Journal of Global Ecology and Environment

Volume 20, Issue 2, Page 1-11, 2024; Article no.JOGEE.12156
ISSN: 2454-2644

Assessing the Status of Improved Stove and Its Contribution Towards the Conservation of Forest Resources, Bulehora Wordea, West Guji Zone, Ethiopia

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.56557/jogee/2024/v20i28732

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.ikprress.org/review-history/12156

Original Research Article

Received: 25/03/2024
Accepted: 31/05/2024
Published: 13/06/2024

ABSTRACT

The study sought to analyze energy consumption trends in Bule hora, Ethiopia, with a particular emphasis on the usage of biomass energy and its impact on deforestation and land degradation. A standardized questionnaire was used to survey 150 households, taking into account various socioeconomic factors. The study discovered a high demand for fuel wood due to the widespread usage of traditional stoves for cooking. The study found that a higher number of respondents (71.4%) expressed positive opinions toward the use of upgraded stoves versus traditional stoves

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Cite as: *Sekhar, P., and Yirged Zewdie. 2024. "Assessing the Status of Improved Stove and Its Contribution Towards the Conservation of Forest Resources, Bulehora Wordea, West Guji Zone, Ethiopia". Journal of Global Ecology and Environment 20 (2):1-11. https://doi.org/10.56557/jogee/2024/v20i28732.*

than negative attitudes (28.6%). Approximately 65% of respondents expressed confidence that upgraded stoves have higher fuel wood and energy usage efficiency.
Despite budgetary constraints that impede the implementation of better stoves, the majority of respondents voiced great support for them. The multiple linear regression analysis revealed that socioeconomic characteristics had a substantial influence on views about the usage of upgraded stoves. It is critical to promote awareness among local inhabitants about the benefits of utilizing upgraded stoves, as well as to work with many stakeholders to distribute these stoves effectively. Government incentives may also be required to encourage widespread use of energy-efficient technologies in Bule hora town, so helping to forest conservation initiatives.

Keywords: Deforestation; energy efficient; fuel wood; forest resources.

1. INTRODUCTION

Deforestation is a serious environmental concern in Ethiopia, primarily caused by the unsustainable use of biomass for cooking [1]. Traditional stoves in rural regions are inefficient and require a lot of firewood to prepare meals. This reliance on firewood adds to deforestation and land degradation, putting important ecosystems at danger [2]. Traditional stoves are exceedingly inefficient and need massive amounts of firewood, owing mostly to the unsustainable use of biomass for cooking, particularly in rural areas [1]. This dependence not only depletes precious forest resources, but it also leads to land degradation, endangering vital ecosystems and biodiversity [2].

According to estimates, more than two-thirds of Ethiopia's population cooks using traditional biomass, emphasizing the importance of resolving this issue [3]. Ethiopia faces a significant environmental challenge: deforestation. Fuelwood dependence for cooking in rural regions, primarily due to inefficient traditional stoves, is a key contributor [1]. These stoves demand a large amount of firewood, which leads to unsustainable resource extraction and land degradation, endangering key ecosystems [1]. According to studies, more than two-thirds of Ethiopians cook using traditional biomass, emphasizing the importance of resolving this issue [3].

Fuel wood collection for cooking is the principal cause of forest degradation in these countries [4], but measuring this issue is difficult even with sophisticated technologies like remote sensing [5]. Furthermore, indoor air pollution caused by conventional cooking is a considerable health risk [6]. As a result, reducing fuel wood use has the potential to mitigate the effects of climate change while both saving forests and enhancing human livelihoods. Fuel demand dominates the forest output in terms of energy production for residential use. For example, in 2021, Ethiopia's total demand for domestic energy is expected to be 68 million m3 of wood equivalent, with fuel wood accounting for 45 million m3.

