

Energy consumption patterns by local residents in four nature reserves in the subtropical broadleaved forest zone of China

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ABSTRACT

Collection of fuelwood by local residents in or around nature reserves of China has caused problems such as disturbance of habitat for wildlife and deforestation. Thus, it is important to study the energy consumption patterns by those local residents live in or around nature reserves to find solutions to reduce the amount of fuelwood consumption. We chose four nature reserves: Longxi-Hongkou National Nature Reserve, Sichuan Province, Taohongling National Nature Reserve, Jiangxi Province, Qingmochuan Nature Reserve, Shaanxi Province, and Laoxiancheng Nature Reserve, Shaanxi Province in the subtropical zone of China to study this problem. We found no significant difference of total energy consumption per household per year in the four nature reserves, which was about 2 ton of standard coal per year. But the energy consumption patterns in different reserves were different. People who live in deep mountains more relied on collecting fuelwoods from surrounding forests whereas those live in areas with relatively developed economy and better transportation condition consumed more coals, liquidinized petroleum gas and electricity. Such a pattern also reflects the changing energy spectrum during the process of modernization in China. We concluded that economic status of household and the transportation condition are two important factors affecting the energy consumption patterns in households in the nature reserves in China, which reflect the general energy consumption in rural China.

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1. Introduction

In developing countries, biomass is the most important energy source, especially fuelwood [1] and crop residuals [2], where biomass provides roughly 30% of the total energy supply and woods account for more than half of the biomass [3]. In some

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countries such as Nepal, Bangladesh, Ethiopia, Burkina Faso, and even oil-rich Nigeria, fuelwood accounts for more than 75% of the energy used [2–5]. Demand for fuelwood has linked to deforestation [6–11], total energy demand [5,6,10], agricultural productivity [5–10], loss of plant and wildlife habitat [5,7,9,11–14], environmental collapse associated with droughts, floods, or other extreme climatic events [5], and increased labor costs for fuelwood collection [5,7,8].

With a total area of 9.60 million km² and a population of 1.3 billion people, China is one of the largest developing countries in the world and a country with extensive rural areas where consumption of biomass such as fuelwood is large. It was reported 61% of the energy used by rural households in China are biomass, in the year 2001 along the country consumed over 190 million m³ of fuelwoods [7]. In some places, fuelwood collection has caused deforestation, consequently it led to serious soil erosion, floods and sand storms [15]. In order to reverse this trend, reforestation programs have been initiated since the beginning of 1980s. For example, two important programs have been implemented in China since late 1990s, one is Natural Forest Protection Program; another is the Green for Grain Program (Conversion of Farmland to Forest Program [7,15]). During the same time, many nature reserves have also been established in China. The development of modern nature reserves in China began in the 1950s but escalates in recent decades [16]. Number of nature reserves increased from 34 reserves in 1978–1999 reserves by the end of 2003, area of those nature reserves accounted for 17.73% of the land territory of country. Among these nature reserves, the nature reserves for protecting forest ecosystems account for about 66% in area [16].

Implementation of the national wide forest protection programs has resulted in improvements of the forest resources. However, such a success has not significantly alleviated China's forest resource crisis that was characterized by a high demand for wood products and environmental services. Fragile and degraded ecosystems and wildlife habitats are in need of rehabilitation and protection through appropriate forest management practices in the country [17]. Most of the nature reserves in China are divided into three functional zones as that recommended by Man and Biosphere (MAB): a core zone, a buffer zone, and an experimental zone [18]. Core zone in a nature reserve is strictly protected; normally no people live in core zone, but there are some people still live in buffer zone and experimental zone of nature reserves. Usually, the people living near or within the nature reserve live on the forest. Primary energy those people use is biomass, especially fuelwoods. In some forest type nature reserves, the behaviors of human, including collection of fuelwood, have caused the degradation of the habitat of wildlife, such as which happened in the Wolong nature reserve [13,19]. Thus, it is important to study the pattern of energy consumption of local people who live near or within nature reserves and find what factors affect their energy consumption patterns. However, such researches are absent and most of the nature reserve managements do not realize this problem. Therefore, we carried out a study on the fuel consumption pattern in four selected nature reserves in broadleaved forested area in subtropical zone of China. We particularly interested in following questions: whether there are statistically significant difference among total energy consumption and quantity of fuelwood consumed in different nature reserves in subtropical China? Are energy consumption and composition of energy consumed correlated with economic status, transportation condition, household size? Does condition of transportation conditions affect energy consumption and composition of energy consumed in villages? We used computer software SPSS to assess significance of the differences and correlation. Finally, we discussed the implication of results to fuelwood use and sustainable development in rural area near the nature reserves.

