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Rural household knowledge regarding energy conservation through clean development mechanism

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Abstract
Energy conservation while cooking in household (HH) is a major challenge and opportunity to curtail greenhouse gases (GHGs) and reduce climate change (CC) thus, lowering global warming (GW). People are gaining greater awareness of the value and need of sustainable energy practices, particularly growing public concerns regarding GW. But, still people fail to take noticeable steps towards energy efficiency (EE) and energy conservation (EC). This account for the fact that there is often a sizeable discrepancy between people's self-reported knowledge, values, attitudes, intentions and their observable behaviours i.e. 'knowledge-action gap'. In this case, when knowledge is imparted it plays a crucial role in developing understanding regarding various aspects of EE and EC, helpful in saving energy for future use. Two hundred forty households were selected from four villages i.e. 60 HHs from each village of Udaipur district having higher energy consumption in kitchen in household system. An interview schedule was used to gather the relevant information regarding respondents' knowledge about various fuel conservation practices which includes all the fuels used for cooking in kitchen in HH system. The findings highlighted that rural respondents had good knowledge regarding fuel conservation practices in HH. This was due to the fact that respondents were influenced by the mass media and exposure to the latest information on account of closeness to the city and impact of urbanization, industrialization, technological advancement and sanskritization.

Keywords: Clean Development Mechanism (CDM), Climate Change (CC), Energy Efficiency (EE), Energy Conservation (EC), Global Warming (GW)

1. Introduction
Knowledge simply refers to the condition of knowing something. It is the information, facts, principles, skills and understanding, etc. that is acquired through education and experience by perceiving, discovering or learning (Wikipedia, 2017) [11]. It is powerful and important part of life. When seen in HH system, general as well as specific knowledge plays a vital role in owning of CDM fuels and technologies. Lack of knowledge, training and lack of service backup, cost of the device, irregular supply of electricity, black-outs and government policies are some of the factors highlighted for low adoption of clean energy sources (Bhaskar and Billava, 2016) [2]. It is therefore important to implement policies that target consumer awareness and education on energy labelling; wise and efficient fuel consumption practices and adoption of energy efficient technologies in HH system which can result into better outcome.

One of the increasing hazards in our society has been the overuse of energy. Over the past decades there is an increase in the amount energy used in HH system due to evolving technology, as well as the lack of knowledge of how harmful this is becoming to the environment. People waste energy because of convenience, lack of information and the lack of immediate results. There is a limited amount of non-renewable energy sources and it is important to budget these sources or use renewable energy sources to save our planet (Volyand *et al.* 2013) [10]. In HH system, the cost of cooking accounts for about 4 per cent of the average gas and electricity bill. By simply changing the way to cook as well as by using energy-efficient cooking appliances can greatly reduce the amount of energy use and cut down energy bills in the process (ProBEC, 2008 [6]. U Switch, 2016) [9]. Along with this, by increasing knowledge and understanding of people about energy efficient cooking methods may increase energy conservation and saving at huge level in a considerable amount. Corroborated findings were also reported by Hasalkar *et al*. 2012 [4]. Freederiks *et al.* 2015 Williams, 2015 [12].

2. Objective

The present paper aims -

- To analyze the knowledge of the respondents regarding cooking practices in household system at three stages:

1. Knowledge regarding pre-cooking practices
2. Knowledge concerning practices accustomed while cooking

a. Material of utensils used for cooking
b. Energy efficient cooking practices
c. Actual cooking practices

3. Knowledge about post cooking practices

3. Methodology

On the basis of higher number of cooking systems and sub system 240 household were selected purposively from the four villages of Udaipur district of Rajasthan. Data regarding pre-cooking, while cooking and post cooking practices by the respondents, was collected personally by the researcher. A structured interview schedule was used to collect data. The unit of inquiry was rural households and males and females were the key informants. The knowledge regarding cooking practices of the respondents towards CDM was taken on dichotomous categories on the basis of 'yes or no' answers. Each correct and incorrect response was given one and zero score. The information gathered from respondents was tabulated and analyzed by using frequency, percentage, mean score and standard deviation.

4. Results and Discussion

The findings revealed the knowledge about the various practices being exercised by the respondents regarding the use of energy systems and subsystems in day today life while cooking. Based on the energy consumption practices in various systems and sub systems of cooking respondents were given scores under three categories viz. poor, average and good practices

4.1 Practices adapted during pre-preparation of food

Food pre-preparation footprints can be greatly reduces by organizing cooking activities (Kumar, 2015). Keeping everything ready prior to cooking saves much fuel (Terlip, 2014) [7]. The average score for knowledge regarding food pre-preparation practices was 2.54 (Sd=1.18).