This suggests that wood fuel is the primary source of home energy in the entire country. Ethiopia's annual fuel wood usage is predicted to be roughly 45 m3, with an additional 12.4 m3 available per year [7]. In this scenario, the fuel wood shortfall was 32.5 million m3 [8]. This shows that use of forest resources has exceeded regeneration capability, resulting in a loss in increasing stock over time. This has resulted in substantial and severe problems such as deforestation, soil erosion, moisture stress, resource use disputes, a lack of water availability for various reasons, poverty, and a negative impact on health (Hagu, 2019).

More than half of the world's population continues to cook and heat with solid biomass or coal fuels [9]. The consumption of such fuels is receiving more attention due to their role in causing damage on three different scales [10]. At the household and village levels, the combustion of solid fuels emits pollution that is harmful to health and contributes significantly to the global disease burden [11], (Mehta and Shahpar, 2018), as well as imposing a significant time burden on those who collect fuel wood, who are typically women and girls. When fuel wood is collected in an unsustainable manner, it contributes to the loss of forest and associated ecosystem services both locally and nationally.

Ethiopia faces a significant fuel wood shortage due to the inefficient use of traditional cooking methods. For example, most people use biomass energy for cooking and heating, and the equipment they use is generally the most basic

stove type, three stone fires, which are formed by arranging three stones in a triangle arrangement around the fire. The main disadvantages of using three stones (traditional mud stoves) include inconvenience, fire hazards, poor quality and high smoke caused by incomplete combustion of the fuel wood, low efficiencies due to excessive heat loss to the surroundings due to wind, and poor fire control. Improved cookstoves provide a transformative answer to deforestation and promote sustainable resource management.

These painstakingly built stoves have much higher fuel economy than their typical equivalents. This reduces demand for firewood, which relieves strain on depleting forest resources [12]. The benefits go beyond environmental gains. Improved stoves improve indoor air quality, reduce respiratory health concerns, and save time by gathering less firewood [13]. These stoves are designed to burn fuel more efficiently, which reduces the amount of firewood required for cooking. By encouraging the use of better stoves, communities can reduce their dependency on forest resources while also contributing to forest conservation initiatives.

"Injera" is the basic flat bread for the majority of Ethiopians, as well as most houses in Bule hora town, because it is utilized in almost every meal. Baking "Injera" accounts for more than half of Ethiopian household energy usage. Because it demands quick and equal heat distribution over energy beneath the standard ceramic plate, there is a considerable loss of heat energy into the surrounding environment. This shows that Bule hora town has a high fuel wood usage rate among households.

To meet such home energy demands, people devote more of their working hours to gathering fuel wood. Furthermore, cow dung, leaves, and crop leftovers are used as fuel wood instead of organic fertilizer, which could increase agricultural output. Furthermore, in order to meet their fuel wood demands, locals cut down trees in the forests, causing the forest resources at the research site to deteriorate. The bulk of Bule hora residents and their neighbors rely on conventional fuels including wood, crop waste, and animal dung to supply their energy needs.

As a result, the town and its surroundings have suffered from environmental degradation, primarily caused by the loss of plant cover, agricultural residues, and animal excrement. The predicament is compounded by the increased need for fuel wood as the population grows. This is mostly owing to a scarcity of research-based quantitative data on the alternative usage of improved stoves as cooking or energy sources [14-16]. This study delves into the current situation of improved stoves in Bulehora woreda, Ethiopia's West Guji zone. The major goal is to determine the prevalence of improved stove usage in households and its effectiveness in saving forest resources.

The study intends to shed light on the variables influencing the adoption of upgraded stoves in the region by conducting a well-designed household survey and interviews with local energy experts. By identifying these factors, the study can help to establish targeted initiatives for increasing the use of better stoves and encouraging a move to more sustainable cooking practices in Bulehora.

2. METHODOLOGY

2.1 Study Site Description

The study was conducted in Bule hora town. The details of the study site were as followed.

2.2 Location

Bule Hora is a town in Oromia Regional State, Ethiopia. It is located in West Guji Zone, approximately 467 kilometers south-west of Addis Abeba, on the Moyale route. The town is located in latitude 9°41′N and longitude 39°32′E. The average height of the town is around 2,840 meters.

