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The Effectiveness of the Ecological Forest Rangers Policy in Southwest China

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Abstract: To achieve the dual goal of poverty alleviation and ecological restoration, the policy of ecological forest rangers (EFRs) was implemented in rural poverty-stricken areas in China, where local residents commonly depend on nearby forest resources for livelihoods. This study aimed to analyze the short-term and long-term effectiveness of the EFRs policy in China mainly in poverty alleviation and income growth, with a brief discussion on the ecological effect of the policy. A questionnaire survey was conducted in four counties in the Karst rocky desertification region in southwest China. By combing through the early literature on REDD+, community forestry, leasehold forestry, etc., this paper summarizes the experience and lessons of similar community forest management models, aiming to explain the unsustainability of EFRs policy from the perspective of forest tenure and governance. The findings of the effectiveness analysis of EFRs policy in the four poverty-stricken counties reflect different degrees of effect in rural households with different income levels. We believe that the EFRs policy has played important roles in short-term regional poverty alleviation while its potential for long-term income growth has not been stimulated. For the amendment of EFRs policy, we put forward the following points: (1) It is necessary to redesign the selection and recruitment mechanism, as well as the exit mechanism of EFRs adapting to the local conditions. (2) It is advisable to further improve the local assessment and monitoring system of forest protection quality of EFRs and optimize the establishment of benefit linkage mechanism between protection effectiveness and EFRs remuneration. (3) The EFRs remuneration standards should be dynamically raised to assure the active participation of EFRs in forest protection. Furthermore, there is a need for one more effective integration model of forest protection and rural livelihoods improvement, which is considered as a potential future research direction.

Keywords: ecological forest ranger; policy effectiveness; poverty alleviation

1. Introduction

For decades, the issues of poverty, ecological deterioration, as well as climate change have become hot topics of global concern [1]. The United Nations (UN), together with its member countries in the world, has long been committed to tackling poverty and eco-environmental deterioration. Meanwhile, many countries around the world are devoted to the research of forestry-related policies or measures to improve farmers' livelihood and ecological environment. The significant role of forests is clearly recognized in the UN sustainable development goals (SDGs) [2]. On one hand, forests have been seen as a key solution to environmental degradation in the context of tireless efforts to combat climate change [3]. On the other hand, as many studies have confirmed, rural households often depend on forests for livelihoods, especially in many less-developed regions where forest resources are relatively rich [4–7].

In response to the global challenges, mobilizing community residents to participate in local forest management and protection has become a typical forest governance model commonly implemented in many countries worldwide. Community forestry (CF) was once

seen as a promising model for poverty alleviation and forest restoration based on state–community cooperation, which has been practiced and promoted worldwide, especially in the Asia-Pacific regions [8,9]. Moreover, community forestry is one proven strategy where collective action by local people can overcome deforestation or degradation and achieve sustainable management, under specific conditions [10]. Generally, the eco-environmental function of CF in forest ecosystem and biodiversity conservation has been recognized by scholars [11–13], yet the suitability of CF for alleviating poverty or livelihood improvement is controversial [14,15]. In particular, opposing views exist on whether it explicitly improves the livelihoods of the poorest and marginal groups within a community [9,16,17]. It always seems that CF is not unleashing its potential [18]—many CF programs have indeed failed.

China has implemented a series of significant projects aimed at alleviating poverty and improving the ecological environment, one of which is the policy of ecological forest rangers (EFRs). EFRs in China specifically refer to personnel who, within the scope of the impoverished population with poverty registration in 22 central and western provinces of China where national poverty-stricken counties are located, are supported by special transfer payments from the central government to local governments to purchase labor services, and are employed to participate in the forest protection, usually including grasslands, wetlands, and desertification lands, etc. [19]. The EFRs policy is formulated by the National Forestry and Grassland Administration, while funds are all allocated by the Ministry of Finance of China. The policy is handed down from the central government to the local government at all levels, including provincial, county, and township government. Normally, the forestry departments at all levels play an important role in policy enforcement. The EFRs system generally consists of recruitment, training, daily patrol, supervision, assessment, and remuneration. The forest department at township level is always responsible for the recruitment, supervision, and assessment of EFRs. Besides, forestry department at county level regularly carries out skills training to EFRs. The remuneration is transferred to EFRs' bank card monthly or quarterly by the county finance department, based on the assessment of EFRs, usually CNY 10,000 per year (Appendix A).

