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WINROCK INTERNATIONAL

CLEAN AND EFFICIENT COOKING TECHNOLOGIES AND FUELS

9. MONITORING AND EVALUATION

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9. MONITORING AND EVALUATION

Because of their cross-sectoral nature, cleaner and more efficient cookstoves and fuels have the potential to impact a number of different development priorities. However, varying levels of success and complex determinants of effectiveness of such programs have led to a growing recognition of the need to prioritize monitoring and evaluation (M&E) to enable informed decisions at program and policy levels.

The M&E of the impacts and outcomes of programs promoting the uptake and use of cooking technologies and fuels covers not only stove and fuels performance testing, but also consumer preferences/willingness to pay, sales tracking and other business indicators, usage/adoption, health and environmental impacts, as well as social impacts.

WHY IT MATTERS

Developing robust monitoring and evaluation systems enables you to understand the impact of your work, and make informed decisions at program and policy levels. It's also critical for reporting aggregated results agency-wide, and reporting to Congress.

BEST PRACTICES

1. First, identify the impacts you want to achieve. Monitoring and evaluating health, environment, business and social impacts all require different tools and approaches.
2. Make sure the technology and fuel you choose to promote/support can deliver your desired impacts. Various protocols exist to evaluate cookstove performance with respect to fuel efficiency, emissions, safety, and durability – make sure the stove/fuel combination has been tested by a reputable testing organization/lab before dissemination at scale.
3. Find out if the stove / fuel is capable of meeting consumer needs (both immediate and long term). If the consumer doesn't use the stove, you won't get the impacts!
4. Sales are an important indicator, but for long-term impact monitoring, be sure to include sufficient resources to look at other key adoption and social impacts!

Included in this toolkit are descriptions and links to some of the methodologies and tools available for monitoring clean cooking programs, divided by:

- M&E for stove performance
- M&E of stove/fuel sales
- M&E on consumer behavior and its determinants
- M&E of social and well-being impacts.

The number of tools available exceeds the scope of this toolkit, but more information on various tools not included here can be found in the Global Alliance for Clean Cookstoves' "Impact Assessment Tools and Resources Guide." More information on the HAPIT tool for assessing health impacts is included in the "Research and Evidence on Health" section of this toolkit.

EVALUATING COOKSTOVE PERFORMANCE

Standardized laboratory and field-testing protocols for testing stove performance (fuel efficiency, total emissions, indoor emissions, and safety) have existed for over a decade, but international efforts to harmonize the various existing protocols, and increase the use and accessibility of third-party testing centers is relatively new (More information is provided in the Standards and Testing section). The current available laboratory and field testing protocols and their appropriate uses are described below.

MEASURING FUEL EFFICIENCY

Three internationally recognized and standardized tests to measure the fuel efficiency of cookstoves are the Water Boiling Test (WBT), the Controlled Cooking Test (CCT), and the Kitchen Performance Test (KPT). The laboratory-based WBT is the most easily controlled of the three, allowing for comparison between stoves. This is usually the first line test carried out during stove development before introducing a product to the market. The CCT uses a controlled field environment to assess the performance of stoves relative to the traditional baseline option, and consists of multiple cooks cooking a typical local meal (using exact quantities of the same ingredients) multiple times for each stove tested. The KPT produces a more 'real- world' estimate as it measures the impact of the introduction of the stove on all household fuel use[1], meaning that it takes into account not just the intervention stove performance, but also the degree to which consumers displace their traditional cooking option. This test is carried out in a larger number of households once the stove has shown positive results using the WBT and/or the CCT. More detail on these and other testing protocols are available here: http://cleancookstoves.org/technology-and-fuels/testing/protocols.html.

