For cook and climate: Certify cookstoves in their contexts of use

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A B S T R A C T

Improved cookstoves are widely promoted as a health and climate improving technology, yet there remains a wide gap between their reputed benefits and the inconclusive outcomes of most interventions. An increasing number of scientists suggest that the popular lab protocols used to test, rate and model the benefits of improved cookstoves are at least partly to blame. Insights from a recent study of improved cookstove users in Darfur, Sudan, reveal the extent to which the logic and goals of lab-based testing protocols differ from actual cooking practices. We elaborate on the climate and energy policy implications of decontextualized lab tests and conclude with a call to design, test and select for dissemination only those improved cookstoves that are rated on the basis of their intended contexts of use.

In developing countries, poor and rural families face extreme health and safety risks when cooking over traditional open fires or with primitive artisanal metal stoves. These risks include physical injury from collecting and carrying fuelwood, contact and radiative burns, exposure to gaseous pollutants such as carbon monooxide, and risks associated with the inhalation of black carbon and fine particulate matter [1,2]. For these reasons, improved cookstoves are widely promoted as an intervention capable of reducing cooking-related health and safety risks. Additionally, where poor households rely on unsustainably harvested wood for fuel, there is growing interest in carbon financing as a win-win mechanism to greatly expand the distribution of improved cookstoves to those who might not otherwise afford one [3]. Although improved cookstoves have been promoted to address health and environmental concerns for over 50 years, changing the cooking and fuel use behaviour of poor and rural people remains an indeterminate task [4]. Indeed, there continues to be a strong disconnect between policy narratives that champion the benefits of improved cookstoves and the inconclusive outcomes of most interventions.

An increasing number of scientists suggest that the failure of interventions to realize their stated objectives is a problem rooted in how improved cookstoves are designed, tested and rated [5]. Similar to the Volkswagen scandal where vehicles were engineered to perform well during emissions tests [6], stove designers are ‘building to the test’ because the measurements taken and metrics generated under popular lab test conditions are almost irrelevant to actual cooking practices (e.g. the Water Boiling Test). In turn, when inappropriate metrics reported by unrepresentative lab test sequences inform performance rating systems (e.g. tiers of performance), emission simulations (e.g. ad hoc dispersion models) and carbon certification methods, cookstove interventions are, based on experience, unlikely to achieve putative, modelled health and climate outcomes, or worse, cause unintended harm [7,8].

We weigh into this discussion by drawing on a recent study consisting of narrative interviews with improved cookstove users in three camps for displaced people in North Darfur, Sudan. Respondents were asked to share their experiences using improved cookstoves with focus on the perceived benefits they derive from using them. Their responses were coded and analyzed for key themes using an inductive thematic analysis research design [9,10].

Of the 56 respondents, 43 use improved mud stoves of various designs (large/small, one/two-pot); 19 use an all-metal Berkeley Darfur Stove (BDS), and 6 use both. Most mud stoves users were trained to make and repair stoves by aid agencies or learned the skill from a friend or relative. A few women report having purchased their mud stove at a local market where business women make and sell them. The price of a mud stove in Darfur ranges from 10 to 40 Sudanese Pounds (roughly 1.7–5.7 USD official currency exchange, or 0.6–2.35 USD black market). Such stoves save about half the fuel compared with a traditional mud stove training also learned to make inexpensive dung and dried okra briquettes. Such briquettes are sold in the camp markets and used to ignite charcoal, displacing plastic bags, straw and paper (Figs. 1).

BDS owners received their stoves from camp leaders who distributed them on behalf of aid agencies through lotteries. Four women...
report using liquid petroleum gas stoves, also received as aid, primarily
to boil water quickly or for space heating. Many women aspire to own
gas stoves but the relatively high cost and inconsistent supply of fuel in
camps hinders uptake. It is worth noting that many women regularly
use more than one stove: large cooking pot-sized stoves to cook meals
and small kettle-sized stoves to make tea or coffee. Interviewees report
having between 6 months and 13 years of experience cooking with
improved stoves, the median being 5 years.

What we find most interesting is that the women interviewed
overwhelmingly describe the main economic benefit of improved
cookstoves as enabling them to transition away from “expensive” wood
to charcoal. A small sack of charcoal purchased with 5 Sudanese Pounds
(> 1 USD) is enough to prepare two meals plus tea; to prepare the same
meals with wood is double the cost in most places. Women also note
that when needed, both wood and charcoal are readily available for
purchase at local markets. Charcoal is perceived to be cleaner than
wood as it produces far less smoke when burning. Hence, regardless
of stove type, women report charcoal as their primary and preferred
cooking fuel. Wood fuels are regularly used to prepare kisra, a sorghum
crepe cooked on a flat metal tray at high temperatures over a ladaya, a
traditional three-stone fire, or on the legs of an inverted BDS, a finding
corroborated by a recent study in Darfur where at least 17% of cooks
were found to use their BDS in this manner [11] Fig. 2.