2.3 Climate

Bule Hora is one of the coolest settlements in Ethiopia's subtropical zone. For example, the town's average yearly temperature is 20.7 °C during the day and 8.2 °C at night. The average annual precipitation in the town is approximately 964mm.

3. METHODS

3.1 Data Collection

Initially, a preliminary survey was carried out in order to get better information about the study area and the types of data to be collected.

3.2 The Household Survey

The household survey was carried out by distributing structured questionnaires containing both closed- and open-ended questions to homes in two randomly selected kebeles within Bule hora town. These kebeles were picked at random through a lottery mechanism based on their numbers. The survey attempted to collect primary data on a variety of socioeconomic characteristics, including gender, age, family size, occupation, livestock ownership, education level, length of residency, land ownership, annual income, access to various energy sources, and the usage of improved stoves. The survey included a total of 150 households, 75 from each kebele.

The information was gathered through house-to-house interviews. In addition to the household survey, interviews were performed with energy specialists and other professionals involved in the town's energy development sectors to give further information. Data gathering took place in May 2023.

3.3 Independent Variables

Independent variables were derived from the following 21 questions: (i) sex, (ii) age, (iii) level of education, (iv) family size, (v) occupation type, (vi) annual income, (vii) livestock ownership, (viii) wanted to keep more livestock than had at present, (ix) length of residence in the area (in years), (x) history of settlement in the area, (xi) had the plan to stay in the area in the future, (xii) private land ownership, (xiii) had allocated land for woodlot plantations, (xiv) got enough supply of fuel wood throughout the year from their land with the existing trees, (xv) had a shortage of fuel wood, (xvi) the type stove that the respondents use for baking "injera", bread, etc., (xvii) the type stove that the respondents use for cooking stew, sauce and boiling purposes, (xviii) familiarity with improved stove, (xix) knowledge to use improved stove, (xx) knew about the contribution of improved stove to reduce the problem of fuel wood shortage and thereby contributing to the conservation of the forest resource, and (xxi) The fuel wood and energy consumption efficiencies of improved stove over traditional stove.

3.4 Dependent Variable

The dependent variable, i.e. attitude towards 'the use of improved stove over traditional stove', was generated from the statement "agree that respondents had positive attitudes toward the use of improved stove over traditional stove."

3.5 Data Analyses

The data was analyzed and interpreted using quantitative approaches based on its nature. Descriptive statistics, such as mean, standard deviation, and proportion, were used to investigate household characteristics. Furthermore, a multiple linear regression model with an alpha value of 0.05 was used to assess and forecast the value of the dependent variable, which is attitude toward 'the usage of upgraded stove over traditional stove'. These analyses were carried out using SPSS version 21.

4. RESULTS AND DISCUSSION

The poll included 150 houses, evenly split between Bule Hagala Kebele and Goro Gudina Kebele, each with 75 households. The gender distribution indicated that 45% of respondents were male and 55% were female. The participants' average age was 38.6 years, with a standard deviation of 13.2, and their average family size was 4.32 people, with a standard deviation of 1.98. In terms of education, respondents' levels varied: 11% were illiterate, 12% were literate, 19% had completed elementary school, 25% had completed secondary school, 22% had a diploma, 10% had a degree, and 1% had a master's.

Notably, none of the respondents worked in crop cultivation or animal rearing, with 17% in mixed farming and the remaining 83% in occupations such as student roles, day jobs, merchant activities, and government duties. The average yearly income was reported at 10,963.96 Ethiopian Birr, with a standard deviation of 13,170.01. In terms of animal ownership, 28% of households claimed owning livestock and 72% did not. Of those polled, 21% expressed a desire to increase their livestock holdings, citing reasons such as having enough grazing land (10%), using livestock as insurance during crop failure (7%), and dairy production (2%), while 81% did not see the need to keep more livestock than they already had.

The respondents' average length of residency in the area was 30.35 years, with a standard deviation of 16.82. When asked about their history of settlement in the area, 22% inherited land, 4% settled for personal reasons, 28% were

settled by the state, 24% purchased land, and 22% fell into other categories (Table 1).

