Submitted to : Government of Nepal (GoN)

Alternative Energy Promotion Center (AEPC)

Khumaltar Height, Lalitpur, Nepal

Final Report on

Impact Study of Karnali Ujjyalo Programme (KUP)

March, 2012

Submitted by

Technology and Rural Upliftment Service Team

(TRUST) Pvt. Ltd.

Jawalakhel, Lalitpur

ACRONYMS

AEPC **:** Alternative Energy Promotion Centre
ASS **:** After Sale Service
CO_2 : Carbon Dioxide
CRE **:** Centre for Renewable Energy
DDC **:** District Development Committee
ECCA **:** Environment Camps for Conservation Awareness
ESAP **:** Energy Sector Assistance Program
FGD : Focus Group Discussion
FY **:** Fiscal Year
GoN **:** Government of Nepal
HH **:** Household
INGOs **:** International Non Governmental Organizations
KUP **:** Karnali Ujjyalo Program
LED : Light Emitting Diode
MHP : Micro Hydro Power
NGOs **:** Non Governmental Organizations
NiMH **:** Nickel Metal Hydride
NR : Not Responded/Recorded
PV : Photo Voltaic
R & M : Repair and Maintenance
SEC : Solar Energy Component
SHS **:** Solar Home System
SSHS **:** Small Solar Home System
ST **:** Solar Tuki
ToR **:** Terms of Reference
TRUST **:** Technology and Rural Upliftment Service Team
VDC **:** Village Development Committee
WLED **:** White Light Emitting Diode
Wp : Watt Peak
WWF **:** World Wildlife Fund

Executive Summary

1. Introduction

Geographically remote, absence of adequate infrastructure development, and backward in development have forced the most places of Karnali Zone and adjoining districts to rely on the kerosene lamp, Jharro (pine wood rich in latex) and dry cell for lighting. The Government of Nepal (GoN) has launched the special programme called "Karnali Ujjyalo Programme" (KUP) in 2007 to enable the people in Karnali zone and its adjoining districts to purchase the Solar Tuki. Under this programme the GoN distributed 31,000 Small Solar Home System (SSHS) called "Solar Tuki" (ST)1 in five districts of Karnali zone and 29,000 ST in four adjoining districts of Jajarkot, Bajhang, Achham and Bajura through Alternative Energy Promotion Centre (AEPC). Ninety five percent of the cost of ST (Unit Price Rs. 4,500) was subsidized by the GoN. The main objective of the program was to provide lighting system for the households in Karnali zone and its adjoining districts focusing on the low income people in remote areas.

2. Objectives of the Study

The major objective of this study is to assess the impact created by Solar Tuki on households in particular and community in general perspective. The specific objectives of the assignment are to assess its socio-economic and environmental impacts at the household and community levels; assess the current status and situation of the distributed ST; assess the effectiveness and importance of the Program from local as well as national perspective and recommend suggestions for future and also to monitor the technical performance of the ST including the after sales services provided by the system suppliers.

3. Methodology

The study has been based on both primary and secondary sources of information. Structured questionnaire has been administered to randomly sampled households in the field survey to collect primary information and data required. A total of 3,001 ST user households (5% of ST user households from each of nine districts) and 151 non-user households (over 5% of no. of sample ST user households) have been selected for household survey. Thus, a total of 3,152 sample households have been surveyed for this study. Field enumeration has been carried out by three separate groups covering three districts each. Each group has organized one FGD in one of their three survey districts to gather information from the community relating to the changes in the socio-economic activities in the community after the installation of ST particularly in their income generation, socialization, environment, health and education aspects in order to assess the impacts (socio-economic, environmental, consumer's satisfaction etc.) of KUP. The field enumerators have also performed on-site field observation and appraisal of ST installation to generate required information. Question survey has also been conducted for the neighboring ST non-user households to trace the difference in the socioeconomic condition of ST user and non-user households. Data entry and analysis have been done using computer software SPSS 12. Both descriptive and inferential statistics have been employed wherever required and findings in a comprehensive report format have been presented with appropriate graphs and photographs.

1 The solar tukis consists of lamps made of WLEDs, storage battery, solar module for charging the battery, controlling units, switches and wires. During the day time the solar module charges the battery and during evening and night hours the stored energy is used to lit the lamps. A small radio can also be powered by the storage battery.

4. Conclusions

KUP districts are male dominated society, which is obvious from the fact that less than 5% households are headed by female out of 3,001 surveyed households. Similarly female ownership over the ST set is found to be only 5.1% ranging from 2.7% in Jajarkot district to 10.3% in Humla district. The highest benefited caste from the Program is the Chhetri followed by Dalit and Thakuri. Hindus are mostly beneficiaries except in Humla district. The ST has not been evenly distributed among different castes and among the different religion in these districts. The sets have not been distributed to each and every household of the same settlement. This uneven distribution of the set has created dissatisfaction in the mind of non beneficiaries. Besides, the quality of the system components, the management and execution of after sales service (ASS) provision during and after the warranty period are found to be the deciding factor in poor performance of the supplied solar tuki.

Implication of solar tuki installation on income generation of these people has been assessed through evaluating the impacts on small shop keeping, agro-business, livestock keeping, wage labor, poultry farming, collection of forest products and others. The rural people of Karnali have been able to harness the highest average monthly incremental household income from livestock keeping and followed by small shop keeping and agri-business in the Program areas. More than 75% of the total solar tuki user respondents have been satisfied with level of energy saving due to the use of solar tuki.

Good improvement in respiratory, optical and other health aspects as well as remarkable improvement in their home sanitation after the installation has also been realized. 76.5% of the total respondents in all districts are satisfactory in relation to the improvement in children's education using solar tuki. Rural people of the program areas have listened to various types of radio programs relating to knowledge and skill development as well as entertainment playing the transistor with power supplied by the solar tuki. They have opined that these radio programs they listened help them in the field of skill and knowledge development as well as entertainment. News, agricultural program, radio serial program, health and sanitation program, women program and other programs are mostly listened programs. The highest number of respondents listen the News program. They have realized the usefulness of these radio programs in enhancing their information, knowledge, skill, and awareness, as well as in enjoying various types of entertainments.

The solar light has helped them to prolong their evening life and consequently, it encourages to work as well as to have social gathering. The social gathering, of course, helps to improve the family as well as social integration in their settlements. Most of the respondents are satisfied with family integration through social gathering in evening. The ST non-user neighbors (including male, female and children) have been found visited to ST user houses for listening to various radio programs in evening. These visiting of neighbors have helped to develop the intimacy and friendship among the neighbors and create the healthy environments in the settlements.

Women empowerment is yet to be a distant target in the country regarding to the female household head and female ownership. Children have been found helping their mothers in household chores satisfactorily using their saved time to make the mother free from household chores at least to some extent. This helps them to enhance their confidence in decision making and to spare their time to involve in socio-economic activities outside house.

After the use of ST, the frequencies of whitewashing the room and washing clothes have been reduced remarkably. Thus, the respondents have realized that the use of ST help them to reduce the whitewashing and laundry activities, which save their time and money. These saved money and time can be utilized in other productive activities.

This social gathering brings happiness of family and social integration. But it is assumed that some sorts of social problems such as: encouraging card playing habit, back biting habits mostly, among women may brings unwanted social problems and social disintegration. But 98.4% respondents have opined that they did not face such negative effects of solar tuki in their settlements. Thus, the use of solar tuki has very negligible percentage of negative social implications on the society in these districts.

Most of ST user respondents are willing to install higher capacity solar system in their homes. Realizing the benefits from the use of ST, they have advised or ready to advise their ST non-user neighbors to install it.

In conclusion the impact of the use of solar tuki has been found positive on livelihood of the rural people as well as on developing their social integration in their villages. But most of the users among the surveyed 3,001 households are not satisfied with technical aspects. Despite the above mentioned favorable socio-economic impacts of the program, we should also consider the fact that the data relating to socio-economic implications of ST installation has been developed based on the responses of the respondents recalling the implications realized during the period of initial 6-12 months of problem free operation of solar tukis.

5. Suggestions

Based on the above findings and conclusions, the following suggestions can be recommended:

- Set up strong distribution network such that targeted household gets the set directly.
- Devise a method during distribution which will prevent multiple distribution of the set to one single family (Some sort of ID viz. citizenship etc. based).
- Make distribution bureaucratic and political pressure free.
- Ascertain quality of each components of the set before distribution.
- Service center should be made available locally and strengthen the after sales service (ASS) accordingly.
- Develop local technical manpower conducting a training program at a hub of villages.
- Distribute to all households of the settlement not on the sample basis that creates a conflict.
- Ensure supply of the spare parts to the local shops for easy access for R&M.
- In spite of showing the positive impact on the income generation of solar tuki, many local people have said in the focus group discussions that the use of set has not brought the noticeable increment in their income due to the lower capacity of the set. So if possible in the future program, increase the capacity of the set (say 10 W).
- Develop the joint program with the schemes of distributing improved cooking stoves so that the remarkable health and environmental impacts can be achieved.
- Include a staff of AEPC in the distribution team for continuous monitoring of the distribution process and modalities.
- Provide skill development training on various aspects of income generating activities regarding agriculture production, agro-based industries, selling of agro-products in the market, cottage industries, and others.
- Mention clearly the amount of subsidy in the price list and advertise widely about it through appropriate channel.

Table of Content

CHAPTER-V: FINDINGS

CHAPTER-VI: CONCLUSIONS AND RECOMMENDATIONS

List of Table

List of Figure

List of Chart

Chapter-I Introduction

1.1 BACKGROUND

Due to the remoteness and lack of adequate infrastructure development, most places of Karnali Zone and adjoining districts have no access to electricity. Moreover, extension of grid electricity in those areas is very expensive. Besides, the people living in these areas have very low income hence they could not afford SHS and Micro-hydro Power. That makes them bound mainly to rely on the kerosene lamp, Jharro (pine wood rich in latex) and dry cell for lighting. Those systems affect environment surrounding to them as well as their health adversely. Some organizations had been involved in disseminating different kinds of Tuki light (Tuki in Nepali means lamp) running from the dry cell which were not tested and not guaranteed to run. Similarly, there was also no assurance of the after sales services.

"Karnali Ujyalo Programme" (KUP) in the annual budget of FY 2063/64 was the effort of Nepalese Government to overcome the situation of severe energy crisis for lighting in those areas. Under this program Government of Nepal (GoN) distributed 31,000 Small Solar Home System (SSHS) called "Solar Tuki" (ST) in five districts of Karnali zone and 29,000 in four adjoining districts of Jajarkot, Bajhang, Achham and Bajura through Alternative Energy Promotion Centre (AEPC) (Table No. 1.1). The cost of such ST was about Rs 4,500 of which GoN provided Rs 4,275 (95% subsidy) and users paid only Rs 225 under this program.

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

Table No. 1.1: Solar Tuki (ST) distributed under Karnali Ujjyalo Program

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

Source: AEPC, 2010.

1.2 OBJECTIVES

The major objective of this assignment is to assess the impact created by Solar Tuki on households in particular, community in general as well as in national perspective. The lessons learnt from present implementation model can be used for designing action plan for the implementation of such program in the next phase.

The specific objectives of the assignment are to:

- assess the impacts (socio-economic, environmental, consumer's satisfaction etc.) of the Karnali Ujjyalo Program at the household and community levels;
- assess the current status and situation of the distributed "Solar Tuki" in Karnali zone and adjoining districts;
- assess the effectiveness and importance of the "Karnali Ujjyalo Program" from local as well as national perspective and recommendation for future; and
- monitor the technical performance of Solar Tuki, assess the service provided by the companies, R and M, major problems encountered etc.

1.3 GENERAL ACTIVITIES

The whole study was completed undergoing activities listed below in close coordination with AEPC/SEC for promptness, efficiency and accuracy:

1. In depth study and review of the reports carried out previously for similar kind of studies.
2. Used proposed areas and sample size for primary data collection with proposed methodology along with the most cost effective way so as to get maximum representation of "Solar Tuki" users.
3. Regular interactions with AEPC for a good understanding of the whole exercise and for necessary coordination/resource mobilization.
4. Used proposed questionnaire and check list (after AEPC finalization) for primary data collection.
5. Organized workshops in districts to get broad perspective on the study.
6. Primary and secondary data collection were done, processed and analyzed consequently in accordance with the proposed methodology.
7. Local institutions viz. health post, schools etc were also consulted to understand the impacts of Solar Tuki to the users.
8. After the detailed analysis this draft report was prepared and submitted to the AEPC for feedbacks.
9. This final report has been prepared incorporating AEPC feedbacks and will be submitted to the AEPC.

1.4 SCOPE OF WORK

The scope of work is to deduce the impacts of ST promoted by Karnali Ujjyalo Programme on the users including parameters such as:

- Operational status of ST
- After sales service and R & M status
- Empowerment
- Social status/Cultural impacts/Consumer's satisfaction and demand
- Livelihood
  - ✓ Income (impact on poverty, increase in economic activities, decrease in investment on fuel)
  - ✓ Health (reduction in incidence of burning due to kerosene lamp/jharro etc., reduction in health centers visits/medicines)
  - ✓ Drudgery (time, working hour reduction/increment)
- Contribution to environment
  - ✓ Indoor environment
  - ✓ Outdoor environment
  - ✓ Reduction in CO_2
- Gender perspective (participation of male and female on technology adoption, uses, repair and maintenance etc)
- Future prospects and need of the same kind of programme

Chapter-II Impact Study Framework

2.1 STUDY APPROACH

The study has been conducted with following approaches and strategies.

- A collaborative and coordinative approach has been adopted for this impact study with the AEPC and other related organizations/institutions. The personnel of AEPC and other organizations have been consulted while conducting survey as mentioned in Terms of Reference (ToR).
- Secondary data and information have been collected exhaustively. These data and information have been reviewed thoroughly. These data and information have been collected from the project appraisal reports, routine reports and other relevant reports and records of AEPC.
- Field visits, field observations and household survey have been carried out to collect primary data and information. In addition, community or group meetings, focus group discussions and individual interactions have also been organized to get logical and qualitative information on problems and issues.

2.2 METHODOLOGICAL FOUNDATION OF THE STUDY

The study has been conducted in a logical sequence. TRUST has adopted two basic methodologies for this study. These are: (a) analytical and evaluative review; and (b) direct sample survey of ST users and ST non-users.

2.3 ANALYTICAL AND EVALUATIVE REVIEW METHODS AND PLANNING PHASE

This study was extensively depended on the collection of primary information as well as secondary data and information. For this, TRUST feels that both analytical and evaluative reviews are required.

Analytical Review: Systematic Secondary Information Collection and Analysis approach have been utilized. Under this approach, an exhaustive list of relevant documents related to ST dissemination activities and the overall socio-economic impacts on users and all cross cutting issues and problems have been collected and reviewed. The review has been analytical to capture the sense of both the experiences and feelings of users on socio-economic and technology related issues concerning the applicability of the system for the sustainable rural energy development and management.

Evaluative Review: TRUST has prepared a simple matrix to draw relevant aspects from the referenced item. The evaluative review has comprehensively drawn the most applicable socio-economic indicators in the context of ST users. The outcomes of both reviews have been synthesized.

Synthesis: The study team has synthesized the information gathered through both types of reviews and present to establish a strong basis for the survey.

Consultation: Once the single activity has completed, strategic consultation has been performed to check the validity of the task, their legibility to the potential groups of planners and communities. Similarly, congruency analysis has been conducted to avoid any discrepancies in the illustrations made in the survey report, its formatting and ultimately the presentation.

Consolidation: The consolidation stage has involved in synthesizing the information collected through the field survey and consultation process. Then all recommendations gathered through consultation have been incorporated to prepare the draft report.

Logical Presentation: As suggested in the ToR, study team has presented the work plan including field schedule in logical form. This has ensured the sequential execution of the study and survey and precaution to be taken (Figure 2.1).