Table 1 clearly portrays that nearly three-fourth of the respondents (74.17 per cent) possessed good knowledge and one-fourth of the respondents (25.83 per cent) had poor knowledge regarding pre-preparation of food. Moreover, the knowledge of respondents regarding practices of pre-preparation of food revealed that majority of respondents (84.16 per cent) prepare and collects all the raw materials needed for cooking. However, nearly half of the respondents were having knowledge regarding thawing of frozen foods before initiating cooking (46.67 per cent) and cutting of food into smaller pieces (49.58 per cent). These practices clearly depicted that the respondents were unaware about the notion of fuel conservation.

Table 1: Distribution of respondents according to their knowledge regarding pre-preparation of food practices n=240

S. No.	Pre -preparation of food	f	%	Mean Score	Sd
1.	Before commencing actual cooking, prepare and collect all raw materials that needed which will save fuel while cooking.	202	84.16	0.84	0.36
2.	Soaking cereals, pulses, rice, whole grain and legumes etc. before cooking saves 25 per cent of fuel.	178	74.16	0.74	0.43
3.	Frozen food when bought to room temperature before cooking consumes less fuel.	112	46.67	0.47	0.49
4.	Cut food into smaller pieces which will cook food more quickly and reduce cooking time.	119	49.58	0.49	0.50
	Level of knowledge regarding pre- preparation practices				
1.	Poor knowledge (0-1 score)	62	25.83	2.54	1.18
2.	Good knowledge (2-4 scores)	178	74.17		

4.2 Practices adapted while cooking food

During actual cooking of food the mean knowledge scores obtained by the respondents were 10.37 (Sd=5.17). The respondents were found to possess poor knowledge regarding the CDM practices which leads to fuel saving and conservation while cooking in kitchen at household though the scores in many aspects were found satisfactory.

4.2.1 Material of utensils used for cooking: Material from which the pots and pans are made plays a important role in fuel saving. Copper, best quality of stainless steel and aluminum is some of the metals with good conductivity hence curtailing the amount of fuel used in cooking (Terlip, 2014 [7]. Timothy and Gourmet, 2017) [8].

Table 2: Distribution of respondents according to their knowledge regarding material of utensils used for cooking sub system n=240

S. No.	Material of utensils	f	%	Mean Score	Sd
1.	Metals are good conductors of heat so cooking is fast in them.	176	73.33	0.73	0.44
2.	Dull or black surfaces of utensils absorbs more heat hence consume less energy.	125	52.08	0.52	0.50
3.	Copper-bottomed pans heat up quicker than stainless steel thus saving much fuel in cooking.	224	93.33	0.93	0.24
4.	In comparison to ordinary cooking, using pressure cooker saves 20 per cent fuel on rice and 46 per cent on soaked gram dal.	92	38.33	0.38	0.48
5.	Pressure cooking meat saves 41.5 per cent of fuels.	115	47.91	0.48	0.50
6.	Pressure cookers are very good at saving energy than ordinary pans.	138	57.50	0.575	0.49
7.	Induction stoves are more efficient than other types.	209	87.08	0.87	0.33
	Level of knowledge regarding material of utensils used for cooking				
1.	Poor knowledge (0-2 scores)	56	23.33	4.49	2.25
2.	Good knowledge (3-7 scores)	184	76.67		

The average knowledge scores of respondents regarding material of utensils was 4.49 (Sd=2.25). Tabulated data described that three-fourth of the respondents (76.67 per cent) had good and less than one-fourth respondents had poor

knowledge in relation to the material of utensils used for cooking.

Majority of the respondents were found to use copper-bottomed pans (93.33 per cent) as copper is good conductor of heat. In concern to the induction stove majority of the respondents (87.08 per cent) were aware about the fuel savvy nature of device but only a meager percentage of the respondents possessed it and were occasionally using it. This is attributed to the popular social media T.V. where advertisement on induction cooker is being displayed frequently. No glaring difference was seen among the respondents using dull or black surfaces of utensils (52.08 per cent) and pressure cooker instead of ordinary pans (57.50 per cent) for cooking of rice, dal (38.33 per cent) and meat (47.91 per cent).

4.2.2 Energy efficient cooking practices: Fuel consumption for cooking in general is high as compared to other household activities. Switching to energy-efficient and low carbon modern cooking appliances allows higher saving. So energy efficient cooking practices when adopted while cooking are very helpful towards fuel saving and conservation (Adria and Bethge, 2014 [1]. U-Switch, 2017).