There are similarities between the EFRs policy of China and community forestry or leasehold forestry when it comes to policy objectives. Particularly, in one sense, the implementation of EFRs policy is a manifestation of community forestry, according to the community forestry definition by FAO as "any situation that intimately involves local people in forestry activity" [20]. The so-called "ecological forest ranger" in China is different in certain aspects from the common forest rangers in other countries, such as that in the US (Appendix A) [21]. To a certain extent, it can be said that China was a pioneer in initiating the EFRs policy aimed at alleviating absolute poverty and improving forest ecology. Since the EFRs policy is a relatively recent forestry-related measure to achieve the dual goal of ecological restoration and poverty alleviation, research on EFRs policy in China is scarce, especially the effectiveness of EFRs policy in poverty alleviation having not been widely concerned by scholars. One latest case study [22] focuses on the influencing factors of the re-employment behavior of EFRs, aiming to assess the differences between goal positioning of central government and realistic choices of local government, finding that there is always a contradiction between policy objectives and realistic choices, for the EFRs with a higher income level are more likely to have re-employment opportunities while the poorest population seems not to be considered.

As reported, from 2016 to 2020, the Chinese government allocated a total of CNY 20.1 billion for the program of EFRs and it has employed more than 1.1 million EFRs in China by 1 December 2020, directly and indirectly driving more than 3 million poor people out of poverty and increasing their income [23]. China has achieved its goal of comprehensive poverty alleviation under the current poverty standard by the end of 2020 as it wishes. Since then, the focus of its anti-poverty work will shift from absolute poverty to relative poverty, while the main objective of EFRs policy will also change. Therefore, it is necessary to access the implementation of EFRs policy. This paper presents the case study of the EFRs policy implemented in four counties in southwest China. In this paper,

we analyze the effectiveness and sustainability of EFRs policy in alleviating poverty or improving livelihoods, with a brief discussion on the role of policy in eco-environmental improvement. This paper firstly reviews the relevant research on forestry-related policies or programs like community forestry to sum up experiences and lessons from them, and then analyzes the problems existing in the implementation of EFRs policy. Finally, this paper puts forward suggestions for the amendment of the EFRs policy in the future.

2. Materials and Methods

2.1. Study Areas

The four sample counties are Longsheng County in Guangxi Province, Luocheng County in Guangxi Province, Dushan County in Guizhou Province, and Libo County in Guizhou Province (Figure 1), all of which are the poor counties designated to acquire pairing-off assistance in poverty alleviation from the National Forestry and Grassland Administration, China. The four counties are all located in the Karst rocky desertification (KRD) region of Southwest China, where the ecology is extremely fragile [24], which is mainly manifested in soil erosion, bare bedrock, as well as decreased soil productivity [25,26].
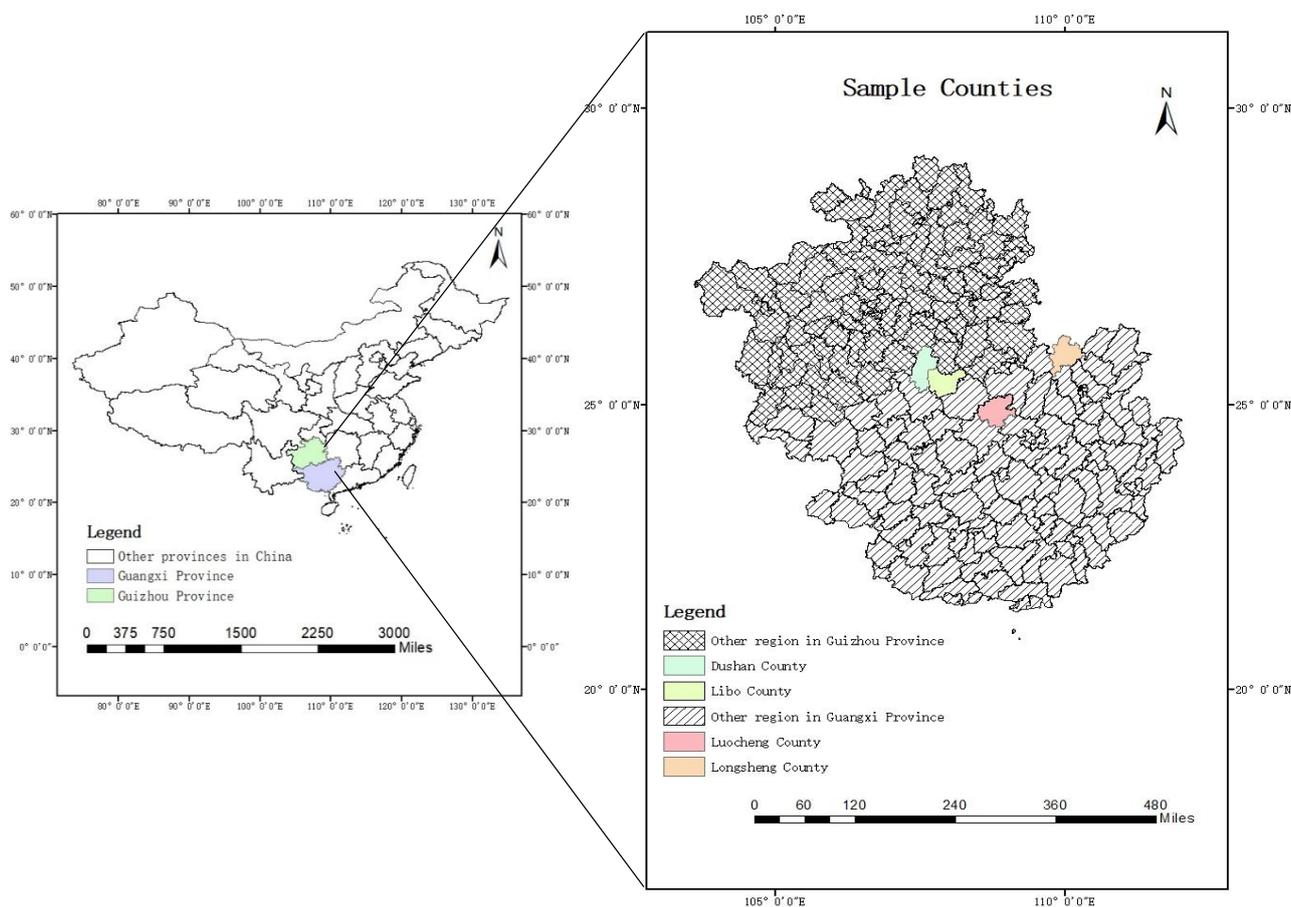