According to Table 2, the survey results revealed that a vast majority of respondents, roughly 73%, intended to stay in the area in the future, while 19% were doubtful and 8% did not expect to remain. In terms of private land ownership, 53% of respondents said they owned land, while 47% did not. Only 23% of respondents had set aside land for woodlot plantations, with the vast majority (77%) not doing so. Among those who planted trees, 23% did so for fuel wood, while 77% did not plant any at all.

When asked if they could get a year's supply of fuel wood from their present trees, just 21% said yes, while 79% said no, indicating a fuel wood deficit. To remedy the deficit, 40% of respondents bought more fuel wood, 29% utilized electricity, 23% harvested fuel wood, and 7% used other ways. Fuel wood was indicated as the primary source of household consumption by 66% of respondents, with electrification accounting for 34%. In terms of stoves used to bake injera, bread, and other items, 41% favored traditional enclosed mud stoves, 28% Mirit or improved injera baking stoves, and 31% electric-powered injera baking stoves.

Table 1. Table showing socio-demographic characteristics of the respondents

Variable	Descriptive Results	Proportion (%)
Area	Bule hagala Kebele (75 households)	50
	Goro gudina Kebele (75 households)	50
Total sample size (*n*)	150 households	
Sex	Male	45
	Female	55
Age	Mean = 38.6 years; SD = 13.2	
Family size	Mean = 4.32 persons; SD = 1.98	
Level of education	Illiterate	11
	Literate	12
	Elementary	19
	Secondary school	25
	Diploma	22
	Degree	10
	Masters	1
Occupation type	Crop cultivation	0
	Livestock rearing	0
	Mixed farming	17
	Others (e.g., student, daily employment, merchant and government jobs)	83
Annual income	Mean = 10,963.96 ETB; SD = 13,170.01	
Livestock ownership	Yes	28
	No	72
Wanted to keep more livestock than they currently had	Yes	21
	No	79
Reason to keep more livestock	Enough grazing land	10
	Insurance during crop failure	7
	Dairy production	2
	No	81
Length of residence in the area (years)	Mean = 30.35; SD = 16.82	
History of habitation in the region	Inherited land from my ancestor	22
	Settled by my own interest	4
	Settled by the state	28
	Bought land	24
	Others	22

Table 2. Table showing attitude of the respondents towards the use of improved stove over traditional stove

Variable	Descriptive Results	Proportion (%)
Had planned to stay in the neighborhood in the future	Yes	73
	Unsure	19
	No	8
Had private land ownership	Yes	53
	No	47
Had given land for woodlot plantations.	Yes	23
	No	77
Purpose of planting trees	For fuel wood	23
	No planting tree	77
With the existing trees on their site, can they get enough fire wood to last all year.	Yes	21
	No	79
Had a shortage of fuel wood	Yes	75
	No	25
Method used to manage fuel wood shortage	Purchasing additional fuel wood	40
	Using electrification	29
	Collection of fuel wood	23
	Other	7
The primary source of fuel wood for domestic consumption.	Fuel wood	66
	Electrification	34
The sort of stove that responders use to bake "injera," bread, and so on.	Traditional enclosed mud stove	41
	Mirit or improved injera baking stove	28
	Electric based “injera” baking stove	31

Table 3. Table showing knowledge of respondents

Variable	Descriptive Results	Proportion (%)
The type stove that the respondents use for cooking stew, sauce and boiling purposes	Modern stove	51
	Open fire	8
	Enclosed clay/mud	15
	Traditional metal tri-pond stove	31
Familiarity with improved stove	Yes	61
	Unsure	6
	No	33
Knew to use improved stove	Yes	61
	No	39
The main reason that restrained the respondents not to use the improved stove	Income constraint	25.3
	Too expensive	11.3
	No supply	3.3
	Lack of interest	1.3
	others	59
Knew about the contribution of upgraded stove to lessen the problem of fuel wood shortage, and so contributing to the protection of forest resources.	Yes	78
	Unsure	7
	No	15
The enhanced stove's fuel wood and energy usage efficiency compared to traditional stoves	High efficiency	65
	Low efficiency	7
	Unsure	19
	No idea	9

