Can the improvement of individual well-being predict rural residents’ choice of green cooking energy consumption? -- Evidence from CFPS 2016

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Abstract. Based on the data of CFPS2016, this paper used binary Logistic regression model and coefficient of variation weighting method to weight the subjective and objective dimensions of individual well-being, and discussed the impact of subjective and objective well-being of rural residents on green cooking energy consumption. The study found that:(1) The increase of Nagelkerke $R^2$ reached 51.2% after adding the subjective and objective well-being variable, which indicates that well-being is of great significance in explaining rural residents’ green cooking energy consumption behaviour.(2) The subjective well-being and objective well-being of rural populations have a significant positive predictive role in green cooking energy consumption.(3) The variation coefficient of rural residents’ subjective environmental attitudes is the highest, indicating that there is a large difference in the level of environmental attitudes among rural groups. Subsequent governments should take it as an important point to guide the improvement of the overall level of rural residents’ environmental attitudes.(4) The demographic factors, gender, age and region of rural residents have significant influence on the choice of green cooking energy consumption. The above research is helpful to understand the influencing factors of rural residents’ green cooking energy consumption behaviour from the perspective of consumers, enrich academic literature in related fields, and provide reference for other green energy consumption behaviours of rural residents in China.

1. Introduction

It is widely believed that solid fuels, including coal and firewood, are widely used in rural China, emitting large amounts of air pollution and climate pollution components [1]. According to in the Third National Agricultural Census Data Bulletin, 45% (103 million households) of rural residents in
China still use firewood, straw and coal as their main cooking fuels [2]. The literature on energy efficiency based on the green perspective also found that there was a large amount of carbon dioxide gas in solid combustion products, which could not be ignored [3]. Despite the many energy measures adopted by the State in recent years, mainly concentrated in the industrial energy sector, the contribution of residential solid fuel combustion to environmental pollution has been largely neglected for a long time [4][5]. Therefore, understanding the influence factors of residential energy consumption will help to guide the consumption behaviour of rural residents, thus optimizing the energy consumption structure. At the same time, it is important for the government to formulate targeted energy policies.

The historical study on the influence of rural household cooking energy consumption mainly focuses on demographic variables, such as gender, income, education, family size and so on, which constitute [6][7], lacking social and psychological factors. Individual well-being, as a multi-dimensional comprehensive indicator related to people's life state, perception and emotion, reflects the integration of the overall quality of life of consumers' micro individuals [8]. At present, the relationship between well-being and ecological environment has attracted global in-depth investigation. The main focus is to explore the relationship between ecosystem services and well-being, while the research on the relationship between well-being and consumption is less [9]. From the perspective of micro survey data, it is found that the quantity and type of energy consumption in rural areas are not well recorded. The existing research is mostly based on the small-scale village or provincial data collection method [6], the representative and obedient research results are deficient. Therefore, this paper takes rural residents as the research object, using the national family follow-up data (CFPS [10]), introduces the use of rural cooking energy in detail. Meanwhile, This paper analyzes the subjective and objective dimensions of personal well-being by using the method of variation coefficient weighting, and discusses the impact of the subjective and objective well-being level of rural residents on the prediction of cooking green energy consumption behavior, in order to have a deeper understanding of the characteristics of energy consumption behavior of rural residents in China and provide guidance for the formulation of energy consumption guidance policies of rural residents.

2. Literature review and research hypothesis

The MA1 considers that individual well-being mainly includes: of the minimum material standards, freedom and choice, health and physical well-being, good social relations, safety, comfort and spiritual experience required for a good life [11]. At present, the definition of well-being is defined by the definition of well-being from the perspective of subjectivity and objectivity, which reflects both the state of being satisfied under the present objective conditions and the degree of feeling of people. Subjective well-being refers to the sensory pleasure and pain, spiritual pleasure and pain resulting from the satisfaction of needs, including the experience of overall satisfaction with life, as well as the experience of positive or negative emotions in the environment. Objective well-being refers to the degree to which objective capital is used to satisfy various human needs, such as income, health and other dimensions [12].

