

**Attitudes of Rural and Urban Women in Bamako District and Koulikoro Region of Mali
to the Use of a Solar Cooker**

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Abstract

In spite of a high rate of environmental degradation and desertification, as well as increasing costs of wood, rural and urban women in Mali still prefer wood and charcoal as cooking energy sources. The abundance of solar energy has prompted the development of the solar cooker. Its adoption among these groups of women is, however, less certain because they are barely aware of it and actually, have rarely started using it. Among the key constraints to its adoption include attitude, cooking time, large family, climate, and acquisition cost.

Key words: Solar cooker, rural women, urban women, and attitude.

Introduction and Problem

Desertification, accelerated by environmental degradation is a critical problem for Mali as “the desert is advancing 2.4 miles each year” (Traore, 2002). Mali can be considered part of the Sahara desert, as about 65% of the country is now desert or semi-desert (Dauda, 2000) due mainly to droughts, over-grazing, topsoil erosion, harsh desert winds, and the scavenging of trees for firewood.

Mali is in dire need of energy generating facilities for its 11 million inhabitants, 28% of which reside in urban settings, and only 1/4 of this have access to electricity. In the rural areas this figure is less than 1% (ME&M, 2001). Mali has potentials for using renewable and environmentally sound technologies for energy, and the Malian climate makes solar energy particularly appropriate. The country’s energy sector is mostly based on traditional fuels, with low per capita consumption (0.3 tons oil equivalent) and 90% of the energy consumed coming from the unsustainable wood fuel (ME&M, 2002). An overall low level electrification, an established renewable energy sector, and a reforming government are factors that favour adoption of renewable energy alternative. Threats to its successful deployment include an unstable economy and limited capacity of rural dwellers to pay for improved energy services.

Biomass producing surface has been disappearing at the rate of 9,000ha per year, leading to soil erosion and desertification, and making this the predominant environmental issue linked to energy consumption (Guindo, 2003).

Fuel wood consumption in the capital, Bamako grew from 600,000 tons in 1994 to about 1.2 million tons in 2000. In an effort to slow this devastating trend, the government of Mali in July 2004, imposed a six-month ban on tree felling and the export of charcoal. This policy increased the price of wood and charcoal by up to 50 percent, putting enormous strain on household incomes. Lacking alternative fuels, people had no options. An array of interlocking institutional, educational and technological solutions is presently being studied to solve “the poor man’s energy crisis” (Eckholm, 1975).

Firewood Crisis and Environmental Degradation

For some years, FAO and other organizations have been warning on the problems being created by human pressure on wood resources. According to FAO (1990), over 100 million people in Africa live in areas where acute scarcity of fuel wood exists and that if the trends were allowed to go unchecked, shortages would affect over two billion people by the turn of the century. Women in Ndeukou, Senegal walk a minimum of 2.5 miles a day in search of firewood (Danton, 2005). There is also the multiplier effect of clearance of trees and vegetation as it permits erosion, thus reducing fertility and food production, and in cases of severe damage, compromising the viability of agricultural land.

The burning of dung and other wastes as a substitute for wood reduces the amount of natural fertilizer available on the farm. This situation is worse in Sahelian countries facing desert encroachment alongside wood scarcity.

Renewable Energy and Solar Cooking

The contribution of renewable energy sources to global commercial energy is expected to increase over time from the 9% contribution (mostly hydroelectric power) in 1990, to 17% in 2020-2025, and possibly as high as 50% by 2050 in a sustained growth or biomass-intensive scenario. Most scenarios project that renewable sources could contribute some 200 EJ (exajoules) or more per year by 2050 (UNDP 1997). Decentralized small-scale renewable are

making considerable inroads and are not limited to remote areas. In India, solar water heaters are now a fairly well established technology. In rural Kenya, more households obtain their electricity from solar energy than from the official rural electrification program (van der Plas 1994) while in China and India, village-level biogas plants still appear mainly applicable on a large scale with a high level of community participation. Small-scale wind and hydro installations are widely used, where resources permit, for pumping water and grinding grain in remote areas, and in some cases, integrated with the grid or acting as mini isolated grids. Hydroelectric power is a well-established renewable energy technology, already contributing a fifth of global electricity supply, though its future will be somewhat limited by environmental and social concerns (UNDP 1997).

