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Analysis and Research on the Current Situation of Energy Use in Rural Areas of Tibet and Sichuan

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Abstract: This article has conducted relevant surveys on the current situation of energy use in rural areas of Linzhi City, Tibet, and Heishui County, Sichuan. The survey results show that in terms of energy sources, fuelwood accounts for the largest proportion in rural areas of Linzhi City, Tibet, accounting for 72.2% to 74.7% of energy use. Moreover, the proportion of renewable energy in rural areas is 4.5 times that of pastoral areas, and 18 times that of resource rich areas. In rural areas of Heishui County, Sichuan Province, dried cow and sheep dung is the main energy source, accounting for 79.8% of the total energy consumption. The utilization rate of renewable energy in daily life is relatively low, only 0.3%.

Keywords: Rural Tibet; Rural Sichuan; Current situation of energy utilization; Analytical research.

1. Introduction

The basic meaning of new energy and renewable energy is to modernize the development and utilization of traditional renewable energy based on new technologies and materials, and replace fossil energy with inexhaustible renewable energy that is limited in resources and pollutes the environment [1]. In the long run, vigorously developing new energy power generation technology can alleviate the problems of uneven distribution of power resources and insufficient development and utilization in Tibet Autonomous Region, and has good economic benefits.

Many countries in the world have formulated new energy and energy conservation policies to promote the development of new energy and energy conservation industries. China's new energy industry is growing rapidly with the strong support of the government, and has initially formed a diversified and three-dimensional new energy project investment and construction system. Tibet's new energy resources mainly include solar energy, hydropower, wind energy, and geothermal energy. The annual average solar radiation in Tibet reaches 3300-4800 MJ/m2, with a total annual radiation amount of 5850-8400 MJ/m2 throughout the region. Direct radiation accounts for 56% - 78% of the total radiation, and can reach 71% - 88% in summer [2]. Tibet's annual wind energy reserves 93×108 kW·h, with an annual effective wind energy density of 130 to 200 W/m2, and an annual effective wind energy hour of 3500 to 4000 h. Tibet has many rivers, and the theoretical reserve of hydropower resources in the whole region is about 2×108 kW, and annual power generation 1.760 billion kW·h[3]. Tibet ranks first in geothermal resources nationwide, with 666 geothermal display points. According to the statistical results of 350 display points, the flow rate of hot spring water is 20 m3/s, and the total geothermal energy is 276.28×104 kJ/s, equivalent to standard coal 3×106 t/a, power generation potential 8×105 kW [2-3].

Based on the rich renewable energy resources in Tibet, this article conducted a survey on the current situation of energy use in rural areas of Linzhi City, Tibet, and Heishui County, Sichuan. Through similar daily energy habits, it compared the differences in energy use patterns and structures between rural areas in Tibet and Sichuan, and proposed relevant suggestions for maximizing the use of renewable energy.

2. Living and Economic Conditions

2.1. Relevant situation in rural areas of Linzhi

Linzhi City is located in the southeast of Tibet, in the middle and lower reaches of the Yarlung Zangbo River. Its west and southwest are respectively connected with Lhasa City and Shannan City, west to Jiali County in Naqu District, east to Changdu City, and part of the south is bordered by southern Tibet (occupied by India) and Myanmar, known as the Jiangnan of Tibet. The electrification areas selected for this survey are Bayi Town, Milin County, Linzhi Prefecture, Zharao Township, Milin County, and Langba Township, Langxian County. With the help of the Linzhi Municipal Science and Technology Bureau, members of the research team conducted field surveys in these three places through random visits and unified questionnaires. The photos of the field survey are shown in Figure 1. A total of 50 survey questionnaires were distributed and 50 were effectively recovered, with a feedback rate of 100%. The total number of effective survey households was 50, involving 278 respondents.

