

Full Length Research Paper

Perceived shortcomings of Mirte stove in Ethiopia: The case of Agarfa District, Oromia Region, Ethiopia

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The national energy balance indicates that traditional fuels (wood, charcoal, agricultural residues and animal waste) meet 94% of the total energy supplied and that the household sector accounts for 90% of the total energy consumed in the country. The vast majority of Ethiopian households depend on the open fire stoves with very poor fuel efficiency. Due to the shortage of firewood growing in Ethiopian communities, baking injera on open fire is becoming increasingly expensive. Currently Mirte injera baking stove has been produced and promoted to improve the livelihoods of the rural and urban households in the country. The major concern of this study was to identify the major shortcomings of the Mirte stove being promoted as perceived by the households: the case of Agarfa district, Oromia region. A two stage random sampling procedure was employed to draw 120 sample households from four sample Kebeles. Descriptive statistics were employed in the study. The results of the study showed that there are some major shortcomings of Mirte stove. The overall findings of the study underline the importance of strengthening institutions that can continuously following up the perceived shortcomings of Mirte stove and make necessary improvements and modifications on it. Thus, research should re-examine the shortcomings of the Mirte stove.

Key words: Injera, perception, shortcoming, stove, technology.

INTRODUCTION

According to Adkins et al. (2010), roughly half of the world's population burns solid biomass fuels for cooking

and heating needs. They also mentioned that throughout poor, rural areas of sub Saharan Africa, biomass is the

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dominant fuel, and cooking is usually performed using a simple three-stone fire or “open fire”.

In Ethiopia, lack of energy infrastructure creates formidable impediments to social and economic progress. Over three quarters of the population have no access to modern energy or electricity; millions of women and children trek for long hours to collect the fuel wood; and urban dwellers spend large proportions of their income on their minimum daily fuel needs. To date, the two most used energy resources are biomass (mainly firewood) and hydro-resources. The development of hydro potential until recently was very low, considering the long years of attempting such development. Major factors causing this low development, especially in connection with the grid, are the high investment cost for power generation and lack of local capacity other than that of the government institution, Ethiopian power corporation (Legesse and Meskir, 2008).

The vast majority of Ethiopian households (93%) depend on open fire stoves with a very poor fuel efficiency of 10 to 12% (EREDPC, 2007; Ephrem, 2008). Ephrem (2008) also indicated that alternative energy exploitation at the moment is very low in Ethiopia, mainly because the necessary technologies are not easily available or, where available, are either very expensive or cheap but short-lived. This makes the cost of exploiting the resources very high for Ethiopian households, thereby making access to and appropriation of energy technologies dependent on economic capacity.

According to MacCarty et al. (2010), “manufactured” stoves are produced entirely in factories, either domestic or international, and then transported to villages as a finished product. According to Eckholm (1975) and Arnold et al. (2003), dissemination of improved cooking stoves date back to the 1970s and till the new millennium, the major focuses were more importantly to develop stoves for increasing fuel efficiency, often because of supposed relationship between deforestation and household energy.

In recent decades, efforts have been undertaken to design, build and promote improved stoves in many parts of the world in the development of a wide variety of stove types employing a range of materials, design features and production processes; and some stove models are made by local artisans in or near the home using locally-available materials such as mud, dried grasses and anthill/termite soil (Adkins et al., 2010). In the study of Smith and Haigler (2008) and review of Johnson et al. (2009) indicated that efforts have been exerted to improve the health of people by minimizing air pollution, possible hazards of traditional stoves, while cooking and climate change impacts of the stove.

The people in Ethiopia rely on injera as their primary source of food. The most valued grain used to make injera is from the tiny, iron-rich teff (BiD Network, 2006). Traditional injera baking has unique requirements. It needs a quick, fast heat, evenly distributed over a 60 cm

ceramic plate. The flat plate or mitad is balanced upon three stones above the open fire and fuel is fed under the mitad (plate) from all directions. While this produces hot, fast flames which are essential for good injera, the energy consumption is highly inefficient that approximately 93% of the fuel is wasted which is unsafe and unhealthy (Gaia Association, 2008).