Phases

I. Negotiation

II. Planning

III. Field Work

IV. Reporting

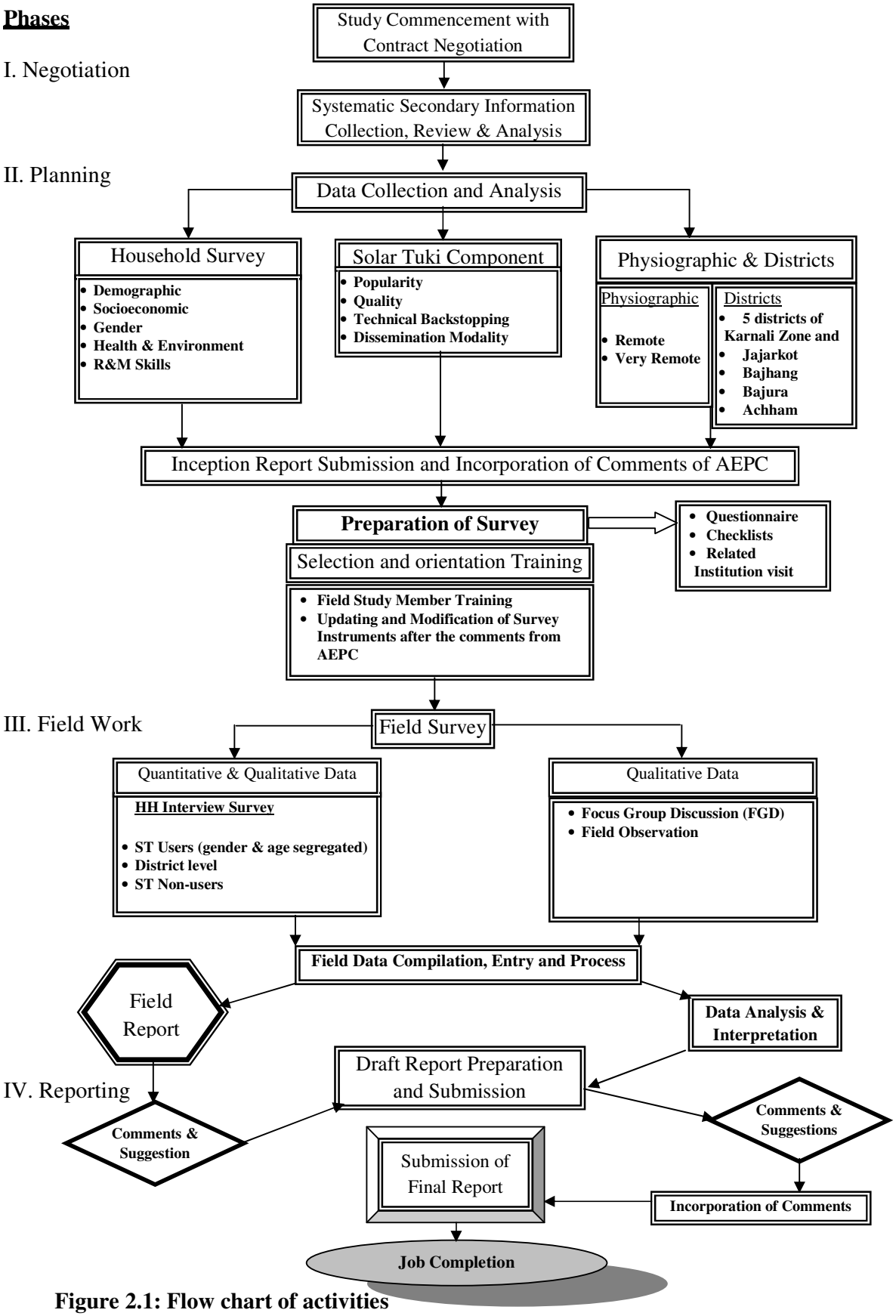


Figure 2.1: Flow chart of activities

2.4 DESK STUDY

Available materials such as existing project records, project appraisal reports, base line survey reports, routine reports of partner organizations of ST and other relevant reports and records of AEPC have been explored and thoroughly reviewed. Impact study has been founded on desk study findings. Following secondary information have been compiled during the desk study.

- Physical progress of ST activities including number of ST installed, training program conducted, promotional activities implemented etc.
- Information regarding socio-economic and ethno-demographic characteristics of Solar Tuki (ST) users and non-users.
- Research methodology for conducting field study including detail survey, questionnaires and a description of other field methods to be used.
- Define, design and develop analysis methods and appropriate statistical packages.

The questionnaires, checklists for workshops are presented in annexes.

2.5 PREPARATION FOR ST USERS' SURVEY

The study team has prepared the systematic plan of ST users' survey in close coordination with AEPC. It has included following activities:

- organization of meetings with AEPC and other related organizations;
- coordination with the study team members and understanding of their role and responsibilities;
- finalization of ST users' survey execution strategies and methodologies;
- finalization of survey questionnaires and checklists for the workshops ;
- conduction of orientation training for field team members; and
- preparation of final field activities and logistic arrangements.

2.6 FIELD SURVEY METHOD

Following field survey methods have been used to collect primary information and data required for ST users' study from the field.

Household and Community Survey

Users' Household Survey: Pre-tested interview questionnaire has been administered to randomly sampled households in the study sites. The random sample households have been extracted by using the random table from the list of ST user households.

A total of 3,001 ST user households (5% of ST user households from each of nine districts) and 151 non-user households (over 5% of no. of sample ST user households) have been selected for household survey (Table No. 2.1). The reason behind the selection of non-user household is to assess the difference in the impact in socioeconomic

condition of ST user and non-user households. Thus, a total of 3,152 sample households have been surveyed for this study. The sample selection has been carried out so that within the district it covers maximum ST user's VDC coverage and most of the ST manufacturers varieties.

Sample selection criteria

1. The sample has cover 5% of the total users population in every district.
2. Within the district sample selection has cover maximum ST user's VDC coverage.
3. Sample selection has covered most of the ST manufacturers varieties.

Table No. 2.1: Sample size

S.N.	District	Number of ST User HHs	No. of Sample ST User Households (5% of ST User HHs)	No. of Non-user Sample Households (5% of No. of Sample ST User HHs)
1	Dolpa	1590	79	4
2	Mugu	5200	260	13
3	Jumla	6800	342	18
4	Kalikot	13760	687	34
5	Humla	3650	185	9
Sub-total		**31000**	**1553**	**78**
6	Jajarkot	6000	300	15
7	Bajura	5000	253	13
8	Achham	11000	551	28
9	Bajhang	7000	344	17
Sub-total		**29000**	**1448**	**73**
Total		**60000**	**3001**	**151**

Further VDC wise and geographical breakdown has been done after consultation with AEPC.

The survey has been conducted to generate information listed below.

- Changes in socio-economic condition of respondent households after the installation of ST. This broadly comprises family size, sex, age, education level, study duration of the children, changes in the expenditure on fuel and their impacts on income and expenditure, environment, satisfaction of the households in ST use etc.
- Motivation factor, source of information and decision making factor for SSHS/ST installation.
- Gender involvement in operation and maintenance of installations.
- Burden and cost sharing in operation and maintenance.
- User's satisfaction in relation to illumination, improvement in family health and household environment etc.
- Mismatch between SSHS/ST performance and users' expectations.
- Gender perception on SSHS activities.

- Identification of most important determinants for the sustainable operation and maintenance of SSHS.
- Implications of SSHS subsidy and their linkages with credit agencies.
- Problems, issues and solutions related to SSHS installation, operation, maintenance and extension.

Community Survey: Discussions have been held with the community people or the groups of people to assess the impacts socio-economic, environmental, consumer's satisfaction etc. of KUP. The checklist has been used to gather information from the community. The focus of the information to be gathered has been on the changes in the socio-economic activities in the community after the installation of ST particularly in opening of shops, social, cultural and religious activities, changes in street fights, changes in the movement of drunken people at night and incidence of other crimes etc. in the community. This has been done in the community which has higher number of ST installation in the district. This has been done at least one in each district.

Non-users' Household Survey: Interview has also been conducted for the neighboring households which has not installed and used ST. This has given idea on the difference in the socioeconomic condition of ST user and non-user households. This has also help design strategies and policies for up-scaling of such program in future. This has generated following information.

- Socioeconomic status of the no-user households.
- Awareness regarding SSHS installation programme.
- Perception on SSHS programme.
- Motivational factor for the adoption and non-adoption of SSHS
- Reasons for non-installation of ST.
- Conviction for adoption of ST installation.

Focus Group Discussion (FGD)

Field enumeration has been carried out by three separate groups covering three districts. Each group has organized one Focus Group Discussion (FGD) in one of their three survey districts. The FGD participants list is included in the Annex.

Field Observation and Appraisal

The field enumerators have performed on-site field observation and appraisal of ST installation to generate following information.

- Operation level of ST.
- Incremental income generating activities.
- Problems and issues related to ST.
- Direct and indirect benefits.
- Technical backstopping and support services.

- Operation and maintenance practices.
- Implications of subsidy.
- Agencies/organizations involved in the promotional activities.

2.7 DATA PROCESSING AND ANALYSIS PHASE

Completed pre-coded questionnaires during the day have been checked in the evening and corrections have been made wherever need arises. Matters like local units reported by the respondents have been converted into uniform and standardized units before data entry into the computer.

- Collected data has been processed and analyzed by using necessary statistical tools and appropriate computer software.
- The physical status of the project, performance, socio-economic impact, socially acceptance status has been analyzed in tandem with remoteness and gender dis-aggregation.

Data entry has been done using computer and later transferred to suitable software viz. SPSS 12 formats or as per AEPC requirements for analysis. Both descriptive and inferential statistics have been employed wherever possible and present findings in a comprehensive report format with graphs and photographs.

2.8 REPORTING SCHEDULE

Reporting and presentation schedule is presented below.

2.8.1 Preparation and Submission of Inception Report

Inception report has prepared and submitted before embarking the actual field survey. The inception report has consisted of review and analysis of secondary information presenting status of Karnali Ujjyalo programme, AEPC policy and implementation strategy, detail field survey methodology and other logistic arrangement schedules. Two copies of inception report have been submitted 15 days after the assignment contract been effective.

2.8.2 Preparation and Submission of Field Report

Upon completion of fieldwork preliminary findings have been produced describing observations and preliminary trend of ST impact on users and its spillover effects on neighboring households.

2.8.3 Preparation and Submission of Draft Report

After consolidation, synthesis, analysis and interpretation of field data, draft report has been prepared and submitted for review and comments. Draft Report has consisted of the findings and conclusion based on the analysis of the data compiled in the previous stages. The report has contained preliminary conclusions and recommendations.

2.8.4 Preparation and Submission of Final Report

Three original copies of report and an electronic version (CD) of final report will be prepared and submitted after incorporating all the comments and suggestion of AEPC. The final report will be submitted 15 days after the receipt of comments and suggestions from AEPC.

Reports Submission/Presentations	Date
Inception Report	15 days after effectiveness of contract
Field Report Preparation and Submission	7 days after completion of fieldwork
Draft Report submission and presentation	30 days after completion of fieldwork
Final Report Submission	15 days after receipt of comments on draft report

2.9 SURVEY ORGANIZATION

The enumerators with proven experience in socio-economic survey with a good education background have been selected for field enumeration. Orientation program has been organized to familiarize the enumerators with the study concept, survey techniques, followed by detailed briefings on the questionnaire. The questionnaire has also been pre-tested and using the feedback from the enumerators, the questionnaire has been further improved in closed collaboration of AEPC.

The following team has been involved in the survey procedure:

SN	Proposed Position	Name
1.	Team Leader	Dr. Durga Lal Shrestha
2.	RE Expert	Dr. Dinesh Kumar Sharma
3.	Statistician	Mr. Raju Manandhar
4.	Survey Coordinator	Ms. Pramila Shrestha
5.	Research Associate	Mr. Jay Ram Tandukar
6.	Computer Operator	Mr. Gyanendra Bajracharya
7.	Data Enumerators	6 Persons

List of Enumerators

SN	Name	Education	Experience
1	Mohan Baniya	I.Com	10 yrs
2	Nirakar Chhetri Bhattarai	I.Com	10 yrs
3	Prem Bdr. Saud	M.A.	4 yrs
4	Hari Joshi	M.A.	10 yrs
5	Kumar Shrestha	B.B.S.	6 yrs
6	Nabin Kunwar	+2	5 yrs

Chapter-III Karnali Ujjyalo Programme in Nepal

3.1 SOLAR TUKI: ACCESS TO LIGHT TO ROMOTE POOR IN NEPAL

In Nepal, 2.4 million households are to this day compelled to use kerosene based wicked lamps (known as Tuki in local language, which is made by inserting strands of cloth or "wicks" in glass or metal bottles filled with kerosene) for household lighting. This form of lighting is neither cost effective nor "environment friendly". On the macro level, since kerosene has to be imported, government has to spend its limited foreign currency reserve (and the international rate of oil is increasing day-by-day). On the micro level, fumes from the tuki affect the eyes and lungs, contribute to global warming due to release of greenhouse gas (CO_2), the quality of light is inferior and there is a high risk of accidental fire hazards.

To replace the kerosene lamps, "Solar Tuki" is being used. As most of the targeted beneficiaries are below the poverty line, most of them will not be able to afford the upfront cost of the Solar Tuki. The Government of Nepal has launched the special programme called "Karnali Ujjyalo Programme" in 2007 to enable the people in Karnali zone and its adjoining districts to purchase the Solar Tuki.

3.2 TECHNOLOGY OF SOLAR TUKI

The solar tukis consists of lamps made of WLEDs, storage battery, solar module for charging the battery, controlling units, switches and wires. During the day time the solar module charges the battery and during evening and night hours the stored energy is used to lit the lamps. A small radio can also be powered by the storage battery. Detailed technical specifications of the system used in this program are outlined in chapter 4.2.

3.3 KARNALI UJJYALO PROGRAMME

"Karnali Ujjyalo Programme" (KUP) in the annual budget of FY 2063/64 was the Government of Nepal's effort to overcome the situation in those areas. Under this program the GoN distributed 31,000 Small Solar Home System (SSHS) called "Solar Tuki" (ST) in five districts of Karnali zone and 29,000 in its four adjoining districts of Jajarkot, Bajhang, Achham and Bajura through AEPC. The cost of such ST was about Rs. 4,500 of which the GoN provided Rs. 4,275 (95% subsidy) and users paid only Rs. 225 under this program. The main aim of the program was to provide lighting system for the households in Karnali zone and its adjoining districts where other means of electricity has not yet reached and where the possibility of extension of other system of electricity in future is low. The program was focused on the low income people in remote areas.

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

The distribution of the Solar Tuki in all the five districts of Karnali Zone and its four adjoining districts viz. Achham, Bajhang, Bajura and Jajarkot are presented in the table below:

Distribution of Solar Tuki by district

SN	District	Number VDC Coverage	Number of STS User HHs
1	Dolpa	13	1590
2	Mugu	24	5200
3	Jumla	9	6800
4	Kalikot	23	13760
5	Humla	27	3650
Sub-total		**96**	**31000**
6	Jajarkot	30	6000
7	Bajura	4	5000
8	Achham	13	11000
9	Bajhang	5	7000
Sub-total		**52**	**29000**
Total		**148**	**60000**

Details of the VDC's under Solar Tuki Programme

SN	District	VDC/No. of Solar Tuki
1	Dolpa	Jufal 8, Tripurakot 8, Pahada 8, Su 8, Liku 8, Lha 8, Sarmi 8, Narku 8, Kalika 8, Raha 8, Foksundo 8, Sahatara 8, Saaldang 8
2	Mugu	Dhainkot 40, Bhie 40, Hyanglu 40, Narthup 40, Kaalai 33, Dolfu 31, Mugu 30, Kimri 30, Pulu 10, Jima 10, Futu 12, Gamtha 10, Khamale 10, Srikot 10, Kotdanda 18, Seri 9, Pina 12, Dowa 8, Ruga 9, Sukadhik 12, Rara 10, Mangri 12, Karkiwada 9, Srinagar 9
3	Jumla	Chhumchaur 105, Dhapa 108, Dharku 1, Jarmi 1, Kundari 9, Lamra 2, Mahate 1, Patarasi 51, Tatopani 121
4	Kalikot	Badalkot 4, Bedmala 1, Bhalkot 7, Bhugtaha 50, Chapre 3, Daha 48, Dhulabegchha 5, Dhulagahi 3, Gela 2, Jubitha 3, Kalikot 1, Khada 7, Khin 68, Kotwada 158, Kumalgaun 63, Lalu 42, Mahakot 51, Mugraha 11, Rupsa 46, Sela 7, Sukatiya 4, Thirpu 98, Wadanku 1
5	Humla	Baraigaun, Bargaun, Chhipra, Dandafaya, Darma, Gothi, Hepka, Jair, Kalika, Khagalgaun, Kharpunath, Lali, Limi, Madana, Maila, Melchham, Mimi, Muchu, Raya, Rodikot, Sarkeedeu, Saya (Sama), Shree Nagar, Shreemastha, Simikot, Syada, Thehe
6	Jajarkot	Archhani 12, Bhagwati 12, Bhur 12, Dandagaun 12, Daha 12, Dasera 12, Dhime 12, Garkhakot 12, Jagatipur 12, Jhapra 12, Jungthapachaur 12, Karkigaun 12, Khagenkot 12, Khalanga 12, Kortang 12, Laha 12, Majhkot 12, Nayakwada 12, Paink 12, Pajaru 12, Punama 12, Ragda 12, Ramidanda 12, Rokayagaun 12, Sakla 12, Salma 12, Sima 12, Suwanauli 12, Talegaun 12, Thalaraikar 12
7	Bajura	Badhu 55, Gotri 99, Jagannath 49, Rugin 57
8	Achham	Kuika 90, Nada 50, Raniban 48, Achham 22, Balata 110, Dhakari 50, Binayak 67, Bayal 50, Kalikasthan 50, Turmakhand 33, Hikila 1, Gwani 1, Neulapur 1
9	Bajhang	Bajh 35, Bhamchaur 1, Dahabagar 160, Kaphalaseri 122, Khiratadi 30

Chapter-IV Impact of Solar Tuki in Karnali

TRUST has assessed following impacts of solar tuki on the livelihood of the rural people of Karnali Zone.

4.1 GENERAL INFORMATION

4.1.1 Geographical Coverage

Nine districts of Karnali zone of Mid-Western Region, namely Dolpa, Mugu, Jumla, Kalikot, Humla, Jajarkot, Bajura, Achham, and Bajhang districts were surveyed covering 3,001 households during the field survey of solar tuki users. During the field survey as shown in the Table No. 4.1, a total of 3,001 solar tuki user households were surveyed consisting 2,216 male respondents (73.842%), 751 female respondents (25.025%) and 34 not recorded (1.133). Since the sample size has been determined based on the number of households having installed solar tuki, the percentage coverage of samples in these districts were varied and ranged from the lowest 2.6% in Dolpa district to the highest 22.9% in Kalikot district. The rest districts were in between them regarding sample coverage. Similarly, the Table No. 4.2 shows that 151 households of Solar Tuki non-users of nine districts namely, Dolpa, Mugu, Jumla, Kalikot, Humla, Jajarkot, Achham, Bajhang and Bajura consisting 138 male respondents (91.4%) and 13 female respondents (8.6%) were surveyed in order to know their interest to install solar tuki in near future.

