Study on Energy Consumption Status and Influencing Factors of Energy Variety Selection of Farmers in Sichuan Province

Yanqiu He, Siyu Zhu, Rou Chen, Jie Xu, Fang Wang

School of Management, Sichuan Agricultural University, 611130, Chengdu, Sichuan, China

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Abstract: Studying the energy consumption structure of farmers can provide an important basis for the government to formulate relevant emission reduction measures. Nowadays, rural energy consumption has become an important part of energy consumption, which has a great impact on the economic development and environmental pollution of a region. Based on the data of the third agricultural census of Sichuan Province published by Sichuan Provincial Bureau of Statistics, this paper uses descriptive statistical method and multinomial logistic model to analyze the energy consumption status of farmers in Sichuan Province and explore the factors affecting their energy choices. The results showed that: (1) non-clean energy is still the first choice of most farmers, but compared with ordinary farmers, large-scale agricultural households are more likely to choose cleaner energy; (2) income is the main factor affecting the choice of energy varieties for large-scale agricultural households, and income and the education level of the household head are the main factors affecting the choice of energy varieties for ordinary farmers. Therefore, the Sichuan Government needs to formulate macro policies on farmers' income and education so that farmers can use cleaner energy.

1. Introduction

For a long time, the government has focused more on macro issues such as energy supply and demand and national energy security, ignoring the concern about household energy consumption. In fact, household energy consumption has become the main source of global energy demand growth [1], especially It is accompanied by the rapid development of China's rural economy, the sharp increase in rural energy consumption demand and the transformation of rural energy consumption structure from traditional non-commodity energy to commodity energy [2]. The more influence farmers have on agricultural economic development and agricultural environmental governance More obviously, its situation should receive more attention. However, the energy consumption of rural households is relatively independent in the energy consumption system and the way of energy use is relatively decentralized. It is difficult for the government to control the energy consumption behavior of rural households through regulatory tools [3, 4]. With the increasing attention of international and domestic environmental issues and the frequent occurrence of fog and haze weather in China, the energy consumption problem of farmers is gradually becoming an "obvious" problem, and has been given a new mission to alleviate the shortage of energy supply and delay the deterioration of climate and environment [5]. Therefore, relying on the comprehensive and detailed data of the third national agricultural census, this paper makes an in-depth analysis of farmers' energy consumption, and further investigates the influencing factors of farmers' energy variety selection, so as to effectively guide rural households' energy consumption and establish an environment-friendly energy consumption model.

2. Energy Consumption Status of Farmers in Sichuan Province

2.1 Contrast of Energy Use Structure of Farmers

From the energy consumption structure of Figure 1, no matter whether it is a large-scale agricultural business household or an ordinary rural household, the domestic energy consumption is

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mainly non-clean energy, and the average rural households use pollution-type energy, which accounts for 13.37% of the larger-scale farmers. Farmers are more inclined to use clean energy, which is 3.6 percentage points higher than that of ordinary farmers.

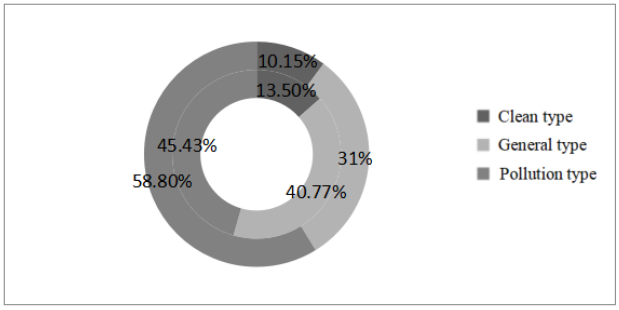

Fig.1. Energy use map of large-scale agricultural operators and ordinary farmers

2.2 Energy Combination Use of Farmers

Table 1 Scale of internal proportion of energy portfolio of large-scale agricultural operators