Due to the shortage of firewood growing in Ethiopian communities, baking injera on open fire is becoming increasingly expensive. Women and young children have to walk many miles a day to collect firewood to feed their families (BiD Network, 2006). Saving energy as well as the overcoming the tragedy of collecting fire wood and other fuel from long distance is totally difficult. In addition to this when injera is baked on traditional mitad highly flammable fuels, such as leaves and twigs, are used by cooks to generate enough heat necessary to cook injera quickly. However, these practices often flare out as the cooks ignite, causing injury through burns. Large amounts of smoke produced by these fires and many women complain about constant stinging eyes and coughing. In a country like Ethiopia, where most of the sources of energy is from biomass, there is reduction in fire wood that baking injera and other local pancakes on open fire is becoming increasingly expensive. Baking injera and other local pancakes on open fire is causing injury through burns, many women and children are spending their time to collect firewood to feed their family.

Currently, in many parts of the country Mirte injera baking stoves have been increasingly utilized both in rural and urban areas. Women are the primary beneficiaries of the improved stoves as household bakers or cooks and as small-scale commercial injera bakers who bake and sell from their homes and often depend on injera baking as their source of income. The Mirte stoves have appealed to large number of household bakers or cooks and commercial bakers, because the stove takes the smoke away from the cook, reduces the quantity of smoke through more complete combustion, protects bakers or cooks from flames and, of course, reduces energy consumption and expenditure.

Mirte stove has been produced and promoted to improve the livelihoods of the rural and urban households in Bale Zone. Considerable efforts have been made by Children and Women’s Affairs Office and Home Economics Office of the district to disseminate the stoves. In spite of these efforts, there are no studies which show the perceived shortcomings of this Mirte stove in the study area. Moreover, since households can discontinue using Mirte stove due to the drawbacks of the technology which would be observed where using it, conducting research on this regard would help to indicate the perceived shortcomings to the designers of the stove for further improvements and modifications. Therefore, this study gives the hindsight on the users’ perception on shortcomings of Mirte stove and the rationale of this study revolves around the following question. What are