Biomass-based technologies have been adopted (though subsidized) on a large scale in Brazil, charcoal rather than coal used in steel production, while the national fuel alcohol program aims at replacing about half the gasoline needed for automobiles. Biomass gasification and the use of vegetable oils as fuel may also be showing up in large-scale commercial programs as well as village applications soon, as maintenance problems with producer gas engine generators are being solved. Renewable energy will play an increasingly important role in energy supplies in both developing and developed societies in the future. Like all energy sources, renewable energy production and consumption are closely linked with the sustainable human development goals: eradicating poverty, increasing women's role in development, providing people with income-earning opportunities and livelihoods, and protecting and regenerating the environment (UNDP 1997).

Solar cooking refers to using the sun's heat to cook food. It is a simple, safe, and convenient way to cook without consuming fuel. Solar cooking can help alleviate the burden on more than 3 billion people who must walk for miles to collect wood or spend their meagre income on fuel. The map above illustrates the countries, which have abundant solar energy for cooking. While this passive technology cannot entirely replace traditional fuels, it can significantly reduce their use. Solar cookers can bake, braise, stew and fry food. The three most common solar cooker designs are parabolic, box and panel cookers.

Parabolic Cooker

The sun's rays are captured in a reflector, which focuses them at a point under a pot. The effect is like a stovetop burner or a campfire. Temperatures can reach above 400 degrees fahrenheit, hot enough to fry food.

Box Cooker

The sun's rays are received in an insulated black box with a transparent lid, which lets in the sun's rays. Inside the box, this sunshine turns to heat which is trapped in the box. The effect is similar to the oven in the kitchen. Temperatures can reach around 300 degrees fahrenheit.

Panel Cooker

This is a combination of the earlier two systems, which is portable and less expensive. Temperatures can reach around 250 degrees Fahrenheit. (This is ample because cooking begins at around 180 degrees Fahrenheit.)

Purpose and Objectives

Sunshine is more than abundant in the Sahel countries and many people in the region place great hopes in its domestic use. Research undertaken in the past 20 years, especially in Niger, Upper Volta and Mali, has led to the development of the solar cooker. In Mali, the Ministries of Energy and Mines as well as that of Women Affairs have developed and introduced the box solar cooker to women groups in the country and also trained women on how to use the solar cooker. It is however the intention of this study to verify the attitudes of urban and rural women in the capital town of Bamako and the villages of Koulikoro to the use of the solar cooker. Specifically, the study seeks to:

- Ascertain cooking energy preference of rural and urban women and reasons for their choice
- Verify the cost implication for various types of cooking energy and cooking methods available to rural and urban women
- Ascertain their knowledge of cooking energy problems in Mali
- Verify their knowledge of solar cooker and its advantages
- Analyze the problems related to the use of solar cookers by the rural and urban women
- Make recommendations for solution to the problems.

Methodology

Two groups of rural and urban women that have been trained in the use of solar cookers were randomly selected from the list available in the Ministry of women affaires. A total of 155 (75 rural and 80 urban) women were in the two groups and they were all included in the study. The only solar cooker producer from Bamako was interviewed on issues related to marketing and cost of production.

Twenty-five officials from the Ministry of Women Affairs, and that of Mines and Energy in charge of extension activities related to the solar cooker were also included in the study. Open-ended questions were developed for the officials while interview schedules were prepared for the rural and urban women groups. Data collected were analyzed using statistical tools such as frequencies, bar charts, percentages, and cost analysis as well as means.

Results

Types of Energy Usage by the Rural Women of Koulikoro and Urban Women Of Bamako District

All the rural women interviewed from the region of Koulikoro claimed that the fuels used are generally taken directly from nature. This however may be due to their proximity to the forest and farms. These fuels (fig.1) were wood (100%), charcoal (25.3%), plant wastes (straw, millet stalks, corn cobs) (96%). The rural women confirmed firewood as their energy preference because their families collect wood directly from the bush and do not have to pay for it (Table 1).

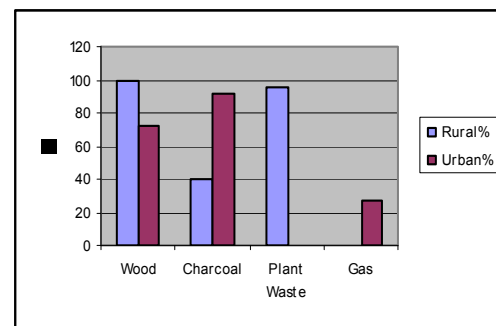


Figure 1. Energy preference by the rural women of Koulikoro and urban women of Bamako, Mali.

