MILLION SOLAR URJA LAMP (SoUL) PROGRAM

Right to Clean Light

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An Initiative of
Indian Institute of Technology Bombay

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Ministry of New and Renewable Energy, Government of India

Concurrent Evaluation Report of Million SoUL Program in Maharashtra

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Million SoUL Program

Million SoUL Program (MSP) is an initiative of Indian Institute of Technology - Bombay (IIT-B). MSP headquater is located in Mumbai within the campus of IIT-B. Its principle funders include Ministry of New and Renewable Energy (MNRE), Madhya Pradesh Govt., Sir Dorabji Tata Trust (SDTT), Larsen and Turbo (L&T) and Tata Motors.
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Table of Contents

List of Tables

List of Figures

List of Acronyms

BP	British Petroleum
CEA	Central Electricity Authority
CRISIL	Credit Rating Information Services of India Limited
MDG	Millennium Development Goal
MNRE	Ministry of New and Renewable Energy
MSP	Million SoUL Program
NGO	Non Governmental Organization
IEA	International Energy Agency
IIT-B	Indian Institution of Technology, Bombay
PDS	Public Distribution System
RGGVY	Rajiv Gandhi Grameen Vidytikaran Yojana
RVEP	Remote Village Electrification Program
SDG	Sustainable Development Goal
SE4ALL	Sustainable Energy for All
SELCO	Solar Electric Lighting Company
SKO	Superior Kerosene Oil
SoUL	Solar Urja Lamps
SRC	SoUL Repair Centre
SRCM	SoUL Repair Centre Manager
TERI	The Energy and Resource Institute

Executive Summary

The Million SoUL Program (MSP) an initiative by Indian Institute of Technology (IIT) Bombay aims to bring 'Right to Clean Light' to every child in India. With this vision, two year program is being implemented in 2014-15 across 4 states (Madhya Pradesh, Maharashtra, Rajasthan, and Odisha) with the help of NGO partners who act as implementers at the ground level. During two year program, one million solar study lamps called as Solar Urja Lamps (SoUL) are to be distributed in two phases (I & II). This report presents the results of the concurrent evaluation (Round I) of the MSP in the state of Maharashtra (MH) in India. The objective of concurrent evaluation is to bring transparency in the MSP, make mid-course corrections and assess impact of the SoUL. The concurrent evaluation, which is made by conducting the household survey in sample blocks, is planned in two rounds: (a) after SoULs are distributed (so that mid-course corrections can be made) (b) 4-5 month prior to the end of Phase I in December 2015. In order to understand the impacts, a comparison between treatment sample (households of students who purchased SoUL) and control sample (households of students who didn't purchase SoUL) as well as electrified and non-electrified households in both the samples was made. The MSP team of IIT-B study conducted this study.

The main findings for Maharashtra indicate a shift towards use of SoUL for different tasks like studying, households chores, etc. Though, there are no major difference in terms of studying hours between the treatment and the control groups, however results from the survey show less dependence on kerosene based devices for studying within treatment group. Studying under clean lighting source can also have health advantage like reduced exposure to soot coming from kerosene chimni. Differences observed between the treatment group and control group in terms of kerosene consumption and overall expenditure indicates the positive impact of SoUL on the rural households. Households also report of SoUL aiding in completing other household chores, which serves as a added benefit. One main concern with respect to performance of SoUL is

the non-functionality rate which is above 15 percent in all the surveyed blocks. While the product quality is being observed as major issue, inappropriate user handling also serves as a major barrier in long term functioning of SoUL. Unavailability and unaffordability of current energy sources are driving the need for more renewable energy products. There is willingnes to pay for lighting devices and cooking devices through renewable energy among surveyed households. Results from impacts of MSP show potential of targeted renewable energy Programs being alternative solutions to energy (in this case lighting) problems. Given the willingness to pay observed within rural communities, suitable financial models needs to be worked out so as to convert this demand into actual sales realization for serving the energy needs of the rural communities.

Chapter 1. Introduction

Energy access is an important issue to be addressed at international, national and sub-national level to accelerate development of low income communities. As the development discussion has progressed from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs), energy access became one of its central goals. UN General Assembly declared year 2012 as Sustainable Energy for All (SE4ALL) and 2014-2024 a decade for the same (UNDP 2011). In 2015, UN General Assembly adopted the agenda for Sustainable Development under which the goal 7 of SDGs aims to "*ensure access to affordable, reliable, sustainable and modern energy for all"*[1]. While the focus on improving the energy access has grown in last decade, there are still billion plus population across the developing and least developed nations across the world countries lack access to modern source of energy (IEA 2013). Lack of access to modern energy such as electricity undermines the key development indicators such education, health and livelihoods. It is clear through understanding of literature that without access to modern energy, achieving social and economic development of countries will remain distant dream. While the energy access is multidimensional which includes houhehold (cooking and lighting needs) and productive (livelihood) needs, this report is specially focused upon the lighting needs presenting arguments and results from evaluation of solar lighting project 'Million SoUL Program' (MSP) introduced by Indian Institute of Technology – Bombay (IIT-B).

1.1. Energy Scenario in India

According to BP statistics review of world energy (2015), India is the fourth largest electricity producer in the world. However India is also home to the largest number of people without access to electricity (IEA 2013). On supply front, India faces multiple challenges in terms of making electricity available to its rural population. One of important challenge faced by the power utilities is form of under-recoveries from sale of

[1] Can be read further read about the goals Sustainable Development Knowledge Platform <https://sustainabledevelopment.un.org/topics>

electricity to the consumers. This results huge financial losses undermining the ability of the utilities to expand and improve services (CRISIL 2012)[2]. Apart from financial constraints that have burdened the state power utilities, the infrastructural challenges seem to more daunting towards making electricity available to the rural communities (IEA 2011). Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), the flagship Program for rural electrification had set objective to achieve complete rural electrification of rural area by 2012, which however the Program has missed and still large population live without electricity.

Most of the people without access to electricity depend upon kerosene as their primary source of lighting in the households. Census (2011) data show around 43.2 percent of the rural households in India depend upon subsidized kerosene as the main source for lighting. Kerosene which pose substantial health risks at household level, also pose a burden on state and national financial budgets by means of subsidy (Nouni et al. 2009). For example, TERI study shows the accumulated under-recoveries on the sale of kerosene over last decade amounts to INR 188,502 crore[3] (TERI 2014).

1.2. Emergence of Renewable Energy

Renewable energy has shown potential for being alternative to energy access problem, specifically for access to electricity for lighting needs. Off-grid applications of renewable energy have been growing over past decade in context of failure of grid electrification to reach the sparsely populated rural population. Various actors – governments, NGOs and social enterprise have experimented with business models for provisioning of off-grid based services. From government standpoint while range of off-grid renewable options (like biomass based generation, wind power, solar power etc.) is available, the most preferred option under renewable energy Programs like Remote Village Electrification Program (RVEP)[4] is seen to be solar (Bhushan and Kumar 2012). As of August 2015, cumulative off-grid solar PV systems already accounts for 279.74

[2] More on the under recoveries of the state power and distribution utilities can be read in CRISIL (2012).
[3] Crore is Indian number system and equals to 10 Million.
[4] Remote Village Electrification Program (RVEP) is government off-grid renewable technology electrification Program for remote villages and hamlets which could not electrified through grid electrification or covered under RGGVY.

Megawatt (MW)[5], of which 45.39 MW was added in the last one year (MNRE 2015). Off-grid systems are installed either through local mini/micro grids[6] or isolated solar home systems, solar lanterns. Similarly, a large range of social enterprises like SELCO, Mera Gaon Power, D.light are experimenting with solar technology as viable off-grid option through different service provisioning models. Off-grid interventions are fast becoming preferred option in rural areas over grid electrification due its reliability (Bhushan and Kumar 2012).

1.3. Literature Review

Literatures are available in context of impacts of off-grid solar interventions in India specifically in small system dissemination like solar lanterns. This impact assessment report adds to the growing literature on impact of small scale technologies like solar lamps and lanterns on improvement in lives and livelihoods of the rural communities. A study on impact of solar lantern Program named LaBL[7] conducted by TISS (2013), have outlined positive impact across education, health and livelihoods through increased studying hours, lesser exposure to sooth from the kerosene lamps and aiding livelihood activities. This substantiate the potential of off-grid solar intervention to offer benefits at household level. A research by Agoramoorthy and Hsu (2009) on 100 households in tribal areas of rural India also confirms increased study duration of children by hour and half as a result of provisioning solar lantern. Similarly, their study also reports of decreased expenditure on kerosene and electricity bill expenditure of these households post purchasing the solar lanterns. Their result were important as the rural areas where study was conducted were not receiving power between 3 to 6 am in the morning and 6 to 9 pm in the evening, which are actually dark hours. Similar insights are provided by Garg (2014) on the solar lantern Programs introduced by Government of India for school going girls in rural areas. Study of solar PV electrification Program in India by Chakrabarti and Chakrabarti (2002) reveal higher willingness to pay by the sample households who currently use solar energy. The study also highlights the overall

[5] Megawatts are used to measure the output of a power plant

[6] Mini/micro grids are centralized generation at local village or Panchayat level

[7] Lighting a Billion Lives (LaBL) is solar lantern Program launched by TERI in 2008. More details about the Program can be found at the Program website http://labl.teriin.org/

change in behavior as communities are willing to move towards adoption of cleaner technology. The authors state (pp. 41), ' … (communities) have expressed their willingness to continue the use of solar power, even if diesel power is available at low cost, to avoid the air and noise pollution caused by a diesel generator'. There are also literatures available on impact of other off-grid solar Programs, however systems disseminated in such cases are of larger capacity (like in case of Solar Home Systems under RVEP in India or IDCOL Program in Bangladesh) which can fulfill higher needs of the households and the impacts literature cannot be contextualized within the scope of MSP.

1.4. The Million SoUL Program

IIT Bombay has developed the 'localisation of solar energy model' through its Million SoUL Program (henceforth MSP). In this model the assembly, distribution and maintenance of the solar lamp are done by the local people. In order to achieve scale, the model is designed such that it can be replicated in parallel in multiple blocks, across districts and states. To achieve Speed, the assembly and distribution for any block is designed to be completed in 90 working days. In order to target skill development, rural people are trained in the assembling, distribution and repair of these lamps in their local areas.

The goal of the MSP is to fulfil 'right to clean light to every child' in rural areas for the study purpose during dark hours in the fastest possible way, thus reducing dependency on kerosene lamp and contribute to build a better future. The specific objectives are:

- Provide one SoUL to every student to increase their study hours
- Involve local people and develop their capabilities to assemble, sale, provide repair and maintenance service for solar products
- Generate sustainable employment in rural areas

The model is based on the solar PV technology with its inherent feature of providing off-grid decentralized energy at an individual or household level. It integrates three critical elements of speed and reach at wider scale (access) through saturation, cost effectiveness (affordability), and sustainability. The model has three core concepts of

'partnership approach', 'capacity building' and 'financial viability'. These concepts in the model are interrelated and interdependent and they converge in to realization of localisation of solar energy.

During two year MSP, one million solar study lamps called as Solar Urja Lamps (SoUL) were targeted to be distributed in two phases (I & II). During phase I, 7,50,000 SoUL are distributed, while in phase II rest 2,50,000 will be distributed. Phase I is implemented across 72 blocks in four Indian states of Madhya Pradesh, Maharashtra, Rajasthan, and Odisha states covering more than 7900 villages. Funding from central and state governments as well as philanthropic partners contributed towards keeping the beneficiary contribution low. The actual cost per solar urja lamp (SoUL) is Rs. 500, however at the subsidised cost the beneficiary contribution is Rs. 120 per lamp. Any child enrolled in the school and studying between Class V to Class XII is eligible to purchase one SoUL and they can avail free servicing facility provided in their vicinity till end of the phase I, i.e. December 2015. For localisation and ground level implementation partnership is formed with the NGOs. The capacity building of the local people has resulted into development of 260 solar entrepreneurs (called as SoUL repair centres managers – SRCM). This report presents the results of the concurrent evaluation (Round I) of the MSP during phase I in the state of Maharashtra in India.

Chapter 2. Methodology

The phase I of the MSP has influenced the sizeable number stakeholders in rural areas of four Indian states in a short span which needs to be studied in depth to gain insights about the efficacy of the MSP. This can further contribute to up-scaling, replication, and the policy recommendations related to solar technology. Hence, the research component formed an integral part of the MSP and accordingly the concurrent evaluation of the MSP was conducted.

The objectives of the concurrent evaluation are to:

1. Assess performance of SoUL and SoUL Repair Centres (SRC)
2. Assess socio-economic impact of the Million SoUL Program
3. Assess market potential for solar PV products in rural areas
4. Bring transparency in the project and make mid-course corrections
5. Assess localisation model for scalability and replicability

The objectives of the research guided to take the mixed methods approach. The research objectives consist of both qualitative as well as quantitative dimensions, so it was appropriate to employ quantitative and qualitative research methods. In the quantitative data the survey method was applied by collecting the data at the household level, whereas for qualitative data collection the focus group discussion and interview methods were used. The main focus of qualitative method is to assess the objective of localisation model and its scalability, whereas the household survey primarily focuses on the objective of assessing the impact of the MSP.