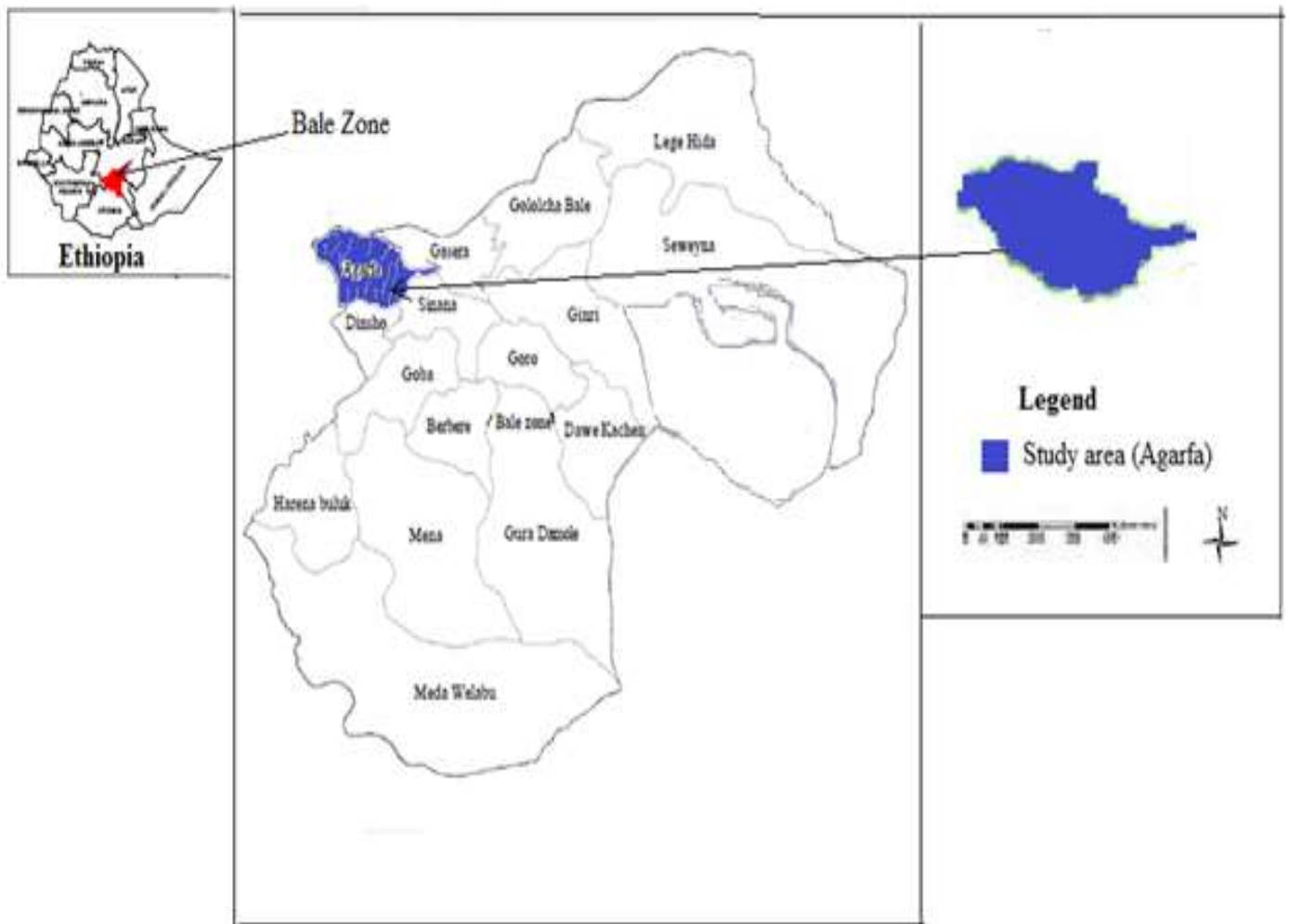


Figure 1. Map of the study area (Bale Zone Finance and Economic Development Department (BFEDD), 1999).

the shortcomings of Mirte stove as perceived by the households in the study area?

RESEARCH METHODOLOGY

Description of the study area

This study was conducted in Agarfa district, which is found in Bale zone of the Oromia National Regional State. The district has 20 Kebeles (smallest administrative organs). Population is unevenly distributed in district. The majority of population is engaged in agricultural activities and the rural population has 86 % out of the total population of the district. Thus, there are high concentrations of population in the rural areas of the district than in the urban areas. The urban population has only 14% of total population. This indicates that the majority of the livelihood of Agarfa district population depends highly on agricultural activities. Almost all households living in the district are using fire wood, animal dung and crop residues as dry fuel for baking and cooking food items (Figure 1).

Data collection and sampling techniques

Primary data was collected from users of Mirte stove using interview schedule, key informants interview, and focus group discussions.

In this study the sample size was determined by taking different factors in to consideration such as research costs, time, human resource, accessibility and availability of transport facility. By taking these factors into account, it was fixed to cover four Kebeles out of 22 Kebeles. A two stage random sampling procedure was employed to draw the sample Kebeles and households. In the first stage of sampling, four major user Kebeles were selected purposively and listed separately based on the information received from: Children and Women's Affairs Office, Home Economics Office, Women's Association of the district and private producers of the Mirte stove. In the second stage, a total of 120 sample women users were selected based on probability to proportional sample size using systematic random sampling from each Kebeles. Since users of the users of the stove could have better understanding about its shortcomings, only users were considered as sample respondents. The total sample household from each sample Kebele is indicated in Table 1.

Table 1. Number of sampled HH by Kebeles; Agarfa district, Bale Zone, Ethiopia (Office of Agriculture, Agarfa district).

Name of Kebeles	Total	
	Total HH	Sampled HH
Ambentu	1100	22
Ali	943	19
Elani	941	19
Agarfa	3041	60
Total	6025	120

Table 2. Results of continuous explanatory variables (Survey result, 2011).

Variable	Users (N=120)			
	Min	Max	Mean value	SD
Age of the women in years	18	60	36.8	9.7
Family size of households in adult equivalent	1	15	6.9	3.1
Total income of households in Birr	40500	94756.8	650596.4	13564.2
Injera baking experience in years	5	45	22.5	9.8

N: Total sample size; Min: minimum value; Max: maximum value; SD: standard deviation.

Two women user focus groups discussions were constituted various wealth and age groups taken into considerations to generate the data required for the study. The first focus group was consisting of 8 women and was conducted in Ambentu Kebele. The other focus group was consisting of 10 women and was conducted in Elani Kebele.

Individual interviews were conducted with the key informants, workers of Mirte stove supplier agency, concerned district officials, private producers of Mirte stove, and children and women's affairs office (supplier of Mirte stoves) in the study area.

