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The Effects of Ecological Public Welfare Jobs on the Usage of Clean Energy by Farmers: Evidence from Tibet Areas—China

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Abstract: In several rural areas of China, ecological public welfare work is an effective way to improve farmers' social participation. This job does not only increase farmers' income but also greatly improves their enthusiasm for ecological environment protection. Under the goal of carbon neutrality in peak carbon dioxide (CO_2) emissions, it is necessary to explore the impact of ecological public welfare jobs on the usage of Clean Energy (CE) in rural areas. Based on the data of 1100 farmers from Tibet areas in China, this paper applied the Ordered Probit model to explore the impact of ecological public welfare jobs on farmers' use of CE. The results are as follows: (1) Holding ecological public welfare jobs can raise farmers' willingness to use CE; (2) Holding ecological public welfare jobs can also promote farmers' use of CE by enhancing their ecological environment cognition and influencing their social behavior; (3) The impact of ecological public welfare work on CE use has regional and income heterogeneities. Firstly, this effect is smaller in mixed pastoral-farming areas than in agricultural and pastoral areas. Secondly, this effect is more obvious in low-income groups. Our study provided several policies aimed at improving rural and environmental development.

Keywords: public welfare jobs; energy consumption; clean energy; social participation

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1. Introduction

In recent years, global climate change (GCC) is a major challenge faced by the international community, and it is profoundly affecting the survival and development of mankind. The Paris Agreement sends a strong signal to promote global green, low-carbon, climate-adaptive, and sustainable development, which indicates that global climate governance has entered a new stage of development [1]. Inefficient energy consumption (EC) and its emissions are the important causes of CC. Therefore, to cope with CC, the global energy structure is undergoing major changes [2]. Countries need to devote themselves to developing clean energy (CE), i.e., gradually seeking avenues to enhance green and sustainable development [3]. As a big developing country and a party to the Paris Agreement, China has also set the corresponding goal of managing local carbon emissions because of the GCC, that is, to achieve peak carbon dioxide (CO_2) emissions by 2030 and carbon neutrality by 2060.

The change in residents' EC behavior and mode is one of the effective ways to achieve the carbon neutral goal of peak CO_2 in China [4]. Rural energy is an important part of China's energy system, and China's rural areas are rich in natural resources. As stated in China's Strategic Plan for Rural Revitalization (CSPRR), it is explicitly required to promote the upgrading of rural energy consumption and greatly increase the proportion of electric energy in rural energy consumption. Improving the level of rural electrification is one of the vital ways to realize the transformation of low-carbon energy in China's rural areas [5]. However, some problems that China's rural energy consumption is currently facing are not conducive to the transformation of rural energy and the realization of carbon neutrality in peak CO_2 in the nation. It is embodied in the following two aspects: First, in the structure of energy consumption, low-grade energy is the main one, and coal and firewood are still the most important energy consumption products for rural residents; Secondly, in the spatial distribution of energy consumption, it has strong regional characteristics. The per capita energy consumption in the Western region is much higher than that in the Eastern and Central regions, and biomass energy is the main energy, while the demand for electricity in the Eastern and Central regions is higher [6].

China's Tibet areas are located in Western China, including Tibet Autonomous Prefecture and Tibet areas in four provinces (Sichuan, Gansu, Qinghai, and Yunnan). Due to its geographical factors, most areas are cold in winter, and there is a great demand for energy consumption. However, the development of Tibet areas is relatively backward, which shows the phenomenon of "energy poverty" in terms of energy infrastructure and energy consumption patterns, thereby leading people to increase their demands on the natural environment, a threat to ecological environment protection [7]. Yang et al.'s [8] research on ethnic areas in China found that ethnic minority families use fuelwood more often than the majority (Han) families. Thus, when looking for alternatives to fuelwood for home cooking and heating, ethnic minority families are more inclined to choose coal over electricity. Moreover, due to the special factor of altitude, the energy consumption in ethnic areas shows certain differences, which is manifested in the fact that straw, livestock manure, and firewood are mainly used in agricultural, pastoral, and mountainous areas and forest areas, respectively. According to the research of Ping et al. [6], the per capita energy consumption of pastoral residents is significantly higher than that of towns, agricultural areas, and farming-pastoral areas, because they live at the highest altitude, and the biomass energy, dominated by livestock manure, accounts for a significant proportion of energy consumption. Similarly, studies on other countries have reached similar views. Katsoulakos et al.'s [9] research on Greece found that altitude is the decisive factor in energy demand, and the heat demand and total energy demand of mountain settlements increased significantly. The annual energy consumption of a typical house with an altitude of 1000 m is 85% higher than the corresponding cost at sea level. Papada et al. [10] quantified the energy demand of Austria, Switzerland, and Northern Italy with the increase in altitude and found that mountainous areas are more vulnerable to energy poverty than lowlands. Therefore, it is of great significance to study the realistic path to promote the transformation of rural energy consumption in Tibet areas of China for comprehensively solving the problems of energy and environment, energy, and rural development in Tibet areas of China.

