Workshop Resources

Indoor Air Pollution and Household Energy Monitoring

World Health Organization

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Workshops were conducted as a contribution to the Partnership for Clean Indoor Air, launched at the World Summit on Sustainable Development in 2002. More than 100 organizations are working together to improve health, livelihood and quality of life by reducing exposure to indoor air pollution, primarily among women and children, from household energy use. For more information, or to join the Partnership, visit www.PCIAonline.org.

The summary for Module 1 Evaluation Basics was prepared by Eva Rehfuess, WHO. Presentations were put together by Eva Rehfuess and Jonathan Rouse, seconded to WHO by the University of Loughborough, in collaboration with Nigel Bruce and Kirstie Jagoe from the University of Liverpool, and David Pennise from the Center for Entrepreneurship in International Health and Development (CEIHD).

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Photo credits: Cover (middle), page 10 (top): Jonathan Rouse. Page 8: Prabir Mallik, World Bank. All other photographs: Nigel Bruce, ITDG/Practical Action.

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Smoky hut in the highlands of Guatemala

Background

More than half of the world's population relies on solid fuels, including biomass fuels (wood, charcoal, dung, agricultural residues) and coal, to meet their basic energy needs. Cooking and heating with solid fuels on open fires or traditional stoves results in high levels of indoor air pollution. Globally, indoor air pollution is responsible for approximately 1.6 million deaths every year.

Various interventions are available to reduce indoor air pollution and associated health impacts at the household level. Working chimneys and hoods, increased ventilation and improved combustion can reduce concentrations of indoor air pollutants. Reducing human exposure to these harmful by-products of combustion leads to reduced illness.

However, few reliable studies have been undertaken to assess the effectiveness of these interventions in the field. Current evidence is insufficient for drawing conclusions about which interventions work in a specific setting, and for making recommendations to local and national policy-makers.

Therefore, there is an urgent need to evaluate intervention projects and programmes around the world. Such evaluation can help inform how interventions reduce pollution and personal exposure, how this results in reduced respiratory disease (in particular among children and women), and what broader impacts interventions have on the household as a whole, for example in terms of freeing women's and children's time for studying or economic activities.

Infants are often carried on their mother's back during cooking

Enlarged windows let air into the home

In addition, it is important to demonstrate the sustainability and cultural acceptability of a given intervention. Documenting these impacts will help generate the evidence to convince policy-makers and donors at all levels that household energy interventions work in reducing one of the major global threats to children's and women's health.

In 2005, WHO organized a series of 5-day training workshops as a step towards building regional capacity in the area of household energy and indoor air pollution monitoring. Workshops were conducted as a contribution to the Partnership for Clean Indoor Air in collaboration with the Pan-American Health Organization, the United States Environmental Protection Agency, the German Technical Cooperation (GTZ), the Center for Entrepreneurship in International Health and Development at the University of California at Berkeley (CEIHD) and the Aprovecho Research Center.

These training workshops were designed to empower governmental and non-governmental organizations as well as research institutions to evaluate the impact of intervention projects or programmes. Participants included representatives of organizations engaged at the technical level in ongoing household energy intervention projects or programmes and those planning to undertake such work in the future.

In addition, all presentations, instructions for practical exercises, protocols, questionnaires and data forms are compiled in the enclosed CD-Rom.