The concurrent evaluation covered both stakeholders as well as non-stakeholders of the MSP. The qualitative method covered NGO partners and the staff involved in the MSP, solar entrepreneurs (i.e. SRCM), parents of SoUL recipients' children, school teachers, knowledgeable person in the village, and IIT B's field officer posted with the NGO Partner. The quantitative method studied the households of the SoUL recipients (treatment sample) and SoUL non-recipients (control sample) who despite being eligible

had not purchased SoUL. The household survey is planned to be conducted in two rounds in 20 representative sample blocks. The round one is after SoULs are distributed and round two is 4-5 months prior to the end of Phase I in December 2015. In survey the same household will be surveyed twice at two intervals. This report presents the results of the household survey for the state of Maharashtra and the mid-course corrections that are required for improvement of the Program.

2.1. Sample for the household survey

The sampling method employed for selecting the sample was "stratified random sampling". The sampling size and plan was as follows:

- Two samples were drawn, viz. Treatment Sample and Control Sample. Treatment sample was defined as the recipients of SoUL (who have purchased SoUL from the school) studying in class V-XII. While control sample defined as the children studying in classes V- XII who have not purchased SoUL from the school.
- 1.2% of the total population (i.e. one million students who have purchased the SoUL) was taken as the "treatment sample".
- The control sample was considered as 10% of the treatment sample, with the 2% of the control sample as the error while surveying, making a total of 12% of the Treatment Sample.
- Stratified Random Sampling was used for the evaluation. The sampling involved dividing the population into two strata, viz. electrification status of house and caste category of the household. The castes were divided into three categories, namely, Scheduled Castes (SC), Scheduled Tribes (ST) and others comprising general and Other Backward Castes (OBC). Thus, the sample (number of households to be surveyed) was arrived at by referring to Census 2011 block level data which determined the proportionate percentage of electrified and non electrified households and caste composition.
- The blocks where the MSP has been implemented were clustered and then a representative block was chosen for the survey. This clustering was based on homogeneity of geographical and social characteristics of the population in each

block. Thus, sample of 20 blocks was selected of a total of 72 blocks where one Million SoULs were distributed.

- Using database on recipients of SoUL, villages having sufficient number of SoUL recipients of the required strata were selected. During selection it was ensured that remote and relatively small villages were not left out.

2.3. Profile of Maharashtra

Maharashtra, located in the western part of India is second most populous state in India with population of 112,372,972 representing almost 9.3 percent of total population of India (Census 2011). Spread over 307,710 sq. km, it is bordered by the Arabian Sea to the west, Gujarat and Madhya Pradesh to the north, Chhattisgarh to the east, and Telangana, Karnataka and Goa to its southern part. Though more urbanized as compared to other states in India, still almost 55 percent of population with reside in rural areas while rest 45 percent reside in urban areas. As per CEA report, the electrification rate of village in Maharashtra is 99.9 percent. While according to Census 2011, 14.46 percent of total households in Maharashtra depend upon kerosene for main source of lighting and the percentage is 23.87 for rural households. Out of total 36 districts in Maharashtra, 10 districts (only parts) have been declared as schedule areas. The MSP works in 2 districts namely – Ahmednagar and Palghar which constitute of schedule areas of Akole Tehsil and Palghar Tehsil.

MSP is implemented in 2 districts and 8 blocks and total distribution in 1, 15,316 SoUL lamps. Two NGOs – Watershed Organization Trust (WOTR) for Ahmednagar district and BAIF Research and Development Organization for Jawhar district were selected as the implementation partners. Thrive Solar was the main vendor for the supply of disassembled kits to the Maharashtra.

Table 1: Overview of NGO partners, Vendors and SoUL Distribution in Maharashtra

NGO Partner	District	Block	Vendor	Distributed SoUL	Start Date	Saturation Date
BAIF	Palghar	Jawhar	Thrive	14373	13/02/2014	1/1/2015

		Vikramgad	Thrive	12507	1/5/2014	6/1/2015
		Wada	Thrive	12393	9/6/2014	5/1/2015
		Junnar	Thrive	1500	14/11/2014	14/11/2014
		Mokhada	Thrive	10525	15/04/2014	29/11/2014
		Palghar	Thrive	10501	25/06/2014	16/12/2014
WOTR	Ahmednagar	Sangamner	Thrive	25028	20/02/2014	15/12/2014
		Akole	Thrive	28489	18/03/2014	13/02/2015

2.3. Cluster approach and representative block for the household survey

As aforementioned the distribution of SoUL in Maharashtra has taken place in 7 blocks. All these blocks have predominant tribal population, which resides in remote rural areas. Conducting household survey for the purpose of concurrent evaluation in all the implementation blocks was not feasible considering the geographic spread and resources required; hence 'cluster' approach was taken towards resolving this issue. The cluster of blocks was formed on the basis of their geographic and demographic similarities, and one block is selected as a representative block from each cluster for conducting the concurrent evaluation. This allowed for generalization of impacts without compromising on the validity of the research sample. There were five such clusters on basis of aforementioned criteria and five blocks were selected as a representative blocks for the concurrent evaluation. The following table 2 presents the clusters that were formed and the representative blocks in which the household survey was conducted.

Table 2: Representative Block and Block Cluster

Representative block for HH Survey	Names of Blocks in the Cluster	District	IP's Name
Vikramgad	Palghar	Palghar	BAIF
	Wada		
	Vikramgad		
Jawhar	Jawhar	Palghar	
Mokhada	Mokhada	Palghar	

Sangamner	Sangamner	Ahmednagar	WOTR
Akole	Akole	Ahmednagar	

Chapter 3. Maharashtra – Concurrent Evaluation Result (First Round)

For study, the household survey was conducted in 5 blocks of Maharashtra which were spread across 115 villages in 95 Gram Panchayats. The total of 2742 sample household was interviewed in the survey of which 2439 households were treatment samples and 303 households were control samples (Table 3).

Table 3: Sampling Details - Households, Village and Panchayats

Block	Treatment Group			Control Group		
	No. of Households	No. of Villages	No. of Panchayats	No. of Households	No. of Villages	No. of Panchayats
Akole	488	15	16	54	12	12
Jawhar	368	30	17	41	11	7
Mokhada	274	17	7	47	15	7
Sangamner	758	26	24	95	13	13
Vikramgad	551	27	31	66	16	15
Total	2439	115	95	303	67	54

3.1. Socio-economic Background of the Sample Households in Maharashtra

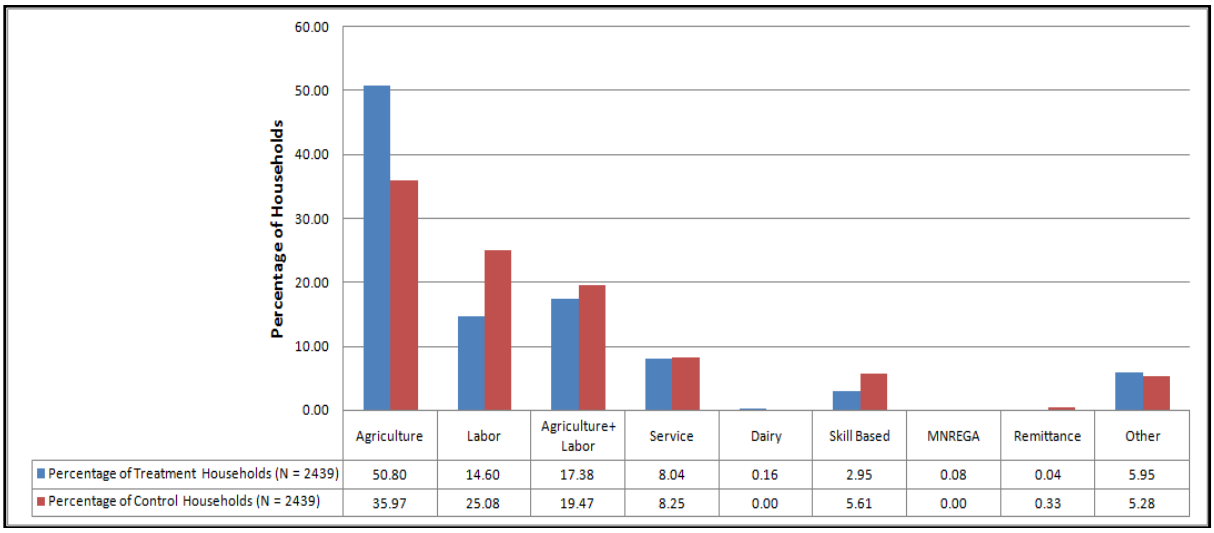
As per Census 2011, in rural Maharashtra 12.17% of the population was Scheduled Caste (SC), 14.63% was Scheduled Tribe (ST), and 73.2% Others. The table 2 given below represents the classification of sample households as per social categories as well as the Census 2011 data for the same. In the sample households the percentage of Scheduled Tribes (STs) was highest in both the groups, with 58.59 percent in treatment group and 59.74 percent in control sample, followed by General category with 22.35 percent in treatment group and 20.79 percent in control group. Other Backward Caste (OBC) represents a little over 14 percent in both the sample groups.

Table 4: Distribution of Sample and Rural Population as per Social Categories

Social Category	No. of Treatment HHs	Percentage	No. of Control HHs	Percentage	Percentage of rural population as per Census 2011
ST	1,429	58.59	181	59.74	14.63
SC	106	4.35	12	3.96	12.17
OBC	356	14.6	45	14.85	73.2
General	545	22.35	63	20.79	
NT/VNT/VJNT	3	0.12	1	0.33	
Other	0	0	1	0.33	
Total	2,439	100	303	100	100

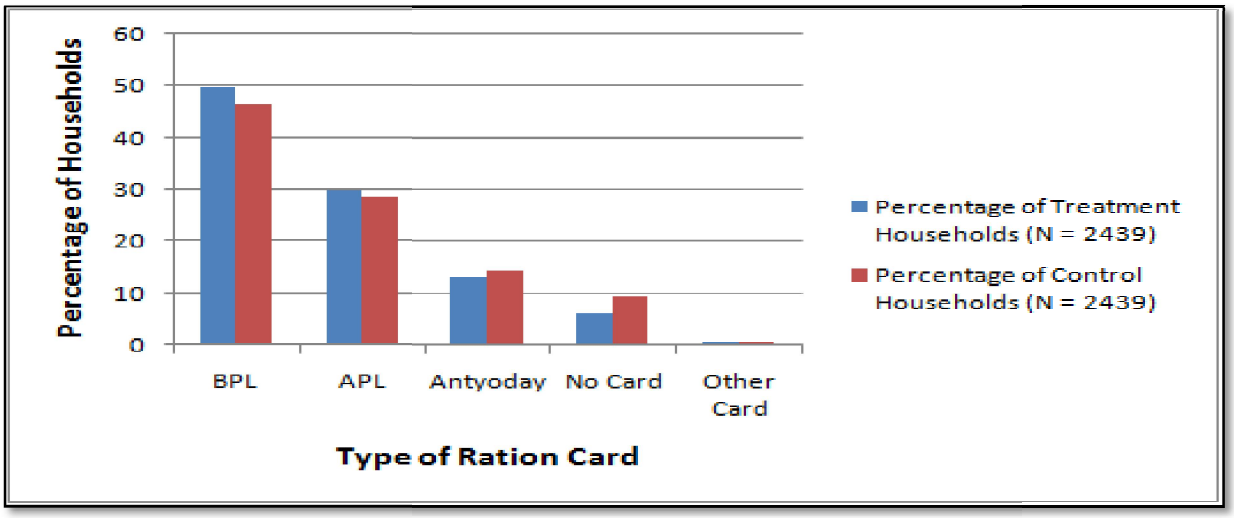
Agriculture is observed to be primary occupation, with 50.8 percent of treatment households and 35.97 percent of control households reporting it as their main income source. It is followed by 'labor' which was informed by the sample households – 14.60 percent by the treatment households and 25.08 by control household as their primary occupation (Fig. 1). Almost 50 percent of the sample households - both treatment and control have 'below poverty line' category, while nearly 30 percent of the treatment and control households belong to 'above poverty line' category (Fig. 2). 82.98 percent of treatment households and 82.84 percent of control household report having electricity in their households. Within electrified households of treatment group and control group, 10.72 percent and 8.36 percent report to have taken electricity connection through either hooking directly to the pole or from the neighbor.

Figure 1: Occupation Profile of Sample Households in Maharashtra



	Agriculture	Labor	Agriculture+ Labor	Service	Dairy	Skill Based	MNREGA	Remittance	Other
Percentage of Treatment Households (N = 2439)	50.80	14.60	17.38	8.04	0.16	2.95	0.08	0.04	5.95
Percentage of Control Households (N = 2439)	35.97	25.08	19.47	8.25	0.00	5.61	0.00	0.33	5.28

Figure 2: Classification of Sample Households as per Poverty Card in Maharashtra



3.2. Children Details

From sample households only the information pertaining to childrens that were either in the school going age group of 5-17 years or were studying between classes 1 to 12 were collected as they fall under the age group who should ideally attend the school. There are total 4231 children studying between class I to class XII in 2439 treatment households, while there are 499 children studying between class I to class XII in 303 control households.

Gender wise classification of the school going children (or studying in class I to class XII) shows 54.03 percent of 2439 children in treatment group represent male children, while 54.11 percent of 499 children in control group are male children. Maximum percentage of households (47.85 percent for treatment group and 55.12 percent for control group) has one child per household followed by two children in 36.16 percent in treatment household and 30.03 percent in control household.