Table No. 4.1: Solar Tuki User Respondents by Sex and Districts

District	Male		Female		Not Responded/ Recorded		Total	
	No.	%	No.	%	No.	%	No.	%
Dolpa	23	29.1	56	70.9	0	0.0	79	2.6
Mugu	173	66.5	87	33.5	0	0.0	260	8.7
Jumla	162	47.4	180	52.6	0	0.0	342	11.4
Kalikot	495	72.1	192	27.9	0	0.0	687	22.9
Humla	119	64.3	66	35.7	0	0.0	185	6.2
Jajarkot	272	90.7	28	9.3	0	0.0	300	10.0
Bajura	227	89.7	21	8.3	5	2.0	253	8.4
Achham	457	82.9	85	15.4	9	1.6	551	18.4
Bajhang	288	83.7	36	10.5	20	5.8	344	11.5
Total	**2216**	**73.84**	**751**	**25.03**	**34**	**1.13**	**3001**	**100.0**

Table No. 4.2: Non User Respondents by Sex and Districts

District	Male		Female		Total	
	No.	%	No.	%	No.	%
Dolpa	3	75.00	1	25.00	4	2.65
Mugu	12	92.31	1	7.69	13	8.61
Jumla	16	88.89	2	11.11	18	11.92
Kalikot	31	91.18	3	8.82	34	22.52
Humla	7	77.78	2	22.22	9	5.96
Jajarkot	12	80.00	3	20.00	15	9.93
Bajura	13	100.00	0	-	13	8.61
Achham	28	100.00	0	-	28	18.54
Bajhang	16	94.12	1	5.88	17	11.26
Total	**138**	**91.39**	**13**	**8.61**	**151**	**100.00**

4.1.2 Household Head

More than 93% of the total households (3,001) interviewed have male household head and only less than 5% of them have female household head. This indicates that mostly male has dominated in families of these districts. These districts are still far behind regarding women empowerment. The Table No. 4.3 shows that the percentage of female household head in Jajarkot district is the least i.e., only one percent; whereas, in this regards, Humla district is the best among them having the highest percentage (8.6%).

Table No. 4.3: Household head by gender

District	Male		Female		Not Responded/ Recorded		Total	
	No.	%	No.	%	No.	%	No.	%
Dolpa	75	94.9	4	5.1	0	0.0	79	2.6
Mugu	247	95.0	13	5.0	0	0.0	260	8.7
Jumla	333	97.4	9	2.6	0	0.0	342	11.4
Kalikot	656	95.5	30	4.4	1	0.1	687	22.9
Humla	169	91.4	16	8.6	0	0.0	185	6.2
Jajarkot	297	99.0	3	1.0	0	0.0	300	10.0
Bajura	230	90.9	15	5.9	8	3.2	253	8.4
Achham	512	92.9	22	4.0	17	3.1	551	18.4
Bajhang	293	85.2	25	7.3	26	7.6	344	11.5
Total	**2812**	**93.70**	**137**	**4.57**	**52**	**1.73**	**3001**	**100.0**

4.1.3 Ownership by Sex/Castes/Religion

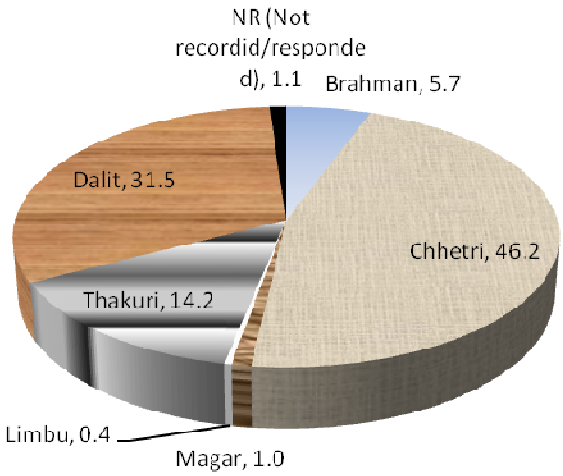
As mentioned above the percentage of female household head is less than 5% of the total households interviewed and similarly female ownership over the solar tuki set is also found to be 5.1% of the total solar tuki ownerships in these surveyed districts as presented in the Table No. 4.4. Overall the female ownership of ST varies from 2.7%, the least, in Jajarkot district to 10.3%, the maximum, in Humla district in the KUP districts.

Table No. 4.4: Solar Tuki Owner by Gender

District	Male		Female		Total	
	No.	%	No.	%	No.	%
Dolpa	73	92.4	6	7.6	79	2.6
Mugu	245	94.2	15	5.8	260	8.7
Jumla	326	95.3	16	4.7	342	11.4
Kalikot	650	94.6	37	5.4	687	22.9
Humla	166	89.7	19	10.3	185	6.2
Jajarkot	292	97.3	8	2.7	300	10.0
Bajura	242	95.7	11	4.3	253	8.4
Achham	531	96.4	20	3.6	551	18.4
Bajhang	322	93.6	22	6.4	344	11.5
Total	**2847**	**94.9**	**154**	**5.1**	**3001**	**100.0**

Similarly, 1,385 Chhetri families (i.e., 46.2%) out of total 3,001 households interviewed in Karnali Zone have installed the solar tuki in their homes. The highest benefited caste from the Karnali Ujyalo Program is the Chhetri. The second highest number of households having solar tuki (945), which is 31.5% of the total solar tuki user households, is the Dalit. The third highest number 425 (i.e., 14.2% of households having solar tuki installed) is the Thakuri. Other castes such as Brahmin, Magar, and Limbu have found significantly less access to the solar tuki as shown in chart 4.1. It might be either by lesser access or by lesser financial capability to install it. Thus, the percentage share of different caste families varies from district to district.

Chart 4.1: Percentage of Solar Tuki Owners by Castes



However, the highest number of families having solar tuki installed in all districts except in Jajarkot district is of Chhetri caste but it ranges from 24.9% in Kalikot district to 85.8% in Bajura district. In Jajarkot district 295 dalit families (98.3%) have installed solar tuki. Thus, the solar tuki has not been evenly distributed among different castes in these districts.

In regards to religion, the chart No. 4.2 shows that the solar tuki user households in all districts except in Humla district have mostly been owned by Hindus. In Humla district only some significant ST users are Buddhist (around 5%). In the case of Bajhang, Bajura and Achham districts significant percentage didn't responded/recorded (viz. 11.6, 5.5, and 3.8% respectively). Thus, the programme has benefited mostly Hindus. The number of Buddhist households benefitted from the solar tuki programme is very low.

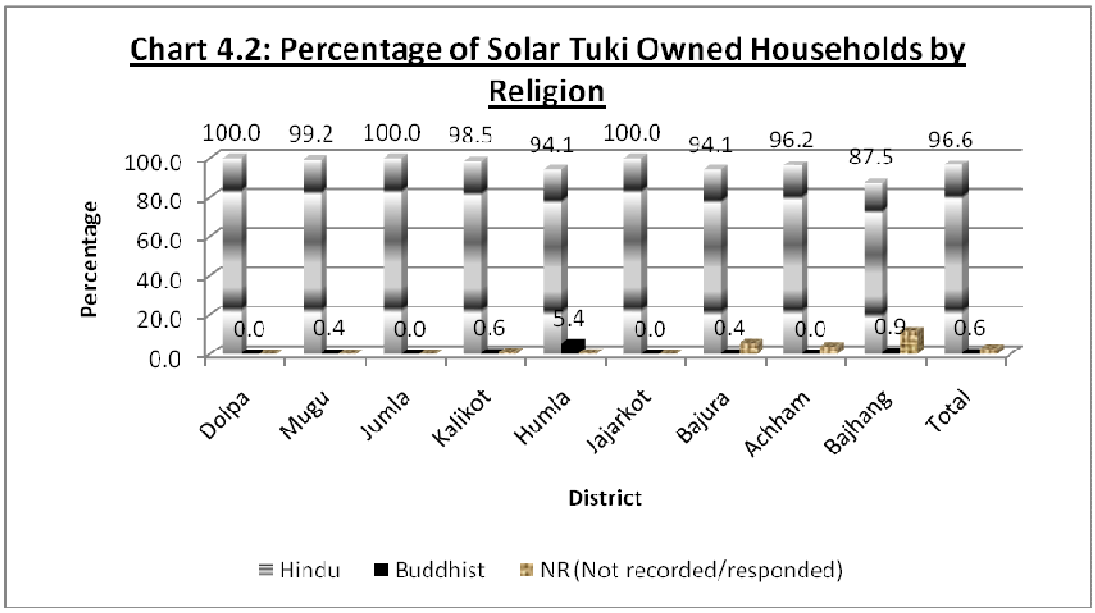


Table No. 4.5: Solar Tuki Owners by Castes

Caste	No	%
Brahman	170	5.7
Chhetri	1,385	46.2
Magar	31	1.0
Limbu	11	0.4
Thakuri	425	14.2
Dalit	945	31.5
Not Responded/Recorded	34	1.1
Total	**3,001**	**100.0**

Table No. 4.6: Solar Tuki Owner by Religion

District	Hindu		Buddhist		Not Responded/ Recorded		Total	
	No.	%	No.	%	No.	%	No.	%
Dolpa	79	100.0	0	0.0	0	0.0	79	100.0
Mugu	258	99.2	1	0.4	1	0.4	260	100.0
Jumla	342	100.0	0	0.0	0	0.0	342	100.0
Kalikot	677	98.5	4	0.6	6	0.9	687	100.0
Humla	174	94.1	10	5.4	1	0.5	185	100.0
Jajarkot	300	100.0	0	0.0	0	0.0	300	100.0
Bajura	238	94.1	1	0.4	14	5.5	253	100.0
Achham	530	96.2	0	0.0	21	3.8	551	100.0
Bajhang	301	87.5	3	0.9	40	11.6	344	100.0
Total	**2899**	**96.601**	**19**	**0.633**	**83**	**2.766**	**3001**	**100.0**

4.1.4 Average Price paid for Solar Tuki

Under the Karnali Ujyalo Program cost of solar tuki set has been shared based on the ratio of 95%:05%. Ninety-five percent of the cost of solar tuki has been shared by the program itself and 5% by the beneficiary household. The price of a set was Rs. 4,500.00. The household has to pay only Rs. 225.00 only. But they have to pay more than the predetermined price due to the irregularities in distribution of solar tuki and resale of it. Some people have collected more sets using political and bureaucratic power and extra sets were resold to villagers at higher prices. That's why; average price per set has varied district to district. The Table No. 4.7 and Chart No. 4.3 demonstrate the average price paid for a set of solar tuki by villagers.

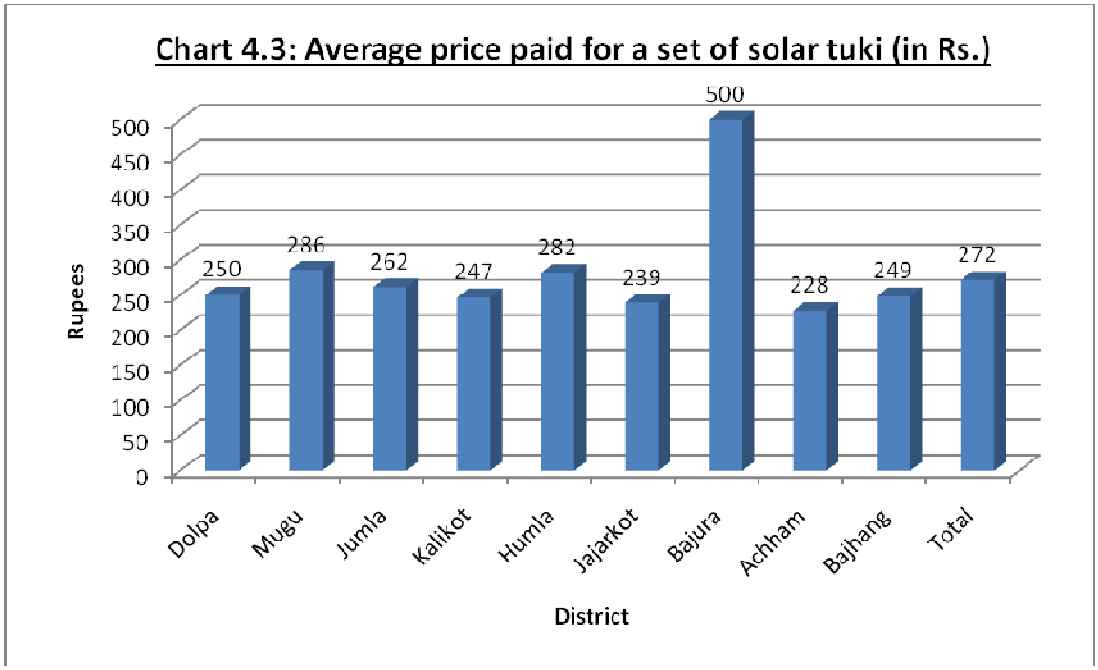


Table No. 4.7: Average Price Paid for Solar Tuki

District	Rs.	District	Rs.
Dolpa	250	Jajarkot	239
Mugu	286	Bajura	500
Jumla	262	Achham	228
Kalikot	247	Bajhang	249
Humla	282	Overall Average	272

4.2 TECHNICAL ASPECTS

The small solar PV system promoted in the Karnali Ujjyalo Programme area consisted of a 5 Wp solar module, a battery box with switches and indicators, two units of WLED based lamps and wiring accessories. The lamps were plug-in types that could be hanged on any place with the support of attached hook. Table No. 4.8 below gives specification of the parts used in the Solar Tuki.

Table No. 4.8: Technical Specification

S.N.	Parts	Specification
1	Solar Panel	i. 5 watt peak power ii. 6 volt panel for Nickel Metal Hydride and Lithium Ion Battery iii. 12 volt panel for Valve Regulated Lead Acid Battery iv. Maximum Power Variation: Within -10 to +20% of rated power
2	Battery	i. Nickel Metal Hydride and Lithium Ion Battery a. 6 volt battery b. Battery capacity: 2300 mAh at C5 discharge rate and 20ºC c. Battery Age: 500 cycles at 50% depth of discharge d. Battery connectors resistance should be not more than 5 mΩ and should be rust resistive ii. Valve Regulated Lead Acid Battery a. 12 volt battery b. Battery capacity: 4 Ah at C10 discharge rate and 20ºC c. Battery Age: 500 cycles at 50% depth of discharge
3	Bulb	i. 12 White Light Emitting Diode (WLED) cluster with high intensity (2000 mcd, milky diffused) with reflector and cover ii. Diode viewing angle ≥ 2 X 25º iii. Luminous capacity of one LED cluster should not be less than 20 lumen per Watt iv. Mean time between failure of WLED should not be less than 50,000 hour

4.2.1 Present Conditions of the Installed Systems

The following interpretation of the terms "excellent, satisfactory and unsatisfactory" were used with respect to various components of the Solar Tuki (Table No. 4.9). It is also to be noted here that the total number of responses may not tally to a fixed number as in some cases not all the questions may have been answered.

Table No. 4.9: Interpretation of the Terms

Terms/ Components	Solar Module	Battery	Lamps	Radio sockets	Cables and connectors
Excellent	Solar module appropriately tilted, south faced cleaned, firmly fixed, undamaged	In good condition, neat and clean	Well cleaned, operating, properly installed	Functioning normally	Well laid cables/connections
Satisfactory	Some of the above missing, slightly dirty	In between excellent and unsatisfactory (to the judgment of enumerator)	Dirty, haphazardly installed but still operating	Functioning but loose connections	Functioning but loose connections
Unsatisfactory	All of above missing, very dirty, damaged	Battery not functioning, not connected, dirty	Not operating at all	Not functioning	Not functioning at all, dismantled

Solar Modules

The installation of 62% of the solar modules was found to be satisfactory (Chart 4.4).

Fig. 4.1: An Example of Well Installed Module

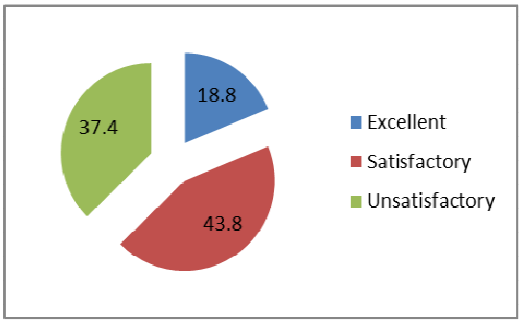


Chart 4.4: Qualities of Solar Module Installations

In remaining cases the modules were either not appropriately tilted/south faced or loosely placed on the surface.

The cleanliness of the solar modules in 43% of the cases (chart 4.5) was not satisfactory.

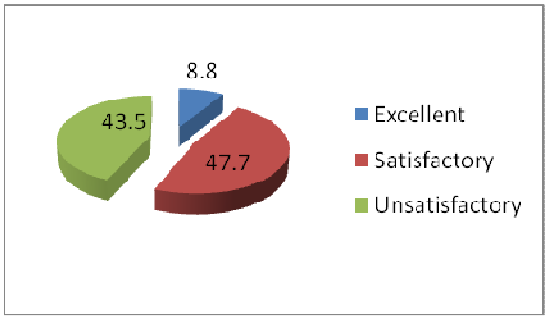


Chart 4.5: Cleanliness of the Solar Modules

Out of 2800 inspected systems, in 394 cases (14%) the solar modules were simply not functioning.

