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Does Construction of High-Standard Farmland Improve Recycle Behavior of Agricultural Film? Evidence from Sichuan, China

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Abstract: Recycle behavior of agricultural film (RBAF) plays an important role in protecting the ecological environment of farmland. Improving RBAF has become an urgent choice for agricultural countries to achieve sustainable development. Construction of high-standard farmland (CHSF) is defined as the artificial improvement of farmland facilities and considered beneficial to agricultural production and farmland environment. This study aims to evaluate the role of CHSF in improving RBAF. Based on survey data of rural areas in Sichuan, China, this study explores quantitative impacts of CHSF on RBAF by econometric model. The results are as follows: (1) There is a positive impact of CHSF on RBAF, i.e., compared with the farmers not participating in CHSF, the possibility of RBAF for the farmers participating in CHSF is increased by 16%. (2) For every 1% increase in the proportion of agricultural labor force in households, the possibility of RBAF is increased by 0.2%. Thus, this study indicates that governments should focus on improving rural infrastructure to help farmers improve their behavior towards environmental protection.

Keywords: high-standard farmland; agricultural film; recycle behavior; plastic pollution; rural China

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1. Introduction

The world population explosion and global climate change have brought great challenges to agricultural production. OECD and FAO [1] point out that with the increasing population, the global population is expected to reach 8.5 billion by 2030. To face the growing population pressure, expanding the agricultural planting area, increasing the yield per unit area, and reduction of food wastage are still important means to improve the expected yield of crops [2]. At present, oil agriculture, which relies on increasing the input of chemical fertilizers, pesticides, and agricultural film, is the main way to improve agricultural productivity. However, the agricultural non-point source pollution brought by oil agriculture is threatening the sustainability of the global ecosystem.

At the same time, the negative impact of extreme temperature and heavy rainfall on food production is increasing [3]. Thus, how to deal with extreme temperature and heavy rainfall becomes the key to improving agricultural productivity [4]. Xiukang et al. [5] and Liu et al. [6] considered that agricultural film plays a positive role in covering negative effect from extreme temperature and heavy rainfall for agricultural production. Zhang et al. [7] found that using plastic film can increase crop yield by 25–42%. Therefore, agricultural film is widely used in agricultural production. The global agricultural land occupies more than one third of the land area [8]. According to statistics, the global annual use of agricultural film reaches more than 2 million tons [9]. Moreover, the quantity and application fields of agricultural film are growing steadily [10].

However, less recycle behavior of agricultural film will pose a great threat to the ecological environment and human beings. Zhao [11] pointed out that film, as the most common plastic chemical product in agricultural production, is not easily eroded by microorganisms. The self-degradation cycle is generally 200–300 years. There are many toxic substances in the degradation process. Agricultural plastic mulching is a potential key source of microplastics pollution in a terrestrial ecosystem [12]. If the used agricultural film is not recycled in time and allowed to be discarded in the environment or landfilled [6], it may have a negative impact on the ecological environment and human health. For example, Zhao [11] believed that the plastic film remaining in the soil will change or destroy the continuity of the internal voids of the soil, and prevent the infiltration and flow of water in the plough layer and the surface layer of the soil, which will cause soil hardening and land salinization. Qian et al. [13] considered that the residue of agricultural film also significantly reduces the activities of soil carbon and nitrogen cycle-related factors and enzymes such as S-β-GC and S-UE. It is one of the reasons for the decline of soil organic matter content and soil fertility. Huang et al. [14] found that the plastic particles left in agricultural film can be absorbed by soil microorganisms and transferred to crops. Plants absorb microplastics from the soil via the crack-entry mode [15], causing damage to human health. In particular, Leslie et al. [16] recently found microplastics in human blood. Dioxins released from plastic polymers are deadly persistent organic pollutants, which can cause tumors and nerve damage in humans [17]. Therefore, how to promote the recycling of agricultural film is an urgent topic to be studied.

Generally speaking, farmers are the main body of agricultural production [18–20], so promoting farmers' recycle behavior of agricultural film is the main way to deal with the problem of agricultural film pollution. RBAF refers to the pro-environmental behavior of recycling the used agricultural film in the field. However, the recovery rate of agricultural film is low all over the world. Especially for developing countries that are backward in agricultural technology and rely on agricultural production, farmers' enthusiasm for recycling agricultural film is not strong. For example, Wang et al.'s study [21], based on the survey data of Hubei Province in China in 2014, found that the recovery rate of residual film by farmers was less than 40%. In the study of 60 Indian cities in 2015, Rafey and Siddiqui [22] found that the recovery rate of agricultural plastics was about 60%. In their investigation on the follow-up treatment of plastic covers in Pakistan, Kasirajan and Ngouajio [23] found that less than 5% of agricultural plastics were recycled, and most of them were landfilled or incinerated. Therefore, it is urgent to discuss how to improve farmers' RBAF.

