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Cooking fuel choice in rural China: results from microdata

Bing-Dong Hou, Xin Tang
Chunbo Ma, Li Liu
Yi-Ming Wei, Hua Liao

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Center for Energy and Environmental Policy Research
Beijing Institute of Technology
No.5 Zhongguancun South Street, Haidian District
Beijing 100081
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Yi-Ming Wei
Director of Center for Energy and Environmental Policy Research, Beijing Institute of Technology

For more information, please contact the office:

Address:
Director of Center for Energy and Environmental Policy Research
Beijing Institute of Technology
No.5 Zhongguancun South Street
Haidian District, Beijing 100081, P.R. China

Access:
Tel: +86-10-6891-8551
Fax: +86-10-6891-8651
Email: ceeper@vip.163.com
Website: http://ceep.bit.edu.cn/english/index.htm

Fuel Choice in China's Rural Household Cooking: Situations, Transitions, and Determinations

Bing-Dong Hou[1, 2, 3], Xing Tang[1, 2, 3], Chunbo Ma[4], Li Liu[5], Yi-Ming Wei[1, 2, 3], Hua Liao[1, 2, 3, *]

1. Center for Energy and Environmental Policy Research, Beijing Institute of Technology, Beijing 100081, China;

2. School of Management and Economics, Beijing Institute of Technology, Beijing 100081, China;

3. Collaborative Innovation Center of Electric Vehicles in Beijing, Beijing 100081, China;

4. Centre for Environmental Economics and Policy, School of Agricultural and Resource Economics, University of Western Australia;

5. Beijing Natural Science Foundation, Beijing 100195, China.

***Corresponding author**

Prof. Hua Liao

E-mail: hliao@bit.edu.cn, liaohua5@gmail.com, liaohua55@163.com
Tel: +86-10-68914459
Fax: +86-10-68918651

Present address:
School of Management and Economics,
Beijing Institute of Technology.
5 Zhongguancun South Street,
Haidian District,
Beijing 100081, China

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Abstract: Unclean cooking fuel is widely used in the developing world, and it is the main indication of energy poverty in rural China. In this paper, we investigate the situation, transition, and determination of fuel choice in China's rural household cooking. Using the large scale micro-survey data of China Health and Retirement Longitudinal Study (CHARLS), we find that there is a big gap in using commercial cooking fuels between rural and urban households: 60% of the rural households adopt traditional biomass resource as their main fuel for cooking in 2011, while this figure is less than 5% in the urban. We also identify a significant spatial divide in fuel choice: in southeastern coastal areas, about 40% of the rural households prefer solid fuels, while this figure jumps to over 80% in northeastern areas. The longitudinal data also reveal a significant transition from traditional to modern fuels from 2008 to 2012. Moreover, the distance to the most commonly used farmer's market, education background, coal price and female labor participation are all influential in determining the households' choices.

Keywords: cooking fuel; solid fuel; household; energy poverty; rural China

Highlights

1. 60% of the rural households adopt traditional biomass as their main cooking fuel.

2. A significant transition from traditional to modern fuels is detected.

3. Clean fuel access and price, income, female labor participation are the influences.

1 Introduction

Energy poverty, such as clean energy unavailability and unaffordability, has long been a serious problem in many developing countries. It commonly refers to the lack of access to clean commercial fuels and heavy reliance on solid fuels (mainly biomass and coal), which often results in severe indoor air pollution (IAP). IAP causes serious hazards and is listed as the leading environmental risk factor for female mortality, accounting for 5% of all female deaths in the developing world — even more than those caused by malaria each year (WHO, 2002; Martin et al., 2011; Miller and Mobarak, 2013; Sophie Bonjour, 2013). According to IEA (2012), there will still be 1 billion people having no access to electricity and 2.6 billion people without access to clean cooking facilities by 2030.

One of the serious hazards caused by energy poverty is poor health of residents, especially for female and children. Cooking with solid fuels in traditional stoves releases smokes containing a large amount of carbon dioxide, carbon monoxide and other harmful gases, as well as particulate matter of high concentrations. These materials are shown to be toxic according to animal studies and may increase risks of infant mortality and respiratory disease (Ezzati and Kammen, 2002; Chay and Greenstone, 2003a; Chay and Greenstone, 2003b). In Kurmi et al. (2010), the authors showed that the use of solid fuel is positively related to the incidents of chronic obstructive pulmonary disease (COPD) and chronic bronchitis. Moreover, recent literatures have paid more attention to the impacts of energy poverty on environment, education and household productivity, etc. For example, the combustion of solid fuels in traditional stoves releases about 20% of the global black carbon emissions (Anenberg, 2012). Overuse of solid fuel may aggravate the destruction of environmental sanity (Mohammed et al., 2015). Mendell and Heath (2005) found that indoor pollutants may reduce students' attendance due to its negative health influence. Duflo et al. (2008) indicates that the impacts of IAP are not only restricted to health. One may not be able to find a strenuous or sustained work if in poor health, thus may weaken his work ability and lower his productivity further.

Governments and international organizations strived to study the factors that influence the residents' choice of solid fuels (Tang et al., 2014). Currently, European Research Council (ERC) is funding an energy program from International Institute for Applied Systems Analysis (IIASA) to explore the intersection among energy access, climate change and poverty, which is also in line with the major global efforts (e.g., the United Nations' proposal of "*Sustainable Energy for All*") (Rao, 2015). In addition, the Chinese government also pays attention to the energy use in rural households. Early in 1982, China's Ministry of Agriculture of China initiated a National Improved Stove Program (NISP) to promote advanced technologies, alleviate IAP and improve the rural households' welfare. Smith did plenty of research about this topic in China and obtained practical conclusions. By the late 1990s, this program had introduced nearly 200 million improved stoves for local needs (Smith et al., 1993; Qiu et al., 1996; Smith and Deng, 2010). Although better stoves were delivered to many households in targeted counties, the cost-effective clean stoves were still with low adoption rates (Sinton et al., 2004; Smith et al., 2007). Feder and Slade (1984) and Conley and Udry (2001) indicated that the reason of low adoption rates was that the residents might not fully realize the adoption benefits. It was also concluded that the adoption of clean stoves can be influenced by whether a female can control resources or make decisions in a family (Miller and Mobarak, 2013).

