that medical stores that have installed solar home systems are open late into the night so it is convenient to get treatment in cases of emergency.

“It is easier to handle emergency cases in hospital at night after installation of SHS”, said the health post in charge of Kalikasthan VDC in Achham.

Some respondents pointed out that cigarette smoking is one of the main causes of respiratory diseases. Therefore, mere installation of SHS does nothing to reduce the incidence of such diseases if people continue to smoke.

4.2.3 Access to Information

Most of the respondent felt that access to information has increased significantly after installation of SHS. This has in turn helped them to stay updated on current national and international political situations as well as to learn new farming techniques. The most common sources of information are radio, television and mobile phone. Explaining the importance of SHS, Nim Bahadur Kauchha of Hadhade VDC in Gulmi told that,

"After installing SHS, I have TV and radio in my home. I watch agricultural programs on TV and it has enhanced my knowledge about scientific agricultural practices which surely helps to increase production and hence my earnings".

4.2.4 Increased Income Generation Activities

Regarding the impact of SHS on income generation activities, it was found that most households have started some kind of new income generating activities and also they felt that they have been able to manage time more efficiently It was found from FGD that some people have started poultry farming while others are running retail or tea shops.

"I have started poultry farming after installation of SHS which has helped me to increase my earnings. I am earning twelve thousand rupees per year from the business which would have been impossible without SHS. ", said a respondent from Gulmi.

"I have started knitting at night through which I am able to earn some money. This is what SHS has done for me" said a woman from Darbang VDC in Ilam.

4.2.5 Impact on Security

On the basis of FGD and in depth interview, it can be concluded that SHS has had some positive impact in minimizing the security threats although SHS alone cannot get rid of the problem completely. Most participants agree that even if crime does take place, with the help of SHS, it is easier to recognize and, in some cases even capture, the culprit.

“I feel that criminals don’t want to take risk of being caught in the light as their identity can be known. We were even able to catch many criminals, and this has certainly helped in reducing crime in our area” said an Assistant Sub Inspector (ASI) of Simli police station in Rukum.

“I don’t think crime rate has decreased or increased due to SHS. I don’t believe it has had big impact on reducing crime” said a high school teacher from Bhorletar VDC in Lamjung.

However, some people still believe that SHS had played a positive role in reducing crime.
“If we don’t have SHS we have to search for torch and candle for lighting, until which a thief can run away. But now when theft happens, just a switch can do the work and it’s easier to catch the thief,” said a respondent from Toli VDC in Achham.

4.3 SATISFACTION LEVEL OF USERS OF SOLAR HOME SYSTEM

4.3.1 Description of the Sample of SHS users

A total of 799 SHS users were interviewed for the survey, out of which nearly seventy six percent were using panels of capacity between 19 and 50 watts, fifteen percent were using SHS with less than 18 watt capacity panels, and the remaining 9 percent were using panels of more than 50 watt capacity. Only six percent of the households were using battery of more than 100 amp/hrs while forty one percent of the sample was using battery of less than 50 amp/hrs and battery of the remaining 53 percent was between 51 and 100 amp/hrs. Please refer to table 15 for the distribution of panel size by development region and ecological belt.

Table 15 Proportion of SHS installed by watts of the panels and size of batteries

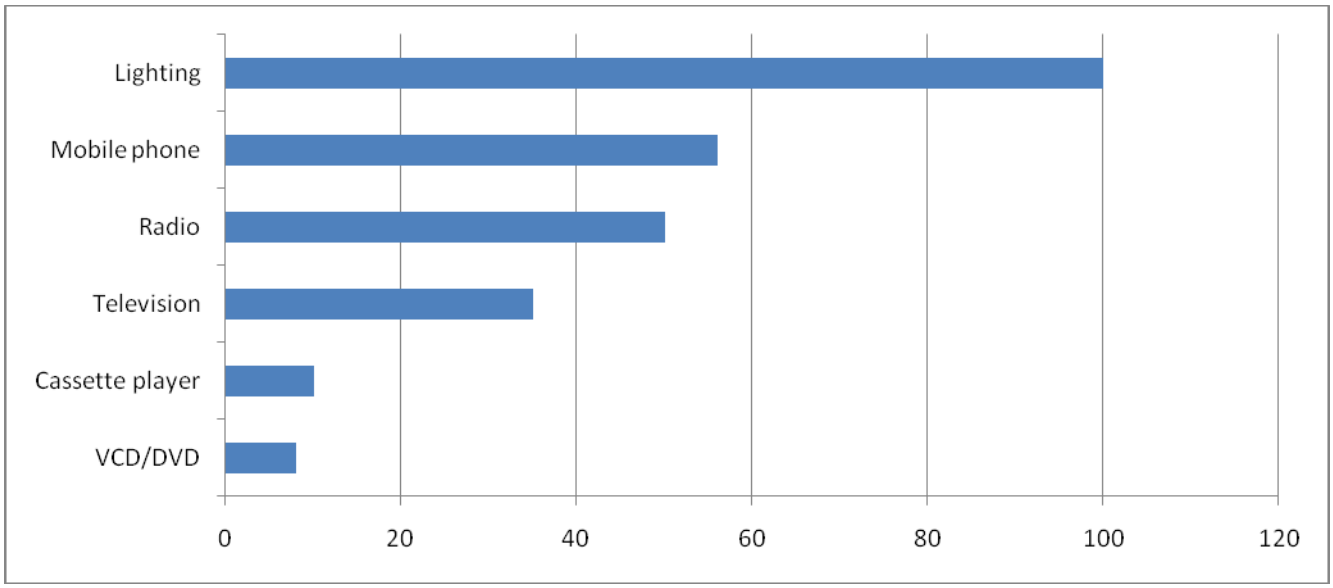
		Development Region					Ecological Belt		
	Total	EDR	CDR	WDR	MWDR	FWDR	Terai	Hill	Mountain
	%	%	%	%	%	%	%	%	%
Panel Size									
<18	15	0.1	0.2	1.2	9.4	4.1	0.1	5.6	9.1
19 to 50	76	15.2	18.7	26.1	10.3	5.7	8.9	58	9.1
>51	9	4.8	1.3	2.6	0.3	0	1.2	6.3	1.5

Source: Survey, 2009

Entire interviewed households reported the use of SHS for the purpose of lighting. Fifty and 35 percent were using radio and television respectively. Eight percent had VCD/DVD in their homes and 10 percent also had cassette player. Fifty six percent owned mobile phones. On an average 4 lamps were installed in a particular house. The average numbers of CFL and FTL bulbs were 4 while average numbers of WLED bulbs were 2.

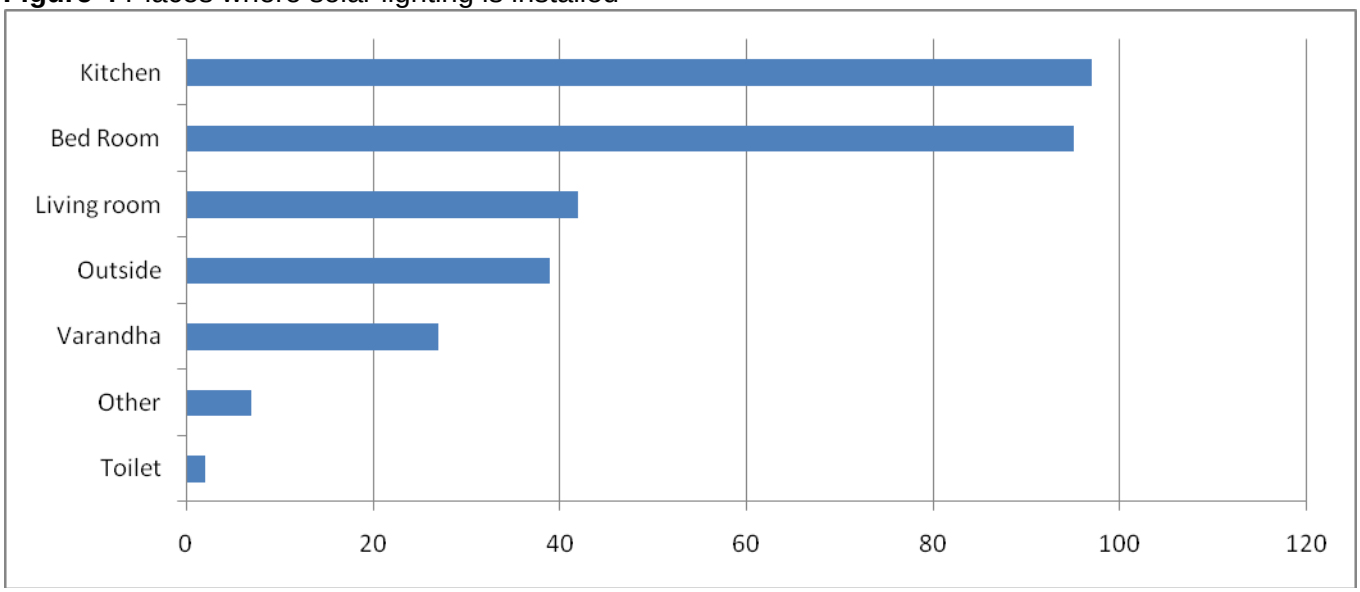
To understand the usage pattern of SHS, SHS users were asked what appliances were they currently using. Hundred percent of users said they have installed lights. Fifty six percent said they are using solar power to charge mobile phones, while fifty and thirty five percent said they operate radio and television respectively. About ten percent of users also use cassette player and eight percent have VCD/DVD in their home. It should be noted that a household may have more than one appliance so the total percent does not sum to hundred.