According to them direct wood collection is widely practiced in the rural sector and it is usually done by women and children. The most common form of transportation is by head load. A few ‘privileged’ women (17%) have bicycles and animal driven carts, which they use to move the wood. The workload depends on the supply or scarcity of wood which influences the travelling distance and the time devoted to collection. Workload also depends on family size, the individual woman’s physical constitution and also the season, since there are periods - especially May and June - when women go wood-gathering every day and even twice a day to build up winter stocks.

The rural women indicate plant waste as their second preferred source of energy because bushes surround them and at harvest times plant wastes are abundant for their cooking. The use of charcoal is not common among the rural women because they have to buy it and it is costly. Only about 25% use charcoal in addition to firewood. None of the rural women use gas for cooking because it is not easily available and it is too costly.

Reasons for Preference for Wood as Energy Source by Rural and Urban Women of Koulikoro and Bamako District

The urban women from Bamako claimed to obtain almost all (97%) of their fuels from the nearby markets and these fuels include: charcoal (91.25%), wood (72.5%) and gas (27.5%). This group of urban women preferred charcoal and wood because they make for rapid cooking (Table 2) for their large families and does not need much monitoring. Many of the urban women interviewed considered it the most economical fuel because, “we find wood and charcoal to buy easily and we don’t have to watch the fire too much.”

Table 1 shows that the urban women (about 91%) also prefer charcoal as a source of energy because it is easily available, does not give out smoke and can be used to cook large quantities of food. Also, about 27% of the urban women prefer gas as cooking energy source because it cooks rapidly and does not blacken their pots. However, they claimed that gas is very costly to refill (about \$80 monthly for the medium gas cylinder), dangerous for children, difficult to handle by maids and at times not available.

Table 1

Reasons for Preference for Wood and Charcoal by Rural Women of Koulikoro and Urban Women of Bamako, 2007

Reasons	Rural women % A	Rural women % D	Urban Women %A	Urban women %D
Family members collect wood	100		07	93
Do not pay for it in most cases	98	02	04	96
Rapid cooking	100		100	
Not too much time wasted	89	11	92	08
Wood/charcoal available to buy	nil	nil	100	nil

Note. Source: Survey data, 2007

Cooking Methods Used by Urban and Rural Women of Koulikoro Region and Bamako District of Mali, 2007

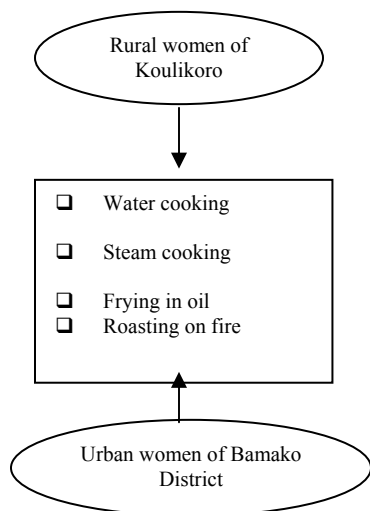


Figure 2. Cooking methods used by the rural women of Koulikoro and the urban women of Bamako.

All of the rural and urban women respondents in this study, like most Sahelians, rarely eat uncooked food. According to them, most dishes are subject to lengthy cooking, due to the nature of the food itself or the need to destroy germs and parasites.

According to the two groups of women, their cooking methods vary but can be grouped into four:

- Water-cooking, for dishes such as cereal porridges; leaves, boiled for sauces or as vegetables; infusions and so on.
- Steam-cooking, for dishes like “dégoué”, millet couscous, and rice
- Roasting for meat, chicken and fish
- Frying in oil, often as a base for a variety of sauces and for plantain, fish and others.

Whatever the cooking method, both the urban and rural women claimed an average of at least 30-45 minutes and frequently 2-3 hours - of processing over a high fire.

Cost of Cooking Energies by Rural Women of Koulikoro Region and Urban Women of Bamako District

The rural women get almost all of their cooking firewood free and this explains why they spend minimally on firewood while the few that use charcoal claimed to spend on the average about \$3 monthly. In the cities according to the urban women, they buy all or major part of their wood and the financial cost also varies.

