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Research Article

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Analysis on rural residents' knowledge of and attitudes toward forestry biomass energy in China

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ABSTRACT

The study investigated rural residents' knowledge of and attitudes toward forestry biomass energy by questionnaires and interviews, and took solid biomass fuel as an example, so as to explore barriers for rural residents to use this kind of renewable energy. To our knowledge, this is the first research to merge pro-environment attitudes theory with work on forestry biomass energy in China, and it will contribute to the development of forestry biomass energy industry. The results of descriptive statistics revealed that rural residents merely had primary knowledge of forestry biomass energy due to lack of opportunities to learn such knowledge, but their attitudes was positive as a whole, despite of uncertain purchase attitude. According to further investigation, two most important aspects to use of household energy were convenience and habit, and economic consideration also exerted important influence on purchase decision. In order to promote the application of forestry biomass energy among rural residents, the following intervention measures were put forward. The government should provide financial support for customers and enterprises, and strengthen dissemination of environment knowledge; marketers need to devise marketing mixes that convince rural residents that using solid biomass fuel is really easy and beneficial to self and society; enterprises also could adopt integration strategies to provide convenience, thrift, and feeling of familiar.

Keywords: Forestry biomass energy, Solid biomass fuel, Purchase attitude, Pro-environment purchase behavior, Rural residents.

INTRODUCTION

To cope with the environment crisis, utilization of forestry biomass energy has emerged as an important strategy for protecting ecological environment in China. In recent years, the average annual growth rate of renewable energy has been beyond 25%, whereas the development of forestry biomass energy obviously lags behind [1]. In some extent, this phenomenon could be attributed to inadequate consumption, which means that lack of demand hinders the development of forestry biomass energy industry. Generally, there are two customer categories that consume forestry biomass energy, namely resident customers and organization clients. The current research is focused on the former customer category through exploring the rural residents' knowledge of and attitudes toward forestry biomass energy.

According to the physical attribute, forestry biomass energy products could be divided into 3 categories, including solid product, liquid product, and gas product, and solid product has a more close relationship with resident customers, which mainly refers to biomass solid fuel. Therefore, we first investigated the rural residents' knowledge of forestry biomass energy and then examined attitudes toward biomass solid fuel so as to find out knowledge of and feeling about this kind of renewable energy product. Biomass solid fuel refers to fuel with certain shape and density that is manufactured by compressing original loose, raw materials with no fixed shape, such as waste crop straw, peanut shells, branches and bark, and sawdust etc, through the method of mechanical high-pressure with or without heating [2]. Because of its energy-saving, emission reduction, renewable and other characteristics, biomass solid fuel is a promising alternative energy product, compared with fossil energy product. For rural residents, biomass

solid fuel has much more advantages compared with firewood or coal, including increasing the heat efficiency of agricultural or forestry waste, reducing the waste of resources and the indoor environment pollution, improving the living environment, and saving on energy expenditures. Due to large population distributing in rural area in China, widely use of biomass solid fuel among rural residents will accelerate the development of forestry biomass industry and be benefit to alleviate the energy crisis. The purpose of this study is to investigate rural residents' cognition and attitudes to forestry biomass energy product, mainly about biomass solid fuel, and put forward intervention measures to promote the development of forestry biomass energy industry.

Theoretical Background

As an emerging important issue, some domestic scholars analyze forestry biomass energy industry from macro perspective, such as forestry biomass resource exploitation, supply, manufacture and distribution [3], but studies that are conducted from micro perspective, just like this research, are really few. To our knowledge, this is the first research to merge pro-environment attitudes theory with work on forestry biomass energy in China. The following analysis is a brief literature review about pro-environmental attitudes and behavior.

As alternative product of fossil energy, purchase or consuming forestry biomass energy product is a kind of green consumption, due to its emission reduction. In other words, the adoption of forestry biomass energy product could be attributed to the pro-environment attitude or value. Many studies had pointed out that people with strong pro-environmental attitudes were more likely to engage in pro-environmental behavior, yet the relationship between attitudes and actions was still inconclusive [4]. Chan examined the influence of various cultural and psychological factors on the green purchase behavior of Chinese consumers, and found out that ecological knowledge had a positive effect on attitudes toward green purchase, and in turn, attitudes were also seen affect green purchase behavior [5]. Liu et al. applied path analysis to analyze green purchase of Chinese citizens, and found out that attitudes had a significant influential on behavior of green purchase via the mediator of green purchase intention [6].