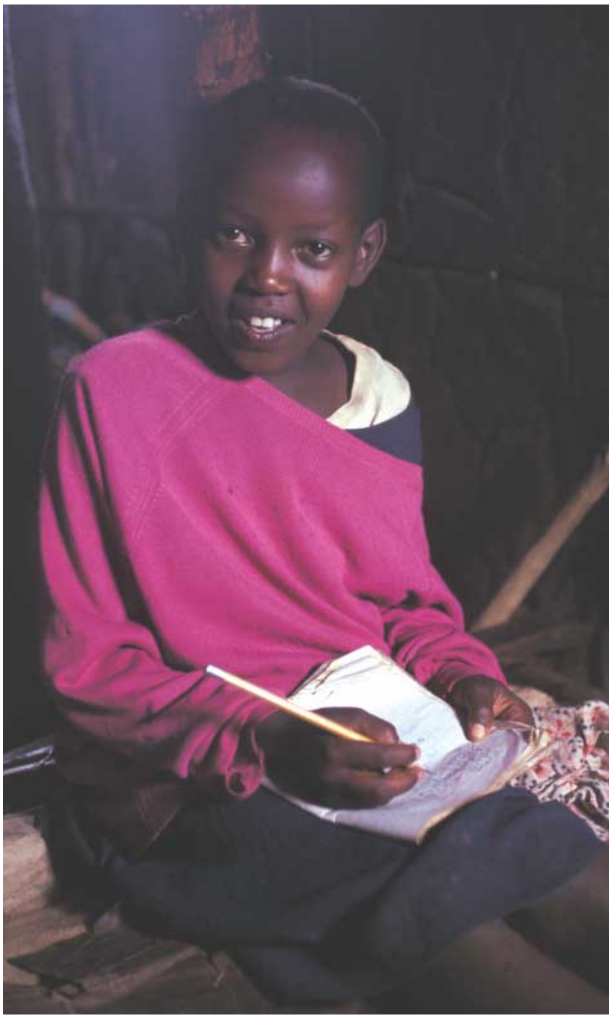
Beyond serving as a reference for workshop participants, this resource represents a starting point for government officials, staff of non-governmental organizations and academics interested in undertaking the evaluation of an intervention project or programme. As past and future workshops are unlikely to meet the high demand for training in this area, this resource can be used as a training manual that introduces key concepts and evaluation methods in an accessible way.

Specific workshop objectives included:

> To emphasize the importance of evaluation in undertaking household energy projects, and in reporting results to the local community, national policy-makers, donors and the international household energy community.
> To provide participants with an overview of different aspects of evaluation in relation to household energy projects, including process versus outcome evaluation, impacts on pollution levels, health, time activity and environment.
> To train participants in the use of questionnaires and monitoring equipment that will permit them to initiate evaluations of their own household energy intervention projects or programmes.
> To discuss principles of study design, ethical considerations and implications for evaluation, and to outline next steps in evaluating ongoing or planned intervention projects or programmes.

This resource provides a brief summary of the content of the five main modules of the workshop:

> Evaluation basics;
> Indoor air pollution monitoring;
> Monitoring impacts on health and well-being;
> Monitoring stove performance; and
> Monitoring socioeconomic impacts.



Doing homework in a smoky environment

Evaluation basics

The Evaluation Basics module lays the ground for all subsequent modules by giving an overview of the different purposes of evaluation and by introducing principles of study design, different evaluation areas and the use of quantitative versus qualitative methods. It also outlines a series of practical issues around the planning and implementation of an evaluation study. The module consists of four presentations and is structured around the following three questions:

> Why evaluate?
> What to evaluate?
> How to evaluate?

Why evaluate?

Following a brief overview of the state of the evidence regarding household energy interventions, indoor air pollution and health, the presentation "Why evaluate?" describes multiple evaluation perspectives. Target audiences and purposes for evaluation can range from informing the community that their needs and concerns have been addressed to contributing to the international evidence base by carefully documenting intervention impacts. Moreover, data on the costs and benefits of an intervention project or programme can feed into economic evaluation.

In general, impact evaluation tries to assess whether an intervention has been adopted and implemented in the community and whether it has been effective in achieving its intended impacts. In contrast, economic evaluation tries to demonstrate the economic return of investments in an intervention and may be used to compare the cost-effectiveness of one intervention against another.

What to evaluate?

Household energy projects or programmes may be designed to reduce respiratory health problems among children and women, to improve people's livelihoods or to tackle deforestation pressures or land erosion. Whether the focus of a project or programme lies in one area or another, interventions always have multiple impacts on their target communities and the local and global environment.

For each of these evaluation areas, the presentation outlines key questions, impact measures and challenges in obtaining or analyzing the required information. The focus of the workshop on indoor air pollution monitoring is explained using the environmental health pathway which links household energy practices to health effects via indoor air pollution concentrations and exposures.

The presentation "What to evaluate?" introduces evaluation areas:

- Adoption
- Market development
- Technology performance
- Pollution and exposure
- Health and safety
- Time and socioeconomic impacts
- Environmental impacts

Even a well-resourced, well-designed evaluation study is unlikely to be able to address all of the above thematic areas. Deciding what to monitor should be demand-driven, informed by the target audience and evaluation objectives as well as the thematic priorities of an organization. Similarly, the characteristics of a project or programme (such as type of intervention, scale, stage) and feasibility issues (such as institutional capacity, financial and human resources and time) are important considerations.

How to evaluate?