Table 2

Mean Monthly Cost of Cooking Energy per Month by Rural and Urban Women, Koulikoro Region and Bamako District, Mali, 2007.

Cooking energy	Mean cost by rural women	Mean cost by urban women
Wood	500cfa (about \$1)	5.500cfa (about \$11)
Charcoal	1500cfa (about \$3)	6000cfa (about \$12)
Gas	Not used	10000cfa (about \$20)
Solar	Not used	1000cfa (about \$2)

Note. *One solar energy package according to Mali women engineer group would cost 7500cfa (about \$15) to acquire and could last for about 7 years.

Source: Survey data, 2007.

For the urban women in this study, wood and charcoal consume a heavy share of the family budget. The urban women supporting large families in Bamako claimed to spend one third of the monthly or daily food allowance on wood and charcoal alone (Dauda, 2000). This is because the rural dwellers who supply wood to the city pay a lot on transportation and other

charges to government agents. Gas is considered too costly and beyond the reach of most urban families.

Awareness of Energy Problem by Rural Women of Koulikoro and Bamako Urban Women

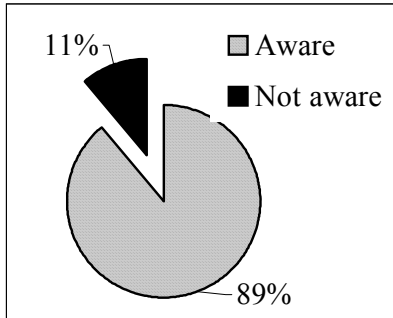


Figure 3. Urban women of Bamako district's awareness of energy problems in Mali.

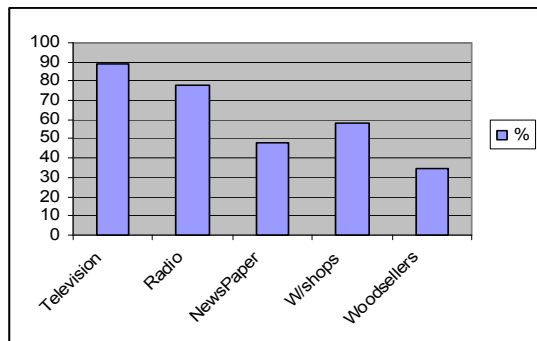


Figure 4. Sources of information about energy problem by the urban women.

The majority of the urban women (89%) were aware of the energy problem in Mali as all of them claimed to listen to radio programme discussions on energy problems and even watched various television programs on the issue. About 58% of the women claimed to have attended sessions where energy problems were discussed. This was because the government of Mali and some NGOs are making serious efforts to sensitize the public about the devastating environmental and energy problems facing the country. Discussions on environmental problems as they affect the Malian agriculture as well as her socio-economic well-being are featured regularly in the Malian print and electronic media. Wood sellers also narrated their experiences to customers as to the difficulty in getting woods to the cities due to various the taxes paid to forest agents and customs as well as the high cost of wood even in villages.

Few (34%) of the rural women respondents claimed to be aware of the energy problems through their personal observations and experience. Few years back, they said they could get firewood close to their huts but now go as far as 25 kilometers and collect much less.

Also, they affirmed that due to lack of rainfall, trees were drying off in the forests without replacement. Those who sell firewood in Bamako also claimed to make less profit now because of reduced supply. Those not aware of the energy problem claimed that they still get firewood free, since it is from nature.

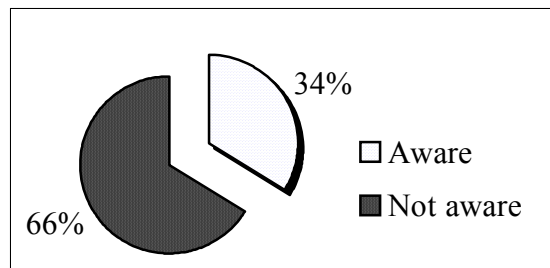


Figure 5. Awareness of energy problems by the rural women of Koulikoro.