Fig. 4.2: An Example of the Damaged Module

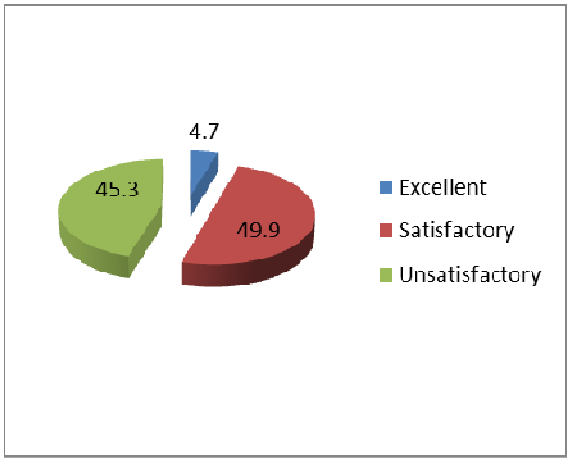


Chart 4.6: Status of the Connection between Module, Battery and Lamps

The connections from solar modules to the battery unit and then to the lamps were not satisfactory in 45% of the cases (Chart 4.6).

In 10% (274 out of 2600) of the cases, the system was malfunctioning due to connections related problems (Fig. 4.3).

ig. 4.3: Panel Directly Connected to the Battery

Lamps (Solar Tukis)

There were two lamps in each system and arbitrarily one lamp is numbered as tuki1 and another tuki2. The status of two units of tukis are shown in the charts 4.7 (a, b) below.

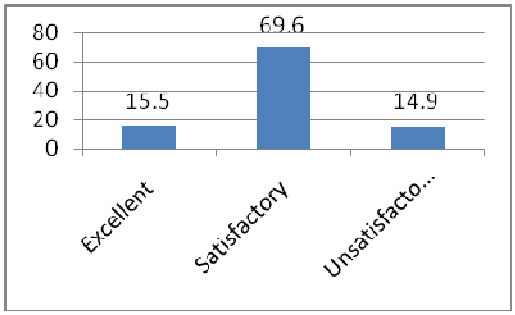


Chart 4.7a: Status of Tuki 1

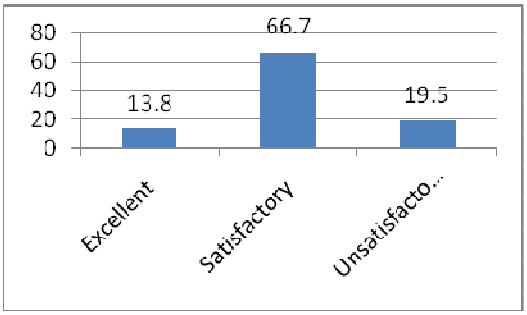


Chart 4.7b: Status of Tuki 2

Out of a total of 5239 lamps (both tuki 1 and 2) inspected 1034 units (19.7%) were not functioning (Fig. 4.4).

Fig. 4.4: A Lamp in Horrible Condition

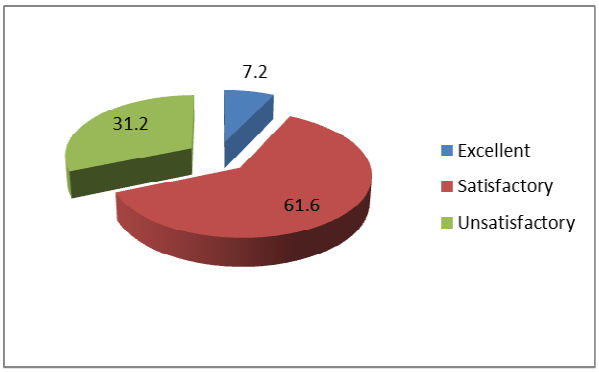


Chart 4.8: Status of Radio Sockets

Radio Sockets

Out of 3,001 cases 17 cases did not responded for this question and out of 2,984 responses, in 1,071 cases the sockets were simply not functioning. Out of 1,913 working radio sockets, the status was as follow: 138 (7.2%) excellent; 1179 (61.6%) satisfactory; and 596 (31.2%) unsatisfactory as illustrated in chart 4.8.

Batteries

1560 battery units (52.2%) out of 2984 inspected were simply not functioning. The conditions of the remaining units were as follows (Chart 4.9, Fig. 4.5).

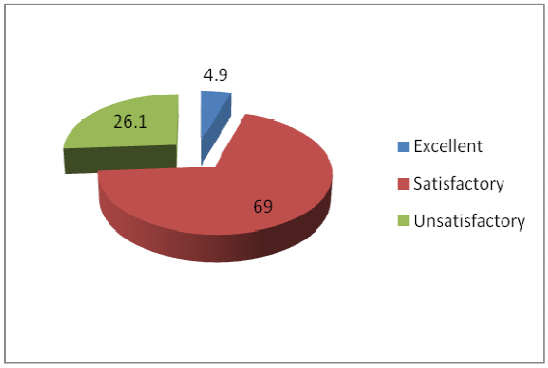


Chart 4.9: Status of the Batteries

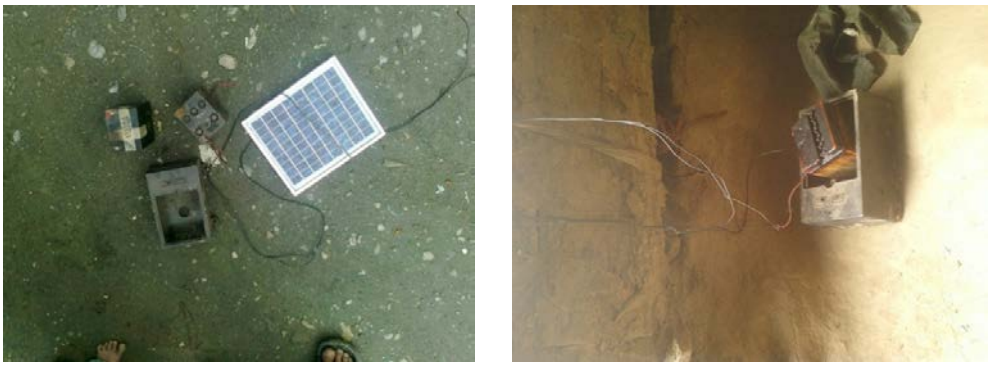


Fig. 4.5: Systems with Damaged Battery/Control Box

Cables and Connections

Out of 3,001 cases 30 cases did not responded for this question and out of 2,971 responses, in 973 cases the cable and connections were simply not functioning (Fig 4.6). Out of 1,998 working cable and connections, the status were as follow: 81 (4.0%) excellent; 1108 (55.5%) satisfactory; and 809 (40.5%) unsatisfactory as illustrated in chart 4.10.

Fig. 4.6: Unit with Disintegrated System Components

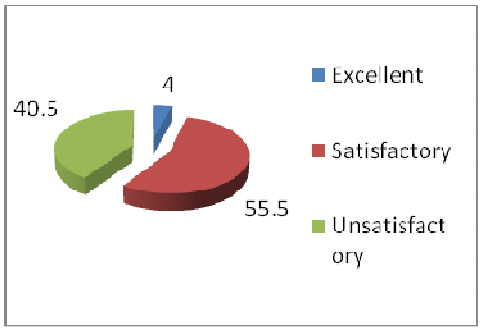


Chart 4.10: Status of Cables and Connections

4.3 AFTER SALES SERVICES

The terms and conditions of the contract for the supply and after sales services (ASS) of Solar Lamps requires that the supplier visit each and every system sold at least once a year and provide guarantee/warrantee of ten, two and one years on the module, battery and lamps respectively. The inspection of the systems revealed that virtually not a single ASS has been made and that the performance of the system was not satisfactory at all (refer to section 4.4) for more detailed discussions on this issue.

4.3.1 Frequency of ASS Visits

No solid evidences of ASS visits by the system suppliers were found during the survey.

4.3.2 Type of Repair Done During Warranty/ ASS Visits

No solid evidences of repairs done during warranty period /ASS visits were found during the survey.

4.3.3 The Cost of Repair

Sixty four cases (49 in Kalikot and 15 in Jajarkot) of repair of the system were recorded during the survey. The Table No. 4.10 below indicates the cost of the repair paid by the users.

Table No. 4.10: The Cost of Repairing the System Components

The cost of repair (Rs.)	The number of users repairing the system
100	1
250	2
350	1
800	5
850	1
900	2
950	2
1000	7
1050	10
1100	12
1150	4
1200	13
1250	1
1700	1
2000	1
3300	1

Most of the respondents were not aware of the repaired components. The higher cost of repair is generally associated with the replacement of the batteries.

4.3.4 Satisfaction over ASS Commitments

The surveyed users were not satisfied with the ASS provided by the suppliers as against the commitments.

4.4 GENERAL OBSERVATIONS

The following paragraphs outline the general observations made by the inspecting team and the feed-back received from the users during informal talks (focused group discussions) with respect to the technical conditions and ASS of the solar system.

Lalu VDC, Ward no. 1, Kalikot

The users were not made aware of the general maintenance of the systems. The users joined the panel directly to the battery once the control box broke-down. Users normally discard the system once it breaks down simply because of non-availability of technical person in the village. The users have walk 5-6 hours upto Jite bazar to get some spares and cost of which is extremely high. The cost of a new battery is around 1000 to 1200 which is too high compared to the price paid by users for the system. The users are ready to pay the maintenance cost if the technicians come to their house for service.

People are found to break the used battery to see what is inside. Some users have traded the damaged battery while buying new ones. Most of the users are keeping the used battery in their house in anticipation that someday it could be used again or sold.

Mugraha VDC, Kalikot

The users were provided very simple knowledge on the placement and use of solar lamps but no other details were given. The users are opening the batteries and adding water on

their own. They also disconnect the wires from the control box and directly connect to the battery. Some have brought new battery whereas others have simply stopped using it. Not a single ASS visit was made. Since most of the systems are already non-functional, the users feel that they are cheated. Those who can afford have now installed bigger (20-50 Wp) systems.

Daha VDC, Kalikot

Ward No.1 of this VDC is grid electrified through a micro-hydro scheme. Nevertheless owing to the uncertainity of the supply from micro-hydro, almost all have procured solar lamps. Like-wise in ward 4 also all have the solar lamps but most of them are non-functional. According to the users nobody from the suppliers has shown up for ASS and that apart from basic knowledge on installation and operation of the lamps the users were not appraised on the basic caretaking of the system.

Sukatia VDC, Kalikot

All the villagers have procured solar systems but excluding one or two all are non-functional. Almost all have brought the larger system (20 Wp) promoted by Himchuli.

Varta VDC, Kalikot

Almost all the villagers have had the solar lamp but except one or two all are non-functional. The villagers are trying to generate electricity from the local river and therefore are not bothered about repairing the solar lamps. Those who can afford have already installed bigger system.

Malkot VDC, Kalikot

All have got the solar lamps and also have installed bigger solar system. Except the dalits, almost all have replaced the batteries of the solar lamp on their own.

Khalanga VDC, Jajarkot

Ward no. 1, 2, 3, 4, 6 and 8 have grid electricity. The priority was given to dalits while distributing the systems. Almost all the systems are defunct now basically due to damaged battery. Some have even sold the solar module and the lamps. Nothing was done by the supplier to repair/maintain the system. The users also did not know that the system can be brought back to operation by installing a new battery.

Punma VDC, Jajarkot

The system was distributed only to dalits and virtually all the systems are now non-operational due to damaged battery.

Jagtipur, Bhoor, Karki Gaon VDCs, Jajarkot

Mostly dalits were given the system and now almost all the distributed systems are not operational. Even in few operational systems the controller is by-passed.

Bham Chaur, Khir Tadi and Daha Bagar, Bajhang

In or around 75% of the solar system in these localities are not functioning. The technicians from the suppliers never returned to the village after distribution of the system.

Tuni Bagar, Bhairab Sthan and Rahaf, Accham

All the systems in these areas are almost defunct within one year of distribution. And in most of the VDCs where solar lamps were distributed, the people with their own investment or with the funding from the private companies have installed MHPs and using it.

In Bhairabsthan only about 25% of the systems are operational, remaining 75% were damaged within a year of distribution. Most of the systems could be brought to operation with minor repair. The villagers opined that if one person from each VDC were trained on basic repair and maintenance of the system, the amount spent by the government on subsidy would have been fruitfully and meaningfully utilized.

Bajura

Around 50% of the systems are non-functional. People are not satisfied with ASS as no visits are made yet. Due to minor technical problems, the entire system is defunct and unused.

Simikot, Humla

According to the locals, initially original "tukis" were distributed and they are in working condition but later on duplicate systems were distributed and these systems have problems. People were mostly satisfied with the solar lamps. The major complain is on the ASS. Some have paid Rs. 500 for so called wiring of the system. No repair or maintenance has been made by the supplier after initial distribution.

Chandannath VDC, Jumla

Very few users are satisfied with the solar lamp. People do complain that duplicate (low quality) lamps were also distributed. Not a single ASS visit was made by the companies. Major complain is about repair and maintenance service.

Suhu VDC, Dolpa

All the wards except 7, 8 and 9 of this VDC have grid electricity. Except in one or two houses, all the solar lamps are non-operational. Almost all the solar lamp systems broke down within 6-12 months of operation. Many of the users have thrown away the modules, batteries and lamps. Some are using the module for direct charging of the mobile phones.

4.5 SOCIO-ECONOMIC IMPACTS

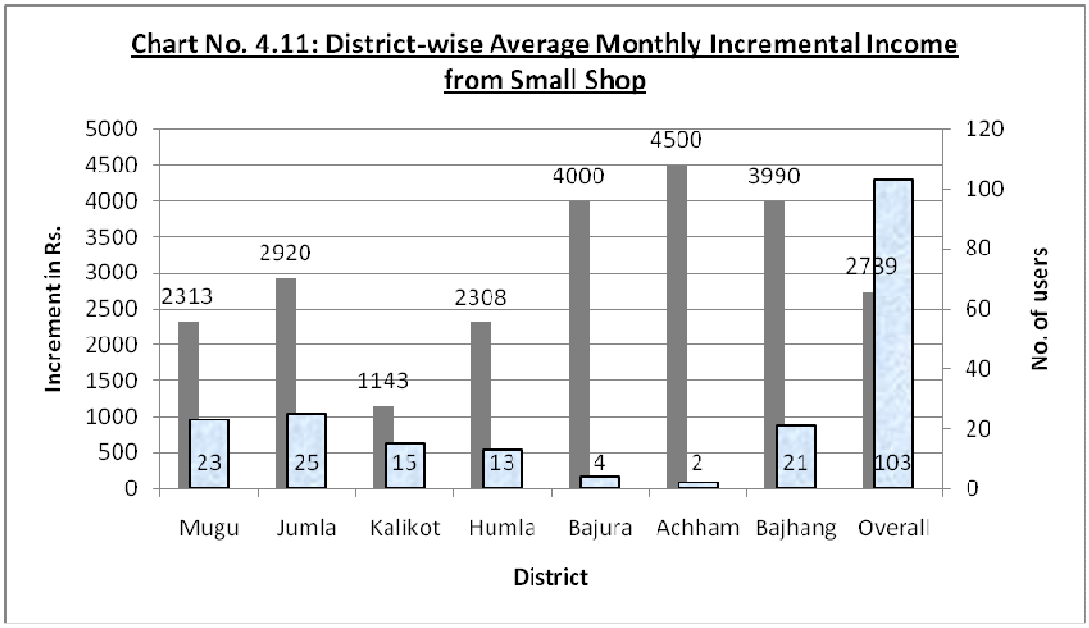
4.5.1 Income Generation and Poverty Reduction

Rural poverty is the major component of national poverty. One of the major objectives of distributing the solar tuki through Karnali Ujyalo Program along its other objectives such as: providing smokeless lighting, improving the health and sanitation environment in the rural settlements, improving child education level, increasing socialization and satisfaction level and uplifting women empowerment, is the additional income generation of these rural people, which is the major means of reducing the poverty level. Use of solar tuki helps the rural people to save the time and energy from their routine work and the surplus time (especially the night time, which was previously unused due to lack of lighting facility) and energy can be used in generating additional income. Hence, one of the most important implications of the installation of solar tuki is the economic upliftment of these rural people through generating additional income and whereby the poverty can be reduced to certain extent. Implications of solar tuki installation on Income generation of these people can be assessed through the implications on small shop keeping, agro-business, livestock keeping, wage labor, poultry farming, collection of forest products (firewood, fodders, herbs etc.) and others.

4.5.2 Small Shops

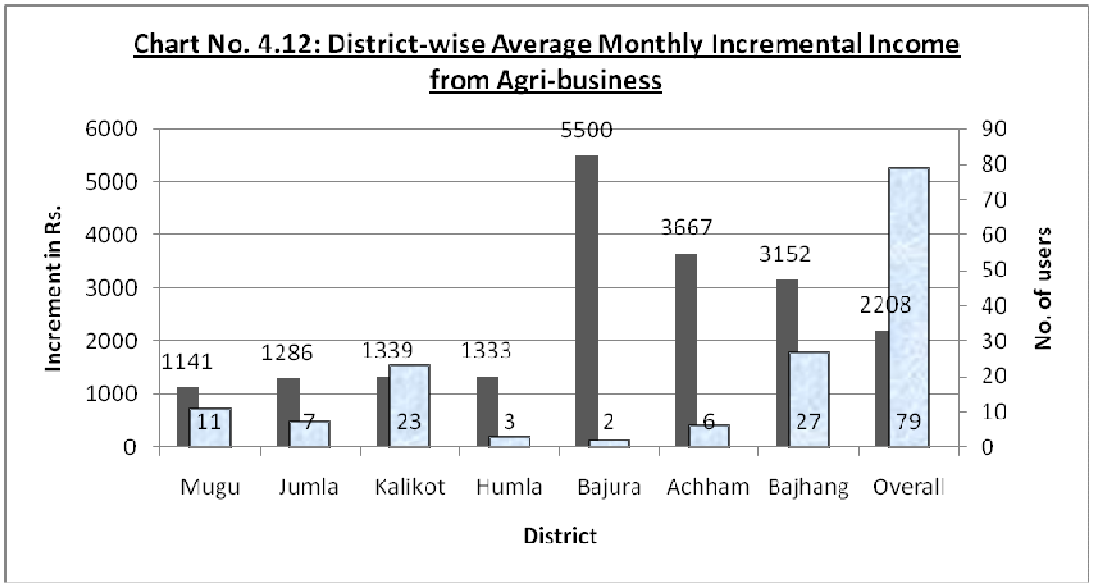
The installation of solar tuki has also several socio-economic impacts on the local livelihood. Most of the local people have realized the positive impacts on generating additional income from their small shops. The use of solar tuki helps them to prolong the opening of small shops for longer period in night time and consequently, they can earn more income from small retail shops. The Chart No. 4.11 shows the district wise average monthly additional income from opening their small shops for longer period in night. The district wise average monthly incremental income from small shop is ranging from Rs. 1,143 in Kalikot to Rs. 4,500 in Achham district and, in totality, the average of district wise average monthly incremental income from small shop is Rs. 2,739, which makes them easier to manage their household expenditure compared to previous time. District wise average monthly incremental income has been calculated based on the number of ST user respondents in the respective district. Number of ST user respondents varies district to district. However, the installation of solar tuki has left favorable economic effect on the livelihood of local people of these districts of Karnali zone (See Table No. 4.11)∗.

