

**Survey Results on Household Fuelwood Consumption and  
Use of Improved Fuel-Efficient Stoves in Four Villages Near  
Chome Forest Reserve<sup>1</sup>**

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**By Wendy Baxter and Sara Hanna  
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**Edited by Lauren Persha  
UNDP-GEF East African Cross Borders Biodiversity Project**

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## **Executive Summary**

In 1998, fuel-efficient cook stoves were introduced by the UNDP-GEF East African Cross-borders Biodiversity Project (CBBP) in five villages adjacent to Chome Forest Reserve in Same District, in an effort to reduce the amount of fuelwood consumption, therefore lessening the human pressure on forest resources in Chome FR. Similar inputs took place in CBBP sites in Bukoba and Monduli Districts. In November 2001, closed-end surveys were administered in 4 of the villages in order to ascertain whether the improved stoves do indeed reduce the amount of fuelwood consumed per household (compared to traditional “open” three stone hearths), and to provide monitoring and evaluation feedback on the CBBP stove implementation program. The surveys were administered to a total of 73 households using improved stoves or traditional three-stone hearths in order to compare patterns of fuelwood collection and consumption between the two groups. The surveys were intended to gather both quantitative and qualitative data regarding the efficiency of the respective cooking methods, by asking questions targeted at villager experiences with the two cooking methods, and by measuring the volume of a typical bundle of fuelwood, which was used to derive an estimate of the volume of fuelwood collected per week. In addition, some of the survey questions focused on issues of stove use, wider uptake among households and awareness of the link between the improved cook stoves and forest conservation. These questions were designed to provide feedback on how CBBP can improve on and expand its stove program in villages adjacent to Chome Forest Reserve.

Qualitative data collected from survey respondents were categorized by cooking method and presented in chart format. The survey attempted to collect hard quantitative data on fuelwood use, to substantiate villagers spoken perceptions. Fuelwood bundles were assessed and frequency of collection recorded. Quantitative data was analysed using T-tests and Mann-Whitney tests for significance between the average volume of fuelwood collected per week by three stone hearth and improved stove users. Statistical analysis showed no significant difference in the volume of fuelwood collected per week by the two groups. Qualitative data strongly supported the assumption that improved cook stove users collect and use much less fuelwood on average than three stone hearth users. Reasons for this discrepancy between quantitative and qualitative data are addressed at length in the discussion section of this report. Responses to questions regarding villager perceptions about stove use, maintenance, and construction were reviewed to make suggestions about how CBBP can increase the use of the improved stoves in the future and make stronger links between conservation and development in the communities adjacent to Chome FR. Stove owners appear to be happy with their improved cook stoves, and many three stone hearth users expressed a desire to acquire an improved cook stove, though there was uncertainty as to how to get one.

A number of suggestions were made regarding CBBP activities which may add to sustainability and scaling up of fuel-efficient cook stoves in forest-adjacent communities near Chome FR. The survey results highlighted a need for increased technical advice to villagers on stove building and maintenance, as well as greater awareness of the link between the conservation of Chome FR and the use of improved cook stoves. The survey results also drew attention to the difficulties in accurately calculating quantitative data related to fuelwood collection and consumption. It is recommended that future surveys evaluating the CBBP improved cook stoves program address cost issues related stove building in order to identify financial barriers to wide uptake of the stoves.

## **Introduction**

Tropical forests in Africa face negative impacts from human encroachment and exploitative resource use. Deteriorating economies and international debt force many tropical countries, including those in East Africa, to mine their forest resources and other biological capital rather than to treat them as renewable resources. In rural Tanzania, forest resources are under intense pressure for fuelwood. Seventy percent of the people in developing countries, most of whom live in rural areas, depend on fuelwood to meet their household needs (Burley 1986). In Africa over 300 million people depend on rural sources of energy such as fuelwood to survive (Fleuret and Fleuret 1978). This dependence has a pronounced negative impact on tropical forests.

The Eastern Arc Mountains of eastern Tanzania are recognized as having the highest endemism to area ratio in the world (Lovett 1993). About 25% to 30% of the 2000 species are endemic to the Eastern Arc. Not only is the Eastern Arc important for its intrinsic value and the species it contains, but also the individual mountain blocks are important for water catchment (Rodgers 1993). Conserving the Eastern Arc Mountains and the biodiversity they contain is therefore an important endeavor. The UNDP-GEF East African Cross-borders Biodiversity Project (UNDP-GEF CBBP) in Tanzania works towards conserving biodiversity in the South Pare Mountains of the Eastern Arc, as well as in two other sites in Tanzania. The project began in 1998 with an aim to bring government agencies and communities together to jointly manage forest resource use and to balance the supply and demand of resources that impact on biodiversity conservation (Kalage 2001).

Chome Forest Reserve in Same District is the focal forest for the Cross Borders Biodiversity Project in the South Pare Mountains. The 14,023-hectare forest, gazetted in 1951, is the most species rich forest in the Pare Mountains and is the most important catchment forest in Same District (Lovett 1993). Chome Forest Reserve is important worldwide for its endemic species, and valuable locally for its catchment qualities. Using Threat Reduction Analysis, CBBP identified fuelwood collection in Chome FR to be one of the major threats to biodiversity in the reserve (Persha 2001). Fuelwood is used by all households in the villages adjacent to Chome FR for cooking, heating, and lighting. Village demand for fuelwood resources puts considerable stress on Chome FR, particularly in recently burned areas of the forest where fire-damaged trees of all sizes are typically harvested for fuelwood after a burn (Persha, pers comm). While links between burning in the forest and fuelwood collection are documented, it is not known to what extent (if at all) intentional burning in the forest may be driven by fuelwood demands.

Activities aimed at reducing household dependency on fuelwood among forest-adjacent communities therefore play an important role in reducing the biodiversity loss of Chome FR. CBBP therefore initiated a program in collaboration with the Same-Mwanga Environment Conservation Advisory Organization (SMECAO) in 5 communities adjacent to Chome Forest Reserve in September 2000 to promote the use of fuel-efficient cook stoves. These stoves are thought to require less fuelwood than the traditional open 3 stone hearths, in addition to providing household benefits of faster cooking time and reduced smoke in the cooking area.