Awareness and Usage of Solar Cookers by the Rural Women of Koulikoro and Urban Women of Bamako District

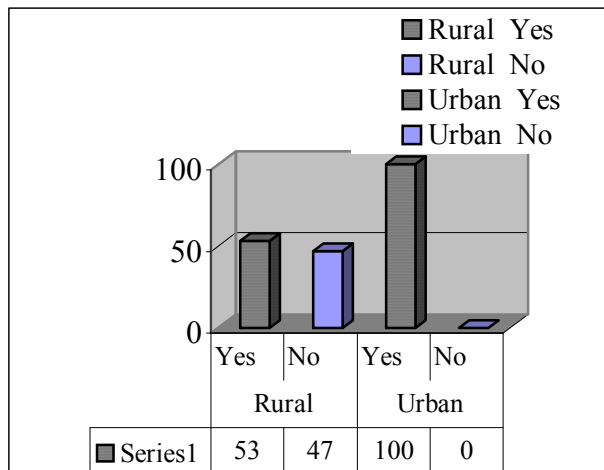


Figure 6. Awareness of rural women of Koulikoro region and urban women of Bamako district about the solar cooker.

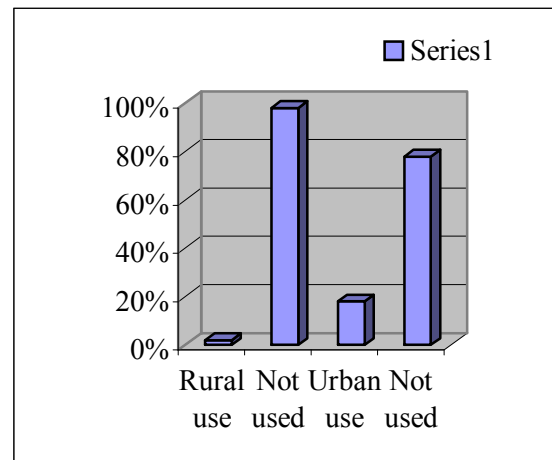


Figure 7. Usage of solar cooker by rural women of Koulikoro and urban women of Bamako District.

The level of awareness of the two groups of women about solar cookers differs remarkably as shown in Figure 6. One hundred percent of the urban women claimed to be aware of the solar cooker.

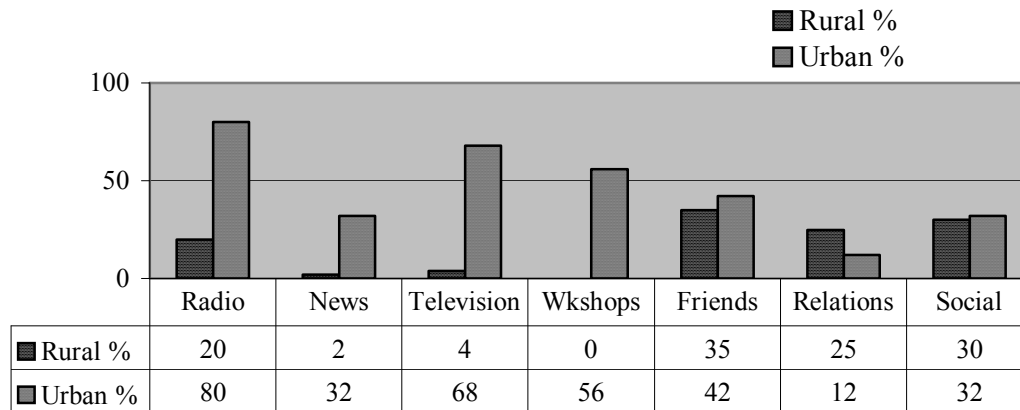


Figure 8. Sources of information about solar cookers by rural women of Koulikoro and urban women of Bamako District.

Figure 8 shows that the radio (88%), television (68%), and workshops (56%) constituted their most important sources of information. Fewer of the rural women group (53%) claimed to be aware of the solar cooker with the majority having been informed through friends (35%), social groups (30%), relations (25%) and the radio (20%) as shown in Figure 8. Informal sources of information constituted the major sources for this group of while the majority of the urban women were informed through formal sources.