Meanwhile, we noticed that "attitude-behavior gap" had been well documented in the pro-environment behavior literature, which indicated that influence factors of green purchase were very complicated. Stern pointed out, different causal factors appeared to work different ways in influencing behavior, and had interaction influence [7]. For example, studies that only examined attitudes found inconsistent effects, since the effects may be contingent on individual capabilities, including environment knowledge or knowledge of action. Although such knowledge has very limited explanatory power for many pro-environment behaviors [8], they may be important for particular green purchase behavior. As alternative product of traditional energy, knowledge about raw material, product category, and function of forestry biomass energy may play a very important role for potential customers to stir up purchase intention. Based on the above-mentioned analysis, the current study investigated rural residents' knowledge of and attitudes toward forestry biomass energy.

EXPERIMENTAL SECTION

Questionnaire design

Based on extant research literature, we set up a pool of items, and selected 21 items which had passed the evaluation of three scholars to measure different dimensions about knowledge of and attitudes toward forestry biomass energy. Then, we interviewed with five rural residents to make a pretest, in order to find out any ambiguity or other difficulties they felt in responding to those scale items. After that, modifications, supplement and elimination of items were conducted so as to make the meaning of items clear. At last, 17 items were selected, among which 8 items were relate to three knowledge dimensions, and 9 items were relate to three attitudes dimensions. Knowledge includes 3 dimensions, namely raw material knowledge, products knowledge and functional knowledge, and attitudes dimensions comprise consist of environment friendly attitude, purchase attitude and prospect attitude. Those items are measured on a 5-point Likert scale from 1=totally disagree to 5=totally agree. In additional, household energy preference is also measured on a 5-point Likert option from 1=totally not important to 5=totally important.

Samples

Since the development of forestry biomass energy industry in China is sill in the early stage and the concept of solid biomass energy is unfamiliar to the majority of rural residents, we decided to carry out investigation in the district where forestry biomass energy industry develops relatively well and Jianning county, which is located in southeast of China and belongs to Fujian province, was selected at last. In Jianning, there is a vast soapberry planting base, about 20 thousand hectare, and the local government devotes a great deal of efforts to push forward the exploitation and application of forestry biomass energy product.

During the summer holiday in 2012, the questionnaire investigation was implemented in Jianning. According to the convenience principle, 137 respondents from 10 villages were surveyed. Investigators were introduced to villagers by the village officer, after that they entered into villagers' house to explain the purpose of investigation, then start interview, and at last give the respondents small gifts that value 2.5 dollars for their cooperation. The number of valid questionnaires was 120, and the effective rate of the questionnaires was 87.6%.The respondents whose age were between 20-39, 40-59, and older than 59 years old, were respectively accounted for 18.3%, 69.2%, and 14.7% of all the samples. And there were only 27 rural residents who sometimes left their villages to find a job as migrant workers, accounting for 22.5% of the total respondents, and other respondents mainly made a living on their land. Therefore, the distribution of samples primarily reflects knowledge of and attitudes toward forestry biomass energy of those rural residents, who was older than 40 years and lived life in the village.

Data Analysis

In the current study, descriptive statistics method and qualitative approach were combined. In order to perform accurate descriptive analysis, the reliability of the questionnaire was tested. First, we purified items by reliability analysis according to the criterion of Cronbach's alpha. The item should be omitted if item-total correlation<0.4 and Cronbach's alpha will increase if the item is deleted. After this procedure, we found no item need to be deleted. Therefore, the number of items still remains 17. Second, we further undertook detail reliability analysis toward items of knowledge and attitudes. Table 1 shows the results of reliability analysis.

Table -1 Results of reliability analysis

Factor	Internal consistency reliability		Cronbach's alpha of the subscale	Cronbach's alpha of the scale
Knowledge of forestry biomass energy	Raw material knowledge	0.672	0.702	0.761
	Product knowledge	0.626		
	Functional knowledge	0.635		
Attitudes toward forestry biomass energy	Environment friendly attitude	0.719	0.735	
	Purchase attitude	0.641		
	Prospect attitude	0.652		

In this study, Cronbach's alpha was also used to examine the internal consistence of different items that belongs to the same dimension. Generally, the value of Cronbach's alpha ≥ 0.5 means acceptance, ≥ 0.7 means reliable, and ≥ 0.9 means very reliable [9]. Table 1 shows that each dimension's value of internal consistency reliability is above 0.6, both subscales' and scale's value of Cronbach's alpha were above 0.7. So, we could draw the conclusion that the scale and subscales had enough reliability. Meanwhile, the content validity of the scale passed through the test by qualitative judgments of 4 experts, including three scholars and one practice expert. Then, we could measure knowledge of and attitudes toward forestry biomass energy by the scale.

Knowledge of forestry biomass energy

As a composite factor in this study, knowledge of forestry biomass energy consists of three dimensions, namely raw material knowledge, product knowledge and functional knowledge, and is measured through 8 items. According to testing results, the score of functional knowledge was lowest among three dimensions, only getting 2.66. It means that respondents' functional knowledge was unclear, even a little below the level of uncertain. The reason was that the most of respondents didn't know whether forestry biomass energy could provide power for vehicles and be applied to generate electricity. The score of product knowledge was 2.95, close to the level of uncertain, while its standard deviation was 0.99, meaning the large variance. The most familiar part for respondents in three dimensions was about raw material knowledge, whose mean value was 3.29, above the level of uncertain but far from clear. The mean value of knowledge as a factor was 2.96. Table 2 shows the mean value and standard deviation of knowledge of forestry biomass energy.

