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Factors influencing the adoption and sustainable use of clean fuels and cookstoves in China -a Chinese literature review ☆

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ABSTRACT

Household solid fuel use has attracted extensive public concerns since it yields a large number of air pollutants from incomplete burning process and consequently has significant environmental and health impacts. Adoption of cleaner fuels and cookstoves is expected to achieve great benefits in many aspects, which however needs more research evidences offering a reference for policy makers. Identification of key factors influencing adoption and sustainable behaviors is one of important prior concerns. While a previous global systematic literature review provided valuable information on influencing factors, unfortunately, peer-reviewed Chinese publications were not included in the review. Here, we conducted a literature review on peer-reviewed Chinese publications so as to identify main enablers and barriers influencing the deployment and sustainable use of cleaner fuels and cookstoves in China. A total of 47,132 papers were retrieved and after two round read and selection, 87 peer-reviewed papers were finally in-depth reviewed and analyzed after data extraction. Factors like fuel/stove technologies (i.e. thermal efficiency, the operation convenience and cost of fuel/stove); public knowledge and awareness of environmental protection and energy saving; location, household setting and structure, family size, age and gender, have clear impacts on fuel choice. Finanical support and market development is essential for the sustainable use of clean fuels and cookstoves. The influence of favorable policies including laws, regulations and standards is obvious and critical. The adoption willing and enthusiasm would be encouraged directly through publicity, neighborhood demonstration and good follow-up service.

Contents

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1. Introduction

Near three billion people use solid fuels (i.e. coal, crop residues and woody materials) as main household energy. Even though the proportion of people relying on solid fuels has been gradually decreased, the absolute remains huge because of a rapid population increase [1]. Residential solid fuel combustion easily emits a large number of gaseous and particulate pollutants (i.e. CO, NO_X, SO_2 and particulate matter) due to relatively low burning efficiency, and hence, imposing significantly adverse impacts on environmental and human health [2]. Household solid fuel use has been recognized as one leading risk factor, leading to approximate 3.55 million premature death and 4.5% global DALYs (disability-adjusted life years) globally in 2010 [3]. The risk is even higher when taking a fraction of ambient air pollutant attributable to residential solid fuel use into account. In many developing countries including China, it has been one top environmental risk factor.

Improved stoves with higher burning efficiency are expected to lower emissions of air pollutants, to save fuels, to freedom women from long cooking duration, and to benefit human health. During the past several decades, some regional or national programs have been deployed to introduce clean fuels and high efficient (improved) stoves into households [4]. It is satisfied to find that benefiting from using improved stoves instead of rudimentary or traditional cookstoves and open fires, more and more organizations are willing to provide financial support and technical supply in a local, national or global scale [2].

It is usually very difficult to deploy improved stoves or alternative fuels in most households at the very beginning since it may change cooking habits and increase economic burden of the residents. Recently, Puzzolo et al. (2011) reviewed over one hundred studies from Asia, Africa and Latin America using state-of-the-art qualitative and quantitative approaches and extracted some important influencing factors affecting the deployment of improved stoves and clean fuels [4]. The study provided very valuable information for policy makers and stakeholders in future intervention programs. However, in their study, peer-reviewed literatures in Chinese language were not included. From the 1980s, a well-known national improved stove program was conducted in China introducing near 129 million improved stoves into rural areas, and more than two-thirds of them are still in use [5]. The cumulative experience of China in conducting successful improved cookstove programs is expected to provide valuable information for future work. Given the scope and scale of previous Chinese invention programs, and the historical lack of results from Chinese research in the English publications, a review of the Chinese language literature is in urgent need. Thus, the main objective of our present review is to identify key factors affecting the deployment and sustainable use of clean fuels and cookstoves in China through a peer-reviewed Chinese literature review.

2. Methods

Peer-reviewed publications were identified from the database of China National Knowledge Infrastructure, Wanfang Data and VIP Journal integration platform, Chinese Science Citation Database and Chinese Social Sciences Citation Index up to October, 2013. The search terms used by Puzzolo et al. (2011) were adopted in the present study, with a minor adjustment according to local names for stoves or fuels in China. The search terms are listed in Table 1. The terms in the first two columns in Table 1 were combined with Boolean search function 'and'. Extend search for literature within some famous improved household stoves programs was also conducted, using the program name or agencies as search terms. Translation in Chinese for these terms is not simply a matter of seeking words with similar meaning, but of finding appropriate terminology that is commonly and frequently used in Chinese language literature. Eligible papers were classified, screened, and in-depth reviewed.

The study team was separated into two groups. Each group conducted the literature search respectively and the results were compared and combined. Duplications were removed. Remaining articles were reviewed independently by two people according to inclusion/exclusion criteria based on title and abstract. Any discrepancies were adjudicated by the third one. The criteria are based on the following components: (1) clear aim and objective, (2) adequate description of context and (3) appropriate study methodology (i.e. sampling, data collection and analysis). The individual studies were assessed according to 6 criteria and graded into 'high', 'moderate' and 'low'. A study with a final grade of very low was excluded based on inadequate quality.

3. Results and discussion

In total, 47,132 records were found from the databases. After initial screening of the titles, 930 articles were selected for abstract review, and then 351 articles for outcomes of interest. Finally, 87 ones of them were read in full-text, of which there were 20 quantitative studies, 23 qualitative studies and 44 case/policy studies (Fig. 1). Data and main results of key enablers and barriers were extracted and analyzed. These study were from different areas in China. As seen in Fig. 2, there were 20 studies reporting a results based on national statistical data or describing a general situation in the national scale. For the other studies, they were from one or several specific provinces, usually depending on resource available for field interview and survey.

3.1. Development of cookstoves in China

The development of household stove in China is generally recognized as four stages (Fig. 3)