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Barriers against the Development of Solar Cooker & its Solution

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ABSTRACT
Cooking with natural gas is not only unhygienic but also results in green house gas emission. So, the alternative method of cooking should need to be checked. Solar cooker provides an efficient way to cook food without any consumption of fuel. The feasibility of solar cooker in rural regions of Bangladesh has been checked. But this renewable energy market faces some barriers against its development. This paper gives an analytic view of the barriers against the development of the solar cooker energy market and tries to suggest some solution in order to overcome this barrier.

Keywords: Solar Cooker; Change agent, Bangladesh.

1. Introduction

A sustainable development is achieved when there is no depletion of natural resources and more emphasis is given on renewable energy resources. Clean cooking technology can play a vital role in achieving this goal. Solar cooker a device that makes direct use of sunlight to cook food or pasteurize drinks is such a technology. Operating principle of these devices are that they use mirrors to concentrate sunlight which is converted to heat & used for cooking [1]. Many local and international organizations have supported solar cookers in many countries. Various types of solar cookers are available, such as the box cooker, panel cooker, and the parabolic reflector cooker etc. They all have the same general principle of using solar radiation as a cooking source with different design [2].Solar cooker can be classified mainly into two categories, direct and indirect on the basis of heat transfer mechanism to cooking pot [3]. A review of the direct and indirect type's solar cooker performance with numerical, experimental and theoretical analysis can be found in [4]. Box, panel and parabolic reflector comprise of direct type solar cooker. Direct type solar cooker mainly depends on sunlight but for indirect type solar cooker heat is transferred to cooking pot by heat transfer fluid. Table 1 shows the comparison between different types of solar cookers [5]. Most of the solar cookers have been tested in rural areas of India [6] &Burkina Faso [7, 8].

In Bangladesh, several households have started using solar cooker. Design and testing of parabolic and two axis spherical solar cooker have been carried out in [9], [10]. Several solar cookers with parabolic reflectors have already been developed and field tested by the Institute of Fuel Research and Development (IFRD) in Bangladesh. The cookers have successfully heat water quickly to its boiling point on a clear sunny day [11].

2. Potential of Solar Cooking Bangladesh

On a clear sunny day for any solar cooker the minimum direct radiation required is 4 KWh/m^2 and for Bangladesh, average global horizontal radiation is 4.806 KWh/m^2 [12]. The following figures (1-2) presents the global horizontal and direct normal radiation Patterns in Bangladesh and the no of days solar cooker can be used [13]. The figures denote that there are approximately 294 days where global horizontal radiation is above 4.0 KWh/m^2. It can be also found that there are approximately 145 days where direct normal radiation is above 4.0 KWh/m^2. Table 1 denotes that the most suitable solar cooker for Bangladesh is Box type cooker. Although higher temperature can be gained from parabolic reflector type cooker, it requires skill and training.

Table 1: Comparison between different types of solar cookers [5]

	Parabolic reflector type cooker	Panel-type cooker	Box type cooker
Solar Radiation	direct only	direct only	direct and diffused
Cooking Temperature	260-538^{0}C	90-150^{0}C	150-200^{0}C
Safety	involves risk; training required for use	moderately safe	safe
Insulation	poorly insulated	poorly insulated	Well insulated; temperature is unaffected by

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			winds
Cooking Time	fastest	slowest	moderate
Possible Cooking Methods	frying, grilling and roasting	boiling, baking, simmering and steaming	boiling, baking, simmering and steaming
Cost($)	349	86	350

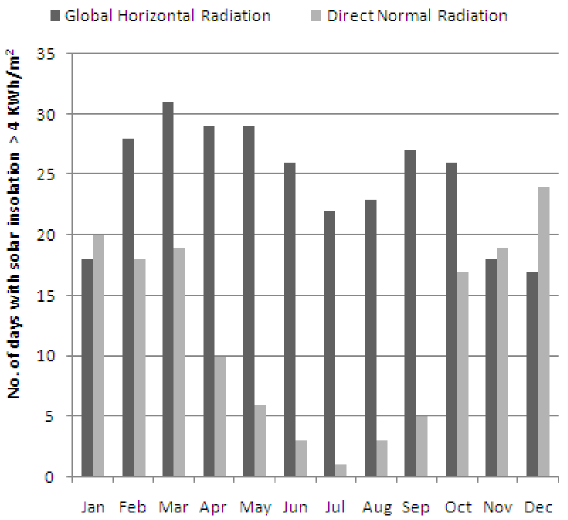

Figure 1: Number of days a solar cooker can be used [13].

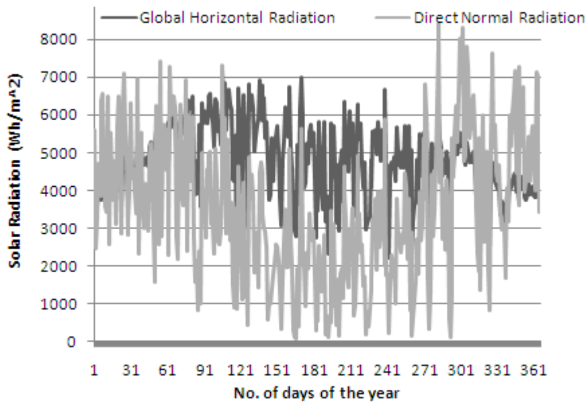

Fig 2: Global Horizontal and Direct Normal Radiation Patterns in Bangladesh [13].

