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Knowledge of energy conservation methods by rural women

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Abstract

A key element of sustainable rural development is household energy conservation. Rural women, as the principal users of domestic energy resources, play a critical role in promoting and implementing energy-saving practices. Their knowledge about energy conservation has a direct impact on fuel usage, cost savings and environmental sustainability. Common methods include using improved cookstoves, fuel-efficient cooking techniques, switching to solar illumination, reducing electricity waste and decreasing reliance on conventional biomass fuels. The study's specific objective was to study the "Knowledge of rural women about energy conservation methods" in the Hisar region of Haryana state. Four villages (Ludas, Rawalwas Khurd, Siswal and Neoli Kalan) adopted by College of Home Science under the RAWE program in recent years were purposefully chosen. To determine the gain in knowledge of rural women, both pre and post scores for knowledge were calculated and data was analyzed using the two sample 'z' test. According to the study, the majority of respondents were between the age group of 20-35 years. Majority was married & more than half lived in nuclear families. Farming was the primary family occupation. The highest gain in knowledge about energy conservation methods was found in "Buy domestic LPG cooker with star level or ISI mark" (M.S.=0.79), followed by "Lighting should be based according to the task to be done" (M.S. =0.77) and "Let the cold food extracted from the fridge come to normal temperature before cooking" (M.S.=0.75). There were substantial differences between the pre and post exposure mean scores for all aspects of the energy conservation strategies.

Keywords: Sustainable, energy conservation, knowledge gain, rural women and home science

Introduction

The world's entire process of evolution, expansion and survival depends heavily on energy. The rising energy consumption has a negative impact on the environment while also putting further strain on the government. For a developing country such as India, the energy criterion dictates the country's progress. Energy conservation refers to the reduction or elimination of wasteful or undesired energy use (Anonymous, 2024) [1]. When it comes to rising energy usage, energy conservation may be the greatest solution. Energy conservation can improve financial capital, the environment, national security, personal security and human comfort. Individuals and organisations that use energy want to conserve it in order to save money and secure economic security (Dhingra and Singh, 2009) [3]. According to the Census of India (2011) [2], women account for 48.0 percent of India's population, with 78.0 percent working in agriculture, which is the backbone of the rural Indian economy. Although women constitute just 50.0 percent of the entire population, they contribute 75.0 percent to the growth of our society, whilst men provide only 25.0 percent (Khatri *et al* 2017) [5]. For India, biomass has long been a valuable energy source. Although India's energy scenario now reflects an increasing reliance on conventional types of energy, biomass still accounts for approximately 32.0 percent of total primary energy use in the country and more than 70.0 percent of the population relies on it for energy (REN, 2009) [9].

Traditional fuel consumption has significant environmental, economic and health effects. Growing use of firewood and charcoal leads to deforestation, resulting in ecological imbalance, whereas growing use of agricultural residues and animal dung depletes the land of vital nutrients required for soil fertility. Smoke from cooking with fuel wood or dung can potentially induce acute respiratory illnesses. This latter issue, i.e. interior air pollution, is exacerbated in underdeveloped countries when households lack separate living and cooking places. Environmental problems are becoming top priorities in the business, public and government sectors. Excessive energy consumption and overexploitation of natural resources have devastated our biosphere (Gamtessa 2003) [4]. Environmental problems are becoming top priorities in the business, public and government sectors. Excessive energy consumption and overexploitation of natural resources have devastated our biosphere. It is essential to improve energy efficiency and move to renewable energy sources in order to counteract the negative consequences of higher energy consumption on the environment. Greater energy efficiency is regarded as an important means of achieving the global goal of reducing

energy consumption and combating climate change and it could be accomplished through improved and faster dissemination of energy-efficient units. CO_2 emissions and the use of fossil fuels may be decreased with increased energy efficiency (Mills and Schleich, 2013) [7].