Clean type	Proportion	General type	Proportion	Pollution type	Proportion
Solar energy	0.53%	Solar Energy + Other	0.18%	Other	6.50%
methane	3.74%	Gas, Natural Gas, LPG + Solar Energy	0.18%	Gas, Natural Gas, Liquefied Petroleum Gas	24.07%
Biogas + Solar Energy	0.53%	Biogas + Gas, Natural Gas, LPG	5.07%	Gas, Natural Gas, Liquefied Petroleum Gas + Other	0.16%
Firewood (including straw)	68.45%	Electricity + Solar Energy	0.36%	electric	12.85%
Firewood (including straw) + solar energy	0.53%	Electricity + biogas	29.71%	Electricity + others	1.63%
Firewood (including straw) + biogas	26.20%	Coal + biogas	0.18%	Electricity + Gas, Natural Gas, Liquefied Petroleum Gas	52.52%
-	-	Firewood (including straw)+others	2.90%	coal	0.65%
-	-	Firewood (including straw) + gas, natural gas, liquefied petroleum gas	9.24%	Coal + Gas, Natural Gas, LPG	0.16%
-	-	Firewood (including straw) + electricity	50.72%	Coal + electricity	1.46%
-	-	Chai Cao (Containing Straw)+Coal	1.45%	-	

From Table 1, it can be seen that large-scale agricultural operators prefer the energy combination

of electricity, firewood (including straw), biogas and gas, natural gas and liquefied petroleum gas. The top three consumption ratios are: electricity and gas, natural gas, liquefied petroleum gas consumption combination (23.86%), firewood (including straw) and electricity consumption combination (20.68%), electricity and biogas consumption combination (12.11%)).

Table 2 Ordinary farmers' energy portfolio internal ratio table

Clean type	Proportion	General type	Proportion	Pollution type	Proportion
Firewood (including straw)	93.08%	Firewood (including straw) + gas, natural gas, liquefied petroleum gas	80.48%	Electricity + Gas, Natural Gas, Liquefied Petroleum Gas	54.85%
Firewood (including straw) + biogas	4.49%	Biogas + Gas, Natural Gas, LPG	2.95%	Electricity + Gas, Natural Gas, Liquefied Petroleum Gas	34.93%
Solar energy	1.61%	Firewood (including straw) + electricity	15.35%	Electricity + others	0.06%
Firewood (including straw) + solar energy	0.38%	Firewood (including straw)+others	0.12%	Gas, Natural Gas, Liquefied Petroleum Gas	9.24%
methane	0.45%	Coal + biogas	0.02%	Coal + Gas, Natural Gas, LPG	0.33%
Biogas + Solar Energy	0.01%	Chai Cao (Containing Straw)+Coal	0.82%	Electricity + biogas	0.30%
-	-	Gas, Natural Gas, LPG + Solar Energy	0.21%	coal	0.06%
-	-	Electricity + Solar Energy	0.05%	Gas, Natural Gas, Liquefied Petroleum Gas + Other	0.17%
-	-	Biogas + Others	0.002%	Coal + electricity	0.05%
-	-	Other + Solar Energy	0.002%	Other	0.01%

From Table 2, it can be seen that ordinary farmers prefer the combination of gas, natural gas, liquefied petroleum gas, firewood (including straw) and electricity. The top three consumption ratios are: consumption mix of electricity and gas, natural gas and liquefied petroleum gas (32.25%), firewood (including straw) and consumption combination of gas, natural gas and liquefied petroleum gas (24.99%), electricity and electricity. Consumption mix of gas, natural gas and liquefied petroleum gas (20.54%).

3. Analysis of Factors Affecting Farmers' Energy Variety Selection

3.1 Variable selection

The annual income level of the households, the number of family members, the age of the household head of the household, and the education level of the head of the household are used as independent variables, and the energy variety is used as the dependent variable.