Age-wise classification of children show maximum percentage of children (60.72 percent of all children in treatment sample and 58.72 percent of all children in control household) fall in the age group of 10-15 years. In treatment group, 21.65 percent of children fall in 15-20 years age group and 17.54 percent fall in age 5-10 years group; while in control group, 20.84 percent of children fall in 5-10 years age and 20.44 percent fall in 15-20 years age group. Class wise distribution show 39.77 percent of children in treatment sample study in upper primary section (6^{th} to 8^{th} standard), followed by 22.62 percent children in secondary section (9^{th} and 10^{th} standard) and 12.92 percent children in primary section (1^{st} to 4^{th} standard). In control sample 36.34 percent of children study in class V followed by 17.04 percent in upper primary section (6^{th} to 8^{th} standard) and 16.84 percent children in primary section (1^{st} to 4^{th} standard).

Of the total of 4187 children in 2439 treatment households, 73.11 percent school-going children have purchased SoUL. 82.62 percent of the treatment households have purchased atleast one SoUL, while 16.32 percent have purchased two SoUL. Rest 1 percent of the households have 3 or more SoUL. Reasons for not purchasing SoUL were explored in both – treatment group and control group. Main reason for not purchasing SoUL in treatment groups was ‘not eligible’ with almost 34.64 percent responding such, followed by ‘not required’ with 20.24 percent and 17.18 percent responding ‘not given in school’. In control group, the main reasons given for not purchasing were ‘not enough money’ and ‘SoUL not available’ with both reasons getting 24.23 percent response. Also, 16.22 percent of control sample responded ‘not required’ as another major reason for not purchasing SoUL (see Table 5).

Table 5: Reasons for Not Purchasing SoUL in Maharashtra

Reason	Treatment Sample		Control Sample	
	No. of Children	Percent	No. of Children	Percent
Child not available when SoUL was given	8	0.79	16	3.29
Don't know the reason	0	0.00	15	3.08
Electricity present 24 hours	0	0.00	2	0.41
Not Eligible	389	38.40	53	10.88
Not Enough Money	48	4.74	118	24.23
Not Given in School	174	17.18	45	9.24
Not Required	205	20.24	79	16.22
Not Aware	0	0.00	27	5.54
Purchased number of SoUL are enough	142	14.02	0	0.00
SoUL lamp not available	24	2.37	118	24.23
Studies from recipient sibling's lamp	21	2.07	0	0.00
Another Solar Device present	0	0.00	4	0.82
Other	1	0.10	10	2.05
Total	1012	100.00	487	100.00

3.3. Lighting: sources, devices and expenditure

3.3.1. Electricity bill: Interval of receiving it and amount paid by sample households

Maximum percentage of households in both the sample groups – 76.09 percent of electrified household in treatment group and 73.99 percent of electrified household in control group received the monthly bill below Rs. 300. 18.72 percent of electrified treatment household receive bill of Rs. 300-600, 2.36 percent receive bill between Rs. 600-900 and 2.83 percent receive electricity bill of excess Rs. 900. In control electrified household, 18.83 percent receive monthly electricity bill in range of Rs. 300-600, while 1.35 percent receive bill between Rs. 600-900 and 5.83 percent receive electricity bill of excess Rs. 900.

3.3.2. Kerosene: purchase, usage, and expenditure

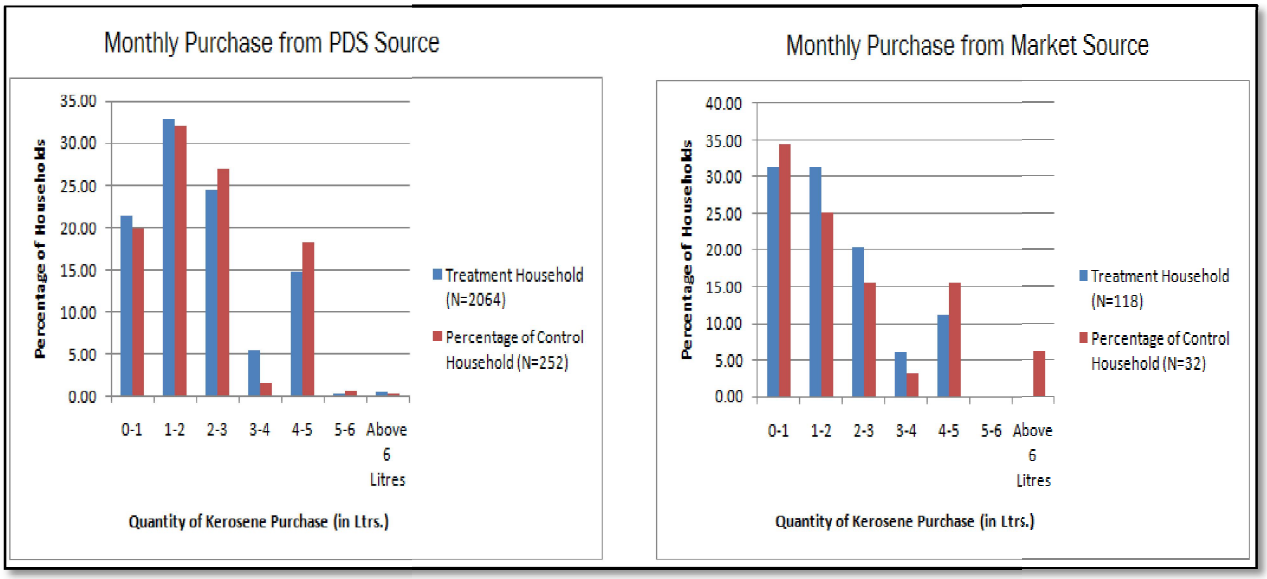
The data related to kerosene purchase, expenditure and usage was calculated for only those households that purchased and consumed kerosene. The distribution of monthly kerosene purchase, usage, and expenditure was examined according to electrification

status of the households to know if any differences exist in. Kerosene is purchased by households through either PDS shops at regulated rate or from market at higher prices or from both sources by the households. In treatment group, 83.07 percent of households purchase kerosene only from PDS shops, 3.57 percent only from market sources and 1.56 from both the sources, while rest 11.81 percent did not purchase kerosene at all. In control households, 78.88 percent households purchase kerosene only from PDS shops, while 6.27 percent purchase from market while 4.29 percent purchase kerosene from both the sources and the rest 10.56 percent households do not purchase kerosene.

The data from kerosene usage within sample households – treatment group and control group indicate the priority of kerosene use for lighting over cooking. Only 18.36 percent of treatment household and 11.81 percent of control household do not use kerosene for lighting purposes. Out of households which use kerosene, 25.13 percent of treatment household and 65.02 percent of control household use kerosene only for lighting, while rest of households reported using kerosene for 'other purposes including lighting'.

Monthly purchase of kerosene from PDS shops reveal maximum percentage of households – 32.80 percent treatment sample and 32.14 percent in control sample purchase 1-2 litre of kerosene per month, followed by 24.42 percent in treatment sample and 26.98 percent in control sample purchasing 2-3 litre per month. Similar trend in purchase of kerosene was observed from market sources. 31.36 percent from treatment sample and 34.28 percent from control sample purchased 1-2 litre kerosene per month from market. It was followed by 31.36 percent treatment household and 25 percent control household purchasing 1-2 litre; 20.34 percent treatment household and 15.63 percent control household purchasing 2-3 litres of kerosene from market (see Figure 3).

Figure 3: Monthly Kerosene Purchase from Different Source in Maharashtra



Consumption of kerosene for lighting purposes was collected during household survey. Both the group – treatment group and control group showed similar pattern with 35.52 percent treatment household and 33.95 percent control household consume 0-1 litre of kerosene for lighting, followed by 21.34 percent treatment household and 21.34 percent treatment household and 26.57 percent control household consuming 2-3 litre of kerosene for lighting. There is not much difference between electrified control treatment and control households with both group showing similar pattern, however difference can be observed in non-electrified treatment and control samples. While only 7.62 percent of non-electrified treatment use 4-5 litres of kerosene for lighting, in non-electrified control treatment this is over 21.15 percent (see Table 6). This indicates larger number of households' use of more kerosene in non-electrified control houses as against non-electrified treatment households. Kerosene consumption for cooking purposes is limited as 38.73 percent of treatment households and 52.77 percent households' report of not using kerosene for cooking purposes. Out of the households that use kerosene for cooking, 45.42 percent in treatment household and 36.16 percent of control household use 0-1 litre of kerosene for cooking purposes.

Table 6: Monthly Kerosene Consumption for Lighting in Maharashtra

Kerosene Consumption (in Ltrs)	Treatment Household						Control Household					
	Electrified		Non-Electrified		Total	%	Electrified		Non-Electrified		Total	%
	Nos.	%	Nos.	%			Nos.	%	Nos.	%		
0-1	655	37.56	109	26.78	764	35.52	86	39.27	6	11.54	92	33.95
1-2	332	19.04	127	31.2	459	21.34	57	26.03	15	28.85	72	26.57
2-3	224	12.84	97	23.83	321	14.92	21	9.59	15	28.85	36	13.28
3-4	43	2.47	37	9.09	80	3.72	2	0.91	5	9.62	7	2.58
4-5	94	5.39	31	7.62	125	5.81	20	9.13	11	21.15	31	11.44
5-6	2	0.11	1	0.25	3	0.14	0	0.00	0	0.00	0	0.00
Above 6 Litres	3	0.17	1	0.25	4	0.19	1	0.46	0	0.00	1	0.37
Kerosene not used for lighting	391	22.42	4	0.98	395	18.36	32	14.61	0	0.00	32	11.81
Total	1744	100.00	407	100.00	2151	100.00	219	100.00	52	100.00	271	100.00

The use of number of kerosene based lighting devices in treatment and control households was looked into to understand if there is a difference in pattern due to presence of SoUL. Of the total 2439 treatment households 71.09%, while 77.23% of the total 234 control households used simple wick lamps (C*himnis*). There were only 2.42% treatment and 5.94% control households that used hurricane lamp indicating its limited usage.

Table 7: Number of Simple Wick Lamps used in Sample Households as per electrification status in Maharashtra

No. of simple wick lamps	Treatment HHs					Control HHs				
	Electrified		Un-electrified		Total	Electrified		Un-electrified		Total
	Nos.	%	Nos.	%		Nos.	%	Nos.	%	
1	640	47.3	187	46.4	827	85	45.45	16	30.77	101
2	528	39.02	184	45.66	712	71	37.97	29	55.77	100
3	125	9.24	28	6.95	153	22	11.76	5	9.62	27
4	46	3.4	3	0.74	49	5	2.67	1	1.92	6
5	11	0.81	1	0.25	12	2	1.07	1	1.92	3
6	1	0.07	0	0.00	1	1	0.53	0	0.00	1
7	0	0.00	0	0.00	0	1	0.53	0	0	1
8	1	0.07	0	0.00	1	0	0.00	0	0	0
10	1	0.07	0	0.00	1	0	0.00	0	0.00	0

Total	1353	100.00	403	100.00	1756	187	100.00	52	100.00	239

As observed in the above table, the electrification status caused a difference with regard to number of simple wick lamps used. In both treatment and control groups, percentage of non-electrified households using two simple wick lamps is more than the percentage of electrified households. However, in case of electrified households multiple rooms and erratic electricity supply necessitate them to rely on simple wick lamp for fulfilling illumination need.

The per day usage of simple wick lamps in hours showed that in treatment group 28.19 percent of households used it for less than 2 hours, followed by 25.97 percent using it for 2-4 hours, and 24.54 percent using it for 2 hours. In the control group, maximum of 28.87 percent used it for 2 hours followed by 23.43 percent using it for less than 2 hours, and 20.50 percent using it for 2-4 hours. In treatment group there were 21.30 percent households and in control 27.30 percent households that used simple wick lamps for more than 4 hours (Table 8). The below given graph present per day usage of simple kerosene lamp in hours as per the electrification status. The data revealed that as the number of hours increased the percentage of non-electrified households in both the groups is more as compared to electrified households indicating higher usage.

Table 8: Per day Usage of Simple Wick Lamps in Hours for Lighting in Maharashtra

Usage in No. of Hours	Treatment HHs	Percentage	Control HHs	Percentage
0-<2	495	28.19	56	23.43
2 hours	431	24.54	69	28.87
2-4	456	25.97	49	20.50
4-6	180	10.25	16	6.69
6-8	78	4.44	19	7.95
8-10	44	2.51	11	4.60
10-12	70	3.99	18	7.53
More than 12 hours	2	0.11	1	0.42
Total	1,756	100.00	239	100.00

Unelectrified households consume and spend higher on kerosene as compared to the electrified counter parts in both the groups. However, the results indicate overall higher

kerosene purchase and average monthly kerosene expenditure by the control households as against the treatment households. Comparison revealed differences between electrified households of the treatment group and electrified households of the control group, as well as non-electrified households of the treatment group and non-electrified households of the control group. Average monthly expenditure on kerosene of electrified treatment sample was only Rs. 49.33 as against Rs. 54.29 by the electrified group. Similarly, higher expenditure is seen in non-electrified control group with these households spending Rs. 61.26 as against Rs. 58.57 by the non-electrified treatment group (Table 9). These results present a general argument towards economic benefits attained by households using SoUL as against those not using SoUL.