Table 3: Distribution of respondents according to their knowledge regarding energy efficient cooking practices used while cooking n=240

S. No.	Energy efficient cooking practices	f	%	Mean Score	Sd
1.	Choose the modern most energy-efficient cooking method.	188	78.33	0.78	0.41
2.	Reheating of food increases fuel consumption.	157	65.41	0.65	0.47
3.	Cook several meals at once and reheat when required saves fuel in cooking.	165	68.75	0.69	0.46
4.	Cook larger quantities and store for later consumption save gas and time.	164	68.33	0.68	0.46
5.	Cook according to the season saves energy.	180	75.00	0.75	0.43
6.	Put just enough water in the pan to cover vegetables.	160	66.67	0.67	0.47
7.	Turn down the burner once the cooking temperature is reached, saves 25 per cent fuel.	143	59.58	0.59	0.49
8.	Make toast in toaster not in grill which will save fuel.	130	54.16	0.54	0.49
	Level of energy efficient cooking practices				
1.	Poor knowledge (0- 2 scores)	61	25.42	5.36	3.13
2.	Good knowledge (3-8 scores)	179	75.58		

The average score obtained by the respondents for energy efficient cooking practices was 5.36 (Sd=3.13). Three-fourth of the respondents possessed good knowledge (75.58) and one-fourth of the respondents displayed poor knowledge regarding energy efficient cooking practices followed by them.

Nearly three-fourth of the respondents were found to adopt the modern most energy-efficient method for cooking (78.33 per cent) and prefer to cook according to the season (75.00 per cent). More than two-third of respondents cook larger quantities of food (68.33 per cent) and several meals at once (68.75 per cent) and stored for later consumption. But the practice of cooking large quantities of food was followed occasionally during emergencies or according to the traditional customs followed by the respondents.

Respondents were adapting practices like fuel wastage in reheating of food (65.14 per cent), use of optimum quantity of water while cooking (66.67 per cent) and turning down the burner once the cooking temperature was reached (59.58 per cent). Regarding the use of toaster more than half percentage of respondents (54.16 per cent) only possessed knowledge but actual use of toaster was very less in number.

4.2.3 Practices adapted while actual cooking: The average score attained by the respondents while initializing actual cooking was found to be 4.99 (Sd=2.24). Nearly three-fourth of the respondents (76.25 per cent) scored higher whereas less than one-fourth respondents (23.75 per cent) obtained poor scores.

Table 4: Distribution of respondents according to their knowledge of food practices adapted while actual cooking n=240

S. No.	While actual cooking	f	%	Mean Score	Sd
1.	Fuel can be saved by using clean, dry pans and pots for cooking.	182	75.83	0.75	0.42
2.	Flame crossing the bottom of the pan leads to fuel wastage.	180	75.00	0.75	0.43
3.	Fuel wastage can be reduced by using right size pots for burner.	212	88.33	0.88	0.32
4.	The small burner of the gas stove consumes – 6 per cent less gas than big burner.	208	86.67	0.87	0.34
5.	Simmer liquid-cooked food, don't boil it vigorously.	115	47.91	0.47	0.50
6.	Keep the pan closed whenever possible avoids loss of heat, thus saving fuel.	114	47.50	0.475	0.50
7.	Make sure the flame is colorless or blue as it indicates full energy is being harnessed.	188	78.33	0.78	0.41
	Level of knowledge regarding cooking practices				
1.	Poor knowledge (0-2 scores)	33	13.75	4.99	2.24
2.	Good knowledge (3-8 scores)	207	86.25		

Data in table no. 4 portrays that majority of the respondents were using right size pots for burner (88.33 per cent), small burner of the gas stove (86.67 per cent). These practices were adopted due to experience of utensil burning while cooking. Three-fourth percentages of respondent were found to use clean, dry pans-pots for cooking (75.83 per cent), trim flame crossing the bottom of the pan (75.00 per cent), and respondents were aware about the colorless or blue color of the flame which indicates full energy is harnessed (78.33 per cent). Near about half of the respondents accounted simmering of liquid while cooking (47.91 per cent) and whenever possible keeping the pan closed while cooking to avoid heat losses (47.50 per cent).

4.2.4 Level of knowledge regarding cooking practices: The average score obtained by the respondents for actual cooking

practices was 14.85 (Sd=7.31). The tabulated data clearly depicts that three-fourth of the respondents (76.25 per cent) possessed good knowledge whereas less than one-fourth of the respondents (23.75 per cent) had poor knowledge concerning actual cooking practices.

