
Photo: Septiyah Widyaningsih

From the Lab to the Field and Back

GUIDANCE NOTE ON USER NEEDS

Social Context, Gender, and User Needs in the Design and Promotion of Clean Stoves in Indonesia

This note is part of a program on social and gender aspects of the development and promotion of clean stoves. Grounded in extensive research in Indonesia, the series consists of practical documents that can be used to integrate social and gender dimensions into work on clean stoves in East Asia and the Pacific and beyond. The target audience is clients and development partners active in the development and promotion of clean stoves. The documents produced by the work program may be downloaded from https://www.astae.net/publication/social-gender-support-to-indonesia-CSI.

East Asia and Pacific

A product of the EAP Gender and Energy Facility and the Clean Stove Initiative

Why a Qualitative Assessment of Clean Stoves?

Important progress has been made in recent years in developing a range of biomass cookstoves that reduce pollutant emissions and burn fuel more efficiently. These improved stoves have the potential to improve health and enhance the quality of life for the 2.5 billion people worldwide who still cook their meals and heat their homes by burning biomass in open fires or inefficient traditional stoves.

Efforts have also been made to develop testing methodologies to evaluate stove emissions and efficiency; a set of accepted test protocols is now available. Fewer studies exist, however, on end-user acceptability, and no single, widely accepted protocol for assessing the social side of stove adoption is available. Gaps in this area are critical; particularly as the rate of adoption of clean stoves has remained low. The benefits of improved stoves will be realized only if people start using them and sustain that use over time. Limited knowledge on users' preferences is a major challenge to adoption, as is the availability of clean stoves that clearly meet those preferences.

Understanding consumer behavior and the contexts in which a product will be used is a backbone of product design in competitive markets. Insights into what people value, their interests, their social worlds, and cultural influences can lead

WORLD BANK GROUP

moving towards gender equality
East Asia & Pacific Gender Practice

ASTAE
Asia Sustainable and Alternative Energy Program

WORLD BANK GROUP
Social, Urban, Rural & Resilience

Box 1. The Importance of Meeting Users' Needs

Available studies on stove uptake in other contexts confirm that failing to meet intended users' needs and preferences is a key obstacle to adoption. In a systematic review of 57 improved stove programs in Africa, Asia, and Latin America, Rehfuess and others (2014) found that offering technologies that meet household needs is as critical for adoption as are effective financing and enabling policy. The review suggests that failure to effectively meet needs almost guarantees that an improved stove either will not be adopted or that it will not be used for long Similarly, Mobarak and others (2012), in a review of successful stove programs in Bangladesh, indicate that responding to users' preferences is a key driver of adoption and that efforts to improve health and reduce environmental problems through the use of improved stoves will be more successful if cookstoves are designed with features valued by users, even if those features are not directly related to health and environmental impacts.

The work of the Clean Stove Initiative in Indonesia suggests that people are willing to try a new technology if they can first assess how it works and if trusted peers and neighbors have positive experiences and recommend its use. Word of mouth is a very strong marketing tool to reach the base of the pyramid, so it is important that the products released are able to meet expectations to a reasonable degree. In an analysis of successful marketing strategies, Hystra (2013) suggested that approximately 60 percent of costumers decide to purchase cookstoves based on what friends and relatives recommend. In their review, Rehfuess and colleagues (2014) found that social networks and opinion leaders influence adoption in positive and negative ways and that a bad experience with the technology is especially destructive.

to unexpected solutions and innovations, increasing the chances for a product's development and sustained use.

As part of efforts to promote the uptake of improved biomass stoves at a large scale, the Indonesia Clean Stove Initiative (CSI) has invested in experimental approaches to better understand end users' needs and preferences and to assess the performance of technologies and products in their intended context of use. The goal of this work has been to shed light on the social and cultural aspects of technology adoption as complements to technical performance tests on emissions and thermal efficiency. The overall objective of the work has been to make clean stoves more responsive to the preferences of end users, thus increasing the probability that the stoves will actually be used widely over time.

What Has Been Done So Far in Indonesia?

In 2012, the CSI established a team of social scientists that included a sociologist, an anthropologist, and a statistician. The team conducted qualitative studies in Java and Sumba Island (EAP Gender & Energy Facility and CSI 2015a, 2015b) that were later complemented by a quantitative survey (EAP Gender & Energy Facility and CSI 2015c). During this exploratory phase, data was obtained on patterns of fuel use and user segments, stove inventories, cooking practices and sequences, preferences, gender roles, and innovation patterns.