In many developing nations, such as India, rural women frequently rely on traditional energy sources, such as biomass fuels and inefficient appliances, which contribute to indoor air pollution, energy waste and health risks. Lack of understanding, restricted access to current technologies and low reading levels impede their capacity to adopt energy-efficient practices. Promoting awareness of energy-saving methods, such as the use of pressure cookers, solar lights, improved cookstoves, star-rated appliances and efficient lighting systems, can help reduce household energy costs and environmental impact while also contributing to women's empowerment and climate resilience (Kumar & Bhattacharya, 2018) [6].

Objectives of the study

1. To study the knowledge of rural women about energy conservation methods
2. To impart knowledge about energy conservation methods and find out the gain in knowledge of respondents

Materials and Methods

The study was carried out in the Hisar area of Haryana. Four villages (Ludas, Rawalwas Khurd, Siswal, and Neoli Kalan) adopted by the College of Home Science under the RAWE program in recent years were purposefully chosen from Hisar district to investigate rural women's prior knowledge of energy conservation practices. A random selection of fifty responders was made from each community. Thus, the overall sample size was 200. Knowledge regarding ways to conserve energy was conveyed to 100 rural respondents (25 from each village) who demonstrated curiosity and willingness to learn. In line with the study's goals, a pretested interview schedule was created. The interview schedule included questions about respondents' backgrounds as well as enquiries about their prior understanding of energy conservation strategies. Objective II was to impart knowledge to 100 rural responders (25 from each village) about energy conservation methods. Knowledge was disseminated through print media that cited relevant publications. The gain in knowledge was measured after 30 days of imparting knowledge to 100 rural respondents. The acquired data was processed, tabulated and analyzed using frequency, percentages, weighted mean score and the two-sample 'z' test.

Results and Discussion

Personal and socio-economic profile of the respondents:

The respondents were mostly young, with nearly 60.0 percent in the age group of 20-35 years. An overwhelming majority was married and about two - fifths belonged to the scheduled caste category. More than half of the families were nuclear in nature, with family size largely between 5-7 members. Education attainment varied, but nearly 28.0 percent had completed education up to senior secondary. Two- thirds of the respondents were housewives, while farming remained the secondary source of engagement. At household level, private service and labour were the major family occupations, with nearly three-fourths of the families earning below Rs. 25000 per month.

Table 1: Gain in knowledge regarding energy conservation methods during cooking (n=100)

S. No.	Energy conservation methods during cooking	Knowledge (mean score)			
		Pre-knowledge	Post-knowledge	Gain in knowledge	z- value
1.	Do not leave the stove burning while vegetables are being chopped or rice is being washed	1.33	2.00	0.67	14.17**
2.	Never put a wet utensil on the fire	1.27	2.00	0.73	16.36**
3.	Keep quantity of cooking water to the Minimum	1.50	2.00	0.50	9.94**
4.	Food is cooked faster in pressure cooker	1.65	2.00	0.35	7.30**
5.	Cover the utensil with a lid to speed up the cooking process	1.26	2.00	0.74	16.78**
6.	Do not cook continuously on a high flame	1.63	2.00	0.37	7.62**
7.	Do not keep too small vessel on too large flame	1.43	2.00	0.57	11.45**
8.	Use wide shallow vessels to cover the entire flame	1.76	2.00	0.24	5.59**
9.	Do not use a utensil that is too large for your requirements	1.61	2.00	0.39	7.95**
10.	Reduce the flame once the food reaches the boiling point/ temperature	1.84	2.00	0.16	4.72*
11.	Always soak rice, cereals and other pulses before cooking	1.32	2.00	0.68	14.50**
12.	Keep the gas burner clean	1.68	2.00	0.32	6.82**
13.	Buy domestic LPG stove with star level or ISI mark	1.21	2.00	0.79	19.29**