Figure 1. Location of sample counties.

Karst areas are typically characterized as small population capacity, simple community structure, high environmental sensitivity, weak disaster bearing capacity, and difficulty in recovery [27], among which, drought is explained to be the major factor that hurts vegetation recovery [28]. In addition, the concentrated ethnic minorities and the less-developed economy are salient features of the KRD region in China [29]. Although plenty of studies have begun to focus on the treatment of the severe rocky desertification in

southwest China [30,31], it is still one of the greatest challenges in the ecological restoration of the KRD region in Southwest China [32].

As listed in Table 1, by the end of 2019, the forest coverage rate of four counties reached 81.76%, 70.28%, 61.84%, and 71.04%, respectively. The four counties are rich in forest resources and have close forest land areas, just having differences in forest coverage rate. Having rich forest resources is one of the reasons why these four counties have been designated by the National Forestry and Grassland Administration. Because forestry-related policies or programs implemented here are more typical and representative, it can play an exemplary and driving role in the surrounding counties. According to local government statistics, the per capita income of rural residents in four counties in 2019 was CNY 12,816, CNY 8915, CNY 11,759, and CNY 11,393, respectively, much lower than the national average rural per capital income CNY 16,021. Based on China's current poverty standard, the incidence of poverty in four counties is 0.26%, 2.21%, 1.36%, and 1.53%, respectively. The situation of EFRs in four counties is listed in the Table 2. Since the implementation of the EFRs policy in 2016 to 2020, the four counties have received a total of CNY 370 million of subsidies from the central finance for EFRs and a total of 15,140 EFRs have been recruited cumulatively.

Table 1. The situation of four sample counties.

Indicators	Unit	Counties			
		Longsheng	Luocheng	Dushan	Libo
Area	km^2	2538	2651	2442.2	2431.8
Population	Persons	1.72×10^5	3.86×10^5	3.58×10^5	1.8×10^5
Forest coverage rate	%	81.76	70.28	61.84	71.04
Poor population	Persons	414	6509	4202	352
Incidence of poverty	%	0.26	2.21	1.36	1.53
Rural per capita income	CNY/year	1.28×10^4	8.9×10^3	1.18×10^4	1.14×10^4

Table 2. The situation of EFRs in four counties.

