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Could the Sloping Land Conversion Program Promote Farmers' Income in Rocky Desertification Areas?—Evidence from China

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Abstract: The Sloping Land Conversion Program (SLCP) is a significant measure to achieve the Sustainable Development Goals (SDGs) proposed by the United Nations in 2015. SLCP plays an important role in poverty alleviation and income increase for farmers in poor areas. The purpose of this study is to analyze whether the income of farmers has increased after participating in SLCP, and whether SLCP has released the agricultural labor force to obtain non-agricultural income by participating in non-agricultural work. Based on the field investigation in Luocheng County and Longsheng County of Guangxi, Libo County, and Dushan county of Guizhou, this paper uses the method of propensity score matching (PSM) to explore the impact of SLCP on the income of farmers in rocky desertification areas. According to our research, it is found that: (1) SLCP has a positive effect of 5.2% on the average annual net income of farmers, a positive effect of 43.2% on agricultural income, and a negative effect of 9.8% on non-agricultural income, but all of the effects are insignificant. Selective deviation will overestimate the impact of SLCP on farmers' total income and agricultural income and underestimate the impact on non-agricultural income. SLCP failed to promote the transformation of farmers into secondary and tertiary industries. The mechanism of SLCP to increase farmers' income is complex. (2) Farmers' participation in SLCP is influenced by work experience and education level in human capital, participation in skills training in social capital, and owning durable consumer goods in physical capital. Although SLCP will promote economic development under the condition of improving the ecological environment in the future, it is not advisable to exchange farmers' livelihood for ecological construction at present. The implementation of SLCP should consider not only the overall ecological benefits, but also the short-term social and economic benefits.

Keywords: Sloping Land Conversion Program (SLCP); rocky desertification area; farmers; propensity score matching (PSM)

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1. Introduction

Sloping Land Conversion Program (SLCP) is an important measure to achieve the Sustainable Development Goals (SDGs) proposed by the United Nations in 2015. It plays an important role in eradicating extreme poverty, responding to climate change, and promoting the sustainable use of ecological resources. At the same time, the land use policy of SLCP will accelerate the realization of the zero net emission goal by 2050 [1]. Cultivated land is the fundamental factor related to social stability and sustainable development. The decline in quality and low efficiency of cultivated land utilization poses great challenges to the sustainable development of it. SLCP can improve land use efficiency and soil quality [2]. Step by step, it can stop the farming of cultivated land with serious soil erosion, desertification, salinization, serious rocky desertification, and low grain output. SLCP restores vegetation by planting trees and grasses according to local conditions, and pays farmers an income equivalent to the value of lost crops [3]. As a program of Payment for Ecosystem Services (PES), SLCP aims to improve ecological conditions and farmers' livelihoods [4]. At the beginning of the twentieth century, the United States and

other European countries successively put forward similar land use policies to promote afforestation [5]. SLCP has gradually evolved into one of China's new forestry poverty alleviation policies. It plays a role in reducing poverty and improving the livelihoods of farmers in backward and fragile ecological resource-rich areas [6]. Therefore, SLCP not only plays an important role in improving the ecological environment, but also provides a new plan to improve both farmers' incomes and the development of rural areas [7].

Since the implementation of SLCP for more than 20 years, it has made great contributions to the "double growth" of forest coverage and forest stock in China. It also pushes China to achieve the goal of "zero global land degradation by 2030" ahead of schedule [8]. From 1998 to 2018, SLCP reduced the incidence of poverty in China by an average of 7.52 percentage points, and the average contribution rate to income poverty reduction was close to 1/3 [9]. The poverty-stricken people identified in the provinces and regions where the project was implemented in China have implemented a new round of returning farmland to forests and grasslands, totaling 7,975,900 mu, with a total direct investment of 8758 million yuan, benefiting 1,364,000 poor households [10]. It has contributed to the overall victory in poverty alleviation.

Academics pay attention to both the ecological effects and the social and economic benefits. In the aspect of ecology, many studies have measured the ecological efficiency of SLCP, providing a theoretical basis for improving the management and technical level of forestry restoration projects [11]. Some also evaluate the productivity of cultivated land, site conditions, and soil health, and comprehensively analyze the sustainable development level of cultivated land [12]. In the social and economic aspects, it mainly focuses on the income economic benefits, the structural economic benefits, and the synergistic economic benefits of the policy of SLCP [13]. Scholars have carried out a lot of research on SLCP and farmers' livelihoods. From the perspectives of the heterogeneity of farmers [14] and the theoretical framework of sustainable livelihood [15], they focus on the impact of SLCP on farmers' livelihoods. There are also studies to evaluate the effect of policy implementation from the aspects of willingness to participate [16] and satisfaction [17]. Some scholars indirectly evaluate the poverty reduction effect of SLCP from the perspectives of farmers' income, livelihood capital, and livelihood strategies [18–20]. Ultimately, the impact of SLCP depends on the local economic situation, project scope, political status of participants, and the situation of participants [21]. A key role of SLCP is to increase the income of rural families and redistribute jobs [22].

