



ORIGINAL RESEARCH PAPER

Engineering

A STUDY ON USER SATISFACTION ON SOLAR LIGHTING DEVICES IN RURAL HOUSEHOLDS IN KOPPAL DISTRICT, KARNATAKA, INDIA

KEY WORDS: Rural lighting, Kerosene, Solar light, pollution, environment

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ABSTRACT

Lighting is a very essential amenity for rural development. It gives identity for the villages and provides illumination for doing different activities at the household level such as cooking, children's study, entertainment and livelihood activities. Absence of lighting is a hurdle for productivity during post sunset and thus impact on economic growth in rural areas. In Karnataka, currently electricity is supplied through grid with expensive infrastructure. Most villages like Karkihalli in Koppal district, Karnataka are electrified, however erratic power supply has resulted in the use of traditional kerosene lamps or paraffin wax candles for lighting. These are expensive options, emit smoke and harmful to the human health. One of the environment friendly and safe alternative solution for this problem is the adoption of solar based lighting devices (Lanterns), which are reasonable and portable too. To address this issue and provide clean lighting solution in Karkihalli village in Koppal district, Karnataka, solar lanterns were extended to 250 households with the support of Salesforce Foundation. This paper provides an overview of the user satisfaction on solar lanterns, cost savings as compared to conventional lighting fuels, social, economic and environmental benefits.

BACKGROUND:

In Karnataka, around 99.95% of the villages are electrified and 0.05% are in the process of electrification and around 86.72% households are electrified (CEA 2013) . However it is noticed that in Northern Karnataka villages are facing erratic power supply, especially during summer and rainy seasons, due to various reasons. This leads rural community to depend on traditional kerosene lamps, paraffin wax candles- etc. for lighting, which are known to cause respiratory diseases over a period of time due to the toxic emissions. As a solution to overcome this problem, in 2015-16, TERI extended solar lanterns for lighting to 250 families. Under the project, 75% of the device cost was provided, while the community paid the remaining 25% of the device cost. TERI has established a service mechanism system for repair and maintenance of solar lanterns through trained, & qualified village youth and product supplier. The community contribution amount was utilized for this purpose. An impact assessment and user satisfaction survey was carried out in 2019 to understand the sustainability of solar lighting devices, customer satisfaction, economic & social benefits, and learnings. It is hoped that the study outcomes presented in this paper will be useful to academic institutions, research organizations, manufacturers of solar devices and civil society, especially the user preferences.

2. STATEMENT OF THE PROBLEM:

Energy is required for different applications in rural areas such as domestic use, agriculture and enterprises. Demand for energy is increasing day by day and this will increase the burden on the Government to produce more power to meet the demand. Instead of depending on grid power, the village community could shift to clean and green energy devices for lighting. Green energy devices are independent, provide reliable and sustainable power. One of the best green energy sources is solar energy, which is abundant in nature, and can be used for different applications such as lighting, drying, heating, and cooling. This study provides an overview of such an initiative where the importance and utility of solar lighting has been demonstrated.



Figure 1: Villagers using of smoky tin kerosene lamps

3. OBJECTIVES OF THE STUDY:

The study aimed to i) understand the status of distributed solar lanterns ii) find out the factor in influencing adoption of solar lanterns iii) usefulness of solar lanterns iv) comprehend the satisfaction of users on solar lanterns. The study focused on various aspects of functioning of solar lanterns, impact and customer satisfaction. Aspects like extent of usage, factors influencing adoption of solar lantern, how the lantern has met the needs of the community have also been assessed.

4. STUDY METHODOLOGY

4.1 Study area:

The study was conducted in Karkihalli village, Koppal district in Karnataka State. The study area has semi-arid climate with extremely hot summers at 45°C during April-May and rainfall is scanty with an average of 572mm per annum. Annual solar normal irradiance in Koppal is 5.5kWh/m²/day. The village population is roughly 2500 and primary occupation is agriculture and agriculture labour. With respect to electrification of households around 97% percent are electrified, during power cuts traditional kerosene lamps and wax candles were being used.

The study was largely based on a secondary and primary survey that was carried out by using a detailed questionnaire.. The study respondents comprised 100 households that had benefitted and adopted solar lanterns under the project supported by Salesforce Foundation. For present study collection and analysis of data and information was done in

two ways i) Collection of secondary data and review of literature ii) Primary data collection from beneficiaries through survey and informal interviews with village representatives to elicit their views on solar lighting device.



