Analyze the Effect of Farmland Protection Compensation Policy Based on Propensity Score Matching Model

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Abstract: Farmland ecological compensation policy is a tool used by the government to redistribute economic benefits of beneficiaries and destroyers through fiscal, taxation, and market adjustments, which can effectively to enhance the value of ecosystem services. Taking Chengdu, which is the first area to develop farmland protection and compensation policies, as an example, combined with 1180 survey data of farmers, using the Propensity Score Matching model and Kernel Distribution Curve, to analyse the impact of compensation policies on the household income, the household expenditure, the labour to supply, and the non-agricultural labours transfer of the interviewed farmers. Research shows that the implementation of compensation policies can significantly increase the per capital income and per capital expenditure of the beneficiary farmers. Compensation policies can increase the investment of beneficiary farmers' households in agricultural labours and reduce the transfer of non-agricultural labours from beneficiary farmers' families.

Keywords: farmland protection compensation policies; farmer participation; economic incentives; policy effect; propensity score matching

1 INTRODUCTION

Farmland ecological compensation policy (FECP) is based on ecological environmental protection, through fiscal, taxation and market regulation, a policy means to redistribute economic benefits of beneficiaries and destroyers. Compared with developed countries, my country's farmland also undertakes very complex and important ecological functions. As one of the important ecosystems, the ecological and environmental benefits of farmland have received more attention and recognition. Some areas with relatively developed economies are also actively exploring practical models of economic compensation for farmland protection, mobilizing farmers' enthusiasm for protecting the ecological environment of farmland through economic incentives and other means. Farmers voluntarily sign agreements to participate in farmland protection, and obtain technical assistance, financial subsidies and economic compensation. The current research are mainly carried out from the aspects of policy goal

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design [1], public satisfaction [2], policy awareness [3], compensation policy management [4], compensation mechanism [5], etc. There are more studies in the early stage of compensation policy. Few people deeply analyze the effectiveness of policies, policy heterogeneity, and effective types of policy participation. Therefore, this article uses Chengdu survey data and a propensity score matching model to analyze the impact on compensation policies on the farm household income, the household expenditure, the agricultural labour supply, and the non-agricultural labour transfer.

2 DATA VARIABLES AND RESEARCH METHOD

2.1 Variable Description

- Participation Variables

The explanatory variable is “whether the farmer receives the farmland protection compensation”. If the farmer receives the compensation fund, it is assigned a value of 1, and which is set as the experimental group. If the farmer does not receive the compensation fund, it is assigned a value of 0 and set as the control group.

- Output Variable

The farm household income, the household expenditure, the agricultural labour supply, and the non-agricultural labour supply are used as the output variables of the model.

- Match Variable

This set of control variables has a significant impact on characteristic factors such as "whether the farmer receives compensation funds for farmland protection" and "income and expenditure of the family".

Tab.1 Variable description

Variable	symbol	Variable description
Average household income	X_1	Net household income per capital
Average household expenditure	X_2	Net household expenditure per capital
Family non-agricultural labour force	X_3	Number of family non-agricultural labour
Family agricultural labour force	X_4	Number of family agricultural labour
Policy satisfaction	X_5	Very significant-very insignificant = 5-1
Maintain the area of farmland not to decrease	X_6	Very significant-very insignificant = 5-1
Mobilize the enthusiasm for protecting farmland	X_7	Very significant-very insignificant = 5-1
Improve the ecological environment of farmland	X_8	Very significant-very insignificant = 5-1
Adjust the planting structure of contracted land	X_9	Very significant-very insignificant = 5-1
Increase investment in agricultural	X_{10}	Very significant-very insignificant = 5-1

production		
Speed up land circulation	X_{11}	Very significant-very insignificant = 5-1

2.2 Research methods

In this paper, the individual characteristic factors of the sample of the Propensity Score Matching (PSM) model are set as the covariant X, and the “participation variable” is set as the explained variable of the regression model [6-7]. Then, we calculate the propensity score, and using regression methods to calculate the propensity score for the individuals that can be matched. The difference between the farmers participating in the compensation policy and not participating in the compensation policy is the Average Treatment Effect (ATE) of the farmland protection compensation policy.

2.3 Conditional hypothesis

This paper uses the PSM Model to evaluate the impact of FECP on the income and expenditure of different farm households. The propensity score matching model needs to satisfy two basic assumptions [8].

- Conditional independence assumption:

After controlling for the common influencing factor X, the incomes of the beneficiary farmers and the non-beneficiary farmers are mutually independent.

$$(Y_i^1, Y_i^0) \perp X_{\mathrm{i}} \tag{1}$$

- Common support conditions:

Using propensity scores to ensure that farmers who can be matched between the treatment group and the control group.

$$0 < P_r(D_i = 1 \left| X_i \right.) < 1 \tag{2}$$

2.4 Average Treatment Effect

The Average Treatment Effect of the compensation policies is shown in formula (3).