Despite the sheer size of China's rural population and severe impacts of burning solid fuels in inefficient stoves, there have been few related studies examining energy transition in rural China. Tang and Liao (2014) carried out a descriptive study on China's rural cooking fuel based on national population census data in 2010, but they did not analyze the determinants further. Peng et al. (2010) showed that the rural areas of Hubei Province were still at an early stage in fuel switching on household level. Zhang et al. (2011) used the household-level data collected in nine provinces to determine factors influencing household fuel consumption and indicated that income and regions have significant influence on the fuel choice. However, previous empirical studies on China were limited in a certain province or local region, and cannot obtain conclusions on the national level. In this paper, based on the micro survey data of China Health and Retirement Longitudinal Study (CHARLS), we not only describe the current rural household fuel use, but also try to determine influencing factors from multiple perspectives.

The rest of this paper is organized as follows. Second 2 describes the data used in our analysis. Section 3 compares differences of cooking fuel choices among rural, township and urban areas in China. Section 4 describes the spatial differences of rural households' cooking fuel choice. Section 5 presents the patterns of energy transition from 2008 to 2012. Section 6 discusses the influential determinants and the last section concludes this paper.

2 Data

Our data comes from the survey of China Health and Retirement Longitudinal Study (CHARLS). The CHARLS is a series of high quality interdisciplinary household-level survey data. In 2008, CHARLS conducted the preliminary survey in Zhejiang and Gansu province representing rich and poor areas of China. CHARLS national baseline survey was initiated in 2011, covering 150 counties, 450 villages, about 17708 people in 10257 households. Such a big sample can be very useful to empirical work. Another benefit of CHARLS reflected in the representativeness of the sample. CHARLS employs a four-stage sampling approach including sampling at the county (district), village (community), household and individual, and adopt the Probabilities Proportional to Size (PPS) to recruit sample at county and village stages. The shaded parts of the map (Fig. 1) indicate sampled areas of CHARLS at the prefecture level. Compared to the mid and east areas, smaller sample has been selected in northwest regions due to the less population.

Fig.1.CHARLS sample locations at prefecture level (2011)

Notes: 126 prefecture areas were sampled in China in 2011. Our data did not include Tibet, Beijing, Shanghai, Hong Kong, Macao and Taiwan. It is a schematic map and does not implicate the definite boundaries.

CHARLS has rich information on community characteristics such as the percentages of residents with different education backgrounds and existence of female migrant workers. CHARLS also collected considerably detailed information on household energy consumption. The survey identified the seven main cooking fuel including coal, natural gas, marsh gas, Liquefied Petroleum Gas (LPG), electricity, biomass and others to be selected. In what follows, we group natural gas, marsh gas, LPG, electricity and others collectively as clean fuels. According to the interim provision of the National Bureau of Statistics on the division of urban and rural in statistics, all sampled areas are classified into town and rural areas with town areas further divided into urban areas and townships (NBS, 2006). Households with missing values are neglected.

3 The Rural-Urban Divide in Cooking Fuel Choices

Based on the CHARLS data in 2011, we have found significant rural-urban deviations in cooking fuel choices. As shown in Figure 2, in rural areas, almost 60% of the households choose biomass as their main cooking fuel while only 10% choose coal, and less than 30% use clean fuels. Contrary to rural areas, the majority of urban households (88%) choose clean fuels such as natural gas, electricity, LPG etc. Only 5% and 7% of the urban households have selected biomass and coal respectively. We also find that in township -- the transition area between urban and rural areas -- about 30% and 14% of households mainly used biomass and coal respectively. In conclusion, the proportion using biomass for cooking is substantially higher in rural areas while that for coal is highest in township, which seems to agree with previous literature that urban households consume disproportionally larger share of commercial energy than rural households (Narasimha and Reddy, 2007; Pachauri and Jiang, 2008).

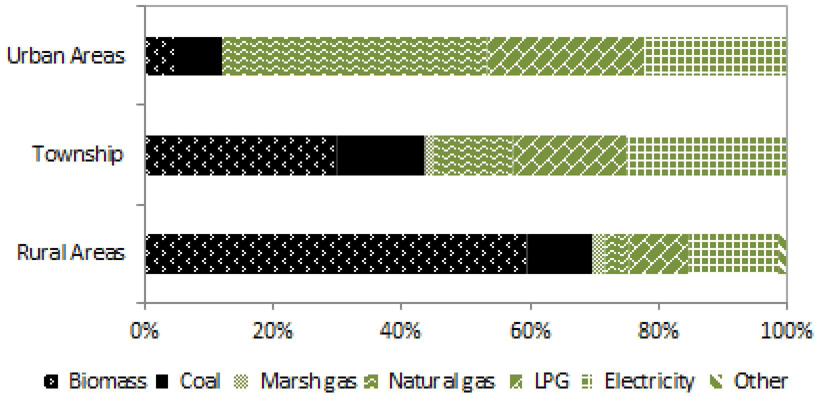

Fig.2. Proportion of Households by main cooking fuel in rural, township and urban China (2011).

4 The Spatial Divide in Cooking Fuel Choices

Heterogeneous natural resource endowments, environment and social economic development may result in different households' preference for cooking fuel across provinces (Smil, 1998; Pachauri and Jiang, 2008). As shown in figure 3, in northeast China – Liaoning, Jilin and Heilongjiang – with abundant forest resources, there were more than 80% of rural households relying on biomass for cooking. In less-developed provinces like Sichuan and Gansu, biomass is the dominant cooking fuel for the majority households (80.36% and 78.89% respectively). In coal-abundant Shanxi province, 67.2% of all rural households use coal as their main cooking fuel. In contrast, households in more developed provinces of East China, such as Zhejiang and Fujian, relied much less on solid fuels.