The presentation "How to evaluate?" gives a taste of evaluation design options and the use of quantitative versus qualitative methods, and addresses the importance of the size of an evaluation study. Not every evaluation design is suitable for every project or programme, and the choice of evaluation design depends on the outcomes of interest (such as technology performance or socioeconomic impacts), local conditions (in particular climatic variability, political or economic instability) and available human and financial resources.

The presentation introduces three designs: the before-and-after design with a control group (Figure 1), the before-and-after design without a control group (Figure 2) and the cross-sectional design (Figure 3). It discusses their

advantages and disadvantages, and gives a real-life example of its application as part of an evaluation study in different countries and settings.

Quantitative methods - including performance testing, indoor air pollution monitoring and questionnaires - can track changes in "quantifiables" and are a means of objectively comparing one intervention against another. Qualitative methods, on the other hand, help reveal the perspectives of individuals or communities and provide important contextual data to explain the results of quantitative analyses. They include in-depth, open-ended interviews, direct observations of behaviours and participatory methods.

Sample size, i.e. the number of individuals, homes or stoves to monitor, is a critical aspect in evaluation planning. If the sample size is too large, time and financial resources are wasted on superfluous data collection. If the sample size is too small, it is impossible to answer the questions asked in relation to the impact of an intervention. The presentation discusses the factors that determine sample size and indicates typical sample sizes for different types of evaluation studies.

Working with people

People are at the centre of any evaluation study that is designed to ensure that the intervention has served beneficiaries well. Moreover, evaluation always involves interaction with people - whether in terms of placing an indoor air pollution monitor in their home, testing the performance of their stove or asking them about their health, time use or expenditure.

The presentation "Working with people" discusses ethical considerations in relation to an evaluation study. It illustrates important issues in collaborative research that avoids treating participants as mere research subjects, such as choice of participants and evaluators and selection of an appropriate location for and timing of interviews or focus group discussions.

Adapting and pilot-testing questionnaires is important for dealing with specific cultural practices, taboos and local terminology. The difficulties in planning and conducting qualitative evaluation and capturing a large amount of information are also addressed, followed by an example of how observation can give the most accurate account of cooking behaviours.