- Average Treatment Effect (ATE) [9]

The model results to indicate that the interviewed households with characteristic value X are randomly selected, and the average value of the average income effect are used to indicate the average income effect if the interviewed household participates in the farmland protection compensation policy. Randomly select the interviewed households whose characteristic value is X, and use the average value of the income effect to express "If all the compensation policies are implemented, then the average income effect of the interviewed households".

$$ATE = E[(Y_i^1 - Y_i^0] \left| X_i \right.] \tag{3}$$

- Average Treatment Effect for Treated (ATT) [9]

ATT means randomly selecting interviewed households whose characteristic value is X, and using the mean value of the average income effect to represent the average income effect if the interviewed household has participated in the farmland protection compensation policy. Using the average value of the income effect to reflect the average income effects of rural households in the area where the compensation policy has been implemented.

$$ATT = E[(Y_i^1 - Y_i^0] \left| X_i, D_i = 1\right] \tag{4}$$

- Average Treatment Effect for Controlled (ATC) [9]

Using the average value of the income effects to represent the average income effect when the compensation policy is assumed to be implemented.

$$ATC = E[(Y_i^1 - Y_i^0] \left| X_i, D_i = 0\right] \tag{5}$$

Among them, Y_i^1 represents the income of the beneficiary farmers' households that have received economic compensation for farmland protection, and Y_i^0 represents the income of the non-beneficiary farmers' households that have not received the economic compensation for farmland protection.

3 EFFECT OF FARMERS PARTICIPATING IN FARMLAND PROTECTION COMPENSATION POLICY

3.1 Kernel distribution curve test

According to the Kernel distribution curve of farmers in Chengdu in 2012, the peaks of the D=0 curve and the D=1 curve before and after matching is relatively close, both around 0.65. The trend of the two curves is relatively flat, the sample distribution is relatively uniform, and the intersection point Appears near 0.55. However, judging from the overall trend of the two curves, there is no significant difference in the probability of benefiting from the policy of the treatment group and the control group in Chengdu.

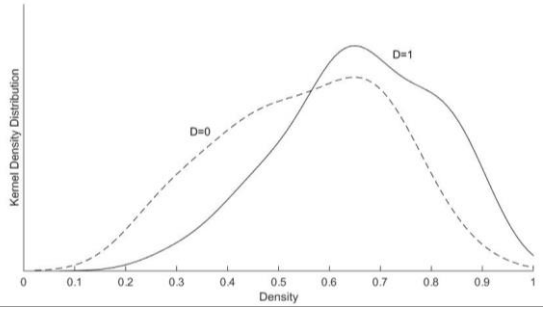

Fig.1 Kernel distribution curve in CHENGDU of 2012

In 2015, from the perspective of the Kernel distribution curve of rural households in Chengdu, the overall fluctuation of the D=0 curve was relatively large, with a peak value around 0.15. The change was significant before the peak, and the change was relatively gentle after the peak. The distribution trend of the D=1 curve is basically the same as that of the D=0 curve. The peak value appears near 0.25, and then rises faster, and the overall trend approaches 1.

Judging from the changing trends of the two nuclear density distribution curves, the first intersection appears at the 0.25 annex, and the changing trends between 0.35-0.45 are basically the same. The probability of farmers benefiting from the policy in the control group is not significantly different from that on the treatment group.

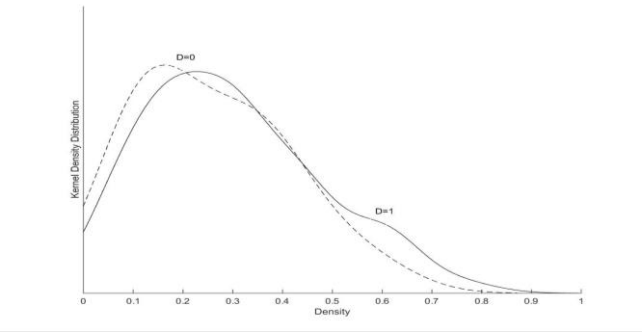

Fig.2 Kernel distribution curve in CHENGDU of 2015

3.2 The net impact of compensation policies on rural household income

As shown in Table 2, in 2015, the average treatment effect (ATT) of the compensation policy in Chengdu on the household income of beneficiary farmers was significant at the level of 1%. Among them, the per capital annual income of beneficiary farmers is 1,131 RMB higher than the per capital annual income of non-beneficiary farmers. It can be seen that the compensation policy of farmland protection for Chengdu can significantly increase the per capital income of beneficiary farmers.