In recent years, the Chinese government has been promoting the construction of a high standard of farmland policy. CHSF is defined as follows: As an agricultural infrastructure construction project, CHSF is to upgrade basic farmland into high-standard farmland that can adapt to modern agricultural production and management mode according to land use planning and land consolidation planning within a certain period of time. It aims to improve the farmland facilities by artificial works, and to make farmland concentrated and flat, well-equipped, of high yield, and ecologically sound [24–26]. In this manner, construction of high-standard farmland may help meet people's needs for upgrading food and food consumption, and further ensure food security. In fact, construction of high-standard farmland funds are jointly funded by the central government and local governments, which has had a positive impact on China's agriculture. For example, Pu et al. [24] found that farmland productivity was increased by 3.30~88.10%, which they owed to the construction of high-standard farmland in Liaoning Province, China. Zhou et al. [27] also believed that China's land consolidation has played an irreplaceable role in stabilizing the dynamic balance of cultivated land and ensuring food security, which is conducive to the development of modern agriculture, poverty alleviation, rural revitalization, and regional sustainable development. Compared with ordinary farmland, the agricultural infrastructure of high-standard farmland is more complete. For example, by increasing the possibility of using machinery in agricultural production, the agricultural production efficiency is improved [28–30]. This may also create favorable conditions for farmers to recycle films. However, few studies have discussed the impact of construction of high-standard farmland on farmer's recycle behavior of agricultural film.

The Chinese government is actively promoting the rural revitalization strategy. Its core goal is to systematically establish the coupling mode of various rural development factors, including population, land, and industry [31]. Land consolidation has been endowed with a new connotation. It should not only aim at activating the key elements of rural development, but also pay attention to the coordination of material space and spiritual core, and the integration of a material space reconstruction and rural governance system. Construction of high-standard farmland is an important part of land consolidation and plays an important role in realizing the strategy of rural revitalization in China.

Therefore, the purpose of this study was based on data from China's Sichuan Province's 397 farmers, and at the village-level, this study quantitatively evaluates the impact of construction of high-standard farmland on farmers' recycle behavior of agricultural film. The research results will help to provide a basis for formulating policies to revitalize rural areas, and will also help to provide a reference for developing countries around the world to improve their rural environment.

Compared with existing studies, the marginal contributions of this study are as follows: (1) The existing research focuses on the harm and recycling behavior of plastic film in urban life. This research mainly focuses on the recycle behavior of agricultural film in the field of agriculture. (2) Existing studies pay more attention to the impact of cognitive, personal characteristics and other factors on recycle behavior of agricultural film. From a new perspective, this study mainly evaluates the impact of construction of high-standard farmland on farmers' recycle behavior of agricultural film. In addition, developing countries use a large amount of agricultural film and are more polluted by agricultural film. This study takes China, the largest developing country in the world, as a case area. The results of the study will help provide reference for developing countries around the world to improve the rural environment.

2. Theoretical Analysis

Recycling of agricultural film is not only an agricultural production behavior, but also one of the important environmental protection measures [21,32,33]. The recycling and utilization of agricultural film can well extend the service life of agricultural film and reduce the consumption of plastic film [34], which is more profitable and environmentally friendly than the new plastic film [35]. Thus, the problem of agricultural plastic pollution can be alleviated [36] and the ecological environment of farmland can be protected [37], which is conducive to the sustainable development of agriculture. At present, there is a gap in the literature on the relationship between CHSF and the adoption of RBAF. Most literature studies related to the CHSF believe that CHSF is an important way to ensure national food security, increase farmers' income, realize agricultural modernization, implement a rural revitalization strategy, and promote rural modernization [38,39]. Studies have confirmed that the implementation of CHSF in China has produced ecological benefits that cannot be ignored [40,41], so it is necessary to explore the impact mechanism of CHSF on RBAF. In the pursuit of yield and benefit in agricultural production, ignoring the quality and safety of agricultural products and environmental protection leads to the decision of whether farmers should take the RBAF, and the low willingness to adopt the RBAF will not be conducive to the green sustainability of agricultural production in the long term. This study believes that participation in CHSF can improve the willingness of farmers to adopt RBAF through the material and consciousness perspectives, and improve agricultural production, which is conducive to the sustainability of agricultural production.