Method of data analysis

Descriptive analysis

Descriptive statistics such as frequency and percentage were used to identify perceived shortcomings of Mirte stove. The latest SPSS version was used to analyze quantitative data. Items that could not be captured through quantitative analysis was analyzed qualitatively using triangulations based upon group discussion and interview with private producers of the stove, key informants, and children and women's affairs office.

RESULTS AND DISCUSSION

Personal and demographic, socio-economic and other characteristics of sample households

The descriptive statistics of some selected characteristics of sample respondents examined in this study are presented in Tables 2 and 3. Continuous explanatory

variables as well as dummy and discrete explanatory variables are presented, accordingly (Table 2 and Table 3).

Age of the women: The results of this study indicate that the age of users of Mirte stove at study area was ranging from 18 to 60 years with the average of 36.8 years with a standard deviation of 9.7.

Family size of households: In this study, it was observed that the mean family size of the sample households was 6.9 in adult equivalent. The family size ranges from 1 to 15 members per family.

Total income of households: It includes income from farm, off farm and nonfarm income of the households. In the study area, the major sources of farm cash income were from the sale of wheat, barley and pepper. The major off farm income sources are labor employment in farm activities and trading grains. There are also sources of non-farm income, petty trade, employment in governmental offices and house rent in some parts of the study area. As it can be seen from Table 2, the average total annual income of the sample households was ETB 650596.4 with standard deviation of ETB 13564.2

Injera baking experience: As far as the experience of baking injera is concerned. The result indicates that the most experienced women in injera baking was 45 years, while the least experienced women in injera baking

Table 3. Case summary results of dummy/discrete explanatory variables (Survey result, 2011).

Variables		Users (N=120)	
		f	%
Education level of the woman	Unable to read and write	29	24.3
	Only able to read and write (only adult education)	18	14.9
	Primary education (1-6)	37	31.1
	More than primary education (>6)	36	29.7
Marital status of the respondents	Single	27	22.7
	Married	93	77.3
Have you been facing shortage of dry fuel in your households?	Yes	92	77
	No	28	23

f: Frequency; N: total sample size.

was 5 years. The sample respondents had an average injera baking experience of 22.5 years with a standard deviation of 9.8.

Education level of the woman: People need enough information about a technology to make the right decisions and choices. Education enhances the capacity of individuals to obtain, process, and utilize information disseminated through different sources. The result of this study shows that the proportion of women who attended primary level of education and who acquired more than primary education were 31.1 and 29.7%, respectively, whereas women who were unable to read and write, and who were only able to read and write (who attended only adult education) were 24.3 and 14.9% , respectively.

Marital status of the respondents: This refers to whether the woman is married or single (represents widowed or divorced). As indicated in Table 3, the amount of married respondents was 77.3%, whereas that of single respondents was 22.7%.

Shortage of fuel to the households: This refers to whether the sample respondents had faced fuel shortage problem for baking injera. It might have cost implication to buy fuel wood. As presented in Table 3, 77 % of the total sample households had shortage of fuel for baking injera and 23% of them had no shortage of fuel for baking injera.

Perceived shortcomings of Mirte stove

Shortcomings of Mirte stoves were listed based on the preliminary test (by discussing with key informants, concerned officials of Mirte stove supplying agencies and private producers of the stove) conducted before data collection. During the discussions while the preliminary

test was conducted, the shortcoming of the Mirte stoves were listed as perceived by households. They include; first, the stove is not flexible and cannot be adjusted for various plates' sizes, secondly, the stove cannot therefore cook different food items other than injera, thirdly, it requires fixed space and finally the stove is not comfortable to burn up the fuels properly.

To identify perceived shortcomings of Mirte stove, users of Mirte stove were considered as the major respondents since they could better know more about the technology than non-users of the technology.

The results indicates that the highest percentage (82.5%) of the total sample women rated that 'Non adjustability of Mirte stove for various plates sizes' was perceived as a very severe shortcoming, whereas 15% of the respondents perceived this shortcoming as less severe and only 2.5% of them did not perceived it as a shortcoming of the stove. The other similar shortcoming of Mirte stove is inability of the stove to cook different food items other than baking injera. As can be seen from the Table 4, 62.5 and 32.5% of women perceived the 'inability of the Mirte stove to cook different food items other than baking injera' as a very severe and less severe shortcoming of the stove, respectively. The remaining 5% of the women users categorized it as not a shortcoming (Table 4). During the focus group discussions, the women explained that Mirte stove is mainly used for baking injera and some local pancakes, rarely. It is because the Mirte stove is not comfortable to cook various cook food items like that of traditional stoves by adjusting the radiuses of Mirte stove to fit plates and pots with various sizes. The result of this study is similar with that of World Vision (2011) which indicated that Mirte improved stoves only accept cooking pots made to certain specifications such as cooking of Ethiopian injera. On the other hand, VITA volunteers (1980) showed that there are modern stoves such as the HERL or smokeless Chula in which the number of pot holes and the size and

Table 4. Perceived shortcomings of mirte stove (Survey result, 2011).