Figure 3 Proportion of households using various appliances



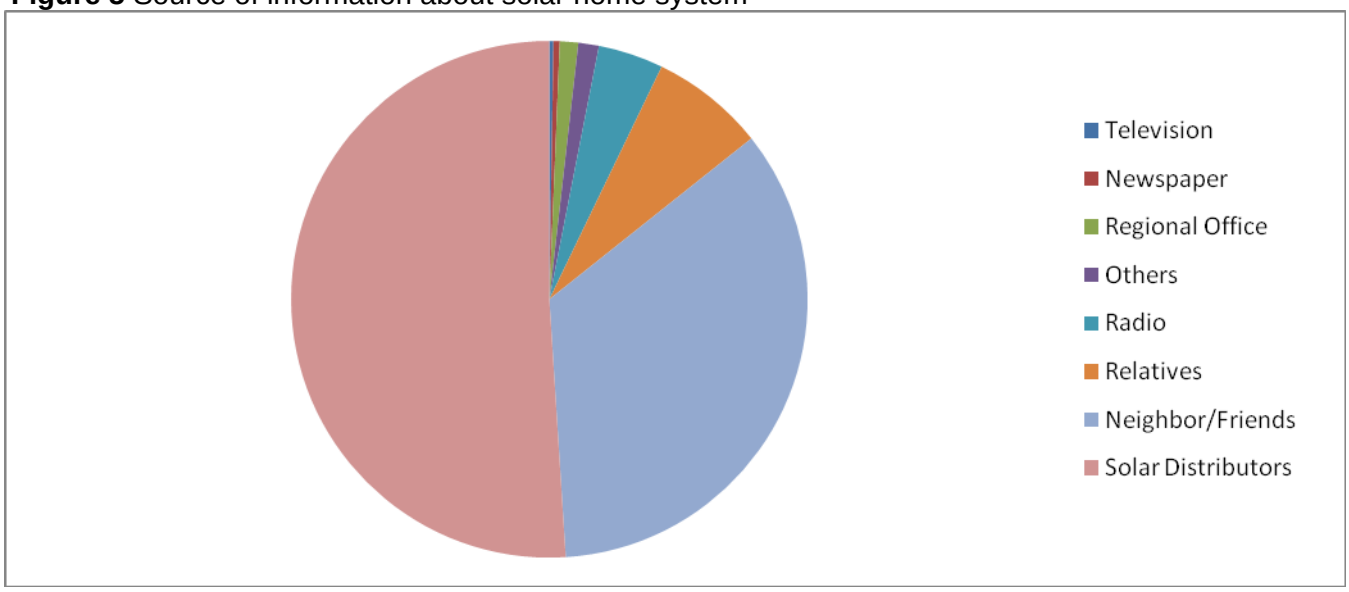
To better understand the usage of light, the respondents in user households were asked the place where they have installed the lights. Kitchen and bedroom seems to be the most common place for installation of lights as 97 and 95 percent of the households reported to have installed lights there. Other places where light is installed include living room, verandah, and outdoors. Forty two percent have installed bulbs in living room while the percent of households who report to have installed bulbs outdoors and verandah are 39 and 27 respectively. Figure 4 illustrates this information in a bar graph.

Figure 4 Places where solar lighting is installed



The respondents were also asked about their major source of information about solar home system. Fifty percent of the respondents said they found out about the system and the subsidy scheme from solar distributors themselves. About thirty four percent of respondents reported they came to know of it from their neighbors or friends, followed by seven percent from relatives, four percent from radio, about one percent from regional office, and negligible proportion knew about it through newspaper and television.

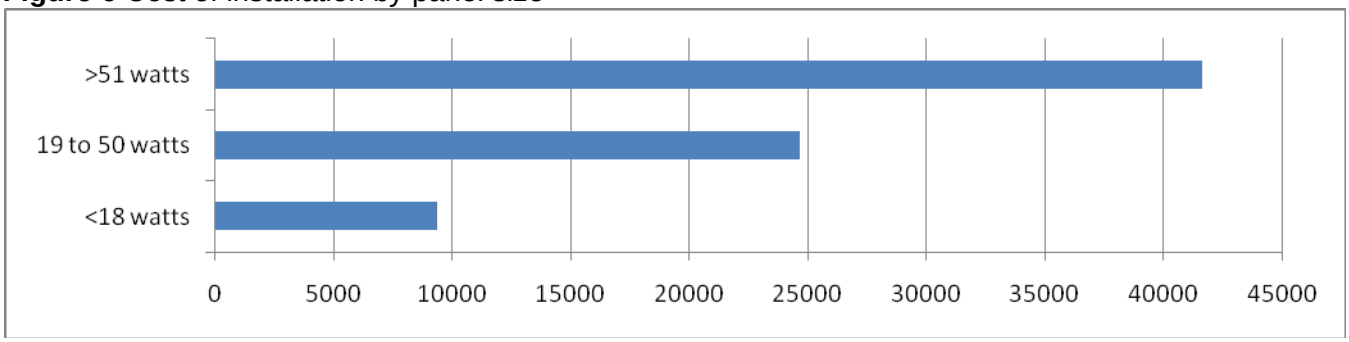
Figure 5 Source of information about solar home system



The proportion of households using kerosene for the purpose of lighting prior to the installation of SHS was 85 percent. Thirteen percent said they were using *jharro* and the remaining 3 percent reported to use candle.

Average cost of installation of solar home system was NRs 24,459 which comes out to be about 35 percent of the total annual income. Not surprisingly, the cost for systems with solar panels of more than 51 watt capacity was high at NRs. 41,631 whereas solar panels of less than 18 watt capacity could be installed for less than 10,000 rupees (Figure 6).

Figure 6 Cost of installation by panel size



Nearly fifty nine percent of the households said they did not receive government subsidy for the installation of solar home system. There could be many reasons for this surprising result. First of all, the person who was interviewed may not be the household head or the person responsible for the household's finances. In that case, the respondent may not be aware of the subsidy received. Secondly, agents from the installation company may not have explained the subsidy scheme properly to the users. Still it is noteworthy that a significant proportion of the respondents are not aware of the subsidy being provided by the government for the installation of SHS.

4.3.1.1 Financing Installation

Table 16 illustrates the primary source of financing for installation of solar home system. Nationally, twenty three percent of households purchased the system from their salary or wage earnings, six percent sold some asset, thirty four percent financed it out of their savings, and thirty seven percent resorted to borrowing. A closer examination of households that borrowed reveals interesting pattern. Most of the borrower households are from the Eastern, Central, and Western development regions. This shows the poor state of financial development in Mid Western and Far Western regions.

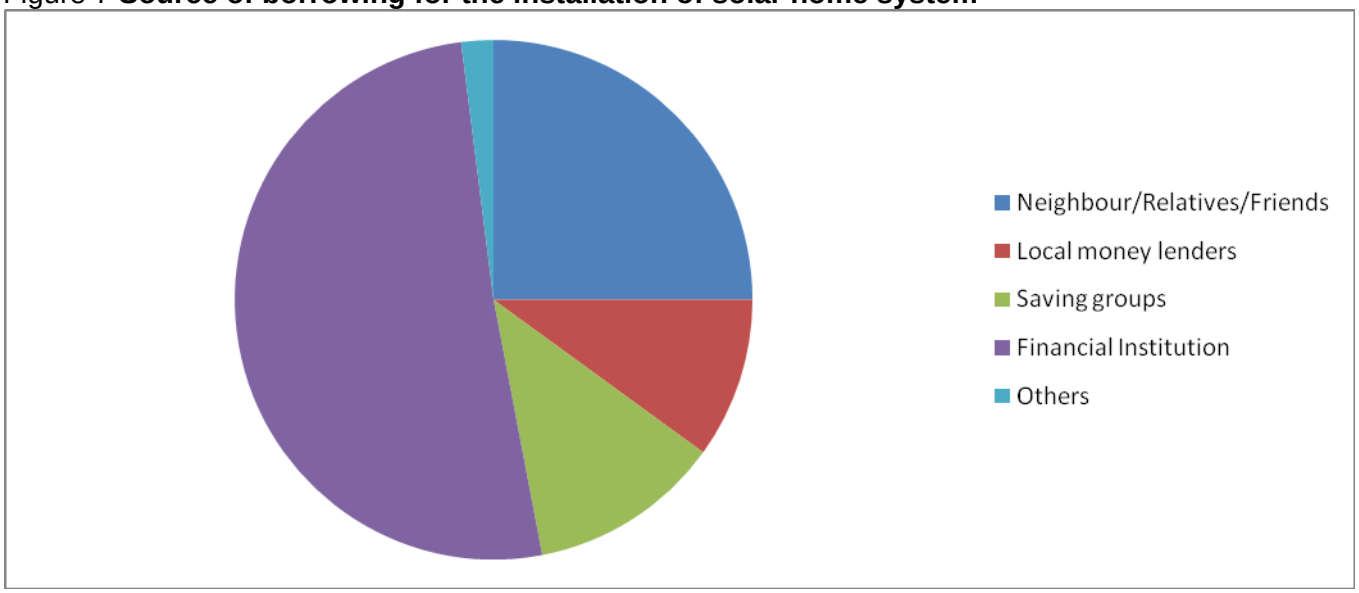
Table 16 Primary source of financing for installation