Figure 4: Usage of Simple Wick Lamps as per electrification status of Households in Maharashtra

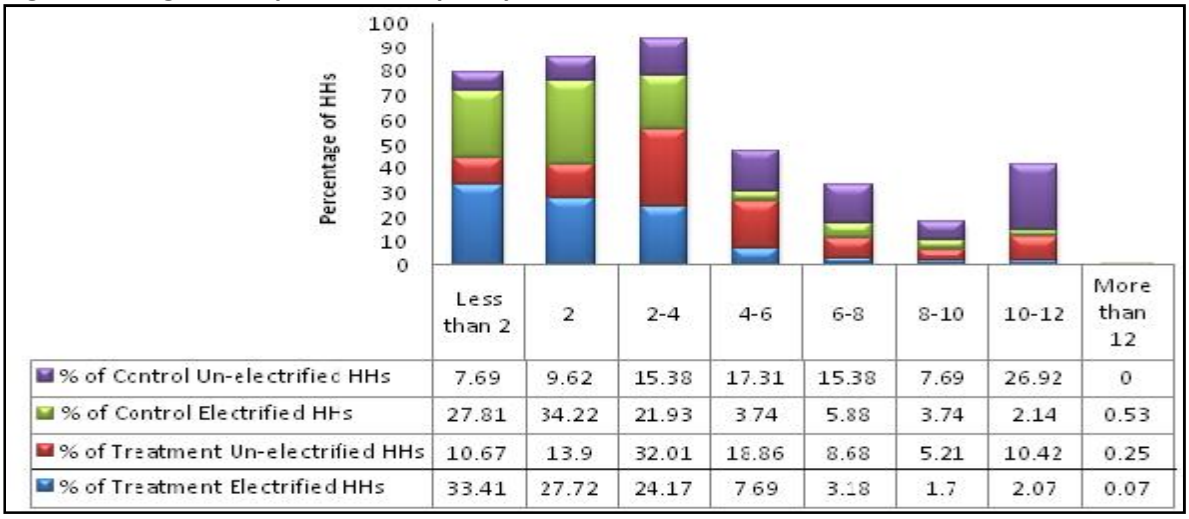


Table 9: Source-wise per litre Kerosene Cost and Monthly Expenditure as per electrification status in Maharashtra

	Treatment HHs						Control HHs					
	Electrified		Non - Electrified		Total HHs	Rs.	Electrified		Non - Electrified		Total HHs	Rs.
	Amount	Nos.	Amount	Nos.			Amount	Nos.	Amount	Nos.		
Average Price from PDS Shops	18.11	1677	17.87	387	2064	18.06	17.84	203	18.3	49	252	17.93
Average Expenditure on PDS	45.89	1677	53.96	387	2064	47.40	45.16	203	57.85	49	252	47.63
Average Price from Market	36.07	92	33.5	33	125	35.39	33.59	27	25.8	5	32	32.37
Average Expenditure on Market	101.65	92	89.69	33	125	98.50	103.14	27	72.8	5	32	98.41

Total Kerosene Purchased*	2.56L	1744	3.12L	407	2151	2.67L	2.74L	219	3.31L	52	271	2.85L
Total Average kerosene Expenditure*	49.33	1744	58.57	407	2151	51.08	54.29	219	61.26	52	271	55.63

* these values have been calculated from the number of households that actually purchase kerosene

3.4. Electricity based devices used for lighting

In Maharashtra, 82.98 percent treatment sample and 82.84 percent control household had electricity connections. Within electrified households – 72.40 percent treatment household and 67.33 percent control household have Compact Fluorescent Lamp (CFL), 50.74 percent treatment household and 53.38 percent control household have incandescent bulbs, 10.56 percent treatment household and 39.84 percent control household use Tube lights, 18.57 percent treatment household and 18.32 percent control household use rechargeable torch, just 1.77 percent treatment household use LED lamps while no control household were found using LED lamps. In terms of numbers of CFLs devices in treatment households, 27.27 percent have one CFL followed by 37.08 percent households having two CFLs and 19.09 percent having three CFLs, while 31.36 percent have one CFL, 35.5 percent have two CFLs and 20.71 percent have three CFL. With regards to number of incandescent bulbs within treatment household, 49.27 percent have one bulb, 35.25 percent have two bulbs and 10.42 percent have three bulbs, while in control households, 50 percent have one bulb, 32.09 report having two bulbs and 10.45 report having three bulbs within households. Average price as reported by the households is for the incandescent bulb is around Rs. 18, while for CFL is around Rs. 138. The average life period for which incandescent bulb work is about 2 months and for CFL is 13 months.

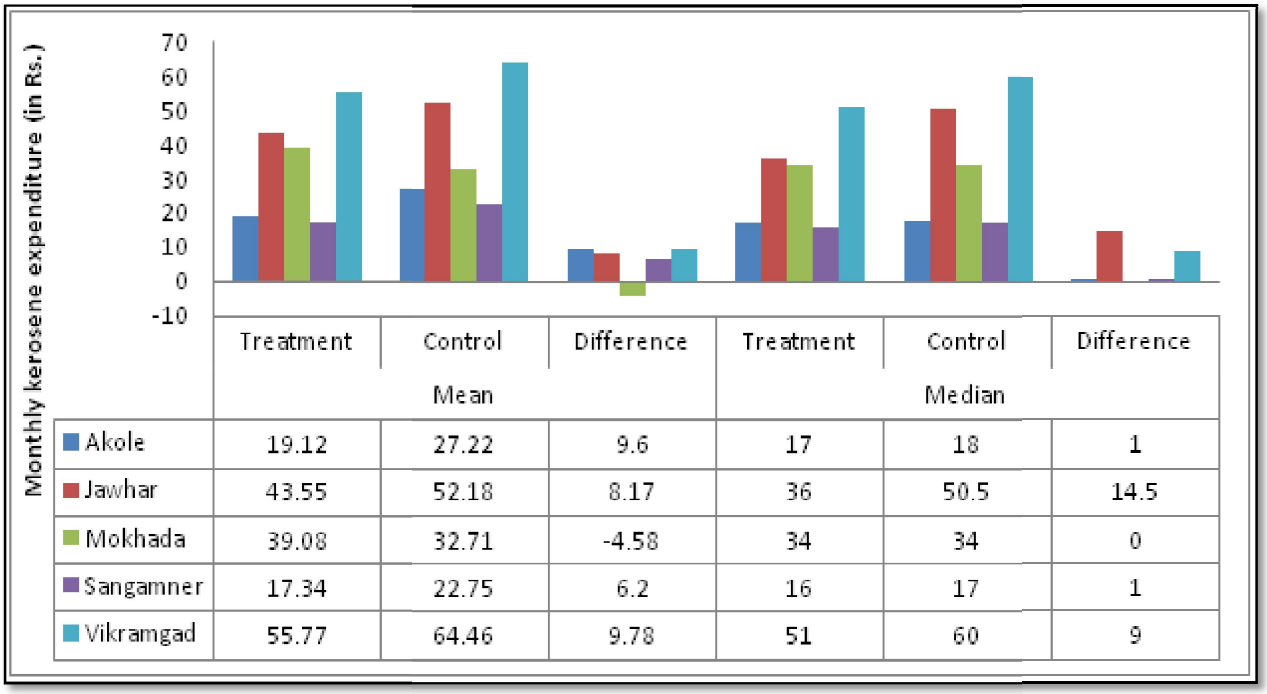
3.5. Expenditure on lighting in Maharashtra

In order to see the impact of SoUL on 'lighting expenditure' of the households the comparison was made between treatment and control households. However for this analysis, data was calculated for those households which had SoUL in working condition, while the households with non working SoULs were not considered. In order to arrive at monthly lighting expenditure monthly mean and median expenditure on various heads such as electrical lighting devices like CFL, incandescent bulb, electricity

bill, and kerosene purchased for lighting purpose was calculated separately and then the total mean and median lighting expenditure was calculated.

3.5.1. Monthly expenditure on kerosene used for lighting: For entire Maharashtra it was observed that the 'mean of monthly kerosene expenditure on lighting' was lesser in treatment group than in control group and this difference were of Rs. 3.27. The mean and median of monthly kerosene expenditure on lighting in treatment and control group across the sample blocks in Maharashtra represented in Figure 5 shows that in five blocks, with the exception for Mokhada block, control group was spending more than the treatment group.

Figure 5: Mean & Median of Monthly Kerosene Expenditure (in Rs.) on Lighting in Treatment & Control groups in Maharashtra



	Mean			Median		
	Treatment	Control	Difference	Treatment	Control	Difference
Akole	19.12	27.22	9.6	17	18	1
Jawhar	43.55	52.18	8.17	36	50.5	14.5
Mokhada	39.08	32.71	-4.58	34	34	0
Sangamner	17.34	22.75	6.2	16	17	1
Vikramgad	55.77	64.46	9.78	51	60	9

The table 10 given below makes two comparisons about kerosene expenditure on lighting: (a) electrified treatment and electrified control group (b) non-electrified treatment and non-electrified control group. Two factors used for comparison are mean and median of monthly kerosene expenditure for lighting.

Table 10: Monthly Expenditure on Kerosene for Lighting as per electrification status in Maharashtra (MH) blocks

MH Blocks – Monthly kerosene expenditure	Treatment				Control				Difference			
	Electrified		Non - Electrified		Electrified		Non - Electrified		Electrified		Non - Electrified	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Akole	15.82	15	28.57	20	24.44	18	55.75	27.5	8.62	3	27.18	7.5
Jawhar	40.85	34	51.29	48	42.63	45	65.11	72	1.78	11	13.82	24
Mokhada	34	36.15	38.32	34	27.62	31	44.35	38	-6.37	-5.15	6.03	4
Sangamner	14.45	10	27.86	24.75	20.6	17	39.25	32	6.15	7	11.39	7.25
Vikramgad	53.6	50	61.24	60	65.31	60	61	60	11.71	10	-0.24	0

It was found that except for Mokhada block, mean and median expenditure of electrified control group is higher than the treatment group. Similarly, except for Sangamner block, mean and median expenditure of non-electrified control group is higher than the treatment group. Thus, the pattern that emerges in Maharashtra blocks is higher expenditure on monthly kerosene purchase by electrified as well non-electrified control than the treatment group.

3.5.2. Monthly expenditure on electric devices: The data on mean and median monthly expenditure on electrical devices showed that except for Sangamner and Vikramgad blocks treatment group in remaining three blocks were spending slightly more than control group and this difference was in the range of Re. 1 to Rs. 10 (refer table 11). Vikramgad is the only block that has both mean and median expenditure of control group is higher than the treatment.

Table 11: Monthly Expenditure on Electric Devices across Sample Blocks in Maharashtra

MH Blocks – Monthly expenditure on electric devices	Treatment		Control		Difference	
	Mean	Median	Mean	Median	Mean	Median
Akole	40.53	28.33	34.1	25	-6.43	-3.33
Jawhar	58.87	33.91	54.32	33.75	-4.55	-0.16
Mokhada	62.53	39.58	56.57	29.16	-5.96	-10.42
Sangamner	28.33	38.3	40.49	26.66	12.16	-11.64
Vikramgad	76.97	35	83.93	45	6.96	10

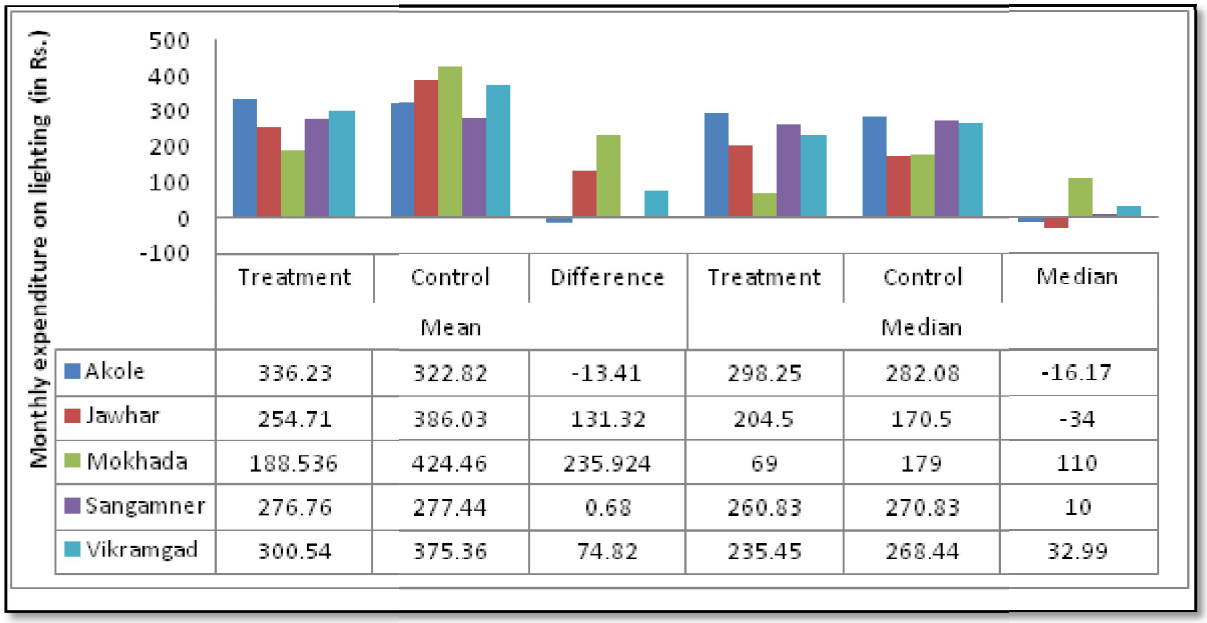
3.5.3. Monthly expenditure on electricity bill: The data on mean of monthly expenditure on electricity bill for Maharashtra showed that it is higher for control group than the treatment group and the difference is of Rs. 71.43. For three blocks of Jawhar, Mokhada, and Vikramgad that are in Palghar district the mean expenditure on monthly electricity bill is higher in control group than the treatment group and the difference is quite large (refer table 12). For the remaining two blocks that fall in Ahmednagar district mean of monthly electricity bill is lesser for control group.

