AJES
ASIAN JOURNAL OF ENVIRONMENTAL SCIENCE ■ VOLUME 7 | ISSUE 2 | DECEMBER, 2012 | 146-151

RESEARCH ARTICLE

# Rural women's access to science and technology in the context of energy

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**Article Chronicle :**
***Received* :**
*30.05.2012;*
***Revised* :**
*18.08.2012;*
***Accepted* :**
*25.09.2012*

**SUMMARY :** It has been reported that even after the sixty five years of independence too many difficulties are faced by rural women. Science and technology solve all the challenges faced by rural women including labour-saving technologies related to domestic work such as, improved cooking technologies, lighting etc. Keeping this in view, a study was conducted in two villages namely, Achitpur and Chhota Mirzapur Khurd of Jamalpur Block of Mirzapur district to find out the association/relationship of personal and socio-economic characteristics of respondents with their knowledge of non-conventional energy sources.

**HOW TO CITE THIS ARTICLE :** Ahmed, Farida and Bishnoi, Indira (2012). Rural women's access to science and technology in the context of energy. *Asian J. Environ. Sci.,* **7** (2): 146-151.

**Key Words :**
Socio-economic charactertics, Rural women, Solar cooker, Solar lantern, Smokeless chulah

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Science and technology (S and T) is a broad term that is in a continual process of reinvention. Many of the S and T break throughs of 20 or 30 years ago are part of everyday life today. In rural area of developing countries like India, there are a large number of people who do not have access to LPG and depend on traditional biomass such as wood, crop, and dung for cooking and kerosene for lighting (Kanagawa and Nakata, 2007). Science and technology offers solutions too many challenges faced by rural women including labour-saving technologies related to domestic work such as, improved cooking technologies, lighting etc.

Today India has been experiencing a gradual shift towards exploring renewable energy resources as a driving force for rural development. The lessons learnt from different demonstrations of RET projects reveal that with careful forward planning, non-conventional energy can provide far-reaching economic, environmental and social benefits to people living in remote rural areas (Mondal *et al.,* 2010). In view of above, present study was undertaken with the objectives to know the socio-economic characteristics of the respondents, to find out the extent of knowledge among respondents about different non-conventional energy sources before and after the training and to find out the association/ relationship of personal and socio-economic characteristics of respondents with their knowledge of non-conventional energy sources.

## EXPERIMENTAL METHODOLOGY

For the study, total 125 rural women (16 per cent of the total household) were selected randomly from the two villages Achitpur and Chhota Mirzapur Khurd of Jamalpur Block of Mirzapur district of Uttar Pradesh. Seven days repeated demonstrations and trainings were given on the use of solar cooker, solar lantern, smokeless fuel efficient stove to the female respondents to make them aware of these new appliances. In the gap of one week, repeated demonstrations and trainings (five times) were given to the one twenty five respondents at the selected study area. During training, rural women were prepared different dishes like various varieties of rice, dal, vegetables and boiled eggs, kheer and roasted peanuts, chickpea (gram) etc. on solar cooker. They enjoyed solar lantern for lighting at night. Two smokeless fuel efficient stoves each in Achitpur and Chhota Mirzapur 'Khurd' villages were installed for demonstration and training of rural women respondents who cooked their

meals on these stoves. The use of smokeless chulah saves firewood consumption, saves trees and the time can be utilized in other productive activities. When these solar cookers and solar lanterns were taken back, the attitudes of the female respondents who used these devices were studied.

Several questions were formed to assess their level of knowledge about the non-conventional energy appliances and these questions were scored. After adding the total scores, the comparisons about level of knowledge of respondents were made with respect to various socio-economic and demographic characteristics. Various statistical tests such as chi-square test, t-test, F-test, one-way ANOVA and multivariate analysis were utilized to test for association between the socio-economic and demographic and other important variables with the various levels of confidence set as $p<0.05$, 0.01 and 0.001 for all type of analysis.

## EXPERIMENTAL FINDINGS AND DISCUSSION

It is evident from Table 1 that 45.6 per cent of the respondents were of younger age group where as 28.8 per cent and 25.6 per cent were of middle age and above middle age group, respectively. It has been observed that economic activities were being taken by majority of young age rural women. The average age and standard deviation of the respondents was 38.90 years and 11.97 years, respectively.

Maximum respondents (55.0%) belonged to OBC (other backward caste) category followed by 37.0 per cent respondents were of SC/ST (schedule caste and schedule tribe) and remaining 8.0 per cent respondents were of the caste of other category. It can be inferred from the above findings that in social system OBC have been dominating.

