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Benefits and constraints perceived by users of solar lighting systems in rural areas

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Abstract
The present study was conducted in two villages viz. Ludas and Patan of Hisar, block II, district Hisar selected randomly, to study the benefits and constraints in use of solar lighting system in rural areas of district Hisar. A sample of 100 rural women respondents was taken randomly from the list of households having solar technologies. Data pertaining to benefits and constraints in use of solar lighting system was collected by using, duly pretested and finalized, interview schedule. It was observed that economic benefits ranked highest among all benefits with WMS of 1.91 which means that the respondents perceived the use of solar technologies as economically beneficial. Technical constraints ranked highest with WMS of 1.35, followed by situational constraints and repairing related constraints (rank II, WMS-1.20). Repairing needs ranked at the highest, followed by needs related to technical aspects and economical aspects.

Keywords: Solar lighting system, benefits, constraints

Introduction
Demand for energy has grown manifold in all sectors of Indian economy and it is expected to increase considerably in the coming years, as a result of increasing population and economic growth in India. Demand for primary commercial energy resources i.e. coal, oil and natural gas, has grown at the rate of six per cent between 1981 and 2001 (Energy Planning Commission, 2009). Per capita electricity consumption rose from merely 15.6 kW/h (kilowatt per hour) in 1950 to 592 kW/h in 2003-04. This was so because till the end of 1980s, India's energy policy was mainly based on availability of these three indigenous energy resources. The per capita energy consumption in India was 572 mtoe in 2006, while the projected energy demands for future i.e. for 2016-17, 2021-22, 2026-27 and 2031-32 are 861, 1,082, 1,417 and 1,818 mtoe, respectively (Maithani, 2009) [2].

Domestic sector is one of the largest users of energy in India, accounting for about 30 per cent of final energy consumption and reflecting the importance of this sector for energy conservation in national energy scenario (Reddy, 2003) [3]. Lighting accounts for approximately 30 per cent of total residential electricity use, followed by refrigerators, fans, electric water heaters, and TVs. Domestic sector consumed maximum energy i.e. 18 per cent, after agriculture (42.00%) and industrial sector (26.00%) in Haryana (Yadav, 2007) [4].

Presently, severe energy crisis is being felt in all sectors because of the depletion of fossil fuels and frequent increase in fuel prices. Use of solar energy is one such option which can be easily adopted by the families to supplement the existing energy use patterns for cooking, heating, and lighting. Moreover, solar energy is inexhaustible and also supplies clean energy without endangering or polluting the environment.

Ministry of Non-Conventional Energy Sources, Government of India, launched Integrated Rural Energy Programme (IREP) in the year 1986-87. The objective of this programme was to supplement the total household energy demand by using solar energy and to promote energy conservation devices at household and community level. Under this programme, several renewable energy devices like solar cooker, solar home lighting system, solar pumps, solar radio, solar lantern, solar water heating system etc. and energy conservation devices like pressure cookers, *Nutan* stoves, energy efficient motors, CFLs, tube lights were promoted by providing them at subsidized rates to the rural masses.

Government and non-government organizations are working hard motivate people for using solar energy technologies for lighting in the home. Therefore, the present study was conducted with the following specific objectives:

- Find out the benefits of using solar lighting system, as perceived by the users
- Identify the constraints in use of solar lighting system

Methodology

The present study was conducted in Hisar district of Haryana state which was randomly selected for the study. Hisar district is divided into nine blocks, out of which Hisar block II was selected randomly and the list of villages falling under this block and having solar energy programmes was obtained from Project Officer, Department of Renewable Energy. Two villages viz., *Ludas* and *Patan* were randomly selected from this list. Lists of all households having one or more type of solar lighting system were obtained for the selected villages from the Department of Renewable Energy. Fifty households having some type of solar lighting system were selected randomly from the list for each village, making a total of 100 rural households. Further, the homemaker from each selected household was taken as the respondent for collection of data. Thus, the total sample size comprised of 100 women respondents.

Interview schedule was developed in accordance with the objectives of the study to collect the data pertaining to benefits and constraints in use of solar technologies. For this, an exhaustive inventory of benefits and constraints of solar lighting system was prepared by consulting relevant literature and discussions with the experts from the Department of Renewable Energy. The interview schedule was duly pre-tested and finalized. Data were collected personally by the researcher with the help of interview schedule developed for this purpose. The data were suitably analyzed by using frequencies, percentages, WMS and ranks to draw meaning inferences.

Results and Discussion

The results of the present research have been presented under the following head:

- Perceived benefits in use of solar lighting system
- Perceived constraints in use of solar lighting system

Perceived benefits in use of solar lighting system

Perusal of the data presented in Table 1 reveals the benefits perceived by the respondents while using their solar technologies and these are discussed under the categories of economical, environmental, personal and family, and technical benefits. Under economical benefits, cent per cent respondents reported that the use of solar lighting system saved fuel, followed by majority of the respondents reporting that it saved money (97.00%), had low installment cost and is available at subsidized rates (96.00% each).