Through field research in the above three places, the proportion of per capita annual income of Bayi Town in Milin County below 10000 yuan is only 2.1%, the proportion of 10000 to 20000 yuan is 33.5%, and the proportion of income above 20000 yuan is 64.4%; The proportion of per capita annual income of Zharao Township in Milin County below 10000 yuan is 14.3%, the proportion of 10000 to 20000 yuan is 40.8%, and the proportion of higher than 20000 yuan is 44.9%; The proportion of per capita annual income of Langba Township in Lang County below 10000 yuan is as high as 52.6%, the proportion of 10000 to 20000 yuan is 34.1%, and the proportion of higher than 20000 yuan is only 13.3%. According to the survey, there is a huge gap between the income of various districts and counties in the same Linzhi region. For example, Bayi Town in Milin County is located on the bank of the Niyang River, and its residents rely mainly on tourism and gravel transportation for their income. Therefore, the per capita annual income is relatively high,

with the proportion of per capita annual income greater than 10000 yuan reaching 97.9%.; In Langba Township, Langxian County, farmers and herdsmen account for the majority of the population, and their income is still mainly derived from working outside and farming and animal husbandry. Therefore, the per capita annual income is relatively low, and the proportion of their per capita annual income greater than 10000 yuan is only 47.4%, less than half.

Fig.1 Photos of on-site investigation in Linzhi area

Even though there are still some problems with low income among local residents in the three townships selected by Linzhi, with the strong power supply guarantee in Linzhi area, each household in the three survey locations still uses commonly used household appliances such as televisions, refrigerators, washing machines, butter tea machines, milk separators, rice cookers, and electric kettles. Linzhi is rich in water resources. There are hundreds of rivers such as the Yarlung Zangbo River, Niyang River, Pailong Zangbo, and dozens of lakes such as Basongcuo, Cuomu, and Ri in the territory. The water area is 77000 hectares, and the reserves of water resources are more than 82 million kilowatts, of which the exploitable water resources are more than 60 million kilowatts. Currently, there are 12 hydropower development enterprises, and more than 120 hydropower stations of various types have been built. The guarantee rate of power grid supply is extremely high. Due to the frequent overcast and rainy weather in Linzhi region in summer, common solar energy utilization methods include solar water heaters, solar stoves, etc.

2.2. Relevant situation in rural areas of Heishui County

Heishui County is located in the east of the Qinghai-Tibet Plateau, in the middle of Aba Tibetan and Qiang Autonomous Prefecture, bordering Songpan in the north, Hongyuan and Maoxian in the east and west, and Lixian and Malkang in the south and southwest. The terrain slopes from northwest to southeast, with an average altitude of 3544 meters, a maximum altitude of 5286 meters, and a minimum altitude of 1790 meters. It belongs to a monsoon plateau climate with distinct dry and rainy seasons, abundant sunshine, small annual temperature difference, and large diurnal difference, which varies greatly with altitude. The annual temperature difference between mountains and valleys reaches 20 ℃. In this survey, Shashiduo Town and Weigu Township in Heishui County were selected as representatives of typical agricultural and pastoral areas in the mainland, and field surveys were conducted in Changde Village, Yangrong Village, Xisu Guazi Village, and Muhua Village in the two townships. The field survey photos are shown in Figure 2. In this field survey, with the help of Heishui County Science and Technology Association staff and relevant township government staff, a total of 60 questionnaires were distributed, and 52 were effectively recovered. The feedback rate was 86.7%. The total number of households effectively surveyed was 52, involving 237 people, all of whom were Tibetans.

Fig.2 Photos of on-site investigation in Heishui County

For typical inland areas with a combination of agriculture and animal husbandry, the living and economic situation of Xisu Guazi Village, Weigu Township, Heishui County is taken as a typical administrative village for example. Xisu Guazi Village is a combination area of agriculture and animal husbandry, with 87 households and a total of 352 people, all of whom are Tibetans. Its main sources of income are:

migrant work, animal husbandry, and agriculture. Agriculture mainly produces wheat, highland barley, corn, potatoes, and beans, and the main cash crops are vegetables and pepper; Animal husbandry focuses on raising consuming cattle, pigs, sheep, and poultry. At the same time, its territory is rich in natural resources, including not only valuable Chinese medicinal materials such as cordyceps, fritillaria, Notopterygium, but also wild green resources such as morel fungus and bracken. In Xisu Guazi Village, the proportion of annual per capita income below 10000 yuan is about 4.1%, the proportion of annual per capita income between 10000 and 20000 yuan is 79.6%, and the proportion of annual per capita income above 20000 yuan is 16.3%. Affected by the 32000kW micro hydropower station in Qinglang Township, Xisu Guazi Village is relatively rich in power resources, but is greatly affected by natural disasters. The main natural disasters in the entire Weigu Township include mountain torrents, debris flows, mountain cracks, mountain landslides, hail, and so on.