Table 12: Monthly Expenditure on Electricity Bill across Sample Blocks in Maharashtra

MH Blocks – Monthly expenditure on electricity bill	Treatment		Control		Difference	
	Mean	Median	Mean	Median	Mean	Median
Akole	336.75	300	302.12	250	-34.63	-50
Jawhar	253.62	200	518.16	205	264.54	5
Mokhada	261.81	200	518.06	150	256.25	-50
Sangamner	284.04	250	273.03	250	-11.01	0
Vikramgad	305.35	245	413.7	250	108.35	5

3.5.4. Monthly expenditure on lighting: In Maharashtra both mean as well as median monthly expenditure on lighting was more in control group than in treatment. The difference in mean is Rs. 63, while it is Rs. 8.59 in median. As observed in figure 6 except for Akole and Sangamner, monthly mean expenditure on lighting was observed to be more in remaining three blocks of Palghar district. Although the treatment and control group level broad findings showed mixed results, however data as per electrification status revealed expected results whereby monthly lighting expenditure of non-electrified control group was higher than the treatment.

Figure 6: Total Expenditure on Lighting in Maharashtra



As observed in the table 13 below 'mean monthly expenditure on lighting' was more electrified control than electrified treatment in Jawhar, Mokhada, and Vikramgad. The difference in these 3 blocks is significant at Rs. 100 and more. The mean monthly expenditure on lighting was more in non-electrified control than non-electrified treatment in all blocks with an exception of Vikramgad.

Table 13: Monthly Expenditure on Lighting in Electrified and Non-electrified Households across Sample Blocks in Maharashtra

Maharashtra Blocks	Treatment				Control				Difference			
	Electrified		Non - Electrified		Electrified		Non - Electrified		Electrified		Non - Electrified	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Akole	368.73	324.5	27.10	20	344.19	368.73	55.75	27.5	-24.54	44.23	28.642	7.5
Jawhar	327.93	262.5	50.05	48	613.34	313	65.11	72	285.40	50.5	15.06	24
Mokhada	329.52	260	38.32	34	585.72	224.16	44.35	38	256.2	-35.84	6.03	4
Sangamner	295.9	271.66	24.15	20	293.5	287.5	39.25	32	-2.4	15.84	15.1	12
Vikramgad	337.93	278.75	61.24	60	438.24	323.33	61	60	100.31	44.58	-0.24	0

T-test for statistical significance

T-test was conducted for checking the statistical significance of the difference in the monthly expenditure on lighting between two sample i.e. treatment group and control group and the related heads. Furthermore t-test was also conducted in order to see any differences between electrified and non-electrified households across both groups. In the t-test mean treatment was subtracted from mean control to observe whether the differences are statistically significant or not. The expected outcome shall be that the expenditure on lighting in treatment should be less than those in control group. Table 14 given below presents t-test results, which were run for two samples, i.e. treatment and control, by calculating 'the mean' for total expenditure on lighting and for related heads separately.

Table 14: Two Sample (Treatment & Control) T-test results for Maharashtra

	Exp on Electricity Bill		Exp on Electric Devices		Exp on Kerosene used for lighting		Total Exp on lighting	
	t- test	**P-Value**	**t- test**	**P-Value**	**t- test**	**P-Value**	**t- test**	**P-Value**
Consolidated MH	2.9334	0.0034	-0.0365	0.9709	1.6024	0.1093	2.9697	0.003
Block Wise								
	t- test	**P-Value**	**t- test**	**P-Value**	**t- test**	**P-Value**	**t- test**	**P-Value**
Akole	-0.7425	0.4582	-1.0186	0.309	3.6235	0.0003	-0.2936	0.7692
Jawhar	2.8488	0.0048	-0.223	0.8237	1.4711	0.1423	1.9859	0.0478
Mokhada	2.2407	0.0267	-0.3456	0.7301	-1.3267	0.1858	3.1573	0.0018
Sangamner	-0.35	0.7265	0.5005	0.6169	2.8989	0.0040	0.0228	0.9818
Vikramgad	2.1793	0.0300	0.2301	0.8181	2.3977	0.0169	1.6598	0.0975

T-test result for difference in 'total lighting expenditure' was significant at 99% confidence level for Maharashtra. However, block wise results showed some variation. In Mokhada it was significant at 99% confidence level, in Jawhar it was significant at 95% confidence, and in Vikramgad it was significant at 90% confidence level. In Akole and Sangamner, the t-test results were insignificant.

T-test for the difference in kerosene expenditure on lighting was significant at 99% confidence level for Akole, Sangamner and significant at 95% confidence level for Vikramgad, whereas as for Mokhada and Jawhar it was insignificant. T-test for

difference in expenditure on electricity was significant at 99% confidence level for Maharashtra as well as for Jawhar, Mokhada, and Vikramgad blocks. T-test for difference in expenditure on electric devices was insignificant.

Two sample (treatment & control) t-test results with electrification status as a constraint

As mentioned earlier electrification status was put as a constraint to explore whether there were any differences between the expenditure pattern of electrified and non electrified households in control and treatment groups. As observed in table 15, t-test results for 'expenditure on kerosene used for lighting' for Maharashtra was significant at 99% confidence level for non-electrified households indicating higher expenditure on kerosene for lighting by control non-electrified households than the treatment. The block wise t-test results showed slightly different pattern as it was insignificant for four blocks with the exception of Akole which was significant at 90% confidence level for non-electrified group. However, for electrified group the significance was 99% confidence level for Akole and Sangamner and 95% confidence level for Mokhada and Vikramgad.

T-test results for total expenditure on lighting for Maharashtra were significant at 99% confidence level for both electrified as well as non-electrified households indicating higher expenditure on lighting by control households than the treatment households. However, block wise t-test results were insignificant for non-electrified group except for Akole in which significance was at 95% confidence level. For electrified group in Jawhar it was significant at 99% confidence level and for Mokhada and Vikramgad the significance was at 95% confidence level.

Table 15: Two Sample (Treatment & Control) T-test Results – Electrification Status as a Constraint

	Exp on Kerosene used for lighting				Total Exp			
	Electrified		Non- Electrified		Electrified		Non- Electrified	
	t- test	P-Value	t- test	P-Value	t- test	P-Value	t- test	P-Value
Consolidated MH	0.5198	0.6033	2.4794	0.0136	3.1479	0.0017	2.7341	0.0065
Block Wise								
Akole	3.9303	0.0001	1.8776	0.0679	-0.5174	0.6052	1.9826	0.0541
Jawhar	0.2755	0.7832	1.3524	0.1794	3.0525	0.0025	1.4652	0.1461

Mokhada	-1.996	0.0481	1.0143	0.3125	2.2081	0.0288	1.0143	0.3125
Sangamner	3.8109	0.0002	1.0525	0.2985	-0.0779	0.938	1.3995	0.168
Vikramgad	2.5472	0.0112	-0.0291	0.9769	1.9775	0.0486	-0.0291	0.9769

3.6. Studying during dark hours: lighting devices, electrification status, gender differentiation (studying during dark hours henceforth referred as studying in night)[8]

As children attend day schools, most of them study and complete their school related work either in late evening or at night. This was reflected in the data collected where 98.30 percent of children in treatment households and 99.38 percent of children in control household were reported to be studying at night on daily basis. And of those who reported of 'not studying at night', the reason for such was mainly given as 'not interested' for 80.28 percent children in treatment group. The underlying reason for this could be various including illiteracy/lack of interests of parents to help children studies or child is earlier classes like primary section and the work load could be less.

Various lighting source/device used for studying were found within both households – treatment and control samples. The impact observed was determined through – 'SoUL as one main and/or one of lighting source/device' in treatment group and 'Kerosene as main and/or one of lighting source' between the treatment group and control group. SoUL was predominant lighting device used for studying in treatment households with 86.3 percent of children in electrified treatment households and 83.11 percent of children in non-electrified treatment households report using SoUL as one of the lighting devices used for studying. Interestingly, 14.01 percent of children in electrified treatment households report using only SoUL as lighting device for studying purposes (Table 16). This highlights the two main issues – electricity being perceived to be an unreliable source and luminosity provided with the bulbs/CFLs in the households are not sufficient.

[8] Dark hours are defined as the time when there is no daylight and there is darkness and lighting devices are required for the illumination. The dark hours pertain to hours from dusk (darker stage of twilight) to dawn (the first appearance of light in the sky before sunrise). These hours will vary from season to season for example in winters it becomes dark early in the evening and the nights are longer as sun rises late and vice-versa during summer.

Table 16: Lighting Devices/Source used for Studying Purposes

	Treatment Household						Control Households					
	Electrified		Non-Electrified		Total		Electrified		Non-Electrified		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Electricity, Kerosene Source	87	2.47	7	1.17	94	2.28	135	33.33	2	2.53	137	28.31
Kerosene Source, Other Solar Device	0	0.00	3	0.50	3	0.07	0	0.00	3	3.80	3	0.62
Only Electricity	327	9.30	8	1.34	335	8.14	185	45.68	3	3.80	188	38.84
Only Kerosene Source	31	0.88	68	11.37	99	2.41	42	10.37	55	69.62	97	20.04
Only SoUL	493	14.01	271	45.32	764	18.56	0	0.00	0	0.00	0	0.00
Other Device	4	0.11	1	0.17	5	0.12	2	0.49	3	3.80	5	1.03
Other Solar Device	0	0.00	1	0.17	1	0.02	3	0.74	2	2.53	5	1.03
SoUL, Electricity	2179	61.94	15	2.51	2194	53.30	0	0.00	0	0.00	0	0.00
SoUL, Electricity, Other Device	11	0.31	0	0.00	11	0.27	0	0.00	0	0.00	0	0.00
SoUL, Kerosene Source	177	5.03	180	30.10	357	8.67	0	0.00	0	0.00	0	0.00
SoUL, Other Device	28	0.80	3	0.50	31	0.75	0	0.00	0	0.00	0	0.00
SoUL, Electricity, Kerosene Source	89	2.53	2	0.33	91	2.21	0	0.00	0	0.00	0	0.00
SoUL, Kerosene Source, Other Device	38	1.08	22	3.68	60	1.46	0	0.00	0	0.00	0	0.00
SoUL, Kerosene Source, Other Solar Device	1	0.03	0	0.00	1	0.02	23	5.68	2	2.53	25	5.17
Electricity, Other Device	11	0.31	0	0.00	11	0.27	11	2.72	8	10.13	19	3.93
Kerosene Source, Other Device	14	0.40	13	2.17	27	0.66	0	0.00	0	0.00	0	0.00
Electricity, Kerosene Source, Other Solar Device	0	0.00	0	0.00	0	0.00	1	0.25	0	0.00	1	0.21
Electricity, Kerosene Source, Other Device	7	0.20	0	0.00	7	0.17	3	0.74	0	0.00	3	0.62
Electricity, Other Solar Device	1	0.03	0	0.00	1	0.02	0	0.00	1	1.27	1	0.21
Kerosene Source, Other Device, Other Solar Device	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
SoUL, Electricity, Kerosene Source, Other Solar Device	7	0.20	0	0.00	7	0.17	0	0.00	0	0.00	0	0.00
SoUL, Electricity, Other Solar Lamp	1	0.03	0	0.00	1	0.02	0	0.00	0	0.00	0	0.00
SoUL, Other Solar Device	7	0.20	4	0.67	11	0.27	0	0.00	0	0.00	0	0.00
SoUL, Electricity, Kerosene Source, Other Device	5	0.14	0	0.00	5	0.12	0	0.00	0	0.00	0	0.00
Total	3518	100.00	598	100.00	4116	100.00	405	100.00	79	100.00	484	100.00

Less dependence on kerosene as lighting source for studying purposes is clearly evident through the data from the household surveys. 20.04 percent of children from control households use kerosene as only lighting source purpose while only 2.41 percent of children from treatment households report using kerosene as only lighting source for studying. Comparison for the same between electrified treatment and control households show only 0.88 percent in of children electrified treatment household study using kerosene as only lighting source, while same if 10.37 percent in electrified control households. This difference is even higher in non-electrified households with 69.62 percent of children from non-electrified control households use kerosene as only lighting source for studying, while the same is mere 11.37 percent for children in non-electrified treatment households. The result only confirms SoUL being an able substitute for kerosene based devices.

3.6.1 Study hours during night

Daily studying hours in treatment group show children majorly study for 1-2 hours where 40.76 percent reporting of such, followed by 40.76 percent reporting 0-1 hours and 13.13 percent stating 2-3 hours of daily studying time. Similar trend is observed in control households where 42.15 percent of children study between 1-2 hours, followed by 38.43 percent studying 0-1 hours and 14.88 percent studying 2-3 hours daily (Table 17). While no major difference in terms of studying hours between treatment group and control group is seen; the gender wise differentiation reveal too do reveal any difference between treatment and control samples.

