



## Solid fuel use in rural China and its health effects



Hua Liao <sup>a,b,c</sup>, Xin Tang <sup>a,b,c</sup>, Yi-Ming Wei <sup>a,b,c,\*</sup>

<sup>a</sup> School of Management and Economics, Beijing Institute of Technology, Beijing 100081, China

<sup>b</sup> Center for Energy and Environmental Policy Research, Beijing Institute of Technology, Beijing 100081, China

<sup>c</sup> Collaborative Innovation Center of Electric Vehicles in Beijing, Beijing 100081, China

### ARTICLE INFO

#### Article history:

Received 1 June 2014

Received in revised form

23 October 2015

Accepted 17 January 2016

#### Keywords:

Rural residents

Solid fuel

Indoor air pollution (IAP)

Cooking

Health

### ABSTRACT

Solid fuels such as firewood and coal are widely used for cooking and heating in the developing countries, which result in serious indoor air pollutions and health effects. Governments and international organizations have been devoted to addressing this issue for a long time. Based on the micro survey data from 1989–2011, this paper quantitatively investigate the situations and evolutions of cooking fuel using and its health effects in rural China. We have four findings: (i) most rural households still rely on solid fuels for cooking in modern China. (ii) the cooking fuels are slowly diversifying in the last two decades, (iii) there are considerably geographical differences in cooking fuel using across China, and (iv) those resident usually using solid fuel have lower levels of self-assessed health and higher prevalence of respiratory diseases. We then draw some policy implications to reduce cooking fuel use.

© 2016 Elsevier Ltd. All rights reserved.

### Contents

1. Introduction . . . . .	901
2. Data and methodology . . . . .	901
3. Cooking fuel use in 2011 . . . . .	902
3.1. Fuel choice . . . . .	902
3.2. The relation between cooking fuel choice and income . . . . .	902
3.3. Provincial differences on rural cooking fuel use . . . . .	903
4. Cooking fuel transition from 1989 to 2011 . . . . .	903
4.1. The diversification of cooking fuels . . . . .	903
4.2. Provincial comparisons . . . . .	903
4.3. The transition matrix of cooking fuel choice . . . . .	904
5. The health effects of household solid fuel use . . . . .	905
5.1. Household solid fuel and resident health status . . . . .	905
5.1.1. Solid fuel, gender and health status . . . . .	905
5.1.2. Exposure level and health status . . . . .	905
5.1.3. House sanitation and health status . . . . .	905
5.2. Household solid fuel use and respiratory disease . . . . .	906
6. Conclusions and policy implications . . . . .	907
6.1. Conclusions . . . . .	907
6.1.1. The cooking fuel are diversifying and more clean in rural China . . . . .	907
6.1.2. Solid fuel results in negative health effects on resident . . . . .	907

\* Corresponding author at: School of Management and Economics, Beijing Institute of Technology, Beijing 100081, China. Tel./fax: +86 10 68911706.

E-mail addresses: [ymwei@deas.harvard.edu](mailto:ymwei@deas.harvard.edu), [ymwei@263.net](mailto:ymwei@263.net) (Y.-M. Wei).

6.2. Policy implications.....	907
6.2.1. Improve modern energy services varied in local conditions.....	907
6.2.2. Promote clean stoves and improve health education concerning IAP.....	907
Acknowledgments.....	907
References.....	907

## 1. Introduction

Indoor air pollution (IAP) induced by solid fuel using in the rural daily life is usually ignored [1,2]. Solid fuel generally includes traditional biomasses (wood, animal dung, agricultural residues, etc.) and coal, which is widely used for cooking and heating in developing countries. IAP, sometimes called household air pollution, has serious adverse effects on residential health [3]. According to a worldwide estimation by the World Health Organization (WHO) [4], the IAP produced by solid fuel using leads to 35.7% of all lower respiratory infections, 22% of the chronic obstructive pulmonary disease, 1.5% of tracheal, bronchial, and lung cancer, and 2.7% of the loss of disability adjusted life years (DALYs). The most recent Global Burden of Disease (GBD) project [5] estimated that there about 3.55 million people in 2010 prematurely died of household air pollution caused by solid fuel using. Moreover, this team found that IAP is the world third largest disease burden (just preceded by hypertension and smoking). The World Bank [6] data showed that there about 2.8 billion people worldwide used solid fuels for daily cooking and heating in 2013, of which rural population accounted for 78%. The wide use of solid fuels and unavailability of modern clean fuels, as manifestations of energy poverty, are important issues need to address around the world, especially in the developing countries [7–11].