Figure2: Map of Koppal and Karkihalli village

4.2 Sample size:

The beneficiary list was sorted and segregated based on the caste composition namely General, Other Backward Community (OBC), Scheduled caste (SC) and Scheduled Tribe (ST). A reconnaissance survey was done among 10 families randomly selected in Karkihalli village. Further, in order to address the objectives of the study, a sample size of 100 (40%) beneficiaries from 4 different communities were randomly selected. The breakup of the respondents is given in above table.

Table 1: Selection of respondents based on different communities.

SN	Beneficiary category	Ranking for selection	Total Population (Solar lantern users)	Sample size (40%) (Solar lantern users)
1	General	1st largest beneficiaries	210	84
2	SC	2nd largest beneficiaries	22	9
3	OBC	3rd largest beneficiaries	11	4
4	ST	4th largest beneficiaries	7	3
		Total	250	100

TOOLS USED FOR STUDY

5.1 Secondary data collection:

The Secondary information related to number of households, demography, electrification details etc. were collected from the Gram Panchayat.

5.2 Primary data

5.2.1 Household survey:

Based on the results obtained in the reconnaissance survey, suitable modifications were done prior to the actual primary data collection. The survey method was used to collect first-hand information from beneficiaries who had received solar lanterns. For the survey of beneficiaries, an interview schedule based on the objectives of the study was developed and administered at the individual beneficiary level. This was done to assess the satisfaction and perception on solar lantern from the customers. During the interview, open and close-ended questions were used. The questions were carefully constructed to elicit correct and detailed information from the respondents at the same time giving them a freedom of choice. The schedules were designed carefully in relation to the knowledge and language of the respondents. Further, a master sheet was prepared by using Microsoft Excel for entering the collected data. Before entering the data, all the filled questionnaires were checked thoroughly to remove errors.

5.2.2 Informal interviews:

This qualitative research method was used to collect data with

the active participation of stakeholders and key persons. This exercise was administered to elicit the views of the Gram Panchayat members, officials and technology.

6. STUDY FINDINGS

Socio-economic details: The study was carried out among 100 beneficiaries, of which 77% were men and 23% were women. It was found that 70% of the respondents were living below poverty line. Nearly 43% of the respondents were illiterate, 27% had completed high school education, 23% primary education, while 6% had completed middle /secondary school. Majority, i.e. 57% respondents had a family size of 3-5 members. Nearly 47% of them were marginal farmers and 27% of them were landless. About 77% of them were dependent on agriculture and 13% on agriculture labour, 10% were self-employment. The average annual household income of 57% respondents was Rs. 10000 – 25000, 23% had an income of Rs. 25,000 – 50000, 13% had an income of less than Rs. 10,000, 3% had an income of 50000-100000 and remaining 3% had an income above Rs.100000. This indicates that nearly 93% of the respondents had lesser income than the district standard per capita income of Rs. 82,787. This shows that majority of the beneficiaries are under below poverty line.

Existing energy consumption for lighting: With regard to lighting devices, all 100 families were using LED based bulbs for lighting in the households, of which 43% of the respondents were using 9W bulbs, 27% of were 5W bulbs, 17% were using 12W bulbs and remaining 13% were using 14W bulbs. This shows communities are aware of energy conservation and using electricity very precisely.

Understanding of what percentage of the electric bill does lighting consumption represent in a selected households, 30% of the respondents said it accounts 10% of the household electricity consumption, 40% of them said it accounts 15%, 10% of them said 25% electricity consumption, each 3% of them said it accounts 35%, 45% and above 50% and remaining 10% of them is having free electricity connection (Bhagya Jyothi). These details will give an idea of spending amount for lighting in total electricity bill.

Existing problem: During power cuts 80% of the respondents used kerosene based lamps, 40% used paraffin wax candles, 17% used rechargeable battery lights. Maximum (70%) of the respondents used 1 litre kerosene and 5 candles per month for lighting during power cuts. During the stakeholder interactions, it was found that 93% faced different problems during power cuts, such as women were unable to venture out of their houses, children were not able to study, economic activities could not be taken up after sunset etc.