Table 3 shows that respondents primarily utilized contemporary stoves (51%), followed by old metal tri-pond stoves (31%), enclosed clay/mud stoves (15%), and open fires (8%). In terms of acquaintance with upgraded stoves, 61% of respondents said they were aware of them, 6% were unsure, and 33% were unaware of them. Similarly, 61% of respondents understood how to operate upgraded stoves, whereas 39% did not.

The primary reasons mentioned by those who did not utilize improved stoves were income limits (25.3%), costliness (11.3%), lack of supply (3.3%), lack of interest (1.3%), and other reasons (59%). A large majority of respondents (78%) recognized the potential of improved stoves in reducing fuel wood scarcity and aiding in forest conservation. When asked about the fuel wood and energy consumption efficiency of improved stoves vs old stoves, 65% saw improved stoves as highly efficient, while 7% saw them as less effective. Furthermore, 19% were unclear about the efficiency levels, while 9% were unaware of the stoves' comparative efficiency.

4.1 Belief statements of the Respondents

The respondents' beliefs on the utility of improved stoves versus traditional ones were tested using a Likert scale (Fig 1). *The mean (M) and standard deviation (SD) values were calculated using scale values (Strongly agree = 5 to Strongly disagree = 1), with higher values indicating more positive opinions toward using an enhanced stove versus a traditional stove.

Fig. 1 depicts the data on belief statements on attitudes toward the usage of improved stoves versus traditional stoves, which found that 54.55% strongly agreed and 30.91% agreed. Furthermore, 8.48% were unsure, 5.46% disagreed, and only 0.60% strongly opposed the idea of preferring better stoves over conventional stoves. The mean agreement score was 4.35, with a standard deviation of 0.87, showing that respondents agreed relatively strongly on the positive sentiments about the use of upgraded stoves as opposed to traditional stoves.

4.2 Multiple Linear Regression Model to Predict Attitudes of the Respondents

Table 4 shows the regression analysis results for the components impacting attitudes toward the usage of improved stoves versus traditional stoves, which revealed several significant findings. Among the demographic variables, education level had a positive effect on attitudes, with a coefficient of 0.12 and a statistically significant t-value of 1.71 ($p = 0.040$). This suggests that those with higher levels of education were more likely to be favorable about using upgraded stoves. animals ownership also played a significant influence, with a negative coefficient of -0.17 and a t-value of -2.58 ($p = 0.011$), indicating that respondents without animals were more likely to have positive attitudes toward enhanced stove utilization.