This study explored the impact of well-being on energy consumption behavior of green cooking. Environmental improvement and the level of living well-being of the residents are mutually reinforcing, increasing the protection of the ecosystem, so as to make more environmental friendly behavior [9]. The satisfaction of income and health as the most basic needs of the population is the level of objective well-being we have focused on. Existing studies generally believe that the income level of consumers is positively correlated with the demand for environmental quality, and high-income groups tend to have more urgent demands for the well-being of the ecological environment and tend to be more inclined to green and friendly consumption behaviors [13]. Residents 'concern about health risks is positive for predicting green energy consumption transformation [1]. Life satisfaction and subjective environmental attitude are important indicators of subjective well-being.

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There is a certain correlation between life satisfaction and further environment-friendly consumer behavior, that is, the satisfaction of subjective well-being needs, which stimulates consumers to further make environment-friendly behavior [14]. Environmental attitudes strongly affect residents' green energy consumption behavior, that is, positive environmental attitudes can promote residents to better implement green energy consumption of environmental friendly behavior [15].

Studies show that demographic factors (age, gender, region, etc.) have an impact on rural residents' cooking energy consumption. For example, older residents have habits that discourage environmentally friendly energy consumption [16]. Regional and gender differences affect the implementation of environmentally friendly behaviors [6].

According to the literature review, the following research assumptions are proposed:

H1: Under the control of other variables, the improvement of the subjective well-being of rural residents has a direct positive effect on the prediction of green cooking energy consumption.

H2: Under the control of other variables, the improvement of the objective well-being of rural residents has a direct positive effect on the prediction of green cooking energy consumption.

3. Research method

3.1. Data source

The data source of this paper is the follow-up survey of Chinese residents in 2016 (China Family Panel Studies, CFPS2), which is based on the data of residents, residents’ relationships and adult questionnaires. After excluding some missing values, the total number of samples is 7032.

3.2. Variables and measurements

3.2.1. Interpreted variable. The choice of rural residents’ green cooking energy consumption is taken as the Interpreted variable. According to China's official recognition of clean energy [17]. Re-assignment of variables, firewood and coal belong to non-green energy, assignment value is 0. Canned gas/liquefied gas, natural gas/pipeline gas, solar energy/biogas and electricity are green energy sources with an assigned value of 1.

3.2.2. Core explanatory variables. Individual well-being is an explanatory variable, which can be divided into subjective well-being and objective well-being. Reference to Guangjie Mu's individual well-being Model from the Perspective of Quality of Life [18]. Subjective well-being mainly uses the method of questionnaire survey to measure individual happiness, happiness and similar feelings [9], including life satisfaction, subjective environmental attitude and other factors. Objective well-being mainly uses measurable social or economic indicators to reflect the extent to which human needs are met, including disposable income per capita, health and other factors.

For the measurement of individual well-being of rural residents in this study, the weighting method of variation coefficient [19] was adopted to assign weight to each indicator. The formula is as follows:

\[ V_i = \frac{p_i}{\bar{X}_i} \quad (i = 1, 2 \ldots n) \]  

\[ W_i = \frac{V_i}{\sum_{i=1}^{n} V_i} \]  

\( V_i \) is the variation coefficient. \( p_i \) is the standard deviation, \( \bar{X}_i \) is the indicator average, and \( W_i \) is the objective weight coefficient.

In the text, Table 1 shows the objective empowerment results of individual well-being indicators of rural residents. The variation coefficient of subjective environmental attitude is the highest, which

\(^2\) CFPS is a nationally representative and large-scale sample size, covering the population of 25 provinces/cities/autonomous regions in China except Hong Kong, Macao, Taiwan, Xinxiang, Tibet, Qinghai, Inner Mongolia, Ningxia and Hainan
indicates that there is a large difference in the level of environmental attitude in rural groups, and it should be an important point to guide the improvement of the overall level of environmental attitude of rural residents.

3.2.3. Control variable. The control variables are Social demographic factors and are set as follows: Gender (male = 1, female = 0); Marital status (unmarried = 1, married = 0); Education level (Primary school and below = 1, Junior-senior high school = 2, University and above = 3); Family size (The number of people who often eat with the stove); Geographical regions (In the eastern region = 1, In the central region = 2, In the northeast region = 3, In the western region = 4).