Table -2 Mean value of knowledge about forestry biomass energy

Dimensions	N	Mean	Std. Deviation
Raw material knowledge	120	3.29	0.78
Product knowledge	120	2.95	0.99
Functional knowledge	120	2.66	0.92

Based on the interview, we found that there were few opportunities for most of respondents to learn such knowledge and most of them never used any product of forestry biomass energy, although minority rural residents, about 15% of respondents, took part in planting energy forestry. Chen Kaishun, a 52 years old respondent, said that he knew waste crop straw, branches and bark, and residues of timber-derived materials could be the raw material of forestry biomass energy from his son, who worked at the local township enterprise that belongs to forestry biomass energy industry, and those respondents who had similar work experience knew it better than him. Therefore, the mean value

of raw material knowledge was highest among three dimensions, due to the direct work experience or the knowledge dissemination among relatives and friends.

During the process of interview, the most frequently mentioned product of forestry biomass energy was biomass solid fuel, and very few respondents knew about biodiesel and biomass gas, not to mention their function. In fact, there are two biomass solid fuel manufactories in Jianning, not far away from those villages that respondents lived in, and they exhibited some degree of interest when talked about this kind of product, because of familiarity. Almost 60% of respondents heard of the biomass solid fuel, a few of them ever provided waste crop straw or branches and bark to manufactories as raw material. Although they knew biomass solid fuel's raw material in some extent, none of them ever used solid biomass fuel in their daily lives for lack of product knowledge, function knowledge, and lack of utensil, a kind of special stoves. In general, according to mean value of three dimensions of knowledge, we could argue that rural residents' knowledge of forestry biomass energy was obviously insufficient, and should be improved through education.

Attitudes toward solid biomass fuel

Similar to knowledge of forestry biomass energy, attitudes toward solid biomass energy are also composed of three dimensions, including environment friendly attitude, purchase attitude and prospect attitude. Environment friendly attitude refers to the influence of products exerted on environment, and prospect attitude refers to the future development of solid biomass energy. As mentioned previously, we took solid biomass fuel as an example in interview, because of easy understanding. Table 3 shows the mean value and standard deviation of attitudes.

Table -3 Mean value of attitudes toward solid biomass fuel

Dimensions	N	Mean	Std. Deviation
Environment friendly attitude	120	3.78	0.87
Purchase attitude	120	2.92	1.13
Prospect attitude	120	3.72	0.76

Among three dimensions, we were most concerned with purchase attitude, which had been shown to exert positive influence on the purchase behavior in many studies. However, not out of our expectations, the mean value of purchase attitude was lowest, only scoring 2.92. And its standard deviation is 1.13, reflecting the large fluctuation of purchase attitude. Meanwhile, the scores of environment friendly attitude and prospect attitude are respectively 3.78 and 3.72, relatively high, indicating favorable feeling of and judgment to solid biomass fuel. The mean value of attitudes as a factor is 3.47, a little higher than uncertain. Based on the above data, we could make a conclusion that the key point to promote the use of solid biomass fuel in rural residents is to enhance purchase attitude. We further analyzed the energy preference of respondents so as to understand how to improve purchase attitude toward solid biomass fuel.

The respondents were asked to evaluate the importance for use of household energy in four aspects, including pro-environment, convenience, habit, and economy, through a 5-point Likert option from 1=totally not important to 5=totally important. Figure 1 shows the results of evaluation.

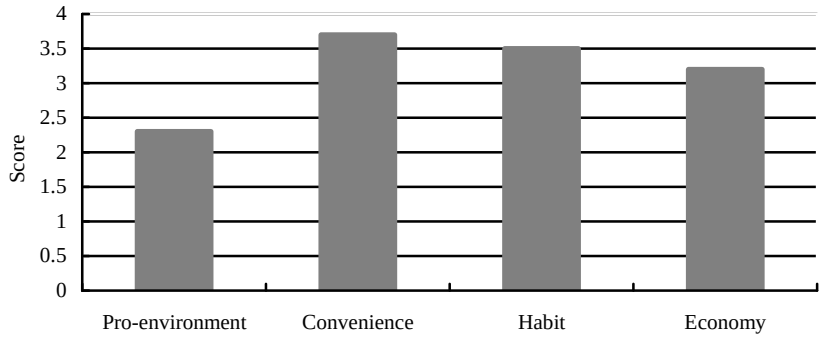

Figure -1 Energy preferences of respondents

Obviously, the most important aspects of household energy for respondents are convenience and habit. In most rural area in China, transportation infrastructure is usually deficiency, and the road condition gets even worse in forestry districts. More than that, rural residents sometimes lived scattered across the village or mountainous area, therefore convenience is really pivotal for them to use household energy. With respect to habit, it also has an important impact on the behavior, since many consuming decisions are made by habit rather than cognitive deliberation [10]. Gao Xun, a 43 years old villager, said that they had been accustomed to use traditional energy such as coal and firewood,

