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A review of chronological development in cookstove assessment methods: Challenges and way forward

Pooja Arora [a], Suresh Jain [a,b,*]

[a] Department of Natural Resources, TERI University, Delhi, 10, Institutional Area, Vasant Kunj, New Delhi 110070, India
[b] Department of Energy and Environment, TERI University, Delhi, 10, Institutional Area, Vasant Kunj, New Delhi 110070, India

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ABSTRACT

This review intended to collect and collate the information related to cookstove testing methodologies applied in lab and field conditions and their output in the form of energy and emission parameters. The important information related to progression of cookstove testing techniques was segregated in order to understand the relationships in different indicators of cookstove performance and to understand the sources of uncertainty in emission data. The major research issue that has been dwelt upon in the recent literature is the establishment of relationship between lab and field results of cookstove performance. It is observed that controlled cooking test and kitchen performance test are the two field based tests which provide a better picture of a particular cookstove performance as it involves the user perspective. Misrepresentation of actual cookstove performance based on laboratory based testing puts the present standard protocols in question. Solutions have been put forward by some research studies; however a validation is needed through multiple scientific investigations conducted at various temporal and spatial scales. It has been observed that cookstove testing methodologies are still in their nascent stage compared to the research that has already been conducted for other sources where biomass combustion emissions have studied thoroughly. Still the shift in focus of upcoming research studies towards field based integrated cookstove testing methodologies has the potential to drive future cookstove research in the new direction.

Contents

* Corresponding author at: Department of Natural Resources, TERI University, 10, Institutional Area, Vasant Kunj, New Delhi 110070, India. Tel.: +91 11 7180 0222; fax: +91 11 2612 2874.
E-mail addresses: sureshjain_in@yahoo.com, sureshj@teri.res.in (S. Jain).

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1. Introduction

1.1. Importance of clean cookstoves

All over the world, around 3 billion people rely on inefficient traditional cookstoves out of which 2.7 billion cook food on these cookstoves using solid biomass fuels such as wood, animal dung and crop residue [1]. The energy crisis of 1970s was the main driving force for cookstove related research and dissemination programs where focus was on fuel wood savings [2–4]. However, the orientation of worldwide research community and national governments began to shift towards health impacts associated with emissions from fuel burning in cookstoves as a consequence of some scientific investigations carried out in late 1980s [5–7]. The health effects are principally mediated through respiratory deposition of particulate matter (PM) [8] resulting in chronic diseases such as chronic obstructive pulmonary disease (COPD), asthma, low birth weight, and cataract [9,10].

The health impacts co-exist with significant impact on climate due to emissions of a group of pollutants that are responsible for positive radiative forcing as illustrated in Fig. 1. With growing body of evidences suggesting significant exposure levels in rural indoor settings [11–13] a set of Indoor Air Quality Guidelines were formulated by WHO in the year 2006 which included a total of 11 pollutants sourced by indoor activities, especially cooking [14]. Recently, a study on global burden of disease revealed that 4,3% of the global disability-adjusted life years (DALYs) can be attributed to indoor air pollution (IAP) caused by household energy use [15]. Apart from the long-lived greenhouse gases (GHGs) like carbon dioxide, methane and nitrous oxide, which are ubiquitous consequence of biomass combustion, some short-lived species such as black carbon (BC) is gaining importance due to its potential to

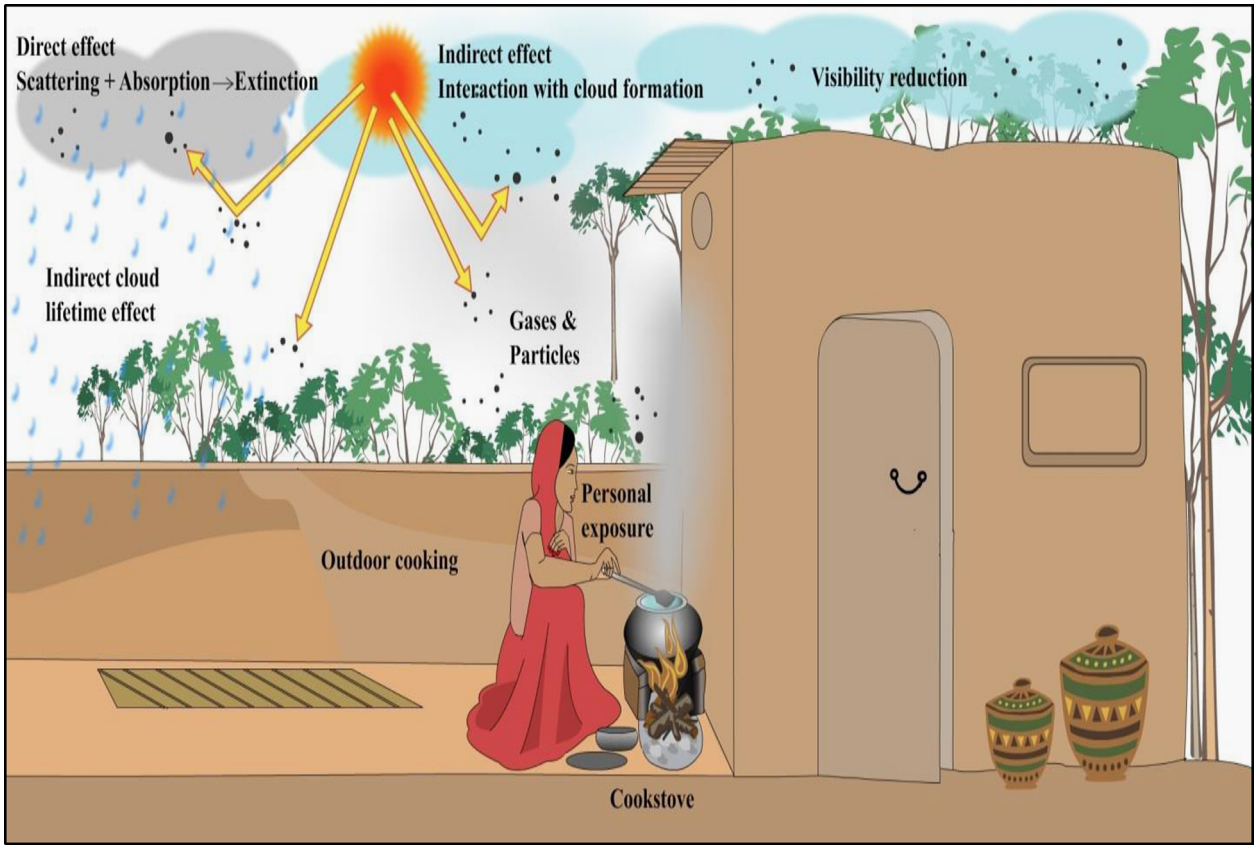

Fig. 1. Graphical illustration of impacts of gaseous and particulate emissions from biomass burning in cookstoves.