Table 17: Studying Hours amongst Children in Maharashtra

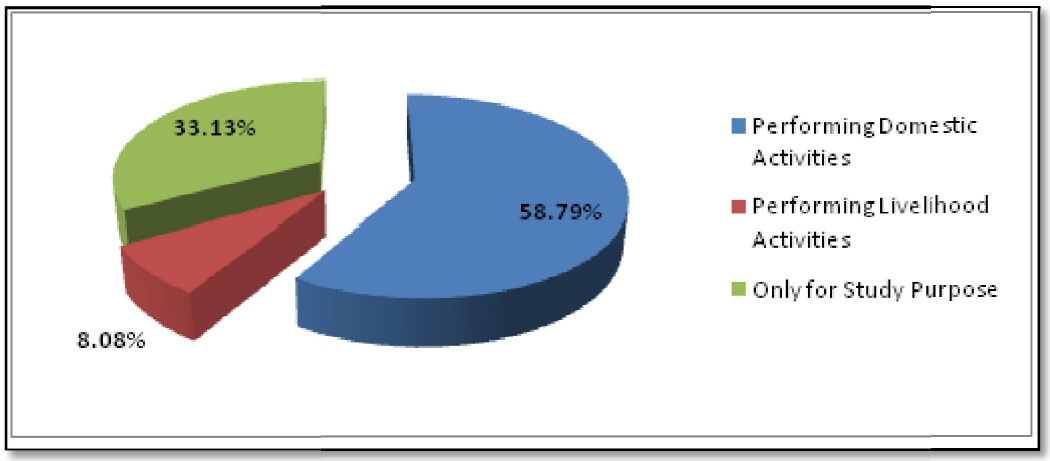
	Treatment Household						Control Households					
	Electrified		Non-Electrified		Total		Electrified		Non-Electrified		Total	
Hours Studies	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0-1	1285	42.33	155	31.19	42	42.33	166	40.99	20	25.32	83	41.66
1-2	1277	42.06	252	50.70	42	42.06	165	40.74	39	49.37	83	41.40
2-3	396	13.04	68	13.68	13	13.04	57	14.07	15	18.99	27	13.56
3-4	53	1.75	14	2.82	2	1.75	6	1.48	0	0.00	3	1.62
4-5	15	0.49	6	1.21	0	0.49	2	0.49	2	2.53	1	0.49

5-6	9	0.30	2	0.40	0	0.30	8	1.98	0	0.00	2	1.14
More than 6 hours	1	0.03	0	0.00	0	0.03	1	0.25	3	3.80	0	0.14
Total	3036	100.00	497	100.00	100	100.00	405	100.00	79	100.00	200	100.00

3.7. Uses of SoUL other than the study purpose

"Other uses of SoUL" is a multiple answer question. The data from the beneficiary households showed SoUL being used for multiple and diverse purposes besides studying at night. The figure 7 presented below shows the percentage of households with various usages. It could be seen that highest percentage of households are using it as an aid in domestic activities. The main domestic activities include aid during cooking (45.67%) and having dinner (20.83 %).

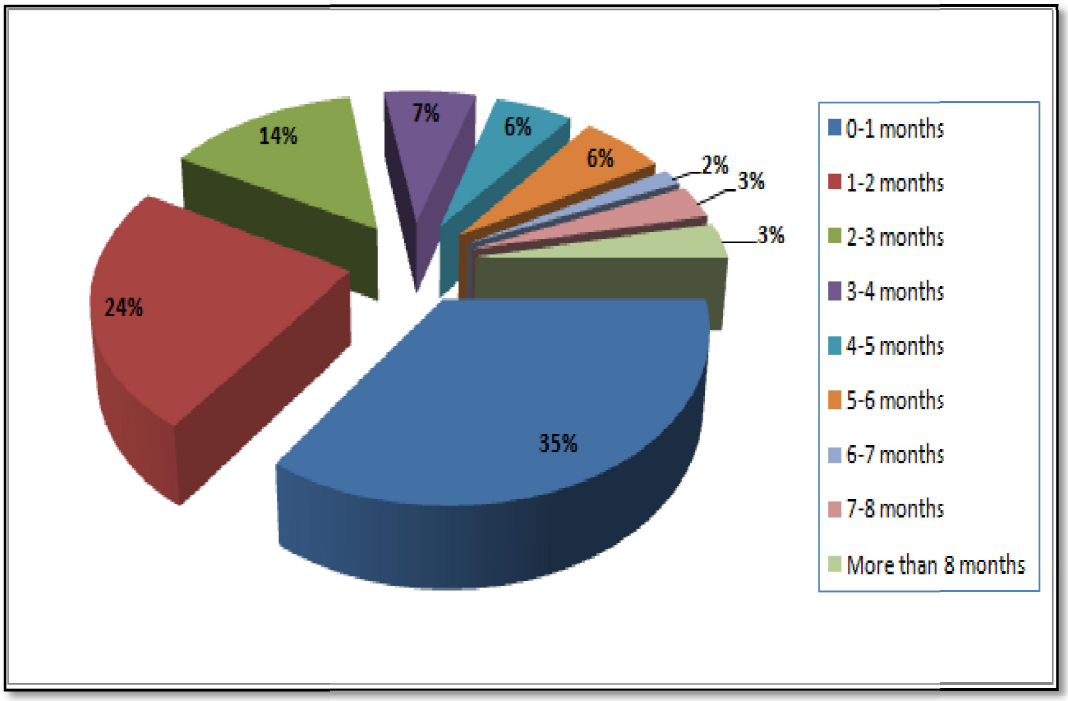
Figure 7: Percentage of Households using SoUL in various activities in Maharashtra



3.8. Performance of SoUL

Performance of SoUL was judged on basis of number of functional lamps and defective components. Out of the 2891 SoUL received by 2439 households in Maharashtra, 82.95 percent (2398) of SoUL were found to be functional and rest were completely non-functional. Most of non-functional lamp functioned for 'one month', followed by 'two months' (Fig. 8).

Figure 8: Percentage of SoUL and Number of Months they functioned before stop functioning in Maharashtra

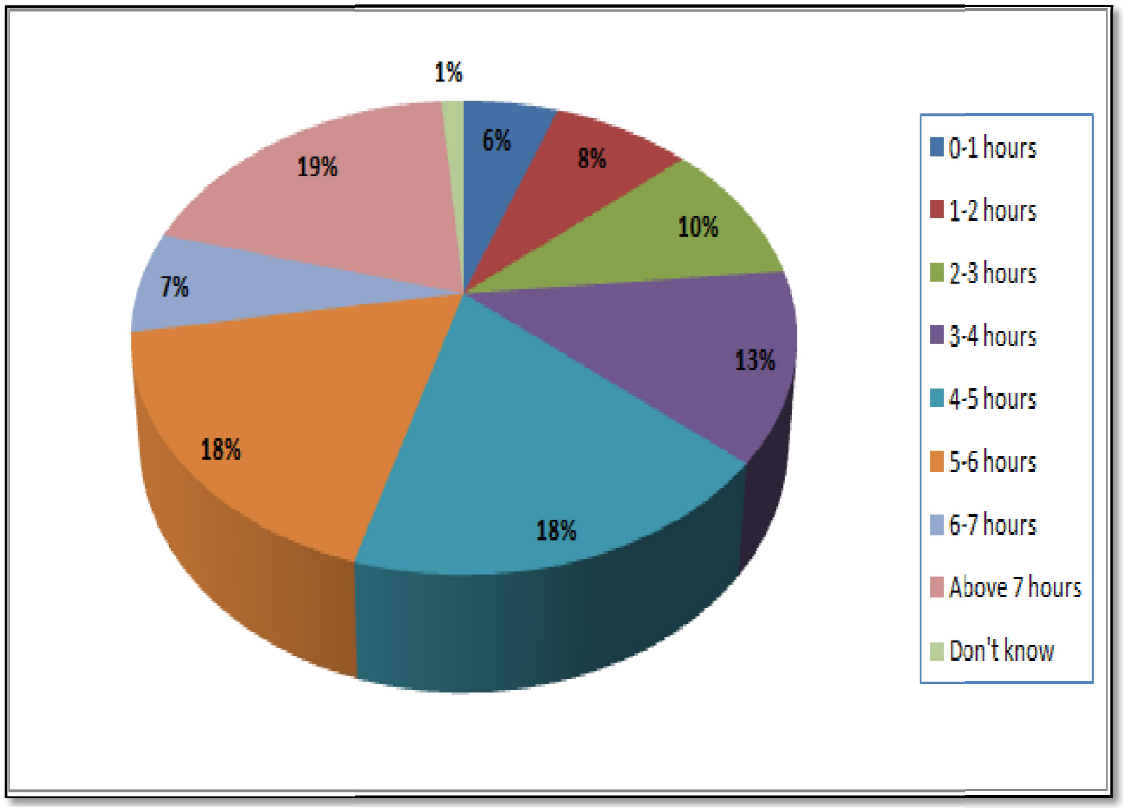


Functional SoULs were checked for defective parts like functioning charging lights etc. Out of 2398 functional SoUL, 28.82 percent had atleast one of the parts as defective. Among the functional SoUL with defective parts, the biggest issue was 'loose connection' which was observed in 19.31 percent of SoUL followed by 'green light'[9] not working in 9.47 percent SoUL while 'switch' problem represented almost 3.38 percent of defective parts. The back-up provided by the SoUL on full charging was also determined through asking the average back-up time provided by SoUL. 19.43 percent reported the SoUL to provide back up for 'above 7 hours', followed by '4-5 hours' which was responded by 18.1 percent and '5-6 hours' reported by 17.97 percent (Fig. 9).

Block-wise non-functionality analysis show there is not much of difference in blocks with 4 blocks – Akole, Jawhar, Sangamner and Vikramgad all having non-functionality of SoUL in range of 15-17 percent, while only Mokhada show non-functionality of 22.15 percent.

[9] Green Light indicate the SoUL Lamps are completed charged and are ready to be disconnected.

Figure 9: Percentage of SoUL and Back-up provided by SoUL in Maharashtra



3.9. Need for solar energy based products and willingness to pay

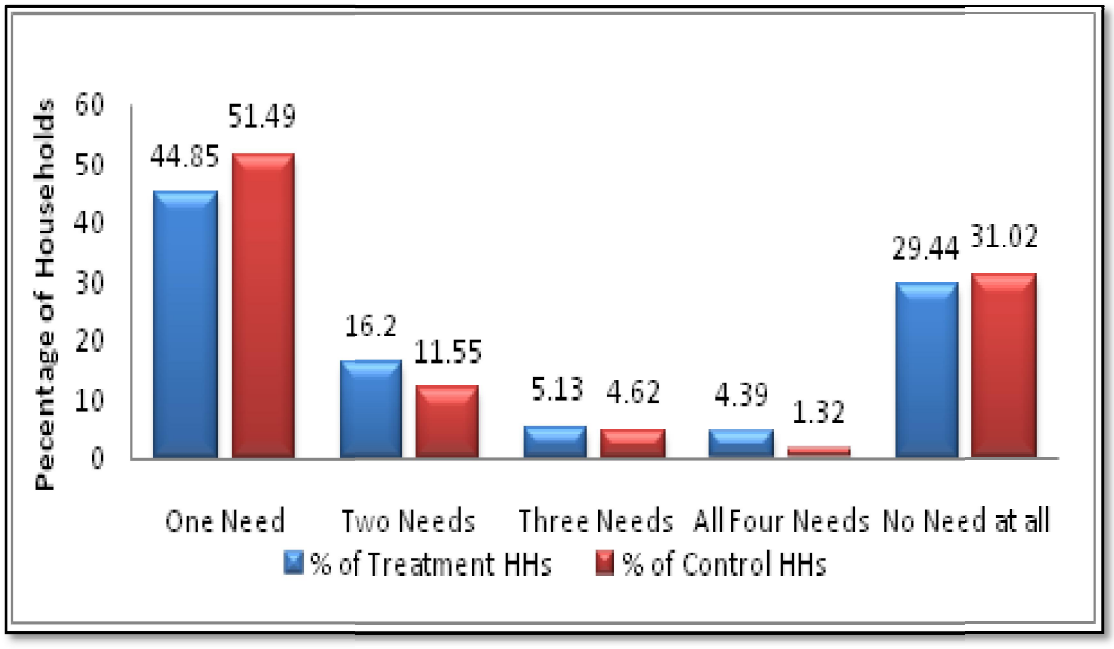
The household survey tried to explore the household level solar energy related needs and in case of presence of such needs then willingness or capacity to pay assuming there is no subsidy available and they are to purchase it from the market. The exploration of needs was linked to assessing the market potential for the solar products in rural areas. However, households in the SoUL Program implementation areas being rural and tribal tend to have less exposure to solar technology and solar products. So the barrier about knowing or visualising the product and state some cost that they think they can afford to pay was anticipated. In order to overcome this barrier a placard illustrating pictures of solar products like solar light, solar torch, solar home lighting system, solar fan, solar pump for irrigation, solar drier for drying crops (food grains, vegetables) and their approximate costs in the market at present was prepared. While administering the questionnaire it was shown to them and care was taken to inform and

assure them that any kind of marketing of solar products was not intended and there is no commitment when they state they can afford certain amount.

Need for solar energy based products mainly covered four types of needs: lighting, cooking, irrigation and additionally if they expressed any other specific need it was recorded. About stating the cost it was noticed that the respondent households were hesitant to state any amount as most of them belonged to poor households.