It will be an interesting process to explore diversified paths to promote cleaner rural energy consumption in Tibet areas of China. From a brand new perspective, this paper is committed to combining the social participation and sustainable development of the relatively poor groups in rural areas and playing a positive role in ecological environmental protection. Ecological commonwealth post will be the focus of this article. Eco-commonwealth jobs come from China's ecological compensation policy in the stage of precision poverty alleviation, similar to the internationally popular payment for ecosystem services (PES), which promotes environmental protection by giving direct or indirect economic compensation to environmentalists [11]. The ecological public welfare post is a compensation scheme for low-income farmers' extra ecological protection work. Farmers can obtain wages and broaden their income channels by providing labor, thus increasing the overall income of farmers' families. Therefore, this policy not only increases farmers' social participation in ecological protection but also enhances their development ability. Studies examining the driving forces of clean energy usage have focused on other factors (e.g., off-farm work, credit, internet) rather than ecological protection jobs, job that give individuals understanding of the environment while increasing their income. We fill this gap using data from China.

This paper explores whether farmers can change their energy consumption patterns after increasing their ecological participation and income. The contributions of this paper are as follows. First, this is a maiden research study to explore the relationship between ecological public welfare jobs and clean energy use. Looking at the benefit of using clean energy and the Chinese government's ability to achieve sustainable environmental development, this study is timely. Second, we tested the role of the farmers' ecological cognition and social welfare performance behavior in the relationship between ecological public welfare jobs and clean energy usage. Finally, unlike other studies, which do not account for the problem of endogeneity, this study considered this problem to prevent inconsistency caused by unobserved and observed heterogeneities in our estimated results.

The remaining parts of this paper are arranged as follows. Section 1.1 is a summary of related research. In Section 1.2, we put forward the theoretical framework and research hypothesis. We introduce the data source, variable definition, and model setting in Section 2 while showing the empirical results analysis in Section 3. Section 4 summarizes the conclusion and discusses the policy implications.

1.1. Literature Review

The "Energy Law of the People's Republic of China (2018)" defines hydropower, nuclear power, natural gas, wind energy, biomass energy, solar energy, geothermal energy, and ocean energy as clean and low-carbon energy. In fact, clean energy induces less pollution [12]. According to the actual situation in the study area, the clean energy used by farmers mainly includes electricity, natural gas, liquefied gas, solar energy, and biogas.

Many studies have highlighted the factors that affect rural residents' energy consumption, including family characteristics, regional characteristics, and policy factors. The factors that influence the family characteristics of farmers' energy consumption mainly include the family income, family size, education level of the head of household, age of the head of household, etc. [13,14]. According to the traditional energy ladder hypothesis, the household energy consumption structure will tend to be low-carbon and clean with increased income [15]. The possible reason is that the traditional biomass energy is mainly collected by the household labor force and is relatively labor-intensive, and the increase of other incomes will increase the opportunity cost of the traditional biomass energy, resulting in a decrease in biomass energy consumption [16]. On the impact of specific energy consumer goods, we argue that the increase in per capita household income will cause an increment in LPG and electricity consumption and reduce the dependence on traditional biomass energy [17]. When excluding the most significant household income variable, it can be found that the per capita energy consumption is negatively correlated with household size when the household income level is equivalent [18]. Additionally, the education level and age of the head of household have a significant positive impact on the energy consumption behavior. The possible explanation is that as the education level and age of the head of household increases, farmers' families have accumulated more knowledge of environmental protection, and their awareness related to environmental protection has also increased, so they are more inclined to use low-carbon and clean energy [19]. Farmers' regional characteristics include: climate difference, market distance, resource endowment, and so on. China's overall geographical and climatic pattern is generally characterized by cold in the North and hot in the South. There are significant differences in the demand for heating in winter between farmers in the North and the South, and farmers' families in the North have a stronger dependence on coal, and it is considered as the most important traditional heat source [20]. Some studies also showed that the distance between the village committee and the county town or bazaar is positively related to the consumption of commercial energy by rural families. Due to the farther distance and the higher costs of commercial energy, the most of rural families choose to use traditional biomass energy [21]. Regional resource endowment also has a significant impact on farmers' energy consumption behavior [22].

Improving the utilization rate of clean energy is a key issue in upgrading energy consumption. The existing research shows that the first is to provide government subsidies.