Perceived shortcomings of mirte stove	Response category (N=120)						Total	
	Not shortcoming		Less severe shortcoming		Very severe shortcoming		N	%
	F	%	f	%	f	%		
Non adjustability of the stove for various plates sizes	3	2.5	18	15	99	82.5	120	100
Inability to cook variety of food items other than injera	6	5	39	32.5	75	62.5	120	100
A fixed space requirement	6	5	52	43.3	62	51.7	120	100
Uncomfortable to burn up the dry fuel	76	63.3	39	32.5	5	4.2	120	100

f: Frequency; N: total sample size.

height of the stove can be adjusted to the user's needs.

A 'fixed space requirement of Mirte stove' was another perceived shortcoming of Mirte stove rated by the users. Table 4 shows that 51.7% of the total respondents perceived 'fixed space requirement of Mirte stove' as a very severe shortcoming and 43.3% of the women rated the fixed space required for Mirte stove as less severe shortcoming of Mirte stove whereas the remaining 5% of the respondents said that they had not perceived it as a shortcoming of Mirte stove. It might be due to the reason that once Mirte stove is fixed in a specific place then the space covered by the stove will not be used for other purposes by moving the stove to elsewhere but it is possible to use the space covered by the traditional stoves since they can easily be moved (portable) from one place to another place. This result is supported by World Vision (2011) which stated that different communities and individuals may have different criteria by which they evaluate a stove's merits – and often those criteria differ from the ones dictating a stove's design. Similarly, MacCarty et al. (2010) revealed that a stove may be designed to maximise energy efficiency and reduce smoke, for example, but stove users may also judge the model based on different factors such as convenience and the aesthetics of the stove.

The 'design of Mirte stove to burn up the dry fuel' was also considered as a shortcoming of the technology. From Table 4, 'design of Mirte stove to burn up the fuel' was not perceived as a shortcoming by 63.3% of the women users of Mirte stove whereas 32.5% and 4.2% of the respondents perceived it as a less severe shortcoming and very severe shortcoming of Mirte stove, accordingly. During the focus group discussions, the group members explained that EREDPC recommended them to utilize the energy that would be lost through the chimney by putting some pots for cooking food or boiling water. They, however, mentioned that putting a pot on the chimney actually is an obstacle for good composition of dry fuel since the pot blocks the water vapour and smoke not to create pressure difference so that air (oxygen) would draw in to firebox. This result is in line with the subsequent impact assessments of Kishore and Ramana (2002) which indicated the real benefits of introducing

improved cooking stoves in terms of fuel wood saving at the household level are likely to be far lower than the claims made in the annual reports of the ministry of non-conventional energy sources of India. The availability of sufficient air is a necessary factor for ensuring the complete combustion of the fuel wood (Ibid). Similarly, Olorunisola (1999) stated that the advantage of a high burn rate during the combustion of a solid fuel is the enhancement of the self-sustenance of the fire. According to the respondent of this study, they eliminated this problem by leaving the chimney open to draw water vapour and smoke out of the kitchen and to create a pressure difference so that air is drawn into the firebox rather than cooking food items or boiling water on it.

The shortcoming of Mirte stove which had not been notified as shortcoming of Mirte stove during the preliminary study and conducting the structured interview was the absence of designed edge of the stove to put the plate on. At the time of focus group discussion held in Ambentu kebele, Tigist Roman is one of the members said, "I lost two plates within a month while I was trying to put the plates on the recently produced Mirte stove for baking injera. This is due to the absence of designed edge to place the plate on." This shortcoming had also been shared by focus group of Elani. One member of focus group of Elani kebele explained, "The recently produced Mirte stove is cheaper than the previous one but it does not have a designed edge of the stove to put plates on the top which exposes the plates to be broken down". Similarly, one key informant from private Mirte stove producers mentioned that he produced a stove with designed edges to put a plate on it but he said that mirte stoves without designed edge had lower price in the market. The price of Mirte stove without designed edge was lower than Mirte stove with designed edge since designing edge of the stove needs special instrument and skill of producers. This shortcoming might appear because of lack of appropriate controlling mechanisms for stove standards. In the same line of the result of this study, MacCarty et al. (2010) and the World Bank (2011) implied that benchmarks for improved stove performance have been suggested, which may lead to international performance standards for cooking stoves.