Awareness on Solar Lighting devices: Awareness about the solar lighting devices before implementing the program, around 33% of the respondents were familiar where as 67% respondents were not familiar, after program implementation, around 86% of them are aware of solar devices where as 14% of them were not aware.

Status of Solar lanterns: The lanterns were provided to the villagers in year 2015-16, to understand the status of distributed solar lanterns, asked the beneficiaries about status of lanterns, about 90% of them said solar lanterns are in working condition and remaining 10% of them said not functional due to battery failure and not able to replace with new one.

Factors influencing adopting of solar lanterns: All the beneficiaries were fully convinced about the technology and its benefits, 60% of the respondents expressed that they adopted the solar lantern to use during erratic power supply,

20% of the respondents felt worth to invest, 30% of contribution to buy the system, remaining 20% said device is handy can be used for multiple purposes.

Usage of solar lantern: Regarding the extent of usage of the solar lanterns, 50% of them used it regularly while the remaining 50% used the solar lanterns during power cuts. The solar lanterns were used for different applications, such as 80% mentioned that it was used for children to do homework, 70% mentioned that it was used during cooking in the kitchen, 53% used it for other household works, 20% of them carried the lantern to the field to do agriculture activities, 13% of them used it for income generation activities (IGA) activities like dairying, tailoring, petty shops, small hotels etc and 3% of the respondents used the solar lantern for operations during harvesting. This indicates that the solar lanterns have been used for diverse activities.

After full charging respondents used lanterns at different illumination levels and different hours. The study brought out the fact that once the lanterns were completely charged, they were used at different illumination level and for varying number of hours by the respondents. Maximum, i.e. 67% respondents used the solar lantern at medium level illumination for 4 to 8 hrs/day, 30% of them used it at high level of illumination for 2-4 hours/day and remaining 3% respondents used low illumination level for 8-12 hours/day. Season-wise variations in the usage showed that 97% respondents used solar lantern during kharif season since the power cuts were more during the rainy season, 57% respondents used it mostly in summer due to more shortages and remaining 43% used it during rabi season during power cuts.

Functionality of the device: Regarding the satisfaction and its functionality, 90% of them expressed that they were satisfied with the system. All of them strongly agreed that the device provided clean light without smoke. Regarding the extent of satisfaction with the solar lanterns, nearly 17% of respondents expressed it was excellent, 67% expressed that it was very good and remaining 16% of mentioned that it was good.

Convenience of device: About 87% of them said that the device could be charged by using solar energy without depending on grid power. Further 40% of them agreed that system is convenient and easy to use, while 50% of the respondents expressed that although the lantern was portable, due to accidental damages, repairs had to be undertaken, while the remaining 10% has affirmed that the battery failed and they were not willing to replace it.

Socio-economic-Environmental Benefits: All the respondents expressed that children were able to study for one hour more on an average per day despite power cuts. Similarly, women could also engage in productive and economic activities for an average of one hour per day. This included IGAs like tailoring, vegetable vending, pettyshop and small hotels.

In 34 months between (2015-16 to 2019-20) the time of dissemination to the time of study, 80% respondents claimed to have saved 1 litre of kerosene per month, i.e. 34 litres. This translates to a saving of Rs. 1,258 at the rate of Rs. 37/ litre in the public distribution system. Similarly 40% respondents opined that they saved the amount spent on 6 candles per month, i.e Rs. 30 per month at the rate of Rs. 5 per candle. This translates to saving of Rs. 1020. Although the savings may not be a significant amount, the respondents opined that the drudgery, associated discomfort and respiratory issues caused by long term use of kerosene lanterns and candles have considerably decreased after using solar lanterns. Each Solar lanterns also saved around 85kg CO₂ (1liter

kerosene emits 2.5 kg CO₂) carbon emissions due to avoid using of kerosene.



Figure3: Distributed Solar Lantern with accessories

6. CONCLUSION:

The identification of the felt needs of a community and understanding user preferences play a main role in promoting any technology in the field. This study has given very clear indication that solar lighting devices are very useful to the rural communities and they are willing to pay for the devices too. Village community has used solar devices regularly for different applications. Village community can easily shift to solar lighting devices to reduce dependency on grid power. Solar energy offers green growth opportunity with co-benefits over conventional power, including savings in power, sustainability of the power source, limited dependence on polluting fuels, and assured quality power.

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