*Significant at 5% level of significance

**Significant at 1% level of significance

Table 1 shows the pre and post-training knowledge levels of rural women regarding various energy conservation methods used during cooking, the statement "Buy domestic LPG cooker with star level or ISI mark" had the largest knowledge gain of any approach, with a mean score of 0.79 and a very significant z-value of 19.29. This was closely followed by "Cover the utensil with a lid to speed up the cooking process" (M.S. = 0.74, 'z' = 16.78) and "Never put a wet utensil on the fire" (M.S. = 0.73, 'z' = 16.36), all of which showed highly significant improvement. The lowest gain in knowledge was noted for "Reduce the flame once the food reaches the boiling point/ temperature" (M.S.=0.16) which was significant at 5 percent level of significance.

Table 2: Gain in knowledge of energy conservation methods regarding home lighting (n=100)

S. No.	Energy conservation methods regarding home lighting	Knowledge (mean score)			
		Pre-knowledge	Post-knowledge	Gain in knowledge	z- value
1.	Keep windows and doors open, so that sunlight can be used	1.77	2.00	0.23	5.51*
2.	Always turn off lights during the day and use daylight as much as possible	1.85	2.00	0.15	4.74*
3.	Use light colours on walls, furnishings etc.	1.26	2.00	0.74	16.78**
4.	Lighting should be installed according to the task to be done	1.23	2.00	0.77	18.20**
5.	Using CFLs or LEDs instead of ordinary bulbs saves energy	1.42	2.00	0.58	11.69**
6.	Electronic choke should be used in tube light instead of traditional choke	1.14	1.90	0.76	17.70**
7.	Table lamps or solar lanterns should be used at the place of work	1.25	2.00	0.75	17.23**
8.	Dirty bulbs and tube lights reduce illumination, so keep them clean.	1.35	2.00	0.65	13.55**
9.	Bulb fixed outside the house should be of low wattage	1.25	2.00	0.75	17.23**

*Significant at 5% level of significance
**Significant at 1% level of significance

Table 2 presents the pre and post-knowledge scores of rural women on various energy conservation practices related to home lighting, following an awareness intervention conducted through print media. The data revealed a marked increase in knowledge across all suggested practices, with statistically significant improvements, as indicated by the z-values. Among the listed methods, the highest gain in knowledge was observed for the practice "Lighting should be installed according to the task to be done", with a mean score of 0.77 and a highly significant z-value of 18.20. Similarly, high gains were noted for: "Electronic choke should be used in tube light instead of traditional choke" (M.S. = 0.76, 'z' = 17.70), "Table lamps or solar lanterns should be used at the place of work" (M.S. = 0.75, 'z' = 17.23), "Bulb fixed outside the house should be of low wattage" (M.S. = 0.75, 'z' = 17.23) and "Use light colours on walls, furnishings etc." (M.S. = 0.74, 'z' = 16.78). These findings highlight that women were less aware of technical and design-based energy-saving methods at pre exposure stage, but responded positively when exposed to print-based educational material. The minimum gain in knowledge was found regarding "Always turn off lights during the day and use daylight as much as possible" (M.S.=0.15) which was significant at 5 percent level of significance. Overall, the findings shows that print media were quite effective in raising knowledge of energy conservation in household lighting among rural women. The constant advances, notably in technical elements of energy conservation, highlight the importance of low-cost, literacy-sensitive communication approaches for encouraging sustainable home practices in rural areas.