The experimental results of Tian et al.'s [23] multiple scenario analysis show that local government subsidies can affect household clean energy substitution in various ways. For example, government financial subsidies will encourage low-income people to participate in the adoption and installation of biogas plants [24]. Moreover, to promote the coordination between rural energy upgrading and urbanization, agriculture, and rural lifestyle modernization, it is necessary to formulate corresponding subsidy principles for clean energy projects [25]. Secondly, provide micro-credit to enhance residents' access to clean energy. Studies have shown that, to promote the related systems of clean energy, providing micro-credit can ensure that the country's remote rural areas can obtain more accessible clean energy [26,27]. Finally, promote residents' social participation in the ecological environment. Sha et al. [28] found that social participation has a significant positive impact on villagers' willingness to participate in clean energy supply facilities in villages. Jain et al. [29] believe that social norms can change residents' traditional concept of small farmers, and endogenous development power can grow rapidly, which is conducive to the green and sustainable development of villages.

The key explanatory variable of this paper, the research of ecological public welfare jobs, is based on the related phenomenon of decentralization and residents' social participation. Dash et al.'s [30] empirical research on Indians also proves this view. They found that decentralizing the full property rights of forest resources to local communities may help to ensure their extensive and active participation in the decision-making process, which may lead to positive changes in local people's attitudes towards biodiversity conservation. After consulting the relevant research, no research has been found on the role of ecological public welfare jobs as a kind of social participation in energy consumption. As a long-term policy of China, it is necessary to explore its positive externalities. This is also the marginal contribution that this paper is expected to make.

1.2. Theoretical Framework and Hypotheses

Ecological public welfare post is an important policy and practice innovation in China, aiming at achieving a win-win situation between ecological environment protection and precision poverty alleviation. From the perspective of employment targets, ecological public welfare jobs are aimed at relatively low-income people. Let us note that these farmers need relevant pre-job training before taking up public welfare jobs, which is associated with certain ecological environmental protection responsibilities in the local area, hence bringing about income increases and knowledge acquisition of ecological environment protection [31–34]. Thus, the farmers' energy consumption behavior is positively influenced to a certain extent.

Hypothesis 1 (H1). *Holding ecological public welfare jobs can promote farmers' use of clean energy.*

In the process of holding public welfare jobs, farmers strengthened their awareness of ecological environment protection and improved their cognitive ability of the importance of ecological environment in their study and practice. According to Icek Ajzen's [35] planned behavior theory, behavior intention determines behavior performance, while behavior intention is influenced by attitude (positive or negative feelings of the individual about the behavior), subjective norms (social pressure of the individual about whether to take a particular behavior), and perceived behavior control. To some extent, the enhancement of eco-environmental awareness affects the "attitude" of the employed farmers (which shows that they will pay more attention to the eco-environment), and the certain responsibility of eco-environmental protection affects the "subjective norm" of the employed farmers (which shows that they will pay more attention to their own behavior in the eyes of others), thus affecting the willingness and trend of farmers to change from biomass energy consumption to low-carbon commercial energy and clean energy consumption in their daily lives. The research of Adjakloe et al. and Irfan et al. can strongly prove the above analysis [36,37].

Hypothesis 2a (H2a). *Holding an ecological public welfare post can promote farmers' use of clean energy by enhancing their ecological environment cognition.*

Hypothesis 2b (H2b). *Holding ecological public welfare jobs can promote farmers' use of clean energy by influencing their social behavior.*

China's Tibet territory is vast, with different lifestyles and development situations among regions. The improvement effect of farmers' energy consumption caused by taking ecological public welfare jobs may be heterogeneous. Firstly, the study area can be divided into pure pastoral areas, semi-agricultural and semi-pastoral areas, and pure agricultural areas by their main economic sources and lifestyles. There are big differences in energy consumption among three regions [38]. In traditional energy consumption, livestock manure is mainly used in pastoral areas, firewood is mainly used in semi-agricultural and semi-pastoral areas, and straw is mainly used in agricultural areas. Therefore, we speculate that the effect of taking the ecological public welfare post on energy consumption is heterogeneous among three regions. Secondly, we argued that there exists a heterogenous effect based on household income level when analyzing the relationship between farmers' ecological social welfare job acquisition and clean energy consumption. According to Maslow's demand principle, after the family's physiological needs are better realized by income increase, it will begin to pay attention to security needs. Studies by Ali et al., Behera et al., and Rahut et al. show that using solid fuel as the main energy source for cooking increases the health risks of rural residents [39,40]. Ding et al.'s [41] research also proves that the total household energy consumption and energy efficiency are significantly improved, and the disease rate is reduced due to renewable energy usage and cleaning equipment. Therefore, after meeting the basic physiological needs, farmers will pay attention to their safety in energy consumption and increase their willingness to use low-carbon commercial energy and clean energy. Employment in ecological public welfare jobs brings about the transformative effect of energy consumption, which should be more obvious among low-income people.