3. Barriers Against the development of Solar Cooker

By reviewing several literatures various barriers have been found that slow down the growth of solar cooker energy technology. These barriers also persist in Bangladesh & they have been listed below in the table 2.

Table 2: Barrier against the development of solar cooker

Barrier	***Description***	***Reference***
Lack of knowledge & education	Education affects decision making. Educated people are likely to adopt clean technologies as they know the benefit of it.	[14]
Poor people's technology	Most of the solar cooker technology is developed for the people with low socio economic status. As people consider it a technology for the poor, the whole project loses overall value & attractiveness.	[15]
Alternative Fuel	People living in rural area have access to biomass. They use them as fuel to cook not knowing that results in increase of greenhouse gas.	[16]
High Complexity	Most people hardly think solar cooker can cook. So people having limited food ration do not risk wasting their food.	[17]
Disturbing cooking method	Many customers have the belief that solar cooker requires major changes in cooking behavior. They see problems such as longer	[18,19]

	cooking time, lower capacity, outdoor cooking and change of taste and texture of the food	
Lack of industry Standards	No of industry that manufactures solar cooker is limited and their products have low standards. This results in lower reputation of solar cookers and the users' perception of the concept	[20]
Low income	Many people in developing country have small income. They cannot afford to buy expensive solar cooker without government providing subsidy on those devices. Cash and credit in some communities may even be new and unknown practices.	[21]
Lack of flexibility:	Cannot be operational in cloudy days and night.	[22]
Limited Access to Sunlight	People living in cities do not have access to solar for cooking purposes. People living in Dhaka do not have adequate space in their apartment for solar cooking purposes.	[13]
Cultural Resistance	In solar cooker all the ingredients along with food are left on the sun until it gets cooked. A study conducted in Gujarat reports that many housewives have found this unacceptable.	[23]

4. SOLUTIONS TO THE BARRIERS

It is the customers who ultimately determine the market success of a new product. Innovation needs to be adopted by customers otherwise market diffusion will not take place [21]. So to do this, proper communication is necessary. Communication can be through the mouth or having a close relationship with customers. So proper communication can help in overcoming these barriers.

The use of change agents is a great way to overcome these barriers. A change agent is a personal being who influence the customers by his communicating skill [22]. A change agent must have several characteristics [23]. These characteristics can help to eradicate the barriers that hinder the development of solar cooker. They have been given below.

- Local knowledge:

Change agents should have local knowledge. They should know about the customers' needs, attitudes, beliefs, social norms and leadership structure. It helps change agents to choose what information that is relevant to attract to the customers. This knowledge will help to improve the understandings of rural people on the solar cooker.

- Similar socioeconomic status:

The change agent needs to have same socio economic status as the customer. This is very essential for the change agent as communication is said to be far more efficient when the communicator and receiver are homophilous.

- Technical knowledge:

Technical knowledge is very important for change agent as he needs it to explain the customers about the technology properly. Since customers find solar cookers are high in complexity, technical knowledge will aid change agents so that they can properly help customers in the adoption process. To prevent cultural resistance, this knowledge will open a new path for the development of solar cooker.

- Alternate means of cooking:
  In order to prevent flexibility problem, alternate means of cooking should need to be adopted. Implementation of biogas stoves can play an effective role here.

- Implementations of Laws:
  The problem of limited access to sunlight can be addressed by implementing laws on urban building designs. The buildings should have adequate space on the rooftop for solar cooking purposes.

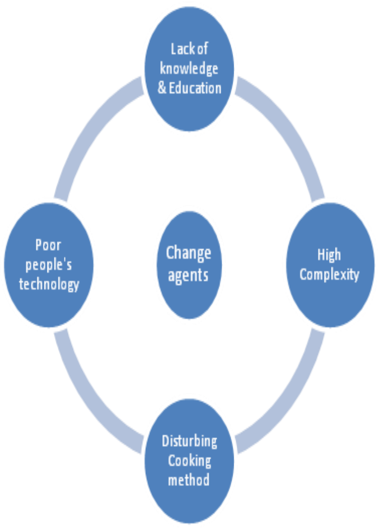

Figure 3: Functions of change agent.

In figure 3 the barriers that can be solved by efficient change agents have been listed. In order to increase solar cooker status change agent, should promote solar cooker as a highly desirable product [17]. He should give a proper demonstration on solar cooker's operation, should provide training to develop people‘s ability by training them. He should provide the knowledge how to work with cooker during cloudy and night time. This can be by providing a hybrid solution [17].

5. Conclusion
Bangladesh has huge solar energy resources. This paper highlights the barrier against the development of solar cooker and suggest some solutions. From the analysis can be said that government should proper subsidy to develop solar cooker energy market. Introduction of change agent by industries to solve the misunderstanding of people will play a great role to overcome the obstacles of solar cooker energy development in Bangladesh.

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