Table 3: Gain in knowledge regarding energy conservation methods while using refrigerator (n=100)

S. No.	Energy conservation methods while using refrigerator (non-automatic)	Knowledge (mean score)			
		Pre-knowledge	Post-knowledge	Gain in knowledge	z- value
1.	Let the food cool enough to room temperature before putting it in the refrigerator	1.39	2.00	0.61	12.44**
2.	Cover all food items before putting them into the refrigerator	1.33	2.00	0.67	14.17**
3.	Let the cold food extracted from the fridge come to normal temperature before cooking	1.25	2.00	0.75	17.23**
4.	Do not keep hot items inside the refrigerator	1.34	2.00	0.66	13.86**
5.	Refrigerator should be kept in a cool place away from a hot place	1.36	2.00	0.64	13.26**
6.	Make sure that rubber door seals are clean and tight	1.35	2.00	0.65	13.55**
7.	Defrost refrigerator regularly	1.23	1.88	0.65	13.55**
8.	The condenser coil of the refrigerator should be kept away from the wall so that it gets enough air to cool down	1.37	2.00	0.63	12.98**
9.	Clean the condenser coils 3-4 times a year	1.32	2.00	0.68	14.50**
10.	Switch off the refrigerator when cleaning the coils	1.49	2.00	0.51	10.15**
11.	Do not open the door of the refrigerator Frequently	1.82	2.00	0.18	4.12*

**Significant at 1% level of significance
*Significant at 5% level of significance

The data in table 3 shows the pre and post-knowledge scores of rural women who were exposed to print media-based teaching materials about energy-saving techniques when using a non-automatic refrigerator. All items indicate statistically significant increases in knowledge, demonstrating that printed communication is helpful at boosting awareness of energy-efficient refrigerator usage. The maximum gain in knowledge of respondents was found about "Let the cold food extracted from the fridge come to normal temperature before cooking" (M.S.=0.75) which was statistically highly significant ('z'=17.23) followed by "Clean the condenser coils 3-4 times a year" (M.S.=0.68) and "Cover all food items before putting them into the refrigerator" (M.S.=0.67); 'z' values for these aspects were significant at 1 percent level of significance. These findings indicate that many respondents were previously not aware of important operating and maintenance measures that have a major impact on refrigerator efficiency and energy consumption. Minimum gain in knowledge was found regarding "Do not open the door of the refrigerator frequently" (M.S.=0.18, 'z'= 4.12) which was significant at 5 percent level of significance. Overall, the findings showed

that print media was a very successful medium for transmitting knowledge about energy conservation when using refrigerators. The most substantial increase were linked to technical and maintenance-related behaviours, which are frequently disregarded but have a strong potential for increasing energy efficiency in rural families.

Table 4: Gain in knowledge regarding energy conservation methods while using electric iron (n=100)

S. No.	Energy conservation methods while using electric iron	Knowledge (mean score)			
		Pre-knowledge	Post- knowledge	Gain in knowledge	z- value
1.	Use appropriate regulator position for Ironing	1.55	2.00	0.45	9.00**
2.	Do not put more water on clothes while ironing	1.48	2.00	0.52	10.35**
3.	Iron the clothes weekly instead of few clothes everyday	1.25	2.00	0.75	17.23**
4.	Switch off the iron just before finishing last cloth	1.35	2.00	0.65	13.55**

**Significant at 1% level of significance

Table 4 presents the knowledge regarding energy conservation methods while using electric iron. The data depicts that maximum gain in knowledge of respondents was observed for the practice "Iron the clothes weekly instead of few clothes everyday" with a mean score of 0.75 and 'z' value of 17.23, which was statistically highly significant followed by "Switch off the iron just before finishing last cloth" (M.S.=0.65) and "Do not put more water on clothes while ironing" (M.S.=0.52); 'z' values for these aspects were significant at 1 percent level of significance. Minimum gain in knowledge was found regarding "Use appropriate regulator position for ironing" (M.S.=0.45) which was highly significant at 1 percent level of significance. These results suggest that although there was a fundamental understanding of how much energy was spent during ironing, the print materials were more effective in conveying certain useful and efficiency-focused approaches. Overall, the findings suggest that print media was an effective strategy for increasing rural women's understanding of energy conservation techniques related to everyday items such as electric irons. The knowledge aided in the implementation of simple but effective behavioral modifications that can result in lower energy use in rural homes.