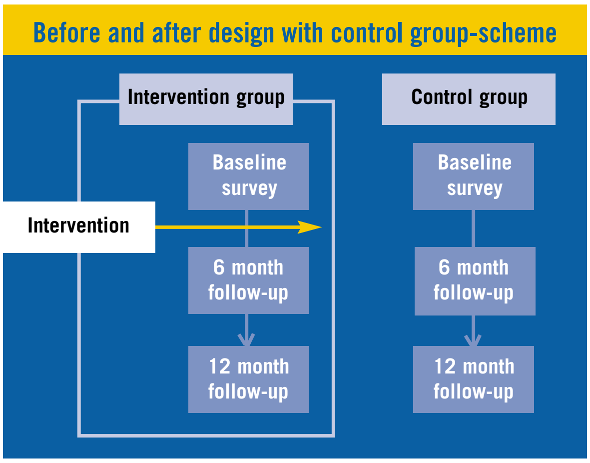


Figure 1

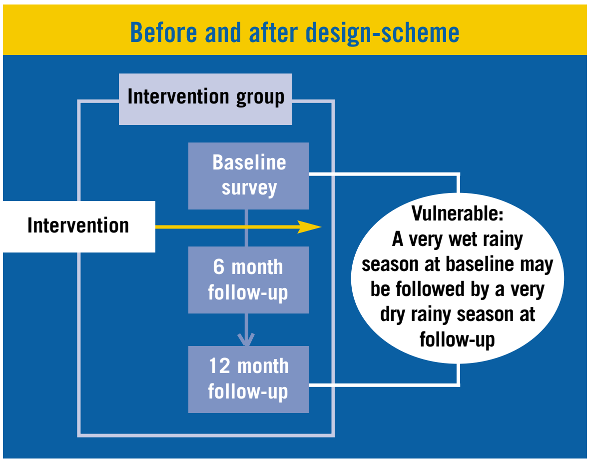


Figure 2

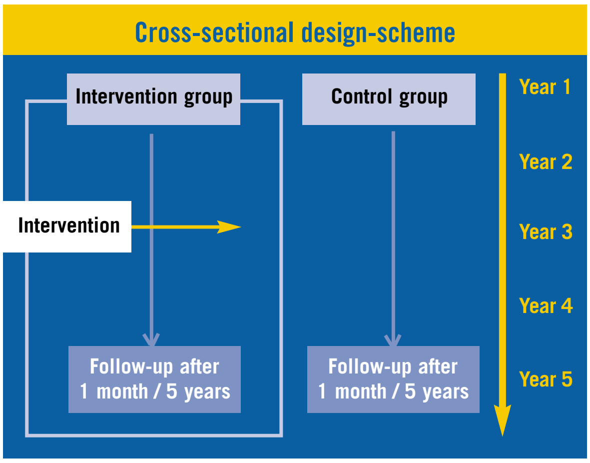


Figure 3

Indoor air pollution monitoring

From a health perspective, reducing exposure to indoor air pollution (IAP) is and should be the primary objective of household energy interventions. Measuring IAP levels is particularly important given the difficulty in assessing health outcomes directly. Thus reductions in pollution levels can be assessed as a proxy for likely reductions in health outcomes.

The Indoor Air Pollution Monitoring module consists of three presentations as well as extensive hands-on training to launch, place and collect the instruments and to download and process the resulting data. By the end of the module, participants should understand the basics of indoor air pollution, be aware of different measurement options, and be familiar with the field work, logistics and data management required to carry out IAP monitoring.

Biomass pollution basics

The presentation "Biomass pollution basics" addresses the basics of biomass burning and introduces participants to the concept of incomplete combustion, the wide range of pollutants emitted from wood fires and stoves and typical pollutant concentrations. Two pollutants are of primary interest for both health effects and IAP monitoring: particulate matter (PM) and carbon monoxide (CO).

Smaller particles ($PM_{2.5}$ and PM_1) are likely to be most harmful, as they penetrate deep into the human lung. Larger particles are more likely to get 'filtered' by the upper respiratory tract. Considering available technologies and the relative cost and ease of monitoring, it is recommended that organizations focus on measuring levels of $PM_{2.5}$. While the precise mechanism of how these pollutants affect human health is not yet known, outdoor air pollution and laboratory studies inform about the different potential effects on the human respiratory tract. The presentation also summarizes the epidemiological evidence that links exposure to PM and CO to various health outcomes.

Indoor air pollution measurement options

The presentation "Indoor air pollution measurement options" describes what characteristics of IAP can be assessed (e.g. indoor concentrations, personal exposure, outdoor or total emissions) and what pollutants can be measured. The exposure assessment pyramid summarizes how increased measurement accuracy tends to be accompanied by increased cost (Figure 4). Measurement duration, seasonality and sampling intervals are important factors in deciding when to measure.

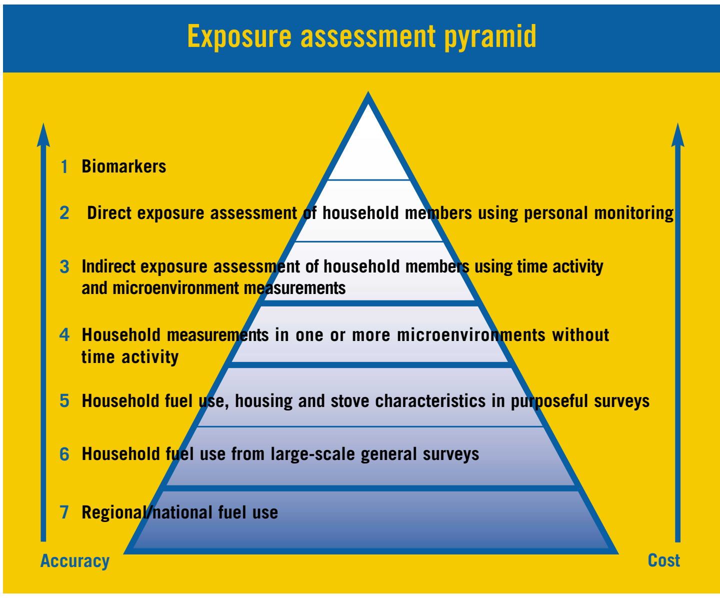


Figure 4

CO measurement options include bag collection and lab analysis, colour-change diffusion tubes and electro-chemical monitors. PM measurement options include gravimetric monitors (pump and filter method) and light-scattering devices. The advantages and disadvantages of each of these methods are discussed, including cost, ease-of-use, accuracy, size detection and time-keeping. The choice of method depends on the context, i.e. the purpose of the project or programme, the capacity of staff and available financial and human resources. All methods require data management and quality control.