The majorities of respondents (66.4%) were illiterate. The respondents who educated upto primary, middle, high school and intermediate were 16.0 per cent, 11.2 per cent, 2.4 per cent and 1.6 per cent, respectively. Higher educated respondents as graduate and post graduate were 1.6 per cent and 0.8 per cent, respectively.

The majority of the respondents were illiterate only 33.6

**Table 1: Distribution of the respondents according to their socio-economic characteristics** **(n=125)**

| Socio-economic characteristics | Frequency | Percentage (%) |
|---|---|---|
| **Age group (years)** | | |
| ≤35 | 57 | 45.6 |
| 36-45 | 36 | 28.8 |
| > 45 | 32 | 25.6 |
| Average age ± SD =38.90 ±11.97 | | |
| **Caste** | | |
| SC/ST | 46 | 37.0 |
| OBC | 69 | 55.0 |
| Others | 10 | 8.0 |
| **Literacy** | | |
| Illiterate | 83 | 66.4 |
| Literate | 42 | 33.6 |
| **Total family annual income (Rs.)** | | |
| ≤ 20,000 | 66 | 52.8 |
| 20,000-40,000 | 39 | 31.2 |
| > 40,000 | 20 | 16.0 |
| Average family annual income ± SD = 28,604.00 ± 24,414.10 | (Rs. 9,600 to 1,10,000) | |
| **Family type** | | |
| Nuclear | 81 | 64.8 |
| Joint | 44 | 35.2 |

**Table 2: Average (± SD) level of knowledge of the respondents about various non-conventional energy sources before and after the training**

| Sr. No. | Items | Before training | | After training | | Value of *t* | *df* | P | *r* |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | | | | |
| 1. | Solar cooker | - | - | 15.35 | 2.89 | 59.42 | 124 | <0.001 | - |
| 2. | Smokeless chulah | 3.67 | 5.01 | 16.23 | 1.71 | 26.81 | 124 | <0.001 | 0.033 |
| 3. | Solar lantern | 1.69 | 2.92 | 8.17 | 1.56 | 24.33 | 124 | <0.001 | ** 0.233 |

per cent respondents were literate which is combined together for comparison purposes. It may be concluded that the female literacy rate in the study area was very low. Similar comments were also given by Prasad *et al*. (2009).

More than half (52.8%) of respondents had family annual income below Rs. 20,000 followed by 31.2 per cent in family annual income of Rs. 20,000-40,000 and rest 16.0 per cent respondents had more than Rs. 40,000 as family annual income. The average family annual income and standard deviation of the respondent's household was Rs. 28,604.00 and Rs. 24,414.10, respectively. The trend shows that in study area, economic status of the people was very poor. Parikh and Laxmi (2000) have also stated poor economic condition of rural people in their study done at Tamil Naidu. Basic reason of poverty in the present study area was found large population growth.

Majority of respondents (64.8%) belonged to nuclear family and rest 35.2 per cent respondents were from joint family. It shows that the family structure trends moving from joint to nuclear family in rural areas too.

Table 2 depicts about the average level of knowledge of the respondents about various types of non-conventional energy appliances before and after the training. It indicates that nobody knows about solar cooker before training in the study area. After providing training about solar cooker, the average level of knowledge score increased to 15.35 with Standard Deviation 2.89 and this difference was found to be statistically highly significant. Somehow, the average knowledge of the subjects about solar lantern as well as smokeless chulah (fuel-efficient stove) was (1.69 ± 2.92) and (3.67 ± 5.01) at the initial stage and it was increased up to (8.17 ± 1.56) and (16.23 ± 1.71), respectively after training. The differences in average level of knowledge regarding solar lantern and smokeless chulah between before and after training were found to be statistically highly significant. It shows that the rural females were more conscious for getting knowledge about various non-conventional energy appliances.

Table 3 depicts about average (± SD) level of knowledge of the respondents about various non-conventional energy sources, time and energy saving household appliances before and after the training with their socio-economic and demographic characteristics. It was found that the respondents did not know about solar cooker at the initial stage. After providing some training, the knowledge acquired by the various respondents increased maximum (16.63 ± 2.83) in younger age group and minimum (13.19 ± 2.57) in the age group of more than 45 years. The pattern of average level of knowledge was found to be in decreasing as age advanced. The levels of knowledge in all the respondents increased significantly at 0.001 level of significance.