This initial phase of work provided key information on local cooking cycles (power ranges and sequences) allowing for their integration into a water heating test that assessed fuel consumption and emissions as in the standard procedure for a water boiling test but while replicating typical local cooking cycles, thus increasing its relevance for assessing performance in a particular context. The Indonesia CSI used this test in 2014 to rate candidate biomass stoves for its first pilot in the country.

Following the selection of a group of clean stoves that passed the CSI emissions and efficiency test, the next step was to develop an experimental procedure to assess the actual performance of selected stoves on parameters of interest to end users under real-life conditions. The emphasis was on obtaining comprehensive and systematic user feedback on stove performance in context, actual stove usability, and user satisfaction.

The approach was tested in Central Java in December 2014 and validated in May 2015, when local users, all highly experienced household cooks using biomass as primary fuel, assessed five advanced clean stoves that had received high ratings for emissions and fuel efficiency in lab tests. The findings from this initial experience suggest that adding a second layer of social assessment to complement technical tests could significantly help to identify potential technical as well as contextual limitations and opportunities prior to large-scale product dissemination.

The social test helped to point out areas where issues of fit with context and of usability could affect adoption, positively and negatively. This in turn made it possible to design a series of activities to mitigate potential risks, such as classifying stoves according to their training requirements, developing training modules to address key issues in stove operation, improving operating manuals, and in some cases providing specific recommendations for retrofitting or redesigning stoves to aid adoption.


Photo: Voravate Tuntivate

Photo: Veronica Mendizabal

What Sets This Experimental Method Apart?

Focusing stove performance on variables of interest to users in a given context responds to an important finding from the initial exploration: what is considered a stove improvement by stove users and stove promoters can vary greatly. While the critical features for promoters might include longer-term public goods such as increased efficiency and reduced emissions, users in studied sites in Indonesia were more interested in improvements with direct and short-term benefits, such as reduced cooking times, greater comfort levels, the ability of the stove to operate with biomass of varying moisture and quality, and reducing household expenditures and physical effort.

The approach described in this note was designed to obtain feedback on the performance of the stove on aspects of interest to the end users in their local context. It focuses on functionality and usability and on the emotional response of users to the product. It was designed to yield answers to the following questions:

1. Fit with cooking environment, social and cultural dynamics

- Does the stove respond to the context and specific needs in which it will be used?
- What is the fit between stove and kitchen types, firewood quality, cooking practices, women's tasks and gender roles, intra-household decision-making, and patterns of fuel and stove use?

2. Functionality and usability

- How does the stove perform on a set of requirements of interest and importance to users when operated under actual conditions?
- How do people engage with the stove? Which aspects of operation are easy? Which are challenging?
- Are the challenges related to novelty? Need for training? Product design? The interface between design and context?

3. Emotional resonance and aesthetic response

- What is the degree of user satisfaction with specific aspects of operation and design (form, materials, dimensions, end result, and so on) and with the overall experience?
- What does the clean stove mean to intended users?

The approach also tries to replicate as much as possible a scenario of large-scale, market-based promotion. For this reason, no training or demonstration is provided to testers before they use the stove for the first time, although all questions are answered throughout the assessment. This design, without previous training, makes it possible to observe users' first encounter with the stove, specific areas of difficulty, and the level of success in users' own problem-solving strategies. The design is also based on the recognition that training and demonstration are not always possible in large-scale interventions, as is the case of the Indonesia Clean Stove Initiative.

What Sort of Findings Does the Method Yield?

The assessment can help to identify specific issues of fit with context, mainly related to clean stove designs originally developed for different contexts. The results in Indonesia suggested, for example, that compared with the local baselines, clean stoves might require additional physical effort and time for fuel preparation, owing to the use of smaller firewood lengths and diameters required in stoves with "rocket" designs. That requirement could place an additional burden for women, who in the Indonesia context are responsible for fuel preparation at the point of use.

The assessment also suggested issues with the ignition performance of some clean stoves when used in the field, and with their overall speed compared with the baseline. Furthermore, the test suggested that some of the stoves, when used by local cooks with local biomass and under field conditions, were still leaving soot on pots and emitting high levels of smoke during ignition or re-ignition. In addition, some specific problems between stove elements and local pot sizes were observed.