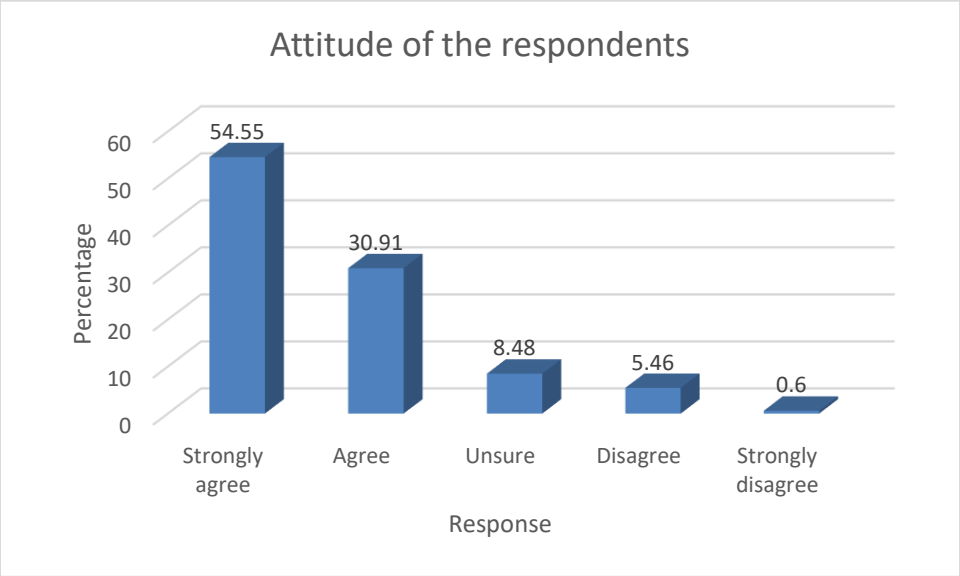

Fig. 1. Figure showing belief statements of the respondents

Furthermore, familiarity with improved stoves (ß = 0.17, t = 2.34, p = 0.021), knowledge of how to use improved stoves (ß = 0.25, t = 3.47, p = 0.001), and awareness of the benefits of improved stoves in terms of reducing fuel wood shortages and forest conservation (ß = 0.32, t = 3.76, p = 0.001) were all significantly associated with more positive attitudes toward adoption. Furthermore, opinions regarding the fuel wood and energy consumption efficiency of upgraded stoves over old stoves had the greatest influence, with a coefficient of 0.62, a high t-value of 5.56, and a very low p-value of 0.0001, indicating a considerable impact on attitudes.

On the other hand, the type of stove used for cooking stew, sauce, and boiling showed a negative relationship with positive attitudes (ß = -0.25, t = -3.43, p = 0.001), implying that those who used traditional stoves for these cooking activities were less likely to have positive attitudes toward improved stoves. Overall, the findings emphasize the relevance of education, familiarity with, and knowledge of better stoves, as well as observed efficiency benefits, in influencing positive views toward their adoption. Addressing these issues through focused awareness campaigns and educational programs may assist encourage the use of better stoves and contribute to the community's adoption of sustainable energy practices.

Table 4. Multiple linear regression model to predict attitudes towards 'the use of improved stove over traditional stove'. + indicates a positive change in attitude and - a negative change in attitude

Variable	Attitude towards 'the use of improved stove over traditional stove'		
	ß	***t***	***P* value**
Intercept	+ 5.16	48.08	-
Sex (Male = 1; Female = 2)	0.03	0.50	0.622
Age	0.09	1.22	0.225
Level of education	0.12	1.71*	0.040
Family size	-0.08	-1.20	0.232
Occupation type	-0.05	-0.70	0.486
Annual income	0.06	0.86	0.392
Livestock ownership (Yes = 1; No = 2)	-0.17	-2.58*	0.011
Wanted to keep more livestock than had at present (Yes = 1; No = 2)	0.07	0.98	0.328
Length of residence in the area (in years)	0.05	0.66	0.513
History of settlement in the area	-0.10	-1.44	0.151
Had the plan to stay in the area in the future (Yes = 1; No = 2; Unsure = 3)	-0.03	-0.37	0.715
Private land ownership (Yes = 1; No = 2)	0.05	0.69	0.491
Had allocated land for woodlot plantations (Yes = 1; No = 2)	0.02	0.33	0.741
Get enough supply of fuel wood throughout the year from their land with the existing trees	-0.01	-0.10	0.920
Had a shortage of fuel-wood (Yes = 1; No = 2)	-0.04	-0.65	0.518
The type stove that the respondents use for baking "injera", bread, etc.	0.11	1.56	0.121
The type stove that the respondents use for cooking stew, sauce and boiling purposes	-0.25	-3.43*	0.001
Familiarity with improved stove	0.17	2.34*	0.021
Knowledge to use improved stove	0.25	3.47*	0.001
Knew about the contribution of improved stove to reduce the problem of fuel wood shortage and thereby contributing to the conservation of the forest resource	0.32	3.76*	0.001
The fuel wood and energy consumption efficiencies of improved stove over traditional stove	0.62	5.56*	0.0001

*Standardized coefficients were reported; *represents significance at the 95% confidence level; [b]Adj. R^2 = 0.34, df = 20; F = 75.55, overall P < 0.0001*

4.3 Discussion

"The study found that the locals at the study site preferred to use biomass as a source of energy for household consumption. One probable explanation is the availability of access to the biomass energy source in the surrounding environment. Previous research has shown that many rural populations in numerous Sub-Saharan countries, including Ethiopia, rely on biomass fuel to meet their household energy needs" [17,18]. Furthermore, "as compared to modern energy sources (for example, electricity), the market price of biomass fuel is affordable to many impoverished people in developing countries such as Ethiopia" [19].