	Total	Dev Region					Eco Belt		
		EDR	CDR	WDR	MWDR	FWDR	Terai	Hill	Mountain
	%	%	%	%	%	%	%	%	%
Salary or daily wage	23	3.7	1.7	14.3	2.0	1.3	1	16.6	5.4
Sell assets	6	0.8	0.4	0.3	0.9	3.6	0.6	3.6	1.8
Savings	34	8.2	7.5	3.7	11.1	3.5	2.7	23.9	7.4
Borrow money	37	10.2	10	10	4.7	2.1	5.5	22.7	8.8

Source: Survey, 2009

The borrowers were also asked about the source from which they borrowed. As figure 7 illustrates, fifty one percent of borrowers relied on formal financial institutions to borrow. About twenty five percent of borrowers borrowed from friends, relatives, or neighbors, while twelve percent did so from savings group of which they are a member. Only about ten percent of borrowers resorted to local money lenders for the money, and two percent obtained it from other miscellaneous sources.

Figure 7 **Source of borrowing for the installation of solar home system**



The average borrowed amount was NRs. 19,474 at an average annual interest rate of nineteen percent. Local money lenders charged the highest interest rate of 28 percent while financial institutions charged an average of 15 percent. The interest rate for loans from savings group and relatives and friends was 23 percent. Average duration of loan repayment was 25 months. 95 percent of respondents reported that they had already repaid the loan. However, it should be noted that the sample included

only those SHS users who had installed the SHS more than 3 years ago. This gives them ample time to repay the loan.

4.3.2 Level of Satisfaction

To measure the level of satisfaction of users, the users were asked if they repaired their unit and how much did it cost them to do so. It is apparent from table 15 that battery is the most repaired part of solar home system as sixty four percent of the households report to have repaired battery after installation. Among them, forty three percent have in fact replaced the battery. Thirty nine percent of users have repaired lamps and twenty one percent have repaired charge controller. There seems to be not much problem with switch and solar panel as they were repaired by just seven and about one percent of users respectively. Average cost of repair was the highest for solar panel with NRs. 6,440, but only eight households report to have repaired it. The cost of repair for batteries was significant with NRs 5,499, while the repair cost for other parts was nominal. Average cost of repair for the whole system since its installment was NRs. 4,205. For the sample, average years of installation is six years which implies the average cost of repair per year is NRs. 700 which is just one percent of total annual income.

Table 17 Details of problems with solar home system

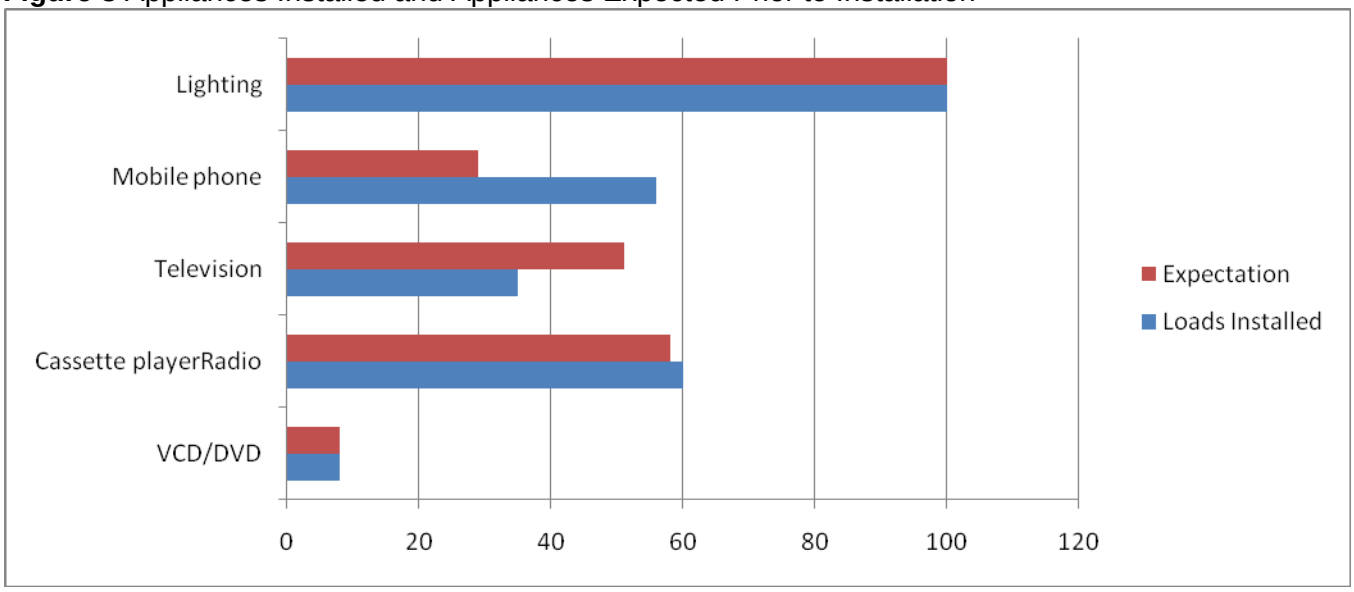
	Total %	Repaired by				Average Cost of Repair (NRs.)
		Self %	Relatives %	Technician %	Others %	
Solar Panel	1.4	50	13	37	0	6440
Batteries	64	54	19	25	2	5499
Charge Controller	21	26	20	49	5	947
Lamps	39	62	15	19	3	1047
Switch	7	53	12	27	7	245
Other	5	84	16	0	0	957

Source: Survey, 2009

Another way to measure the satisfaction level of users is by asking if their expectation was met by SHS. Figure 8 presents information on what households expected from the system before they installed it, and whether or not the system delivered what they expected. All households expected to have lighting, and the expectation was fulfilled for all households. However, only twenty nine percent of

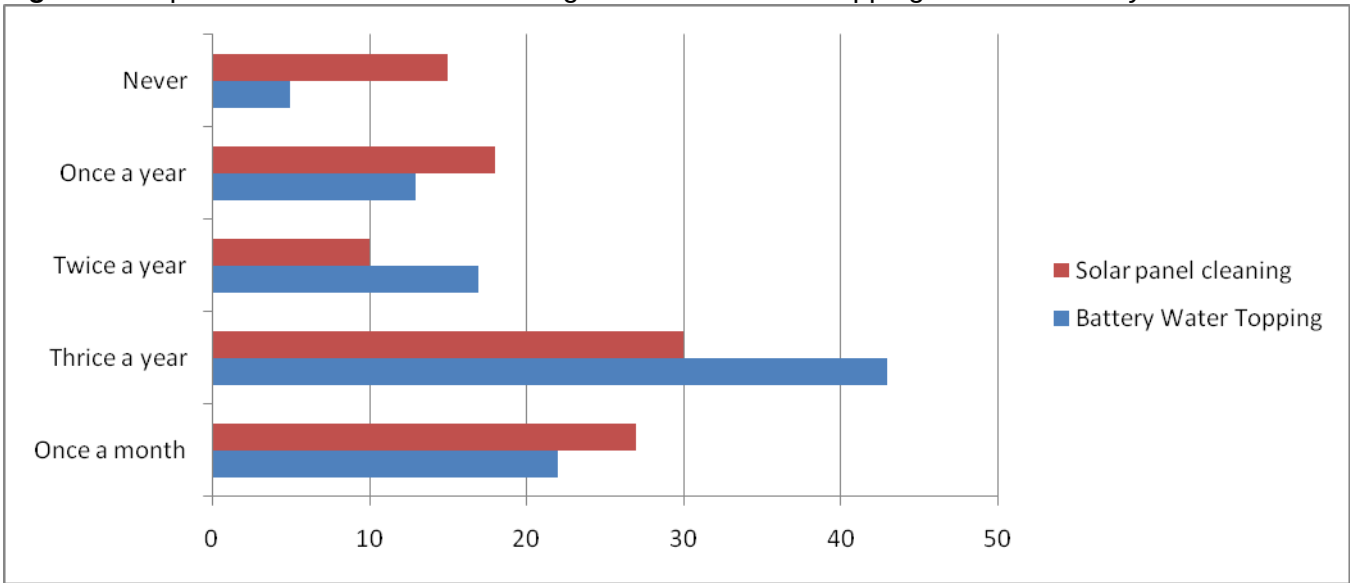
households hoped to charge mobile phone, but fifty percent are currently doing so. This difference could be because the use of mobile phone was not so widespread a few years back so few households had expectation of using it. The same is true for cassette player or radio by a small margin; fifty eight percent expected to use it while sixty percent are using it. In contrast, the proportion of television users is less than the proportion of households who expected to be able to watch television after installing solar home system. In case of VCD or DVD players, all eight percent of households who expected to use it have been using it after installing SHS.