In September 2000, an improved stove technician was employed for one month to hold demonstrations in 5 villages adjacent to Chome FR (Mhero, Gwang'a, Marieni, Mvaa, and Mjema) to educate villagers about how to build the stoves. Awareness raising meetings were also held to inform villagers of the importance of the stoves in the context of biodiversity conservation (Kalage 2001). The five pilot villages were chosen because of their close proximity to the reserve and the documented demand for fuelwood resources from the forest (as opposed to woodlots outside the reserve) in these villages.

The improved stoves promoted by CBBP are stated to be more fuel-efficient than three stone hearths, and to decrease cooking time and reduce the amount of smoke released into the cooking area. Their design allows the wood to burn slower and increases the amount of heat trapped to reduce cooking time (see App., Figure 1 and Figure 2.). The chimney leading to the outside or roof of the kitchen allows for a majority of the smoke to leave the

kitchen, creating a less smoky cooking environment. All of the materials needed to build the stoves (gravel or small stones, clay soil or cement, and a stove mould) are locally available to any interested villagers. It is surmised that promotion of these stoves could potentially reduce fuel-wood consumption by 50% (Kalage 2001). It is therefore important to know whether or not these stoves do indeed use significantly less fuel-wood than traditional three stone hearths. In order to determine this, surveys were conducted in four of the five villages (Mhero, Marieni, Gwan'ga, and Mvaa) where improved stoves were promoted. Surveys were administered to as many individuals with improved stoves and three stone hearths as was possible in the time available for the study (73 households total were visited). Information was gathered to ascertain community members' attitudes towards the improved stoves. Respondents were asked to give their perceptions of the efficiency of improved cookstoves compared to 3 stone hearths. Data were collected on the volume of fuelwood collected per week, used per week, used per day, and required to cook one pot of makande (a typical component of a meal). The assumption at the outset of the survey was that significantly less fuelwood would be collected and used in households having improved stoves compared to traditional three stone hearths.

A common oversight in Integrated Conservation and Development Projects such as CBBP, is a lack of research and monitoring to follow-up on whether or not project activities are being implemented successfully, both during and after the program is complete (Newmark and Hough 2000). The UNDP-GEF project is scheduled to end in mid 2003, but long term monitoring has not yet been conducted to determine the impacts of the improved stoves in the five villages where stoves were introduced. Since CBBP is a project with a finite lifespan, it is important that community members are educated about where to get assistance to build the stoves, and about the links between the stoves and the environment. This knowledge feeds into long term sustainability of the stove program after CBBP assistance tails off. In this study, survey questions were also employed to ascertain community member's knowledge of stove maintenance and construction, the relationship between improved stoves and forest conservation, and towards the effectiveness of the improved stoves.

### **Study Area**

This study took place in Same District in 4 villages in Chome and Bombo Wards (Mhero, Gwan'ga, and Marieni villages in Chome Ward on the west side of the Chome Forest Reserve and Mvaa Village in Bombo Ward on the east side of the reserve). The reserve is located at 4°10' - 4°25' South and 37°53' - 38°00' East. Access to the reserve is from Makanya to Mwembe Road. The reserve covers the highest ridge of the S. Pare Mountains, which runs north-south between the old and new Tanga to Moshi highways. The climate of the reserve is characterized by oceanic rainfall with oceanic temperatures. The estimated rainfall in the reserve on the eastern slopes is 3000mm/year and 1500-2000mm/year on the western slopes. Vegetation in the reserve varies from east to west and as elevation changes and can be broadly categorized as submontane forest in the lower elevations and montane forest above approximately 1500 meters (Lovett and Pócs 1993).

Bordering the reserve are the four surveyed villages - Mhero, Gwan'ga, Marieni, and Mvaa - which have similar physical, economical, and social characteristics, although these are not well documented. In each of these montane villages, the major ethnic group is Mpare, who speak Kipare and Kiswahili.

The major economic activities in this district are agriculture and livestock keeping. Crop farming is mainly subsistence agriculture and the major crops include coffee, bananas, maize, cassava, cocoyams, and beans. Most of the available arable land is currently cultivated and 7500 ha (10%) of cultivated land is under irrigation. The average farm size in this district is 2.8 acres per household. (Kigula 2001)

At the time the surveys were administered, improved stoves had been introduced in each village. The exact numbers of improved stoves in each village is unclear as discrepancies occur between UNDP-GEF CBBP information and information provided by local Forest

Rangers in the villages. Below is a table indicating population, household, and improved stove numbers for each of the surveyed villages.

Table 1: Population, Household, and Improved Stove numbers for the four surveyed villages.

Village	Population	Household Number	Households with improved stoves	
			UNDP Numbers	Forest Ranger Numbers
Mhero	2700	500	15	13
Gwan'ga	2500	300	50	20+
Marieni	-	-	20	10
Mvaa	1875	240	16	6

These four villages were chosen as study sites because they border Chome Forest Reserve and were identified by CBBP to be villages having a high impact on the reserve, mainly through forest resource utilization (see Table 2.).

Table 2. Villages and their dependency on Chome Forest Reserve for forest resources.

Village	Dependency Rating	Resources Used From Reserve
Mhero	High	Water, fuelwood, medicinal plants
Gwan'ga	High	Water, fuelwood, medicinal plants
Marieni	Medium	Fuelwood, timber, water
Mvaa	Very High	Timber, fuelwood, fruits, cultural values

## Methods

In order to determine whether or not improved stoves use significantly less fuelwood on average than three stone hearths, closed-end surveys were administered (Nichols 1995) over the course of six days in the four villages of Mhero, Gwan'ga, Marieni, and Mvaa, from November 17-27, 2001 (see App., Figure. 2). The surveys conducted over two days in Mhero were used to test out the survey questions and make any needed alterations to the survey (see Appendix 1, Figure. 1). The number of individuals surveyed in each village was dependent upon the number of improved stoves present (see Table 3).

Table 3. Number of households surveyed and days spent surveying.