The income of farmers is an important factor affecting farmers' willingness to participate in SLCP. It is necessary to improve farmers' willingness to participate in SLCP to ensure the sustainability of the project [23]. The key is to stimulate the increase of farmers' income. There are two ways to increase farmers' income by compensation for SLCP. One is the compensation for SLCP directly allocated by the government, but some scholars think that the effect of this compensation on increasing farmers' income is not obvious [24]. Second, after SLCP, part of the labor force was liberated, which made the employment of the working population more flexible, thus enriching its income sources and increasing the income of farmers [20]. In addition, the scale of SLCP is different, and the effect of increasing farmers' income is also different. For example, there is a positive correlation between the income of farmers returning farmland to economic forest and the scale of economic forest, while the scale of ecological forest is 9.7 mu. If it exceeds this scale, there is a negative correlation between the scale of returning farmland and the income of farmers [25]. Although SLCP has greatly improved the ecological improvement effort and played a certain role in poverty reduction, its effect on income is still controversial because of its characteristic of "giving priority to ecological interests". SLCP is one of the largest PES programs in China, which is also one of the largest PES programs in the world [23]. Although it supports the restoration of ecosystems, the reduction of cultivated land caused by the implementation of the policy puts pressure on farmers who depend on cultivated land for their livelihood [5]. To balance ecological and economic benefits, the government issues compensation fees to offset these pressures. However, due to the limitation of time

and amount of funds, the level of subsidy funds is not high and there is no time limit for returning farmland. In principle, farmers will participate in non-agricultural work after returning farmland. They overcome the negative impact of this problem by earning non-agricultural income [26]. Farmland is the guarantee for farmers. If these landless peasants who participate in SLCP could not find a stable other job, they will easily become poor or return to poverty once they encounter the risk of vulnerability.

Due to topography, soil, vegetation, and economic characteristics, China's karst areas are different from other areas in SLCP, as shown in Table 1. The implementation of SLCP has brought benefits to farmers, but its policy effects are significantly different due to geographical differences [27]. Karst areas in southwest China have implemented land use conversion afforestation projects such as SLCP to deal with land degradation. In karst areas, marginal farmland on sloping hills has low agricultural potential but high risk of erosion. The rocky desertification in the southwest region is more widely distributed. The ecological environment in rocky desertification areas is fragile, and it is difficult to control geological and ecological disasters. The southwest region with the poorest ecological environment is coupled with the spatial gradient distribution of poverty in China from west to east [28]. Research shows that the poverty reduction effect of SLCP is the most obvious in the western region, followed by the Yangtze River basin and the Yellow River basin [29]. It can not only increase the income of local farmers, but also effectively improve the ecological benefits of ecologically fragile areas [30,31]. Guizhou and Guangxi are the provinces with the widest area of rocky desertification, and the contribution rate of local ecological engineering to the control of rocky desertification areas is nearly 70% [32].

Table 1. Characteristics of SLCP in Karst Area.

Type	Detailed Content	Source
Topographic features	There are various landform types, steep terrain, and unfavorable hydrological characteristics. The amount of cultivated land in karst areas is small, generally concentrated in basins and hilly areas, which is not easy to cultivate, and the area for planting trees is very large.	Li et al. (2022) [33]
Soil characteristics	The soil group in this area is mostly called rocky desertification soil, with thin soil layer, poor texture, and lack of fertility and moisture, which is characterized by acidity or neutrality, barren, multi-lithology, and oxidation.	Han et al. (2019) [34]
Vegetation characteristics	Due to the limitation of dry climate, barren land, and special terrain, there are only a few available plant resources in the vegetation of returning farmland to forest in karst areas. Common types are grassland, grass, reed wetland, shrub, and deciduous broad-leaved forest. In the process of returning farmland to forest, it is necessary to choose tree species and shrubs with strong adaptability, drought resistance, and adversity resistance, such as holly, cypress, oak, and sea buckthorn.	Zou et al. (2019) [35]
Economic characteristics	The economy is relatively backward, mainly agricultural economy, mainly planting rice, corn, peanuts, camellia oleifera, grapefruit, and other crops, and the development of animal husbandry is relatively backward. The main industries are green agriculture and fruit processing industries.	Han et al. (2020) [36]

Previous studies have studied the income effects of SLCP in different regions, but there are few studies on the income effects of SLCP in karst areas. Therefore, it is necessary to study the contribution of compensation for SLCP to increasing farmers' income and reducing poverty in rocky desertification areas, especially in Guizhou and Guangxi.

The aims of this article are mainly to solve two issues: (1) whether SLCP can improve farmers' income; (2) whether SLCP can promote labor migration and increase non-agricultural income. After the implementation of SLCP, its effect needs special consideration. Especially for the rocky desertification areas in southwest China, it is still necessary to further analyze the contribution of the implementation of this policy to increasing farmers' income. Based on the

survey of four counties from Guizhou and Guangxi in China (Longsheng County, Luocheng County, Libo County, and Dushan County), we use the propensity score matching method (PSM) to evaluate the impact of SLCP on farmers' income in rocky desertification areas. We hope to clarify the effect of SLCP on the income of different farmers. In addition, we expect to provide more valuable references for optimizing SLCP policy.