Table 1: Perceived benefits in use of solar lighting system

Sr. No.	Benefits	Solar home lighting system (n=83)		Solar lantern (n=17)		Total (n=100)	
		F (%)	WMS	F (%)	WMS	F	WMS
1.	Economic						
	Saves fuel	83 (100)	2	17 (100)	2	100	2
	Saves money	80 (96.39)	1.91	17 (100)	2	97	1.97
	Low installment cost	79 (95.18)	1.95	17 (100)	2	96	1.96
	Available at subsidized rate	79 (95.18)	1.95	17 (100)	2	96	1.96
	Low maintenance cost	72 (86.75)	1.86	8 (47.06)	1.47	80	1.80
	Saved money available for meeting other needs	64 (77.11)	1.77	15 (88.24)	1.88	79	1.79
	WMS	1.90 (Rank I)		1.89 (Rank I)		1.91 (Rank I)	
2.	Environmental						
	No harmful radiations	76 (91.57)	1.91	13 (76.47)	1.76	89	1.89
	Saves environment	70 (84.34)	1.84	15 (88.24)	1.88	85	1.85
	No carbon emission	63 (75.90)	1.75	15 (88.24)	1.88	78	1.78
	WMS	1.83 (Rank III)		1.84 (Rank II)		1.84 (Rank III)	
3.	Personal and family						
	Saves time	63 (75.90)	1.75	15 (88.24)	1.88	78	1.78
	Promotes health	83 (100)	2	17 (100)	2	100	2
	Reduce drudgery	70 (84.34)	1.84	10 (58.82)	1.58	80	1.80
	Promote family well being	64 (77.11)	1.77	11 (64.71)	1.64	75	1.75
	WMS	1.87 (Rank II)		1.82 (Rank III)		1.86 (Rank II)	
4.	Technical						
	No chances of short circuit	75 (93.75)	1.93	10 (58.82)	1.58	85	1.85
	Easy /convenient to use	83 (100)	2	17 (100)	2	100	2
	High durable	72 (86.75)	1.86	8 (47.06)	1.47	80	1.80

	Can be used outdoor in night	50 (62.5)	1.62	17 (100)	2	67	1.67
	Can be used anywhere in the house	64 (77.11)	1.77	17 (100)	2	81	1.81
	WMS	1.80 (Rank IV)		1.76 (Rank IV)		1.78 (Rank IV)	

F= frequency; %= Percentage; WMS= Weighted mean score; *= Multiple response

Majority of the respondents also reported that solar technologies had low maintenance cost (80.00%) and the money which is saved through their use is available for meeting other needs of the family (79.00%).

Table 2: Perceived constraints in use of solar lighting system

Sr. No.	Constraints*	Solar home lighting system (n=83)		Solar lantern (n=17)		Total (n=100)	
		F (%)	WMS	F (%)	WMS	F	WMS
1.	Situational						
	Seasonal use	15 (18.07)	1.18	8 (47.06)	1.47	23	1.23
	Lack of post-purchase services	11 (13.25)	1.13	7 (41.18)	1.41	18	1.18
	WMS	1.15 (Rank II)		1.44 (Rank III)		1.20 (Rank II)	
2.	Technical						
	Difficulty in care and maintenance	15 (18.07)	1.18	5 (29.41)	1.29	20	1.20
	Requires regular monitoring	41 (49.40)	1.49	7 (41.17)	1.41	48	1.48
	Less durability of construction	11 (13.25)	1.13	9 (52.94)	1.52	20	1.20
	Insufficient lighting	39 (46.99)	1.46	8 (47.06)	1.47	47	1.47
	Insufficient air flow	41 (49.40)	1.49	NA		41	1.41
	WMS	1.35 (Rank I)		1.42 (Rank IV)		1.35 (Rank I)	
3.	Economic						
	High maintenance cost	11 (13.25)	1.13	9 (52.94)	1.52	20	1.20
	Expensive repairs	8 (9.64)	1.09	7 (41.17)	1.41	15	1.15
	WMS	1.11 (Rank IV)		1.46 (Rank II)		1.17 (Rank III)	
4.	Repairing						
	Non availability of repairing facilities	11 (13.25)	1.13	9 (52.94)	1.52	20	1.20
	Non availability of spare parts	11 (13.25)	1.13	9 (92.94)	1.52	20	1.20
	WMS	1.13 (Rank III)		1.52 (Rank I)		1.20 (Rank II)	

F= frequency; %= Percentage; WMS= Weighted mean score; *= Multiple response; NA = Not applicable

On the whole, technical constraints ranked highest with WMS of 1.35, followed by situational constraints and repairing related constraints (rank II, WMS- 1.20). Economic constraints got the lowest rank (rank III) with WMS of 1.17.

Summary and conclusion

Respondents (60%) belonged to middle age group (36-45years), were married (90%), were illiterate (36%) and belonged to nuclear family (66%). Respondents belonged to middle income group i.e., Rs. 10,000-20,000 (78%), had mixed type of house (60%) and had no land (52%). They had medium mass media exposure (45%). Economic benefits ranked highest among all benefits with WMS of 1.91 which means that the respondents perceived the use of solar technologies as economically beneficial. Personal and family related benefits ranked next in order with WMS of 1.86. This was followed by environment related benefits which ranked third with WMS of 1.84. Technical benefits ranked lowest with WMS of 1.78. Technical constraints ranked highest with WMS of 1.35, followed by situational constraints and repairing related constraints (rank II, WMS- 1.20). Economic constraints got the lowest rank (rank III) with WMS of 1.17.

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