Village	Number of households surveyed with:		
	Improved Stoves	Three stone hearths	Number of days surveys conducted
Mhero	12	10	2
Gwan'ga	13	10	2
Marieni	6	11	1
Mvaa	5	6	1
<b>Totals</b>	<b>36</b>	<b>37</b>	<b>6</b>

Participants were non-randomly chosen to be surveyed based on their use of an improved stove or a three-stone hearth. Some individuals chosen to be surveyed were not present when their homes were visited and as a result, others were chosen because of lack of time in which to return at a later date to the initial chosen households. Women were chosen to be interviewed instead of men because the survey questions generally related to the traditional daily activities and responsibilities of Pare women rather than men. It must be noted that the most prevalent method of cooking in each of the villages is the Usambara stove, which was introduced to the area in the 1980's (F. Umilla, pers comm). The Usambara stove is similar in form to the improved stove in that it is an enclosed stove that conserves heat. It differs from the improved stove in that it lacks specific dimensions, has only one opening for a pot, and lacks a chimney so that smoke stays in the kitchen.

Two surveyors, each accompanied by one translator, visited one village together, with one surveyor interviewing individuals with improved stoves and the other interviewing individuals with three stone hearths. Each surveyor introduced herself to the participants, and the translators explained and read the surveys to the participant. The surveyor recorded the participant's answer. At the end of each survey, the participant was asked to show the surveyor a typical bundle of fuelwood collected. The length and circumference of each piece of fuelwood was then measured and recorded.

This quantitative data was used to generate an estimate of average volume of fuelwood collected per person per week for improved stove and three stone hearths users, by multiplying the volume of the measured fuelwood bundle by the respondents estimate of the number of bundles collected per week, and then divided by the number of household members. Questions were also asked related to the amount of wood collected per week, the amount of wood used per week, the amount of wood used each day, and the amount of wood used to cook one pot of makande, a typical Mpare meal. It was noted, however, that respondents generally had much difficulty estimating the number of pieces of wood they collected and used each week. To account for variance in household size, the volume of wood collected per week at each household was then divided by the number of household members (household member = person who eats meals in the house on a daily basis), giving a volume of fuelwood collected per person per week. After removing outlier results, tests for significance were then carried out on the data in order to determine whether the volume of wood collected per person per week varied significantly between households cooking with improved cook stoves and 3 stone hearths. Survey questions relating to villagers' attitudes and knowledge about the stoves were also tabulated to observe trends.

## Results

Over the course of six days 73 participants were surveyed in the 4 villages. Of the 73 participants, 36 had improved stoves and 37 had three stone hearths. Mhero village served as a test run to finalize survey questions and agree on consistent methodology between the two surveyors, and was therefore not included in the tabular results of qualitative data. However, data from Mhero village was included in the statistical analysis in the interest of maintaining an appropriate sample size<sup>2</sup>. Because all of the improved stoves were made to specific dimensions, it is assumed that there are no discrepancies between improved stoves in different villages. Additionally, three stone hearths across the district are similar and the village they are located in should not affect the functioning of the stoves and the amount of fuelwood they consume.

Calculations derived from the measurement of a standard fuelwood bundle for the two groups indicated that, on average, improved stove users collect 301.12 m<sup>3</sup> of fuelwood per household person each week, while three stone hearth owners collect 286.44 m<sup>3</sup> of fuelwood per household person per week. Standard T-Test and Mann-Whitney ranked sums tests for significance showed that there was no significant difference between the mean volume of each of the two groups (p. = 83)<sup>3</sup>.

On the other hand, 88% of the respondents agreed that their improved stove required less wood than traditional three stone hearths, while 8% were not sure, and only 4% disagreed.

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<sup>2</sup> Leaving the Mhero data out of the statistical analysis showed no difference in the significance of the results.

<sup>3</sup> Note that this is contrary to assumptions made at the onset of the study, and actually suggests that 3 stone hearths consume less fuelwood than improved stoves. See the Discussion section for an analysis of issues related to these surprising figures, and Appendix 2 for statistical results.



Figure 1. Participant responses to Question 22.

In addition to collecting data on differences in the amount of wood used in improved stoves versus three-stone hearths, information was also gathered on community members' knowledge about the improved stoves and their attitudes towards the stoves.

The majority of people with improved stoves (70%) heard about the stoves from the CBBP, while 18% heard about the stoves from their neighbors, and the rest from a combination of friends, relatives, and neighbors/village leaders (see Figure 2).

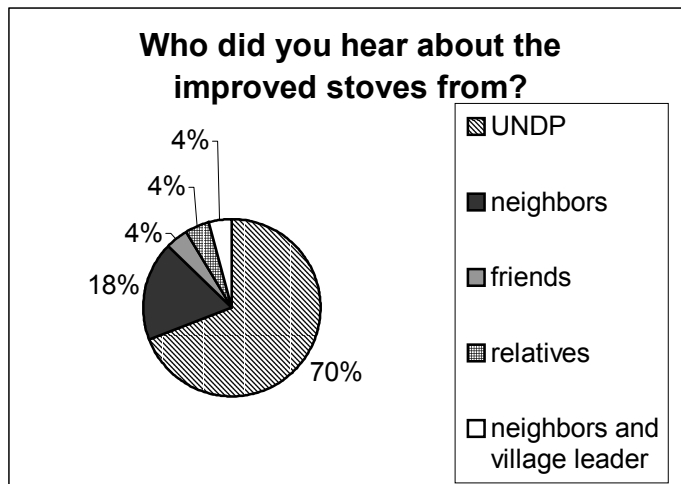


Figure 2: Participants' responses to Question 16.

Of the participants with three stone hearths, 81% have heard about the improved stoves. 24% of participants with three stone hearths heard about improved stoves from their neighbors, 19% from a village environmental committee member, and 15% from friends. The rest of the participants heard about the improved stoves from the CBBP, relatives, UNDP-GEF CBBP/village leader, relatives/neighbors, and others. Only 7% of people with three stone hearths said that they heard about the improved stoves from the CBBP (see Figure 8). This may be due to low Project name recognition, as CBBP works primarily through District partners to implement its activities on the ground – a strategy designed to enhance longterm sustainability of Project activities over time.