2. Literature Review and Research Hypothesis

Most of the afforestation projects under SLCP focus on economic forests, which can generate certain economic benefits and compensation [13]. Participating households in SLCP have reconfigured their livelihood capital, diversified their income by promoting the transfer of the labor force from agriculture, and continuously changed their livelihood strategies [3]. SLCP has a positive impact on household income by promoting labor force transfer and reducing liquidity constraints [37]. Research has also found that participation status in land retirement, local economic conditions, project degree, and political leadership do have significant effects on household income and non-agricultural employment, and there are significant differences in income types as a result of participating in SLCP [21]. It has a significantly negative impact on animal husbandry, and a very positive impact on non-agricultural income and total income [21]. However, some studies have shown that SLCP has no significant effect on farmers' production structure adjustment, non-agricultural employment, and income increase. Moreover, households that suffer income losses among those participating in land retirement are more likely to view SLCP as a mandatory government policy, thereby suppressing the increase in total household income from SLCP policies.

With the promotion of SLCP policies, surplus labor in agriculture tends to choose to work in urban areas. In some areas and households, they even choose to give up agricultural production, which promotes the transfer of agricultural population to urban areas, increases urbanization rates, and promotes the increase in non-agricultural income while decreasing agricultural income [13]. At the same time, households can reduce liquidity constraints and promote the increase of non-agricultural income through the redistribution of income subsidies [37]. However, some studies have shown that since the regions participating in SLCP are less developed and have lower education levels, local farmers are often more sensitive to risks and therefore choose to continue their agricultural production. Thus, the transformation of SLCP to non-agricultural employment is not significant, and the increase in non-agricultural income as a result of SLCP is not significant either. SLCP investments mainly involve ecological compensation paid to farmers to encourage structural planting adjustments. Land retirement investments can be used for agricultural production material investments to incentivize farmers to plant higher cost, higher economic benefit crops, thereby increasing agricultural income [38]. Southern China's karst region is a global hotspot for land greening, and soil depth's low output due to land desertification often has little impact on local food production. Selling forest products typically yields substantial income [31].

Therefore, based on the above literature analysis, this study proposes the following three hypotheses:

Hypothesis 1 (H1). *SLCP promotes an increase in total household income for farmers in the Karst region.*

Hypothesis 2 (H2). *SLCP promotes an increase in agricultural income for farmers in the Karst region.*

Hypothesis 3 (H3). *SLCP promotes the transformation of non-agricultural employment for farmers in the Karst region.*

3. Materials and Methods

3.1. Study Area

Geographically, Libo County is located in the south of Guizhou Province, bounded between 107°37′ and 108°18′ east longitude, 25°7′ and 25°39′ north latitude. It is located in the transition zone from Guizhou Plateau to Guangxi hills. The terrain is high in the north and low in the south, with an average altitude of 758.8 m, belonging to the central subtropical humid monsoon climate zone. The average annual temperature of the county is 18.5 °C, and the average precipitation is 1211.9 mm. Dushan County is located in the southernmost part of Guizhou, bordering Guangxi Zhuang Autonomous Region, bounded by 25°04′~25°31′ north latitude, 107°41′~107°55′ east longitude. It is located in the Yunnan-Guizhou Plateau, with an average altitude of 850~1100 m, belonging to the central subtropical temperate monsoon climate. The annual average temperature is 15 °C, and the annual rainfall is 1429.9 mm. Luocheng County is located in the northwest of Guangxi, the southern foothills of the Miaoling Mountain Range of the Yunnan-Guizhou Plateau, bounded by 108°29′ to 109°10′ east longitude, between 24°38′ and 25°12′ north latitude. The terrain is high in the northwest and low in the southeast, belonging to the subtropical monsoon climate zone, with an annual average temperature of 18.9 °C and an annual average rainfall of 1566.6 mm. Longsheng County is located in the northeast of Guangxi, northwest of Guilin, bounded by 109°43′28″~110°21′14″ east, 25°29′21″~26°12′10″ north latitude. The whole territory is mountainous. The average altitude is 700–800 m. The terrain is high in the east, south, and north and low in the west. It is a subtropical monsoon climate. The annual average temperature is 18.2 °C, and the average annual precipitation is about 1500 mm. Four counties are located in the southwest of China, with obvious karst geomorphological characteristics.

Figure 1 shows the characteristics of karst geomorphological.

Figure 1. Geomorphology in karst area.

According to a survey of the related reference, the compensation subsidies received by farmers in the four counties in the past three years accounted for 51.43% of the forestry transfer income, which accounted for half of the share. Moreover, the forestry development of the four counties is marvelously good, and the implementation of the forestry ecological poverty reduction policy is typical. Specifically, during the "13th Five-Year Plan" period, 26,800 mu of farmland was returned to forest in Libo County, and the forest coverage rate reached 71.97%. In Dushan County, 57,300 mu of farmland were returned to forest, and the forest coverage rate reached 64.5%. Luocheng County has returned 40,800 mu of farmland

to forest, with a forest coverage rate of 71.44%. Longsheng County has returned 25,000 mu of farmland to forest, with a forest coverage rate of 80%. Relying on local advantageous characteristic industries, all counties have orderly developed forestry industries such as fruit forest, under-forest economy, and forest health care. They have achieved good benefits.