Figure 8 Appliances Installed and Appliances Expected Prior to Installation



To understand how well the users are taking care of their solar home system, the respondents were asked if they cleaned their solar panels regularly and if they added water in the battery in regular interval. Five percent of households said they have not added water in the battery, while thirteen percent say they do it once a year, seventeen percent do it twice a year, forty three percent do it thrice a year, and twenty two percent add water in battery once a month. Table 9 illustrated this information graphically.

Figure 9 Proportion of Households Cleaning Solar Panels and Topping Water in Battery



Similarly, fifteen percent of households said they have never cleaned the solar panel, eighteen percent said they do so once a year, ten percent do it twice a year, thirty percent clean it thrice a year and twenty seven percent of households clean their panel every month.

Yet another dimension of users' satisfaction could be captured by asking if they want to increase the capacity of the system. Nearly fifty percent of the respondents were interested in increasing the capacity of their system, but just five percent mentioned they have actually increased the capacity since the first installation. Ninety four percent of the users said the solar companies gave them the user's manual at the time of installation. In response to the question "in general, how satisfied are you with the solar home system" twenty one percent of the users said they are highly satisfied, seventy four percent said they are satisfied, and the remaining five percent said they are not satisfied. Since just five percent of users report dissatisfaction, it can be concluded that the solar home systems have provided valuable and reliable service to their users.

4.3.2.1 Findings from Qualitative Investigation

On the basis of FGD and KII it was revealed that most respondents are satisfied with the outcome and consequences of SHS in their home. Most respondents are using lights, mobile phone, radio, and television with the help of SHS.

"It was my dream to watch television and talk to my relatives in India. My dream has turned into reality with the help of SHS. Now I can talk to my relatives whenever I want and watch programs on TV", said a respondent from Rukum.

However, there were some users who were dissatisfied with the company that installed the system in their home. The respondent felt that once they installed the SHS, they did not visit them again and did not provide after sales support.

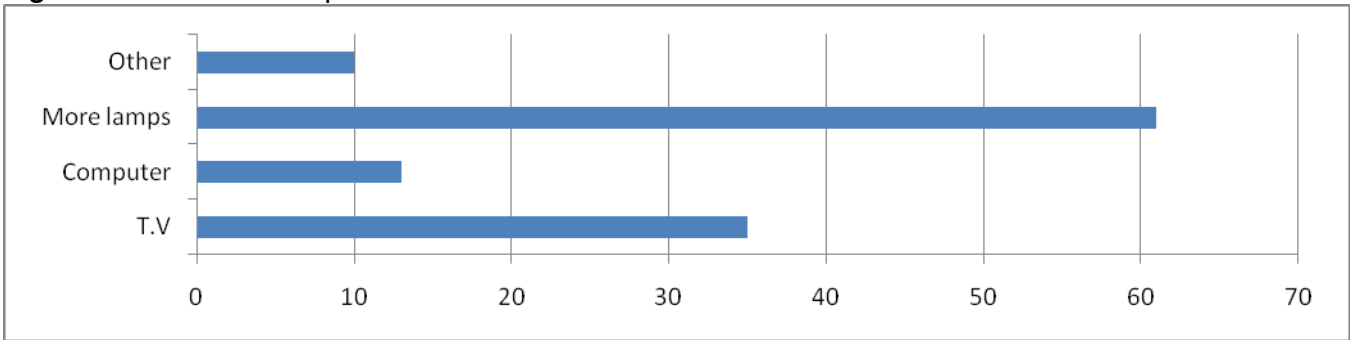
On the issue of maintenance and proper use of SHS, it was concluded from FGD and KII that most respondents are not knowledgeable about how to maintain their unit. Most respondents also felt that technicians from the installation company were unavailable to assist them with repair and maintenance and even when available, their help did not arrive on time.

One of the advantages of solar power over micro hydro is the fact that power from micro hydro may not always be available. Power supply may be restricted to certain hours or there may not be sufficient power for all households. However, once installed, light from solar home system is always available.

4.4 IDENTIFICATION OF POSSIBLE END USE

To investigate what could be the further uses of solar home system, the current users were asked what more they desired. Sixty one percent of users said that they would want to install more lights as the existing ones are insufficient to light all the areas in home. Thirty five percent of users said they would like to add television. Thirteen percent would like to use a computer, and among the remaining ten percent, most preferred to have a refrigerator. These responses are important in formulating rural energy policies in the future.

Figure 10 Additional Requirements



4.4.1 At Household Level

FGD and KII reveal that at the household level, most of the respondents are willing to enhance the capacity of SHS. Most of them want to have a system capable of running computer, refrigerator,

and electric stove in their home. They mention that they could also use the appliances for income generation purposes. But they are also aware that to run such equipments, SHS with high capacity is required and the major barrier for households to install a high capacity system is money. To resolve this problem, two options are forwarded by the respondents: the first is to increase the amount of subsidy and the second is for the government to provide easy loan through financial institutions for the installation of SHS.

"Young, literate people are certainly attracted to new technology but without sufficient power, we can't run cyber. If we get subsidy from the government, the community is willing is to start up a cyber cafe", said respondents from Gulmi and Achham.

Some respondents mentioned that it would be very beneficial if water pump could be operated from solar power. Water pump could be used to draw water from nearby river or ponds for the purpose of irrigation. This would improve their livelihood significantly.

It was often mentioned in FGDs that high efficiency bulbs were not available in the local market. This is an encouraging sign because it suggests households are becoming aware of the need for energy efficiency. Respondents also said that they would like to talk to their relatives abroad using internet phone. They are keen on contributing some amount to establish solar powered cyber café in their community. However, most respondents feel that such cafés should be run by the community or by social organizations and not by private parties because they don't want businessmen profiting from the centers that they helped establish.

4.4.2 Schools and Health Posts

It was revealed from FGDs that there is need for solar systems in schools and hospitals. "We have four computers in our school, but they are not functioning because we don't have enough power. If we are able to enhance the capacity of solar panels, we would be able to use them", said the principal of Ishaneswor Higher Secondary School in Bhorletar VDC in Lamjung.

It was common for teachers and principals to report that they would like to have a printer in the school. They think that they could print

“If we are provided solar to run computer in our school, it would surely help to improve teaching methods, students would able to learn new technology as well as helpful in reducing the cost of printing”, said a high school teacher from Achham.

We also found out from our interviews that in some schools, teachers feel the need for solar power so that they can use a microphone during various programs in the school.

Respondents in health centers are in favor of subsidy for the installment of high capacity solar systems in health centers. It was frequently mentioned that vital supplies like vaccines and some medicines could not be stored for long in absence of refrigerator. Health professionals thought that solar power could be used to run refrigerators. Some health workers even mentioned that they were thinking of opening a birthing center and solar energy could be the solution to power the center. Emergency cases can also be handled property at night if there is the facility of lighting from solar panels.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY OF MAIN FINDINGS

1. **Solar home system is an effective means to increase the access to information.** Having SHS is likely to increase ownership of various appliances like radio (8 percent), television (38 percent), and mobile phones (25 percent). Likewise, findings show that SHS is also likely to change the radio listening habit, television watching habit and number of phone calls made. This facilitates the access to information and in turns helps in the empowerment of the people. The increase in access to information is high for households having SHS with more than 18 watts panel.

2. **Solar home system appears to have no impact on health outcomes.** Impact estimates from the propensity score matching suggests that there is no significant reduction in the incidence of respiratory and eye infection. One possible reason could be that the major source of indoor pollution is smoke through firewood used for cooking. Findings from qualitative investigation also suggest the same. Though few respondents explained the positive impact of SHS in reducing respiratory and eye infections, most of the respondents site smoke through firewood as being the major factor responsible for such health hazards.

3. **Educational attainment of children is likely to increase by means of solar home system as the system provides light during night.** Findings show that students having SHS in their home are likely to study 15 more minutes daily. This helps in increasing the percent secured by them in their exam. Solar home system also is likely to increase the percentage secured by students by 2 more percent and students are 5 percent more likely to pass the exam. Similarly, school dropout rate is likely to decrease by 2 percent. The increase in study time is higher for the students of older age group. Similarly, study time is more for male students compared to females and working time has positive relation with SHS for male but negative for female.

4. **Though SHS has no impact on farm income it is likely to increase the probability of initiating income generating activities and thus income**. SHS is likely to increase the probability of initiating small business by 3 percent and income from such business by nearly NRs. 1500. But farm income has had no impact due to solar home system.

5. **Access to credit for the installation of SHS is low in Mid and Far western development region.** The main source of finance for the installation of SHS is borrowing as 37 percent of users mentioned it. A breakdown of this figure by development region reveals that the proportion of households borrowing money is much less in Mid Western (4.7 percent) and Far (2.1 percent) Western development regions compared to Eastern (10.2 percent), Central (10 percent) and Western (10 percent) development region.

6. **Significant numbers of people are unaware of the subsidy being provided by the government.** Significant proportion of respondents (59 percent) said that they did not receive the subsidy from the government for the installation of SHS. There could be many reasons for this but still the proportion is high.