Knowledge of the Women Groups about the Usage of the Box Solar Energy Cookers for Cooking

Table 3

Knowledge of Rural Women of Koulikoro & Urban Women of Bamako District About Box Solar Cookers

Items on knowledge of the box solar cooker	Rural women %				Urban women %			
	N	Yes	No	Do not know	N	Yes	No	Do not know
Energy from the sun can be used for cooking	70	58.57	20	21.43	80	100	-	-
Unfold and fold the box cooker as specified so that it is not damaged	70	20	75.71	04.29	80	56.25	43.75	-
No water is added for fresh foods like legumes and meat	70	-	67.1	32.9	80	45	55	-
During cooking, do not open the pot and do not stir	70	-	88.57	11.43	80	65	35	10
Tie the sack so that heat does not escape	70	11.43	-	88.57	80	75	-	25
Turn the solar cooker towards the sun	70	20	-	80	80	100	-	-
Clean the nylon sack always	70	-	-	100	80	55	35	10
During cooking, when there is steam all over the nylon bag, food is cooked	70	-	24.28	75.72	80	50	50	-
Solar cooker can bake	70	-	-	100	80	40	15	45
Solar cooker can braise, stew and fry foods	70	-	-	100	80	55	25	20
Solar cooker does not burn foods	70	-	-	100	80	85	10	05
Solar cooker cook heats up to 135° C and destroys all the germs in food	70	-	-	100	80	50	50	-
Solar cooker is durable	70	-	54.28	45.72	80	55	45	-

Note. Source: Field data, 2007

The two groups of women have different levels of knowledge about the box solar cooker. The rural women only know that the sun energy can be used for cooking because, they claimed to be drying legumes and meat in the open sun and as such they know that the same sun that dries food stuffs could be able to cook. Apart from this, very few of them have knowledge of how to use the solar cooker and the technical aspects. However, the urban women have high knowledge of the usage of the solar cookers, what can be cooked with it, how to cook the food, the precautions and its durability.

Attitudes of Rural Women of Koulikoro and Urban Women of Bamako to the Box Solar Cooker

Table 4 shows that the two groups of women did not agree that the usage of solar box cooker can solve energy problems in Mali. The rural group claimed that the capacity of the solar cooker is limited compared to that of wood and charcoal when using their cooking utensils. As such, there will always be need for wood and charcoal. The urban women also made similar claims that the solar cooker was relatively slow, so they still have to resort to gas, charcoal, and wood for rapid cooking, and that the solar cooker usage will not reduce cooking time because at times they have to wait for the sunrise before they can start cooking.

According to the two groups, the solar cooker was not economical because of the need to buy more than one cooker to start with and the quality of the carton used for its production makes it less durable as well as calls for frequent replacement of the box cooker. They also did not agree that the solar cooker can cook all food types, especially foods such as the Malian 'tuo'. This makes its acceptance extremely difficult within the Malian culture where tuo is an important staple food. The urban women, however, agreed that the solar cooker was easily available and that it did not burn foods.

Generally, the rural women still showed negative attitudes towards the solar cooker while the urban women's attitude was still lukewarm.

Table 4

Attitudes of Rural Women of Koulikoro and Urban Women of Bamako District to the Box Solar Cooker in Mali, 2007

Items	Mean	SD	Mean	SD
Solar cooker usage will solve energy problem	2.51	.64	2.81	.33
Solar cooker usage will reduce time spent on cooking	2.22	.70	2.79	.47
Solar cooker is more economical than all other types of energy in Mali	1.73	.75	2.97	.56
Solar cooker cooks all types of food	1.34	.97	2.65	.59
Solar cooker is durable	2.19	.46	2.95	.77
Solar cooker is accepted in the Malian culture	1.74	.76	1.43	.82
Solar cooker is easily available	1.56	.54	3.57	.93
Solar cooker does not burn foods	2.37	.38	3.25	.97

Note. 1=Strongly disagree, 2=Disagree, 3=Somewhat agree, 4=Agree, 5=Strongly agree
Source: Field data: 2007

Constraints to the Use of Box Solar Cooker by the Rural Women of Koulikoro and Urban Women of Bamako, Mali

Table 5 shows that both the rural (58 out of 80) and the urban women (50 out of 75) did not see irregularity of sunshine as a problem to solar cooker usage because Mali has a typical tropical climate with a single rainy season and a long dry season. The climate is hot around the year and heat is most uncomfortable during the period May to October, when humidity and cloud are greatest. Hours of sunshine are greatest during the dry season, when they average eight to

nine hours a day as compared with six to seven hours during the rainy season. So getting sun energy to cook does not constitute a problem for the two groups of women.