3.2. Data Sources

The data used in this study comes from the four designated counties of the National Forestry and Grassland Administration from May to October 2021—Field investigation in Libo County and Dushan County of Guizhou Province, Longsheng Autonomous County of Guangxi Zhuang Autonomous Region, Luocheng Mulao Autonomous County, covering 32 villages. Each village randomly selects 10 samples, trying to cover different types of farming households with different economic conditions. The survey adopted the method of face-to-face interviews in the field, which ensured the quality of the questionnaire and understood the opinions and suggestions of local farmers on SLCP. A total of 320 questionnaires were distributed in this survey. After removing invalid questionnaires, a total of 303 valid questionnaires were obtained, with a sample effective rate of 94.69%. Among them, 54 participated in SLCP and 249 did not participate.

Figure 2 shows the location of four investigation county.

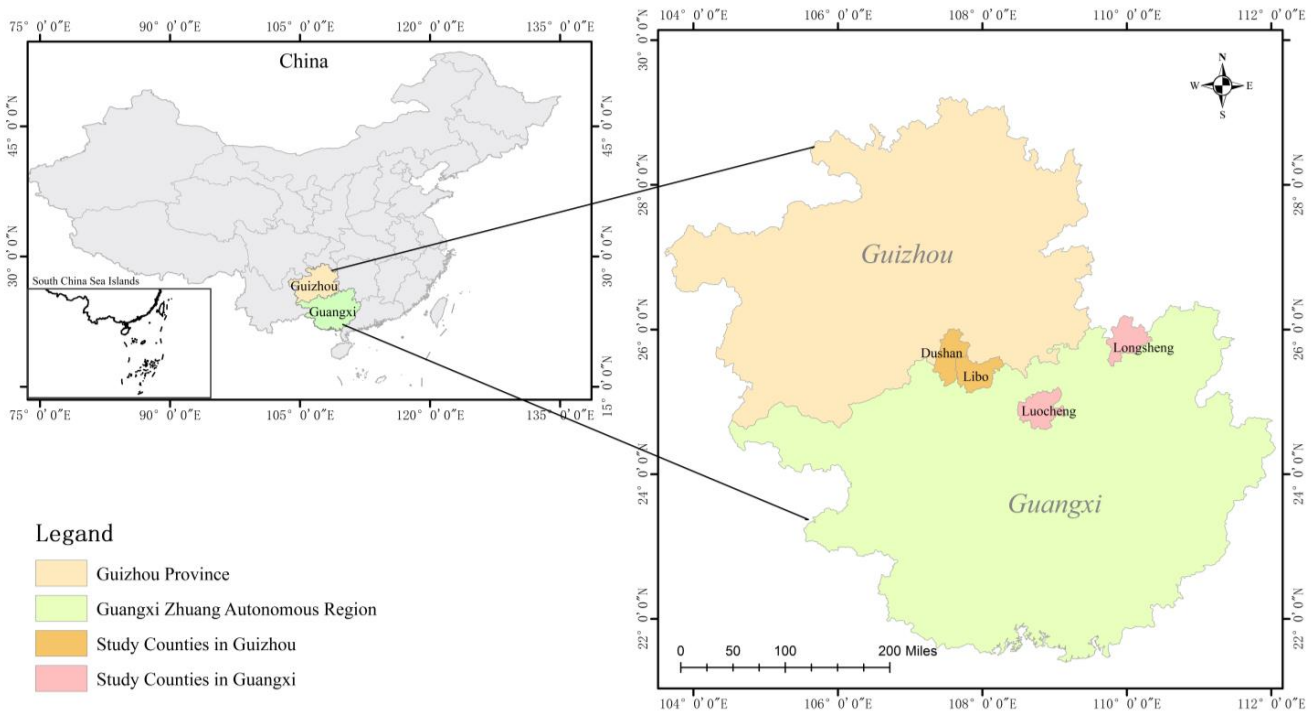

Figure 2. Location of the study area.

3.3. Variable Setting

There are three outcome variables selected in this paper. The first is "Total income" which reflects the total income amount of a family. The second is "Agricultural income". Considering that the implementation of SLCP directly reduces the area of cultivated land and increases the area of forest land, it may have a direct impact on agricultural income. The third is "Non-agricultural income". The policy of SLCP may have an indirect impact on non-agricultural employment income by changing the employment structure of farmers. The treatment variable in this paper is "SLCP", which reflects whether to participate in SLCP or not. The other is covariate. The existing research shows that human capital and natural capital are two factors that affect farmers' income, in which human capital includes its quality and quantity, and natural capital includes cultivated land area and woodland area [30]. In addition, livelihood capital should also include material capital,

financial capital, and social capital [32]. Therefore, we take into account whether farmers join cooperatives and participate in skills training as social capital, whether they have loans as financial capital, and whether they have durable consumer goods as material capital as a whole to be included in the covariate. The setting and assignment of specific variables are shown in Table 2.

Table 3 describes the basic situation of the sample. 249 households did not participate in SLCP, and 54 households participated in SLCP.

Table 2. Description of variables.