Indicators	Unit	Counties			
		Longsheng	Luocheng	Dushan	Libo
Accumulated employees	Persons	3965	4621	3054	3500
Accumulated dismissals	Persons	813	413	104	350
On-duty personnel	Persons	3152	4208	2950	3150
Per capita protection area	Hectare	61.27	42.6	40.4	53.47
Cumulative capital investment	CNY	7.7×10^7	1.14×10^8	8.85×10^7	9.05×10^7

2.2. Data and Processing

One type of data is about the general situation of the four counties (Table 1), and the overall situation of the EFRs in the four counties (Table 2). This type of data comes from local government statistics and forestry-related department. Another type of data is about characteristics of the sample EFRs (Table 3), and it will be presented in the following analysis of EFRs in the four counties. The analysis of the policy is based on the survey data of EFRs in four impoverished counties. We adopted the method of random sampling, randomly selecting 3 townships from each county, 3 to 4 villages from each township, and 5 to 6 EFRs from each village for on-site questionnaire survey. A total of 205 questionnaires were collected from 38 villages. After eliminating the missing values of relevant data, 192 valid samples were obtained.

Table 3. Characteristics of the sample ecological forest rangers.

Characteristic	Category	Frequency	Percentage
Age	below 31 years old	5	0.03
	31–40 years old	39	0.20
	41–50 years old	82	0.42
	51–60 years old	64	0.32
	over 60 years old	2	0.01
Gender	Male	176	0.92
	Female	16	0.08
Education	Not attending school	8	0.04
	Primary (Grade 1–6)	87	0.45
	Middle (Grade 7–9)	86	0.45
	High (Grade 10–)	11	0.06
Use of smartphone	Yes	183	0.95
	No	9	0.05
Use of WeChat	Yes	178	0.93
	No	14	0.07

The following is a formula to calculate the incidence of poverty:

$$\text{Incidence of poverty} = \text{The number of poor}/\text{The total number of people} * 100\% \quad (1)$$

In Table 1, the overall incidence of poverty is calculated by the local departments respectively. In Section 3.2, the sample incidence of poverty is calculated based on the survey data of EFRs in the four counties, which has a total sample size of 192.

3. Results

3.1. Characteristics of the Ecological Forest Rangers

Characteristics of the sample EFRs are demonstrated in Table 3. In terms of the age of sample EFRs, the majority are aged between 41 to 50 and 51 to 60, accounting for 43% and 33%, respectively. Besides, the oldest ecological forest ranger is up to 63 years old and the youngest one is 23 years old, while the average age is 46.5. It is obvious that the team of EFRs is mainly composed of middle-aged and elderly people. This age structure is unfavorable for forest protection positions, which require great physical exertion. In terms of gender, almost 92% of the sample EFRs are men and only 8% are women. There is no denying that men become the main force of EFRs, which, of course, has something to do with the innate physical advantage of men. In fact, women can give play to some incomparable advantages over men in some non-physical activities such as publicity of forestry-related laws and regulations. Besides, it is visible that the education levels of sample EFRs are generally low. As is shown in Table 3, EFRs with primary education level and that with middle education level both account for 45% respectively. Less than 6% of EFRs have a high-level education. Many old illiterate EFRs do not recognize Chinese characters at all so that they can hardly complete the daily patrol diary independently. Although all EFRs are provided with skill training freely from time to time, it seems that these forestry-related training could only improve their awareness and skills of protecting forest resources, yet does not result in an increase of income. There is a positive discovery that the rate of smartphones use among sample EFRs is almost up to 95%, meaning that most of them can use the smartphones' camera function on the forest patrol to keep an instant record of the real situation in front of them, which is meaning for timely reporting of potential problems like forest pests and diseases. Meanwhile, 93% of EFRs are able to use WeChat app, an instant messaging application like Facebook. In this way, most of EFRs can conveniently carry out instant communication, sending images, videos and text messages to each other in the presence of network signals.

3.2. Short-Term Effectiveness of the EFRs Policy in Poverty Alleviation

On the whole, the policy of EFRs has achieved remarkable results in overall poverty alleviation. The remuneration of EFRs in various regions is paid at a standard of CNY 8000 to CNY 10,000 per capita every year, as required by the policy. According to the survey, the real average remuneration of sample EFRs is CNY 9507.41 per capita every year (Table 4). Based on China's rural poverty line of CNY 3000, the sample incidence of poverty of EFRs households before EFRs were employed was 54.82%. However, the sample incidence of poverty has dropped to 4.06% by the end of 2019, indicating a significant decrease in the incidence of poverty. The arithmetic average of per capita household income of the sample families in 2019 reached CNY 6686.99, far higher than the current poverty line of CNY 3000. If a certain income accounts for more than 50% of the family income, it is regarded as the main source of family income. Then, the main income of nearly 39.1% of the sample EFRs families comes from the remuneration of EFRs, indicating that these poor rural households are highly dependent on the income of EFRs remuneration. In fact, in addition to the daily patrol of EFRs duties, some EFRs also engage in household manual workshops, small-scale farming, and other activities to obtain additional income. According to the current poverty standard, the effectiveness of EFRs policy in poverty alleviation is immediate and has generally achieved the policy declaration of "One person protecting the forest, the whole family out of poverty".