Table 5

Constraints to the Use of Box Solar Cookers by Rural Women of Koulikoro and Urban Women of Bamako District of Mali

Constraints	Rural women (N=80)					Urban women (N=75)				
	Yes	No	Do not know	M	SD	Yes	No	Do not know	M	SD
Sunlight irregular	20	58	04	2.71	.62	15	50	10	2.78	.47
Family size	60	12	08	1.72	.71	26	40	09	2.43	.56
Length of cooking	56	6	20	1.84	.74	50	18	07	1.56	.73
Attitude	72	04	04	1.46	.82	60	10	05	1.24	.64
Box can easily spoil while folding	30	20	30	2.25	.74	55	15	05	1.34	.57
High initial cost	72	04	04	1.46	.56	60	05	10	1.23	.88
Cannot cook all types of food	65	05	10	1.47	.82	62	10	03	1.21	.69

Note. Source: Field data, 2007

For the rural women, family size constitutes an obstacle to its usage as they operate the extended family system where all members eat together at each meal. Using a small size of solar pot to cook food is therefore not ideal for them. However, the urban women of Bamako do not consider this a constraint because most of them live in the low cost two or three- bedroom apartment or bungalows where there is limited space for extended family members.

Length of cooking is seen as a constraint for both groups of women. According to them, having to wait for the sun is a problem, especially on rainy and cloudy days. They claimed that their husbands and children would not bear it and this could lead to tension. Apart from waiting time, they also claimed that solar cooking is slow compared to wood or charcoal.

The two groups of women agreed that ‘attitude’ is an important factor in the usage of the solar box cookers. They are used to preparing food with wood and charcoal and this is difficult to abandon. Also, they claimed that their husbands appreciated the smell of smoke on the food and that it was also an indication that the women are hard working.

It is also not in their culture to mix all ingredients and just leave it without tasting it until the food gets cooked. They believe that the ingredients are added one at a time and not everything at once. They affirmed that foods should be stirred gradually until it gets cooked. They also claimed that they are used to cooking with big iron pots and not the small metal pots prescribed for solar cookers. The women believed that they were used to staying in the shade to prepare their food and that looking into the sun directly may cause some health problems for them.

The two groups also believed that the carton material used to make the box does not allow for its durability. Also, one has to buy more than one solar cooker to prepare for large families so as to get all food components ready at the same time for the family. This makes the solar cooker rather costly. Finally, the two groups of women believed that the solar box cooker cannot be used to prepare all types of food, especially the staple dish, “tuo,” that needs turning throughout its preparation.

*Recommendations to Improve the Use of the Solar Box Cooker
by Rural Women of Koulikoro, Urban Women of Bamako,
and the Ministry Officials*

Increased sensitization of the public about the advantages of the solar box cooker and how it can help contribute to solving energy problem in Mali at the local, regional and national levels by the national extension officers and through the media such as the radio, newspapers and the television (programs and jingles) will help improve its popularity. All the respondents also agree that organizing training workshops for women groups especially in the rural areas will help increase their knowledge level and usage of the solar box cooker. Due to high cost of the cooker and the need to have more than one, subsidy by the government is recommended. Government intervention in the form of implementation of the law against deforestation and unofficial wood cut should be strengthened. Finally, the respondents recommended the use of more durable materials like plastic and pots of bigger capacity to make it more adaptable to the local needs and conditions.

Table 6

Recommendations by Rural Women, Urban Women, and Ministry Officials to Improve the Use of the Box Solar Cooker in Mali, 2007

Items	Rural women%	Urban women%	Ministry officials%
Sensitization	100	100	100
Training workshops in the rural areas	100	100	100
Subsidy	100	100	100
Government intervention	78.71	100	100
More durable materials and pots of bigger capacity	86.19	100	95

Note. Source: Field data, 2007

Conclusion

Solar cooker usage among rural women of Koulikoro and urban women of Bamako is still at the awareness stage. A lot of sensitization is needed to increase their awareness and basic knowledge of the solar cooker as well as training on usage. Prototypes should be distributed to women after training to encourage usage at home. Extension agents need to be involved in the diffusion of the technology and spread of news about energy problems in Mali.

Educational importance

This study is to help the government, NGOs, officials of the ministry, and manufacturers of the solar box cooker understand that it is not yet adopted as a complementary option to wood fuel by the rural women of Koulikoro and urban women of Bamako. Attitudes, unit cost, and cooking time are important constraints to its acceptability. Extension agents, NGOs, and the government have a key role to play in its adoption by the population.

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