Currently, all towns and villages in Heishui County have achieved full coverage of the power grid, and each household has used household appliances such as televisions, refrigerators, washing machines, butter tea machines, milk separators, rice cookers, and electric kettles. Heishui County is rich in water resources, with crisscross rivers, abundant water, steep riverbed, rapid water flow, large drop, and abundant hydraulic resources. The theoretical reserve of hydropower in the county is 1.7 million kilowatts, and the exploitable capacity is 1.2 million kilowatts. The construction of several large, medium, and large-scale water conservancy and power generation hubs, such as Nonferrous Ergu Power Station, Maorgai Power Station (as shown in Figure 2), Liwei Hekou Power Station, Qinglang Power Station, Zhugeduo Power Station, and Erdaoqiao Power Station, has enabled many hydropower stations to operate while ensuring the power demand within the county. Throughout the year, only temporary power outages occur in the event of grid failure, and other times, when there is almost no power outage, the power supply is stable, the guarantee rate of power grid supply is extremely high. The use of new energy is mostly for devices that do not directly affect living security such as solar stoves and solar water heaters, while the utilization rate of new energy used for essential household appliances such as solar photovoltaic household systems is relatively low [4].

3. Current situation of energy use

3.1. Current situation of rural energy use in Linzhi

The three towns and townships under investigation in Linzhi Prefecture are mainly composed of modern energy (mainly including liquefied gas, hydropower, solar power, and solar stoves) and biomass energy (mainly firewood) due to their electrification (i.e., grid coverage). The former comes from self-purchase (liquefied gas), enterprise land compensation (hydropower), and government assistance construction (hydropower, solar power, and solar stoves); The latter comes from the government's policy of allowing people to go up the mountain to collect firewood once every two years. Convert the energy sources of the three towns into standard coal, and the proportions are shown in Figure 3.

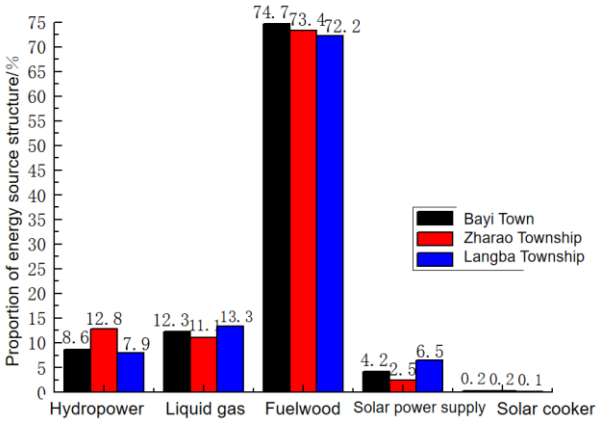

Fig.3 Structure of rural energy sources in Linzhi

In the three places of Bayi Town, Milin County, Zharao Township, and Langba Township, Langxian County, Linzhi Prefecture, the main energy sources are hydropower, liquefied gas, and firewood. Among these three energy sources, the overwhelming majority is still firewood. Due to the shortcomings of too much dry firewood, too many diseases and insects, and low combustion heat value, most farmers and herdsmen choose to collect firewood when they go up the mountain to collect firewood. The proportion of energy consumption using firewood in Bayi Town, Milin County is 74.7%; The proportion of energy used by firewood in Zharao Township, Milin County is 73.4%; The proportion of fuel wood used in Langba Township, Langxian County is 72.2%. The average usage of firewood in these three places is about 3-5 tons per year, and it is mainly used for cooking and winter heating. The proportion of energy used in Linzhi District is shown in Figure 4. In addition to cooking and winter heating, the proportion of energy used in household appliances has increased compared to pastoral and agricultural areas.