∗ The survey questionnaires also include ST user's increment in monthly income due to various IGAs and tabulated systematically in SPSS 12.0 and various tables are generated from the SPSS 12.0.



4.5.3 Agri-business

Due to the installation of solar tuki in the house, the farmers of these districts of the Karnali zone have been able to increase the income from agro-business using the night time, which is made possible due to the lighting from solar tuki. Since the solar tuki is portable, it can be carry wherever they required. It is used even in the field for irrigating the crops and for other types of work in the field in night. Besides, they can work longer period in the field in evening thinking to complete household works in night with solar light. Thus, they have been able to increase the agriculture production. At past they shortened their field work in day to manage their household work in daylight because they cannot work in night with wooden torch and kerosene lamp. Hence, the working hour in a day has been increased and helps to increase income from agri-business. The Chart No. 4.12 shows that the district wise average monthly incremental income from agri-business alone ranges from Rs. 1,141 in Mugu district to Rs. 5,500 in Bajura district. The average of district-wise average monthly incremental income from agri-business is Rs. 2,208. (See Table No. 4.11)



4.5.4 Wage Labor

Previously mostly household works done in day has been done at present in night with solar tuki. They can save day time to work as wage labor and earn wage income. But wage labor is usually influenced by the social status and social norms of people. So all persons do not go to work as laborer. That's why; their implication on wage income earnings has been found relatively low. Unlikely to district-wise average monthly incremental income from small shop and agro business, they have not been able to get incremental income from labor work in all districts. The wage rate also varies drastically based on the types and nature of labor work and consequently, wage income. These solar tuki users are able to get average monthly incremental income from labor work only in two districts namely Kalikot and Jajarkot districts. The Table No. 4.11 depicts that district wise average monthly incremental wage income ranges from Rs. 967 in Kalikot district to Rs. 1,071 in Jajarkot district. The average of district-wise average monthly incremental wage income from labor activities using time saved is Rs. 1,023, which has been calculated based on 13 wage labor respondents of the entire study area (See Table No. 4.11)

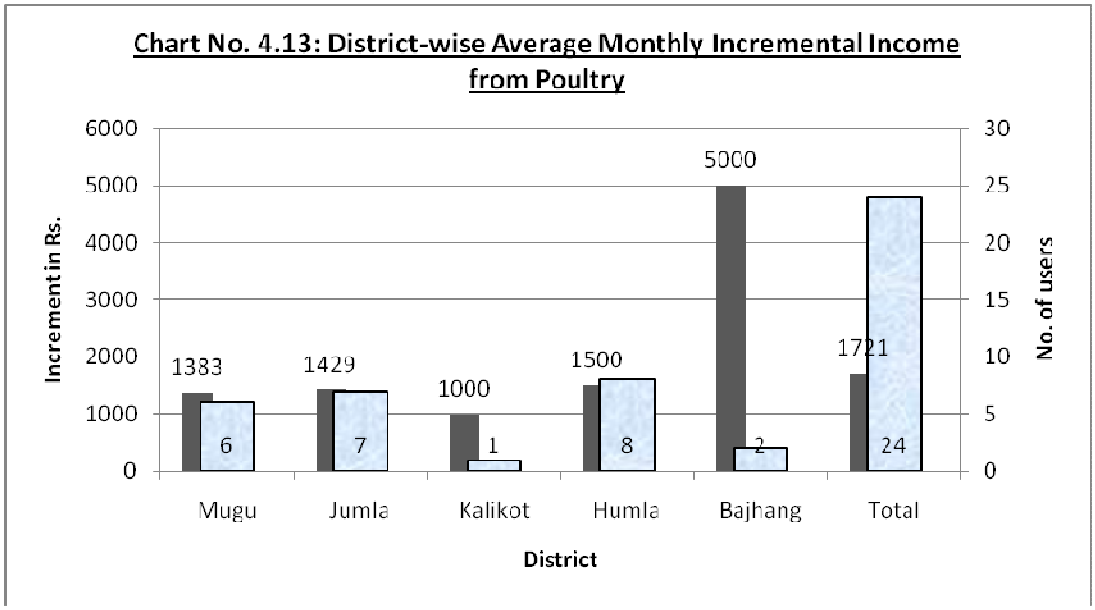
4.5.5 Collection of Forest Products

Wooden and wheat straw torches as well as kerosene lamp were used in their homes for lighting purposes in these districts before the installation of solar tuki. They had to spend their time and energy for collecting wood for wooden torch from the forest. Now they do not need to collect pine wood for wooden torch. If they have collected wood they can sell them and generate additional income. They can also collect herbs and other forest products from the forest and generate additional income. But collection of forest products may not be the same in districts because it depends on availability of forest areas. Each district does not have equal forest areas. The Table No. 4.11 shows that the installation of solar tuki, except in two districts, namely, Jumla and Kalikot districts, do not have seen significant impacts on the income generation from collection of forest products in districts of KUP areas. Only two ST users (one from each district - Jumla and Kalikot) have responded that they have generated additional income from collecting the forest products

during the spared time. The respondent of Jumla district is getting Rs. 2,500 as an average monthly incremental income from collecting forest products using surplus time whereas; the respondent of Kalikot has been able to generate only Rs. 500 as average monthly incremental income from collecting forest products. The range between these two district averages is unexpectedly very high. The implication of the ST installation on generating additional income from collecting the forest product is not found significant. However, they can use the surplus time generated with the use of solar tuki in night to generate additional income if the forest does exist in surrounding of their settlements.

4.5.6 Poultry Farming

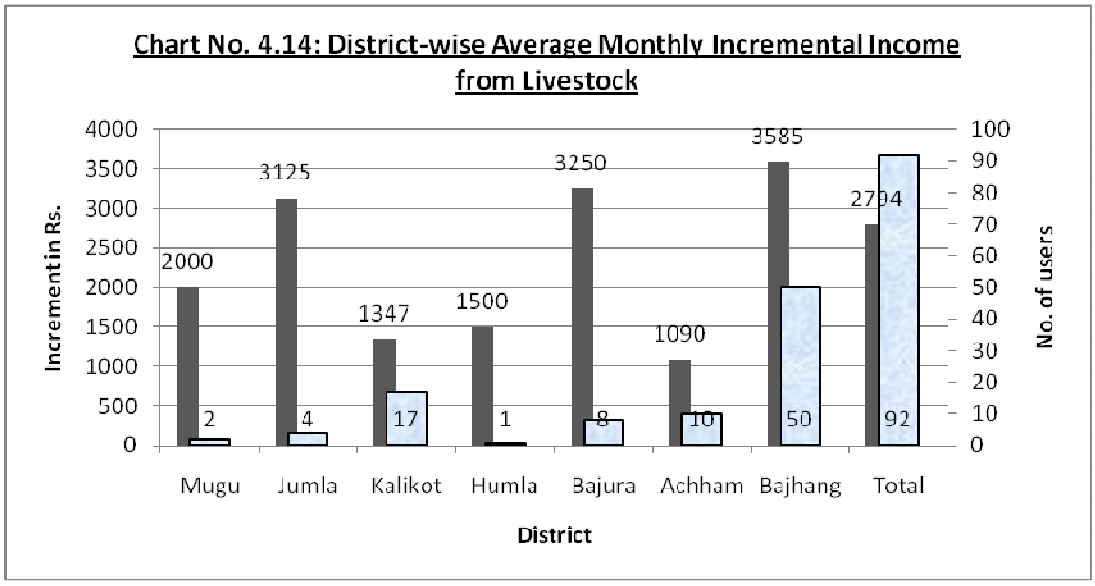
Poultry farming has being mostly popular occupation in the rural areas to meet the increasing need of urban centers. It has become the mostly profitable agriculture activities and its gestation period is also short. Raw materials for this farming are easily available in the rural areas and manure can also be used as the most effective fertilizer for agriculture farming. The solar tuki has been proved as the most useful in the poultry farming because this farming is mostly done inside the house. The use of solar tuki makes the farmers more comfortable in poultry farming compared to the use of wooden torch and kerosene lamp. The use of solar tuki is also harmless and does not have any sort of dangerous effect, e.g., fire. It does not result any type of health hazards to men, animals and birds. Farmers can work in poultry farms for longer period in night as required. Hence, the use of solar tuki can increase the poultry production and increase the additional income from poultry farming. The Chart No. 4.13 depicts that the average monthly household income from poultry ranges from Rs. 1,000 in Kalikot district to Rs. 5,000 in Bajhang district. In an average of all district-wise average monthly income from poultry is found Rs, 1,721.



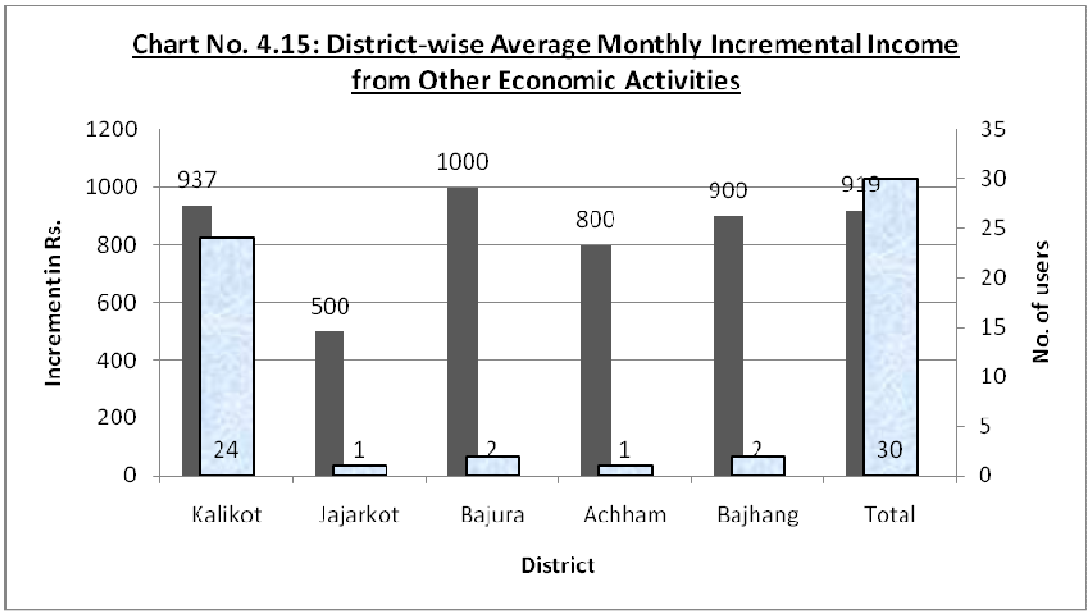
4.5.7 Animal Farming

The lighting facility from the solar tuki helps to the farmers in preparing animal feeds and other animal nourishing activities in the night, which was not possible without this lighting facility. It helps them to increase in their monthly income from livestock keeping. The Chart No. 4.14 shows that the farmers are able to harvest from minimum Rs. 1,090 as

the district average monthly incremental income from livestock in Achham and the maximum Rs. 3,585 in Bajhang district. Average of district-wise average of monthly incremental income from livestock is found Rs. 2,794, which is remarkable increment in the household income.



Similarly, the district average monthly incremental income from other economic activities except above mentioned income generating activities also ranges from Rs. 500 in Jajarkot to Rs. 1,000 in Bajura district as depicted in Chart No. 4.15. The average of these district average monthly incomes generated from other economic activities is Rs. 919.



The Table No. 4.11∗ shows the comparative picture of average monthly incremental income from different economic activities that have been possible with the availability of solar lighting facility in the house. Farmers have been able to harness the highest average monthly household incremental income from livestock keeping (Rs. 2,794) and followed by small shop keeping (Rs. 2,739) and agri-business (Rs. 2,208) in the Karnali Ujyalo Program areas. The number of benefitted respondents from these major income generating activities namely, small shops, livestock keeping, agri-business and poultry are 103, 92, 79 and 24 respectively. This indicates that a very limited number of ST owners have harnessed the benefits from the installation of ST in these districts in spite of having a lots of possibilities.

Table No. 4.11: District wise Average Monthly incremental income from different economic activities (The no. of respondents is included inside the parenthesis ( ) in each case.)

District	Small Shop	Agri-business	Wage labour	Forest Products	Poultry	Livestock	Others
Mugu	2313(23)	1141(11)			1383(6)	2000(2)	
Jumla	2920(25)	1286(7)		2500(1)	1429(7)	3125(4)	
Kalikot	1143(15)	1339(23)	967(6)	500(1)	1000(1)	1347(17)	937(24)
Humla	2308(13)	1333(3)			1500(8)	1500(1)	
Bajura	4000(4)	5500(2)				3250(8)	1000(2)
Achham	4500(2)	3667(6)				1090(10)	800(1)
Bajhang	3990(21)	3152(27)			5000(2)	3585(50)	900(2)
Jajarkot			1071(7)				500(1)
Average	**2739(103)**	**2208(79)**	**1023(13)**	**1500(2)**	**1721(24)**	**2794(92)**	**919(30)**

4.6 ENERGY SAVING

The use of solar tuki saves the energy consumed for lighting purpose. The energy saved equivalent to the expenses on either on the wooden torch, or on the wheat straw torch, or on the kerosene lamp, or on the combination of two or more used on the lighting in the house. To save money means to earn money. The same money can be used on the expenses of other household need. The Table No. 4.12 shows the level of satisfaction in energy saving caused by the use of solar tuki. In totality, more than 75% of the total solar tuki user respondents have been satisfied with level of energy saving due to the use of solar tuki including 47% excellent level of satisfaction. Nearly 25% of them are unsatisfied with the level of energy saving that they achieved. Only 100% users of Dolpa district have shown their dissatisfaction whereas 75% in Achham district and 51% in Bajura district have shown their dissatisfaction with the level of energy saving that they achieved and respondents of rest districts have shown their full satisfaction with their achieved energy saving level. Thus, most of the respondents are highly satisfied with the use of solar tuki in regard to energy saving.

∗ The survey questionnaires also include ST user's increment in monthly income due to various IGAs and tabulated systematically in SPSS 12.0 and various tables are generated from the SPSS 12.0.

Table No. 4.12: Energy Saving

District	Excellent		Satisfactory		Unsatisfactory		Not responded		Total
	No.	%	No.	%	No.	%	No.	%	No.
Dolpa	-	-	-	-	79	100.0	-	-	**79**
Mugu	225	86.54	34	13.08	-	-	1	0.38	**260**
Jumla	263	76.90	79	23.10	-	-	-	-	**342**
Kalikot	593	86.32	90	13.10	4	0.58	-	-	**687**
Humla	117	63.24	68	36.76	-	-	-	-	**185**
Jajarkot	67	22.33	213	71.00	20	6.67			**300**
Bajura	4	1.58	119	47.04	130	51.38	-	-	**253**
Achham	53	9.62	85	15.43	411	74.59	2	0.36	**551**
Bajhang	87	25.30	164	47.67	93	27.03	-	-	**344**
Total	**1,409**	**46.95**	**852**	**28.39**	**737**	**24.56**	**3**	**0.10**	**3001**

Solar Tuki user respondents are satisfied because its installation has helped them to reduce the consumption of kerosene for lighting purposes and consequently it has saved the expenses on kerosene. Similarly, it also helps to save the battery required for lighting and playing FM radios. Table No. 4.13 demonstrates that the installation of solar tuki has saved 3.5 liters of kerosene, in an average, and Rs. 365 is the average monthly saving. Similarly, the same table also shows that the average monthly battery saved is equivalent to Rs. 110, in an average, which was previously used for lighting lamps and playing FM radios before the installation of solar tuki, ranging from Rs. 79 in Jajarkot district to Rs. 125 in Achham district. In aggregate (considering both kerosene saved and battery saved), the average monthly household energy saved with the installation of solar tuki is equivalent to Rs. 475.

Table No. 4.13: District wise Average Monthly Saving from Kerosene and Battery Saving

District	Kerosene saved per month		NRs saved per month due to battery saving	Total NRs saved per month
	in liters	in NRs		
Mugu	4.22	655.44	97.70	753.15
Jumla	3.92	508.57	107.82	616.39
Kalikot	3.40	213.08	82.81	295.88
Humla	2.37	371.57	105.61	477.18
Bajura	-	-	118.60	118.60
Achham	3.48	347.33	125.42	472.75
Bajhang	3.72	439.65	122.27	561.92
Jajarkot	2.64	167.38	78.58	245.96
Average	**3.54**	**365.21**	**110.19**	**475.40**

Table No. 4.14 shows the total district-wise total kerosene saved and resultant CO_2 reduction per year due to the use of Solar Tuki in those districts. From the table it is obvious that a total of around 271 Tonnes of CO_2 emission is reduced due to the use of Solar Tuki in KUP districts per year.