3.2 Analysis of Farmers' Energy Influencing Factors

Table 3 Regression results of influencing factors of farmers' energy variety selection

Farmers above scale								
independent variable	Clean type				General type			
	B	S.E	Sig.	Exp(B)	B	S.E	Sig.	Exp(B)
Constant	-4.214	0.869	0.000		-2.273	0.513	0.000	
Age of household head	0.013	0.008	0.114	1.013	0.010	0.006	0.122	1.010
Number of family members	0.084	0.051	0.100	1.088	0.046	0.040	0.251	1.047
Education Level 1	1.052	0.823	0.201	2.862	-0.294	0.533	0.582	0.745
Education Level 2	1.382	0.767	0.072	3.982	0.788	0.416	0.058	2.199
Education Level 3	1.098	0.757	0.147	2.998	0.356	0.403	0.376	1.428
Educational attainment 4	0.563	0.811	0.488	1.756	0.313	0.433	0.469	1.368
Family annual income 1	1.267	0.469	0.007	3.550	-0.027	0.468	0.973	0.973
Family annual income 2	1.907	0.338	0.000	6.732	1.465	0.248	0.000	4.329
Family annual income 3	0.575	0.300	0.056	1.776	0.476	0.199	0.017	1.610
Family annual income 4	-0.779	0.502	0.121	0.459	-0.288	0.278	0.750	0.750
Ordinary farmers								
independent variable	Clean type				General type			
	B	S.E	Sig.	Exp(B)	B	S.E	Sig.	Exp(B)
Constant	-4.355	0.148	0.000		-3.048	0.079	0.000	
Age of household head	0.014	0.001	0.000	1.014	0.011	0.001	0.000	1.011
Number of family members	-0.088	0.005	0.000	0.915	0.016	0.004	0.000	1.016
Education Level 1	1.713	0.148	0.000	5.546	1.205	0.080	0.000	3.336
Education Level 2	1.430	0.144	0.000	4.180	1.045	0.076	0.000	2.842
Education Level 3	0.944	0.143	0.000	2.570	0.649	0.075	0.000	1.913
Educational attainment 4	0.443	0.150	0.000	1.557	0.280	0.080	0.000	1.323
Family annual income 1	2.151	0.034	0.000	8.594	1.753	0.024	0.000	5.769
Family annual income 2	2.386	0.067	0.000	10.867	2.395	0.050	0.000	10.966
Family annual income 3	1.146	0.031	0.000	3.146	1.234	0.019	0.000	3.436
Family annual income 4	1.349	0.028	0.000	3.855	1.382	0.019	0.000	3.983

From the perspective of farmers above the scale, first of all, income is the main factor affecting farmers' choice of energy varieties. Secondly, among the farmers who choose clean energy, only the "low-income group" and "middle-low-income group" show the significance of choosing energy

varieties, and with the increase of income, the probability of choosing clean energy will gradually increase. Thirdly, among the farmers who choose general energy types, only the “middle-low income group” and “middle income group” farmers show the significance of the dependent variable, and with the increase of income, the probability of selecting general energy is greater. The reason may be that farmers are the same as ordinary residents, they are “rational economic people”, and they will maximize the utility of consumption according to their own preferences and market prices under certain conditions of income. However, according to the theory of Maslow’s demand, we must first guarantee Because of their own physiological needs, farmers below the “middle income group” have a significant impact.

From the perspective of ordinary farmers, first of all, all independent variables have a significant degree of significant influence on the dependent variables. Secondly, the number coefficient of households with clean energy households is negative, indicating that for each additional unit of household members, farmers are more willing to choose conventional energy sources; and as the age of the head of household increases or the level of education increases or family income increases, Both increase the probability that farmers will choose clean energy. Finally, all the independent variable coefficients of farmers who choose general energy are positive, indicating that if the independent variable increases or decreases by one unit, the ratio of the probability of farmers choosing general energy to the probability of choosing polluting energy will increase or decrease accordingly. The reason may be that with the increase of age, the increase of personal knowledge and the change of thinking flexibility offset each other, which ultimately leads to the fact that age has little influence on farmers' energy choice. According to environmental psychology, energy consumption, as a social behavior, will be affected by social culture, social relations, lifestyle and so on.