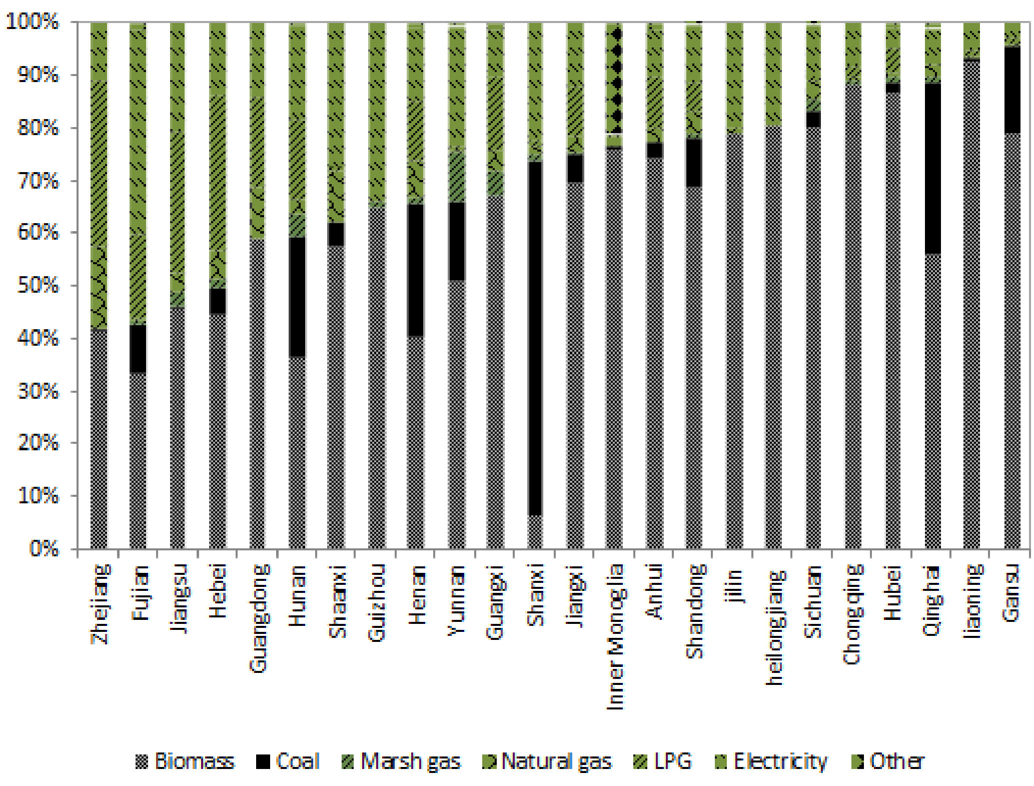

Fig.3. Composition of Rural Households by Main Cooking Fuel and Province in 2011.

Figure 4 shows the spatial distribution of rural households mainly using solid fuels (biomass and coal) for cooking in 2011. There also seems to be a spatial divide in cooking fuel choice. The more developed provinces in eastern and southern China depend much less on solid fuels while those in the northeast and west have the highest proportion of rural household still use them. More specifically, there are more than 40% of households used solid fuels in eastern and southern rural China (e.g., Jiangsu, Zhejiang, Fujian and Guangdong). The regions with highest ratio of dependence on solid fuels distribute in northeast China including Liaoning, Shenyang; west China including Xinjiang, Qinghai, and central China like Sichuan and Chongqing. The percentage of households that using solid fuels in Inner Mongolia, Shaanxi, Henan is between 60% and 80%.

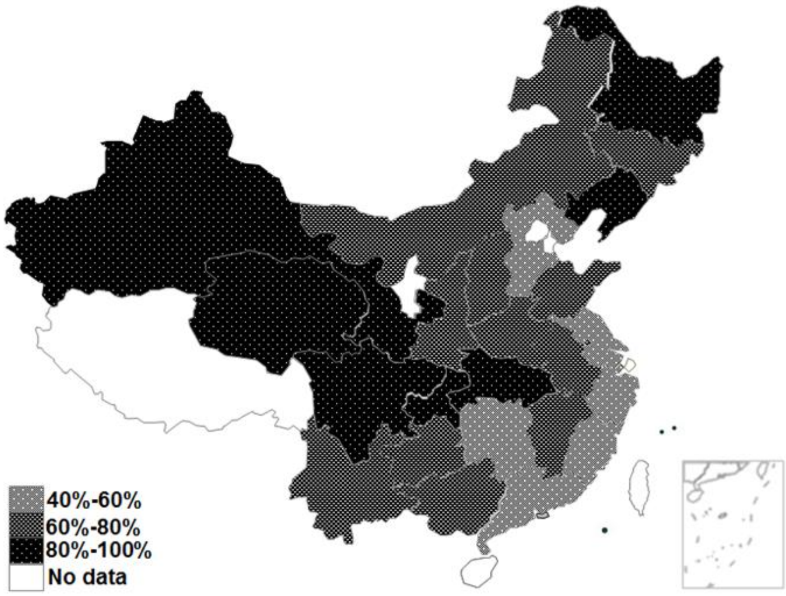

Fig.4. Spatial distribution of households mainly using solid fuels in 2011.

Notes: In the surveyed provinces, the proportions of households using solid fuels are all larger than 40%. It is a schematic map and does not imply the definite boundaries.