Caste was also an important factor which affected the level of knowledge in the study area so the level of knowledge about solar cooker was evaluated according to the caste of

**Table 3: Association of level of knowledge of the respondents about solar cooker before and after the training with their socio-economic characteristics**

| Sr. No. | Variables | Before training | | After training | | Value of *t* | *df* | P | *r* |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | | | | |
| **Age (years)** | | | | | | | | | |
| 1. | ≤35 | - | - | 16.63 | 2.83 | 44.33 | 56 | <0.001 | - |
| 2. | 36-45 | - | - | 15.25 | 1.98 | 46.29 | 35 | <0.001 | - |
| 3. | > 46 | - | - | 13.19 | 2.57 | 29.01 | 31 | <0.001 | - |
| **Caste** | | | | | | | | | |
| 1. | SC/ST | - | - | 14.85 | 2.41 | 41.74 | 45 | <0.001 | - |
| 2. | OBC | - | - | 15.32 | 3.00 | 42.38 | 68 | <0.001 | - |
| 3. | Others | - | - | 17.90 | 3.03 | 18.65 | 9 | <0.001 | - |
| **Literacy** | | | | | | | | | |
| 1. | Illiterate | - | - | 13.89 | 1.85 | 68.24 | 82 | <0.001 | - |
| 2. | Literate | - | - | 18.23 | 2.35 | 50.38 | 41 | <0.001 | - |
| **Family annual income (Rs.)** | | | | | | | | | |
| 1. | ≤ 20000 | - | - | 14.39 | 2.31 | 50.41 | 65 | <0.001 | - |
| 2. | 20000-40000 | - | - | 15.28 | 2.65 | 36.08 | 38 | <0.001 | - |
| 3. | > 40000 | - | - | 18.65 | 2.72 | 30.67 | 19 | <0.001 | - |
| **Family type** | | | | | | | | | |
| 1. | Nuclear | - | - | 15.46 | 2.73 | 51.00 | 80 | <0.001 | - |
| 2. | Joint | - | - | 15.14 | 3.18 | 31.56 | 43 | <0.001 | - |

the subjects which showed that the level of knowledge was minimum (14.85 ± 2.41) in SC/ST where as it was maximum (17.90 ± 3.03) in other type of caste after training. In the entire caste group the average increase in the level of knowledge was found to be highly significant as compared before training till after training.

The level of knowledge regarding solar cooker was also assessed according to the literacy status which indicated that the literate female respondents acquired more level of knowledge (18.23 ± 2.35) in comparison to the illiterate respondents (13.89 ± 1.85). The difference in average level of knowledge for the literacy status (illiterate and literate) between before and after training was found to be statistically highly significant.

Economic status of the respondents affects their knowledge, educational status as well as standard of living so the level of knowledge of respondents was also evaluated which reflects that the awareness gained by those respondents who were from higher income group in that locality, was maximum (18.65 ± 2.72) and minimum (14.39 ± 2.31) in those respondents who were from lower income group. The average increase in the level of knowledge about solar cooker of respondents for all the economic groups was found to be statistically highly significant. It was also observed that trend of gaining knowledge was in increasing pattern as income group was increased *i.e.* gaining of knowledge was directly associated with the economic status of respondents.

The level of knowledge was also evaluated according to family type because it is a good indication of socio-economic status. It was found that the level of knowledge gained by the respondents of nuclear family was more (15.46 ± 2.73) in comparison to the respondents of joint family (15.14 ± 3.16). The differences in average level of knowledge for both the respondents of nuclear and joint family were found to be highly significant.

Table 4 reveals that the average level of knowledge of respondents was more at initial stage of the age group (36-45) years where as the awareness gained after training was more in younger age group of respondents. It indicates that the level of acquired knowledge was in decreasing pattern at age advanced after training. The average level of knowledge increased about solar lantern in all the stated age groups was found to be statistically highly significant from initial period to after training. A positive correlation was observed between the level of knowledge before and after training for all groups of female respondents which was significant only for the age group of ≤35 years of females.

According to caste wise distribution of level of knowledge about solar lantern of respondents reveals that the average knowledge was more (5.40 ± 2.87) in other type of caste in comparison to OBC and SC/ST at the time of survey where as after providing training, the awareness gained by the respondents of other caste was maximum (8.80 ± 2.30) and minimum (7.89 ± 0.71) in the respondents of SC/ST caste,