The method made it possible to identify those stoves that would require only explanation at the point of sale or an improved manual, as well as those that were less intuitive and that would require training, demonstration, or even retrofitting or redesign to improve their performance in the context of use. This information was used in pre-release marketing and promotional strategy that addressed stove limitations while highlighting their real (and not just hypothetical) benefits.

Description of Testing Process

The method can be divided into two distinct phases of data collection. The first, exploratory phase allows for gathering a wide range of information on social and cultural aspects related to the use of fuels and stoves. This phase is a prerequisite for the second stage, which links stove performance to the context of use, with an emphasis on user feedback. The entire testing processing is described below and summarized in box 2.

Box 2. Summary of Qualitative Stove Assessment Process

Preparatory phase

- Establish and train a team to conduct the assessment.
- Select testers that have similar cooking skills from the most common fuel-user segments.
- Have all testers try all selected stoves and the baseline.
- Conduct the assessment is in the field—that is, in the kitchens of testers.
- Define the number and type of dishes based on local practices.
- Standardize the amounts to be cooked.
- Standardize the pots to be used to reflect common local types and sizes.
- Do not provide fuel. Testers are asked to use their own fuel in order to assess the flexibility of the stove to operate with varying qualities and types of biomass.

Field test

- Brief testers on objectives; present the ingredients, the stove, and the manual.
- Conduct no training or demonstration, but answer all questions throughout the assessment.
- Ask testers to imagine a scenario in which they have just purchased the stove and bring it home to cook a complete meal.
- Systematically record: key aspects of operation, problems, strategies to solve problems, successes and failures, the time required for each key operation (fuel preparation, ignition, re-ignition, cooking, etc.), all questions asked, all sequences of trial and error, and testers' emotions and reactions to aspects of use.
- Repeat this process for all stoves, including the baselines.
- Conduct a structured interview at the end of each session.

Lab test (optional)

- Brief testers on objectives, present all materials and ingredients, the stove, and the manual provided by the manufacturer.
- Testers may be offered access to dry, quality firewood in various sizes.
- Conduct briefing or demonstration on key issues and difficulties as observed during the field test, in addition to answering all questions posed during the assessment.
- Systematically record:
  - All key aspects of operation, problems, strategies to solve problems, successes and failures
  - The time required for each key operation
  - All questions asked and all sequences of trial and error
  - Emotions and reactions to aspects of use
  - Learning between field test and lab test
- Repeat this process for all stoves, including the baselines.
- Conduct interviews at the end of the session.

Analysis

- Analyze data per tester and later aggregated per stove.
- Analyze problems and possible causes (variables)
- Summarize findings and tailor messages for the various stakeholders, including problem-solving strategies.

Exploratory Phase

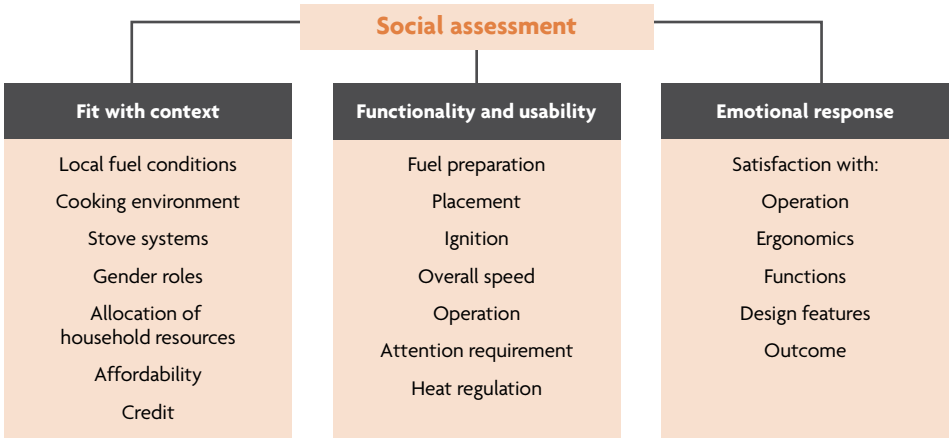
In this phase, in-depth information is obtained on local fuel-user segments, fuel and stove uses, stove inventories, cooking practices, and relevant sociocultural aspects of stove use, particularly gender roles, household decision making, and patterns of innovation and adoption of new technologies. Data collection should emphasize contextual needs and preferred stove features. Collection methods—focus group discussions, unstructured interviews, and ethnographic research—should allow for direct interaction with users. For the CSI in Indonesia, in addition to qualitative methods, a survey was conducted and 1,500 respondents were added to the initial sample of 200 participants. This survey (EAP Gender & Energy Facility and CSI 2015c) helped to triangulate and validate the initial qualitative information.