5 Cooking Fuel Transition

The last section provides a sectional snapshot of household cooking fuel choice in rural China. However, both energy ladder theory and energy stacking model indicates that households' energy consumption may transit from lower quality fuels to higher quality ones (Pachauri and Jiang, 2008; Peng et al., 2010). Figure 5 presents a cooking fuel transition matrix from 2008 to 2012 (the data used in this part comes from the preliminary survey in 2008 and its longitudinal survey in 2012, which was sampled in Gansu and Zhejiang representing the poor and rich provinces of China respectively). As is seen in Fig.5, there is substantial bi-directional transition between two solid fuels – coal and biomass, and there is also sizable transition between clean fuels –especially between natural gas, LPG and electricity. More importantly, during this short period of time, bi-directional transition between solid fuels and clean fuels can be observed while overall there is a significant net transition from solid fuels to clean fuels. Based on the transition matrix we can also make a prediction of proportions of households using different fuels in 2016 and 2020. As shown in figure 6, solid line represents the actual figures in 2008 and 2012 and dashed line represents the predicted figures in 2016 and 2020. It is predicted that there will be 35.53% and 11.72% of rural households preferring biomass and coal in 2020, with a decrease of 11.6% and 3.2% respectively. On the other hand, the proportion of households using clean fuels has a significant increase according to predicted values. One of the notable aspects is that the proportion of using electricity has a large increase from 5.3% in 2008 to 16.76% in 2020, which may be associated with the popularity of electronic cooking products like microwave oven, soybean milk machine and rice cooker.

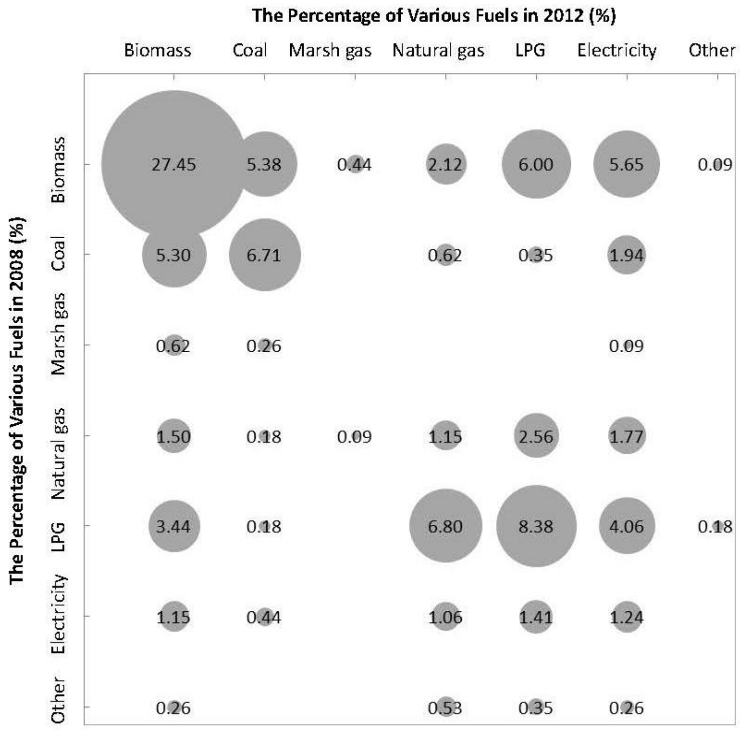

Fig.5. Cooking Fuel Transition Matrix (2008 - 2012)

Notes: Vertical and horizontal axes represent the various fuel types in 2008 and 2012 respectively. The number within each bubble indicates the percentage of households switching from using row-wise fuel in 2008 to column-wise fuel in 2012. Bubble size is proportional to the associated percentage. Bubbles on the main diagonal represent those who have not changed their main cooking fuel during this period.

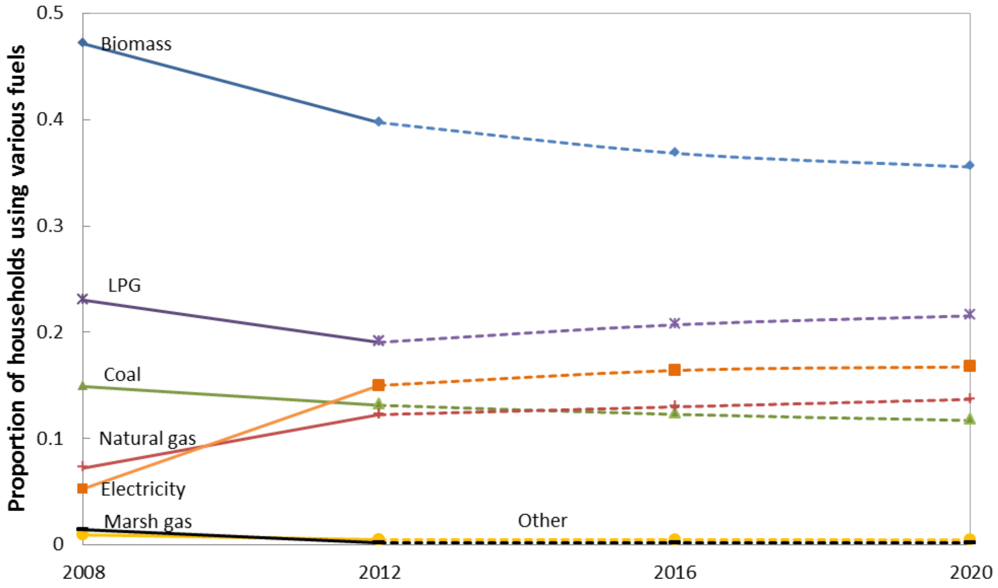

Fig.6. Predicted Tendency of Various Fuels

6 The Influence Factors of Rural Household Cooking Fuel Choice

The household fuel choice is variable and affected by multifaceted factors. A better understanding of those factors may help considerably accelerate the transition from biomass and solid fuels to modern and clean fuels. The factors involve many aspects: the characters of energy carrier including price, efficiency, convenience of storage etc.; the characters of a household such as family size, household head's age, education, culture, customs etc.; and socio-economic characters such as urbanization, market access and landscape etc. The following sections provide preliminary analysis on the relationship between rural households' cooking fuel choice and some influencing factors.