Variables	Definition	Description
Outcome variable		
Total income (Y)	Per capita annual income of families.	Continuous variable
Agricultural income (Y1)	Per capita annual agricultural income, including net income from planting, net income from aquaculture, and net income from forestry production.	Continuous variable
Non-agricultural income (Y2)	Including non-agricultural wage net income and other non-agricultural production and operation net income.	Continuous variable
Treatment variable		
SLCP (D1)	Whether to participate in SLCP.	Yes = 1; No = 0
Covariate		
Going out to work (X1)	Whether the family goes out to work.	Yes = 1; No = 0
Number of family members (X2)	The total number of family members.	Continuous variable
Proportion of labor force (X3)	The ratio of labor force to total family population.	Continuous variable
Education level of laborers (X4)	This value is the average of the education level of each labor force member. The education level of each labor force member is assigned as follows. Order 1 is illiterate or semi-illiterate. Order 2 is primary school. Order 3 is junior high school. Order 4 is high school. Order 5 is junior college or above.	Continuous variable
Cultivated land area (X5)	-	Continuous variable
Woodland area (X6)	-	Continuous variable
Land degradation (X7)	Whether there is land degradation in the family.	Yes = 1; No = 0
Participation in cooperatives (X8)	Whether to participate in cooperatives.	Yes = 1; No = 0
Participation in Skills Training (X9)	Whether family members participate in skills training.	Yes = 1; No = 0
Loan (X10)	Whether there is a loan at home.	Yes = 1; No = 0
Owning durable consumer goods (X11)	Proportion of durable consumer goods owned at home. We set the total number to seven, namely TV, refrigerator, washing machine, car, motorcycle, computer, and others. This value is the proportion of the above items owned by the respondents farmers.	Continuous variable

The total income of households who participate in SLCP is higher than those who do not participate. The agricultural income is significantly higher for those who participate compared to those who do not participate. The non-agricultural income of farmers who have not participated in SLCP is higher than that of farmers who have returned farmland. The degree of participation in SLCP and going out to work is low. In addition, families with a highly educated labor force are more willing to participate in SLCP. Families who participate in skills training and have a high proportion of durable consumer goods at home are more involved in SLCP. The difference between the two groups is significant at 5%.

3.4. Research Methodology

The influencing factors of farmers' income are various, and there are obvious synergistic effects and substitution effects among them [39] which leads to endogenous problems. Propensity Score Matching (PSM) is a research method to solve endogenous problems. PSM can better alleviate the systematic differences caused by the influence of observable "common factors" by constructing a "counterfactual outcome" hypothesis [40]. The income effect of farmers can be described by the difference between the income status of farmers who participate in SLCP and those who do not.

Table 3. Descriptive statistics of variables.

Variable Type	Variables	All Samples (N = 303)	Mean Value of Not Participating in SLCP (N = 249)	Mean Value of Participation in SLCP (N = 54)	Standard Deviation
Income	Total income (Y)	11,506.30	11,326.83	12,333.86	410.75
	Agricultural income (Y1)	2348.04	2104.55	3663.72	249.95 **
	Non-agricultural income (Y2)	7100.90	7129.30	6969.98	501.45
Human capital	Going out to work (X1)	0.35	0.37	0.22	0.15 **
	Number of family members (X2)	4.27	4.25	4.37	−0.12
	Proportion of labor force (X3)	0.62	0.62	0.63	−0.01
	Education level of laborers (X4)	2.78	2.60	2.81	0.21 **
Nature capital	Cultivated land area (X5)	5.66	5.64	5.76	−0.13
	Woodland area (X6)	13.34	12.44	17.48	−1.12
	Land degradation (X7)	0.05	0.05	0.07	−0.03
Social capital	Participation in cooperatives (X8)	0.84	0.84	0.87	−0.04
	Participation in Skills Training (X9)	0.74	0.72	0.85	−0.14 **
Financial capital	Loan (X10)	0.34	0.33	0.37	−0.04
Physical capital	Owning durable consumer goods (X11)	0.56	0.55	0.59	−0.04 **

Notes: ** indicate statistical significance at 5% respectively.

Farmers' choice to participate in the policy of SLCP is not random. Its selection process is usually influenced by factors such as livelihood capital, which may affect farmers' income at the same time and lead to systematic differences [40]. Due to the different initial endowments of involved households and uninvolved households, there is a "deviation" in the influence of farmers' participation in SLCP on their income. PSM can better alleviate the systematic differences caused by the influence of observable "common factors" by constructing a "counterfactual outcome" hypothesis [40]. The income effect of farmers can be described by the difference between the income status of farmers who participate in SLCP and those who do not. In reality, farmers can only get income in one state, and the unobservable situation contrary to reality is called "counterfactual event" [15]. For example, it is an unobservable counterfactual for farmers who participate in SLCP. PSM aims at this counterfactual problem to solve the sample selectivity deviation.

In the PSM method, the appropriate covariate set is selected first. Based on the selected covariate set, the tendency score of individuals to enter the treatment group is calculated by a logit model.

$$Y_i = \alpha + \beta_1 X_i + \beta_2 D_i + u_i \quad (1)$$

Virtual variable D_i is usually called "treatment variable". X_i is "covariate". Y_i is "covariate" of SLCP. Among them, Y_{1i} is the income of sample farmers after participation in SLCP. Y_{0i} is the income of sample farmers who participated in SLCP when they did not participate in SLCP. Since Y_{0i} cannot be observed in practice, it is obtained by PSM. After getting the score of matching, the treatment group and the control group were matched by the nearest neighbor caliper matching, the kernel matching, the local linear regression matching, and the radius matching method, respectively. The average value was then taken as the result. Finally, the average treatment effect (ATT) is calculated. That is, the influence of being involved in SLCP on the different income brackets is calculated. If the matching

effect is good, there is a large common support area between those who participate in SLCP and those who do not. There is a large range of overlapping intervals in the tendency score, which further shows that the PSM method is suitable for this study. The formula is:

$$ATT = \frac{1}{N_1} \sum_{i=D_i=1} (Y_{1i} - Y_{0i}) \quad (2)$$

Among them, ATT is the average treatment effect of sample farmers who participate in SLCP, and $N_1 = \sum_i D_i$ is the number of individuals in the treatment group.