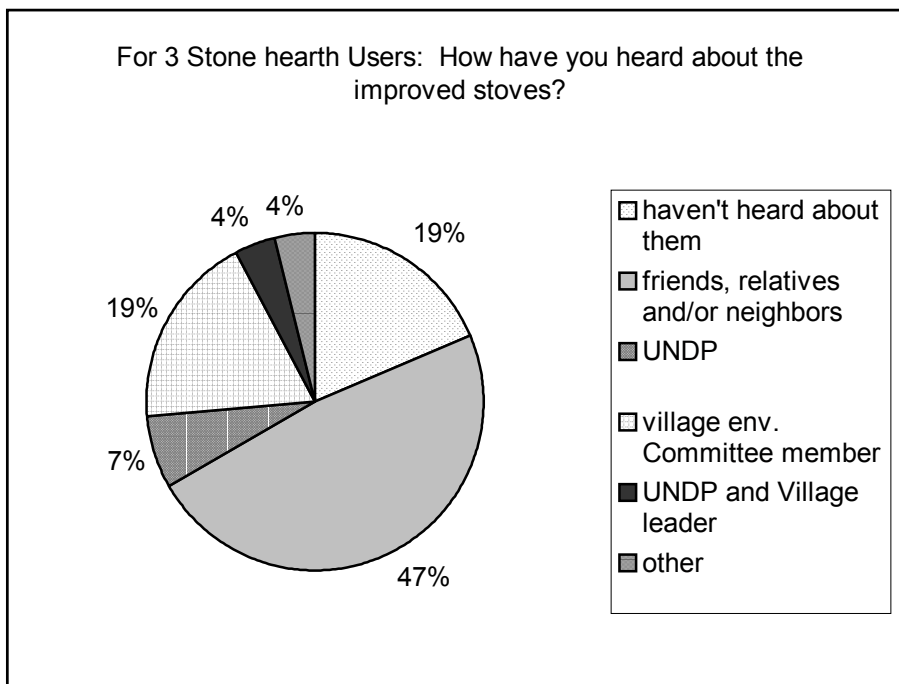


Figure 3: Participants' responses to Question 23. Note that this question pertains to 3 stone hearth users only.

CBBP is interested in enhancing the link between the use of improved cookstoves and forest conservation. Villagers' attitudes about the relationship between the stoves and forest conservation were obtained by asking each stove owner why he/she chose to build an improved stove for their household. 57% of villagers having improved cook stoves responded that they have an improved stove because it reduces cooking time, 26% responded that the stoves is both environmentally friendly and reduces cooking time, 13% responded that the stove is environmentally friendly, and 4% responded that the improved stove was easy to use (see Figure 4).

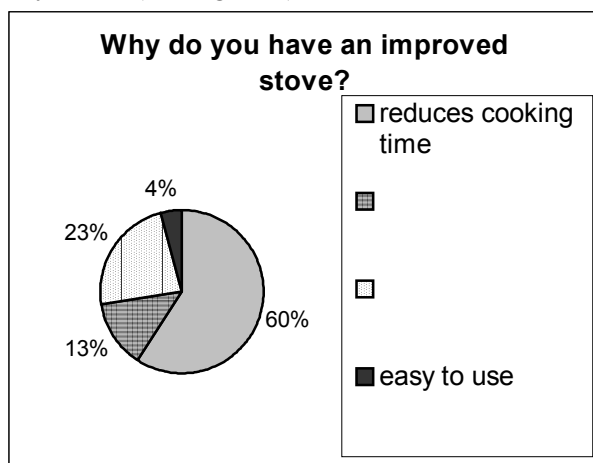


Figure 4: Participants' responses to Question 16.

A number of questions were asked of respondents having improved cook stoves, regarding their perceptions of stove functioning, and their level of satisfaction with the improved cook stove (See Table below).

Questions for improved cook stove owners regarding perceptions of stove functioning and satisfaction with the new stove.	No	Yes	Don't Know
Q17. Has your stove ever broken or not worked ?	83%	17%	
Q20. Have you had any problems with your stove ?	80%	20%	
Q21. Does your stove require less wood for cooking than traditional methods ?	4%	96%	
Q22. Would you recommend your stove to someone else ?	4%	92%	4%
Q25. Do your relatives, friends or neighbors have any problems with their improved stoves ?	96%	4%	
Q26. Do your relatives, friends or neighbors like their three stone stoves ?	81%	15%	4%

Participants with three stone hearths were asked why they have chosen not to use an improved stove. 35% said that they weren't sure who to talk to in order to get one, 27% indicated that they have plans in place to build one in the future, 20% like traditional methods, 11% think that their kitchen is too small to fit an improved stove, and 7% are too busy to build an improved stove. (See Figure 5.)

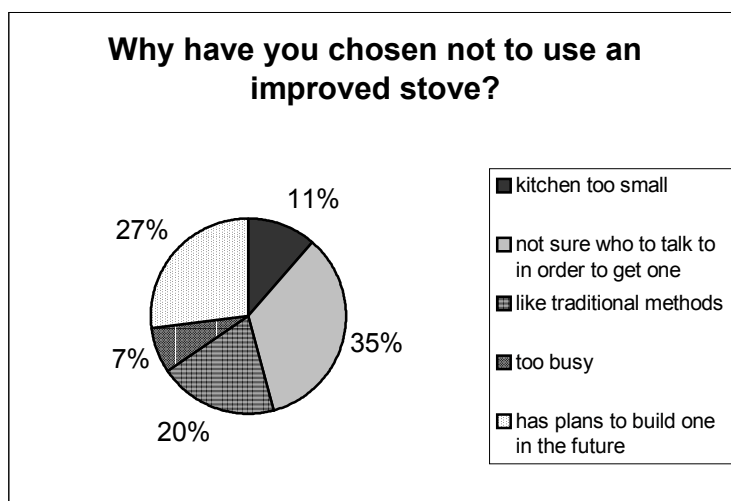


Figure 5: Participants' responses to Question 27.