6.1 Administrative Divisions

According to the regulation of China's National Bureau of Statistics regarding the administrative divisions, China's territory can be divided into town and rural areas when collecting statistic data. Town includes urban area and township. More specifically, the urban include city and combined urban-rural areas (CURAs), township include town center areas (TCAs), combined town-township areas (CTTAs) and special district (special district is not shown in figure7 because of its uncertain real socio-economic development level); the rural area include township center areas (TSCAs) and village. The arrangement of "Village, TSCAs, CTTAs, TCAs, CURAs, City" is not only a reflection of administrative divisions but also an indication of their social-economic development levels. Higher level of social-economic development often implies better energy availability to commercial and clean energy due to its improved infrastructure, abundant employment opportunities and higher household income. This study tends to show the changing trend of the proportion of households using various fuels with the development of socio-economic level. The direction of the arrow represents the progression of the socio-economic development. As shown in figure 7, an obvious downward trend shows in the percentage of households using biomass as main cooking fuel, from 60% to less than 5%. In contrast, the proportion of households using clean fuels shows a dramatically increasing trend, from less than 30% to more than 90%. However, the percentage of household using coal does not show obvious change with socio-economic development. This result is consistent with the findings of Rahut et al. (2014) that urban households consume more commercial fuels compared to rural households in quantity. Besides, Reddy and Srinivas (2009) also found that the quality of fuel consumption in rural household is far behind urban household.

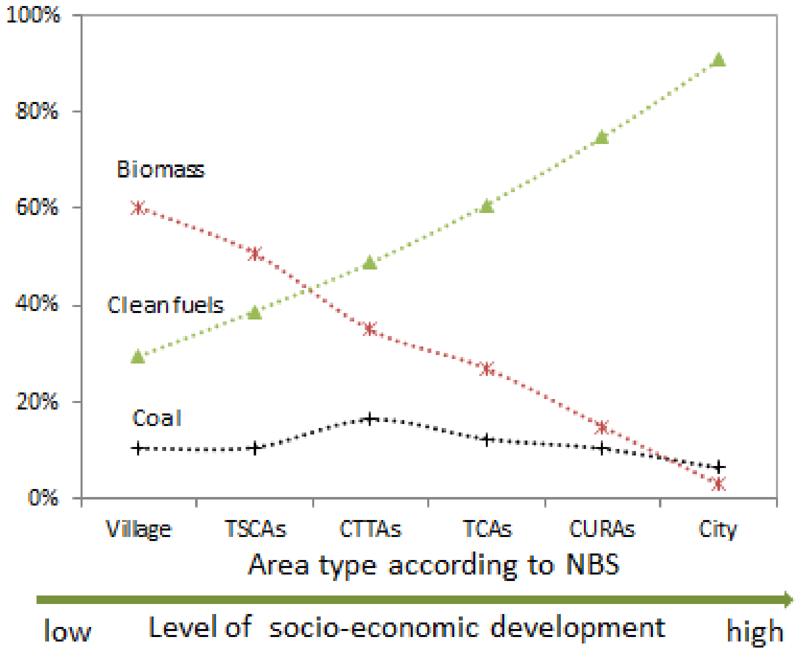

Fig.7. The percentage of household fuels choice by different socio-economic development level (Year 2011)

Notes: TSCAs: township center areas; CTTAs: combined town-township areas; TCAs: town center areas; CURAs: combined urban-rural areas.

6.2 Fuel accessibility

Fuel accessibility is one of the most important external factors that influence household fuel choice especially in rural areas (Zhang and Hassen, 2014). Access to urban amenities may benefit the adoption of modern fuels (Ahmad and Puppim, 2015). Distance and poor transportation infrastructure are often the main reasons for poor fuel accessibility. As a result, as the access cost for commercial and clean fuel is driven up, the rural households' affordability for a transition towards these better quality fuels is further reduced. In the following two sections, we selected two proxy indicators for fuel accessibility, namely, landscape types and the distance to the most commonly used farmer's market to examine the relationship between households' choice of cooking fuels and fuel accessibility.

6.2.1 Landscape Types

The consumption patterns of cooking fuel vary tremendously across land. There are five terrain types in China: plain, basin, hill, plateau and mountain. Peng et al. (2010) used cross-sectional data from rural

Hubei and found that households in plain areas are less likely to choose biomass as their main energy supply due to limited biomass resources while mountainous and hilly areas are rich in biomass resulting in heavier reliance on these resources. Using a nationally representative dataset, this study provides new evidence that is consistent with Peng et al. (2010). As shown in Figure 8, rural households in plain areas consume biomass by the least proportion than those in the other four landscape types.

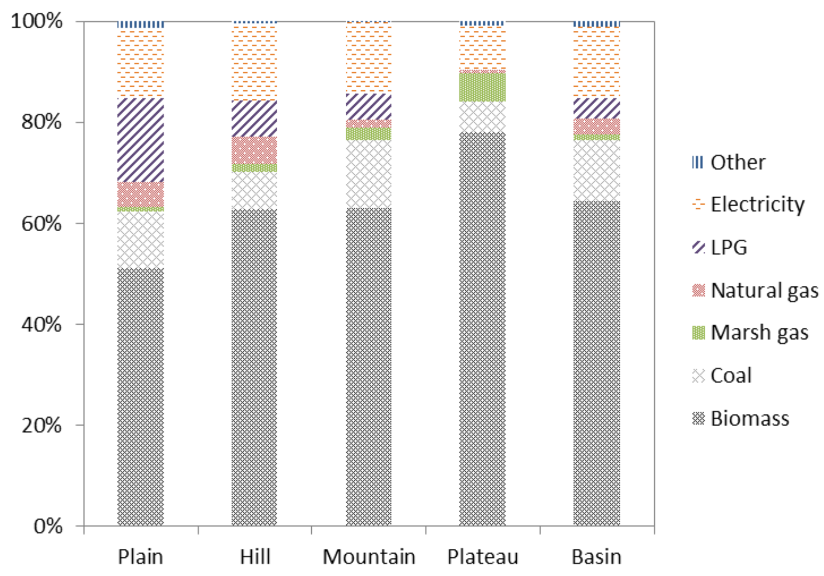

Fig.8. Composition of Rural Households by Main Cooking Fuel and Landscape Types (2011)

6.2.2 Distance to Major Fuel Supply Infrastructure

The distance to major fuel supply infrastructure is also critical in household decision about fuel choice. In rural areas, farmer's market is one of the main places for households to purchase commercial and clean fuels. Households in communities closer to the most commonly used farmer's markets are more likely to purchase clean energy carriers such as natural gas and LPG as gas fuels supplied in cylinders. Figure 9 presents the relationship between the distance to the most commonly used farmer's market and the proportion of households using various fuels in a community. The choice of biomass as the main cooking fuel is positively correlated to the distance to the most commonly used farmers' market. The choice of clean fuels, however, is negatively correlated to the distance, both of which are consistent with expectations. While the relationship between coal use and the distance is unclear.