Regardless of stove type, all respondents perceived the health ben-
efits of improved cookstoves as reduced smoke inhalation, reduced eye
infections and fewer burns. Mud stoves were acclaimed safer for chil-
dren because unlike metal stoves they are cool to the touch. Eye in-
fec tions are framed as an economic issue because treatment is relatively
expensive. Additional benefits include general safety and cleanliness as
both fire and ash are contained within the stove, there is less smoke in
the household and fewer stove-induced fires in camps.

To summarize, the women interviewed report the key drivers for
improved cookstove adoption are the immediate economic and health
benefits realized, namely the transition to a cheaper fuel, reduced
smoke inhalation and fewer burns. They report that fuel is readily
available at the camp markets, and materials to make improved mud
stoves and briquettes are also broadly accessible. These findings suggest
that the generic baseline narrative that all women travel long distances
at personal risk to collect wood to cook over open fires does not uni-
versally hold. As such, our study provides further evidence discrediting
the idea that improved cookstoves are an effective intervention to
reduce gender violence [12,13]. Moreover, where there is a functioning
market economy, women who do scavenge for fuel view spare fuel as
potential income and donated stoves as a saleable asset.

The relevance of these findings for climate and household energy
policy come into focus when considered against the typical protocols
used to model the climate benefits of improved cookstoves and certify
them for carbon financing. Currently, performance ratings rely on
controlled lab tests that specify a standard fuel (almost always wood), a
fixed burn cycle (high and low power), a standard pot size, a limited
number of replications, and the assumption that all biomass fuel is
harvested unsustainably [14,15]. This lab logic fails to appreciate that
stoves burn whatever users put in them, an example being the testing of
the BDS as ‘wood-burning’ while in practice Darfuris might use it to
burn charcoal of questionable origin [16].

Indeed, the cooking and fuel choices of women in Darfur vitiate the
relevance of wood-centric protocols to test and carbon-certify improved
cookstove performance. Where charcoal is the primary cooking fuel,
charcoal should be used to test and rate the performance of a given
stove. There is no functional reason not to replicate patterns of use even
when multiple fuels and stoves are involved. This is extremely relevant
for testing and certifying carbon-offsetting technologies; for instance,
the Clean Development Mechanism of the Kyoto Protocol requires
carbon certification methods to account for net carbon dioxide emis-
sions from combustion, deforestation, unsustainable wood harvesting
and charcoal production. If actual cooking and fuel practices are not
taken into consideration, performance modelling may overestimate the
potential climate benefits of improved cookstoves and there may be
positive cash exchange for net-negative results [17]. A first step is to
better understand how, with what and why people cook, and to in-
corporate these into cookstove design and testing methods.

To conclude, the widespread use of mud stoves and charcoal as the
primary fuel in Darfur suggests that the oft-repeated baseline narrative
that ‘all poor and rural women cook with wood over open fires’ does not
universally hold. This reinforces our point that improved cookstoves
should be tested and rated in their contexts of use with actual cooking
practices. Though this may seem intuitive, there is an almost complete
absence of peer-reviewed scientific articles on field-based protocols for
testing improved cookstoves. Similarly, the ongoing ISO process to
develop a standard for improved cookstoves, with which we are both
involved, is overwhelmingly preoccupied with lab-based protocols
employing an arbitrary test sequence. The scientific community
working on cookstoves requires a fundamental redirection away from
the logic of arbitrary lab tests to contextual design, testing and

Fig. 1. A selection of improved cookstoves found in Darfur’s camps. They include variants of locally made improved mud stoves and the metal Berkeley-Darfur Stove.
certification. Doing so also requires taking appropriate technologies such as improved mud stoves and a broader array of biomass fuel into serious consideration [18,19]. A context-centric logic requires a better understanding of how the availability and market price of fuel influences cooking preferences and practices in specific settings, and in turn, how they relate to the wider economic, environmental and societal policy implications of fuel use in developing countries [20,21]. In places like Darfur, energy policies that promote sustainably harvested and produced charcoal at local markets is likely to realize greater climate benefits than giving away free cookstoves designed to burn wood. To reiterate, improved cookstoves should be designed, tested and rated in their contexts of use, lest interventions will continue to fail policy makers, users and the climate.

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References