A COMPARATIVE STUDY ON THE UTILIZATION AND ECONOMICS OF THE TRADITIONAL AND THE IMPROVED-BIOMASS WOODCHARCOAL COOKSTOVES

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ABSTRACT

This study was conducted to compare the utilization and economics of the traditional and the improved-biomass woodcharcoal cookstoves. The study is primarily a comparative type of research design. The participants were the 64 respondents who are using woodcharcoal cookstoves as the main cooking device for their family. The information needed were collected using a questionnaire, which consists of the following items: (a) design, (b) operation, and (c) economics of using the stoves. Data gathered were processed with the use of a computer and were analyzed using SPSS version 11. Analysis of the data includes both descriptive analysis (i.e., frequency, percentages, mean, and Cramer's V) and inferential analysis (i.e., chi-square). Economics of using the stoves was also determined by analyzing the operating costs. Highlight of the findings are: the improved cookstove has better design and operation features than the traditional stove; economic analysis showed that the improved cookstove has lesser operating cost that the tradition, with a difference of P5.00 per hour in favor of the improved one; and because of these considerations, utilization of the improved cookstove is more preferred over the traditional. Based on the foregoing findings, it is concluded that the improved cookstove has better design and operation features than the traditional. It has also lesser operating cost and is more preferred over the traditional.

INTRODUCTION

Background and Rationale of the Study

Fuel cost for domestic cooking is fast increasing. Many households are getting interested in biomass fuel because of the energy saving on fuel that can be derived. And among the biomass fuel, fuelwood has the largest contribution of 63.60% (Elauria, 1999).

Mainly, biomass energy is used to cook food using either the traditional or improved cookstoves (ARECOP, 2003). The use of traditional woodcharcoal cookstove has already been introduced in the past. Many have been and are still using such kind of stove in the rural areas as well as in the marginal sector in the

urban areas. In one day cooking, about one and a half kilos of wood charcoal will be needed by a single household alone. At P5.00 per kilogram of wood charcoal (one plastic pack), a family would spend an average monthly cost of P450.00 on fuel. Although the investment cost of traditional cookstove is much cheaper compared with that of LPG, kerosene, and electric stoves, the monthly expense on fuel seems to result in a much higher operating cost.

Barnes, et al. (1993) pointed out that modern improved stoves can be an important bridge for the millions of people who either do not have access to low-cost, readily available biomass from local woodlands or are unable to afford the high-cost, more expensive modern fuels. According to them, to perform that function, stove programs must identify the groups that can benefit most from improved stoves and determine if it is technologically feasible to design and produce a stove that is both efficient and meets their cooking needs.

In order to help households reduce fuel cost incurred and minimize excessive use of forest wood, the Appropriate Technology Center of the Department of Agricultural Engineering and Environmental Management, College of Agriculture, Central Philippine University has designed an improved biomass woodcharcoal cookstove (Belonio, 2003). The promising performance and the potential of the technology for mass utilization in the Philippines has led the Aprotech Asia and the Asia Regional Cookstove Program (ARECOP) in Indonesia to promote and disseminate the technology in the country. Performance testing and evaluation of the stove has shown a thermal efficiency of up to 32 percent, which is so far the highest among the improved biomass cookstoves in the Asian region. However, before the stove is to be disseminated throughout the country and probably in the Asian region, a comparative study on the use of this biomass improved cookstove as against the traditional stove should be conducted to further determine its advantages and the benefits to end users.

Objectives of the Study

The general objective of this study was to compare the utilization and economics of the traditional and the improved-biomass woodcharcoal cookstoves. Specifically, it aimed:

1. To describe the design and operation features of the cookstoves and determine which of the charcoal cookstoves is better in terms of design and operation;
2. To find out which type is more preferred to use by the respondents;
3. To identify the respondents' reasons for their preference;
4. To determine whether the design and operation features of the cookstoves significantly influenced the respondents' utilization preference; and

5. To analyze the economics of using the traditional and the improved-biomass charcoal cookstoves in terms of operating cost per hour.

Theoretical Framework

The assume relationship between design and operation features and the utilization of cookstoves is anchored on the theory of product design. This theory states that "demands of consumer markers for a particular good is influenced by product's appearance, quality of material, production efficiency, functionality, and cost of fabrication (Millevo, 1995).

Millevo (1995) further added that good design and product performance have always meant good business. In todays competitive market, manufacturers can no longer afford to take product design and development for granted. Consumers are learning to be choosy due to a surplus in many products. It is no longer the question of which product employs the cheapest means of production but rather which product offers the best features.