The presentation concludes with a description of the specific instruments included in the IAP monitoring kit compiled by CEIHD and the Shell Foundation: the UCB particle monitor, the HOBO CO logger and CO diffusion tubes. It explains how they work and discusses their capabilities and limitations.

Launching and placing monitors

After the two introductory presentations, participants receive hands-on training in how to operate (launch on a computer, troubleshoot, etc.) the UCB particle monitor, the HOBO CO logger and CO diffusion tubes. During a field trip to a nearby biomass-using home they place the instruments in the kitchen, record important sampling information on a sampling data form and collect basic information about the kitchen and household. A post-monitoring questionnaire characterizes important factors that can affect IAP levels. Participants are also encouraged to take photographs of the placement of the monitors and the household itself; these serve as a basis for a later discussion of the sampling experience.

Downloading and processing data

The monitors are retrieved from the home the following day. For the UCB particle monitor and the HOBO CO logger, participants learn how to download the data and store them on a computer. Data are processed to obtain information such as average and peak concentrations. Participants also learn how to read the CO diffusion tubes and how to convert the readings into average CO concentrations. Microsoft Excel is used to organize and store the data.

Questionnaire-based IAP assessment

This presentation introduces and discusses three types of questionnaires used for IAP assessment: basic questions on solid fuel use (household surveys), matrix-based assessment of solid fuel use (World Bank) and a tailor-made questionnaire.

Weighing an exposed filter

Monitoring personal exposure using the pump and filter method

Monitoring impacts on health and well-being

Ultimately, most household energy interventions - directly or indirectly - aim to improve health among their target populations. This module consists of one presentation and one practical exercise that are concerned with methods available to monitor the impact of interventions on children's and women's respiratory health and overall well-being.

A review of the evidence for the linkages between indoor air pollution, household energy and health provides the introduction to this module (Figure 5). Acute lower respiratory infections (ALRI) among children under five, chronic obstructive pulmonary disease (COPD) and lung cancer (in relation to coal use) emerge as the health impacts of greatest public health concern.

Evaluation is time-limited (usually between six months and two years), and it is thus important to consider possible short-term improvements in different health outcomes in response to an intervention. Due to the long latency period for cancer we cannot expect to see a reduced cancer risk in the short-term; ALRI risk, on the other hand, is likely to fall quickly. It is not clear if and how quickly the risk of COPD decreases following the implementation of an intervention, but it may be possible to monitor improvements during the early stages of COPD. In addition, changes in several household energy-related aspects of health and well-being - ranging from burns and scalds to eye irritation, headache and backache - can be investigated during an evaluation study.

Health impacts of indoor air pollution

Health outcome	Evidence	
> ALRI (children < 5 years) > COPD (adults) > Lung cancer (coal)	Between 10-20 studies Few measured exposure Confounding problematic	STRONG
> Tuberculosis > Cataract > Upper airway cancer > Asthma	Several consistent studies (more conflicting for asthma)	MODERATE
> Low birth weight > Perinatal mortality > Otitis media	Very few studies, support from environmental tobacco smoke and ambient air pollution studies	WEAK
> Cardiovascular disease	No studies, but suggestive	

Figure 5

Physician examining child in a Guatemalan hospital

The presentation describes three ways of assessing changes in health outcomes:

- "The best-available assessment", a physician-based assessment of pneumonia in children and COPD in women;
- "The feasible quantitative assessment", a questionnaire-based assessment of respiratory disease symptoms; and
- "The qualitative assessment", which obtains information from interviewees on those symptoms perceived to be associated with indoor air pollution.

"The best-available assessment"

Acute respiratory infections (ARI) are a complex group of conditions of various aetiology and severity. It is critical to distinguish between the frequent but non-serious upper ARI (such as common cold, sinusitis) and the much rarer but potentially life-threatening lower ARI (in particular pneumonia). This discrimination is challenging, even more so in poor communities where many children are unlikely to see a doctor on a regular basis. "The best-available assessment" describes how a combination of (i) weekly

home visits by a trained fieldworker to check for disease symptoms, (ii) a clinical assessment by a trained medical doctor, and (iii) an X-ray of the lungs can diagnose pneumonia in a relatively accurate but very resource-intensive way.

COPD, such as emphysema and chronic bronchitis, comprises a group of lung diseases that are characterized by limited airflow, airway inflammation and progressive lung tissue destruction. The various stages of COPD (ranging from at risk to very severe disease) are accurately classified based on a combination of symptoms (such as chronic cough, chronic phlegm and chest tightness) and lung function. Lung function is assessed using spirometry equipment - a resource-intensive technique that can present particular challenges among rural, indigenous populations.