4. Results

4.1. Control Variable Regression Analysis

Table 4 shows the results of regression analysis by introducing control variables and estimates the income effect of SLCP. It can be found that the coefficient of participation in SLCP is positive, from which it can be inferred that SLCP can promote farmers' income, but the effect is not significant. From the estimated results, SLCP can increase farmers' income by 436.97 yuan. At the level of 1%, the proportion of labor force is significant and has a positive impact on income, while the education level and forest land area of labor force have a negative impact on income at the level of 5%, the cultivated land area has a positive impact on income at the level of 5%, and the number of family members has a positive impact on farmers' income at the level of 10%. In addition, for migrant workers, whether there is land degradation, whether they have joined a cooperative, whether they have participated in skills training, whether they have loans at home, and whether they have durable consumer goods at home have not passed the significance test. Hence, they were not included in the model.

Table 4. Control variable analysis of total income effect of SLCP.

Independent Variable	Coef.	Std. Err.	T	P
SLCP (D1)	436.967	1208.156	0.36	0.718
Going out to work (X1)	−56.715	740.631	−0.08	0.939
Number of Family member (X2)	636.187	330.622	1.92	0.055 *
Proportion of labor force (X3)	11,312.030	1690.684	6.69	0.000 ***
Education level of laborers (X4)	−1177.044	567.832	−2.07	0.039 **
Cultivated land area (X5)	156.184	72.506	2.15	0.032 **
Woodland area (X6)	−2591.614	1089.359	−2.38	0.018 **
Land degradation (X7)	165.582	1717.034	0.1	0.923
Participation in cooperatives (X8)	−220.975	825.477	−0.27	0.789
Participation in Skills Training (X9)	997.462	948.495	1.05	0.294
Loan (X10)	−1018.958	754.456	−1.35	0.178
Owning durable consumer goods (X11)	3188.709	5117.083	0.62	0.534

Notes: *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively.

4.2. Estimation of Propensity Score by Logit Model

By logit regression of farmers' participation in SLCP, the logit estimate of the χ^2 score is 23.1, and the probability is less than P is 0, which shows that the overall fitting effect of the whole model is good and the model is remarkable as a whole. The results are shown in Table 5. In human capital, going out to work has a restraining effect on farmers' participation in SLCP at a significance level of 5%, and less migrant workers participate in it. Education level of laborers at a significance level of 1% inhibits farmers' participation in SLCP. The higher the education level, the less farmers participate in SLCP. Whether social capital has participated in skills training can promote farmers' participation in SLCP at a significance level of 5%. In physical capital, the situation of owning durable consumer goods at home can promote farmers' participation in SLCP at a significance level of 10%. The higher the proportion of owning durable consumer goods at home, the easier it is for farmers to participate in SLCP.

4.3. Estimation of Average Treatment Effect on the Treated

We use three matching methods to check the balance by changing the estimation strategy. After the propensity score is matched, the estimated results of farmers' participation in SLCP income are shown in Table 6. The T values obtained by using four PSM methods (Nearest Neighbor Matching, Kernel Matching, Llr Matching, Radius Matching) are all less than those obtained by regression analysis of control variables. The ATTs of farmers' total income and agricultural income are all positive, but the T values are not significant. It indicates that SLCP can promote an increase in total income and agricultural income, with the promotion effects after matching of 5.2% and 43.2%, respectively. However, the effect is not obvious. The ATT of non-agricultural income is negative, and its T value is not significant. It indicates that SLCP has an inhibitory effect on non-agricultural income, with a 9.8% inhibitory effect after matching. However, it too is not significant.

Table 5. Estimation results of logit model for PSM.

Independent Variable	Coef.	Std. Err.	Z	P	95% Confidence Interval	
Going out to work (X1)	−0.784	0.365	−2.15	0.032 **	−1.499	−0.069
Number of family members (X2)	0.070	0.116	0.60	0.549	−0.158	0.297
Proportion of labor force (X3)	0.249	0.663	0.38	0.707	−1.051	1.550
Education level of laborers (X4)	−0.741	0.281	−2.64	0.008 ***	−1.292	−0.191
Cultivated land area (X5)	0.005	0.027	0.20	0.84	0.048	1.005
Woodland area (X6)	0.070	0.455	0.15	0.878	−0.822	0.962
Land degradation (X7)	0.777	0.657	1.18	0.237	−0.511	2.065
Participation in cooperatives (X8)	0.252	0.460	0.55	0.585	−0.651	1.154
Participation in Skills Training (X9)	0.873	0.434	2.01	0.044 **	0.022	1.724
Loan (X10)	0.161	0.331	0.49	0.627	−0.488	0.810
Owning durable consumer goods (X11)	2.885	1.630	1.77	0.077 **	−0.310	6.081

Notes: **, *** indicate statistical significance at 5%, and 1%, respectively.

Table 6. Average treatment effects of SLCP on different incomes of farmers.