EMISSIONS MONITORING

For health and climate-focused programming, emissions monitoring is essential to track effectiveness and inform program planning. Small particles ($PM_{2.5}$) and carbon monoxide (CO) are the most commonly measured pollutants, as they are widely accepted to pose the greatest health risk. Following the distinctions made in the interim international standards tiers of performance, emissions are often categorized either as total emissions (all pollutants coming from the stove) or indoor emissions (the amount of pollutants that the stove produces indoors, not including those exiting through a chimney). For climate-focused programs, total emissions is an important indicator, whereas health-focused programs may be more interested in indoor emissions. That said, even pollutants that are carried out of the home through a chimney still have health impacts by re-entering through an open window, or accumulating in outdoor environments – especially in tightly packed communities. Other factors taken into consideration when assessing household air pollution include ventilation rates, the size and type of kitchen, the mix of stoves and fuels used, the number of people cooked for, lighting, and other indoor sources of pollution, such as emissions from kerosene lighting and cigarettes.

Emissions monitoring is most often done in conjunction with the other testing protocols described above, and can be done in both lab and field settings. The Water Boiling Test, for example, has a section on emissions testing as part of the formal protocol. Due to the complex procedures and equipment required to collect robust informative data, it is recommended that any emissions testing is carried out by a professional testing lab (such as the Regional Testing and Knowledge Centers) or other testing-focused organization/institution.

1 http://cleancookstoves.org/technology-and-fuels/testing/protocols.html

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SAFETY

In addition to fuel efficiency and emissions, safety is the only other metric currently included in the interim international standards for stove testing. Safety considerations for cookstoves and fuels are primarily focused around preventing burns and house fires (tipping, fuel containment, surface temperature, accessible flames), but also include evaluating sharp edges and other possible hazards. The internationally recognized Biomass Stove Safety Protocol is available on the Alliance protocols page. It's important to note that this safety protocol was created specifically for biomass stoves, and other important safety considerations for non-biomass stoves are not covered here (e.g., LPG canister erosion issues, prevention of leaks from gas or liquid fuel stoves).

DURABILITY

The durability of the stove can have a significant impact on the other elements of stove performance described above. As a stove deteriorates, so can its ability to perform optimally in terms of fuel efficiency, emissions and safety, which in turn impacts consumer perception and use as well as willingness to repair and replace the stove. Stove durability can be affected by the duration of use, the frequency of use, the type of fuel used, as well as other factors. A household stove used for institutional cooking will wear out sooner than its expected lifetime. Charcoal from distinct regions in the same country (in-land areas vs. coastal areas) can have different effects on stove longevity. Various forms of durability testing can be carried out, and differ by the stove model, construction materials, and expected use. Durability tests range from simple tests that can be done in the field, to sophisticated durability testing requiring an advanced laboratory setting. Colorado State University and the Global Alliance for Clean Cookstoves have created the first publically available comprehensive durability protocol, the newest of the protocols described here, which is available on the Alliance protocols page. A webinar on Cookstove Durability Testing, organized by US EPA and Winrock International, provides more examples.

SALES TRACKING

Sales tracking is a key project monitoring component to not only follow and react to trends in stove sales but also to carry out customer analysis allowing for enhanced customer relationship management and after-sales service provision (including warranty fulfillment). Sales databases can also support monitoring of sales agent performance, business growth indicators and provide important information for carbon financing programs. Sales tracking software is readily available and can be linked with mobile monitoring technologies that allow for easier and more accurate collection and automation of stove sales data, using simple SMS data capture tools, GPS location services, smart phone or tablet applications, and cloud-based information storage. A common sales tracking software is Salesforce, but other similar platforms exist, which can be customized to the specific needs of a company or donor, and are available and used by cookstove companies globally.

EVALUATING CONSUMER BEHAVIOR AND ITS DETERMINANTS

M&E for cookstove and fuels programs extends beyond the performance of the technology itself. Unless fully incorporated into household stove use patterns, even the most efficient, clean stove cannot achieve impact. It is therefore essential to measure and understand consumer behavior and its determinants related to cleaner, more efficient stoves. There are many tools available to support this M&E.