## Discussion

### A) Quantitative Survey

At the onset of the study, it was predicted that improved stove users on average would require significantly less fuelwood than three stone hearth users. This prediction was made because of the efficient design of the improved stoves that enables fuelwood to burn slower, resulting in less wood consumption. This prediction was tested by comparing the amount of fuelwood collected per week between the two cooking methods<sup>4</sup>. The fuelwood collection figures for comparison were calculated in terms of the volume of fuelwood collected per household person per week (by dividing the volume by the number of people in the household), in order to account for variations in volume due to household size. However, the average volume of fuelwood collected by households using improved cook stoves compared to 3 stone hearths (quantified per household member per week) did not support the assumption that improved

<sup>4</sup> The amount of fuelwood *collected* was used as a proxy indicator of actual fuelwood consumption, because the time available and tools available for this survey did not allow the surveyors to measure the actual amount of fuelwood consumed.

cook stoves require less fuelwood than 3 stone hearths<sup>5</sup>. This is contrary to qualitative responses by villagers, and is likely tied to the complexities involved in accurately quantifying fuelwood collection and consumption volumes given the methodology used in this study. This is most likely due to the introduction of calculation errors that result from extrapolating a figure for the amount of wood collected per week based on measuring the volume of a single bundle of fuelwood. Other sources of error which would have influenced the calculations include the possibility that respondents did not accurately (intentionally or unintentionally) estimate how many bundles of fuelwood they collect each day or week, and the possibility that volume measurements were not standardised between the two surveyors. A more rigorous methodology for measuring fuelwood collection and use would likely provide more accurate numbers in this respect, however the surveyors were required to forgo the use of a more rigorous methodology in the interest of speaking to as many villagers as possible in the short time period available.

Contrary to the calculated fuelwood volumes, qualitative data based on people's perceptions of the amount of wood they collect and use per week overwhelmingly supported the hypothesis that improved stoves require less wood per week than 3 stone hearths: 88% of improved stove users agreed that their stoves required less wood for cooking than traditional three stone hearths. These results do suggest that increased use of improved stoves by villagers living adjacent to Chome Forest Reserve would decrease the amount of fuelwood consumption, thus reducing pressure in Chome Forest Reserve.

## **B) Effectiveness**

This survey was also intended to provide monitoring and evaluation feedback to CBBP regarding the effectiveness of the improved stove program in Chome, and to help identify barriers to wider uptake of the new stoves in communities adjacent to Chome Forest Reserve. Respondents' answers to questions regarding how they had heard about the stoves, why they did or did not want one, and problems they may have encountered with the stoves was targeted to help CBBP identify and prioritise activities that would overcome these barriers and achieve greater impact. Information pertaining to how people learned about the improved stoves indicates that of those participants who already have improved stoves, 70% learned about the stoves from the UNDP-GEF CBBP while 18% learned about the stoves from their neighbors. Of the participants who have three stone hearths, 24% heard about improved stoves from neighbors, 7% heard about improved stoves from the UNDP CBBP, while 19% hadn't heard about the improved stoves at all. This indicates that the dissemination of information from the UNDP-GEF CBBP about improved stoves is not very wide spread beyond those villagers who already have stoves. Word of mouth via neighbors appears to be the most effective means of spreading information about the improved stoves. Data pertaining to community members' attitudes about the stove suggest that there has been a positive reception for the stoves in each of the villages, though it is then unclear why more villagers have not adopted the new technology. It must be noted here that the survey questionnaire did not provide an opportunity to discuss financial issues related to building an improved cook stove. It may be that building costs are prohibitive to villagers, and this should be a point for further study. The majority of community members who have improved stoves indicate that they haven't had any problems with their stove, that their stoves require less wood for cooking than traditional methods, and that they would recommend improved stoves to other villagers. A majority of people who use three stone hearths reported that people that they know who have improved stoves like their stoves and don't have problems with them. These results suggest that the stoves work well, and that participants with improved stoves desire to keep and maintain their stoves. Of those respondents who currently have three-stone hearths, most have heard primarily positive things about the improved stoves and desire to have one. However, many (35%) of these respondents expressed uncertainty about who to talk to get an improved cook stove.

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<sup>5</sup> See Appendix 2.

The improved cook stoves introduced by CBBP are beneficial to the user in three main ways: they most likely reduce the amount of fuelwood the user has to collect each week, they reduce the amount of smoke in the kitchen, and they reduce cooking time. Overall, villagers' impressions of the stove are positive and the use of the stoves could potentially spread as more people are made aware of how to build the improved stoves, and recognise the benefits of using an improved stove. As more and more villagers in Mhero, Gwan'ga, Marieni, and Mvaa start using improved stoves, the amount of fuelwood consumption is likely to decrease, thus reducing the pressure on Chome Forest Reserve.

## **Recommendations**

### *Improving the Study*

Although useful information was obtained through this study, there are many procedural aspects that could be improved in order to obtain more thorough and accurate data. The survey should have been tested on a few people in the area and then the necessary changes made before surveying an entire village. The data from Mhero village could not be analyzed with data from the other villages because many changes were made to the survey during the course of the two days in Mhero. The number of days spent collecting data was not sufficient to spend an adequate amount of time with each participant, which would be required to establish good rapport with the respondent and make sure each question is understood. The number of surveys administered should be reduced to three to four per day so that each respondent has adequate time to answer each question thoughtfully, and to avoid confusion over specific questions (although the drawback to this would be more time taken away from participants' daily duties).

The surveys were administered by two female surveyors, each accompanied by at least one male translator. Given the nature of gender relations in rural communities in the Pare Mountains, it is suggested that female translators from the villages accompany the survey administrators in future surveys, as the female respondents may answer the questions differently and more freely in an all female environment. It is noted that for this survey, one of the translators in each village was the local Forest Ranger for Chome FR, which was problematic in that the presence of a government representative and forest authority may have influenced how participants answered certain questions related to fuelwood and Chome FR<sup>6</sup>.

The majority of households in the surveyed villages cook with Usambara stoves rather than improved stoves or three stone hearths. The limited number of improved and three stone hearths made it very time-consuming to find houses with these types of stoves and made it impossible to get a random sample of each stove type.