The other perceived shortcoming of the currently produced Mirte stove (especially the one supplied by the district Children and Women's Affairs Office and Home Economics Office) had short life span that they were exposed to additional cost to replace those stoves. An expert from Children and Women's Affairs Office indicated that some customers were complaining about low quality of Mirte stoves which had being disseminated by their office. This might be because of materials used like cement, water, etc., and their mixtures for Mirte stove. This result is similar with that of VITA volunteers (1980) in which they indicated that the durability of a stove depends on the materials and construction skills used. Similarly, the World Bank (2011) indicated that use of varying sizes and low-quality construction materials reduced reliability, leading to user dissatisfaction.

During the focus group discussions, the group members were asked why they were still continuing to use Mirte stove by tolerating the perceived shortcomings. The users' focus group discussants in Ambentu and Elani Kebeles explained that Mirte stove technology has more relative benefits than the traditional three stone stoves for baking injera. The benefits of Mirte stove mentioned by the focus group members during the discussions were: its fuel saving efficiency, reduced burning accidents for the household members specially children from back flash fire, reduced production of smoke inhalation and increased cleanness of the kitchen for injera bakers. While conducting the discussion, Tigist Roman, one of the focus group members of Ambentu Kebele said, "Since I started using Mirte stove, my children have not spent much time on fetching fuel wood and animal dung due to fuel saving efficiency of the technology and like Mirte stove, I would also like to suggest to the government to produce other fuel saving cooking stoves which can help to cook different types of food items." One of the women in the focus group of Elani Kebele explained the smoke reduction and increasing cleanness of the technology as compared to the traditional three stone stoves as follow, "As the name indicates, it is true that Mirte stove is 'mirte' (best in English). Now, I am free from sneezing caused by irritation of nasal smoke inhalations and I can bake injera even within my 'Habesha libiss' (white Ethiopian traditional holiday dress) with no dust from the Mirte Stove." The discussant also witnessed that they bake injera only on Mirte stove when much amount of injera is needed to bake (e.g. for wedding ceremony and other social rituals) in their village because of its comfort According to the study conducted by Komolafe and Awogbemi (2010) in Nigeria, improved charcoal cooking stove had better performance in terms of total time taken for burning fuel, burn rate and efficiency compared with the traditional metal stove of the same design.

Generally, with these perceived shortcomings rated in Table 4 and mentioned during focus group discussions by the users of Mirte stove, the continuation of using the

technology was preferred by sample users. This preference was due to the fact that there are better cumulative relative benefits of Mirte stove than the traditional three stone stoves only to bake injera and some local pancakes.

CONCLUSION AND RECOMMENDATIONS

Mirte stove has been produced and promoted to improve the livelihoods of the rural and urban households in Agarfa district, Bale Zone, Oromia region of Ethiopia. Using Mirte stove instead of the traditional three stone open fire stoves have a paramount importance for improving the livelihoods of the household by reducing time spent on searching fire wood and it can also reduce causes of injury occurred through burns, and reducing deforestation by utilizing smaller amount of firewood than the traditional three stone stoves. This study found major shortcomings of Mirte stove. Based on the findings of this study, the following points are recommended to overcome the perceived shortcomings so as to improve Mirte stove more convenient to the households.

As indicated in the discussion part of this study, sample women of Mirte stove, the focus group discussants and key informants contacted during data collection period of the study, they mentioned that Mirte stove had different shortcomings with different degree of severity. Hence, continues monitoring and evaluation of Mirte stove about its pros and cons should be conducted from users point of view and great attention should be given by the researchers to minimize or avoid the shortcomings of Mirte stove. In addition to this, other alternatives (e.g. Gonziye stove which is more flexible and able to put pots to cook various food items) should also be tried simultaneously with Mirte stove.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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