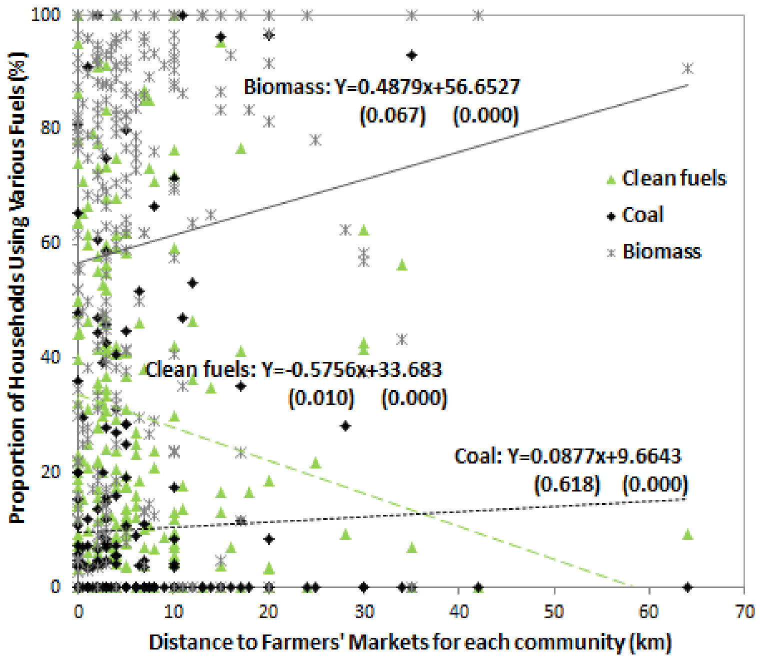

Fig.9. Cooking Fuel Choice and Distance to Farmers' Market for Communities

Notes: *p*-values are shown in the parentheses under each equation

6.3 Fuel Affordability

In addition to socio-economic development, fuel affordability is another external factor which largely influences the cooking energy choice. The energy ladder hypothesis emphasizes the income as sole driving force in energy transition (Hosier and Dowd, 1987), and a substantial number of literatures have justified the relationship between income and energy choice (Ouedraogo, 2006; Pachauri and Jiang, 2008; Peng et al., 2010; Lee, 2013). However, there are also studies not supporting this hypothesis (Sehjpal et al., 2014). Here, we use Engel's coefficient calculated from the questionnaire of rural household (see Appendix 1), as a proxy of fuel affordability and divide it into 5 quintiles. Engel's coefficient is the proportion of food expenditure in total spending for a household. It is an indicator to explain the living standard of household. The reasons that we use Engel's coefficient rather than income level lie in the following aspects. Firstly, the data of household income is difficult to collect. Secondly, Engel's coefficient focuses on food – a lower coefficient means a better affordability for non-food expenditures including clean energy, paid education, health and entertainment etc., which results in a better living standard. In this sense, Engel's coefficient may be a reasonable proxy of income. The higher Engel's coefficient means a worse living condition and quality of life in a household. As shown in figure 10, the numbers 1 to 5 represent the decline of Engel's coefficient and the increase of expending level. The greater the number is, the smaller the Engel's coefficient. And the Engel's coefficient can be obtained by dividing the food expenditure by the total expenditure. Obviously, as expending level rising, the ratio of use of biomass fuel declined from 70% to 50%. In contrast, the ratio of coal and clean fuels, on the whole, showed a slight increasing trend. In other words, the substitution of clean fuels to solid fuels is rather limited if we consider the effect of Engel's coefficient solely.

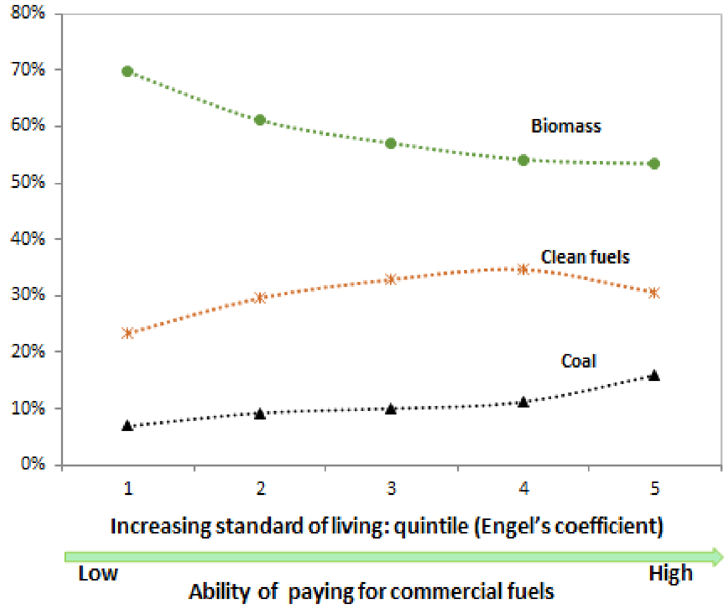

Fig.10. Cooking Fuel Choice and Standard of Living

Notes: 1 to 5 represents the quintiles of Engel's coefficient.

6.4 Residential educational level

Educational level is an important demographic factor affecting the energy choice of a household (Özcan et al., 2013). Higher level of education, on one hand, may increase household's income and hence strengthen their affordability for more commercial fuels; on the other hand, it improves their awareness of various environmental and health impacts of the consumption of different fuels and promotes the need for cleaner fuels (Baiyegunhi and Hassan, 2014; Rahut et al., 2014). We use the proportion of illiterate or semi-illiterate adult population as a proxy for the overall education level of a community. As shown in Figure 11, the proportions of households using clean fuels and biomass are positively related to the community educational level. And this relation for coal is unclear and insignificant as well. Overall, our results are generally consistent with Farsi et al. (2007) and Peng et al. (2010) who found that the opportunity cost of wood collection is increasing with women's higher educational level, which leads to less wood consumption and more consumption of commercial fuels.