Stove Assessment Phase

In this phase, local testers assess selected clean stoves in their context of use for usability and desired features, and compare these with their baseline. The assessment is conducted in the field (that is, in the kitchens of the selected local testers) under ordinary day-to-day conditions of use, including the use of the testers' own fuel. During the assessment, observers systematically record all aspects of operation, problems encountered, the solutions adopted to solve those problems, successes and failures, the time required for each one of the key operations (such as fuel preparation, ignition, cooking), all questions asked and all sequences of trial and error, and testers' emotions and reactions to aspects of use.

This process is replicated for all stoves selected, including the baseline. Structured interviews are conducted at the end of field trials. The forms used in Indonesia are included in a companion "toolkit" available from https://www.astae.net/publication/social-gendersupport-to-indonesia-CSI. In addition to the field test, a lab test may be conducted to assess

Figure 1. Social Assessment Framework



important variations between field and lab (controlled) experiences. Figure 1 presents the areas of inquiry covered during the application and validation of the method in Indonesia between December 2014 and May 2015.

Selection of Testers

For the assessment stage, it is recommended to define and select testers from the predominant biomass user segments identified during the exploratory stage. The intention in having testers from each key segment is to obtain information on their specific experience of use and to identify important variations. For example, would the use of biomass as a single fuel or in combination with other fuels such as liquefied petroleum gas (LPG) affect the perceptions of clean stoves? Or would certain stoves be preferred by specific user segments because they were better suited to aspects of their cooking practices (niches) or systems of fuel combination?

In Indonesia, the criteria for selection included being primary cooks, having similar cooking skills and experience (15–20 years), using biomass as the primary fuel, and being available to participate in the assessment from beginning to end. This sample included two user profiles: those who used biomass as their single fuel and those who used it in combination with LPG.

Regarding sample size, the method aims at obtaining insights on usability and fit with context through in-depth observation of the stove operation for the preparation of common full meals. This is time consuming and requires detailed preparation. Thus, for practical reasons

Photo: Veronica Mendizabal

Photo: Veronica Mendizabal

the sample will be limited to resources and time available. Nonetheless, it is recommended that at least five to ten testers try the stoves and, if testing a large number of stoves, that the number of testers match the number of stoves so that all testers have the chance to use all of the stoves to enable comparisons.

Selection of Cooking Tasks

The method proposes a task-based assessment. Testers are given a common scenario and a common goal allowing for the observation of strategies, patterns of use, and recurrent problems among users. The goal is the preparation of a complete daily meal replicating local practice. The dishes selected should be representative of daily dishes cooked in the region. These are identified during the early phase of the process and reconfirmed with the local testers prior to the assessment. In Indonesia, preparing a full daily meal involves boiling and steaming rice, boiling and simmering soup, frying tempeh and tofu, and deep-frying chili paste. Testers were also asked to boil water, a common daily activity in the area. These tasks tested the stove on the heat ranges needed to cook local meals.

The cooking ingredients are provided to testers. To enable comparison across testers, all weights and measurements should be standardized. In Indonesia, the amounts were expected to serve four, the average household size in Java where the test took place.

Selection of Pots

All cooks prepare exactly the same meals in the exact same amounts using the same type of pots. The pots to be used should represent the common practice in the region. It is important to note that if using their own pots soot should be removed from pots prior to testing to avoid variations in outcome.

Biomass

If variables such as stove performance with various qualities of biomass are to be assessed, the use of local biomass is recommended, as this will make it easier to observe the stove in operation under real conditions of use. In this case, moisture content, dimensions, and amounts used should be recorded.

Field Test

Actions and effects of use cues are recorded and tasks are timed, counting the number of trials and questions asked to assess the degree of difficulty per task. The observers pay attention to the intuitiveness in the design and to the interface between user and product. Testers' problems operating the stove are detailed, as is the emotional state of users as they engage with the product.

Photo: Veronica Mendizabal

Testers are not given demonstrations, but they do have the user manual that comes with the stove. Observers answer all questions posed. As indicated previously, this design makes it possible to observe users' first encounter with the stove, highlighting specific areas of difficulty, the level of success in users' own problem-solving, the intuitiveness of the design, and the speed and easiness of learning. It also avoids a situation in which the focus of attention is redirected from assessing the stove to assessing the user.