7. **Household seems to be satisfied with their system.** Average cost of installation is NRs. 24,459 which is 35 percent of the average annual income. Average cost of repair per year is NRs. 700 which is nearly 1 percent of the average annual income. SHS met the expectations of almost all households. Only five percent of respondents said they were not satisfied with their system. But findings from qualitative investigation showed that unavailability of technicians locally for repair is the only factor for dissatisfaction.

8. **Possible end use**. At household level more lighting, refrigerator, computer and television are desired. Nearly fifty percent of households are willing to upgrade the capacity of their system. At institutional level, health centers want to install refrigerator to store vaccines and medicines and want to install light to handle cases during night whereas schools want to operate computer and printers**.** Households and institutions are aware that installation of solar panels of high capacity is costly, but they are willing to bear the cost if proper credit facilities were available.

9. **Replacement of kerosene by SHS.** Eighty five percent of users said they used kerosene for the purpose of lighting prior to the installation of SHS. Survey of non users reveals that kerosene is the primary source of fuel for lighting for 59 percent of the households. Average kerosene consumption per week among non users is 660 ml and the average monthly expenditure on kerosene is NRs. 188. With the average cost of installation of SHS is NRs. 24,459, the payback period for investment in SHS is about eleven years.

10. **SHS helps to identify the criminal in cases of burglary.** The qualitative portion of the survey reveals that SHS does not necessarily help in decreasing the crime rate in a community. However, in cases of theft or burglary, SHS can help in identifying or arresting the culprit.

5.2 CONCLUSION

Solar home system increases the probability of initiating own business and income from own business. There is no effect on farm income due to the system, and it is understandable because farm income is function of many variables that are subject to fluctuation. Solar home system does not have much impact on health outcomes. This is a reasonable observation because the major source of indoor pollution is smoke from firewood. Although the observed effect in our survey is quite small, there is a strong potential for SHS to have positive impact on educational outcomes of students. However the impact on access to information, an important aspect for the empowerment of the people is largest compared to all other outcomes.

There is also scope for expansion of the program to reach more households and health and educational institutions. Many households are interested in increasing the capacity of their system, but they are unable to do so due to lack of credit facilities. Health institutions are eager to install solar systems so they can operate refrigerators to store vaccines and medicines and provide around the clock care. Educational institutions also feel the need for solar power to run computers and make printing facilities available to teachers and students. However, there is still a need to educate people about the subsidy scheme as a significant proportion of households are unaware of it. Solar installation companies should be instructed to provide complete information at the time of installation.

One of the major benefits of SHS is the reduction in household expenditure in purchase of alternative sources of fuel for the purpose of lighting. Households should be educated about this aspect of investment in SHS and informed that the one-time cost of SHS can be recouped in about eleven years.

In general, households are satisfied with the system they have installed in their homes.

5.3 RECOMMENDATIONS

1. **Health and education institutions are willing to install high capacity systems if proper credit facilities were available.** AEPC/ESAP should partner with financial institutions to make credit facilities available to those who are willing to install high capacity system. Alternatively, arrangements could be made for them to pay the cost in installment.

2. **Provide soft loan to upgrade the system.** Nearly fifty percent of households are willing to upgrade the system while only five percent have in fact done so. It is understandable that subsidy cannot be provided to the same household twice. In such cases, AEPC/ESAP could arrange for soft loans to such households.

3. **Ensure that solar installation companies explain the subsidy scheme properly.** A majority of users said they did not receive subsidy from the government for the installation of SHS. In the future, it should be required of the solar installation companies to explain the subsidy scheme to the users properly and clearly. In addition to this advertisement through radio and Television could be one of the effective means to raise awareness about subsidy and basic maintenance not only among the current users of SHS but also among the non users of SHS.

4. **Train local technicians for on-site repair and maintenance of SHS.** Finding shows that unavailability of technicians for repair is one of the major dissatisfaction over the system. AEPC/ESAP could train some local person in the village to repair the components of the system. This could help to reduce the dissatisfaction level of the user.

5. **Recommendations for further study.** Our survey only captured the direct benefits of SHS on health. Future studies could also measure if SHS has had any effect on health indirectly such as by increase in access to information.

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APPENDICES
A1. ADDITIONAL TABLE

Table 18 Summary Statistics of the determinants of installation of Solar Home System

Variables	Mean	S.D	Min	Max
Socio Economic Status: Proxy for income	2.71	6.65	0	104
Number of person in household	4.90	2.17	1	17
Total land (Ropani)	10.46	20.27	0	533.33
Number of livestock	8.64	9.77	0	115
Remittance income in last year	0.204	0.403	0	1
Uses firewood for cooking	0.965	0.183	0	1
Uses improved cooking stove	0.125	0.331	0	1
Uses other fuel	0.034	0.183	0	1
Has simple floor in the dwelling	0.029	0.168	0	1
Has advanced floor in the dwelling	0.032	0.176	0	1
Other floor	0.0003	0.017	0	1
Has simple roof in the dwelling	0.100	0.301	0	1
Has advanced roof in the dwelling	0.541	0.498	0	1
Has natural roof in the dwelling	0.035	0.183	0	1
Roof others	0.002	0.052	0	1
Number of rooms in the dwelling	3.303	1.677	1	10
Awareness				
Newspaper readership (per month)	2.719	6.653	0	104
HH head has completed primary education	0.547	0.497	0	1
HH head has completed secondary education	0.214	0.410	0	1
HH head has completed above secondary education				
HH head has some informal education	0.147	0.354	0	1
HH head education don't know	0.048	0.214	0	1
HH head woks in agriculture sector	0.833	0.372	0	1
HH head has salaried job	0.041	0.199	0	1
HH is self employed	0.034	0.183	0	1
HH is daily wage earner	0.044	0.206	0	1
HH is unemployed	0.0134	0.115	0	1
HH is has some other occupation	0.020	0.143	0	1
Development Region				
Eastern	0.199	0.400	1	0
Mid	0.200	0.400	0	1
Western	0.300	0.458	0	1
Mid western	0.199	0.399	0	1
Far western	0.100	0.300	0	1
Ecological Belt				
Terai	0.100	0.300	0	1
Hill	0.699	0.458	0	1
Mountain	0.199	0.400	0	1
Others				
Distance to nearest electrified village (In Mins)	207.80	180.32	0	1080
Nearest village was electrified less than 3 years ago	0.444	0.497	0	1
Nearest village was electrified 3 to 5 years	0.108	0.311	0	1
Nearest village was electrified more than 5 years ago	0.380	0.485	0	1

Ethnicity				
Upper caste (Brahmin, chettri, thakuri)	0.411	0.492	0	1
Janajati	0.422	0.493	0	1
Dalit	0.135	0.342	0	1
Other	0.030	0.172	0	1
Religion				
Hindu	0.777	0.416	0	1
Buddhist	0.165	0.371	0	1
Kirati	0.0497	0.217	0	1
Christian	0.003	0.055	0	1
Other religion	0.004	0.063	0	1

Table 19 Average Predict Probability (Propensity score) by SHS Treated and Untreated

	Average Predicted Probability (Propensity Score)	SD	Min	Max
Treated (SHS User)	0.4399	0.2539	0.0047	0.9917
Untreated (SHS Non User)	0.1875	0.1601	0.0024	0.9499

Table 20 Interviews Completed by district and VDC

District	VDC	PSU (Ward No)	Completed interviews	
			Users	Non users
Achham	Babla	8,6,4	16	48
	Ghughurkot	2,4,7,8,9	16	48
	Kale Kanda	7	16	48
	Pulletola	1,2	16	48
	Sidhdeshwor	1,2,3	16	48
Chitwan	Ayodhyapuri	6	16	48
	Baghauda	3	16	48
	Gardi	2	16	48
	Kalyanpur	1,2	16	48
	Kalyanpur	5	16	48
Gulmi	Arje	3,4	16	48
	Bishukharka	7,8	16	48
	Hastichaur	2	16	48
	Musikot	1,2	16	48
	Shantipur	1	16	48
Humla	Kharpunath	2,4,5,6,7	16	46
	Muchu	6,7	16	52
	Simikot	2	18	53
	Simikot	4	16	46
	Thehe	4,7,8,9	14	43
Ilam	Aamchowk	5,6	16	48
	Ekatapa	1	16	48
	Jirmale	8,9	16	48
	Nayabazar	1,2	16	48
	Samlabung	1,2	16	48
Kavre	Biratadeurali	6,7	16	48
	Pokahari narayanthan	6	16	48
	Madan Kundari	1	16	48
	Sipali chilaune	4,5	16	48
	Sisakhani	1,2,3,4	16	48
Lamjung	Bhorletar	3,4	16	48
	Gauda	5,6	16	48
	Karapu	8	16	48
	Pachok	3,6,7,8,9	16	48
	Taghring	5,6,7,8,9	16	48
Myagdi	Babiyachaur	5	16	48
	Baranja	7	16	48
	Darwang	8,9	16	48
	Kuhu	7	16	48
	Takam	2	16	48

Rukum	Chaurjhari	3,4	15	46
	Jang	6	16	48
	Khang	2,3,4,5,6,7,8	16	48
	Purtimkanda	4,5	16	48
	Simli	7,8	16	48
Taplejung	Dokhu	1,2	16	48
	Lelep	5,6,7	16	47
	Phawakhola	7	16	48
	Phungling	4	16	48
	Thechambu	4,5,6,8	16	48