Dependent Variable		Treated	Control	ATT	Std. Err.	t
Total income (Y)	Unmatched	12,333.86	11,326.83	1007.024 (8.9%)	1073.528	0.94
	Matched	12,428.89	11,813.09	615.7933 (5.2%)	1536.326	0.40
Agricultural income (Y1)	Unmatched	3470.792	2104.553	1366.239 (64.9%)	649.4575	2.10 **
	Matched	3456.513	2414.059	1042.454 (43.2%)	1029.471	1.01
Non-agricultural income (Y2)	Unmatched	6969.982	7129.297	−159.315 (−2.2%)	1312.452	−0.12
	Matched	6835.272	7580.134	−744.861 (−9.8%)	1686.118	−0.43

Note: The final result is the average of the results calculated by the four methods as Nearest Neighbor Matching; Kernel Matching; Llr Matching; Radius Matching. ** indicate statistical significance at 10%, 5%, and 1%, respectively. The corresponding *t* values are 1.68, 1.96, and 2.58, respectively.

4.4. Matching Quality Analysis by Robustness Test

In this paper, through the hypothesis of common support and the hypothesis test of balance, it can be seen from the distribution map of tendency score kernel density before and after matching (Figure 3) that the two groups of samples in the research area after matching have large overlapping areas in the tendency score density. It indicates that the tendency value matching sufficiently meets the common support condition. The absolute value of standard deviation after matching is less than 20%, which shows that the matching result can pass the robustness test [41]. The results of the balance test show that the absolute value of standard deviation after matching is less than 10%, and the deviation rate of most variables is greatly reduced. The result of the variable T test does not reject the original hypothesis that there is no systematic difference between the treatment group and the control group. The difference between variable groups is not significant, and it can pass the robustness test. Overall, the trend value matching achieves a good balance effect. Moreover, there is no obvious difference in the characteristic attributes of the combined control group, which meets the requirements of randomness and passes the balance test.

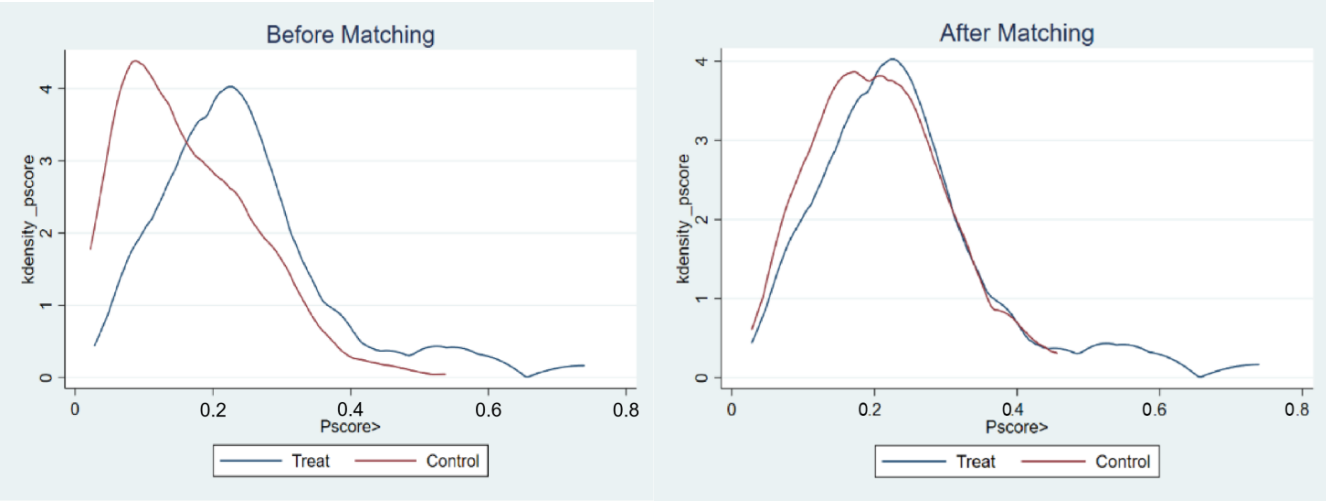

Figure 3. Tendency value kernel density before and after matching.

5. Discussion

The livelihood of farmers is a very important issue, and the income of farmers is the most direct reflection of their livelihood situation. Only by stabilizing the people's livelihood can the policy play its role better. We measure the effect of SLCP on different incomes by using the PSM method, and the following problems are worth further discussion.

- SLCP promotes farmers' income growth, but it is not significant.

For rocky desertification areas, the ecological benefits brought by the compensation policy of SLCP are much higher than its economic benefits. It may be because SLCP mainly changes the economic structure of farmers' families in rocky desertification areas [19] and the local ecological environment [42]. In mountainous areas and rocky desertification areas, agricultural labor production efficiency is low and cultivated land is reduced. The marginalization of farmland has accelerated rural migration under urbanization, which has become a common trend. At the same time, it also leads farmers to choose different methods to improve agricultural productivity. Farmers can no longer rely on the traditional farming model to obtain the maximum benefits. They improve their efficiency by adjusting the agricultural structure, and then increase their income [43]. SLCP helps to adjust the agricultural industrial structure and promote the development of industrial agriculture, so the increase in income in the short term is not obvious. At the same time, the direct subsidy funds of SLCP come from the government, and the government subsidy funds are low and there is a time limit, which cannot meet the needs of farmers to increase their income. Therefore, although SLCP increases income, it is not significant, which is consistent with the results of another study [22]. This is also consistent with H1.