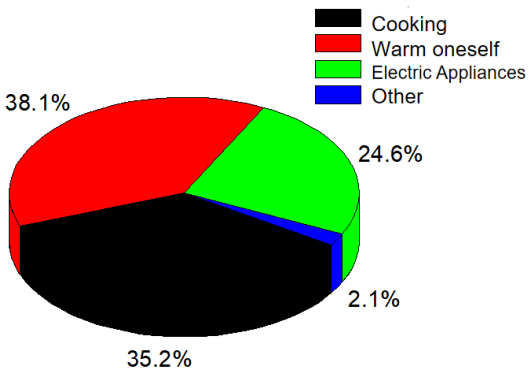

Fig.4 Proportion of rural energy consumption in Linzhi

After investigating and studying pastoral, agricultural, and resource rich areas in Tibet, it was found that there are significant differences in energy source modes due to different natural resources, different geographical locations, and different climatic conditions. In terms of the proportion of renewable energy use, the following is true: Shigatse region>Naqu region>Linzhi region, that is, agricultural region>pastoral region>resource rich region, Moreover, the proportion of renewable energy (solar household systems, solar stoves, and other household energy) in total energy consumption in agricultural areas is 4.5 times that of pastoral areas, and 18 times that of resource rich areas.

3.2. Current situation of rural energy consumption in Heishui County

This survey learned about the energy consumption structure of relevant townships and rural areas in Heishui County, and found that the domestic energy demand of local residents mainly includes cooking, lighting, heating, bathing, and household appliances. The calculation of energy consumption for cooking and heating is considered to be calculated by multiplying the annual consumption by the calorific value of fuel. The calculation of energy consumption for lighting and household appliances is considered to be calculated by converting their annual total electricity consumption into energy units, In the calculation of bathing energy consumption, heat conversion is performed based on the annual bathing temperature of 90 times, 60 L/person/time, and 50 ℃. After analysis and integration, take Xisu Guazi Village, Weigu Township, Heishui County as an example to reflect the energy consumption ratio of rural households in Heishui County, and obtain the energy consumption results and energy utilization method ratio of Xisu Guazi Village, as shown in Figure 5.

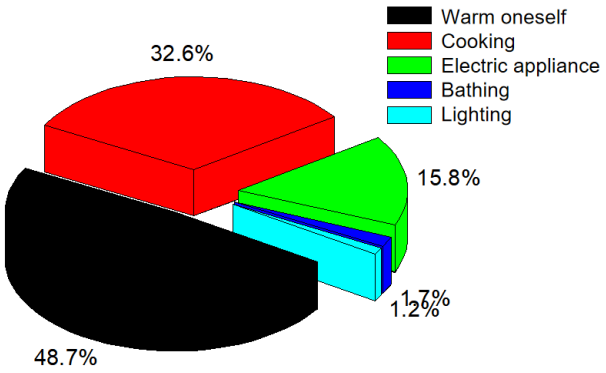

Fig.5 Proportion of rural energy consumption in Heishui County

As can be seen from Figure 5, among the annual living energy consumption of the villagers in Xisu Guazi Village, heating energy consumption is the highest, accounting for about half of the total energy consumption, followed by cooking and household appliances, with bathing energy consumption accounting for only 1.7%, which is related to the living habits and climatic conditions of the villagers. However, compared to areas such as Naqu, Shigatse, and Nyingchi in Tibet, there are more energy consumption items for bathing. This is because farmers and herdsmen in Tibet, influenced by their living culture and family environment, generally go to the city, county, or township bathhouses for centralized bathing, so household energy consumption is basically not generated due to bathing. Xisu Guazi Village has a relatively high altitude compared to other areas in Sichuan, with a long cold winter period, cold and humid weather, and a strong sense of cold. The minimum temperature can reach - 14.1 ℃, and the annual average temperature is 7.9 ℃. Therefore, villagers need higher energy consumption for heating.

4. Conclusion

New energy power generation can not only reduce the consumption of traditional energy, but also improve the development and utilization rate of resources and the level of cleanliness, to meet the daily electricity consumption of people in pastoral areas and areas where direct power supply is difficult. In the current energy shortage environment in Tibet, it is an inevitable trend to vigorously develop new energy. Therefore, increasing research on new energy power generation technology is a top priority in the development of Tibet's energy industry. "The spatiotemporal distribution of new energy resources in Tibet is uneven, and is also affected by factors such as climate. However, the overall distribution is relatively obvious [5]. In the future, we should adapt measures to local conditions and focus on developing advantageous resources in various regions.". In addition, future research on new energy power generation technologies can begin with improving photoelectric conversion efficiency, improving the stability of wind power generation, and new composite power generation technologies, moving towards forming a power generation model with Tibetan characteristics.

Acknowledgment

“Investigation and comparative analysis of the current situation of rural households' energy use inside and outside the district”

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