Table 1. The objective empowerment by the method of variation coefficient.

| Individual well-being | Subjective well-being | Objective welfare |
|----------------------|-----------------------|------------------|
| Indicator            | Life satisfaction     | Subjective environmental attitude | Health | Per capita disposable income |
| Standard deviation   | 1.12                  | 2.76             | 0.63   | 1.43                      |
| Average value        | 3.64                  | 5.80             | 1.72   | 3.27                      |
| Coefficient of variation | 0.31                | 0.48             | 0.37   | 0.44                      |
| Weight               | 19%                   | 30%              | 23%    | 28%                       |

Table 2. Statistics of variables.

| Variable Name                          | Overall Sample | Average value | Standard deviation | Minimum Value | Maximum value |
|----------------------------------------|----------------|---------------|--------------------|---------------|---------------|
| Interpreted variable:                  |                |               |                    |               |               |
| The choice of rural residents’ green cooking energy consumption | 7032           | 0.57          | 0.50               | 0             | 1             |
| Core explanatory variable:             |                |               |                    |               |               |
| Subjective well-being                  | 7032           | 2.43          | 0.84               | 0.19          | 3.95          |
| Objective welfare                      | 7032           | 1.31          | 0.43               | 0.51          | 2.09          |
| Control variable:                      |                |               |                    |               |               |
| Gender                                 | 7032           | 0.60          | 0.49               | 0             | 1             |
| Marital status                         | 7032           | 0.05          | 0.22               | 0             | 1             |
| Level of education                     | 7032           | 1.40          | 0.53               | 1             | 3             |
| Age                                    | 7032           | 54.11         | 13.11              | 16            | 95            |
| Family size                            | 7032           | 3.98          | 1.95               | 1             | 19            |
| Geographical regions                   | 7032           | 2.35          | 1.19               | 1             | 4             |

4. Research results

4.1. Descriptive discovery

In the text, Table 3 shows the proportion of rural residents choosing non-green cooking energy is higher than the national average of 32%. Further open the analysis, found in the cooking energy consumption: the firewood grass proportion is 40%, coal is 6%. It further indicates that in the rural community, although the energy is relatively diversified at present, firewood is still the main source of cooking energy for residents. In addition, it is not difficult to find that women are more likely to choose green cooking energy consumption than men. Rural residents in eastern and central China are
more likely to choose green cooking energy consumption than rural residents in northeast and northwest China.

Table 3. The choice and distribution of green cooking energy consumption of rural residents.

| Category               | Entirety | Gender | Region          |
|------------------------|----------|--------|-----------------|
|                        |          | Female | Male | Eastern | Central | Northeast | Western |
| Green cooking energy   | 57.20%   | 63.20% | 58.50% | 74.30% | 55.70% | 45.20% | 44.20% |
| Non-green cooking      | 42.80%a  | 36.80% | 41.50% | 25.70% | 44.30% | 54.80% | 55.80% |
| energyb                |          |        |       |         |         |         |         |

Notes: among the non-green cooking energy consumption, firewood accounts for 40% and coal accounts for 6%.

4.2. Regression results
In the text, Table 4 shows the result of regression model. Model 2, based on model 1, explains that variables are added to subjective well-being and objective well-being. Nagelkerke R² rose from 0.129 to 0.195, an increase of 51.2%. At the same time, the percentage of model prediction has also increased, that is, the full sample model has the best interpretation significance for predicting rural residents’ green cooking energy consumption. We found that subjective well-being and objective well-being have a positive predictive effect on green cooking energy consumption behavior. That is, for every 1 point increase in the comprehensive subjective well-being score, the predicted energy consumption behavior of green cooking will increase by 0.060 points. Hypothesis H1 validation is valid. For every 1 point increase in the comprehensive objective well-being score, the energy consumption behavior of green cooking is predicted to increase by 0.536 points. Hypothesis H2 validation is valid. It was also found that the younger the female group, the more predictable the choice of green cooking energy consumption. Geographically, the eastern and central regions with a higher degree of economic development are more likely to implement green cooking energy consumption.