Hypothesis 3a (H3a). *The impact of ecological public welfare work on farmers' use of clean energy is different among pastoral areas, mixed pastoral-farming areas, and agricultural areas because of the difference in available traditional energy.*

Hypothesis 3b (H3b). *The impact of ecological public welfare jobs on the use of clean energy by relatively low-income farmers is more pronounced.*

2. Materials and Methods

2.1. Data

The data of this paper was collected from July and August 2021 in Sichuan and Gansu provinces of China based on the survey questionnaires. The selected areas include: Ngawa Tibetan Qiang Autonomous Prefecture and Garzê Tibetan Autonomous Prefecture in Sichuan Province and Gannan Tibetan Autonomous Prefecture in Gansu Province. Ngawa Tibetan Qiang Autonomous Prefecture and Garzê Tibetan Autonomous Prefecture are both located in the west of Sichuan, with vast land and sparsely populated areas. Their population densities are 10 people per km^2 and 8 people per km^2, respectively. Additionally, their urbanization rates are 41.4% and 31.01%, respectively [42]. At present, they are typical agricultural societies, and a large number of people still live in villages. Agricultural activities mainly include planting, breeding, and animal husbandry, but there are regional differences. According to the data of the Third National Land Survey, Ngawa Tibetan Qiang Autonomous Prefecture and Garzê Tibetan Autonomous Prefecture both are two of the "three big forest areas" and "three big pastoral areas" in Sichuan Province, with most of the forest land and grassland areas in the province. The situation in Gannan Tibetan Autonomous Prefecture is similar. Gannan Tibetan Autonomous Prefecture is located in the south of Gansu Province, adjacent to Ngawa Tibetan Qiang Autonomous Prefecture, with a population density of 18 people/km^2 and an urbanization rate of 43.52% [43]. According to the data of the Third National Land Survey, Gannan Prefecture is the largest natural forest area and alpine meadow distribution area in Gansu Province. The study area is rich in natural resources, but its development is relatively backward, and it is a typical ecologically fragile area in China. Therefore, it is necessary to study the ways to promote the harmonious development of human and ecological environment in these similar areas.

The implementation of China's "Three-Year Action Plan for Comprehensively Solving the Electricity Consumption Problem of People Without Electricity" (2013–2015) has solved the problem of electricity supply in all areas of China. Five years after the plan period, the State Grid vigorously developed hydropower, photoelectric, and other projects in the western region. The research area of this paper has also upgraded the power grid, and by 2020, all residents in the area could use stable electricity. At present, these areas are still vigorously developing clean energy projects. The research of this paper is devoted to promoting farmers to use clean energy, which is consistent with the development goal of the region.

The authors used field interviews as a means for the data collection. Additionally, the centralized organization of the village committee and local college students helped us in the data collection process. Our team designed a structured questionnaire, and the team members surveyed and collected the data in face-to-face interviews in their various residences. The survey questionnaires mainly include the personal characteristics of the respondents, the basic characteristics of the family, the basic situation of family income and consumption, and some psychological cognition of the respondents. In fact, most of our respondents were heads of households. The survey area covers 17 counties and 50 townships based on stratified sampling and random sampling. A total of 1200 questionnaires were collected for the study, including 800 in Ganzi Prefecture and Garzê Prefecture and 250 in Gannan Prefecture after applying the multistage sample collection approach. However, after screening, 1100 valid questionnaires were finally employed as our sample size.

2.2. Method

2.2.1. Dependent Variables

The intensity of farmers' clean energy use is the outcome variable of this paper. Existing studies generally measured the energy use structure of farmers by analyzing the total amount of different energy used by farmers or whether they mainly use clean energy in their lives [20,44,45]. However, in the survey, it is difficult to accurately obtain the data on different total energy consumption of the farmers, especially firewood and cow dung. In fact, except for lighting, the farmers in the survey area's energy sources for cooking, heating, and bathing may come from either clean or dirty energies. Therefore, this paper measured the intensity of clean energy used by farmers in these three aspects, i.e., cooking, heating, and bathing. Thus, if the respondent does not use clean energy as a source of energy for any of the aspects (i.e., cooking, heating, and bathing), we assigned 1; if the respondent uses clean energy as a source of energy for one of the aspects, we assigned 2; if the respondent uses clean energy as a source of energy for two of the aspects, we assigned 3; if the respondent uses clean energy as a source of energy for all the three aspects, we assigned 4.

2.2.2. Key Variables

The main independent variable is whether the respondent has undertaken ecological public welfare jobs. The respondents undertaking or who have undertaken ecological public welfare jobs before the survey year take 1 and 0 for otherwise.

2.2.3. Mediator Variables

Ecological Cognition

Respondents' attention to the surrounding ecological environment is selected to measure farmers' cognition of the ecological environment. This variable is an orderly classification variable. The higher the attention, the higher the score (1~5 points).

Social Performance Behavior

Choosing whether the respondent participates in other skills and knowledge training activities organized by villages except for ecological public welfare post training to measure farmers' social performance behavior. If the respondent participated in activities, this variable takes 1 and 0 for otherwise.