Incomplete combustion of solid fuels in a simple/traditional stove (refers to those without chimney or grate) produces a large amount of harmful material, including carbon monoxide, oxides of nitrogen and sulfur, hydrocarbons, and inhalable particulates, etc. As the main components of IAP, these harmful pollutants have serious adverse effects on household health. Smith et al. [12] have continuously studied the IAP for decades. Usually, women are responsible for most of the cooking, and children often accompany their mothers during cooking. Therefore, women and children are possibly in higher health risk. WHO [4] reported that indoor smoke resulted in 2.8% of the loss of DALYs for women, which was higher than that for men (2.5%). WHO data [13] showed that indoor air pollution accounts for more than 50% of Children's deaths to pneumonia in children less than five years of age.

Though China has achieved great success on universal household electricity access and become one of the upper-middle-income countries (according to World Bank Classifications), there about 59% and 17% of rural households still mainly use firewood and coal for cooking in 2010, respectively [14]. Some researchers have studied the cooking fuel situation in China. Tang and Liao [14] investigated the energy poverty and solid fuels use based on national population census (statistical) data. Sinton et al. [15] and Edwards et al. [16] examined stove improvements in China's rural households. Zhang and Smith [17] reviewed more than 200 Chinese and English papers relating to household solid fuel use and connection with health. However, most historical and current researches are focused on a specific county, town or village, which are not the representative sample of China. In addition, these studies usually employ one year or short term data, which fails to find the evolutions of cooking fuels and health effects in the long term. In this paper, we try to address this issue using a large-scale longitudinal household survey dataset. In Section 2, we will describe the dataset and methodology in detail.

## 2. Data and methodology

All the data used in this study was sourced from the China Health and Nutrition Survey (CHNS). The CHNS is a large-scale social health survey jointly conducted by the University of North Carolina at Chapel Hill and the Chinese Center for Disease Control and Prevention. The survey questionnaires include variables about household, nutrition, health, adults, children, and community, etc. and the data files that link longitudinally households and individuals are easy to statistically analysis. The survey has been conducted for 9 times (in 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011) and will be continued. According to the survey introduction, CHNS covers nine provinces (Liaoning, Heilongjiang, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi, and Guizhou), which substantially vary in geography, economic development, natural resources (see Fig. 1). They are the representatives of China to some extent. The multistage, stratified and random cluster sampling was used to draw the villages and townships samples in each province. For more details about the sampling process, please see the website <http://www.cpc.unc.edu/projects/china>. After excluding the households with missing or abnormal values, we get the valid samples by year (Fig. 2)<sup>1</sup>.

Though CHNS has a large panel dataset (about 4400 households with 19,000 individuals), there are few variables related to cooking fuel selection and impacts. In addition, most of these variable are 0–1 ones. It is difficulty to use econometrical methods. Therefore, in this paper we will mainly employ the descriptive statistics to investigate the cooking fuel evolution and its health effects. First, we analyze the static situations of cooking fuel use in 2011 (the latest survey). Subsequently, we examine the evolutions of cooking fuel in 1989–2011. Based on the historical trend, we calculate a Markov transition matrix and forecast the future household distribution in cooking fuel using. Finally, we investigate the health effects especially the respiratory disease burden possibly related to indoor air pollution induced by solid fuel use.

CHNS questionnaire divides the cooking fuels into 8 sub-groups: 'coal', 'electricity', 'kerosene', 'liquefied petroleum gas (LPG)', 'natural gas', 'charcoal', 'wood, sticks and straw', and 'others'. In this paper, 'charcoal' is combined with 'wood, sticks and straw', and referred to as 'traditional biomass' or 'biomass' in brief. In addition, since only few rural households use kerosene for cooking in the sample (possibly data record mistakes), we include kerosene into 'others'. Therefore, cooking fuels in this study has 6 types: coal, traditional biomass, natural gas, LPG, electricity, and others. In the cases where no special explanation is required, the term 'solid fuel' in this study merely refers to coal and traditional biomass.

The questionnaire requires answering two kinds of fuel for cooking: the most often used is referred to the primary cooking fuel, and the second most often used is referred to the secondary cooking fuel. If a household only uses one cooking fuel, then that fuel is the primary cooking fuel and there is no secondary cooking fuel. Therefore, we divide the cooking fuels into four

<sup>1</sup> According to the CHNS, rural households/residents refer to those residing in village areas (*Cun* or *Xiang*) and townships (*Zhen*). Urban Site includes urban (or city) and suburban neighborhoods (*Shi* and *Jiaogu*). With this definition we consider a household/resident to be rural or urban.

Download English Version:

<https://daneshyari.com/en/article/8114162>

Download Persian Version:

<https://daneshyari.com/article/8114162>

[Daneshyari.com](https://daneshyari.com)