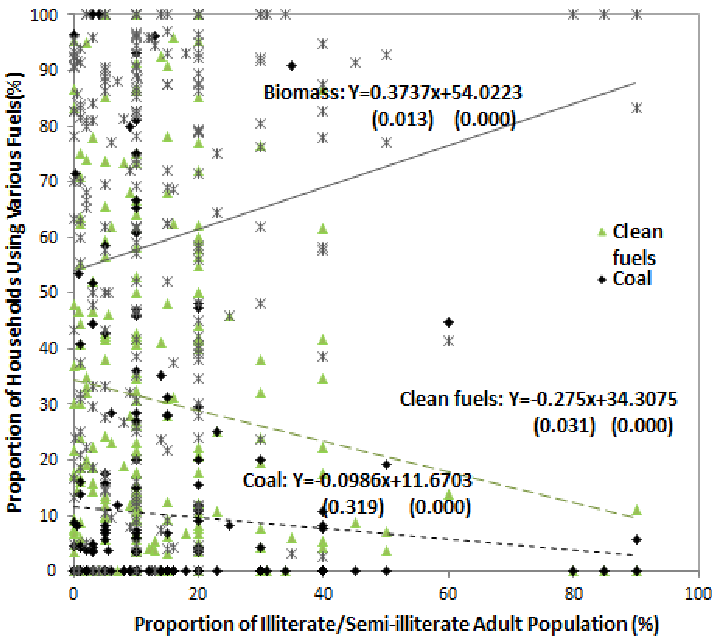

Fig.11. Cooking Fuel Choice and Education Level by Community

Notes: *p*-values are shown in the parentheses under each equation.

6.5 Fuel Price

Energy price is one of the most important factors in households decisions of choosing fuels (Narasimha and Reddy, 2007; Pachauri and Jiang, 2008). When the price of commercial fuels increases, poor households may have to turn to some cheaper but typically less efficient fuels. Farsi et al., (2007) found that Indian households are more likely to move to less efficient energy types when the prices of kerosene and LPG increase. And consistent results in China are found in the present study. Figure 12 shows the relationship between the percentage of households using various fuels and the logarithmic of average coal price in each community. Communities with higher coal prices are found to have lower proportions of households using coal as main cooking fuel but higher proportions of households using biomass. Changes in coal prices have no significant impact on the choice of clean fuels.

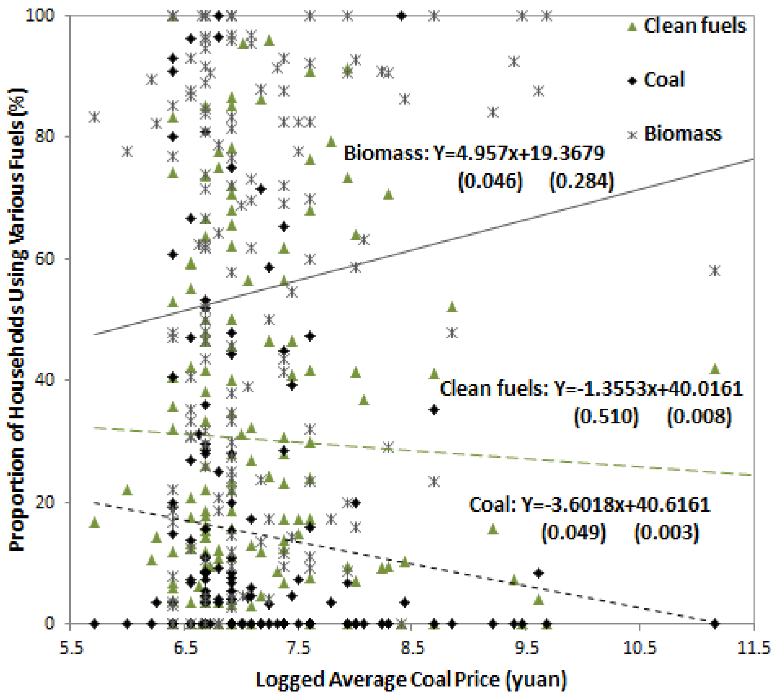

Fig.12. Cooking Fuel Choice and Fuel Price by Community

Notes: *p*-values are shown in the parentheses under each equation

6.6 Female Migrants

The characters of female household members including education and age are also important factors influencing household energy choice since female plays a dominant role in fuel collection and cooking (Pandey and Chaubal, 2011). Better education raises the opportunity cost of female labor and makes female members less available for cooking and household fuel collection. Similarly, one would expect families and communities with more females migrated into city areas to be less dependent on biomass and more on clean fuels. As shown in Fig. 13, the proportion of female migrants in total migrants of a community is positively related to the proportion of households using clean fuels as their main cooking fuels. It also seems that a negative but insignificant correlation between biomass use and female migrants, which is consistent with previous literature that female labor participation in other industries reduces household biomass use (Burke and Dundas, 2015).