2.2.4. Control Variables

Based on the existing prior studies as well as the data we obtained, the related variables at the two levels of the respondent and family characteristics are introduced as control variables [46–48]. In the aspect of the characteristics of the respondent, the control variables of the age and education level of the respondent are introduced; in the aspect of family characteristics, the control variables including family size, family livelihood source, family natural resource endowment, and the altitude of the family house are introduced. Furthermore, to control the impact of environmental differences in different autonomous prefectures, this paper also introduces the virtual variables of autonomous prefectures. In addition, the costs and availability of clean energy also need to be considered. In fact, the research area of this paper is rich in natural resources for power generation, so the main clean energy used is electricity, and the government also encourages to use electricity. The popularity of other clean energy sources is not high, and the subsidy policy has not been formed well. Moreover, the electricity prices of the same autonomous prefecture are consistent. This paper has already controlled the virtual variables of the autonomous prefecture. If the electricity prices continue to be controlled, collinearity problems will occur. For the availability of clean energy, this paper uses "the distance between the family and the township government" to control it.

At the same time, we choose the variable lectures (if the respondent has attended any government lectures related to public welfare jobs in rural areas and villages) as the instrumental variable (IV). In contrast, the instrument for this article is a relatively exogenous variable because a farmer who has experienced such lectures is more advantageous in securing or willing to secure public welfare jobs of ecological environmental protection. However, the selected instrument will not directly affect farmers' energy consumption behavior. In Table 1, we present the model variables and summary statistics.

Table 1. Definition and data description of variables in model.

Variables	Definition	Mean	S.D.
	Dependent Variable		
Intensity	1 if the respondent does not use clean energy as a source of energy for any of the aspects (i.e., cooking, heating, and bathing); 2 if the respondent uses clean energy as a source of energy for one of the aspects; 3 if the respondent uses clean energy as a source of energy for two of the aspects; 4 if the respondent uses clean energy as a source of energy for all the three aspects	2.530	0.871
	Key variable		
PWjob	1 if the respondent holds a public welfare job of ecological environmental protection, 0 otherwise	0.38	0.486

Table 1. *Cont.*

Variables	Definition	Mean	S.D.
	Mediator variables		
Cognition	The attention of the respondent to the surrounding environment (1–5 points); a higher score represents more attention	3.358	1.459
Behavior	1 if the respondent participated in other skills and knowledge training in the village, 0 otherwise	0.565	0.496
	Control variables		
Income	Logarithm of per capita household income (Yuan)	9.028	0.659
Age	Age of the respondent (years)	49.879	12.712
Gender	1 if the respondent is male, 0 otherwise	0.704	0.457
Education	Years of education of the respondent (years)	4.556	2.272
Family size	Total family size	4.546	1.829
Land	Family-owned farmland, woodland, grassland area (Ha)	5.192	14.086
Non-farm job	1 if families engaged in non-agricultural employment, 0 otherwise	1.759	0.740
Distance	Distance from the family resident location to the township (km)	9.804	14.389
Altitude	Logarithm of the altitude of the house (m)	7.802	0.332
Autonomous prefecture	Dummy variables of an autonomous prefecture	–	–
Lectures (IV)	1 if the respondent has attended any government lectures related to public welfare jobs in rural areas and villages, 0 otherwise	0.806	0.395
Observation	1100		

2.2.5. The Ordered Probit Model

As the explained variable in this paper is ordered data, the OLS estimation is no longer applicable. Therefore, this paper uses the Ordered Probit model, which is widely used in the literature for estimation. The model is set as follows:

$$Intensity_i = F(\alpha Pwjob_i + \beta X_i + \varepsilon_i) \tag{1}$$

In Equation (1), $Intensity_i$ is the explained variable, which measures the intensity of farmers' use of clean energy. $Pwjob_i$ is the key explanatory variable in this paper. It is a dummy variable, defined as 1 if the respondent holds a public welfare job of ecological environmental protection, otherwise it is 0. X_i is another factor that affects farmers' clean energy use. $F(\cdot)$ is a nonlinear function, and its specific form is:

$$F(Intensity_i^*) = \begin{cases} 1 & if \quad Intensity_i^* \le \lambda_1 \\ 2 & if \quad \lambda_1 < Intensity_i^* \le \lambda_2 \\ 3 & if \quad \lambda_2 < Intensity_i^* \le \lambda_3 \\ 4 & if \quad \lambda_3 < Intensity_i^* \end{cases} \tag{2}$$

In Equation (2), $Intensity^*{}_i$ is the latent variable of $Intensity_i$ and satisfies Equation (3), where $\lambda_1 < \lambda_2 < \lambda_3 < \lambda_4$, which is called tangent point, are all parameters to be estimated.

