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Temporal and spatial variations of energy consumption in rural China

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ABSTRACT

Presented in this paper is an overview of energy consumption in rural China in view of temporal and spatial variations. Characterized by steadily decreased proportion of biomass use and increased percentage of coal and electricity use, coal and biomass are still the major energy sources in rural areas, accounting for nearly 80% of the total rural energy consumption. Moreover, the energy consumption varies significantly across provinces both in total sum and by fuel types due to diversities of geographic features, economic development levels and local energy source availability. Three statistical groups are clustered associated with quantitative change and structural change, exhibiting evident transition from noncommercial energy pattern to commercial energy pattern. Much more work need to be done to cope with the forthcoming dramatic changes associated with booming rural economy and newly released policy from the points of both energy security and environmental pressure in China.

1. Introduction

China's rural economy has undergone an incredible high-speed development since 1978, accompanied by a substantial and profound change of rural energy pattern, which deserves more attention from several viewpoints, due to its relations with energy demand and supply, land degradation, air pollution, and social behavior and lifestyle changes in rural areas [1]. For a long time, however, the energy issues in rural areas of China have not been fully considered, in comparison with those in urban areas, due to its subsidiary position in Chinese overall development strategy. This, in turn, resulted in a negative influence on commercial energy supply and use in rural areas. At the same time, the shortage and inefficient energy utilization as well as excessive fuelwood collection and pollution in rural areas have troubled China for decades [2,3].

Highly relevant to national energy security and rural environment, an escalating interest has been emerging for the extensive analysis of rural energy issues in China. In the recent researches on systematic resource accountings and sectoral energy efficiency of China, rural energy issues have been incorporated and emphasized [4–17]. The major characteristics and affecting factors of rural household energy consumption in China have been revealed through case studies as well [3,18–23]. The development potential of biomass and other renewable resources has also been emphasized [24–29]. Nevertheless, it is necessary to give an overall picture and a well-grounded prospect of rural energy consumption in China. This paper intends to present a better understanding of the observed variations and current situation through a historic evolution of the rural energy consumption.

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2. Rural energy data

The data on rural energy in China are mainly associated with the state statistics bureau (SSB, representing governmental statistics) and ministry of agriculture (MOA, belonging to sectoral statistics). These two departments catch different aspects of information through different channels. MOA mainly possesses data of renewable energy such as straws, biogas, and small hydropower, through its hierarchical energy offices in provinces, counties and even in towns, while SSB gathers residential data through rural household survey conducted annually by its branch – China rural socio-economic division (CRSED) and data reported by sectoral sources.

We try to collect as much available data as possible to give a holistic picture and a preliminary assessment from these available data sources. Most of the data are from the Science, Technology and Education Division of MOA (from 1991 to 2005), who is responsible for rural energy statistics and various reports (particularly before 1991). All the data are compared and rectified through various sources [30–34].

Official statistics are not necessarily always accurate, of course. The biomass may especially be underestimated [35], but they are an irreplaceable starting point for analyzing a national energy system and do reflect a tendency to some extent. No alternative information is available to improve the past energy statistics. In addition, it will also take significant resources and time to achieve better data collection [36]. Since the government has started to pay attention to the rural energy statistics, it is expected the future data will be improved.

3. Overall trends of China's rural energy consumption

3.1. General trends

Our analysis is initiated by briefly reviewing the overall trends in rural energy use based on the available discontinuous time series data. Total rural energy consumption has increased substantially from 307.19 Mtce in 1979 to 869.21 Mtce in 2005, nearly tripling with an annual growth of 4.08%. Correspondingly, the per capita energy consumption has increased at a steady rate of 4.31% from 388.78 kgce in 1979 to 1166.03 kgce in 2005. As shown in Fig. 1, the total energy consumption in rural China illustrates a trend of steady increase throughout the years of study, of which three different phases can be identified. The first phase is characterized by steady increase of total energy consumption from 1979 to 1995, reaching the first peak at 649.52 Mtce in 1995. During the second phase, the total energy consumption remained relatively stable until the end of the last century, but has resumed another fast growth in recent years, i.e., from 2000 onwards (the third phase). The energy decline against increased economy in the late 1990s is considered to be greatly attributed to improved efficiency rather than structural change [37,38].

As to the energy users in rural areas, the proportion of energy for livelihood has declined from 83.13% in 1979 to 55.95% in 2005, but still takes over 50% of the total energy consumption. In fact, the absolute amount of energy consumed by

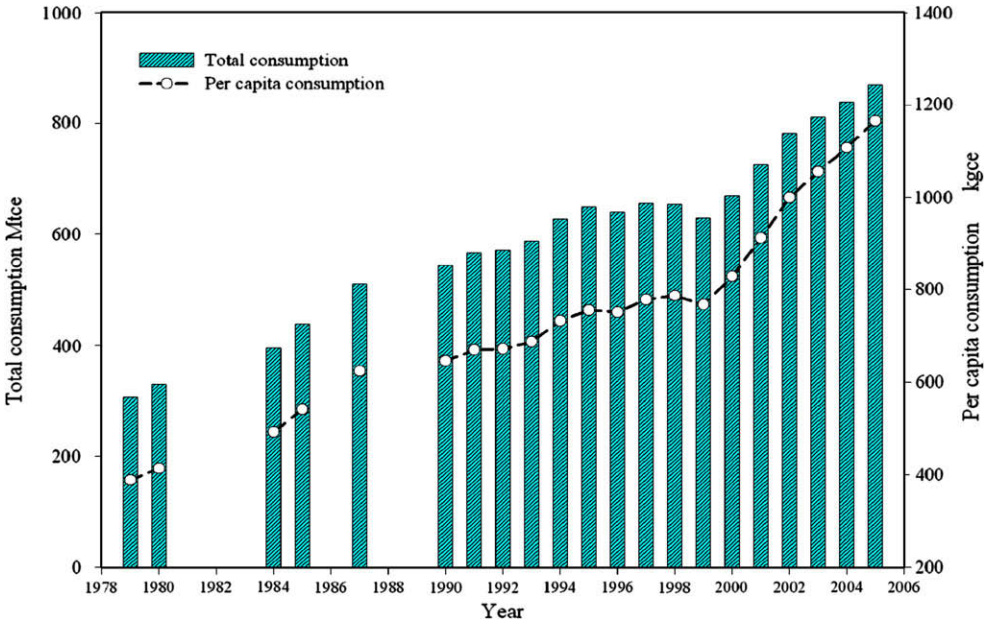

Fig. 1. Total and per capita energy consumption in rural China from 1979 to 2005.