Table 21 Quintile cut off point

Quintile	Cut-off point		Average	Sd
	Lowest	Highest		
Poorest	-75670	14200	5575	8334
Second	14225	28000	21086	4007
Third	28100	48200	36914	5628
Fourth	48300	99000	69368	14479
Richest	99075	1854500	214532	176839

Table 22 Activity Included in Own Business

Activities	Frequency
Handicraft (Doko, Nanglo, Thanka)	15
Small Hotel/Tea Shop	11
Tailor	8
Metal Work	6
Other	6
Shop/contract business	41
Tuition	13

Table 23 Calculation of annual household income

Main Component	**Items to add**	**Items to deduct**	**Average Income (In NRs.)**
Farm Income	Value of total crop production i.e Income = total production * unit price. Price is taken as reported by the respondent	Cultivation cost (Seeds, fertilizers, hired labor etc)	25287
	Earnings from sale of livestock	Expenditure for the purchase of livestock	
	Value of sales from non crop farm production (milk, ghee)	Expenditure on feed, veterinary services	
Wage Income	Value of cash and in kind earning per year in and outside agriculture (includes daily, piece-rate and permanent labour)		7031
Own business	Income from small business	Expenditure for business	12133
Transfer Income	Remittances, pension, allowances		24988
Total Annual Income	Farm Income, Wage Income, Own business, Own business	Cultivation cost, Expenditure for the purchase of livestock, Expenditure on feed, veterinary services, Expenditure for business	**69440**

A2. NAME OF THE ENUMERATORS INVOLVED IN THE STUDY

District	Name of the Enumerators
Achham	Dasrath Oad Ram Prashad Pokharel
Chitwan	Sarita Poudel Poonam Neupane
Gulmi	Chandra Kala Chudal Sangita Bastola
Humla	Ram Jung Rokaya Sur Bir Raut
Rukum	Dipak Budhathoki Ramesh Acharya
Kavre	Suman Pant Roshani Shrestha
Lamjung	Mohan Baniya Samir Shrestha
Myagdi	Sarita Shrestha Manita Regmi
Ilam	Kula Devi Baral Nabin Khatiwada
Taplejung	Jibesh Dulal Khagendra Prasai

A3. STRUCTURED QUESTIONNAIRE FOR HOUSEHOLD SURVEY

SOCIO ECONOMIC IMPACT STUDY OF THE USER OF SOLAR HOME SYSTEM

STRUCTURED QUESTIONNAIRE FOR HOUSEHOLD SURVEY WHO HAD INSTALLED SHS BEFORE FY: 2063/64

IDENTIFICATION AND ELIGIBILITY	
NAME AND CODE OF DISTRICT_____	___ ___
NAME AND CODE OF VDC _____	___ ___
WARD NUMBER……..	___ ___
THIS HOUSEHOLD IS IN TREATMENT OR CONTROL GROUP…….. (1= TREATMENT, 2=CONTROL)	___
HOUSEHOLD ID NUMBER……	___ ___
NAME OF RESPONDENT_____	
HOW MANY PERSON LIVE IN THIS HOUSEHOLD……..	___ ___
INTERVIEW ELIGIBILITY…… ASK: Did this household installed SHS prior to 2006? (YES=1, NO=2, HH IN CONTROL GROUP=3)	___
IF NO, DO NOT START QUESTIONNAIRE AND VISIT NEXT HOUSEHOLD	
IS IT A HOUSEHOLD ORIGINALLY SELECTED (YES=1, NO=2)	___
NAME OF SHS OWNER (FOR REPLACED HOUSEHOLD ONLY)	

INTERVIEW DETAILS	
DATE	……..
TIME STARTED	……..
TIME FINISHED	……..

INTERVIEWR	**SUPERVISOR**	**ENTERED BY**
NAME……..	**NAME……..**	**NAME……..**

DATE……..	DATE……..	DATE……..

Information:

Namaste, My name is……. And I am working as part of research team under Alternative Energy Promotion center in the Ministry of Environment and Samuhik Abhiyan, a research partner. We are carrying out a survey of households who use some alternative source of energy including solar home system to assess the socio economic impact caused by it. We would like to ask a few questions about your experience of SHS and also other information about your household. Please try and answer every question, but if you are not sure then please give the best answer you can. The information you provide will be strictly confidential. The interview will take approximately 45 minutes.

Participation in this survey is voluntary, and if you should come to any question you don't want to answer, just let me know and I will go on to next question: or you can stop the interview at any time without having to give a reason. However, we hope that you will participate in this survey since your views are important to us.

At the time do you want to ask me anything about the survey?

May I begin the interview now?

If so, please sign or mark below to indicate you are willing to be interviewed.

I am ready to be Interviewed

Signature:

Date:

(Interviewers please ask for the respondent's signature but if respondent can't sign then ask to put a tick mark and sign yourself as a witness).

SECTION I: GENERAL INFORMATION OF HOUSEHOLD MEMBER

LINE No Q 1.1	**USUAL RESIDENTS** Q 1.2	**SEX** Q 1.3	**AGE** Q 1.4	**MARITAL STATUS** Q 1.5	**EDUCATION** Q 1.8
	Please give me the names of the persons who usually lives in your household, starting with the household head	Is (Name) Male or Female **1= Male** **2= Female**	How old is (Name)	What is (Name) current Marital Status **1=Married** **2=Unmarried** **3=Widowed** **4-Divorced** **5=Separated**	**Write '00' if Member has not ever attended school.** **Write 97 for Nursery to K.G** **01-09 = Grade 1 to 9** **10 = Completed SLC** **11= Intermediate Not Complete** **12= Intermediate Completed** **13= Bachelors Not Complete** **14=Bachelors Completed/Higher** **96= Non Formal Education** **98 = Don't Know**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					

ENUMERATORS PLEASE NOTE THE OCCUPATION OF HH HEAD AND SOLAR OWNER

1=AGRICULTURE 2=SALARIED OR GOVERMENT

3= SMALL BUSINESS 4=WAGED LABOUR 5= FOREIGN EMPLOYMENT 6=NOT WORKING 7= OTHER

	LINE NUMBER	OCCUPATION
HH HEAD		
SOLAR OWNER		

Don't ask for HH in control group

SECTION II: HEALTH AND EDUCATION

EDUCATION (SECTION 2.1)

LINE NO. Q 2.1.1	SCORES Q 2.1.2		DROP OUT Q 2.1.3	STUDY HOURS Q 2.1.4		WORK AT HOME Q 2.1.5	
List line no all members who is between 5 to 20 years and study living in same hh.	What is the score secured by (Name) in his last completed grade. (Interviewers, please ask for the percentage and Division). (See Report Card if required).		Did (Name) stop going school **1= YES** **2= No**	How many hours do (Name) spends studying at home? (Write '00' if don't study)		Does (Name) help in household work? **Ask number of hours members spend working at home** (Write '00' if don't work at home)	
	%	Div		Hr	Min	Hr	Min

HEALTH (SECTION 2.2)

Did any of the family members suffered/is suffering from respiratory diseases or eye Infection in last one year? (Refer Diseases section below for the list of diseases)

1 Yes

2 No Go to Section III

LINE NO. Q 2.2.1	DISEASES Q 2.2.2	HEALTH INSTITUTION Q 2.2.3	MONEY Q 2.2.4	TIME Q 2.2.5
List the line number of members who are suffering from such diseases	**1= Runny Nose/ Cold in past 1 year** **2= Sinusitis** **3= Headache (Migraine)** **4= Flu/Fever/ in past 1 year** **5= Allergy (ENT Irritation)** **6= Cough/Dry** **7= Asthma** **8= Bronchitis** **9= Pneumonia** **10= Tuberculosis** **11=Eye Infection** **12= Other Specify**	How many times did (Name) visit to health institution due to (this) illness. (Write '0' if no visit is made)	How much money did you spent to cure the disease (Write amount in words) (Write 0000 if no money is spent). INCLUDING TRANPORTATION	)

SECTION III: ACCESS TO INFORMATION

Q. NO	QUESTIONS	CODING CATEGORIES			SKIP
3.1	How many times in the last month have you or anyone in your household read a newspaper or had one read for you?	___ ___ ___ (Write in Numbers) Not read at all=000 Don't Know = 999			
3.2	Does your household have: A Radio A Television A Mobile Phone A Non-Mobile Phone VCD/DVD Player		YES	NO	
		RADIO/TAPE RECORDER	1	2	
		TELEVISION	1	2	
		MOBILE PHONE	1	2	
		NON MOBILE PHONE	1	2	
		VCD/DVD PLAYER	1	2	
3.3	How often do you or anyone in your household listen to radio?	Every Day……	1		
		A few times a week……..	2		
		Once a Week……	3		
		Less than once a week……..	4		
		Never……	5		
3.4	What kind of program do you listen in the radio?	News……	1		
		Entertaining……..	2		
		Other	3		
3.5	How often you or anyone in your household watch a television?	Every Day……	1		
		A few times a week……..	2		
		Once a Week……	3		
		Less than once a week……..	4		
		Never……	5		
3.6	How long does it take you to get to the nearest working telephone?	Telephone in the house…….	1		
		Less than 15 minutes…….	2		
		15 – 30 minutes……	3		
		31 – 60 minutes……	4		
		More than 1 hour……	5		