Table No. 4.14: District-wise Total Kerosene Saved and Resultant CO_2 Reduction/Year

District	Kerosene saved/Year (In ltr.)	CO_2 Reduction/year (In kg.)*
Achham	22866	60973
Bajhang	14958	39886
Humla	1452	3872
Jajarkot	6336	16895
Jumla	16092	42910
Kalikot	26892	71709
Mugu	13116	34974
Grand Total	**101712**	**271219**

4.7 HEALTH AND ENVIRONMENT

The second important implication of solar tuki installation is the implication on health of solar tuki users and their house and surrounding environment. Level of improvement in health problems relating to respiratory, optical, and others are assessed as the indicators of health implications. Similarly, level of improvement in the smoky house and cleanliness and neatness of the house and its surroundings are considered for assessing the environment implications.

4.7.1 Improvement in Respiratory, Optical and Other Health Problems

The opinions of solar tuki user respondents relating to before and after the use of solar tuki have been compared in the Table No. 4.15. In the field survey, 3001 users respondents with 106 non responded before and 108 non responded after for this particular question have been interviewed in Dolpa, Mugu, Jumla, Kalikot, Humla, Jajarkot, Bajura, Achham and Bajhang districts and 1,067 out of 3,001 (i.e., 35.6%) have said good health environment and they have no respiratory problem before the installation of solar tuki in these districts but after the installation 2,461 (i.e., 82.0%) have said good health environment saying no respiratory problem. Thus, in totality, they have realized the significant level of improvement in respiratory health. In relation to the districts, the respondents of Dolpa, Jajarkot, Kalikot and Humla districts have realized the entire improvement in the respiratory health and the respondents of other districts have also realized remarkable level of improvement in respiratory health. The Table No. 4.16 also shows the same situation in case of optical health problems. It has been realized about cent percent improvement in optical problems in Dolpa, Jajarkot, Kalikot and Humla. The Table No. 4.17 shows that the installation of solar tuki has been found highly effective in solving other health related problems in these districts. The situation in totality is also similar to that of the respiratory health. See Chart 4.16 and 4.17.

* calculation is done referring (i) http://timeforchange.org/what-is-a-carbon-footprint-definition (ii) http://www.asknumbers.com/carbonEmissionConversion.aspx

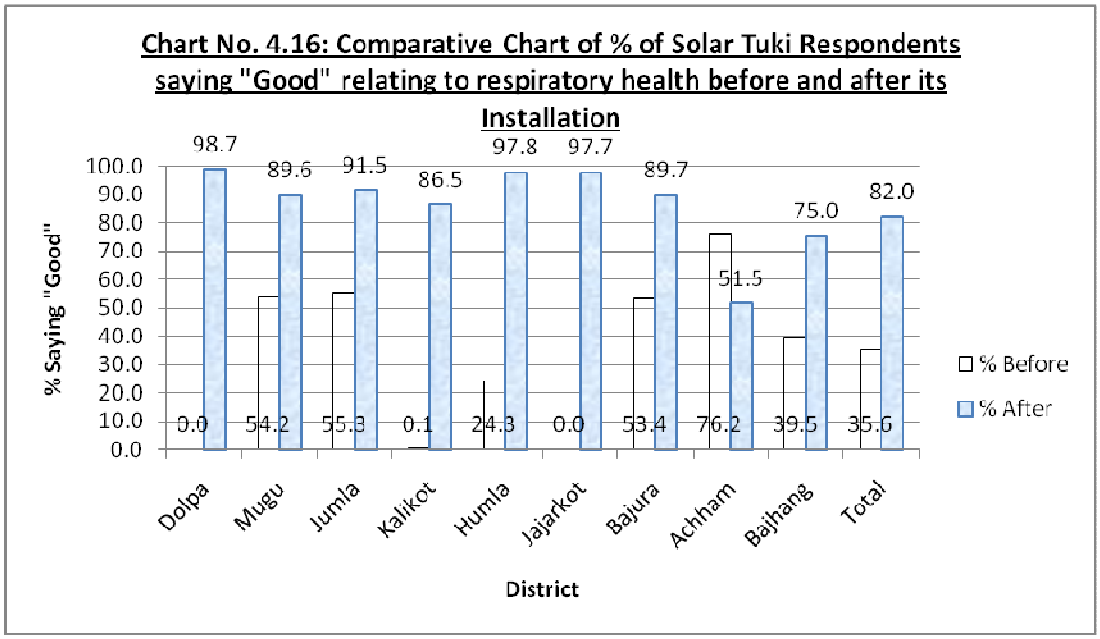


Table No. 4.15: Level of Improvement in Respiratory Problem

District	Before Solar Tuki Installation*				After Solar Tuki Installation				Percentage of Saying "Good"	
	Good	Bad	NR⊗	Total	Good	Same	NR	Total		
	No.	No.	No.	No.	No.	No.	No.	No.	Before %	After %
Dolpa	0	78	1	79	78	0	1	79	0.0	98.7
Mugu	141	119	0	260	233	26	1	260	54.2	89.6
Jumla	189	150	3	342	313	25	4	342	55.3	91.5
Kalikot	1	595	91	687	594	2	91	687	0.1	86.5
Humla	45	139	1	185	181	3	1	185	24.3	97.8
Jajarkot	0	293	7	300	293	0	7	300	0.0	97.7
Bajura	135	118	0	253	227	26	0	253	53.4	89.7
Achham	420	131	0	551	284	267	0	551	76.2	51.5
Bajhang	136	205	3	344	258	83	3	344	39.5	75.0
Total	**1067**	**1828**	**106**	**3001**	**2461**	**432**	**108**	**3001**	**35.6**	**82.0**

∗ The health condition before the installation of Solar Tuki is also included along with the health condition after the ST installation and systematically recorded in SPSS 12.0 in order to visualize and illustrate comparative increment in level of health condition after the installation of Solar Tuki in KUP districts.

⊗ NR (Not responded/recorded)

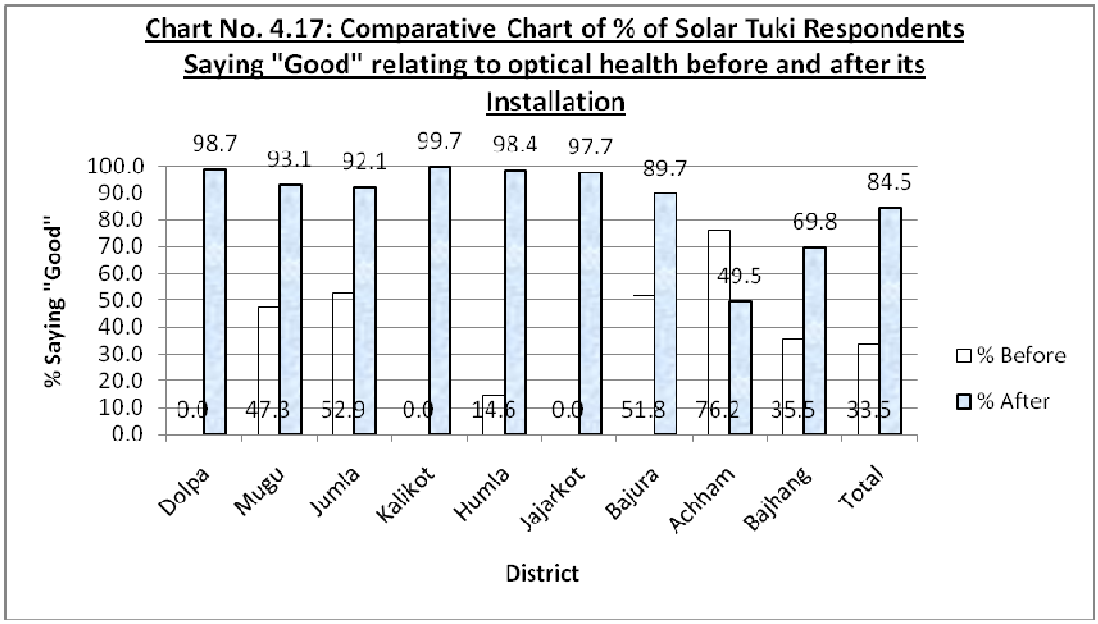


Table No. 4.16: Level of Improvement in Optical Health Problem

District	Before Solar Tuki Installation				After Solar Tuki Installation				Percentage of Saying "Good"	
	Good	Bad	NR	Total	Good	Same	NR	Total		
	No.	No.	No.	No.	No.	No.	No.	No.	Before %	After %
Dolpa	0	78	1	79	78	0	1	79	0.0	98.7
Mugu	123	137	0	260	242	18	0	260	47.3	93.1
Jumla	181	158	3	342	315	22	5	342	52.9	92.1
Kalikot	0	685	2	687	685	0	2	687	0.0	99.7
Humla	27	157	1	185	182	2	1	185	14.6	98.4
Jajarkot	0	293	7	300	293	0	7	300	0.0	97.7
Bajura	131	122	0	253	227	26	0	253	51.8	89.7
Achham	420	121	10	551	273	268	10	551	76.2	49.5
Bajhang	122	191	31	344	240	73	31	344	35.5	69.8
Total	**1004**	**1942**	**55**	**3001**	**2535**	**409**	**57**	**3001**	**33.5**	**84.5**

Table No. 4.17: Level of Improvement in Other Health Problems

District	Before Solar Tuki Installation			After Solar Tuki Installation			Percentage Of Saying "Good"	
	Good	Bad	Total	Good	Same	Total		
	No.	No.	No.	No.	No.	No.	Before (%)	After (%)
Dolpa								
Mugu		6	6	5	1	6	-	83.3
Jumla								
Kalikot		89	89	89		89	-	100.0
Humla								
Jajarkot		1	1	1		1	-	100.0
Bajura								
Achham	1		1				100.0	
Bajhang	4	2	6	4		4	66.7	100.0
Total	**5**	**98**	**103**	**99**	**1**	**100**	**4.9**	**99.0**

4.7.2 Home Sanitation

Poor sanitation in home and its surroundings are, in fact, more responsible in creating health problem in the rural areas since level of literacy and awareness is low in rural areas. Less attention has been paid to the home sanitation. The people of these districts have been realized the remarkable improvement in the home sanitation after the installation of solar tuki in their residential homes and their surroundings. All together 2,145 (71.5%) out of 3,001 user respondents (including 5 non respondents for this particular case) of these districts have accepted the fact that the installation of solar tuki has improved their home sanitation. Almost cent percent respondents in Dolpa, Jajarkot, Humla and Kalikot districts have agreed the improvement in home sanitation after its installation. In contrary, respondents in Achham, Bajhang and Bajura districts are reluctant to accept the fact. The percentage of respondents saying "No" is only 3.6%. In totality, the percentage of respondents with indifferent effect (22.2%) is also remarkable in these districts. However, most of respondents have agreed that the installation of solar tuki has positive impacts on the improvement of home sanitation and its surroundings (See Table No. 4.18).

Table No. 4.18: Level of Improvement in Home Sanitation after the Use of Solar Tuki

District	Yes		No		Same		Don't Know		NR*		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Dolpa	78	98.7	0	0.0	0	0.0	0	0.0	1	1.3	79	100
Mugu	235	90.4	2	0.8	23	8.8	0	0.0	0	0.0	260	100
Jumla	324	94.7	5	1.5	13	3.8	0	0.0	0	0.0	342	100
Kalikot	685	99.7	0	0.0	2	0.3	0	0.0	0	0.0	687	100
Humla	185	100.0	0	0.0	0	0.0	0	0.0	0	0.0	185	100
Jajarkot	300	100.0	0	0.0	0	0.0	0	0.0	0	0.0	300	100
Bajura	116	45.8	16	6.3	103	40.7	18	7.1	0	0.0	253	100
Achham	111	20.1	51	9.3	355	64.4	34	6.2	0	0.0	551	100
Bajhang	111	32.3	34	9.9	171	49.7	24	7.0	4	1.2	344	100
Total	**2145**	**71.5**	**108**	**3.6**	**667**	**22.2**	**76**	**2.5**	**5**	**0.2**	**3001**	**100**

4.8 EDUCATION, KNOWLEDGE AND AWARENESS

Since the solar tuki is used for lighting purpose, it has, of course, desirable implications on the education especially in children education, on the skill and knowledge development of the rural people and on the awareness creation for these people.

4.8.1 Improvement in Quality of Children's Education

Prior to the use of solar tuki, kerosene lamp or wooden torch is mostly used and it generates remarkable quantity of smoke and affects the eye and respiratory health of children while they are reading and writing their home works. In addition to them, other family members are also equally adversely affected. The survey has shown that 76.5% (12.7% + 63.8%) of the total respondents 3,001 (including 6 non respondents in this case) in all districts are satisfied in relation to the improvement in children's education using solar tuki and only 23.3% of them are not satisfied relating to it. The higher percentage of respondents in Achham (74.8%), and Bajura (52.2%) are reluctant to accept that the use

* NR = Not responded/recorded

of solar tuki improves the children education and a little bit less but 36% respondents in Bajhang are still not accepting the improvement of children education because of the use of solar tuki (See Table 4.19).

Table No. 4.19: Improve In Children's Education

District	Excellent		Satisfactory		Unsatisfactory		NR		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Dolpa	2	2.5	77	97.5	0	0.0	0	0.0	79	100
Mugu	112	43.1	148	56.9	0	0.0	0	0.0	260	100
Jumla	109	31.9	230	67.3	3	0.9	0	0.0	342	100
Kalikot	49	7.1	613	89.2	23	3.3	2	0.3	687	100
Humla	36	19.5	149	80.5	0	0.0	0	0.0	185	100
Jajarkot	44	14.7	250	83.3	6	2.0	0	0.0	300	100
Bajura	18	7.1	103	40.7	132	52.2	0	0.0	253	100
Achham	3	0.5	134	24.3	412	74.8	2	0.4	551	100
Bajhang	7	2.0	211	61.3	124	36.0	2	0.6	344	100
Total	**380**	**12.7**	**1915**	**63.8**	**700**	**23.3**	**6**	**0.2**	**3001**	**100**

4.8.2 Access of Information ∗

A small FM radio can also be played with power supplied by the solar tuki and playing these transistor rural people can listen to various types of radio programs relating to skill development as well as entertainment. Among the solar tuki users, only 53.9% (18.4% + 35.5%) have opined that these radio programs they listened help them in the field of skill and knowledge development as well as entertainment. 41.9% of the respondents are not accepting that they can be benefited from listening the radio powered by the solar tuki in the field of skill and knowledge development and entertainment whereas 4.3% of the respondents didn't respond for this particular case. Usefulness of playing FM radio has been realized where the electricity power supply is not available. The availability of electricity in the settlement can make them possible to have audio and visual facilities through watching the television, which is more attractive than the audio from the FM radio. Something is better than nothing. Most of the respondents in Mugu, Jumla, Humla and Bajhang districts are satisfied whereas; those in Dolpa, Achham, Kalikot, Jajarkot, and Bajura districts have shown relatively higher level of dissatisfaction from radio facility which is made them possible with the use of solar tuki due to the short operational life of the distributed solar tuki.

∗ Survey questionnaires include the questions seeking these information and tabulated systematically in SPSS 12.0 which helps in producing various tables depicting these cases district-wise.

Table No. 4.20: Knowledge & Skill Enhancement

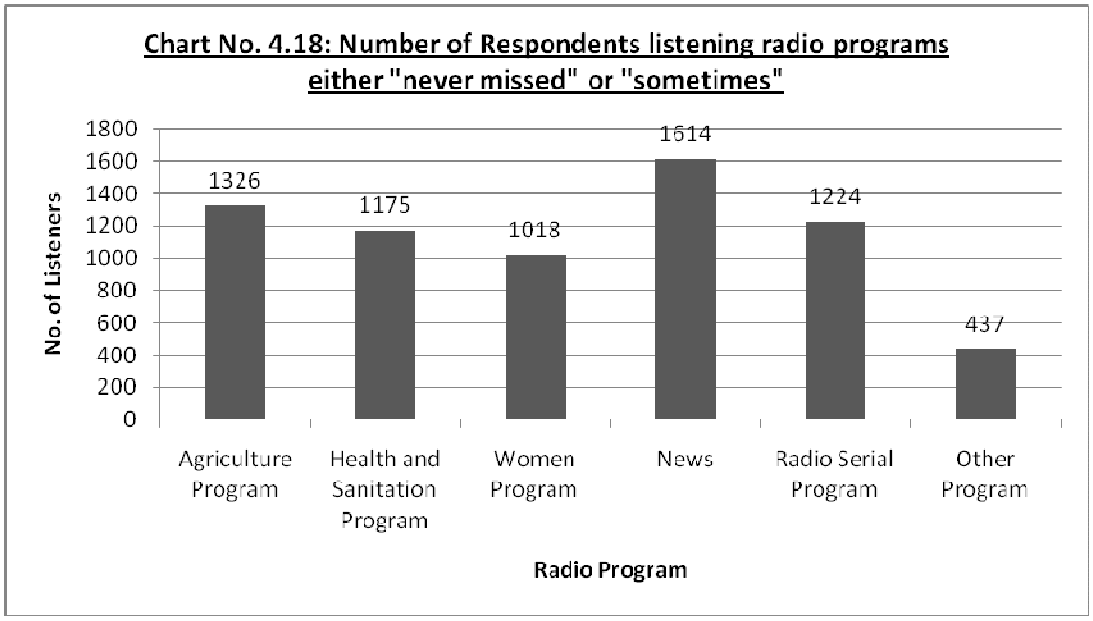
District	Excellent		Satisfactory		Unsatisfactory		NR		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Dolpa	0	0.0	1	1.3	78	98.7	0	0.0	79	100
Mugu	148	56.9	111	42.7	0	0.0	1	0.4	260	100
Jumla	143	41.8	199	58.2	0	0.0	0	0.0	342	100
Kalikot	140	20.4	58	8.4	367	53.4	122	17.8	687	100
Humla	31	16.8	153	82.7	1	0.5	0	0.0	185	100
Jajarkot	20	6.7	102	34.0	178	59.3	0	0.0	300	100
Bajura	18	7.1	105	41.5	130	51.4	0	0.0	253	100
Achham	3	0.5	134	24.3	411	74.6	3	0.5	551	100
Bajhang	48	14.0	201	58.4	91	26.5	4	1.2	344	100
Total	**551**	**18.4**	**1064**	**35.5**	**1256**	**41.9**	**130**	**4.3**	**3001**	**100**

4.8.3 Radio Programs and its Usefulness

As described earlier in the technical aspects out of 3,001 ST units surveyed, in 1071 units radio sockets were simply not functioning. Furthermore, out of ST units with working radio socket, some of the users didn't possess radio and some simply didn't respond to these questions, hence the no. of respondents for these cases were far less than 3,001. Mostly listened radio programs playing the FM radio by the respondents are news, agricultural program, radio serial program, health and sanitation program, women program and other programs in descending order of ranking. The Chart No. 4.18 and Table No. 4.21 shows that the highest number (1,614) of respondents listen the News program and the least number (437) of respondents listen other programs.