Table 5: Gain in knowledge regarding energy conservation methods while using washing machine (n=100)

S. No.	Energy conservation methods while using washing machine	Knowledge (mean score)			
		Pre-knowledge	Post-knowledge	Gain in knowledge	z-value
1.	Use water according to size of load	1.39	2.00	0.61	12.44**
2.	Clean the lint filter of the washer after every use	1.53	2.00	0.47	9.36**
3.	Use timer facility to save energy	1.48	2.00	0.52	10.35**
4.	Always use cold water in the rinse cycle	1.28	2.00	0.72	15.95**
5.	Natural drying should be preferred over electric dryers in washing machine	1.26	2.00	0.74	16.78**

**Significant at 1% level of significance

Table 5 summarizes the pre and post-knowledge levels of rural women regarding energy-saving practices while using washing machines, after imparting the knowledge. The maximum gain in knowledge of respondents was found about "Natural drying should be preferred over electric dryers in washing machine" (M.S.=0.74) which was statistically highly significant ('z'=16.78) followed by "Always use cold water in the rinse cycle" (M.S.=0.72) and "Use water according to size of load" (M.S.=0.61); 'z' values for these aspects were significant at 1 percent level of significance. Minimum gain in knowledge was found regarding "Clean the lint filter of the washer each time you use it" (M.S.=0.47) which was highly significant at 1 percent level of significance. Overall, the findings indicated that print media was an effective medium for raising rural women's knowledge of the energy-efficient usage of home appliances such as washing machines. The techniques emphasized not only energy conservation, but also resource optimization, which is crucial in low-resource rural areas.

Table 6: Gain in knowledge regarding energy conservation methods while using electric geyser/ water heater (n=100)

S. No.	Energy conservation methods while using electric geyser/water heater	Knowledge (mean score)			
		Pre- knowledge	Post- knowledge	Gain in knowledge	z- value
1.	Geyser should be switched off for long unused hours	1.30	2.00	0.70	15.19**
2.	Set the thermostat of the geyser at a lower setting	1.35	1.90	0.55	13.55**
3.	Buy the electric geyser with a thick insulation on the shell	1.28	1.82	0.54	12.15**
4.	Provide thermal insulation on hot water pipes to reduce heat loss	1.34	1.85	0.51	11.86**

**Significant at 1% level of significance

Table 6 presents the pre and post-knowledge scores of rural women regarding energy-saving practices related to the use of electric geysers/water heaters, following print media-based knowledge dissemination. The results indicate statistically significant improvements in knowledge across all listed practices. The data shows that maximum gain in knowledge of respondents was found about "Geyser should be switched off for long unused hours" (M.S.=0.70) which

was statistically highly significant ('z'=15.19) followed by "Set the thermostat of the geyser at a lower setting" (M.S.=0.55) and "Buy the electric geyser with a thick insulation on the shell" (M.S.=0.54); 'z' values for these aspects were significant at 1 percent level of significance. Minimum gain in knowledge was found regarding "Provide thermal insulation on hot water pipes to reduce heat loss" (M.S.=0.51) which was highly significant at 1 percent level of significance. These activities, particularly those involving insulation and thermostat adjustment, demonstrate technical energy-saving knowledge that was likely unknown prior to the imparting the knowledge but significantly enhanced afterward. Overall, the data suggest that print media was an effective strategy for raising knowledge about energy conservation strategies in water heating. The increased understanding, particularly of efficiency-oriented appliance selection and consumption behaviour, emphasizes the necessity of targeted visual communication in motivating rural women to embrace sustainable energy practices in their daily lives.