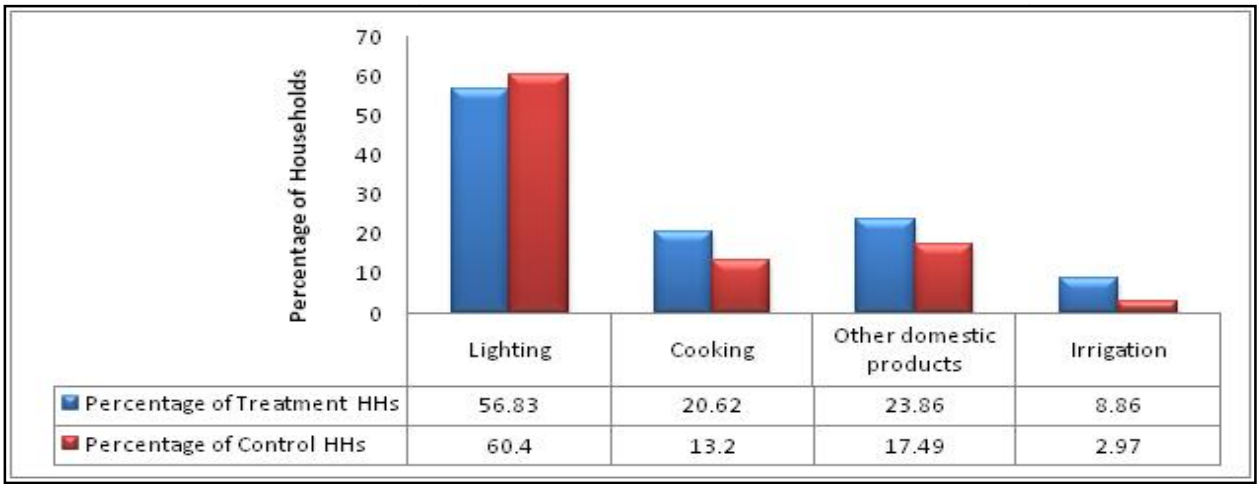
The total households surveyed were 2439 for treatment and 303 for control group. The figure 10 below shows the percentage of households and the number of solar product needs that they were expressed by them. From the figure it could be observed that 70.56% treatment household and 68.98% control households has expressed the need for the solar product/s. Maximum percentage of households, 44.85% in treatment and 51.49% in control had one need.

Figure 10: Percentage of Sample Households & Need for Solar Products in Maharashtra



From the following figure 11, it is observed that maximum percentage of households in both the groups have expressed the need for solar home lighting.

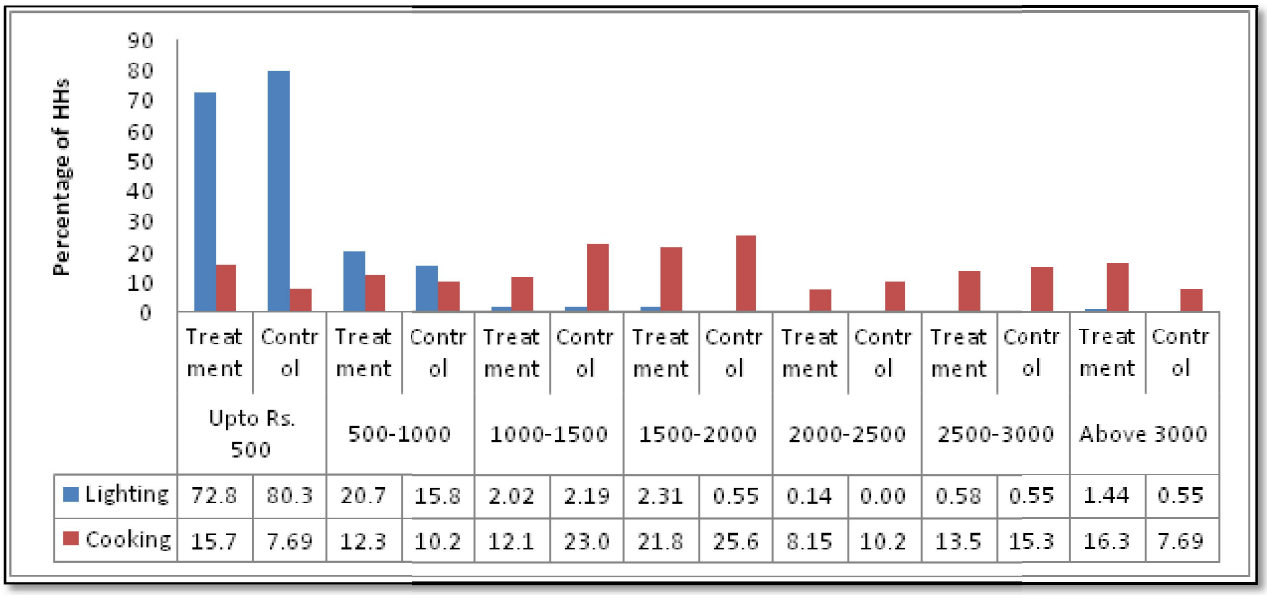
Figure 11: Percentage of HHs expressing Needs that are to be addressed by Solar Technology in Maharashtra



	Lighting	Cooking	Other domestic products	Irrigation
Percentage of Treatment HHs	56.83	20.62	23.86	8.86
Percentage of Control HHs	60.4	13.2	17.49	2.97

As observed from the figure 12 below, amongst the households that expressed need for solar lighting, in both the groups maximum percentage of household showed willing to pay up to Rs. 500. The need for solar cooking was stated by 503 treatment and 40 control households. Amongst these there was highest percentage of households in both the groups that showed capacity to spend between Rs. 1500-2000.

Figure 12: Capacity to Spend on Solar Lighting and Cooking Needs in Maharashtra



	Upto Rs. 500		500-1000		1000-1500		1500-2000		2000-2500		2500-3000		Above 3000	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
Lighting	72.8	80.3	20.7	15.8	2.02	2.19	2.31	0.55	0.14	0.00	0.58	0.55	1.44	0.55
Cooking	15.7	7.69	12.3	10.2	12.1	23.0	21.8	25.6	8.15	10.2	13.5	15.3	16.3	7.69

The need for solar based pump for irrigation was reported by less households with 8.57% treatment and 5.88 percent control households. In treatment group 75.89 percent and 72.23 in control were willing to spend in above Rs. 25,000 for solar irrigation pump. There were 7.51 percent treatment households that expressed to spend between Rs. 5000-10000.

For other domestic needs (refer table 18) maximum percentage of 38.32 percent in treatment expressed capacity to spend above Rs. 3000, while 47.17 percent control group showed willingness to spend up to Rs. 1000.

Table 18: Willingness to Spend for Other Domestic Needs in Maharashtra

Amount (in Rs.)	No. of treatment HHs	%	No. of control HHs	%
0-1000	197	33.85	25	47.17
1000-2000	125	21.48	13	24.53
2000-3000	37	6.36	4	7.55
Above 3000	223	38.32	11	20.75
Total	582	100	53	100

As observed from table 19 there were few households in both the groups that expressed the need for solar irrigation. In the treatment group a maximum of 71.3 percent households were willing to spend above Rs. 25000.

Table 19: Willingness to Spend on Solar Irrigation Need in Maharashtra

Amount (in Rs.)	No. of treatment HHs	%	No. of control HHs	%
0-5000	27	12.5	3	33.33
5000-10000	12	5.56	0	0.00
10000-15000	6	2.78	0	0.00
15000-20000	11	5.09	0	0.00
20000-25000	6	2.78	0	0.00
Above 25000	154	71.3	6	66.67
Total	216	100	9	100

Chapter 4. Conclusions and Recommendation

Much has been written in the literature over the energy access and energy poverty. MSP is one such initiative that works on targeted approach to eliminate the darkness from school childrens lives. The evaluation have show mixed to positive results with observed kerosene expenditure lower within the households of SoUL users as against the non-users. As a simple device, the SoUL has impacted various facets of life of the users. For one, school going children are now able to study in safer environment. Better luminosity provided by SoUL has enabled a sense of freedom amongst the children. Though the results do not indicate difference in study hours from both groups, however the dependence on kerosene devices are very less in the treatment sample as compared to control samples. Having said, indirect health benefits accrued cannot be disregarded as children have less strain on eyes and less exposured to soot arising out of kerosene wick lamps due to use of SoUL. Kerosene purchase is seen to be lesser in the treatment group as compared to the control group which further advances our stance that SoUL lamp has positive impact kerosene consumption and overall household expenditure on lighting. Overall total lighting expenditure as observed is higher in control group compared to treatment group with difference showing significance at 99 percent confidence. The difference observed in terms of savings can be argued by some to be small, but however overall lighting need seem the household is much larger (with multiple rooms) and SoUL is able to fulfill only a part of such need. The households generally consists of 2 or more rooms, thus there is need for kerosene for lighting in emergency situation which can be one reason for not complete eradicaton of use of kerosene. SoUL also aids household activities through providing lighting to accomplish tasks like cooking, cleaning, etc which has been reported by large percent of households. While difficult to quantify, such result only point towards the multi-purpose usability of SoUL.

One alarming result from the survey which was consistent in every survey block was the high non-functionality rate of the SoUL. The non-functionality rate may hamper the

confidence of the rural communities on the technology. Long term sustainence of the technology based solution to rural people depend upon multiple factors including provision of on-site service. The project has tried to address it through establishment of SoUL Repair Centre (SRC), however lack of information about SRC amongst the users seems to be main reason for SoULs not being repaired rather than inability of SRCs to provide post sale provisions. Appropriate Information, Communication and Education (ICE) needs to be designed so as communitcate every facet of the Program to the befeciaries. Given the demand and willingness to pay for solar products only shows how the technology has the potential to be drawn on wider scale looking at different needs of the communities. Demonstration of solar technology on such large scale and relative impacts observed only induce confidence in the technology and Million SoUL Program struture which was drawn to make such solutions available at affordable rates. Support through appropriate institutional and financial mechanism is necessary for wider adoption of solar technology inorder to eradicate the energy poverty persisting in rural communities.

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Annexures

A1. Household Impact Survey

State	**[Pre-printed]**	**District**	**[Pre-printed]**	**Block**	**[Pre-printed]**

Form Number													**Interviewer's Name**	**Date**	**Gram Panchayat**	**Village**	**Hamlet**
			/					/									
Block code [Pre-printed]			**/**	**Village code**				**/**	**Serial number**								

A. Household Details						
A1	Full Name of respondent		A3	Full Name of head of household		
			A4	Sex of head of household	◯ Male	◯ Female
A2	Relation of the respondent to the beneficiary		A5	Mobile Number		
			A6	Number of Members in the Family		
			A7	No of rooms in the house(including kitchen)		

B. Children's Details (Irrespective of receipt of SoUL lamp, applicable to all children from 5 to 17 years or up to 12th Class)										
	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
S. No.	Full Name	Age	Sex (M/F)	Does he/she go to school? (Yes/ No)	Class	Has he/she received SoUL lamp? (Yes/ No)	If **"Yes" for B6**, specify the **lamp code** here. If only one child has bought and others are applicable why other children have not brought SoUL?*	Which devices** do you use for studying (Specify all the devices, else specify the reason for not studying in the dark hours)	If, **for B8**, one of the devices is SoUL lamp, specify **time** of **study using SoUL lamp**. If, **for B8**, none of the devices is SoUL lamp, specify the **reason for not using SoUL lamp** for studying	If the SoUL is working, and the child is using Chimni/Electricity with SoUL, mention the reason for using the same?
1										
2										
3										
4										
5										
6										

*If unable to obtain the lamp code, state the reason in B7

** If studying in street light or community light (in temple) etc. then specify in B8

C. Performance of SoUL lamp (Interviewers can themselves check SoUL lamp for following details)											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
S. No.	Lamp Code	Is the SoUL lamp working? (Yes/ No) **If "Yes" go to C4**	If No, for how much time did it work? (days/weeks/ months) **Specify and go to E1**	Is the Switch working? (Yes / No)	Is LED working? (Yes / No)	Is red light in indicator working properly? (Yes/ No)	Is green light in indicator working properly? (Yes/ No)	After one day of charging, for how much time SoUL lamp works?	Is there any loose connection? (Yes/ No)	Is the panel broken? (Yes/ No)	State other problem, if any. If SoUL is not working; then state the problem with it?
1											
2											
3											
4											

D. Usage of SoUL lamp									
D1 Lamp code	D2 Do you charge SoUL lamp with mobile charger? (Yes/ No)	D3 What is the usage of SoUL in hours per day for purposes **other than Studies**?	D4 For what other purposes **other than Studies** SoUL lamp is used & used by whom **(Relation to the beneficiary)**						
			Other purpose 1	Used by whom	Other purpose 2	Used by whom	Other purpose 3	Used by whom
E. Repair and Maintenance of SoUL									

S. No.	E1 Lamp code**(Repeat the lamp code again if R&M availed more than once)**	E2 Have you availed R&M service?[#] (Yes/ No) **If Yes, Go to E4**	E3 If **E2 is "No"**, & SoUL lamp is not working then why service is not availed? **Specify and go to E11**	E4 If **E2 is "Yes"**, what was the problem in the SoUL lamp before repair?	E5 Was it repaired at SoUL R&M centre? (Yes / No)	E6 Where was it repaired? (Shop name, Village name, Gram Panchayat name)	E7 When did you avail R&M? (Month & year)	E8 In how many days was SoUL lamp repaired?	E9 How much did you pay for it? (Rs.)	E10 Are you satisfied with R&M service? (Yes/ No)
A										
B										
C										
D										
E										
F										

E11 If any of the SoUL lamps have been repaired at home (yourself), was it successful? (Yes/ No):

E12 Specify which component was not working before repair at home (yourself):

F1 Kerosene Purchased					
S. No.		Litre/s per month	Avg. Price per litre	Frequency (Number of trips for purchase per month)	Generally collected by whom? (specify whether Adult woman/Adult man/ Girl child/boy child)
1	Purchased from Govt. Ration shop - PDS				
2	Purchased from Market				

F2 Kerosene Used				
	Lighting	Cooking	Heating water	Other (Please specify)*
Consumption (litre/s per month)				

*Other use may also include resale, in vehicles, etc.