Table 4. Change in household income and remuneration of EFRs.

Indicators	Unit	Value
Average household income before employment	CNY/Year	13,693.28
Average household income in 2019	CNY/Year	26,220.31
Change in household income	CNY/Year	12,527.03
Average remuneration of EFRs	CNY/Year	9507.41
The ratio of remuneration to household income in 2019	%	36.26
The ratio of remuneration to income change	%	75.9

It should be pointed out that among the 192 valid samples, after being employed to be an ecological forest ranger, the added value of per capita household income in 5 samples decreased, while the per capita household income in 5 samples remained unchanged. Among the 10 families, the lowest per capita income was CNY 1428.57, while the average per capita income of the other 9 sample families was above the poverty line of CNY 3000. According to the survey, this kind of family chooses to accept the employment of EFRs with a lower remuneration against the principle of benefit maximization, which is mainly caused by the elderly and children who need to be taken care of at home while the way of migrant work is blocked, etc. Anyway, on the whole, the implementation of EFRs policy has achieved remarkable results in poverty alleviation.

3.3. Sustainability of the EFRs Policy in Income Growth

In the short term, the EFRs policy has achieved remarkable results in poverty alleviation, but in the long term, the effectiveness of EFRs policy is weakened. In other words, the sustainability of the EFRs policy is poor. The average remuneration of sample EFRs in 2019 accounts for 75.9% of household income change before and after the employment of EFRs (Table 4), meaning that about 75.9% of total household income growth is contributed by EFRs remuneration, which is significantly decreased, compared with the growth contribution rate of nearly 100% of EFRs remuneration at the beginning of the policy implementation. The contribution of EFRs remuneration to the growth of EFRs household income has a weakening trend. On the other hand, it reflects the increase in the proportion of income other than the remuneration of EFRs. Predictably, the constant remuneration for EFRs will contribute less and less to the income growth of poor households.

Considering that the remuneration of EFRs is constant, the increase of income mainly comes from the income other than the remuneration of EFRs. Under the assumption that

the family resource endowment is almost stable, the increase of income other than the remuneration of EFRs is very limited. According to the survey, 191 EFRs were qualified for the position of EFRs, and only one of them has a slight leg disability, which proves that EFRs are generally capable of labor and competent for the major manual labor. The possibility of engaging in other kinds of labor jobs cannot be ruled out. Two potential factors could explain why they are not engaged in the other jobs. One factor is the information occlusion leading to blocked employment channels and the other is non-economic factors such as the need to take care of the elderly and children in the family. In the survey, we found that many EFRs use nearby land resources to develop agriculture independently at home, which were not scaled up and could only meet their daily needs. There was almost no large-scale family farming that could lead to surplus agricultural or forestry products flowing into the market. In terms of using the income of EFRs remuneration to develop other industries, those who mentioned the development of forestry or agriculture only accounted for about 20%.

Additionally, it takes up a lot of disposable labor time of EFRs to fulfill their responsibilities. Many local regulations require EFRs to be on duty 22 days a month, which is almost the same as the requirement for full-time forest rangers. Part-time positions as EFRs have squeezed a lot of time available for other work, although the official document states that EFRs are encouraged to participate in the forestry-related industries or projects to increase their additional income, on the condition that they have completed the prescribed forest protection tasks [33]. In other words, the opportunity cost of being an ecological forest ranger is increased. With the increase of the time on duty, the income level of EFRs weakens instead, and the growth rate of per capita household income slows down. The most direct reason for this diminishing income effect lies in the fact that the remuneration of EFRs is fixed at about CNY 10,000 per capita one year. Meanwhile, with the significant economic development and price rise, the actual value or utility of the labor remuneration of EFRs decreases actually. Furthermore, the EFRs policy is still a "blood transfusion" poverty alleviation measure, lacking a long-term income generation mechanism. The EFRs policy seems not to fundamentally mobilize the internal impetus for poverty alleviation as well as the endogenous development power of poor households.