Though, the average score attained by the respondents regarding cooking practices was good but in reality respondents were unaware about the scientific reasoning of the practices being followed by them. Mass media especially television played a vital role in disseminating information about the certain practices relevant to the type of utensils and fuel savvy ideas.

Table 5: Distribution of respondents according to their level of knowledge regarding cooking practices n=240

S. No.	Level of knowledge regarding actual cooking practices	f	%	Mean Score	Sd
1.	Poor knowledge (0-8 scores)	57	23.75	14.85	7.31
2.	Good knowledge (9-22 scores)	183	76.25		

4.3 Post cooking practices

If post cooking practices are properly followed by the homemakers it will be helpful in fuel saving. The average score for post cooking practices was found to be 2.19 (Sd=0.77). Less than two-third of the respondents (61.67 per cent) were found to had poor knowledge regarding post cooking fuel conservation practices whereas more than one-third of the respondents (38.33 per cent) had good knowledge about post cooking practices.

Table 6: Distribution of respondents according to their knowledge of post cooking practices n=240

S. No.	Knowledge regarding post cooking practices	f	%	Mean Score	Sd
1.	Regular cleaning of clogged gas burners reduces fuel consumption.	199	82.92	0.82	0.37
2.	Check the regulator, pipes, burner for leaks.	170	70.83	0.70	0.45
3.	Scrubbing cooking vessels decreases fuel consumption by 10 per cent.	157	65.41	0.65	0.47
	Level of Knowledge regarding post cooking practices				
1.	Poor knowledge (0- 2 scores)	148	61.67	2.19	0.77
2.	Good knowledge (up to 3 scores)	92	38.33		

After cooking is over, when post cooking practices are followed they lead to fuel conservation by avoiding fuel wastage or through fuel leakage. Majority of respondents (82.92 per cent) were found to regular clean clogged gas burners. Cleaning of clogged burners and spillovers avoids fuel leakages and wastage (Terlip, 2014). No glaring difference was seen among the respondents checking the regulator, pipe and burner for leakage (70.83 per cent) and respondents scrubbing vessels while washing (65.41 per cent). Scrubbing of utensils was exercised from the point of view of cleanliness but respondents were unaware about the importance of fuel conservation *via*. scrubbed utensils. When utensils are scrubbed any type of water insoluble minerals are washed out which otherwise enhances fuel consumption while cooking (PCRA, 2017).

4.4 Level of Knowledge regarding cooking practices in the three sub systems pre-post and while cooking

On the basis of knowledge scores obtained by the respondents in three sub systems pre, while and post cooking system the average score was 20.22 (Sd= 9.27). More than three-fourth of the respondents (76.25 per cent) scored higher for practices being exercised for cooking whereas less than one-fourth of the respondents (23.75 per cent) were customizing poor practices.

Table no. 7: Distribution of respondents according to the cooking system n=240

S. No.	Level of knowledge regarding three sub systems of cooking system	f	%	Mean Score	Sd
1.	Poor knowledge (0-11 scores)	57	23.75	20.22	9.27
2.	Good knowledge (12-30 scores)	183	76.25		

This may be attributed to the fact that closeness to the city, impact of technological advancement, industrialization and sanskritization plays a vital role. The exposure rate of the respondents is higher to the new technologies and also to mass media.

5. Conclusion

Concisely it can be said that knowledge of rural women regarding CDM will promote home level energy sustainability by conservation of natural resources, maximizing the use of renewable energy and biomass based technologies in cooking in household system which will help to reduce GHGs. So by increasing knowledge and understanding about energy issues regarding cooking at household level is vital for achieving improved energy saving behaviors.

6. Recommendation

1. To fill knowledge action gap of respondents there is need to generate awareness regarding CDM fuels, technologies, practices and various energy efficient appliances available through vigorous extension activities and mass media mainly T.V. and newspapers that have a mark able impact on human psychology.
2. Respondents should be well acquainted with the scientific reasons behind the practices being followed by them unknowingly which will ensure their regular adoption in day today life.
3. There is need to popularize energy efficient technologies in rural areas with their advantages (economic, fuel savvy and environmental) as still majority of people lack conscience about the role of energy efficient technologies in promoting fuel conservation and environmental sustainability in long run.

4. There is to provide subsidy on low carbon and energy efficient CDM devices for the rural areas for its higher adoption.
5. It is important to implement policies that target consumer awareness and education on energy labelling; wise and efficient fuel consumption practices and adoption of energy efficient technologies in HH system which can result into better outcome.

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