F3 Usage of other oil for lighting (For example, if used for lighting purpose, any of the cooking oils like groundnut, mustard, sunflower, etc.)			
Name of oil	Consumption (litre/s per month)	Avg. Price per litre	Device/s used

F4 Devices using kerosene/ other oil					
S. No.	Device	Do you use the device? (Yes/ No)	Quantity used*	Number of hours per day	Number of days per month
1	Chimni (Simple wick lamp)				
2	Hurricane lamp				
3	Wick stove				
4	Other (Please specify)				

*By "Quantity used" we mean number of devices they are actually using for lighting purpose and NOT the number of devices they possess.

F5 Do you have electricity at home? If "No" go to F10	◯ Yes	◯ No
F6 Do you have electric meter/ one point connection/ shared connection?	◯ Yes	◯ No

F7 Interval of electricity bill receipt		
◯ Not applicable	◯ Every month	◯ Every 3 months
◯ Every 6 months	◯ Every year	◯ Other (Please specify)

F8	**Electricity bill amount paid as per the above mentioned interval (Rs)**	

F9 Features of electric lighting devices (bulbs/ tubes) used at home				
S. No.	Type of device	Number of devices	How much period (days/weeks/ months/ years) does this device last for?	Avg. price of device (Rs per unit)
1	Incandescent bulb			
2	CFL			
3	Tubes			
4	LED			
5	Chargeable torch			
6	Other (Please Specify)*			

* If using torch in mobile phone specify that also as other electric lighting device.

F10 Features of candle		
Number consumed/ month (Specify candle or pack)	Usage in hours per day	Avg. price of candle or pack (Rs per unit)

F11 Features of battery torch at home (non-rechargeable)				
	Number of cells	Number of times cells replaced per month	Avg. price of torch (Rs per unit)	Maintenance Cost (Rs per unit)**
Torch 1				
Torch 2				
Torch 3				

** If use-and-throw (Chinese) torch, then in 'Maintenance Cost' write **not applicable**

F12 Features of renewable energy devices other than SoUL used at home								
S. No.	Name of device	Purchase inspired by SoUL lamp (Yes/ No)	Number	Capacity	Initial investment (Rs)*	Working (Yes/ No)	Maintenance Cost (Rs per unit)	Year of purchase
1								
2								
3								

* If no investment has been made (grant/ donation), then in 'Initial investment' write **not applicable**

G. Willingness to pay for other Solar Products (Please tick in the appropriate circle)			
G3	**What are the solar energy related needs**	**Energy Needs**	**As you are aware, actual cost of SoUL lamp is Rs 500 but due to subsidy it is available for students**

	of the household?		**at Rs 120. Keeping this in mind, how much you are willing to invest for the following uses?**
		◯ Lighting	
		◯ Cooking	
		◯ Irrigation	
		◯ Others (Please specify)	
		◯ None	

G.3.1 Preference of Lighting in the household			
G3.1	**What is the preferred source of lighting for the Household- Electricity; Kerosene Source; Solar Product? (Eg. Rank1 given to first preferred source etc.)**	**Energy Needs**	**Preferred Source of Lighting**
		Rank 1	
		Rank 2	
		Rank 3	
		Remarks (if any)	

G.3.2 Solar Needs		
G3.2	**Does SoUL lamp satisfy your child's study lighting needs? If No, then why?**	

H. Community Details (Please tick in the appropriate circle)		
H1	**Type of Card Holder (Please tick in the appropriate circle)**	
◯ Below Poverty Line (BPL)	◯ Antyoday	◯ Other (Please specify)
◯ Above Poverty Line (APL)	◯ No card	

H2	**Primary Source of Income (Please tick only one)**	
◯ Agriculture	◯ Labor	◯ Agriculture + Labor
◯ Service	◯ Dairy	◯ Skill-based occupation (carpentry, pottery, etc.)
◯ MGNREGS	◯ Remittance	◯ Other (Please specify)

H3	**Religion (Please tick only one)**		
	◯ Hindu	◯ Muslim	◯ Christian
	◯ Sikh	◯ Buddhist	◯ Jain
	◯ Other (Please specify)		

H4	Social Group (Please tick only one)	
	◯ Scheduled Tribe (ST)	◯ Scheduled Caste (SC)
	◯ Other Backward Caste (OBC)	◯ Nomadic/ Denotified Nomadic Tribe/ Vimukta Jati Nomadic Tribe (NT/ DNT/ VJNT)
	◯ Open (General)	◯ Other (Please specify)

H5	Name of caste/ tribe you belong to	

H6	Wealth Indicator					
Name of the asset	**#**	**Name of the asset**	**#**	**Name of the asset**	**#**
Radio		table		other asset 1	
Bicycle		chair		other asset 2	
motorcycle/scooter		mattress		other asset 3	
washing machine		bullock cart			
Fans		thresher			
Heaters		tractor			
colour television		buffalo			
b/w television		Cow			
telephone set/ mobile phone		bullock			
sewing machine		goats			
pressure cooker		cock/hen/duck			
Watches		Pigs			

H7 Household type: Tick the correct option		
Kacchha	**Semi- Pakka**	**Pakka**

H8: Preferred Activity for the children in the family					
How do all *MALE* children spend their non-schooling hours? Enlist three activities in which he spends most of his time and the number of hours spent on the same	**Activities**	**No. of Hours**	**How do all *FEMALE* children spend their non-schooling hours? Enlist three activities in which he spends most of his time and the number of hours spent on the same**	**Activities**	**No. of Hours**
Remarks (if any)			**Remarks (if any)**		

Signature of the respondent		Signature of the interviewer	

Please note the suggestions and complaints by the respondent below.

Interviewer's Notes:

A2. Household Control Survey Form

State	[Pre-printed]	District	[Pre-printed]	Block	[Pre-printed]

Form Number												Interviewer's Name	Date	Gram Panchayat	Village	Hamlet
			/					/								
Block code [Pre-printed]			/	Village code				/	Serial number							

A. Household Details						
A1	Full Name of respondent		A4	Full Name of head of household		
A2	Mobile Number		A5	Sex of head of household	◯ Male	◯ Female
A3	Number of Members in the family		A6	No of Rooms in the House(including Kitchen)		

B. Children's Details (Irrespective of receipt of SoUL lamp, applicable to all children from 5 to 17 years or up to 12th Class)								
	B1	B2	B3	B4	B5	B6	B7	B8
S. No.	Full Name	Age	Sex (M/F)	Does he/she go to school? (Yes/ No)	Class	Why has he/she not received SoUL lamp? (Specify the reason)	Which devices* do you use for studying (Specify all the devices, else specify the reason for not studying in the dark hours)	If, **for B7**, devices are used for studying, specify **time** of **study (mins/hours)**. If, **for B7**, no devices are used for studying, **go to C1**
1								
2								
3								
4								
5								
6								

*If studying in street light or community light (in temple) etc. then specify in B7

C1 Kerosene/ Other oil Purchased					
S. No.		Litre/s per month	Avg. Price per litre	Frequency (Number of trips for purchase per month)	Generally collected by whom? (specify whether Adult woman/Adult man/ Girl child/boy child)
1	Purchased from Govt. Ration shop - PDS				
2	Purchased from Market				

C2 Kerosene Used				
	Lighting	Cooking	Heating water	Other (Please specify)*
Consumption (litre/s per month)				

*Other use may also include resale, in vehicles, etc.

C3 Usage of other oil for lighting (For example, if used for lighting purpose, any of the cooking oils like groundnut, mustard, sunflower, etc.)			
Name of oil	Consumption (litre/s per month)	Avg. Price per litre	Device/s used

C4 Devices using kerosene/ other oil					
S. No.	Device	Do you use the device? (Yes/ No)	Quantity used*	Number of hours per day	Number of days per month
1	Chimni (Simple wick lamp)				
2	Hurricane lamp				
3	Wick stove				
4	Other (Please specify)				

*By "Quantity used" we mean number of devices they are actually using for lighting purpose and NOT the number of devices they possess.

C5 Do you have electricity at home? If "No" go to C12	◯ Yes	◯ No
C6 Do you have electric meter/ one point connection/ shared connection?	◯ Yes	◯ No
C7 Do you have inverter at home?	◯ Yes	◯ No
C8 Do you have generator at home?	◯ Yes	◯ No

C9 Interval of electricity bill receipt		
◯ Not applicable	◯ Every month	◯ Every 3 months
◯ Every 6 months	◯ Every year	◯ Other (Please specify)

C10	**Electricity bill amount paid as per the above mentioned interval (Rs)**	

C11 Features of electric lighting devices (bulbs/ tubes) used at home

S. No.	Type of device	Number of devices	How much period (days/weeks/ months/ years) does this device last for?	Avg. price of device (Rs per unit)
1	Incandescent bulb			
2	CFL			
3	Tubes			
4	LED			
5	Chargeable torch			
6	Other (Please Specify)*			

* If using torch in mobile phone specify that also as other electric lighting device.

C12 Features of candle		
Number consumed/ month (Specify candle or pack)	Usage in hours per day	Avg. price of candle or pack (Rs per unit)

C13 Features of battery torch at home (non-rechargeable)				
	Number of cells	Number of times cells replaced per month	Avg. price of torch (Rs per unit)	Maintenance Cost (Rs per unit)**
Torch 1				
Torch 2				
Torch 3				

** If use-and-throw (Chinese) torch, then in 'Maintenance Cost' write **not applicable**

C14 Features of renewable energy devices used at home

S. No.	Name of device	Number	Capacity	Initial investment (Rs)*	Working (Yes/ No)	Maintenance Cost (Rs per unit)	Year of purchase

1							
2							
3							

* If no investment has been made (grant/ donation), then in 'Initial investment' write **not applicable**

D. Willingness to pay for other Solar Products (Please tick in the appropriate circle)			
D1	**What are the solar energy related needs of the household?**	**Energy Needs**	**As you are aware, actual cost of SoUL lamp is Rs 500 but due to subsidy it is available for students at Rs 120. Keeping this in mind, how much you are willing to invest for the following uses?**
		◯ Lighting	
		◯ Cooking	
		◯ Irrigation	
		◯ Others (Please specify)	
		◯ None	

D.2 Preference of Lighting in the household			
D.2	**What is the preferred source of lighting for the Household- Electricity; Kerosene Source; Solar Product? (Eg. Rank1 given to first preferred source etc.)**	**Energy Needs**	**Preferred Source of Lighting**
		Rank 1	
		Rank 2	
		Rank 3	
		Remarks (if any)	

E. Community Details (Please tick in the appropriate circle)		
E1	**Type of Card Holder (Please tick in the appropriate circle)**	
◯ Below Poverty Line (BPL)	◯ Antyoday	◯ Other (Please specify)

◯ Above Poverty Line (APL)	◯ No card	

E2	Primary Source of Income (Please tick only one)		
◯ Agriculture	◯ Labor	◯ Agriculture + Labor	
◯ Service	◯ Dairy	◯ Skill-based occupation (carpentry, pottery, etc.)	
◯ MGNREGS	◯ Remittance	◯ Other (Please specify)	

E3	Religion (Please tick only one)		
	◯ Hindu	◯ Muslim	◯ Christian
	◯ Sikh	◯ Buddhist	◯ Jain
	◯ Other (Please specify)		

E4	Social Group (Please tick only one)	
	◯ Scheduled Tribe (ST)	◯ Scheduled Caste (SC)
	◯ Other Backward Caste (OBC)	◯ Nomadic/ Denotified Nomadic Tribe/ Vimukta Jati Nomadic Tribe (NT/ DNT/ VJNT)
	◯ Open (General)	◯ Other (Please specify)

E5	Name of caste/ tribe you belong to	

E6	Wealth Indicator					
Name of the asset	**#**	**Name of the asset**	**#**	**Name of the asset**	**#**
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sewing machine		goats			
pressure cooker		cock/hen/duck			
Watches		pigs			

E7 Household type: Tick the correct option		
Kacchha	**Semi- Pakka**	**Pakka**

E8: Preferred Activity for the children in the family					
How do all *MALE* children spend their non-schooling hours? Enlist three activities in which he spends most of his time and the number of hours spent on the same	**Activities**	**No. of Hours**	**How do all *FEMALE* children spend their non-schooling hours? Enlist three activities in which he spends most of his time and the number of hours spent on the same**	**Activities**	**No. of Hours**
Remarks (if any)			**Remarks (if any)**		

Signature of the respondent		Signature of the interviewer	

Please note the suggestions and complaints by the respondent below.

Interviewer's Notes:

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Follow us on twitter **@lightismyright**