Tab.2 average treatment effect on the famer household income

Years	Nearest neighbour matching		Radius matching		ATE	
	ATT_1	ATE_1	ATT_2	ATE_2	ATT	ATE
2012	14044(0.22)	1968	14044(-0.41)	-1696	14044	181
2015	18176***(2.53)	2144	18176***(5.59)	744	18176	1131

3.3 The net impact on compensation policies on rural household expenditures

The data results from Table 3 indicates that: the farmland protection compensation policy implemented in Chengdu has a significant effect on average treatment effect of beneficiary farmers' household expenditure at the level of 1%.

Tab.3 average treatment effect on the famer household expenditure

Years	Nearest neighbour matching		Radius matching		ATE	
	ATT_1	ATE_1	ATT_2	ATE_2	ATT	ATE
2012	5080(0.55)	272	5080***(-2.79)	552	5080	285
2015	8601(-0.34)	524	8601***(-6.82)	556	8601	418

This shows that under the condition that other factors remain unchanged, in 2012, the farmland protection and compensation policy made the per capital expenditure of beneficiary farmers' households 285 RMB higher than that of non-beneficiary farmers' households. In 2015, the average treatment effect of the compensation policy on the economic expenditure of rural households was 418 RMB. It can be seen that the compensation policy of farmland protection can significantly increase the family expenditure of the beneficiary farmers. In addition, the average treatment effect of the compensation policy on the economic expenditure of the beneficiary farmers' households is more significant and effective in the mid-term of the policy.

3.4 The net impact on the compensation policies on the agricultural labours supply

The impact on the compensation policy on Farmers' family agricultural labours forces is shown in Table 4. The compensation policy has a significant positive impact on increasing the agricultural labours input of beneficiary families, and it is significant at the level of 1%. Under the condition that other family characteristics remain unchanged, the number of beneficiaries households participating in the compensation policy engaged in agricultural labours increased by 0.006 and 0.007 on average compared with non-beneficiary households. In other words, the number of agricultural labours forces of beneficiary households participating in the compensation policy is significantly higher than that of non-beneficiary households. Farmers who receive compensation funds have more family agricultural labours forces than farmers that do not receive the compensation funds.

Tab.4 the average treatment effect on famer household agricultural labours

Years	Nearest neighbour matching		Radius matching		ATE	
	ATT_1	ATE_1	ATT_2	ATE_2	ATT	ATE
2012	1.234(-0.93)	0.053	1.234***(-3.27)	0.006	1.234	0.010
2015	0.885(-1.76)	0.084	0.885***(2.71)	0.007	0.885	0.014

3.5 The net impact of compensation policies on the non-agricultural labours transfer

The average treatment effect of farmland protection compensation policy on non-agricultural labours forces of beneficiary households is shown in Table 5. From the estimated results of ATT and ate, in 2015, the implementation of the compensation policy had a significant negative impact on reducing the non-agricultural labours input of farmers' families, and it was significant at the level of 1%. Among them, the number of labours forces engaged in non-agricultural employment in beneficiary households is 0.008 less than that in non-beneficiary households. Overall, the implementation of the compensation policy can reduce the probability of benefiting

farmers' families engaging in non-agricultural employment and reduce the input of family non-agricultural labours forces to a certain extent.

Tab.5 average treatment effect on famer household non-agricultural labours

Years	Nearest neighbour matching		Radius matching		ATE	
	ATT_1	ATE_1	ATT_2	ATE_2	ATT	ATE
2012	1.401**(1.97)	0.170	1.401(1.00)	-0.012	1.401	0.098
2015	1.481(0.56)	-0.004	1.481***(3.47)	-0.008	1.481	0.061

4 CONCLUSION

Taking the survey data onto farmers as an example to analyse the impact on farmland protection and compensation policies on the household income, the household expenditure, labour input, and non-agricultural labours transfer of the interviewed farmers. Research shows that the implementation of farmland protection and compensation policies can significantly increase the per capital annual income and per capital expenditure of the beneficiary farmers. Among them, the average income of beneficiary farmers increased by 1,131 RMB compared with non-beneficiary families, and the average expenditure of beneficiary farmers' families were 285 RMB more than that of non-beneficiary farmers. In addition, the compensation policy of farmland protection can increase the investment of beneficiary farmers' families in agricultural labours, with an average of 0.006 and 0.007 labours. Compensation policies can reduce the input of non-agricultural labours for beneficiary farmers. By 2015, the implementation of compensation policies will reduce the number of labourer's engaged in non-agricultural employment in beneficiary farmers by an average of 0.008 labours compared with non-beneficiary farmers.

This paper verifies the effectiveness of promoting farmers' participation policies through economic incentives, and screens the types of effective farmers participating in the policies, and provides a reference for optimizing and perfecting my country's farmland protection economic compensation system.

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