STOVE USE MONITORING

An emerging theme in the clean cooking sector is stove adoption, which is described in more detail in the "Consumer Preferences / Adoption" section of this toolkit. Even the best performing stove will not have the desired impacts unless it's being used consistently and correctly in homes. The extent to which consumers use a certain stove depends on many factors, including (but not limited to): how well it cooks staple foods, ease of use, familiarity, and fuel costs. Stove stacking, using multiple stoves or fires to meet the household needs, is prevalent worldwide and in many contexts cleaner, more efficient stoves are used side by side with traditional stoves and open fires. Even minimal use of an open fire or rudimental traditional stove can quickly result in exposures to emissions that exceed WHO guidelines (see Health section of this toolkit for more information and references) . Stove use can be assessed using quantitative survey methods but recent field data suggests a pattern of under reporting of use of traditional devices and over reporting of intervention stoves. Stove use monitoring systems (SUMS) eliminate the effect of recall and reporting bias by providing an objective measure of stove use patterns including an indication of traditional stove displacement.

SUMS record stove temperature at regular intervals to determine how often and for how long stoves are alight. SUMs can monitor multiple stoves in the same household to assess the proportion of cooking made up by different fuel/stove combinations. SUMS allow tracking of cooking events, length of cooking, and changes in use by season or community over an extending duration allowing for understanding of the initial uptake and use and then the longer term usage patterns.

New SUMS devices and analysis tools are coming on the market regularly. Prices range from approximately $20 - $200 per system, depending on functionality (i.e., battery life, memory, temperature range, sampling rate, wireless vs. manual data transmission, # of stoves monitored at once, air quality monitoring capability). **Some of the currently available stove monitoring devices include:**

- Maxim iButtons: small data-logging thermometers attached to stoves. (e.g., with special high temperature tape, embedded in the stove itself, or attached with a specially-made metal or wood holder). Various open-source data analysis software options are currently under development.
- NexLeaf Analytics StoveTrace Sensors: wireless monitoring system attached to the stove, transmits data in real-time through cellular network. Comes with own data analysis software.
- SWEETSense: wireless thermocouple and air quality (CO/CO_2) monitoring, attached to the stove, transmits data in real time through cellular or wifi networks. Comes with own data analysis software.
- kSUMS: data-logging thermocouple, can simultaneously monitor multiple stove if in close proximity.
- A-SUM: sensor monitors temperature, USB voltage, fan speed, and pot presence. Created by UC Berkeley with support from USAID to measure use of fan / thermoelectric generator stoves. Used with open source data analysis software.
- Infrared thermocouples: mounted in homes near open fires. Various brands available.

Different SUMS serve different purposes and there are advantages and disadvantages to each. It's best to first determine your primary objectives, where the study will take place, available budget, staff capacity and what type of stoves you are monitoring before selecting a specific SUMS.

A SUMS protocol for iButton deployment is currently under development by the Global Alliance for Clean Cookstoves in conjunction with the National Autonomous University of Mexico (UNAM). When finalized it will be made available on the Alliance protocol page.

CONSUMER PREFERENCE MONITORING TOOLS

Determining the most appropriate stove technology for a specific context can be a complex process which requires time and resources. There is no one stove/ fuel combination that will meet the needs of all cooks, even within a country or region. As mentioned elsewhere in this toolkit, it is critical that target consumers are brought into stove design and marketing decisions and processes. Any potential barriers to access, uptake and use of the new stove need to fully understood and if possible addressed. Consumers will only purchase and use, and especially exclusively use, cookstoves that fully meet their cooking needs and priorities. This means regular, effective evaluation of consumer perceptions and preferences is essential for any program.

The USAID-funded WASHplus project developed a tool for consumer research, including consumer preference testing, using Trials of Improved Practice (TIPs) methodology, which is available at http://designlab360.org/washpluscookstovetoolkit/. The World Health Organization Catalogue of Methods is another good resource for tips and tools on evaluating adoption and market development of household energy and health interventions. Other tools and methods include focus groups, individual interviews, household trials, or market demonstration events. The USAID Fuel-Efficient Stove Programs in Humanitarian Settings Toolkit also includes sample survey forms and guidance for assessing appropriate interventions based on consumer needs.