Conceptual Framework

The utilization and economics of any cookstove are influenced by factors such as design and operation. In this study, it is assumed that design and operation features of cookstoves influenced the utilization and the economics of the woodcharcoal cookstoves. To determine differences in the design between the traditional and the improved cookstoves, the following indicators were used: durability, quality of materials used, beauty and shape, portability, and appropriateness of size for family cooking requirement. To determine differences in operation between the two charcoal cookstoves, on the other hand, the following indicators were used: loading of fuel, ignition time, cooking and boiling performance, fly ash, smoke emission, fuel consumption, and ash removal.

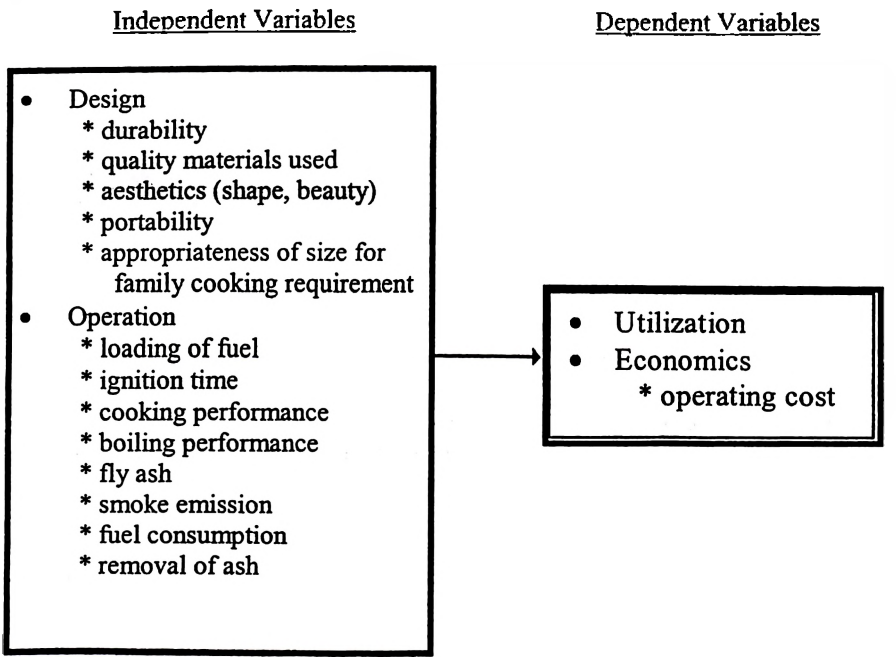

Figure 1. Schematic Diagram of the Assumed Flow of Relationship between the Design and Operation Features to the Utilization and Economics of the Woodcharcoal Cookstoves.

Significance of the Study

Results of this study would promote awareness to the people in the locality. It would benefit primarily the households for they would be informed of the availability of a cooking device that is more efficient and more economical to use than the existing cookstoves in the market. Also, those entrepreneurs who are engaged in food service like "carinderias" in the nearby places would likewise be benefited.

Scope and Limitation of the Study

This study was conducted among housewives, students as well as husbands, regardless of their place of residence in Iloilo. Eighty-five participants were given a pair of cookstoves and a questionnaire, however, only 64 returned the accomplished questionnaire. The study was conducted from April to July, 2004.

METHODOLOGY

Research Design

The study is primarily a comparative type of research design. In this study, the improved-biomass cookstove was compared with the traditional cookstove. One traditional and one improved-biomass cookstove were provided to the participants for them to use.

The Participants

The participants of the study were of varied occupation who are using woodcharcoal cookstove as the main cooking device for their family. Quota sampling was employed by giving out 85 traditional and 85 improved-biomass cookstoves to 85 individuals. But out of this number, only 64 were able to return the filled up questionnaires.

The participants were oriented on the rationale and the mechanics of the study so that they would be willing to provide accurate information that are needed in achieving the objectives of the study.

Preparation of Stoves

A total of 85 traditional stoves and an equivalent number of improved-biomass cookstoves were prepared for the study and were given out to the participants. The traditional cookstoves were obtained from Jibao-an, Pavia, where the stoves are being mass-produced and sold. On the other hand, the improved biomass cookstoves were obtained from the CPU Appropriate Technology Center, where the technology was developed.

Research Instrument

A questionnaire was prepared to gather the needed information for the study. The questionnaire generally consists of the following items: (a) design which include durability, quality of materials used, aesthetics, portability, and appropriateness of the size for family cooking requirement; (b) operation which include loading of fuel, ignition time, cooking performance, boiling performance, presence of fly ash, smoke emission, fuel consumption, and removal of ash; and (c) economics of using the stoves which include operating cost.