$$Intensity_i^* = \alpha Pwjob_i + \beta X_i + \varepsilon_i \tag{3}$$

2.2.6. The Instrumental-Variable-Based Ordered Probit Model (IV-Oprobit)

There may be some endogenous problems in this study. First of all, because this paper uses the data obtained from non-experimental research, there may be the problem of sample self-selection; thus, some un-observable factors may affect farmers' employment in ecological public welfare jobs. Secondly, farmers who do not want to use clean energy may prefer to work in ecological public welfare positions to obtain some traditional fuels; there may be a two-way causal relationship between working in ecological public welfare positions and using clean energy. Finally, missing variables may also lead to endogenous problems. Therefore, using instrumental variable (IV) is necessary to remedy the endogenous problems in our regression analysis. Since farmers' clean energy use intensity is a discrete variable, the instrumental variable method based on continuous variables such as two-stage regression might not be suitable [49]. Therefore, referring to Roodman's research [50], this paper uses the Conditional Mixed Process (CMP) instrumental variable estimation method to analyze our results; thus, the Ordered Probit model becomes appropriate. This method constructs a recursive equation to realize two-stage regression based on the maximum likelihood estimation method. Therefore, before estimating Equation (1), it is necessary to add the induced equation between the explanatory variable and instrumental variable obtained by using the instrumental variable method, as follows:

$$Pwjob_i = \delta Z_i + \sigma IV_i + \mu_i \quad (4)$$

where $Pwjob_i$ is the key explanatory variable in this paper, IV_i is the instrumental variable, and Z_i is other exogenous control variables that affect *Pwjob*.

3. Results and Discussion

3.1. Empirical Results of the Oprobit Model

This section reports the results of the OLS regression. Firstly, the Oprobit Model column in Table 2 shows that the key explanatory variable (*Pwjob*) coefficient is estimated to be (0.303) and statistically significant at the 1%, indicating that serving in ecological public welfare jobs can significantly encourage farmers to use clean energy. However, the coefficients of Oprobit model cannot be directly explained and can only be used to judge the influence direction of variables. Therefore, it is necessary to calculate the marginal effect further, as shown in Table 3. As displayed in Table 3, compared with non-ecological public welfare posts holders, the probability of those who hold ecological public welfare posts not using clean energy for the three aspects (i.e., cooking, heating, and bathing) reduce by 5.6% (see column 2). We also observed that ecological public welfare posts holder's probability of using clean energy for one of the three aspects reduces by 5.1% (see column 3). Columns 4 and 5 show a positive and statistically significant marginal effect. The findings show that families holding ecological public welfare jobs will choose cleaner energy consumption patterns.

Table 2. The Ordered Probit regression results.

Intensity	OLS		Oprobit Model	
Pwjob	0.227 ***	(0.054)	0.303 ***	(0.074)
Income	0.136 ***	(0.042)	0.185 ***	(0.058)
Age	−0.001	(0.002)	−0.001	(0.003)
Gender	−0.085	(0.056)	−0.118	(0.077)
Education	0.100 ***	(0.030)	0.137 ***	(0.041)
Family size	0.001	(0.015)	0.001	(0.020)
Land	−0.060 **	(0.028)	−0.081 **	(0.039)
Non-farm job	0.121 **	(0.051)	0.167 **	(0.069)
Distance	−0.073 ***	(0.022)	−0.098 ***	(0.030)
Altitude	−0.707 ***	(0.078)	−0.983 ***	(0.110)
Dummy Aut-Pre [1]	Yes		Yes	
Constant	7.07 ***	(0.749)		
Wald			232.991 ***	
Observations	1100		1100	

Note: Robust standard errors are in parentheses; ** $p < 0.05$, *** $p < 0.01$; [1] Aut-Pre = Autonomous prefecture.

Table 3. Marginal effect of the key variables.

Intensity	1	2	3	4
Pwjob	−0.056 *** (0.014)	−0.051 *** (0.013)	0.050 *** (0.012)	0.057 *** (0.014)

Note: Robust standard errors are in parentheses; *** $p < 0.01$; 1–4 is described in Table 1.

Secondly, the coefficient column in Table 2 also shows the effect of other explanatory variables on energy consumption. Specifically, land, altitude, and distance significantly negatively affect farmers' clean energy usage. In contrast, income, education, and non-farm job engagement significantly positively affects farmers' probability of using clean energy. Variables with significant effects and results from existing studies in the literature are consistent. In addition, age, gender, and family size did not pass the significance test.

3.2. Empirical Results of the IV-Oprobit Model

Before using IV, it is necessary to test the validity of instrumental variables. This paper refers to the practices of Chyi and Mao [51] and uses the weak instrumental variable test method. The test results are shown in Table 4. The test results show that the instrumental variable is exogenous and has no weak instrumental variable. *Pwjob* is indeed an endogenous variable.

Table 4. Weak Instrumental Variables Test.

Kleibergen-Paap rk LM statistic	40.195	(0.000)
Kleibergen-Paap rk Wald F statistic	41.302	{16.38}

Note: *p* value is in parentheses; Stock–Yogo Weak Recognition Test 10% Critical Value is in big parentheses.