Testers are asked to imagine a scenario in which they had just purchased the stove. They are then asked to cook a full daily meal and to boil water. Upon completing the cooking tasks, testers are asked to rate the resulting food on taste and texture, and to rate the stove on areas of expressed interest, which, according to the context, might include ignition, power, speed, ease of use, cleanliness, and efficient use of fuel.

A structured interview is given at the end of the field test. The interview covers satisfaction with use, functions, outcomes, and the potential place of the stove in testers' cooking systems, either as a stand alone or as a complement for specific tasks. In Indonesia, a tentative price was also cited to testers, and the issue of affordability was discussed. Testers were also asked if they would be interested in obtaining credit to purchase the stove and if they would need their husband's consent for the purchase. Finally, they were asked to choose between the stove assessed and other stoves, including LPG.

After having tried all of the clean stoves, testers use their own baseline stoves and the fuel mixes they would normally use (e.g., firewood and LPG) to prepare the same dishes. As with the other stoves, this process is systematically observed and timed, and a rating and final interview follow.

Laboratory Test (Optional)

Following the field test, a lab test may be conducted in which testers try the stoves in the lab under a controlled environment. In this case, testers are closer to the conditions under which technical tests are usually conducted. The lab is generally free of drafts and has tiled floors. It may have raised surfaces. If a lab test is conducted, it offers a good opportunity to observe learning between first and second use and differences in stove performance between field and lab tests.

Analysis

All of the recorded information is analyzed for each tester and aggregated for each type of stove. Problem areas are identified, along with the variables potentially responsible for those problems. Also recorded are possible risks and opportunities for uptake. At this stage, recommended measures to increase the chances of adoption of the tested stoves are prepared.

Conclusion

This social assessment is a work in progress. Further testing will be conducted under the umbrella of the Indonesia CSI, and tools will be refined. The work proposes the use of exploratory studies to support large-scale adoption of clean stoves through a focus on the user. For this reason it takes user preferences and needs as key aspects to inform marketing and promotion strategies. It also aims at providing insights that could inform further work on stove design and development of the next generation of clean stoves.

Owing to the size of the sample, the findings produced from the application of the methodology described here are not statistically representative. However, they show tendencies and are expected to complement results from technical testing protocols, putting emphasis

on the experience of the user and obtaining a closer understanding of the value proposition of the product and its actual performance under real conditions of use.

In Indonesia, the assessment provided a level of external validity to controlled laboratory tests. By testing stove performance under real conditions of use it was possible to identify operation issues, classify the stoves according to their training requirements, suggest specific improvements to the operation manuals, and to recommend modifications to stove design to ensure their suitability for use in a specific context. This note is expected to contribute to the understanding of user preferences and to the design of methods for systematic assessment of clean stoves and their capacity to respond to users' needs in diverse contexts, thus encouraging adoption.

References

EAP Gender & Energy Facility and CSI (Clean Stove Initiative). 2015a. "Stoves, Fuels, and Cooking Practices on Sumba Island, Indonesia: Findings and Recommendations of Qualitative Field Research." GPSURR, World Bank, Washington, DC.

———. 2015b. "Stoves, Fuels, and Cooking Practices in Central Java, Indonesia: Findings and Recommendations of Qualitative Field Research." GPSURR, World Bank, Washington, DC.

———. 2015c. "Clean Biomass Cookstoves in Central Java, Indonesia: A Quantitative Market Analysis." GPSURR, World Bank, Washington, DC.

HYSTRA (Hybrid Strategies Consulting). 2013. "Marketing Innovative Devices for the Base of the Pyramid: Lessons from 15 Global Pioneers That Challenge Conventional Sales and Marketing Approaches to Successfully Serve the Poorest." Paris. March.

Rehfuess, E. A., E. Puzzolo, D. Stanistreet, D. Pope, and N. G. Bruce. 2014. "Enablers and Barriers to Large-Scale Uptake of Improved Solid Fuel Stoves: A Systematic Review. *Environmental Health Perspectives* 122: 120–130. http://dx.doi.org/10.1289/ehp.1306639.

Mobarak, A. M., P. Dwivedi, R. Bailisb, L. Hildemann, and G. Millerd. 2012. "Low Demand for Nontraditional Cookstove Technologies." *Proceedings of the National Academy of Sciences* 109(27). July 3.

For additional information, please contact Lourdes Anducta (landucta@worldbank.org).