2. Study areas

We carried out the survey in four nature reserves in the subtropical forest zone: Taohongling National Nature Reserve, Jiangxi Province (29°42'–29°53' N, 116°32'–116°43' E), Longxi-Hongkou National Nature Reserve (31°04'–31°22' N, 103°32'–103°43' E), Sichuan Province, Qingmochuan Nature Reserve, Shaanxi Province (32°50'–32°56' N, 105°28'–105°40' E), and Laoxiancheng National Nature Reserve, Shaanxi Province (33°43'–33°57' N, 107°40'–107°49' E) in China from 2002 to 2005 (Fig. 1).

Taohongling National Nature Reserve was established in 1981. The reserve is established for protecting southern China subspecies of wild sika deer (*Cervus nippon kopschi*), which is a critically endangered wild animal in China. Local flora is complex and the vegetation is dominated by evergreen broadleaved forest. Because of the over logging and frequently wildfire, original vegetation was destroyed in the history. Now shrubs developed in most of the areas in the reserve [20].

Longxi-Hongkou national reserve was established in 1997 for protecting forest ecosystem and wild animal species, such as giant panda (*Ailuropoda melanoleuca*), golden-haired monkey (*Rhinopithecus roxellana*), takin (*Budorcas taxicolor*) and dove tree (*Davidia involucreta*). This nature reserve links the giant panda populations in the Mishan Mountains and the Qionglai Mountains; thus it serves as an important natural corridor for the giant panda and other wild animals in the region.

Qingmochuan Nature Reserve was established in 2002 for protecting giant panda, golden-haired monkey and its associated fauna. Biogeographically, the reserve lies between the Palaearctic Realm and Oriental Realm, where subtropical evergreen broadleaved forest and subtropical deciduous forest develop due to typical northern subtropical climate: rich precipitation and solar radiation. There are three major forest types: subtropical mixed deciduous and evergreen broadleaved forest, sub-alpine cool temperature deciduous broadleaved forest and evergreen coniferous forest. The fauna has animal species from warm temperate zone to subtropical zone, but the species of the Oriental Realm: takin, golden-haired monkey, macaque (*Macaca mulatta*), musk deer (*Moschus berezovskii*), golden pheasants (*Chrysolophus pictus*), golden eagle (*Aquila chrysaetos*), and the giant panda are found here [21].

Laoxiancheng nature reserve was established in 1993, the reserve is located in the center of the Qinling Mountains. There are

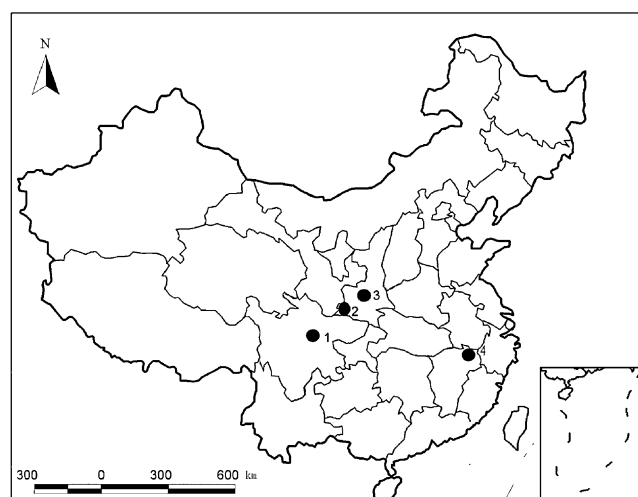


Fig. 1. Locations of the four nature reserves in China. 1: Longxi-Hongkou National Nature Reserve, Sichuan Province; 2: Laoxiancheng National Nature Reserve, Shaanxi Province; 3: Qingmochuan Nature Reserve, Shaanxi Province; 4: Taohongling National Nature Reserve, Jiangxi Province.

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