The regression results of IV-oprobit model are shown in Table 5. First of all, the auxiliary estimation parameter atanhrho is significantly different from zero (*p* value is 0), indicating a significant correlation between the two equations in the simultaneous equation model. It is more effective to adopt the conditional mixing process for simultaneous estimation than to estimate separately, indicating that *Pwjob* is an endogenous variable. Therefore, the simultaneous equation model is used to estimate the conditional mixing process, and the estimated result is reliable. Secondly, judging from the estimated coefficient of *Pwjob*, the coefficient is still significantly positive, indicating that after controlling the endogeneity of *Pwjob*, ecological public welfare jobs still have a positive impact on household clean energy consumption. In addition, considering the endogeneity of *Pwjob*, the regression results of control variables are basically consistent with Table 2, indicating that the regression results are robust.

Table 5. The IV-oprobit regression results.

Variables	*Pwjob*		Intensity	
Pwjob			0.708 ***	(0.153)
IV	0.209 ***	(0.034)		
Income	−0.456 ***	(0.027)	0.196 ***	(0.057)
Age	-0.001	(0.001)	−0.001	(0.003)
Gender	−0.111 ***	(0.028)	-0.053	(0.080)
Education	0.031 **	(0.015)	0.129 ***	(0.041)
Family size	−0.006	(0.007)	0.006	(0.020)
Land	0.034 **	(0.014)	−0.094 **	(0.039)
Non-farm job	0.071 ***	(0.026)	0.130 *	(0.071)
Distance			−0.089 ***	(0.029)
Altitude			−0.970 ***	(0.108)

Table 5. *Cont.*

Variables	*Pwjob*		Intensity	
Dummy Aut-Pre [1]	Yes		Yes	
Constant	−0.179 *	(0.100)		
Wald			590.39 ***	
atanhrho			−0.219 ***	(0.076)
Observations	1100		1100	

Note: Robust standard errors are in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; [1] Aut-Pre = Autonomous prefecture.

3.3. Analysis of Action Mechanism

Compared with the traditional method of testing the intermediary effect of the linear model, the Karlson–Holm–Breen (KHB) method proposed by Breen et al. can be used to analyze the intermediary effect of the non-linear probability model. It is also applicable to the case of multidimensional intermediary variables [52]. Therefore, this paper uses the KHB method to test the channels through which the ecological public welfare jobs affects farmers' energy consumption. Table 6 gives the test results. Both cognition and behavior obtained a statistically significant coefficient value in our intermediary effect analysis, which indicates that H2 in this paper has been verified; that is, holding an ecological public welfare post can influence farmers' energy consumption behavior by influencing their ecological environment cognition and social behavior.

Table 6. Results of the mediation effect test.

Mediator Variable	Cognition	Behavior
Mesomeric effect	0.097 *** (0.027)	0.024 *** (0.013)
The proportion of indirect effects (%)	7.87	31.74
Observations	1100	1100

Note: Robust standard errors are in parentheses; *** $p < 0.01$.

3.4. Heterogeneity

3.4.1. Regional Heterogeneity

Considering the difference in farmers' energy consumption in agricultural and pastoral areas, continuously exploring the heterogeneity among regions is essential for our study. Therefore, we divided the samples into pastoral areas, semi-pastoral areas, and agricultural areas for regression, and the results are shown in Table 7. Although our core explanatory variables are significant, there are differences in the size of coefficients. Pure pastoral areas have the greatest influence, followed by pure agricultural areas, and finally, semi-agricultural and semi-pastoral areas. This result can be found in the "energy accumulation theory". According to the Fuel Stacking Theory, families need to use multiple energy sources as backup due to the instability of modern energy supply, so fuel stacking is common in both urban and rural areas of developing countries [53]. In fact, rural areas in Western China have convenient access to traditional solid energy, and farmers will pile up solid energy. Moreover, semi-agricultural and semi-pastoral areas are rich in forestry resources, and farmers in these areas have the natural advantage of hoarding fuelwood. Therefore, the employment of ecological public welfare jobs has a relatively weak impact on farmers' use of clean energy in this area.

Table 7. Results of the regional heterogeneity test.

Variables	Pasturing Area	Farming-Pastoral Area	Agricultural Area
Pwjob	1.571 ***	1.267 *	1.402 *
	(0.263)	(0.396)	(0.641)
Control Variables	Yes	Yes	Yes
Wald	95.75 ***	88.81 ***	80.00 **
atanhrho	−0.557 **	−0.487 **	−0.617 **
	(0.188)	(0.235)	(0.448)
Observation	359	344	397

Note: Robust standard errors are in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

3.4.2. Income Heterogeneity

Considering the difference of household income, which leads to the difference of energy consumption, it is necessary to continue to analyze the heterogeneity between these two groups. Therefore, we divided into two groups for regression. The median per capita income of the sample is the breakeven point. If it is greater than the median, it will be classified as a high-income group; otherwise, it will be classified as a low-income group. The estimated results are shown in the first two columns of Table 8. From the significance of *Pwjob*, it can be seen that the impact of undertaking ecological public welfare jobs on farmers' energy consumption behavior is more obvious in low-income groups.