Data Gathering Procedure

Copies of the questionnaire were given to the participants of the study upon giving them the stoves. The participants were given at least a month to use the cookstoves then the questionnaires were retrieved. During retrieval of the instrument, it was found out that there were participants who were not able to locate the instrument and, so they were given another copy. But, not all of them who were given a second copy of the instrument were able to return it.

Data Processing and Analysis

All the data gathered were processed with the use of a computer and analyzed using SPSS version 11. Analysis includes descriptive statistics (i.e., frequency, percentages, mean, and Cramer's V) and inferential statistics (i.e., chi-square test).

The results of the chi-square test were further subjected to Cramer's V test to determine the extent of influence of the stoves' design to their utilization. Likewise, the extent of influence of operation features on the utilization of the stove was also determined using the same test.

Cramer's V values with the corresponding description are as follows (http://www.ag.ohio_state.edu/~agred887/sessions/third.html):

Value	Description
0	No relationship
0.01 - 0.10	Very weak relationship
0.11 - 0.25	Weak relationship
0.26 - 0.50	Moderate
0.51 - 0.75	Strong relationship
0.76 - 0.99	Very strong relationship
1.0	Perfect assocaition

Moreover, the economics of using the stoves was also analyzed by computing their operation cost.

RESULTS AND DISCUSSIONS

Respondents' Profile

Data in Table 1 show the distribution of respondents in terms of age, occupation, and place of residence. The age of the respondents ranges from 17 to 64 years, with the mean age being 37 years old. But, most (31.3%) are under the 20 to 29 years old category. As to occupation and place of residence, most (37.6%) of the respondents are housekeepers or housewives and with the great majority (81.2% coming from within the city.

Utilization of Woodcharcoal Cookstoves

The distribution of respondents as to their utilization of cookstoves is shown in Table 2. More than half of the respondents (51.6 %) reported that they are using the cookstove every meal preparation. When it comes to type of utilization, majority of them use it for cooking (82.8 %), boiling of water (68.8 %), frying (67.2 %), and grilling (56.3 %).

Design Comparison

The design of the cookstoves used in this study were compared in terms of durability, quality of materials used, shape and beauty, portability, and appropriateness of size for family cooking requirement (Table 3). Most of the respondents favored the improved cookstove as to durability and quality of materials used (82.8%), attractiveness in terms of shape and beauty (78.1%), portability (59.4%), and appropriateness of size for family cooking requirement (67.2%).

Operation

As shown in Table 4, the majority (59.4%) of the respondents claimed that it is easier to load fuel to the improved cookstove and favored the same in terms of ignition time. For the questions "which can cook faster" and "which can boil faster," most (76.0 and 78.1%) respondents chose the improved cookstove.

Most pf the respondents also favored the improved cookstove because of it has less fly ash (78.1%), less smoke emission (76.6%), less fuel consumption (78.1%) and easy ash removal (56.3%) (Table 5).

Table 1. Distribution of Respondents in Terms of Age, Occupation, and Place of Residence (N = 64)

Profile	Frequency (f)	Percentage (%)
Age		
60 & above	4	6.3
50 – 59	13	20.3
40 – 49	10	15.6
30 – 39	10	15.6
20 – 29	20	31.3
19 & below	7	10.9
Total	64	100.0
Mean	37	
Occupation		
Student	15	23.4
Driver	1	1.6
Welder	1	1.6
Barangay official	1	1.6
Employee	3	4.7
Housekeeper/Housewife	24	37.6
Church worker	3	4.7
Teacher	7	10.9
Vendor	3	4.7
Househelper	2	3.1
Storekeeper	1	1.6
Dentist	1	1.6
Laborer	2	3.1
Total	64	100.0
Place of Residence		
Outside the city	12	18.8
Within the city	52	81.2
Total	64	100.0

Table 2. Distribution of Respondents as to Their Utilization of Woodcharcoal Cookstoves (N = 64)

Utilization	Frequency (*f*)	Percentage (%)
Frequency of using the charcoal stove		
Once a day	2	3.1
Twice a day	6	9.4
Thrice a day	9	14.1
Every meal preparation	33	51.6
When LPG is not available	9	14.1
When needed	5	7.8
Total	64	100.0
Type of activity where the stove is being used (Multiple Response)		
Cooking	53	82.8
Broiling	28	43.8
Grilling	36	56.3
Frying	43	67.2
Steaming	17	26.6
Boiling of water	44	68.8
Roasting	1	1.6
Barbeque	1	1.6

Table 3. Distribution of Respondents as to which of the Woodcharcoal Cookstoves has Better Design in Terms of Durability, Quality of Material Used, Shape and Beauty, Portability, and Appropriateness of Size for Family Cooking Requirement