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QUALITATIVE MONITORING METHODS

Qualitative methods are included in several of the above-mentioned protocols and tools, but it's worth emphasizing here that they play an important role in understanding consumer behavior, satisfaction and impacts. Qualitative methods tell us how and why consumers decide to purchase or use technologies, and can work to provide important context to explain quantitative data. The most informative M&E methods for cookstoves and fuels programming include a mixed method approach, which incorporates both quantitative and qualitative methods. Qualitative methods include direct observation, focus group discussions, semi-structured interviews, and participatory methods using channels such as diaries, art, and photography.

Focus group discussions are generally undertaken with groups of 6-10 people, and are useful in exploring consensus and diversity of views around a list of themes and issues. They are facilitated in a flexible way to allow the group to explore new topics as they arise. Group dynamics are important to consider (e.g., separate sessions for men and women). Focus groups can employ other tools such as mapping and ranking exercises to aid discussion. Cookstove manufacturers, researchers and other types of implementers can get important consumer insights from these types of focused but flexible group discussions. Semi-structured interviews follow a similar flexible format, but may be more appropriate when individuals are not comfortable speaking in front of others, particularly around sensitive subjects. Guides for qualitative research can be found at LINK. Before organizing a focus group, it's important to consult with someone that has extensive experience in the field conducting these types of research.

Photovoice is a participatory method, wherein participants are asked to photograph their daily lives and communities along research themes. This allows the researcher to capture images and information that might be otherwise missed, and provides insights into what participants value most. The Cooking and Pneumonia Study (CAPS) in Malawi used this technique in their randomized controlled trial of advanced cookstove interventions to prevent pneumonia in children under 5 in rural Malawi.

SOCIAL IMPACT MONITORING

For the purpose of this toolkit the term social impacts includes impacts related to individual livelihoods, social and economic empowerment, household-level social and economic well-being, and time savings, among others. Social impact monitoring is the focus of one of the ISO working groups, included in the global standards discussions. The Alliance and the International Center for Research on Women (ICRW) have developed an M&E framework to measure socio-economic impacts in the clean cooking value chain. It includes a conceptual framework, indicators, surveys, and detailed guidance notes to measure impacts such as time, income, livelihoods, and empowerment. It is currently in its final phase of field testing and once finalized, it will be made available on the Alliance website.

Social impact investors have developed their own monitoring tools around determining these sorts of impacts. Acumen, for example, has developed a field guide for collection and use of social performance data called the "Lean Data Field Guide" which includes tools for efficient but rigorous data collection in a way that also benefits the company and customers. They also created a detailed report called "Innovations in Impact Measurement" that includes lessons learned from their use of mobile technology for social impact measurement. Other useful and relevant information on impact metrics and methods is available on the Global Impact Investing Network website at https://thegiin.org/tools/. The IRIS catalogue of metrics provide standardized guidance about the types of metrics to use and a common language to improve comparability across investments.

SOCIAL IMPACT INDICATORS

ENTERPRISE LEVEL	**JOBS**	
	QUALITY OF JOBS CREATED	
	Full-time/ part-time	
	Permanent/ temporary	
	Management level	
	Area within the value chain	
	Geographic location	
	INCOME NON-MANAGEMENT STAFF full-time/part-time or permanent/annual & temporary/seasonal	
	Income management staff	
	Women-owned	
EMPLOYEE/ ENTREPRENEURS LEVEL	**LIVELIHOODS**	
	ACCESS TO AND USE OF FINANCIAL SERVICES	
	ACCESS TO AND USE OF CREDIT	
	TRAINING AND MENTORING	
	ACCESS TO AND PARTICIPATION IN NETWORKS	
	EMPOWERMENT/AGENCY	
	Agency/self-efficacy	
	Communications skills	
	Status	
	Decision-making & control over resources/ assets	
CUSTOMER LEVEL	**ADOPTION**	Use
		Economic stability
		Fuel expenditure
		Income through productive use of cookstove
		Time spent on fuel collection
		Time spent on cooking
	STATUS	Status within the family/community
		Safety/ protection
		Fuel collection safety/ protection
		Cooking safety/ protection
	DRUDGERY	Fuel purchase drudgery
		Fuel collection drudgery
		Cooking drudgery

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