Table No. 4.21: Radio Programs By District

District	Never Missed		Sometime		Never		Total	
	No.	%	No.	%	No.	%	**No.**	**%**
Agricultural Program	324	22.2	1002	68.8	131	9	**1457**	**100**
Health and Sanitation Program	157	11.4	1018	74	200	14.5	**1375**	**100**
Women Program	186	13.8	832	61.9	327	24.3	**1345**	**100**
News	759	46.4	855	52.2	23	1.4	**1637**	**100**
Radio Serial Program	387	27.2	837	58.8	200	14	**1424**	**100**
Other Program	234	52.8	203	45.8	6	1.4	**443**	**100**



Usefulness of radio programs have been assessed based on some important indicators such as: knowledge oriented, skill oriented, income oriented and others. 1,547 (98%) out of total 1,579 news program listener respondents have played radio transistor for news program and they have claimed that this program is knowledge oriented and 32 (2%) respondents have opined that the news program has helped to enhance the skill. 1,170 (89.7%) out of 1,305 agricultural program listener respondents have the opinion that this program helps them to generate income and similarly, 87 (6.7%) agricultural program listener respondents and 48 (3.7%) agricultural program listener respondents have claimed that the news program helps them to enhance their skill and to gain the knowledge respectively. Cottage industries program helps them mainly to enhance the skill and to generate income. Most of the respondents have agreed that women program is knowledge oriented and helps to enhance skill a little bit. Thus, the radio programs are found useful in gaining knowledge, enhancing skill, generating income and others (See Table No. 4.22).

Table No. 4.22: Usefulness of the Radio Programs

District	Knowledge gain		Skill enhance		Help to generate income		Other		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Agricultural Program	48	3.7	87	6.7	1,170	89.7			1,305	100
Cottage Industries Program	13	1.2	678	64.3	363	34.4			1,054	100
Women Program	953	96.7	33	3.3					986	100
News Program	1,547	98.0	32	2.0					1,579	100
Other Program	68	17.3	1	0.3	2	0.5	323	82.0	394	100

4.9 SOCIALIZATION AND SATISFACTION LEVEL

4.9.1 Social Gathering in Evening

The next important impact of the solar tuki is socialization and level of satisfaction they gained. In the process of socialization, benefit may be both positive and negative. Of course, the positive benefit covers the higher share. The respondents have realized the positive implication of the installation of solar tuki in their home with increasing socialization in their settlements. Social gatherings have been encouraged in evening due to the availability of lighting facilities in their home. Previously they used to sleep early due to the light problem. The solar light has helped them to prolong their evening life and consequently, it encourages to work as well as to have social gathering. The social gathering, of course, helps to improve the family as well as social integration in their settlements. The Table No. 4.23 shows that 2,143 respondents (71.4%) out of 3,001 respondents (including 18 non respondents for this case) are satisfied with family integration through social gathering in evening and only 840 respondents (28.0%) are not satisfied and not agreed with the fact that solar light improves the family integration through social gathering in evening. More than half of the respondents in Achham and Bajura districts are not satisfied and not agreed with this type of social implications of the solar tuki. However, in totality, 71.4% respondents are satisfied with the family and social integration they achieved with the use of solar tuki.

Table No. 4.23: Level of Improvement in Family Integration

District	Excellent		Satisfactory		Unsatisfactory		NR		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Dolpa	2	2.5	77	9.7	0	0.0	0	0.0	79	100
Mugu	61	23.5	175	6.7	23	8.8	1	0.4	260	100
Jumla	33	9.6	241	7.0	67	19.6	1	0.3	342	100
Kalikot	24	3.5	650	9.5	9	1.3	4	0.6	687	100
Humla	10	5.4	146	7.9	27	14.6	2	1.1	185	100
Jajarkot	42	14.0	256	8.5	2	0.7	0	0.0	300	100
Bajura	4	1.6	113	4.5	132	52.2	4	1.6	253	100
Achham	0	0.0	119	2.2	430	78.0	2	0.4	551	100
Bajhang	7	2.0	183	5.3	150	43.6	4	1.2	344	100
Total	**183**	**6.1**	**1960**	**65.3**	**840**	**28.0**	**18**	**0.6**	**3001**	**100**

4.9.2 Incoming of Neighbors for Listening the Radio

Male, female and children of neighboring houses with not having solar tuki have been found attracted to visit to houses having solar tuki to listen to various radio programs such as: agriculture program, health and sanitation program, cottage industry program, radio serial programs, news program, women program and other programs. 40% of male, 33% of children and 27% of female neighbors are used to visit to listen to radio programs in evening. These visiting of neighbors help to develop the intimacy and friendship among the neighbors and create the healthy environments in the settlements. This is also one of the most important means of developing socialization process in the settlements (See Table No. 4.24).

Table No. 4.24: Types of Neighbors Visiting Your House to Listen Radio by District

District	Children		Female		Male		Total	
	No.	%	No.	%	No.	%	No.	%
Mugu	97	36.7	68	25.8	99	37.5	264	100
Jumla	76	24.4	104	33.4	131	42.1	311	100
Kalikot	13	19.4	24	35.8	30	44.8	67	100
Humla	17	8.4	66	32.7	119	58.9	202	100
Jajarkot	4	22.2	3	16.7	11	61.1	18	100
Total	**207**	**33.0**	**170**	**27.1**	**250**	**39.9**	**627**	**100**

4.9.3 Negative Effects of Using ST

As each coin have two faces: head or tail, everything has two complementary aspects i.e., good and bad. As mentioned above, the availability of lighting facility from solar tuki creates the social gathering facilities among the neighbors. This social gathering brings happiness of family and social integration as well as social problems such as: encouraging card playing habit, back biting habits mostly, among women, which brings unwanted social problems and social disintegration. 2,953 respondents (98.4%) out of 3,001 (including 16 non respondents for this case) have opined that they do not have faced with such negative effects of solar tuki and only 1.1% of them have realized such negative implications of solar tuki in their settlements. Thus, solar tuki has very negligible percentage of negative social implications on the society in these districts and it has left very positive social impacts on the settlements of the study area i.e., Karnali Zone. See also Table No. 4.25.

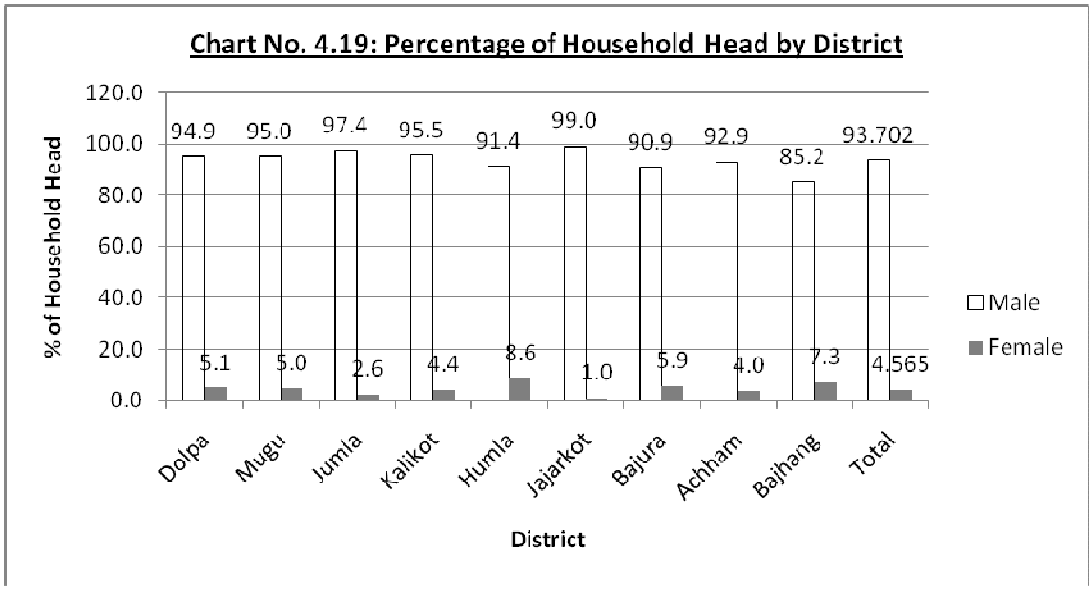
Table No. 4.25: Negative effects on the society from Solar Tuki

District	Yes		No		NR		Total	
	No.	%	No.	%	No.	%	No.	%
Dolpa	0	0.0	78	98.7	1	1.3	79	100
Mugu	2	0.8	253	97.3	5	1.9	260	100
Jumla	0	0.0	342	100.0	0	0.0	342	100
Kalikot	3	0.4	684	99.6	0	0.0	687	100
Humla	0	0.0	185	100.0	0	0.0	185	100
Jajarkot	0	0.0	296	98.7	4	1.3	300	100
Bajura	0	0.0	253	100.0	0	0.0	253	100
Achham	0	0.0	549	99.6	2	0.4	551	100
Bajhang	27	7.8	313	91.0	4	1.2	344	100
Total	**32**	**1.1**	**2953**	**98.4**	**16**	**0.5**	**3001**	**100**

4.10 WOMEN EMPOWERMENT AND WOMEN'S DRUDGERY REDUCTION

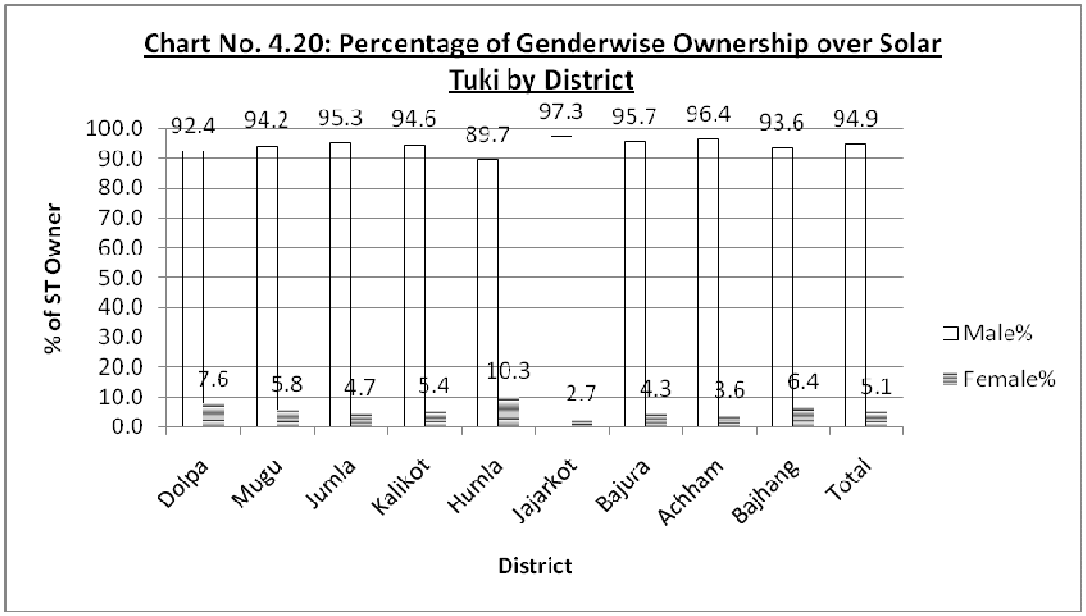
4.10.1 Women as a Head of Family

As discussed above, the increasing women's access to family income, wealth and decision making process increases the women empowerment. This access can be achieved by being head of the family. At present in these districts, the status of women family head has been shown in the following Chart No.4.19 and also in Table No. 4.28 under section 4.3.1 Household Head. The Chart shows that 4.6% of the households are headed by female in Karnali ranging from 1% in Jajarkot district to 8.6% in Humla district. In conclusion, it can be said that women empowerment is yet to be a distant target in the country regarding to the present status of percentage of female household head.



4.10.2 Women's Ownership on Solar Tuki

Traditionally Nepalese social structure was and even today is male dominated and female has being dominated since a long history in the country. Women had /have less access to income, wealth, decision making. That's why; they were/are less empowered in the family as well as in society. For women empowerment, the greater access to family income, family wealth and family and social decision making process should be provided and should be exercised by themselves in their real lives. As discussed above, female household head is very low and similarly the female ownership on the solar tuki is found to be very low in these districts ranging from 2.7% in Jajarkot district to 10.3% in Humla district. However, female ownership over the family asset has been increasingly being in practice as the government has also increased emphasis on it. In this regards, future seems to be hopeful.



4.10.3 Children's Support in Household Chores

In the rural areas, most of the household chores are under the responsibility of women in the family. Male are mostly engaged in the outside home activities. Traditionally also, male is usually discourage to work inside the home and it is regarded as the responsibility of women. If some male partner has support his female partner in household chores, he is called as "Joitingre" i.e., a wife dominated male, which is socially not accepted. That's why; women are mostly busy inside the house and they have to work till late night and need to be wake up early morning to complete the work that they could not complete in the last night. This sleepless night has usually worsened their health. Before installation of solar tuki, with light source like wooden and wheat straw torches or kerosene lamp, reading and writing are not possible, so children had to do their homework in daylight and slept earlier to save the kerosene. But after the installation of solar tuki in their home, their children can do their homework even in evening and night without any problem including health problem. It also helps them to save the time. They have started to help their mothers in household activities after completing their homework in previous night using ST. 1,917 respondents (63.8% including both excellent and satisfactory responses) have told that their children are helping their mothers in household chores satisfactorily and only 1,068 respondents (i.e., 35.6%) are not satisfied with the children support to their mothers in household activities. Level of dissatisfaction is more than the average (35.6%) in Achham (74.6%), Bajura (50.6%), Dolpa (40.5%) and Bajhang (38.1%) districts. However, in totality, children do help their parents during their leisure period of time, saved due to the use of solar tuki for lighting. Thus, the installation of solar tuki helps to empower the women and to reduce the women household drudgery (Table No. 4.26).

Table No. 4.26: Children helping in HH Activities

District	Excellent		Satisfactory		Unsatisfactory		NR		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Dolpa	4	5.1	43	5.4	32	40.5	0	0.0	79	100
Mugu	89	34.2	168	6.5	1	0.4	2	0.8	260	100
Jumla	50	14.6	258	7.5	34	9.9	0	0.0	342	100
Kalikot	85	12.4	320	4.7	276	40.2	6	0.9	687	100
Humla	40	21.6	144	7.8	1	0.5	0	0.0	185	100
Jajarkot	32	10.7	214	7.1	54	18.0	0	0.0	300	100
Bajura	6	2.4	119	4.7	128	50.6	0	0.0	253	100
Achham	1	0.2	137	2.5	411	74.6	2	0.4	551	100
Bajhang	6	1.7	201	5.8	131	38.1	6	1.7	344	100
Total	**313**	**10.4**	**1604**	**53.4**	**1068**	**35.6**	**16**	**0.5**	**3001**	**100**

4.10.4 Time Saving from Laundry Activity and Shopping of Kerosene

Most of respondents have their opinion in group discussion that the solar tuki is smokeless lamp. It has replaced the smoky kerosene and wooden burnt lamps. It has helped them to reduce the volume of smoke inside the home. The smoke can be totally eliminated in the home if smoke free stoves i.e., improved cooking stove, can also be used. But most of the families are still using the traditional cook stove in the kitchen; which generates sufficient level of smoke. The smoky environment inside the home makes the room dark as well as dirt their clothes. Clothes are required to be washed more often. After the use of solar tuki, the frequency of whitewashing the room and washing clothes has been reduced remarkably. Thus, the respondents have realized that the use of

solar tuki help them to reduce the laundry activities, which save their time and money. It also saves expenditure on soap and kerosene as well as reduces expenditure on clothes. Furthermore, time spent before the use of Solar Tuki for collecting firewood in the nearby forest and visiting market place for the purchase of kerosene for lighting can be utilized in other productive works and activities.