3.7	In the past month, how many times you have made or received a phone call?	___ ___ ___ ___ (Write in Numbers) No phone calls=0000 Don't Know = 9999	
3.8	What are the three most important source of about what the government is doing? (Such as Constitutional Assembly Election, Government Change etc) (Enter the code in first which is most important to the respondent)	Relatives, friends and neighbors.. 1 Community…….. 2 Local Market…… 3 Local newspaper…….. 4 National Newspaper……. 5 Radio……... 6 Television……. 7 Groups or Association…….. 8 Business or work associates……. 9 Political associates…….. 10 Community leaders…….. 11 An agent of the government……. 12 NGOs…… 13 Internet……. 14 First ___ Second ___ Third ___	

Q. NO	QUESTIONS	CODING CATEGORIES	SKIP
3.9	In general, compared to five years ago, has access to information improved, deteriorated, or stayed about the same? (Enumerators please note, for treatment group or user of SHS, 5 years ago means prior to installing the SHS)	Improved…….. 1 Deteriorated…….. 2 Stayed about the same…….. 3	
3.10	How long it takes to get to the nearest village which is electrified through grid?	___ ___ ___ ___ ___ ___ (Days) (Hours) (Minutes)	
3.11	Do you know when it was electrified?	1-3 Years ago 1 3- 5 Years ago 2 More than 5 years ago 3	

SECTION IV: GENERAL INFORMATION OF THE HOUSEHOLD:

Q. NO	QUESTIONS	CODING CATEGORIES	SKIP
4.1	What is your religion	HINDU 1 BUDDHIST 2 MUSLIM 3 CHRISTIAN 4 OTHER _____ 5 (Specify)	
4.2	What is your ethnicity/caste WRITE CODE USING CODING SHEET	ETHNICITY ___ ___	
4.3	What type of fuel does your household mainly use for cooking?	ELECTRICITY 1 LPG 2 NATURAL GAS 3 BIOGAS 4 KEROSENE 5 COAL, LIGNITE 6 CHARCOAL 7 WOOD 8 STRAW/SHRUBS/GRASS 9 AGRICULTURAL CROP 10 ANIMAL DUNG 11 NO FOOD COOKED IN HOUSEHOLD 95 OTHER _____ 96 (SPECIFY)	
4.4	Do you use improved cooking gas?	YES…….. 1 NO…….. 2	
4.5	Main Material of the floor (RECORD OBSERVATION)	**NATURAL FLOOR** EARTH/MUD 11 DUNG 12 **RUDIMENTARY FLOOR** WOOD PLANKS 21 PALM/BAMBOO 22 **FINISHED FLOOR** PARQUET OR POLISHED WOOD 31 VINYL OR ASPHALT STRIPS 32 CERAMIC TILES 33 CEMENT 34 CARPET 35 OTHER _____ 96	

		(SPECIFY)	

Q. NO	QUESTIONS	CODING CATEGORIES	SKIP
4.6	Main material of the roof? (RECORD OBSERVATION)	**NATURAL ROOFING** NO ROOF 11 THATCH/STRAW 12 **RUDIMENTARY ROOFING** RUSTIC MAT 21 BAMBOO 22 WOOD PLANKS 23 CARDBOARD 24 FINISHED ROOFING GALVANIZED SHEET 31 WOOD 32 ASBESTOS 33 CERAMIC TILES/SLATE 34 CEMENT 35 ROOFING SHINGLES 36 OTHER _____ 96 (SPECIFY)	
4.7	How many rooms does the house have?	___ ___	
4.8	At what time do you or your family members go to bed in the night?	___ ___ **P.M** **(Write in 12 hours Format)**	
4.9	Does any member of this household own any agriculture land?	YES 1 NO 2	→**4.8**
4.10	How many Kattha/bighas/ropani of agriculture land do members of this household owns?	KATTHA 1 ___ ___ ___ BIGHAS 2 ___ ___ ___ ROPANI 3 ___ ___ ___ 99 or more Bighas/Ropani 995 DON'T KNOW 998	
4.11	Does this household own any livestock, herds, other farm animals, or poultry?	YES 1 NO 2	→**5.1.1**

4.12	How many of the following animals do this household own? IF NONE, ENTER '00'. IF MORE THAN 95, ENTER '95'. IF UNKNOWN, ENTER '98'.	BUFFALO __ __ COWS/BULLS/OXEN __ __ HORSES/DONKEYS/MULES __ __ GOATS __ __ SHEEP __ __ CHICKENS __ __ DUCKS __ __ PIGS __ __ YAKS __ __	

SECTION V: INCOME (5.1. 1 AGRICULTURE INCOME FOR LAST 1 YEAR)

	PRODUCTION			EXPENDITURE
TYPES OF CROPS Q 5.1.1.1	UNIT 1= quintal/k.g 2=Muri/Pathi Q 5.1.1.2	TOTAL HARVEST Q 5.1.1.3	PRICE PER UNIT Q 5.1.1.4	Do you know how much you spend for the production of (crops)? Including purchase of seed, fertilizers, incesctide and hired labor, livestock. Q 5.1.1.5
RICE		/		
MAIZE		/		
WHEAT		/		
MILLET		/		
BARLEY		/		
POTATO		/		
OIL SEED		/		
PULSES		/		
VEGETABLES 1. 2. 3. 4.				
FRUITS 1. 2. 3. 4.				
OTHERS 1.				

2. 3. 4.				

SECTION V: INCOME (5.1.2 LIVESTOCK INCOME)

Check whether household owns some kind of live stock or not? CHECK Q.4.8

Tick appropriate box

Owns some kind of live stock ☐----- Go to Q. 5.1.2.1

Do not own any kind of live stock ☐----- Go to Q. 5.4.1

SECTION V (5.1.2 SALE/PURCHASE OF LIVESTOCK IN LAST 1 YEAR)

Did your HH Sold or purchased any Livestock in past 1 year

Yes	1	
No	2	Skip to5.2.1

	SALE			PURCHASE		
	UNIT Q. 5.1.2.1	**PRICE PER UNIT** Q. 5.1.2.2	**TOTAL INCOME** Q. 5.1.2.3	**UNIT** Q. 5.1.2.4	**PRICE PER UNIT** Q. 5.1.2.5	**TOTAL EXPENDITURE** Q.5.1.2.6
BUFFALO						
COW						
BULL						
GOAT						
SHEEP						
PIG						
CHICKENS						
OTHER (SPECIFY						

SECTION V: INCOME (5.2 EXPENDITURE ON LIVESTOCK)

Write money spent for the purchase of:

	FEED Q. 5.2.1	**MEDICINE** Q. 5.2.2	**VETENIRARY SERVICES** Q. 5.2.3	**TRANSPORTAION** Q. 5.2.4	**OTHER EXPENDITURE IF ANY** Q 5.2.5
BUFFALO					
COW					
BULL					
GOAT					
SHEEP					
PIG					
CHICKENS					

OTHER (SPECIFY					

SECTION V: INCOME (5.3. INCOME FROM SALE OF LIVESTOCK PRODUCTS)

Does you r HH make any income through the sale of Livestock products?

Yes	1	
No	2	Skip to5.4.1

PRODUCTS Q.5.3.1	**UNIT** **1=LITRE** **2=MANA** **3=K.G** **4=NUMBER** Q.5.3.2	**TOTAL PRODUCTION** Q.5.3.3	**PRICE PER UNIT** Q.5.3.4	**TOTAL INCOME** Q.5.3.5

SECTION V: INCOME (5.4. OWN BUSINESS – ECONOMIC ACTIVITIES)

Q. NO	**QUESTIONS**	**CODING CATEGORIES**	**SKIP**
5.4.1	As you know, aside from household work, some have a small business or some make and sell handicrafts, from which they make money. Such business or handicrafts includes 1. Tea shop or restaurant 2. Doko, Nanglo, Khucho etc 3. Khukuri etc. 4. Utensils made out of mud. 5. Mobile charging service 6. Tuition Classes 7. Others **(CAN BE MORE THAN ONE)** *Record line number of HH member	YES 1 ____ NO 2 ____ * **SPECIFY ACTIVITIES** — **From when** — **MONEY INCOME** — **Expenditure** ____	---- 5.5.1
5.4.2	When do you usually work for such activity	Specify time In the Morning 1 _____	

	(NOT FOR SHOP OR RESTAURANT OWNER)	During the Day 2 _____ In the Evening 3 _____ At Night 4 _____	
5.4.3	What time do you usually close your shop at night? (ONLY FOR SHOP OR RESTAURANT OWNER)	_____ (SPECIY TIME)	

SECTION V: INCOME (5.5 WAGE INCOME)

Does any member of your HH earn

Yes	1	
No	2	Skip to5.6.1

wage

LIST LINE NUMBER OF HH MEMBER, WHO ARE INVOLVED IN WAGE EARNINGS Q 5.5.1	NUMBER OF MONTHS EMPLOYED Q 5.5.2	CASH WAGE PER DAY Q 5.5.3	WAGE IN KIND PER DAY Q 5.5.4	TOAL WAGE INCOME Q 5.5.5