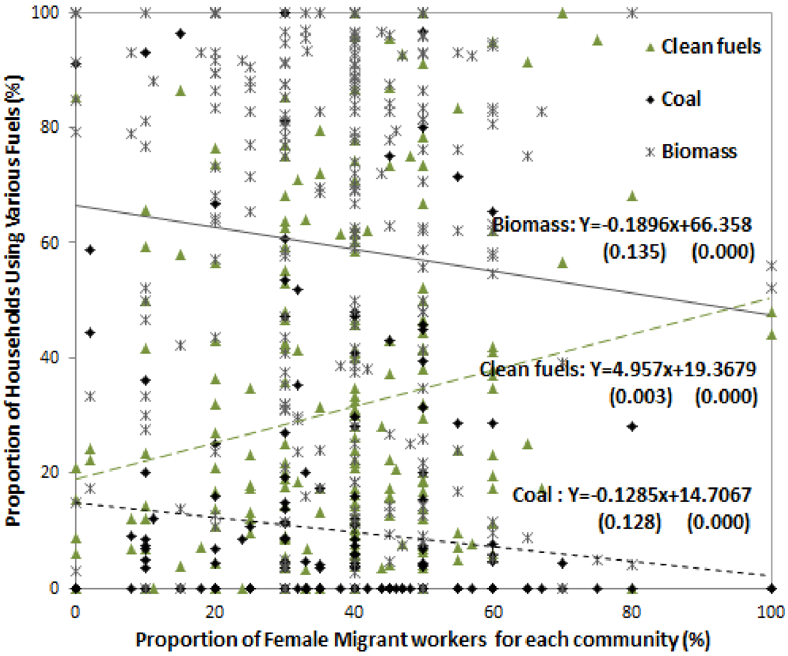

Fig.13. Cooking Fuel Choice and Female Migrants

Notes: *p*-values are shown in the parentheses under each equation

7 Conclusions

Due to the cost of survey and micro data unavailability, most previous studies on the use of China's household cooking fuel usually focused on a single county or local district. However, with China's vast territory and regional disparity of development, it is difficult to get an unbiased profile of China's household cooking fuels through several local surveys. Our paper has instead employed a nationwide survey data to explore the household energy use.

Firstly, we find that there's a large gap between cooking fuel choice in rural, township and urban areas. There are respectively 60%, 30%, and 5% of the households in those areas using traditional biomass as main household cooking fuel. In contrast, the percentages of clean fuel use as main fuel (including marsh gas, natural gas, LPG, electricity and others) are 30%, 56% and 88% respectively. Our result agrees with the study using national population census data (Tang and Liao, 2014).

Secondly, we find that the transition from traditional to modern fuels is observed in rural China. About 17.21% of the surveyed 1133 households changed from traditional to modern fuels during 2008-2012. It is significant and encouraging figure since it occurs in 5 years. According to this transition speed, it is estimated that 52.75% of rural households will be using clean fuel for cooking in 2020.

Thirdly, we analyzed some of the typical influence factors of rural household cooking fuel. Factor analysis shows that the distance to the most commonly used farmer's market, education background and average coal price have positive effects on biomass using in a community and statistically significant at least in 10% levels. The distance to the most commonly used farmer's market and female labor force participation have negative and positive effects respectively on clean fuel using in a community respectively and statistically significant both at 0.01 level. The usage of coal in a community is only statistically influenced by average coal price in our analysis. This work may provide a reference for further study on energy choice influence factor.

There are limitations in this study. (1) We could not explore the long-term trend of energy transition in rural China because of the data limit. (2) The quantitative data of main rural household cooking fuel is missing. (3) The influence of clean fuel availability, fuel prices, income (affordability) and other possible factors on rural residents' fuel selection are discussed in this paper, while the comprehensive influence of those factors and other control variables such as cultural background, tax and subsidy have not been analyzed (Beunder and Groot, 2015). More proper methods like econometrics are expected to be used to further explore the significance of these factors in the future. Since the better understand of the factors may accelerate the switching process.

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APPENDIX 1: Engel's Coefficient

This appendix is attached to explain how Engel's coefficient is calculated in this paper. The following information is all collected in the questionnaire of CHARLS in 2011. We introduce the labels of each variance name and then explain the formula we used to calculate Engel's coefficient.

GE006: In the past week, what was the value of household consumption of food, including food purchased and food eaten from your own production (excluding eating out expenditure, alcohol, Cigarettes, cigars and tobacco expenditure)?

GE007: Among it, how much did your household spend on eating out?

GE008: Among it, how much did your household spend on alcohol, Cigarettes, cigars and tobacco?

GE009: Please tell me the expenditure last month for your household for the following items.

	Item	Expenditure (Yuan)
1	Communication fees (including post, internet usage, telephone and cell phone usage.)	GE009_1
2	Utilities: water and electricity	GE009_2
3	Fuels (including gas, coal, etc.)	GE009_3
4	Fee for Matrons, housekeepers and servants	GE009_4
5	Local Transportation	GE009_5
6	Household items and personal toiletries that are used daily plus beauty treatments (e.g., detergent, soap, toothpaste, toothbrush, cosmetics, beauty salon, etc.)	GE009_6
7	Entertainments (including fees to buy books, newspapers, VCCs, DVDs, going to cinema and bars)	GE009_7

GE010: In the last year how much did your household spend on the following items?

	Item	Expenditure(Yuan)
1	Clothing and bedding	GE010_1
2	Long distance travelling expenses (including travel fees	GE010_2

	through train, car, bus, plane and ship)	
3	Heating (centrally heated)	GE010_3
4	Furniture and consumption of durable goods, includes refrigerator, washing machine, TV and expensive instruments like piano.	GE010_4
5	Education and training (including tuition, training fees, etc.)	GE010_5
6	Medical expenditure	GE010_6
7	Fitness expenditures	GE010_7
8	Beauty (including make-ups, facials, massages, etc.)	GE010_8
9	Purchase, Maintenance and repair (of transportation vehicles, appliances, communication products, etc.)	GE010_9
10	Taxes and fees turned over to the government	GE010_10
11	Automobiles	GE010_11
12	Electronics (laptops, computers and accessories, video games, etc.)	GE010_12
13	Property management fees (including parking fee)	GE010_13
14	Donations to the society (including cash, and items like food, clothing, etc.)	GE010_14

The formula used to calculate Engel's coefficient:

Engel's coefficient = (GE006*52) / (GE006+GE007+GE008)*52 + (GE009_1+GE009_2+GE009_3+GE009_4+GE009_5+GE009_6+GE009_7)*12 + (GE010_1+ GE010_2+ GE010_3+ GE010_4+ GE010_5+ GE010_6+ GE010_7+ GE010_9+ GE010_10+ GE010_11+ GE010_12+ GE010_13+ GE010_14)