"The feasible quantitative assessment"

Questionnaires can be employed to assess a range of symptoms. While these symptoms are not sufficient for a correct diagnosis of ALRI and COPD, they can provide an indication of whether a person's respiratory and other health problems have improved following an intervention. Child health questionnaires (with the mother recalling her children's health symptoms) may be limited to two simple questions about cough and rapid breathing, address respiratory health through a series of detailed questions, or cover a broad range of health symptoms including eye irritation and burns and scalds. The presentation also introduces questions in relation to women's respiratory health and other aspects of well-being, such as headaches, backaches and eye irritation.

"The qualitative assessment"

Asking women open-ended questions about their own health as well as the health of their children in relation to indoor air pollution can generate a list of their biggest health concerns. Interestingly, results from a study by the Intermediate Technology Development Group/Practical Action in Kenya, Sudan and Nepal reveal that the most widely recognized concerns are almost identical in three very distinct populations in three different countries. Such a qualitative assessment of health outcomes does not only provide important insights into communities but also represents an important tool to design locally relevant questionnaires.

The physician-based assessment of ALRI and COPD is unlikely to be feasible for most small- to medium-scale projects and programmes, unless they partner with a research or governmental agency interested in conducting a thorough health study. On the other hand, a combination of qualitative methods (such as key informant interviews and focus group discussions) and a questionnaire-based health assessment can yield results of great value to both the community and the implementers, as well as relevant insights for public health.

The presentation is complemented by a practical exercise entitled "Health and well-being: questionnaires in practice". This exercise encourages participants to try out example child and women's health questionnaires and to identify challenges in relation to the application of these tools, for example, with respect to terminology or cultural sensitivities.

Women and children are most exposed to indoor smoke

Monitoring stove performance

A chimney stove routes pollutants to the outside

It is often stove performance that determines whether a given intervention is adopted or not, and whether it is used and maintained appropriately. As a minimum, an improved stove must meet the users' needs as well as the fire or stove that was used initially. Beyond this, stoves should decrease the amount of fuel needed and make the cooking task easier.

The Stove Performance Monitoring Module is laid out in three steps. First, participants are introduced to the criteria for evaluating stove performance and the various methods to determine performance. Secondly, the module looks at the principles behind the creation of a better stove. Finally, participants get experience in undertaking a test as part of a practical exercise.

Stove performance criteria

Six criteria are important for evaluating stove performance: efficiency, specific consumption, turn down ratio, speed of cooking, user satisfaction and emissions.

Efficiency: This is the most commonly used criterion for comparing stoves. Efficiency is determined by dividing the amount of energy trapped in a pot by the amount of energy burned in the stove. The amount of energy trapped in the pot is calculated by measuring the rise in water temperature and the amount of water turned into steam. While this is a useful concept for evaluating stoves, numbers can be misleading as they reward a stove for producing an excess of steam.

Specific consumption: This is the most useful criterion for determining how much fuel a stove is likely to consume. Specific consumption is defined as the amount of fuel it takes to perform a specific task, for example, the amount of fuel consumed per litre of water boiled or food cooked.

Turn down ratio: This is also known as control efficiency, determined by the difference in fuel consumption per minute between high power (bringing water to a boil) and low power (simmering). Stoves with a higher turn down ratio are likely to use less fuel during a real-life cooking task, which involves bringing food to a boil and then cooking it at a simmer for an extended period of time.

Speed of cooking: This is mostly a measure of user friendliness. Speed of cooking is specified as the time it takes to boil or cook a given amount of food, generally per litre. However, cooking time also tends to be the time a cook spends near the stove and thus determines duration of exposure to indoor air pollution.

User satisfaction: This represents a subjective but important criterion, as user satisfaction determines stove adoption and use. Stoves are frequently chosen because they cook well and not because they save fuel or emit less pollution. We gain an idea of user satisfaction by surveying local use of the stove.

Emissions: Standard emissions criteria and methods to assess them are not yet available but in the process of being developed. Out of all the performance criteria, stove emissions are most directly related to indoor air pollution levels and thus health.

Stove performance tests

Following a brief overview of the development of stove performance testing, this section describes the protocols for conducting and analyzing three commonly used tests: the Water Boiling Test, the Controlled Cooking Test and the Kitchen Performance Test.