Table 7: Gain in knowledge regarding general energy conservation methods (n=100)

S. No.	General points regarding energy conservation methods	Knowledge (mean score)			
		Pre-knowledge	Post-knowledge	Gain in knowledge	z- value
1.	Electronic regulators for fans should be used instead of electric regulators	1.20	2.00	0.80	19.78**
2.	Use solar energy equipments as much as Possible	1.26	2.00	0.74	16.78**
3.	Always switch off fans, light and other electric devices when you go outside	1.94	2.00	0.06	2.51*
4.	Unplug the electrical equipment when not required.	1.35	2.00	0.65	13.55**
5.	Stop using old electric appliances because these consume more power than today's modern appliances.	1.18	2.00	0.82	21.23**
6.	Purchase electrical appliances of higher star rating endorsed by 'Bureau of Energy Efficiency (BEE)'.	1.25	2.00	0.75	17.23**

*Significant at 5% level of significance
**Significant at 1% level of significance

The table 7 displays the pre and post-knowledge levels of rural women on general energy conservation practices after imparting the knowledge. The results demonstrate that awareness of all general energy-saving points has increased statistically significantly, confirming the efficacy of this low-cost communication approach. The highest gain in knowledge of respondents was found about "Stop using old electric appliances because these consume more power than today's modern appliances" (M.S.=0.82) which was statistically highly significant ('z'=21.23) followed by "Electronic regulators for fans should be used instead of electric regulators" (M.S.=0.80) and "Purchase electrical appliances of higher star rating endorsed by 'Bureau of Energy Efficiency (BEE)" (M.S.=0.75); 'z' values for these aspects were significant at 1 percent level of significance. Lowest gain in knowledge was found regarding "Always switch off fans, light and other electric devices when you go outside" (M.S.=0.06) which was highly significant at 5 percent level of significance. Finally, the table shows that print media was helpful in teaching general energy-saving information to rural women, particularly in areas such as modern appliances, energy rating awareness, and the utilization of renewable energy sources. Such experiences are critical for establishing long-term energy-efficient behaviors in rural homes.

Summary and Conclusion

The study concluded that the respondents were predominantly young and married, representing a balanced mix of caste groups with a considerable portion belonging to the schedule caste category. More than half live in nuclear families with medium sized households comprising 5 -7 members. The educational status of respondents indicated a fair level of literacy with a large share educated up to the secondary and higher secondary levels. Most respondents were housewives while farming constituted a major occupational engagement. At the household level, labour and private service were the main source of livelihood and a majority of families had a monthly income below rupees 25,000 indicating a modest economic background. The data was collected across multiple functional domains: cooking, lighting, refrigerator use, electric iron, washing machine, electric geyser and general points on energy conservation. In case of cooking, the maximum gain in knowledge was found about "Buy domestic LPG stove with star level or ISI mark" (M.S.=0.79). In case of home lighting, the maximum gain in knowledge was found about "Lighting should be based according to the task to be done" (M.S. =0.77). In case of using refrigerator, the maximum gain in knowledge was found about "Let the cold food extracted from the fridge come to normal temperature before cooking" (M.S.=0.75). In case of using electric iron, the maximum gain in knowledge was found about "Iron the clothes weekly instead of few clothes everyday" (M.S.=0.75). In case of using washing machine, the maximum gain in knowledge was found about "Natural drying should be preferred over electric dryers in washing machine" (M.S.=0.74). In case of using electric geyser/water heater, the maximum gain in knowledge was found about "Geyser should be switched off for long unused hours" (M.S.=0.70). Regarding the general energy conservation methods, the maximum gain in knowledge was found about "Stop using old electric appliances because these consume more power than today's modern appliances." (M.S.=0.82). The statistically substantial increases in knowledge across all categories establish the methodology as a low-cost, scalable and effective method for promoting rural energy literacy. The most significant benefits were seen in previously unknown technical and efficiency-oriented behaviors. On the other hand, previously recognized habits (such as turning off lights) showed moderate increases, indicating that the material effectively addressed knowledge gaps. This research emphasizes the importance of targeted educational communication, particularly visual and printed media, in

motivating rural women to adopt sustainable and energy-efficient practices that benefit both the household economics and the environment.

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