**Table 4: Association of level of knowledge of the respondents about solar lantern before and after the training with their socio-economic characteristics**

| Sr. No. | Variables | Before training | | After training | | Value of *t* | *df* | P | *r* |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | | | | |
| **Age (years)** | | | | | | | | | |
| 1. | ≤ 35 | 1.75 | 3.01 | 8.54 | 2.10 | 16.96 | 56 | <0.001 | 0.35** |
| 2. | 36-45 | 2.03 | 3.12 | 7.92 | 0.77 | 11.09 | 35 | <0.001 | 0.04 |
| 3. | > 46 | 1.19 | 2.52 | 7.78 | 0.79 | 14.21 | 31 | <0.001 | 0.02 |
| **Caste** | | | | | | | | | |
| 1. | SC/ST | 0.78 | 2.04 | 7.89 | 0.74 | 24.07 | 45 | <0.001 | 0.24 |
| 2. | OBC | 1.75 | 3.02 | 8.26 | 1.81 | 16.71 | 68 | <0.001 | 0.18 |
| 3. | Others | 5.40 | 2.87 | 8.80 | 2.30 | 3.32 | 9 | <0.001 | 0.23 |
| **Literacy** | | | | | | | | | |
| 1. | Illiterate | 1.13 | 2.43 | 7.66 | 0.67 | 23.65 | 82 | <0.001 | 0.01 |
| 2. | Literate | 2.79 | 3.48 | 9.17 | 2.22 | 10.99 | 41 | <0.001 | 0.19 |
| **Family annual income (Rs.)** | | | | | | | | | |
| 1. | ≤ 20000 | 1.18 | 2.55 | 7.74 | 0.73 | 20.76 | 65 | <0.001 | 0.13 |
| 2. | 20000-40000 | 1.72 | 2.78 | 8.02 | 0.90 | 13.44 | 38 | <0.001 | -0.01 |
| **Family type** | | | | | | | | | |
| 1. | Nuclear | 1.29 | 2.63 | 8.16 | 1.64 | 22.81 | 80 | <0.001 | 0.26* |
| 2. | Joint | 2.44 | 3.29 | 8.18 | 1.42 | 11.48 | 43 | <0.001 | 0.20 |

respectively. The average level of knowledge increased in all the caste groups between before and after training was highly significant. A positive correlation co-efficient was found between level of knowledge of respondents in before and after training but not significant way.

The literate respondents had more average level of knowledge (2.79 ± 3.84) and (9.17 ± 2.22) in comparison to illiterate respondents who have average level of knowledge (1.13 ± 2.43) and (7.66 ± 0.67) before and after training, respectively. The differences in average level of knowledge for both the literacy status groups between before and after training were found to be highly significant. There were positive correlations between levels of knowledge before and after training but these correlation co-efficients were not significant.

Higher income group's respondents had maximum average level of knowledge (3.30 ± 3.79) and (9.85 ± 2.96) while lower income group respondents had minimum level of knowledge (1.18 ± 2.55) and (7.74 ± 0.73) during initial period and after training, respectively. The average increase in level of knowledge about solar lantern in all the group of economic status was found to be highly significant. Positive correlation co-efficient was observed between level of knowledge in all the economic status groups before and after training except the middle income group in which negative correlation but not significant was observed.

The respondents of joint family had more level of knowledge regarding solar lantern in comparison to the respondents of nuclear family both in before and after training. Statistically, it was observed that the differences in the average level of knowledge of the respondents before and after training were found to be highly significant in both type of family. A significant positive correlation was found in the respondents of nuclear family while positive but insignificant correlation was found in joint family respondents.

Table 5 describes that the old age group female respondents had maximum average level of knowledge about smokeless chulah in comparison to the respondents of other two age groups at the time of survey where as it was just reverse after training *i.e.* younger age group female respondents gained maximum awareness in comparison to two other age groups, respectively. It indicates that before training, the average level of knowledge was in increasing pattern and after training; it was in decreasing pattern as age advanced. The average increment in the level of knowledge in all age groups of respondents between before and after training was found to be statistically significant at 0.001 level of significance. An insignificant negative correlation was observed in the respondents of younger age group while insignificant positive correlation in remaining both the age groups between the awareness at the initial stage and after training.