Table 4. A full sample model based on binary regressionb

| Variable Name                        | Model 1 |        |        |
|--------------------------------------|---------|--------|--------|
|                                      | β       | Exp (β) | β      | Exp (β) |
| Subjective well-being                |         | 0.060** | 1.062  |
| Objective well-being                 |         | 0.536*** | 1.710  |
| Control variable:                    |         |        |        |
| Gender (female)                      | 0.219*** | 1.245  | 0.250*** | 1.284  |
| Marital status (married)             | 0.257**  | 1.293  | 0.147  | 1.158  |
| Age                                  | -0.209*** | 0.811  | -0.108*** | 0.898  |
| Level of education (University and above) |        |        |        |
| Primary school and below             | -0.586*** | 0.557  | -0.245  | 0.783  |
| Junior-senior high school            | -0.013  | 0.987  | 0.174  | 1.190  |
| Family size                          | -0.049*  | 0.953  | -0.006  | 0.994  |
| Geographical regions (In the western region) |        |        |        |
| In the eastern region                 | 1.288*** | 3.627  | 1.118*** | 3.058  |
| In the central region                 | 0.446*** | 1.562  | 0.368*** | 1.445  |
| In the northeast region               | -0.031  | 0.969  | -0.151* | 0.860  |
| Constant                             | -0.166  | 0.847  | -0.327  | 0.721  |
| -2 Log Likelihood                    | 8892.757 |        | 8498.648 |        |
| Nagelkerke R²                         | 0.129  |        | 0.195  |        |
| Correct percentage of forecast       | 64.20%  |        | 66.50%  |        |
| N                                   | 7032    |        | 7032    |        |

Notes: a, *, **, and *** indicate the significant levels of 10%, 5%, and 1%, respectively.

b All variables have been standardized by Z.
5. Conclusions and implications
The empirical results show that rural households have achieved the coexistence of traditional energy and modern energy, but firewood is still the main cooking fuel for rural residents, and there is still a gap between the upgrading of green energy consumption. When the individual well-being variable is added, Nagelkerke R² increases by 51.2%, indicating that the individual well-being plays an important role in explaining the green cooking energy consumption behavior of rural residents. The variation coefficient of rural residents' subjective environmental attitude is the highest, which indicates that we should pay more attention to the improvement of rural residents' overall environmental attitude. The results also verify that the improvement of the subjective and objective well-being of rural residents has a positive impact on the prediction of green cooking energy consumption behavior. Objective well-being, as the most basic demand satisfaction of consumers, has a greater coefficient to explain the prediction of green cooking energy consumption, that is, with the further satisfaction of per capita income and health needs, it has a positive impact on the prediction of green cooking energy consumption. As the need for well-being is further satisfied, consumers will focus on the higher level of demand satisfaction. That is, the increase of subjective environmental attitude and life satisfaction has a positive impact on the prediction of green cooking energy consumption.

The study also found that the three demographic variables of gender, age and geographical regions have significant influence on the prediction of green cooking energy consumption. The female group is more likely to implement the green cooking energy consumption than the male group. The younger the more easily to implement the green cooking energy consumption behavior. Geographically, developed regions are more likely to implement green cooking energy consumption than poor regions.

The research conclusion has the following enlightenment to guide the rational green cooking energy consumption of rural residents: (1) Enhancing education and risk communication. The negative health impact of rural residents' solid fuel consumption has long been neglected. Mass media channels should be used to increase publicity, raise awareness of environmental hazards, stimulate people's awareness of health, and give full play to the subjective initiative of the people, encourage consumers to change their unhealthy patterns of consumption. (2) In the management of civilian energy consumption, we should give full play to the positive influence of female groups in green consumption. Carry out learning activities on the advantages of green energy in the community, encourage and drive older elderly groups that are not easy to produce green energy consumption, and advocate low-carbon green lifestyle. (3) The government should pay attention to geographical differences during policy guidance. For the more developed regions in the eastern and central regions, we should pay more attention to the requirement satisfaction of the emotional value level. And for the western and northeast areas, it is mainly to strengthen the economic incentive policy, to meet the needs of the consumer base.

6. Limitations and future research
The empirical study is primarily of an exploratory nature, focusing on the investigation of the actual behavior of green cooking energy consumption, and does not measure the intention of rural residents to actually choose green cooking energy. However, the relationship between behavioral intention and behavior is often stronger than that between behavioral intention and attitude [20]. Future research should add some psychological research, join some research on consumers' mindsets, and further clarify the internal relationship between consumer green behavior and individual well-being, and thus better boost the development of green society.

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