and a few rural residents who lived in suburb area were accustomed to use liquefied gas or electricity as household energy. Although the habit of energy consuming is rooted in heritage and tradition, Gao Xun expressed positive intention to try to use solid biomass fuel as alternative energy, if it was easy to purchase and apply, meanwhile its price should not expensive than that of coal. According to rational assumption, consumers make purchase decisions to maximize self-interest, so economy also plays an important role to apply solid biomass fuel. For pro-environment, most of respondents didn't care much about it, and this situation accorded with the low mean value of purchase attitude.

CONCLUSION

The study examined the rural residents' knowledge of and attitudes toward forestry biomass energy, and took solid biomass fuel as an example in the phase of testing attitudes. We found out that respondents merely had preliminary knowledge about forestry biomass energy, but they showed positive attitudes. In fact, the mean value of attitudes was 3.47, significant above the mean value of knowledge of forestry biomass energy, whose score was only 2.96. The respondents were not familiar with product knowledge and functional knowledge, especially the latter, because they had few opportunities and channels to learn such knowledge. In comparison, they showed more positive attitudes toward solid biomass fuel, especially about its positive effect on environment and future development. Whereas, the purchase attitude was only close to of uncertain, due to the lack of product knowledge. According to our investigation, the most important aspects for use of household energy were convenience and habit. Meanwhile, economy also exerted its important influence on purchase decision, yet pro-environment was relatively ignored. In summary, despite of the respondents' lack of knowledge, their attitudes toward solid biomass fuel were positive as a whole, although their purchase attitude was only ambiguity and needed to be improved.

Suggestions

Research in environmental consumerism has produced different evidence in support of the correlation of knowledge and attitudes with mixed results that support both a positive relationship between knowledge of action and green purchase attitude as well as weak relationships. Anyhow, increasing rural residents' knowledge of forestry biomass energy only will be benefit to lead to more favorable purchase attitude and purchase behavior. Hence, the local government and enterprises should work together to provide convenience and economic incentive, and strengthen the information dissemination among potential customers so as to promote the application of forestry biomass energy. As an emerging industry with environmental benefits, the development of forestry biomass energy industry could not leave support of the government, especially under the business conditions in China. In other words, the government's policy may effectively improve purchase attitude by offering preferential policy, such as financial subsidy. Also, enterprises engaging in forestry biomass energy also could accelerate the process of applying this kind of renewable energy through appropriate strategies, such as integration of industry chain.

It is suggested that the factors drive consumers from positive attitudes to the meaningful purchase behavior are a combination of perceived personal benefits, a sense of control over costs, and decreased perceived risk and uncertain [11]. Consequently, efforts should be taken to combine those factors. In the short term, government policies may play a key role in product diffusion, because subsidies can provide compensation to customers and enterprises, and can further enhance the customers' perceived personal benefits and decrease uncertain. For solid biomass fuel, the government could directly provide financial support to the product price, and also could offer free utensils, namely special stove to use solid biomass fuel, to rural customers. At same time, the government should illustrate the environment crisis, environment knowledge to rural residents to enhance their purchase attitude, because stern pointed out that customers without positive attitudes toward green product would abandon purchase behavior once the economic incentive policy was canceled [7]. In the long term, the boom of forestry biomass energy industry requires scientists and designers to develop better product of forestry biomass energy that eliminate the unattractive attribute tradeoffs that push most rural customers selecting traditional energy, meanwhile enterprises' marketers need to devise marketing mixes that convince rural residents that using solid biomass fuel is really easy and beneficial to self and society.

Besides above suggestions, we also put forward a suggestion from the perspective of industry chain. In order to provide convenience, thrift, and feeling of familiar, enterprises could adopt integration strategies, and the integration path is described as "small-sized production equipment suppliers→ individual manufacturer → rural residents customers". It means that small-sized production equipment suppliers establish strategic alliances with special stove manufacturers, and sell both small -sized biomass solid fuel production equipment and special stoves at low price to rural residents who have rich agricultural and forestry waste material. Then, they could make full use of those materials to manufacture biomass solid fuel to meet their household energy needs in daily life and could sell products to other villagers. In this way, villagers could get products more convenient at low price. In particular, for

rural families that have a great number of relatives, purchasing and using small-sized equipment together, could accelerate the recovery of funds, and get benefits from cost saving.

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