Design Features	Frequency (*f*)	Percentage (%)
More durable		
Traditional cookstove	7	10.9
Improved cookstove	53	82.8
Both	4	6.3
Total	64	100.0
Better quality material used		
Traditional cookstove	8	12.5
Improved cookstove	53	82.8
Both	3	4.7
Total	64	100.0
More attractive in terms of shape and beauty		
Traditional cookstove	10	15.6
Improved cookstove	50	78.1
Both	4	6.3
Total	64	100.0
More portable		
Traditional cookstove	24	37.5
Improved cookstove	38	59.4
Both	2	3.1
Total	64	100.0
More appropriate size for family cooking requirement		
Traditional cookstove	13	20.3
Improved cookstove	43	67.2
Both	8	12.5
Total	64	100.0

Table 4. Distribution of Respondents as to the Operation Features of the Woodcharcoal Cookstoves in Terms of Loading of Fuel, Ignition Time, Cooking and Boiling

Operation Features	Frequency (f)	Percentage (%)
Easier to load fuel		
Traditional cookstove	18	28.1
Improved cookstove	38	59.4
Both	8	12.5
Total	64	100.0
Takes shorter time to ignite		
Traditional cookstove	29	45.3
Improved cookstove	30	46.9
Both	5	7.8
Total	64	100.0
Can cook faster		
Traditional cookstove	8	12.5
Improved cookstove	49	76.6
Both	7	10.9
Total	64	100.0
Can boil faster		
Traditional cookstove	8	12.5
Improved cookstove	50	78.1
Both	6	9.4
Total	64	100.0

Table 5. Distribution of Respondents as to the Operation Features of the Woodcharcoal Cookstoves in Terms of Presence of Fly Ash, Smoke Emission, Fuel Consumption, and Ash Removal.

Operation Features	Frequency (f)	Percentage (%)
Less fly ash		
Traditional cookstove	8	12.5
Improved cookstove	50	78.1
Both	6	9.4
Total	64	100.0
Emits less smoke		
Traditional cookstove	10	15.6
Improved cookstove	49	76.6
Both	5	7.8
Total	64	100.0
Less fuel consumption		
Traditional cookstove	9	14.1
Improved cookstove	50	78.1
Both	5	7.8
Total	64	100.0
Easy to remove ash		
Traditional cookstove	18	28.1
Improved cookstove	36	56.3
Both	10	15.6
Total	64	100.0

Respondents' Preference

As to their preference between the two types of cookstoves (Table 6), it is evident that most (67.2%) of the respondents preferred to use the improved cookstove. It can further be observed from Table 7 that in terms of the design, most of the respondents favored the improved cookstove. This is supported by 82.8% of the respondents who claimed that they prefer the improved cookstove because of its durability and quality of materials used, and 78.1, 59.4, and 67.2% of the respondents who reported that their preference for the improved cookstove is due to its aesthetics, portability, and appropriateness of the size for family cooking requirement, respectively. Results of the chi-square test showed that these design features are significantly related to the stove preference of the respondents, as indicated by asymptotic significance value of .000.

Furthermore, results of Cramer's V test indicated that durability, portability, and appropriateness of size for family cooking requirement are moderately related to the respondents' preference on the type of cookstove, while quality of material used and aesthetics are strongly related to the respondents' preference.

Table 6. Distribution of Respondents as to their Preference Between the Two Types of Charcoal Cookstoves

Type of Charcoal Cookstoves	Frequency (*f*)	Percentage (%)
Traditional cookstove	7	10.9
Improved cookstove	43	67.2
Both	14	21.9
Total	64	100.0

Table 7. Distribution of Respondents According to Their Preference on the Type of Charcoal Cookstove as Influenced by Their Design

Design Features	Type of Cookstove						Total	X^2 Value	Sig.	Cramer's V	Description
	Traditional		Improved		Both						
	f	%	f	%	f	%					
Durability	7	10.9	53	82.8	4	6.3	64	29.508	.000	.480	Mod
Quality of material used	8	12.5	53	82.8	3	4.7	64	49.950	000	.625	Strong
Aesthetics (beauty & shape)	10	15.6	50	78.1	4	6.3	64	57.583	.000	.671	Strong
Portability	24	37.5	38	59.4	2	3.1	64	20.288	.000	.398	Mod
Appropriateness of size for family cooking requirement	13	20.3	43	67.2	8	12.5	64	21.899	.000	.414	Mod

Mod – Moderate

As previously shown in Table 4 and 5, preference for the improved cookstove by most of the respondents was influenced by its different operation features. Result of chi-square analysis revealed a highly significant association between stove preference and the different operation features (Table 8). Moreover, the results of the Cramer's V analyses showed that operation features such as cooking and boiling performance, fly ash, smoke emission, fuel consumption, and ash removal are strongly associated with utilization preference. On the other hand, loading of fuel and ignition time are moderately associated with cookstove utilization preference.