Furthermore, the aging of poverty and the income gap are prominent problems. It is worth noting that the aging of EFRs is interwoven with deep poverty, and the income gap between EFRs households of different age groups is widening. On the one hand, EFRs are older, and aging is negatively correlated with poverty to some extent. Through the investigation, we found that older EFRs family's per capita income level is generally lower. It can be inferred that young people in poverty-stricken areas are more inclined to go out to search for jobs or choose to engage in local higher-salary jobs. Meanwhile, young EFRs are more likely to engage in other part-time labor in addition to EFRs to obtain additional income, by contrast, the older poor people are relatively weaker in working ability, more generally choose to work as a single ecological forest ranger, and have fewer ways to obtain additional income. On the other hand, the income gap among EFRs families of different income levels has widened. The families whose main income comes from the EFRs remuneration are usually the deep poor families with a single income source, and they are more dependent on the remuneration for EFRs position, and their family income levels are often at the bottom of the range. On the contrary, the general poor families with a weak dependence on the subsidy for the position of EFRs tend to have a relatively rich source of income, a relatively high-income level, a relatively better family situation, and a significantly higher level of income growth than the deep poor families with a single income source. In short, the elderly in rural area generally lacks the ability to work, whose families are commonly more dependent on forest resources and have enjoyed more policy dividends in the short time, but they are more likely to fall into the poorest group, once they lose the policy support.

4. Discussion

4.1. Determinants of the Successful Policy Implementation

The implementation of the EFRs policy in recent years has witnessed a large number of rural poor populations lifted out of poverty as well as a visible improvement of ecological environment. It is undeniable that the original intention of EFRs policy is ideal and corresponds with the international trend of poverty alleviation and ecological protection. As we know, forests are the most important natural resources that can be relied on in many rural areas, especially in the Karst rocky desertification areas in southwest China. However, the current forestry policy strictly limits the access of local forest farmers to valuable forest resources. Furthermore, the heads of the local forestry department are overly cautious about the reasonable use of forests for fear of violating forestry regulations accidentally, even it is in fact within the scope of the law. EFRs have gradually become the main force in forest protection and even management in some areas of China, even if it is not always regard as a typical community forestry model, for EFRs policy is only to purchase services to allow local farmers to participate in forest protection, yet EFRs themselves almost have no right to develop or use this collective forest in the community. The policy is more inclined to encourage poor people to participate in forest protection for remuneration rather than guiding the poor to get revenue from developing forest resources. EFRs who participate in forest protection, regardless of the protection quality, are all expected to acquire nearly CNY 10,000 annual remuneration, which is obviously inefficient and non-motivating in an economic sense.

Hopefully, we may be inspired by previous studies on various programs related to REDD+, community forestry, and leasehold forestry, etc. The successful implementation of these forestry-related policies or programs is affected by a lot of internal and external factors [34]. For REDD+, there is a broad consensus that clear tenure rights have a significant impact on the successful implementation of REDD+ [35], whether effectively supporting local livelihoods or managing forests. To ensure a wider range of ecological restoration, more attention should be paid to the nature of tenure rights in the particular area [36]. As one scholar pointed out early, the revenue for rural poor households from forests should be increased through improved access rights, tenure, and benefit-sharing with removal of regulations that disadvantage the poor [37]. There had been calls to permit a more formalized role of communities in forest management, for top-down measures alone have proven inefficient [38]. In other words, the limited participatory governance seems to be problematic. The community forestry in many countries such as Nepal has been confronted with a failure to have a significant impact on alleviating poverty, which is attributed to governance issues, particularly related to differences in the social status of those who hold decision-making power and those who have the most demand, according to the relevant research [39]. In terms of the determinants of success of CF, many case studies have provided potential pieces of evidence in different positions. As we know, the role of community forestry does not always arise independently. On the one hand, the interaction between community forestry and market forces is often visible, which has been fraught with tension [40]. Decisions of forest users to attain and provide eco-environmental services are commonly influenced by market mechanisms and rational choices [41]. In addition to the goals of alleviating poverty and improving the forest condition, CF is also connected to the objective of empowering the forest users [42]. Broadly, CF implies the devolution of forest management rights to local populations and fostering forest-based livelihoods that maintain forest cover and biodiversity conservation [43]. Due to the disappointing results of centralized management of forest resources in the past, it is more commonly believed that devolution of forest tenure rights to communities is a necessity for achieving dual goals of environmental protection and poverty alleviation [44]. As in many countries, it entails devolving government control of forest lands and resources to local communities [45]. Andika et al. found that secure tenure right is the primary motivation for forest users to participate in community forestry and comply with government-imposed regulations [46]. In spite of this, the devolution of forest tenure rights itself should not be viewed as a

sufficient condition [47], as current research doubts whether the CF program can achieve the empowerment of local communities [48]. In addition, limited democracy of governance is another factor influencing the successful implementation of CF [49].