Likewise the knowledge about other appliances, the average level of knowledge of the respondents about smokeless chulah had more knowledge in comparison to the

**Table 5: Association of level of knowledge of the respondents about smokeless chulah before and after the training with their socio-economic characteristics**

| Sr. No. | Variables | Before training | | After training | | Value of *t* | *df* | P | *r* |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | | | | |
| **Age (years)** | | | | | | | | | |
| 1. | ≤ 35 | 3.09 | 4.85 | 16.60 | 1.49 | 19.68 | 56 | <0.001 | -0.07 |
| 2. | 36-45 | 3.17 | 4.90 | 16.53 | 1.46 | 17.00 | 35 | <0.001 | 0.27 |
| 3. | > 46 | 5.28 | 5.20 | 15.25 | 1.98 | 10.89 | 31 | <0.001 | 0.20 |
| **Caste** | | | | | | | | | |
| 1. | SC/ST | 2.02 | 3.74 | 16.04 | 1.53 | 22.65 | 45 | <0.001 | -0.11 |
| 2. | OBC | 4.01 | 5.23 | 16.23 | 1.79 | 18.18 | 68 | <0.001 | -0.03 |
| 3. | Others | 8.90 | 4.77 | 17.10 | 1.85 | 5.56 | 9 | <0.001 | 0.25 |
| **Literacy** | | | | | | | | | |
| 1. | Illiterate | 2.55 | 4.33 | 15.94 | 1.68 | 25.32 | 82 | <0.001 | -0.11 |
| 2. | Literate | 5.88 | 5.55 | 16.81 | 1.64 | 12.4 | 41 | <0.001 | 0.06 |
| **Family annual income (Rs.)** | | | | | | | | | |
| 1. | ≤ 20000 | 2.39 | 4.13 | 16.06 | 1.73 | 22.69 | 65 | <0.001 | -0.27 |
| 2. | 20000-40000 | 2.33 | 4.39 | 16.10 | 1.48 | 19.61 | 38 | <0.001 | 0.18* |
| 3. | > 40000 | 10.50 | 2.89 | 17.05 | 1.93 | 7.99 | 19 | <0.001 | -0.15 |
| **Family type** | | | | | | | | | |
| 1. | Nuclear | 2.47 | 4.39 | 16.30 | 1.61 | 26.37 | 80 | <0.001 | -0.03 |
| 2. | Joint | 4.89 | 5.35 | 16.11 | 1.92 | 12.57 | 43 | <0.001 | 0.16 |

respondents of OBC and SC/ST before the training as well as after the training, respectively. The difference in average level of knowledge before and after training was found to be statistically highly significant in all caste groups. Insignificant negative correlation was found between before and after training knowledge with the exception of other caste's respondents in which positive correlation was observed.

Literate respondents had more average level of knowledge than illiterate respondents in both the periods. The average increment in the awareness in literate as well as illiterate respondents between before and after training was found to be highly significant. An insignificant negative correlation in illiterate and an insignificant positive correlation in literate respondents was seen regarding awareness between before and after training.

Like as earlier pattern, the average knowledge about smokeless chulah of higher income group respondents had maximum knowledge in comparison to lower and middle income group respondents for both periods that are before and after training. The differences in average level of awareness between before and after training of the respondents of all economic groups were found to be statistically highly significant. A significant negative correlation was found in lower income group where as an insignificant positive and negative correlation was seen in middle and high income groups of respondents, respectively.

Type of family wise distribution showed that the respondents of joint family had more mean level of knowledge in comparison to the respondents of nuclear family at the time of survey while it was just reverse after providing training. The differences in average level of awareness between before and after training was highly significant in both types of families. An insignificant negative and positive correlation were seen between the knowledge of before and after training in the respondents of nuclear and joint family.

**Conclusion:**

Seven days repeated demonstrations and trainings were given on the use of solar cooker, solar lantern, smokeless fuel efficient stove. The demonstrations and trainings results showed that level of knowledge about time and energy saving kitchen appliances was influenced by socio-economic factors such as age, caste, literacy, family income and family size. The level of knowledge about non-conventional energy appliances after the training was higher among respondents in the age group $\leq$ 35 years. Level of knowledge was higher among literate respondents than illiterate. More level of knowledge about solar cooker, solar lantern, smokeless fuel efficient stove was also acquired by respondents earning above Rs. > 40000. Joint families have more knowledge about pressure cooker and kerosene stove before and after the training than nuclear families.

After demonstrations and trainings when solar cooker and solar lanterns were taken back, the attitudes of the female respondents who used these devices were studied. They were very happy, but when they were asked that "weather you will purchase it, they said "Yes". but many answered that they could not purchase it because of money constraints. The knowledge level of the respondents about the non-conventional energy was found very low before training hence the adoption has been affected. Economical constraints seriously faced by the respondents was followed by educational constraints. The limited outlets of non-conventional energy appliances in the rural area, high cost of devices and lack of maintenance facilities were the constraints that affected adoption of non-conventional energy. It would be better to provide proper training to un-employed youths or self-employed workers, having basic knowledge of science or electronics, for repair and maintenance of systems. After proper training they can provide R & M facility for the non-conventional energy devices and earn money.

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