This is the first attempt to objectively assess local people's views toward the usage of upgraded stoves over traditional stoves in Bule Hora town. In general, the study found that a higher percentage of respondents had positive (71.4%) than negative (28.6%) attitudes regarding 'the usage of enhanced stove over traditional stove'. This might be related to respondents' knowledge of the significance of improved stoves to reducing the problem of fuel wood shortages and, as a result, contributing to the protection of forest resources at the study site. For example, compared to conventional stoves, over 65% of respondents were confident that improved stoves have higher fuel wood and energy consumption efficiency (Table 1).

Furthermore, the majority of respondents (about 78%) were aware of the role of upgraded stoves to reducing the problem of fuel wood scarcity and thus contributing to the protection of forest resources in the study site. The study also found that knowledge of the locals was a strong and consistent predictor of views toward 'the usage of improved stove over traditional stove'. For example, the multiple linear regression model demonstrated that socioeconomic characteristics had a substantial effect on views regarding 'the usage of enhanced stove over conventional stove' (34% variation explained) (Table 3).

Previous research has shown that boosting respondents' awareness about improved stoves and their contribution to forest resource conservation can significantly influence their views toward using them (Seid, 2003). "Informing local populations about the use and usefulness of improved stoves can assist to raise favorable attitudes, increasing local support for forest protection. This is because raising public awareness will help locals comprehend the benefits of using an enhanced stove versus a traditional burner" [20].

For example, "the use of improved stoves has various benefits to the local communities, including saving time for cooking, increasing fuel wood and energy usage efficiencies, reducing the number of labor and time required to collect fuel woods (e.g., the time could be used for other activities such as farming), reducing indoor house pollution, and thus reducing the negative impacts of emitted smoke on the health of the residents of the households" [6].

5. CONCLUSIONS

The survey found that the majority of respondents in the study site preferred utilizing traditional enclosed mud stoves for baking "injera" and bread, indicating a strong reliance on local fuel wood use in the area. Instead of using modern energy sources such as electricity, respondents mostly used fuel wood, cow dung, leaves, and crop wastes for cooking and heating, citing unreliability of modern energy sources and high electricity costs as primary factors driving this dependence. The affordability of contemporary energy sources, particularly for urban poor households, was a major worry, with income levels and family size influencing the decision to adopt local energy sources due to the financial restraints associated with modern energy options.

The study concluded that economically disadvantaged and less educated residents' reliance on local energy sources, notably fuel wood, contributed to higher deforestation rates in the study area. In contrast, highly educated and economically rich persons prefer modern energy sources such as electrification for their residential energy demands. This gap in energy consumption patterns may have encouraged the formation of favorable views regarding the use of upgraded stoves over traditional stoves in Bule Hora. Encouraging women's participation in activities to reduce fuel wood shortages and deforestation by promoting improved stove technologies is critical for future sustainability efforts. While some respondents reported utilizing better stoves, many said financial restrictions prevented them from obtaining these technology.

The introduction and distribution of improved stoves, such as "merit" stove technology,

represent a promising option to address energy efficiency, fuel wood conservation, cost savings, and indoor air pollution reduction, all of which help people's health and well-being. By encouraging the use of modern stove technology over inefficient conventional stoves, the community may save energy, contribute to socioeconomic growth, and protect natural resources. This transition toward sustainable energy practices is consistent with Ethiopia's overall poverty reduction goals, and it emphasizes the necessity of addressing energy access difficulties through innovative solutions that benefit both the community and the environment.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
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