### *Improving the Survey*

Although the original survey (Appendix, Figure 1) was modified in Mhero, the final survey (Appendix, Figure 2) could also be further improved to decrease confusion for participants and increase accuracy for some of the fuelwood questions. In particular, respondents had difficulty estimating quantitative answers in kilometers, kilograms, time, and so forth. It is likely that many of the quantitative data is inaccurate as a result. This problem could be overcome if the surveyors had the time and permission to accompany the women while they collected wood and cooked meals, thus allowing the surveyors to measure these parameters directly rather than relying on estimates.

Questions 34 and 41, pertaining to the amount of wood used and length of time needed to cook makande were not accurate assessments of fuelwood consumption because of the various ways to cook makande. Some women put a pot of makande on the stove in the morning using a few pieces of fuelwood and leave it there all day cooking slowly while they work in their shamba; others cook the makande very quickly in the evening using a lot of

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<sup>6</sup> For example, questions related to where and how often respondents collect their fuelwood (fuelwood collection from inside Chome FR is restricted).

fuelwood at once. Due to these different cooking styles, it was difficult to determine the extent to which the improved stoves reduced the amount of fuelwood used and the amount of cooking time. In future studies, it would be better to choose another type of meal or to be present during the cooking process to accurately record amount of fuelwood and cooking time.

Number discrepancies in the data for questions relating to amount of fuelwood in pieces per bundle and in pieces per week could stem from the preference of some women to collect large pieces of wood and then cut it into smaller pieces to use. Questions pertaining to amounts of wood should specify large vs. small pieces and measurements should be taken of large and small pieces and recorded accordingly. In addition to using a measuring tape, a small scale could be used to weigh the pieces of fuelwood to gain a more accurate estimate of the amount being used. Adding a question about the age of the improved stove would be beneficial to observe if people's attitudes about the improved stoves differ depending on how long they have had one.

#### *Future Suggestions for CBBP Same Site Stove Implementation Program*

While conducting the study, it became apparent that many people have questions about their improved stoves and many more are interested in obtaining improved stoves. Some of the participants who have improved stoves haven't built their chimneys properly or haven't cleaned them out recently and as a result smoke gets trapped and comes out into the kitchen. Some of the older stoves have cracked over time and certain building materials (i.e. cement) last longer than others (i.e. clay). One of the main problems with the stoves, according to A. Sambura (2001), are cracks which cause heat and smoke to escape. In order to reduce these problems, workshops should be held in each of the villages, teaching villagers how to maintain the improved stoves. These workshops should be targeted towards women as they are the primary users of the stoves and are responsible for maintaining them.

The most obvious observation made while surveying the villages is the need for more education in the area, both about how to build or acquire the improved stoves and about the conservation of Chome Forest Reserve. Specifically, a connection between the two should be made known to villagers so they understand how improved stoves are benefiting the forest, and ultimately their own survival. More village meetings need to take place to make villagers aware of who they can talk to about building an improved stove and to teach about the benefits of the improved stoves, as there seems to be a desire to learn but not enough knowledge circulating on how to actually build an improved stove. An effective way of spreading knowledge about the stoves would be to educate a few people in dispersed areas of the village as it appears that knowledge is often spread by neighbors. Alternatively, a group of villagers could be trained in stove building, and then offer their services out to others for a small fee.

Issues related to costs of building an improved cook stove were not addressed during this survey, however such information is vital to understanding how to further promote the stoves in communities near Chome FR. It is recommended that future surveys or studies make an attempt to discuss building costs with villagers, with an aim towards providing information on whether materials / labour needed to build the stoves are cost prohibitive for certain villagers, and if so how to overcome such problems.

Lastly, it is imperative that as the UNDP-GEF CBBP comes to a close, a final assessment of the improved stoves in these villages takes place. In order to ensure that stove use continues to spread after the project ends, it is important to obtain information as to the success of the introduced stoves, both how widespread their use and how villagers perceive them. It is recommended that this final evaluation be carried out through a series of surveys and open meetings which target at least 20 households in each of the villages where stoves were introduced.

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## Appendix 1

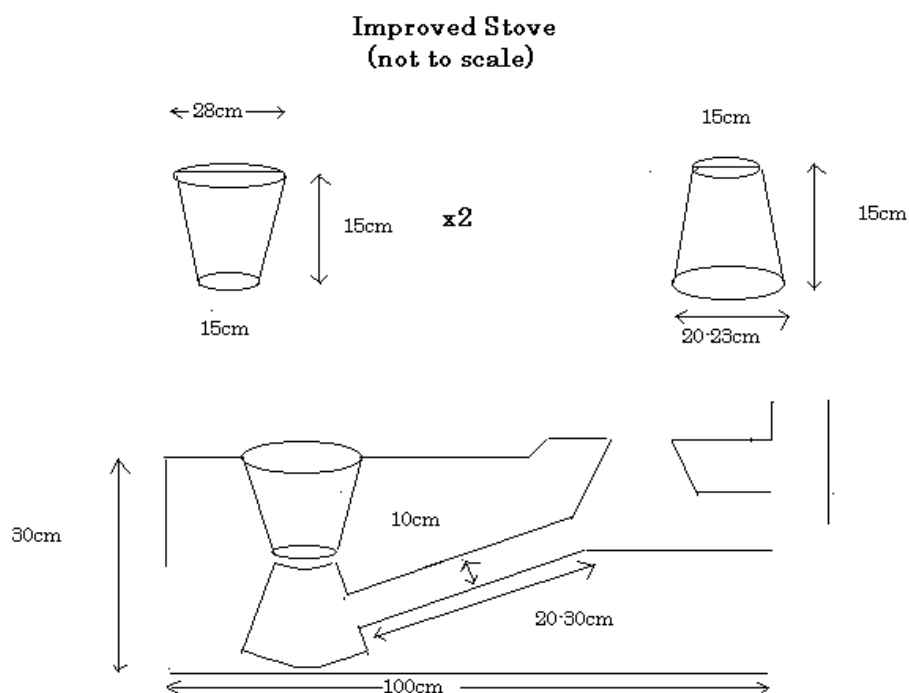


Figure 1. Improved stove dimensions and assembly instructions.