4. Conclusions and Recommendations

4.1 Conclusion

1) Non-clean energy is still the first choice for most farmers

Whether it is farmers above the scale or ordinary farmers, their daily energy consumption is mainly based on polluting non-clean energy. According to the census data, 45.42% of the household energy consumption of above-scale farmers is non-clean energy, and the proportion of ordinary farmers is 58.8%. The above households' clean energy use accounted for 13.81%, which was 3.6 percentage points higher than that of ordinary farmers.

2) Income is the main factor affecting the choice of energy products for farmers above designated size. Income and education level of heads of households are the main factors affecting the choice of energy choices for ordinary farmers

With the increase of income, the probability of selecting environmentally friendly energy sources will gradually increase. And as incomes increase, even if there is no choice of clean energy, the probability of choosing a combination of energy types (a combination of clean and non-clean energy) will increase. In addition to income, the choice of energy varieties of ordinary farmers is also significantly affected by the age of household heads and the level of education. With the increase of household heads' age, the probability of household choosing clean energy will increase significantly.

4.2 Proposal

1) Constructing a complementary supply system of clean energy, implementing energy subsidies, and reducing the cost of using clean energy for farmers

Sichuan Province should rely on the advantages of "National Clean Energy Demonstration Province". On the one hand, it should accelerate the construction of a complementary supply system of clean energy, plan and build wind and photovoltaic power generation bases, and form a modern power system with water, wind and solar complementary operation. At the same time, we should speed up the exploration, development and utilization of conventional natural gas, vigorously

develop unconventional natural gas resources, build a modern energy system with renewable energy and natural gas utilization as the main sources, and strive for more opportunities for farmers to use clean energy. Accelerate the implementation of the policy of “returning coal with electricity and replacing electricity with electricity” to minimize the emission of polluting gases; on the other hand, provide additional subsidies to farmers using clean energy to reduce the cost of clean energy use.

2) Strengthen policy propaganda, improve the cultural and educational level of farmers, and increase farmers' awareness of environmental protection

First, conduct environmental knowledge education through local TV stations or public information resources channels, popularize the benefits of using clean energy and the disadvantages of using polluting energy, and let farmers know the country's policy of benefiting people on the issue of clean energy use; Secondly, we should implement the requirement of improving the educational level in areas with weak educational foundation and low popularization level in Sichuan Province's Higher Education Popularization Plan (2017-2020) issued by the Ministry of Education, so as to improve the educational level of farmers as a whole. Finally, combined with the precise poverty alleviation policy, one-on-one poverty alleviation staff will serve as a preacher to promote the use of clean energy by farmers, and implement the provincial government's policies to each farmer.

3) Increasing the Income of Farmers and Making Farmers Choose Clean Energy as Much as possible

Firstly, we should improve the system and mechanism of land transfer to promote the large-scale industrialization of agriculture; secondly, we should encourage farmers to start businesses and give strong support from personnel training, tax certification, land construction and other aspects. The third is to promote the development of rural one, two, and three industries, and promote the employment of farmers; the fourth is to cultivate new types of professional farmers, continuously strengthen the vocational training of new professional farmers, tap the potential of modern agriculture to increase income, broaden the channels for increasing income of professional farmers, and ensure the income of professional farmers.

4) Strengthen regional management, comprehensively grasp local endowments, and develop and utilize clean energy according to local conditions

There are great differences in resource conditions among different regions of the province, so different energy measures should be implemented. The western mountainous areas should vigorously build solar photovoltaic power stations to promote the use of solar energy by each household to meet the daily production needs; In western Sichuan and other regions, it is possible to advocate the recycling of resources, mainly using clean energy such as biogas or firewood (including straw), and to build a large-scale biogas digesters in a government-led manner for use by farmers in the contiguous areas.

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