Water Boiling Test: This lab-based test attempts to simulate the most common cooking modes of a stove while keeping other factors constant to make the results as comparable as possible between different projects. The test consists of three phases, each representing a particular cooking

situation: (1) bringing water to a boil with a cold stove; (2) bringing water to a boil with a hot stove; and (3) simmering water with a hot stove. The results relate to four of the six performance criteria: efficiency, specific consumption, time to boil and turn down ratio.

Controlled Cooking Test: This lab-based test involves local cooks preparing a local dish. Adding these variables limits comparability of results to a given setting but provides important feedback as to the likely acceptability of a stove by local users. The results relate to specific consumption, speed of cooking and user satisfaction.

Kitchen Performance Test: This is the most difficult and resource-intensive test. It consists of a survey and a fuel consumption test with families using both the traditional and the improved cook stove. The test gives results of user satisfaction and per capita fuel consumption for a given stove. As the test encompasses many different variables, often a large number of tests need to be performed to assure statistical accuracy in the results.

Stove design criteria

Design criteria are important for improving stove performance, and design solutions exist for creating stoves that succeed in improving all six performance criteria. Two design criteria must be met to create a stove that uses less fuel and produces less pollution: improving fuel combustion (combustion efficiency) and directing more of the heat into the pot (heat transfer efficiency). High combustion temperatures and good mixing of gases, air and fire reduce dangerous emissions through more complete combustion. Forcing the heat to scrape against the pot in small channels dramatically increases heat transfer efficiency, thereby reducing the fuel used for cooking.

The presentation explains in detail the various factors that affect combustion and heat transfer efficiencies. It concludes with a description of ten stove design principles used by indigenous teams around the world to create appropriate technologies that meet local requirements.

At the end of the module participants perform a water boiling test to put into practice the protocols and to try out the analysis of the results.

Traditional mud stove in India

Charcoal stove in Sudan

Improved plancha stove in Guatemala

Monitoring socioeconomic impacts

Evaluating socioeconomic impacts is concerned with understanding the visible impacts of interventions on people and poverty. The presentation in this module describes what socioeconomic impacts are, discusses why they are important, presents a case study based on an intervention in Kenya, and considers how these impacts are measured. The module also includes two practical exercises on focus group discussions and seasonal charts.

What are socioeconomic impacts?

Socioeconomic impacts include:

> **Time use:** An improved cooking stove which consumes less fuel will result in less time spent on fuel collection for those who gather wood. Equally, shorter cooking times (for example when moving from a 1-pot to a 2-pot stove) also free up time. Saved time can have secondary benefits: perhaps it will be spent in school, engaged in an income generating activity or invested in childcare.

> **Changes in expenditure:** In situations where fuel is purchased, fuel savings will result in lower expenditure on fuel. Occasionally, for example when shifting from using gathered wood to liquefied petroleum gas (LPG), expenditure on fuel may increase. However, the increased expenditure is often offset by time savings and other benefits. Purchase and maintenance costs must also be considered. Like time savings, financial savings may have secondary benefits, such as increased expenditure on food and better nutrition.

> **Prestige and status:** A cleaner house due to less smoke or the prestige of owning a modern stove can result in a perceived rise in the status of users. This can be empowering and may also be an important promotional tool.

> **Other impacts - including problems:** Users often identify benefits not foreseen by the implementing organization. Examples include improved portability of the cooking device, the ease of keeping it alight or a reduction in pot-blackening soot. Users may also identify drawbacks of an intervention, and it is important to understand these. For example, the removal of smoke from homes has been associated with fear of snakes living in the smoke-free thatched roofs or termites attacking the wooden structure of the house.

Women spend many hours a week on fuel collection

Why are socioeconomic impacts important?

Many women identify time and money savings due to higher fuel efficiency as the most critical outcomes of an intervention. Impacts on their status, the cleanliness of their homes and secondary benefits are also considered very important. Unlike CO or PM levels or longer term health impacts, the users can directly and immediately notice changes. This makes socioeconomic impacts key to people's willingness to adopt, pay for and maintain improved cooking practices.

Moreover, socioeconomic impacts link household energy to many of the Millennium Development Goals, and a number of slides are devoted to illustrating how changes in household energy practices can contribute to achieving these goals. Evaluation of socioeconomic impacts also represents an important component of economic analysis.