## Initial Survey

1. Sex: Female / Male
2. Age: \_\_\_\_\_
3. Marital Status: Not married / married / divorced / separated / widowed
4. Do you have children? Yes / No
5. If yes, how many? \_\_\_\_\_
6. Occupation: \_\_\_\_\_
7. Tribe: \_\_\_\_\_
8. What is your house made of? Cement / wood and sticks / mud bricks / regular bricks
9. What is your roof made of? Bati sheets / bati pieces / thatch
10. Do you have a chicken? Yes / No If yes, how many? \_\_\_\_\_
11. Do you have a cow? Yes / No If yes, how many? \_\_\_\_\_
12. Do you have a goat or a sheep? Yes / No If yes, how many? \_\_\_\_\_
13. Do you have a shamba? Yes / No If yes, what do you grow? How many acres is it?  
\_\_\_\_\_

## **Questions for people with improved stoves:**

14. Who built your stove? UNDP-GEF Biodiversity Project / local fundi / SMECAO / other NGO
15. Who did you hear about the improved stoves from? UNDP-GEF Biodiversity Project / friend / relative / neighbor / other NGO or project (which one) / village leader / village environmental committee member / other
16. Why do you have an improved stove? Wanted to try one / easy to use / environmentally friendly / reduce time cooking

17. Has your stove ever broken or not worked? Yes / No
18. Does your stove take the smoke out of your kitchen? Yes / No
19. Do you use smoke from the kitchen to preserve food? Yes / No
20. Have you had any problems with your stove? Yes / No
21. Does your stove require less wood for cooking than traditional methods? Yes / No
22. Would you recommend your stove to someone else? Yes / No

**Questions for people with three stone hearths:**

23. Have you heard about improved stoves? Yes / No If yes, from whom? UNDP-GEF Biodiversity Project / friend / relative / neighbor / other NGO or project (which one?) / village leader / village committee member / other
24. Do you have any relatives, friends, or neighbors that have stoves? Yes / No

**SKIP TO 29 IF NO**

25. Do they ever have any problems with theirs? Yes / No
26. Do they like their stoves? Yes / No
27. Why, if you have heard about the stoves, have you chosen not to have one? Too expensive / they don't work well / prefer traditional methods / not sure who to talk to in order to get one / kitchen too small / other
28. How do you get your fuelwood? Collect it / buy it
29. Is there a place in your village to buy fuelwood? Yes / No
30. Is there a place in your village to collect fuelwood? Yes / No
31. How much fuelwood do you collect / buy per week? (Answer in kilos) \_\_\_\_\_
32. How many bundles of fuelwood do you collect / buy each week? 1 / 2 / 3 / 4 / 5 / 6 / 7
33. How much fuelwood do you use for cooking one meal? (Answer in pieces) \_\_\_\_\_
34. How much fuelwood do you use in one day? (Answer in kilos) \_\_\_\_\_
35. How far do you have to go to collect fuelwood? ½K / 1K / 2K / 3K / 4K / 5K
36. How long do you spend collecting / buying fuelwood? 1H / 2H / 3H / 4H / 5H
37. How many times a week do you collect / buy fuelwood? 1 / 2 / 3 / 4
38. Where does your fuelwood come from? Forest / market / village woodlot / public land outside of forest / shamba
39. Do you collect fuelwood to store? Yes / No
40. Do you do the cooking for the family? Yes / No If yes, how long does it take you to cook a pot of rice? 1H / 2H / 3H / 4H / 5H
41. Do you clean the house? Yes / No If yes, how much time each day do you spend doing it? 1H / 2H / 3H / 4H / 5H
42. Do you garden and harvest food from the shamba? Yes / No If yes, how much time each day do you spend doing it? 1H / 2H / 3H / 4H / 5H
43. Do you collect water each day? Yes / No If yes, how much time does it take? 1H / 2H / 3H / 4H / 5H
44. Do you ever have any free time? Yes / No If yes, what do you do with your free time? Visit friends / make crafts / collect things to sell / church related activities
45. Do you collect extra fruit and vegetables to sell? Yes / No
46. Do you collect extra fuelwood to sell? Yes / No
47. Do you collect water for the family? Yes / No
48. How many times a day do you collect water? 1 / 2 / 3 / 4 / 5
49. How far do you have to go for water? ½K / 1K / 2K / 3K / 4K / 5K
50. How much time do you spend collecting water? 1H / 2H / 3H / 4H
51. Where do you go to collect water? Forest / village tap / traditional irrigation canal / own tap / other
52. How many buckets of water do you collect a day? 1 / 2 / 3 / 4 / 5 / 6 / 7
53. Do you have to make more than one trip to collect water? Yes / No
54. How many buckets of water do you collect each trip? 1 / 2 / 3
55. Does your family use water for bathing each day? Yes / No
56. Do you collect water for drinking? Yes / No
57. Do you collect water for cooking? Yes / No



58. How many bundles of wood do you use for cooking each week? 1 / 2 / 3 / 4 / 5 / 6 / 7

**Final Survey (Changed or added questions are in bold)**

1. Sex: Female / Male
2. Age: \_\_\_\_\_
3. **Number of people living and eating in your home:** \_\_\_\_\_
4. Marital Status: Not married / married / divorced / separated / widowed
5. Do you have children? Yes / No
6. If yes, how many? \_\_\_\_\_
7. Occupation: \_\_\_\_\_
8. Tribe: \_\_\_\_\_
9. What is your house made of? Cement / wood and sticks / mud bricks / regular bricks
10. What is your roof made of? Bati sheets / bati pieces / thatch
11. Do you have a chicken? Yes / No If yes, how many? \_\_\_\_\_
12. Do you have a cow? Yes / No If yes, how many? \_\_\_\_\_
13. Do you have a goat or a sheep? Yes / No If yes, how many? \_\_\_\_\_
14. Do you have a shamba? Yes / No If yes, what do you grow? How many acres is it?  
\_\_\_\_\_