In China, the forest tenure rights all belong to collectives, as no private forest is existing. When the EFRs policy is implemented in China, the ownership of forest land does not change, and there is no transfer of forest use right. In other words, no relevant official documents are declaring that employed EFRs have the proper rights of developing the forest resources to acquire the revenue. Under the strict legal system, the mutual supervision derived from collective action and the supervision and assessment mechanism stipulated by the policy make it almost impossible for EFRs to gain profits by illegally stealing forest resources and even destroying the forest, otherwise they will bear huge legal liability. The policy of EFRs is a potentially significant measure to appeal to rural poor populations to participate in local forest protection without changing the tenure rights of forest land. Although the root cause of this policy defect may be the collective ownership of forest tenure rights, this fundamental tenure system would remain relatively stable and not change easily in China. Not to mention that there is no evidence showing that collective property rights system is bound to be the culprit. So, we need to find another way. Regardless of the issue of ownership, more attention should be paid to the shortcomings of EFRs policy in participatory forest governance. Furthermore, the consciousness of forest users themselves is also an important factor that cannot be ignored.

Many studies have shown that secure communal property rights provide incentives to the residents for community forest protection and exploiting nested layers of governance from the state to the local communities could enhance the governance of the commons and lead to better environmental outcomes. It is believed that devolution of forest tenure rights and training are only basic policy instruments [50]. For the long-term stability of community forestry, extra incentivizing measures are needed, including diversified sources of revenue from non-destructive forestry activities. In any case, when there are obvious signs of gradual improvement in the ecological environment, it is necessary to pay more attention to the improvement of livelihoods of local residents.

4.2. Implications

As an important measure of ecological poverty alleviation, the EFRs policy has played a vital role in economically backward and ecologically fragile areas since its implementation in 2016. However, with the continuous progress of the targeted poverty alleviation project and the increase in the income level of poor people, the EFRs policy inevitably appears the phenomenon of diminishing policy effectiveness. After the completion of the comprehensive poverty alleviation program of China by 2020, the objectives of EFRs policy will have to change.

The selection and recruitment of personnel is the first step in the implementation of the EFRs policy and also an important link that affects the effectiveness of policy. As Yan et. al. suggest, those EFRs with higher income level are more accessible to the re-employment opportunities. Instead, the poorest populations are often ignored and the characteristic variables like age, education, and health seem to have no remarkable impact on re-employment of EFRs [22]. Thus, it is necessary to reasonably redesign the selection and recruitment mechanism of EFRs adapting to local conditions. On the one hand, it is desirable to develop the differentiated standards for EFRs employment based on actual forest protection requirements in different regions, giving preference to families with relatively deep poverty. On the other hand, a scientific exit mechanism for EFRs is also necessary for simplifying the team of EFRs and optimizing the structure of the EFRs team. Adopting supportive policies and measures is advisable to encourage competent recruiters to quit the team of EFRs and engage in other non-agricultural employment to enrich the sources of income growth.

The policy can be considered sustainable only on the basis of protecting the right of local residents to secure livelihoods. Setting reasonable remuneration standards for

EFRs is significant as remuneration is not only the main source of motivation for EFRs to participate in forest protection, but also an important basis for their livelihoods. Thus, it is necessary to improve the level of EFRs remuneration to assure the active participation of local EFRs in forest protection and management. Since the remuneration of EFRs is based on labor factor, the opportunity cost of EFRs employment should be fully considered. Meanwhile, considering the increasing economic development level and income level, the EFRs remuneration standards are supposed to be dynamically raised. Besides, due to the differences in regional economic development and ecological status, remuneration standards for regional differentiation should be formulated according to the actual situation of the region.

In fact, people in some countries and areas have been given access to national forests to collect non-timber forest products (NTFPs) in return for their contribution to national forest management [51]. China's EFRs policy is inclined to attract local poor population into the collective forest, which is a good start, yet more measures need to be taken to encourage rural residents to actively participate in forest protection and obtain NTFPs from continuous improved forests for diversifying income.

Supervision of EFRs is the key to ensuring the quality of forest protection and management as well as the effectiveness of policy. It is advisable to optimize the management mechanism of EFRs and further improve the local assessment and monitoring system of forest protection quality of EFRs, optimize the establishment of interest linkage mechanism between protection effectiveness and EFRs remuneration, avoiding the EFRs policy becoming a mere formality of direct payment of funds. Training and publicity are also important measures that cannot be ignored to improve the policy effectiveness. A qualified training institution to conduct a pre-position skills training for EFRs is necessary to ensure the specialization, standardization of training. Meanwhile, it is motivational to help EFRs master a few practical forestry-related technologies to get valuable resources from the forest. Furthermore, publicity is a subtle way to improve people's forest protection awareness from ideological levels.