4.11 WILLINGNESS TO USE OF LARGER SIZE OF ST AND SUGGEST NON-USERS FOR ITS USE

4.11.1 Willingness to Use of Larger Size of ST

Realizing abovementioned benefits from the solar tuki, respondents have shown positive interest on its installation. The Table No. 4.27 shows that solar tuki users have shown higher willingness to install higher capacity solar system if its supply is possible in their localities. 2,037 (67.9%) of the total 3,001 respondents (including 10 non respondents for this case) are willing to install higher capacity solar system in their homes. 9.5% respondents have given negative answer. And rests of them are indifferent and not yet decided.

Table No. 4.27: Willingness to install higher capacity Solar system

District	Yes		No		Don't Know		NR		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Dolpa	78	98.7	0	0.0	0	0.0	1	1.3	79	100
Mugu	254	97.7	2	0.8	2	0.8	2	0.8	260	100
Jumla	341	99.7	1	0.3	0	0.0	0	0.0	342	100
Kalikot	686	99.9	1	0.1	0	0.0	0	0.0	687	100
Humla	185	100.0	0	0.0	0	0.0	0	0.0	185	100
Jajarkot	298	99.3	2	0.7	0	0.0	0	0.0	300	100
Bajura	7	2.8	112	44.3	134	53.0	0	0.0	253	100
Achham	134	24.3	106	19.2	310	56.3	1	0.2	551	100
Bajhang	54	15.7	60	17.4	224	65.1	6	1.7	344	100
Total	**2037**	**67.9**	**284**	**9.5**	**670.0**	**22.3**	**10**	**0.3**	**3001**	**100**

4.11.2 Suggest Non-users for Its Use

Realizing the benefits from the use of solar tuki, the user respondents have suggested or advised other non user neighbors to install it. The Table No. 4.28 suggests that 92.2% of total 3,001 user respondents (including 7 non respondents in this case) have advised or ready to advise their non-user neighbors to install it. Only 7.5% user respondents are not agree to advise non-users to install it since they are not fully satisfied with it.

Table No. 4.28: Suggest Non-Users to Install Solar Tuki

District	Yes		No		NR		Total	
	No.	%	No.	%	No.	%	No.	%
Dolpa	78	98.7	0	0.0	1	1.3	79	100
Mugu	257	98.8	3	1.2	0	0.0	260	100
Jumla	338	98.8	4	1.2	0	0.0	342	100
Kalikot	678	98.7	9	1.3	0	0.0	687	100
Humla	183	98.9	2	1.1	0	0.0	185	100
Jajarkot	298	99.3	1	0.3	1	0.3	300	100
Bajura	191	75.5	62	24.5	0	0.0	253	100
Achham	458	83.1	92	16.7	1	0.2	551	100
Bajhang	287	83.4	53	15.4	4	1.2	344	100
Total	**2768**	**92.2**	**226**	**7.5**	**7**	**0.2**	**3001**	**100**

Chapter-V Findings

5.1 GENERAL INFORMATION

- Nine districts of Karnali zone of Mid-Western Region, namely Dolpa, Mugu, Jumla, Kalikot, Humla, Jajarkot, Bajura, Achham, and Bajhang districts were surveyed covering 3,001 households during the field survey of solar tuki users.
- During the field survey, a total of 3,001 solar tuki user households were surveyed consisting 2,216 male respondents (73.8%) and 751 female respondents (25.0%).
- The percentage coverage of samples in these districts were varied and ranged from the lowest 2.6% in Dolpa district to the highest 22.9% in Kalikot district.
- 78 households of Solar Tuki non-users of five districts namely, Dolpa, Mugu, Jumla, Kalikot, and Humla consisting 69 male respondents (88.5%) and 9 female respondents (11.5%) were surveyed in order to know their interest to install solar tuki in near future.
- Less than 5% of the total households (3,001) interviewed have female household head. The percentage of female household head in Jajarkot district is the least i.e., only one percent; whereas, in this regards, Humla district is the best among them having the highest percentage (8.6%).
- Similarly female ownership over the solar tuki set is also found to be only 5.1% in these surveyed districts and varies from 2.7% in Jajarkot district to 10.3% in Humla district.
- The highest benefited caste from the Karnali Ujyalo Program is the Chhetri (i.e., 46.2%) followed by Dalit (31.5%) and Thakuri (14.2%). The solar tuki has not been evenly distributed among different castes in these districts.
- Mostly beneficiaries are Hindus except in Humla district.
- The household has to pay Rs. 225.00 only i.e., 5% of Rs. 4,500.00. But some of them had paid more than that due to irregularities in distribution of solar tuki and practice of its resale.

5.2 TECHNICAL ASPECTS

- The data processed after the survey gives a tragic picture of the conditions of the solar lamps distributed on a heavily subsidized model to the people of Karnali region. Out of 3,001 sampled users, 1560 systems were non-operational because of the damaged battery, 394 systems were defunct because of the damaged solar modules, 274 systems were non-functional due to connection related problems and 1034 units of lamps (517 systems; each system consists of two lamps) were not functioning. It leaves us with a very small number of the operational solar lamp amounting just 255 units. It comes to be 8.5% of the sampled solar lamp users. But however a unit system itself could have more than one component non-functional (e.g. both battery and the solar panel). A detailed unit-by- unit analysis of the surveyed solar tukis revealed that around 70% of the installed and surveyed units are either non-functional or are in unsatisfactory condition. This figure is also substantiated by the statements made by the users in focused group meetings.
- The battery seems to be the weakest part (but the major one) of the distributed system.

- The management and execution of after sales service obligations during and after warranty period is found to be the next deciding factor for poor performance of the program. No solid evidence was found during the survey that the suppliers made ASS visits and provided support for repair of the faulty system components.

5.3 SOCIO-ECONOMIC IMPACTS

- Implication of solar tuki installation on Income generation of these people can be accessed through the implications on small shop keeping, agro-business, livestock keeping, wage labor, poultry farming, collection of forest products and others.
- The use of solar tuki helps them to prolong the opening of small shops for longer period in night time and consequently, they can earn more income from small retail shops. In totality, the average of district wise average monthly incremental income from small shop is Rs. 2,739.
- The average of district-wise average monthly incremental income from agro-business is Rs. 2,208.
- The average of average district monthly incremental wage income from labor activities using time saved is Rs. 1,023.
- The saved time and energy due to use of solar tuki, which were previously spend for collecting wood for wooden torch from the forest, can now be used to collect wood, herbs and other forest products from the forest and can generate additional income from selling them but this benefit has been harnessed by only two ST user respondents of Jumla and Kalikot districts having Rs. 2,500 and Rs. 500 respectively as average monthly incremental income from collecting forest products.
- In an average of all district-wise average monthly income from poultry is found Rs. 1,721.
- Average of district-wise average of monthly incremental income from livestock is found Rs. 2,794, which is remarkable increment in the household income.
- In an average of district wise average monthly income generated from other economic activities is Rs. 919.
- Thus, the rural people of Karnali have been able to harness the highest average monthly household incremental income from livestock keeping and followed by small shop keeping and agri- business in the Karnali Ujyalo Program areas.
- More than 75% of the total solar tuki user respondents have been satisfied with level of energy saving due to the use of solar tuki including 47% excellent level of satisfaction.

5.4 HEALTH AND ENVIRONMENT

- 1,067 (35.6%) out of 3,001 have said good health environment and they have no respiratory problem before the installation of solar tuki in these districts but after the installation 2,461 (i.e., 82.0%) have said good health environment saying no respiratory problem. This indicates the improvement in health with the use of ST in these districts. The same situation is in the case of optical health problems. It has been

realized about cent-percent improvement in eye problems in Dolpa, Jajarkot, Kalikot and Humla.

- All together 2,145 (71.5%) out of 3,001 user respondents of these districts have accepted the fact that the installation of solar tuki has improved their home sanitation.

5.5 EDUCATION, KNOWLEDGE AND AWARENESS

- 76.5% of the total respondents (3,001) in all districts are satisfactory in relation to the improvement in children's education using solar tuki
- Playing the radio with power supplied by the solar tuki rural people can listen to the various types of radio programs relating to knowledge and skill development as well as entertainment. Among the solar tuki users, 53.9% have opined that these radio programs they listened help them in the field of skill and knowledge development as well as entertainment.
- Mostly listened radio programs are news, agricultural program, radio serial program, health and sanitation program, women program and other programs in descending order of ranking. The highest number (1,614) of respondents listen the News program and the least number (437) of respondents listen other programs.
- Usefulness of radio programs have been assessed based on some important indicators such as: knowledge oriented, skill oriented, income oriented and others. 1,547 (98%) out of total 1,579 news program listener respondents have played radio transistor for news program and realized that this program is knowledge oriented. 1,170 (89.7%) out of 1,305 agricultural program listener respondents have the opinion that this program helps them to generate income and similarly, 87 (6.7%) agricultural program listener respondents have claimed that this program helps them to enhance their skill and to gain the knowledge. Most of the respondents have agreed that women program is knowledge oriented and helps to enhance skill a little bit. Thus, the radio programs are found useful in gaining knowledge, enhancing skill, generating income and others.

5.6 SOCIALIZATION AND SATISFACTION LEVEL

- The solar light has helped them to prolong their evening life and consequently, it encourages to work as well as to have social gathering. The social gathering, of course, helps to improve the family as well as social integration in their settlements. The 2,143 respondents (71.4%) out of 3,001 respondents are satisfied with family integration through social gathering in evening.
- Male, female and children of neighboring houses without solar tuki have been found attracted to visit to houses with solar tuki to listen various radio programs. 40% of male, 33% of children and 27% of female neighbors are used to visit to listen to the radio programs in the evening. These visiting of neighbors help to develop the intimacy and friendship among the neighbors and create the healthy environments in the settlements.

5.7 NEGATIVE EFFECTS OF USING ST

- This social gathering may bring social integration as well as social disintegration caused by unwanted social problems such as: encouraging card playing habit, back biting habits mostly among women. But 2,953 respondents (98.4%) out of 3,001 have opined that they did not have faced with such negative effects of solar tuki in their settlements. Thus, solar tuki has very negligible percentage of negative social implications on the society in these districts.

5.8 WOMEN EMPOWERMENT AND WOMEN'S DRUDGERY REDUCTION

- 4.6% of the households are headed by female in Karnali ranging from 1% in Jajarkot district to 8.6% in Humla district. In this regard, women empowerment is yet to be a distant target in the country regarding the female household head.
- The female ownership on the solar tuki in these districts is found to be 5.1% ranging from 2.7% in Jajarkot district to 10.3% in Humla district.
- 1,917 respondents (63.8% including both excellent and satisfactory) have told that their children have been helping their mothers in household chores satisfactorily
- After the use of solar tuki, the frequency of whitewashing the room and washing clothes have been reduced remarkably. Thus, the respondents have realized that the use of solar tuki help them to reduce the whitewashing and laundry activities, which save their time and money reducing the expenditure on soap, kerosene and clothes. Furthermore, time spent before the use of Solar Tuki for collecting firewood in the forest and visiting market places for the purchase of kerosene, soap and clothes can be utilized in other productive works and activities.

5.9 WILLINGNESS TO USE OF LARGER SIZE OF ST AND SUGGEST NON-USERS FOR ITS USE

- Solar tuki users have shown higher willingness to install higher capacity solar system. 2,037 (67.9%) of the total 3,001 respondents are willing to install higher capacity solar system in their homes.
- Realizing the benefits from the use of solar tuki, 92.2% of total 3,001 user respondents have advised or ready to advise their non-user neighbors to install it.

Chapter-VI Conclusions and Recommendations

6.1 CONCLUSIONS

KUP districts are male dominated society which is obvious from the fact that less than 5% households are headed by female out of 3,001 surveyed households. Similarly female ownership over the solar tuki set is found to be only 5.1% ranging from 2.7% in Jajarkot district to 10.3% in Humla district. The highest benefited caste from the Karnali Ujjyalo Program is the Chhetri followed by Dalit and Thakuri. Mostly beneficiaries are Hindus except in Humla district. The solar tuki has not been evenly distributed among different castes and among the different religion in these districts. The sets have not been distributed to each and every household of the same settlement. This uneven distribution of the set has created dissatisfaction in the mind of non beneficiary. Theoretically the system is supposed to be 95% government subsidized i.e. the beneficiary is to pay only Rs. 225.00 (5%) out of Rs. 4500.00 which is the system's actual cost but some of them had paid more due to irregularities in distribution of solar tuki and mal-practice of its resale.

The quality of the system components, the management and execution of after sales service (ASS) provision during and after the warranty period are found to be the deciding factor in poor performance of the supplied solar tuki.

Implication of solar tuki installation on Income generation of these people can be assessed through evaluating the impacts on small shop keeping, agro-business, livestock keeping, wage labor, poultry farming, collection of forest products and others. The rural people of Karnali have been able to harness the highest average monthly household incremental income from livestock keeping and followed by small shop keeping and agri-business in the Karnali Ujjyalo Program areas. More than 75% of the total solar tuki user respondents have been satisfied with level of energy saving due to the use of solar tuki.

In regards to the impacts, most of the user respondents have said good improvement in respiratory, optical and other health as well as remarkable improvement in their home sanitation after the installation. 76.5% of the total respondents in all districts are satisfactory in relation to the improvement in children's education using solar tuki Playing the transistor with power supplied by the solar tuki rural people have listened various types of radio programs relating to knowledge and skill development as well as entertainment. They have opined that these radio programs they listened help them in the field of skill and knowledge development as well as entertainment. News, agricultural program, radio serial program, health and sanitation program, women program and other programs are mostly listened programs. The highest number of respondents listen the News program. They have realized the usefulness of these radio programs in enhancing their information, knowledge, skill, and awareness, as well as in enjoying various types of entertainments.

The solar light has helped them to prolong their evening life and consequently, it encourages to work as well as to have social gathering. The social gathering, of course, helps to improve the family as well as social integration in their settlements. Most of the

respondents are satisfied with family integration through social gathering in evening. The solar tuki non-user neighbors (including male, female and children) have been found visited to solar tuki user houses for listening to various radio programs in evening. These visiting of neighbors have helped to develop the intimacy and friendship among the neighbors and create the healthy environments in the settlements.

Women empowerment is yet to be a distant target in the country regarding to the female household head and female ownership. Children have been found helping their mothers in household chores satisfactorily using their saved time to make the mother free from household chores at least to some extent. This helps them to enhance their confidence in decision making and to spare their time to involve in socio-economic activities outside house.

After the use of solar tuki, the frequency of whitewashing the room and washing clothes has been reduced remarkably. Thus, the respondents have realized that the use of solar tuki help them to reduce the whitewashing and laundry activities, which save their time and money. These save money and time can be utilized in other productive works and activities.

Most of user respondents are willing to install higher capacity solar system in their homes. Realizing the benefits from the use of solar tuki, they have advised or ready to advise their non-user neighbors to install it.

This social gathering brings happiness of family and social integration. But it is assumed that some sorts of social problems such as: encouraging card playing habit, back biting habits mostly, among women may brings unwanted social problems and social disintegration. But 98.4% respondents have opined that they do not have faced with such negative effects of solar tuki in their settlements. Thus, solar tuki has very negligible percentage of negative social implications on the society in these districts.

In conclusion the impact of the use of solar tuki has been found positive on livelihood of the rural people as well as on developing their social integration in their villages. But most of the users amongst the surveyed 3,001 households are not satisfied with technical aspects. Despite the above mentioned favorable socio-economic impacts of the program, we should also consider the fact that the data relating to socio-economic implications of solar tuki installation has been developed based on the responses of the respondents recalling the implications realized during the period of initial 6-12 months of problem free operation of solar tukis.

6.2 SUGGESTIONS

Based on the above findings and conclusions, the following suggestions can be recommended:

- Set up strong distribution network such that targeted household gets the set directly.
- Devise a method during distribution which will prevent multiple distribution of the set to one single family (Some sort of ID viz. citizenship etc. based).
- Make distribution bureaucratic and political pressure free.
- Ascertain quality of each components of the set before distribution.

- Service center should be made available locally and strengthen the after sales service (ASS) accordingly.
- Develop local technical manpower conducting a training program at a hub of villages
- Distribute to all households of the settlement not on the sample basis that creates a conflict.
- Ensure supply of the spare parts to the local shops for easy access for R&M.
- In spite of showing the positive impact on the income generation of solar tuki, many local people have said in the focus group discussions that the use of set has not brought the noticeable increment in their income due to the lower capacity of the set. So if possible in the future program, increase the capacity of the set (say 10 W).
- Develop the joint program with the schemes of distributing improved cooking stoves so that the remarkable health and environmental impacts can be achieved.
- Include a staff of AEPC in the distribution team for continuous monitoring of the distribution process and modalities.
- Provide skill development training on various aspects of income generating activities regarding agriculture production, agro-based industries, selling of agro-products in the market, cottage industries, and others.
- Amount of subsidy be clearly mentioned in the price list and subsidy provider widely advertise it through appropriate channel.

6.3 LISTS OF REVIEWED REPORTS AND DOCUMENTS

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4. Solar Energy Component Description Energy Sector Assistance Programme in Nepal (Ref. No. 104.Nepal/Energy) August 1998.
5. Status of Solar Photovoltaic Sector in Nepal, 2003, SEMAN and Community Awareness Development Centre, Kathmandu, Submitted to: Alternative Energy Promotion Center/Royal Danish Embassy Kathmandu June 1999).
6. Subsidy Application Form for Solar Home System and other solar information sheet.
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14. कर्णाली उज्यालो कार्यक्रम - सौर्य टुकी प्राविधिक मापदण्ड, २०६३, नेपाल सरकार वातावरण, विज्ञान तथा प्रविधि मन्त्रालय, बैकल्पिक उर्जा प्रवर्द्धन केन्द्र, पौष २०६३
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