Table 8. Distribution of Respondents According to Their Preference on the Type of Charcoal Cookstove as Influenced by Operation Features of the Cookstoves

Operation Features	Type of Cookstove						Total	X^2 Value	Sig.	Cramer's V	Description
	Traditional		Improved		Both						
	f	%	f	%	f	%					
Easy to load fuel	18	28.1	38	59.4	8	12.5	64	29.309	000	.476	Mod
Horter ignition time	29	45.3	30	46.9	5	7.8	64	20.559	000	401	Mod
Cook fast	8	12.5	49	76.6	7	10.9	64	42.057	.000	.573	Strong
Boils water fast	8	12.5	50	78.1	6	9.4	64	34.437	000	519	Strong
Less fly ash	8	12.5	50	78.1	6	9.4	64	49.307	000	621	Strong
Less smoke emission	10	15.6	49	76.6	5	7.8	64	43.922	000	586	Strong
Less fuel consumption	9	14.1	50	78.1	5	7.8	64	45.768	000	598	Strong
Easy as removal	18	28.1	36	56.3	10	15.6	64	36.574	000	535	Strong

Mod - Moderate

Reasons for Using the Improved Cookstove

Listed in Table 9 are the reasons of the respondents for using the improved cookstove. The top three reasons cited by the respondents are: it is economical, it cooks faster, and it is convenient to use as claimed by 41.0, 14.4, and 12.0% of the respondents, respectively.

Economics of Using the Stove

The economics of using the stove was analyzed by computing the operating cost of the stove. This was determined by getting the average amount of fuel consumed per cooking and then multiplying it by the cost of fuel per pack.

Table 9. Distribution of Respondents as to Their Reason(s) for Using the Improved Cookstove (Multiple Response)

Reasons	Frequency (*f*)	Percentage (%)
Economical/consumes less fuel	34	41.0
Easy to clean	6	7.2
Cooks faster	12	14.4
Less time to cook	5	6.1
Clean and neat	2	2.4
Durable	5	6.1
Easy/convenient to use	10	12.0
Easy to load fuel	1	1.2
Can cook for a longer period/time	2	2.4
More efficient	4	4.8
Emits less smoke	2	2.4
Total	83	100.0

As shown in Table 10, the improved cookstove consumes 0.5 to 1 pack of charcoal fuel for 15 to 30 minutes, or an average of 2 packs per hour; while the traditional cookstove consumes 1.5 to 3 packs of fuel for 30 to 60 minutes, or an average of 3 packs per hour.

The claim by the respondents that the improved cookstove is economical to use (Table 9) is affirmed by the economic analysis (Table 10), which shows that the cost of operating the improved cookstove for one hour is only P10.00 while that for the traditional is P15.00.

Table 10. Operating Cost Analysis of Using the Improved Cookstove

Item	Traditional Cookstove	Improved Cookstove
Average number of pack of charcoal fuel consumed per cooking	1.5 to 3 packs	0.5 to 1 pack
Cost per pack of fuel	P5.00	P5.00
Cooking time per pack of fuel	3- to 60 min	15 to 30 min
Number of types of food cooked	1 to 4	2 to 4
Operating cost per hour (# of packs of fuel consumed x cost of fuel per pack)	P15.00	P10.00

As further shown in Table 10, a pack of fuel worth P5.00 can cook 2 to 4 types of food using the improved cookstove while the same amount of fuel can cook only 1 or 2 types of food using the traditional cookstove.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the foregoing findings, it can be concluded that the improved cookstove has a better design (i.e., durability, quality of materials used, aesthetics, portability, and appropriateness of size for family cooking requirement) and operation (i.e., loading of fuel, ignition time, cooking performance, boiling performance, presence of fly ash, smoke emission, fuel consumption, and ash removal) features than the traditional. It has also lesser operating cost. Because of these considerations, utilization of the improved cookstove is more preferred over the traditional.

Recommendations

Based on the aforementioned findings and conclusions, the following acitons are suggested:

1. Information dissemination on the advantages of the cookstove must be done.
2. The improved cookstove model should be made available in the market, after improvements on operation features, such as loading of fuel and ash removal are incorporated.
3. After the improved cookstove is made commercially available, a study on its acceptability should be undertaken among users of more varied occupations.

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