4.3. Limitation and Future Research Directions

The EFRs policy needs to realize the win-win goal of eco-environmental protection as well as poverty alleviation. This paper is more inclined to discuss the effectiveness of the EFRs policy in poverty alleviation and income growth, yet the effect of eco-environmental restoration is rarely covered. Surely, since the implementation of EFRs policy, the eco-environmental indicators in these places have generally improved. One defect of this paper is that it is difficult to measure the precise contribution that EFRs have made to ecological restoration and improvement. The actions of all EFRs can hardly be supervised when they are on their duties in the vast forests, despite the requirement that everyone records their working experience in the handbook, as a basis for performance appraisal. Another limitation of this paper is the fact that many factors could have impacts on the income level and income variation of rural households. Due to the lack of relevant research index design, this study does not fully consider other factors affecting income variation such as household resource endowment, and only concludes that the effectiveness of EFRs policy in income growth of poor families has a weakening trend. The impacts of other poverty alleviation policies on household income are not fully taken into account.

Anyway, it can be concluded that if it cannot balance the dual goal of ecological restoration and poverty alleviation, those EFRs would be in a poverty trap for a long time, which will certainly reduce the passion of EFRs for preserving the ecological environment. Eventually, the attainment of the ecological restoration goal would be affected to some extent. In fact, the achievement of the ecological goal is dependent on the interaction of ecological and socioeconomic factors [52]. Of course, the effectiveness of EFRs policy in ecological conservation remains to be further studied. One potential future research direction is how to appropriately relax the conditions for EFRs to obtain valuable resources from the forests so that the enthusiasm of EFRs in ecological protection would be im-

proved. Fortunately, the increasingly mature forest carbon sequestration trading system for achieving the goal of peaking carbon dioxide emissions and carbon neutrality provides a bright and expectable prospect for the realization of forest value and the improvement of farmers' livelihoods in forest areas, though it is still a long way. Furthermore, the effective amendment of the policy needs to solve the problems of low management and protection efficiency, poor monitoring and evaluation, and the lack of incentives. In other words, the organic integration model of forest management and rural residents' livelihoods needs to be further studied and discussed in the future.

5. Conclusions

This paper introduces a unique policy oriented to rural poor populations to achieve dual goals of poverty alleviation and forest restoration in China, and then analyzes the short-term and long-term effectiveness of this EFRs policy mainly in poverty alleviation and income growth, based on the survey in four counties in the Karst rocky desertification area in southwest China. The findings of the effectiveness analysis of EFRs policy in the four poverty-stricken counties reflect different degrees of effect in rural households with different income levels. We believe that the EFRs policy has played important roles in short-term regional poverty alleviation while its potential for long-term income growth has not been stimulated. By reviewing the early literature on forestry-related policies and programs in terms of REDD+, community forestry, etc., this paper summarizes the successful experience and failure lessons of similar community forest management models, aiming to explain the unsustainability of EFRs policy from the perspective of forest tenure and governance. Finally, this paper provides some probably meaningful suggestions for the amendment of EFRs policy and put forward potential future research directions in terms of integration models of forest management and rural livelihoods.

Appendix A

Table A1. Difference between China and the US.

Category	Ecological Forest Rangers in China	Forest Rangers In the US [21]
Contents	• Publicizing the laws and regulations on forest protection. • Performing daily patrol, stopping deforestation and woodland invasion. • Preventing hunting wild animals and destroying wild plants. • Inspecting and preventing the forest fire. • Monitoring the forestry pests and disease.	• Planting seedlings • Monitoring seedling growth and inspecting tree stands for signs of pests and disease • Spraying or injecting pesticides to protect trees and shrubs • Removing diseased trees with hand or power equipment • Loading cut trees onto trucks • Operating skidders and trucks • Preventing fires through construction of fire lines • Fighting forest fires • Conducting informational and educational programs • Participating in search and rescue • Maintaining and repairing agency vehicles • And etc.
Place	• In the collective natural forests in central and western China, especially in those deeply poor rural areas.	• In state and national parks across the country.
Working Time	• According to the weather, location, average time is 22 days per month.	• Most are employed full time and work regular business hours
Remuneration or Salary	• About CNY 10,000 per year.	• The average salary for advertised forest ranger positions was $26,000 per year as of December 2014.

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