SECTION V: INCOME (5.6. REMITTANCE/TRANSFER INCOME

Q. NO	QUESTIONS	CODING CATEGORIES	SKIP
5.6.1	Did your household receive any money from abroad in last 1 year? If Yes how much	___ ___ ___ ___ ___ ___ **(Write 000000 if not received any money)**	
5.6.2	Did any of your household members receive pension? If yes how much	___ ___ ___ ___ ___ ___ **(Write 000000 if not received any money)**	
5.6.3	Did any of your household members receive old age or widower's allowances? If yes, how much	___ ___ ___ ___ ___ ___ **(Write 000000 if not received any money)**	

SECTION VI: SHS DETAILS (THIS SECTION IS ONLY FOR SHS USERS OR TREATMENT GROUP)

Q. NO	QUESTIONS	CODING CATEGORIES	SKIP
6.1	What is the capacity of your SHS?	**Solar panel___ ___, Battery ___ ___** **(Specify Watts) (Specify AH)**	
6.2	When did you install SHS (Ask, how many years back SHS was installed?)	___ ___ **(Write in years)**	
6.3	What are the types of load installed in your house? **(MULIPLE CHOICE)**	Lamps 1 Radio 2 TV 3 DVD/VCD 4	

		Cassette player 5 Mobile phone 6 Others 7	
6.4	How many lamps are installed in your house?	___ ___ **(Specify Numbers)**	
6.5	What are the types of lamps used in your house?	**Type** **Number** CFL ___ ___ 1 FTL ___ ___ 2 WLED ___ ___ 3 Other ___ ___ 4	
6.6	Where have you installed the Lamps? **(MULTIPLE CHOICE)**	Kitchen 1 Living Rooms 2 Bed Rooms 3 Toilet 4 Verandah 5 Outside 6 Other 7	
6.7	Who told you about the SHS?	Radio 1 Television 2 Newspaper 3 Regional Office 4 Relatives 5 Neighbors 6 Promoter 7 Others 8	
6.8	Which family member in your HH decided to install the SHS (If respondents says, SHS is installed from a collective decision then enter the line number of HH Head)	___ ___ (Insert Line number from section 1)	
6.9	What was the source of energy used for the purpose of lighting before installing a SHS?	Kerosene 1 Jharo 2 Candle 3 Other 4	
6.10	What was the total cost of installation of SHS	__ ___ ___ ___ ___ (Specify in Rupees)	
6.11	Was that amount inclusive of government subsidy?	Yes 1 No 2	
6.12	How did you finance the cost for installation? (Multiple Choices)	Routine wage or salary income 1 Sell of assets 2 Savings 3 Borrowed 4	} 7.1

Q. NO	QUESTIONS	CODING CATEGORIES	SKIP
6.12	**ONLY, IF BORROWED** From where	Relatives/ Neighbors 1 Local money lenders 2 Saving Groups (CFUS, Mothers groups etc) 3 Financial Institutions (Bank etc) 4 Others 5	
6.13	What was the annual interest rate?	___ ___ (Specify)	
6.14	In how many months/years you were/are suppose to repay the loan?	___ ___/___ ___ Years / Months	
6.15	Have you fully repaid the loan?	Yes 1 No 2	------7.1
6.16	How much money do you owe?	___ ___ ___ ___ ___ (Specify in Amounts)	

SECTION VII: SATISFACTION LEVEL (THIS SECTION IS ONLY FOR TREATMENT GROUP OR USER OF SHS):

Q. NO	QUESTIONS	CODING CATEGORIES	SKIP
7.1	What was your expectation from SHS before its installation? (MULTIPLE CHOICES)	Only Lamps 1 Radio/Tape Recorder 2 Television 3 VCD/DVD Player 4 Mobile Phone 5	
7.2	Did your SHS meet such expectations?	Yes 1 No 2	
7.3	Was there any problem with your system till date?	Yes 1 No 2	--→**7.6**
7.5	Which part of the system was repaired? **(Multiple Choice)**		
7.6	How many times battery water topping was done?	Once a month 1 Thrice in a year 2 Twice in a year 3 Once a year 4	

Coding for problem resolved through	
Self maintenance	1
Neighbor's help	2
Solar technician from company	3
Other	4

		Problem resolved through	Cost of repair
PV panel	1		
Battery	2		
Charge controller	3		
Lamps	4		
Switches	5		
Other	6		

		Never 5	
7.7	How many times have you cleaned the solar panel?	Once a month 1 Thrice a year 2 Twice a year 3 Once a year 4 Never 5	

Q. NO	QUESTIONS	CODING CATEGORIES	SKIP
7.8	Did you upgrade your SHS	Yes 1 No 2	
7.9	Did you change your battery	Yes 1 No 2	
7.10	Do you still feel your lamps are as brighter as it was when you installed?	Yes 1 No 2	
7.11	How often do you clean your lamps?	Once a week 1 Once a month 2 Once a year 3 Never 5	
7.11	Did your SHS installer gave you enough technical information on repair and maintenance of SHS	Yes 1 No 2	
7.12	Do you want to increase the capacity of your system?	Yes 1 No 2	
7.13	What is your additional requirement?	TV 1 Computer 2 Lamps 3 Others 4	
7.14	How satisfied you are with the performance of your SHS	Highly Satisfied 1 Moderately Satisfied 2 Not satisfied 3	

SECTION VIII: DETAILS ON SOURCE OF LIGHTING OTHER THAN SHS (THIS SECTION IS ONLY FOR NON-USER OF SHS OR CONTROL GROUP).

<table>
<tr><th>Q. NO</th><th>QUESTIONS</th><th>CODING CATEGORIES</th></tr>
<tr><td>8.1</td><td>What is the source of energy used for the purpose of lighting?

(MULTIPLE CHOICE)</td><td>
<table>
<tr><th></th><th></th><th>Unit
1= liter
2=number</th><th>Per unit price</th><th>Amount required per week</th><th>Total Amount per week</th></tr>
<tr><td>Kerosene</td><td>1</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jharo</td><td>2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Candle</td><td>3</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Battery</td><td>4</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Other</td><td>5</td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>8.2</td><td>Is the source of energy regularly available?</td><td>Yes 1
No 2</td></tr>
<tr><td>8.3</td><td>Where do you get the source of energy from?</td><td>From the nearby forest(for Jharro) 1
From market in the district headquarter 2
From local market in villages 3
Others 4</td></tr>
<tr><td>8.4</td><td>What are the uses of lighting at your house?</td><td>Uses Hours
Kitchen lighting 1
Study for children 2
Income generating activity 3
Others 4</td></tr>
<tr><td>8.5</td><td>Is the source you use, good and sufficient?</td><td>Yes 1
No 2</td></tr>
<tr><td>8.6</td><td>What is your plan for better lighting if you have money?</td><td>Install SHS 1
Install Biogas 2
Contribute to power generation by MHP 3
Others 4</td></tr>
</table>

CODING
ETHNICITY/C ASTE

01	BRAHMIN
02	CHHETRI
03	DANUWAAR
04	GHARTI
05	GURUNG
06	KAAMI
07	KIRATI
08	MAGAR
09	MAJHI
10	MUSALMAN
11	NEWAR
12	PARIYAR
13	PRAJA
14	RAJBANSI
15	SANYASI
16	SARKI
17	SATAR
18	TAMANG
19	THAKURI
20	THARU
21	OTHER
98	DON'T KNOW

A4. CHECKLIST FOR FGD AND KII

Socio Economic Impact Study of the User of Solar Home System

Checklist for Group Interview and FGD among user of SHS

Questions:

1. When did you install the solar home system?

2. **Do you think SHS has made positive impact on the areas like:**
    1. Access to information? How? Can you give an example?
    2. Livelihood? Did it facilitate to initiate some income generating activities? If yes, please give the details of your activities. How much money do you make monthly from such activities?
    3. Health? Do you think SHS has made positive impact on health of HH members by reducing the smoke coming through kerosene?
    4. Education? Do you think SHS has improved the performance of your children in school, as it provide light during night so that your children can study during night as well.
    5. Time? Do you think SHS has increased the time available to work?
    6. Security? Do you think SHS has helped in reducing the incidents of crime, thief etc?
    7. Gender? Do you think SHS has distinct impact on male and female member of your family? How?

3. **Satisfaction level: Are you fully satisfied with your SHS?**
    1. What was your expectation from SHS before installing? Like lamps, radio, television?
    2. Did SHS meet such expectations? How?
    3. How many times your SHS, battery or lamps broke down? Did you repair it? How? What was the cost or repairing?

4. **Did you borrow money to install the SHS? If yes, how much?**
    1. From where did you borrow the money?
    2. What was the rate of interest?
    3. Did you fully repay the money?
    4. Was it difficult to raise the money?

5. **Possible End Use**
    1. What else do you expect from SHS or what other electrical equipments other than you have already installed do you want to use through SHS? Like refrigerator, computer etc
    2. Are you ready to pay to upgrade your system to use such electrical equipments?
    3. Do you want government to increase the amount of subsidy for installing SHS with high capacity?
    4. If government decides to install a SHS to establish a cinema hall or cyber cafe in your village, do you think people in your village are willing to pay some percentage of money?