According to our research, we found that SLCP forces farmers to change their livelihood strategies to overcome situations where its subsidies cease [44]. SLCP can increase the income of farmers in areas with poor ecological environments, such as rocky desertification areas, especially in Guizhou and Guangxi. This policy increases total income mainly by increasing agricultural income.

- SLCP has increased agricultural income to some extent.

The advantage of SLCP in adjusting industrial structure is also reflected in the increase of agricultural income. On the one hand, due to the soil quality, agriculture in the original karst area was poorly developed and the innate resource endowment was poor, resulting in low agricultural income. However, after the implementation of SLCP, the industrial structure was adjusted, and the land was used better again, which increased agricultural income. This is also consistent with H2. Although farmers' income from traditional farming and planting may be even lower because of their participation in SLCP, after the land use

efficiency is improved, they can regain different types of agricultural income by developing new industrial models, such as forest planting, undergrowth economy, and undergrowth breeding in the research area. However, due to the small-scale peasant economy and other reasons [37], the effect of increasing farmers' income is not good.

- After returning farmland, SLCP did not promote the increase of non-agricultural income.

The experimental results are inconsistent with H3. The mechanism of SLCP to promote farmers' non-agricultural employment income can be understood as that the farmers who return farmland are agricultural surplus labor, and they can invest in other industries to work—that is, engage in non-agricultural work—to obtain wage income and improve their overall income. From the perspective of the migration of the agricultural labor force to other regions, it is not enough to guide farmers' non-agricultural employment after returning farmland, which makes farmers unable to obtain significant non-agricultural income. According to the descriptive statistical results, we can also find that the degree of migrant workers who participate in returning farmland is lower than that of farmers who do not participate in returning farmland. This is not only reflective of the low enthusiasm of labor transfer brought by returning farmland, but also shows that the overall guidance of non-agricultural employment in this area is not enough, and farmers' willingness to move abroad to get high wages is weak. From the perspective of labor migration to other agricultural models in the region, the research area has established forestry specialized cooperative organizations and introduced leading agricultural (forestry) enterprises, so that farmers can get corresponding dividends and wage income without going out to work. Nonetheless, its short-term effect is not as high as that of migrant workers. In addition, the outbreak of COVID-19 has further blocked farmers from going out to work, resulting in a decrease in non-agricultural income. This result is consistent with an existing study. Family structure will also affect the impact of SLCP on farmers' livelihoods, which makes the agricultural labor force unable to transform to non-agricultural occupations after participating in SLCP [19].

Although the sample selected in this article is representative and comes from a typical area of rocky desertification, we still need to strive to obtain more comprehensive data in the future, aiming to cover a wider range of times and obtain more reliable results.

6. Conclusions

On the basis of understanding the influencing factors of farmers' income according to the theory of livelihood capital, this paper measures the effects of the project of SLCP on farmers' income in rocky desertification areas by using the method of PSM. The main conclusions are as follows:

(1) SLCP promoted the total household income of farmers to increase by 5.2%, agricultural income to increase by 43.2%, and non-agricultural income to decrease by 9.8%. Although SLCP generally promotes income increase, it fails to promote non-agricultural transformation sufficiently to obtain more income. SLCP's ecological contribution has achieved remarkable results, but its social and economic effects still need to be improved.

(2) Farmers' participation in SLCP is influenced by going out to work and education level in human capital, participation in skills training in social capital, and owning durable consumer goods in physical capital.

The formulation of policies should be comprehensively considered from the long-term and short-term. Although SLCP will promote economic development under the condition of improving the ecological environment in the future, it is not advisable to exchange farmers' livelihoods for ecological construction at present. We need to consider the policy from a long-term and systematic perspective. The implementation of SLCP should consider not only the overall ecological benefits, but also the short-term social and economic benefits. This study provides a theoretical basis for the government to implement and optimize SLCP.

We propose to vigorously develop the forestry industry, including characteristic fruit forests, under-forest economic industries, special forest product processing industries, and forest tourism and forest health care industries, and so on. Furthermore, the governments

of rocky desertification areas should focus on farmers' professional organizations and give play to the effect of economies of scale through agricultural specialized organizations. Overall, the local governments should improve the agricultural income of farmers in many different ways.

Above all, we believe that local government plays an important role in this PES program. It means that after the SLCP, the local government should establish a mechanism to protect the interests of farmers who have returned farmland. Strengthen the guidance of non-agricultural employment so that farmers can benefit directly or indirectly from participating in ecosystem restoration projects and improve their quality of life. Reward the returning farmland households by means of work instead of relief and provide jobs for returning those people. While ensuring the smooth implementation of the policy, the government should focus on the income of farmers who are relatively poor and who go out to work and return home. Enrich the forestry transfer income sources of relatively poor farmers in rocky desertification areas to strengthen the skills training and welfare guarantee of this group. Moreover, for each project, the source of funds is crucial. Importantly, we believe that local government should attract social institutions and enterprises to participate in paid projects to increase the source of funds. The implementation of SLCP should introduce society and enterprises to obtain more channels for payment.

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