Measuring socioeconomic impacts

Questionnaires and participatory techniques can be used to assess and understand socioeconomic impacts. Qualitative questionnaires assess people's perceptions of impact, while quantitative questionnaires determine measurable impacts, such as time use or expenditure. The presentation introduces example questions from simple and more complex questionnaires used by different organizations.

Participatory methods can be a powerful tool for assessing social and economic impacts. Focus group discussions, ranking exercises, seasonal charts and time-activity charts are briefly described, and the module concludes with two practical exercises:

- An exercise on preparing a seasonal chart and facilitating its completion with group members role-playing as women cooks.
- An exercise on defining discussion topics and questions for a focus group discussion and facilitating its completion with group members role-playing as women cooks.

Switching to liquefied petroleum gas has many benefits

CD-Rom

The enclosed CD-Rom includes the following materials:

Background

> Household energy and indoor air pollution monitoring: workshop resources
> List of acronyms
> Working towards a draft evaluation strategy

Module 1: Evaluation basics

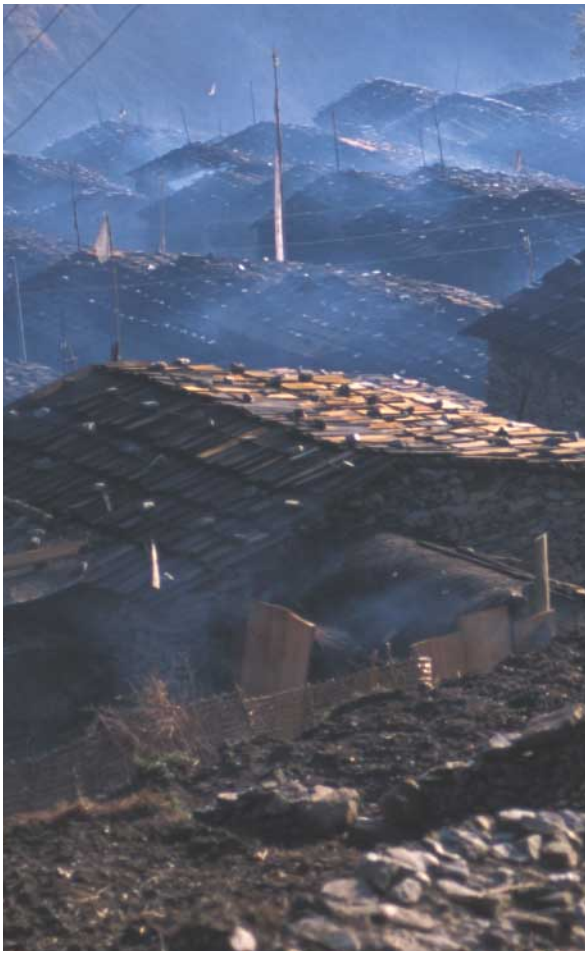
> Why evaluate? (presentation)
> What to evaluate? (presentation)
> How to evaluate? (presentation)
> Working with people (presentation)

Module 2: Indoor air pollution monitoring

> Biomass pollution basics (presentation)
> IAP measurement options (presentation)
> Questionnaire-based IAP assessment (presentation)
> Indoor air pollution monitoring protocols (read me)
> CO dosimeter tube protocol (protocol)
> HOBO CO calibration check protocol (protocol)
> HOBO CO logger protocol (protocol)
> UCB particle monitor protocol (protocol)
> Installing IAP instruments in a home (protocol)
> Sampling data forms (form)
> Post-monitoring questionnaire (form)

Module 3: Monitoring impacts on health and well-being

> Household energy and health (presentation)
> Questionnaires in practice (practical exercise)
> Child questionnaire (questionnaire)
> Woman questionnaire (questionnaire)



Cooking with wood indoors leads to outdoor air pollution in mountainous Nepal

Module 4: Monitoring stove performance

> Stove design and performance (presentation)
> Water boiling test: long description (protocol)
> Water boiling test: data and calculation (form)
> Controlled cooking test: long description (protocol)
> Controlled cooking test: short description (protocol)
> Controlled cooking test: data and calculation (form)
> Kitchen performance test: short description (protocol)
> Kitchen performance test: long description (protocol)
> Kitchen performance test: data and calculation (form)
> Stove performance testing protocol (protocol)

Module 5: Monitoring socioeconomic impacts

> Understanding visible impacts on people (presentation)
> Focus group discussion (practical exercise)
> Seasonal chart (practical exercise)

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