**Questions for people with improved stoves:**

15. Who built your stove? UNDP-GEF Biodiversity Project / local fundi / SMECAO / other NGO
16. Who did you hear about the improved stoves from? UNDP-GEF Biodiversity Project / friend / relative / neighbor / other NGO or project (which one) / village leader / village environmental committee member / other
17. Why do you have an improved stove? Wanted to try one / easy to use / environmentally friendly / reduce time cooking
18. Has your stove ever broken or not worked? Yes / No
19. Does your stove take the smoke out of your kitchen? Yes / No
20. Do you use smoke from the kitchen to preserve food? Yes / No
21. Have you had any problems with your stove? Yes / No
22. Does your stove require less wood for cooking than traditional methods? Yes / No
23. Would you recommend your stove to someone else? Yes / No

**Questions for people with three stone hearths:**

24. Have you heard about improved stoves? Yes / No If yes, from whom? UNDP-GEF Biodiversity Project / friend / relative / neighbor / other NGO or project (which one?) / village leader / village committee member / other
  25. Do you have any relatives, friends, or neighbors that have stoves? Yes / No
- SKIP TO 29 IF NO
26. Do they ever have any problems with theirs? Yes / No
  27. Do they like their stoves? Yes / No
  28. Why, if you have heard about the stoves, have you chosen not to have one? Too expensive / they don't work well / prefer traditional methods / not sure who to talk to in order to get one / kitchen too small / plans to get one in the future / other
  29. How do you get your fuelwood? Collect it / buy it
  30. Is there a place in your village to buy fuelwood? Yes / No
  31. Is there a place in your village to collect fuelwood? Yes / No
  32. **How much fuelwood do you collect / buy per week? (Answer in pieces)** \_\_\_\_\_
  33. How many bundles of fuelwood do you collect / buy each week? 1 / 2 / 3 / 4 / 5 / 6 / 7

34. **How much fuelwood do you use for cooking one meal, like makande? (Answer in pieces) \_\_\_\_\_**
35. **How much fuelwood do you use in one day? (Answer in pieces) \_\_\_\_\_**
36. How far do you have to go to collect fuelwood? ½K / 1K / 2K / 3K / 4K / 5K
37. How long do you spend collecting / buying fuelwood? 1H / 2H / 3H / 4H / 5H
38. How many time a week do you collect / buy fuelwood? 1 / 2 / 3 / 4
39. Where does your fuelwood come from? Forest / market / village woodlot / public land outside of forest / shamba
40. Do you collect fuelwood to store? Yes / No
41. **Do you do the cooking for the family? Yes / No If yes, how long does it take you to cook a pot of makande? 1H / 2H / 3H / 4H/ 5H**
42. Do you clean the house? Yes / No If yes, how much time each day do you spend doing it? 1H / 2H / 3H / 4H/ 5H
43. Do you garden and harvest food from the shamba? Yes / No If yes, home much time each day do you spend doing it? 1H / 2H / 3H / 4H / 5H
44. Do you collect water each day? Yes / No If yes, how much time does it take? 1H / 2H / 3H / 4H / 5H
45. Do you ever have any free time? Yes / No If yes, what do you do with your free time? Visit friends / make crafts / collect things to sell / church related activities
46. Do you collect extra fruit and vegetables to sell? Yes / No
47. Do you collect extra fuelwood to sell? Yes / No
48. Do you collect water for the family? Yes / No
49. Hw many times a day do you collect water? 1 / 2 / 3 / 4 / 5
50. How far do you have to go for water? ½K / 1K / 2K / 3K / 4K / 5K
51. How much time do you spend collecting water? 1H / 2H / 3H / 4H
52. Where do you go to collect water? Forest / village tap / traditional irrigation canal / own tap / other
53. How many buckets of water do you collect a day? 1 / 2 / 3 / 4 / 5 / 6 / 7
54. Do you have to make more than one trip to collect water? Yes / No
55. How many buckets of water do you collect each trip? 1 / 2 / 3
56. **Do you boil your water for drinking? Yes / No**
57. **Have you been educated about the Chome Forest Reserve? Yes / No If yes, how?**
- a. school
  - b. my children
  - c. from the forest ranger
  - d. neighbors and friends
  - e. seminars and meetings
  - f. elsewhere
58. **Why do people cut trees from the forest? (Choose two)**
- a. fuelwood
  - b. building
  - c. selling or other purposes
59. **Do you think the improved stoves are good for the environment? Yes / No If yes, how?**
60. How many bundles of wood do you use for cooking each week? 1 / 2 / 3 / 4 / 5 / 6 / 7

## Appendix 2. Chome Improved Stove and 3 Stone Hearth Statistics (Outliers Removed)

### Case Processing Summary

		Valid Cases		Missing		Total	
		N	Percent	N	Percent	N	Percent
Vol coll / person / wk (m3)	3 stone hearth	28	77.8%	8	22.2%	36	100.0%
	Improved Cookstove	32	97.0%	1	3.0%	33	100.0%

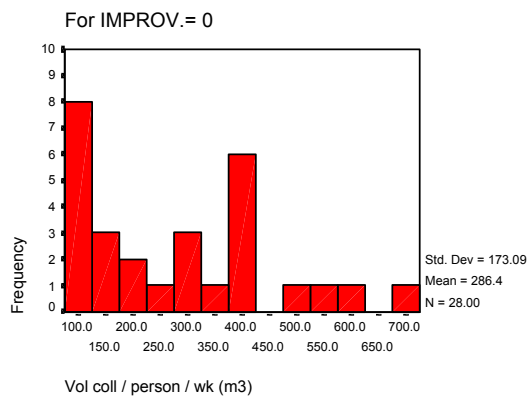
### Group Statistics

		N	Mean	Std. Deviation	Std. Error Mean
Vol coll / person / wk (m3)	Improved Cookstove	32	301.1189	178.3683	31.5314
	3 Stone hearth	28	286.4407	173.0874	32.7104

### Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Vol coll / person / wk (m3)	Equal variances assumed	.048	<b>.827</b>	.322	58	<b>.748</b>	14.6782	45.5261
	Equal variances not assumed			.323	57.357	<b>.748</b>	14.6782	45.4335

#### Histogram



#### Histogram