Table 8. Results of the income heterogeneity test.

Variables	Low-Income Groups	High-Income Groups	Total
Pwjob	1.164 ***	0.848 *	3.489 ***
	(0.383)	(0.490)	(0.887)
Income			0.131 **
			(0.066)
Pwjob × Income			−0.252 ***
			(0.100)
Control Variables	Yes	Yes	Yes
Wald	202.40 ***	152.57 ***	637.07 ***
atanhrho	−0.404 *	−0.264 *	−0.468 ***
	(0.213)	(0.247)	(0.169)
Observation	552	489	1100

Note: Robust standard errors are in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

At the same time, we added the interaction of *Pwjob* and income to the regression of the overall sample for further verification, and the estimated results are shown in the total column of Table 8. The coefficient of interaction is negative, indicating that the impacts of ecological public welfare work on clean energy use gradually weakens with the increase of income, hence (H3b) has been verified.

4. Conclusions and Implications

Recently, the Chinese government has issued some documents to promote rural energy transformation. For example, the "Implementation Opinions on Accelerating the Transformation and Development of Rural Energy to Help Rural Revitalization promulgated" in 2022 mentioned "building a green and low-carbon pilot project of rural energy" and "increasing the proportion of wind power, solar energy, biomass energy, and geothermal energy in rural energy". For China, the green transformation and development of energy in rural areas is an inherent requirement to meet people's needs for a better life, an important part of building a modern energy system, and of great significance to consolidate and expand the achievements in poverty alleviation, promote rural revitalization, realize the goal of peak CO2, carbon neutrality and agricultural and rural modernization. The main purpose of this paper is to help this process.

4.1. Conclusions

On the basis of theoretical analysis and several empirical estimations, the following conclusions are obtained. First, taking the post of ecological public welfare can significantly enhance farmers' willingness to use clean energy. Additionally, other explanation variables such as land, altitude, and distance significantly negatively affect farmers' clean energy usage. In contrast, income, education, and non-farm job engagement significantly positively affects farmers' probability of using clean energy. Secondly, holding the post of ecological public welfare can influence farmers' clean energy use behavior by influencing their "attitude" and "behavior norms". From the measurement level, farmers' eco-environmental awareness (7.87%) and social participation behavior (31.74%) play a partial intermediary role in the impacts of eco-public welfare jobs on farmers' use of clean energy. Third, the heterogeneity analysis shows that the influence of holding ecological public welfare jobs on enhancing farmers' willingness to use clean energy is more obvious in pastoral areas and in low-income groups. This implies that, compared to individuals who are not residing in pastoral areas and considered as high-income earners, for those who are low-income earners and pastoral area residents, the possibility of using clean energy is high should they participate in public social welfare jobs.

4.2. Implications

The current study has several effective theoretical and practical significance. In a theoretical sense, this study further supports the "energy accumulation theory" and "energy ladder theory" through heterogeneity research. The convenience of energy reserves will indeed inhibit the enthusiasm of farmers to use clean energy. Income increase will promote the upgrading of farmers' energy consumption system, especially for low-income groups. In a practical sense, the research conclusion of this paper suggests that policymakers should put down measures that will keep the continuation and deepening of China's ecological public welfare post policy. First, ecological public welfare posts should be adapted to rural revitalization, prioritizing the employment of relatively low-income people, and committed to promoting rural ecological livability. Secondly, some efforts can be made in the following two aspects to enhance farmers' eco-environmental cognitive and eco-environmental behavior. On the one hand, the government should attach importance to the guiding role of education for farmers and strengthen farmers' concern for the ecological environment through skills training and policy publicity lectures. On the other hand, the government should gradually decentralize its responsibilities for ecological environmental protection by combining more ecological protection projects with ecological public welfare posts. For example, the government can delegate more responsibility concerning local ecological environment protection to farmers, which will help regulate farmers' behaviors and positively impact their eco-environmental behaviors. Additionally, a monthly meeting can be organized by expert environmentalist for rural dwellers to increase their eco-environmental behaviors. When these practical recommendations are put in place, it will improve the citizens' understanding about the consequences of poor air-pollution, hence affecting their clean energy consumption.

4.3. Limitation of the Study

There are still some deficiencies in this study that need to be addressed in future research. First, we only focus on some rural areas in China's Tibet, without considering other rural areas' situations, and our sample size may be small considering China's population. Future studies can expand the geographic scope (e.g., other provinces) and increase the sample size of the study to further validate our findings. Second, cross-sectional data was used in this paper, while the impact of holding ecological public welfare positions on farmers' clean energy use may be dynamic. Future studies could be based on panel data from follow-up surveys to analyze dynamic relationships. Finally, this ecological public welfare job may play a relevant role in other specific national contexts or agenda such as agrarian structure and agricultural policy. Future studies can assess the relationship between the ecological public welfare job and these specific national contexts.

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