As a pro-environmental behavior, RBAF is affected by the following factors: (1) The cognition of agricultural film pollution will affect farmers' RBAF. Xue et al. [42], Hou et al. [43], and Wang et al. [44] found that cognition has a significant impact on farmers' RBAF, and the lack of pollution cognition will reduce people's pro-environmental behavior. Xue et al. [42] found that compared with farmers with high awareness of agricultural film pollution, farmers with low awareness of agricultural film pollution have poor RBAF. The government should encourage farmers to take measures to protect the environment, strengthen environmental protection publicity, and improve their environmental protection attitude and awareness. (2) Farmers' individual characteristics such as age and gender will affect farmers' RBAF. Liu et al. [45] found that the aging of rural population has an adverse impact on farmers' adoption of cleaner production. The aging of rural population inhibits farmers' cleaner production behavior by reducing their learning ability. Wang et al. [46] found that the gender differences among agricultural producers will affect their willingness to adopt pro-environmental technologies. Male individuals are more likely to accept new things than female individuals [47]. (3) The impact of household characteristics on farmers' RBAF. Cai-hong et al. [48] and Feng et al. [49] found that annual per capita household income, the proportion of household labor force, and the proportion of agricultural income have a positive impact on the adoption of pro-environmental technologies. Tsegaye et al. [50], Xie and Huang [51], and Kong [52] found that household size, degree of land fragmentation, and proportion of non-agricultural income may inhibit farmers from adopting eco agricultural technology. (4) The influence of social capital and social norms. Jin [53] found that various components of social capital can have different effects on individual behavior according to the background of environmental problems. Promoting citizens' awareness of sustainable environmental protection should be a priority to achieve effective government policies. Keizer and Schultz [54] and Jans [55] considered that social norms and social identity, such as formal system and informal system, have a direct or indirect impact on farmers' RBAF. For example, Li et al. [56] studied the impact mechanism of China's representative informal institutional environmental village regulations on RBAF. He found that environmental village rules and regulations have a significant direct and positive impact on RBAF, and as an informal institution, village rules and regulations play a greater role in improving farmers' awareness of agricultural plastic film pollution than government regulations [42].

However, the RBAF may have some positive externalities. Specifically, the RBAF is beneficial to the environment, but these environmental benefits cannot be fully shared by the farmers who implement the RBAF. At the same time, compared with not using RBAF, RBAF will also increase the additional labor cost investment in agricultural production. For example, if the thinner film is used in the field for a long time, recycling costs will be more expensive. Thus, if farmers recycle agricultural film under the above situation, they will pay a higher labor cost. As a result, they have to lower the possibility of RBAF. In China, the film used by most farmers is very thin (10 mm), which is usually difficult to remove from the farmland [57]. In other words, farmers cannot obtain full environmental benefits from RBAF, and their welfare will be damaged due to the positive externalities of RBAF. Therefore, it is urgent to improve the production conditions of farmers and reduce the cost of RBAF. It is necessary to study how CHSF affects RBAF. As a return, it is possible to improve the enthusiasm of farmers to recycle film.

2.1. CHSF Directly Affects RBAF

(1) As a formal system and social norm [54,58], CHSF's contents include provisions on green production, ecological protection, resource saving, and improving the utilization rate of agricultural production inputs, which promote the government's incentive policies for agricultural film recycling. Under the influence of public constraints [59], it will directly promote farmers to adopt RBAF.

2.2. CHSF Indirectly Affects RBAF

(1) CHSF improves the basic environment of farmland and reduces the cost through field consolidation, soil improvement, road construction, field management and protection, and other material forms [60,61]. On the one hand, a flat and wide farmland environment creates conditions for the relevant agricultural film recycling machinery and equipment services [62] and reduces the mechanical cost of agricultural film recycling. On the other hand, for farmers who take the decision of manual recycling of agricultural film, a good farmland environment improves the convenience of recycling agricultural film, reduces the labor cost, and thus promotes their willingness to take RBAF.

(2) CHSF plays the role of an informal system [56] by holding meetings and discussions, knowledge lectures, environmental protection technology training, cadre publicity, and other forms of consciousness, which improves farmers' awareness of the problem of agricultural film pollution and environmental protection. These achieve the role of propaganda. For farmers with better cognition of agricultural film pollution, they will pay more attention to ecological environmental protection in the process of agricultural production and actively adopt the RBAF.

In summary, there are various ways for the CHSF to influence the RBAF (as shown in Figure 1). This study puts forward the following research hypotheses:

H1. CHSF improves the possibility of farmers' RBAF.

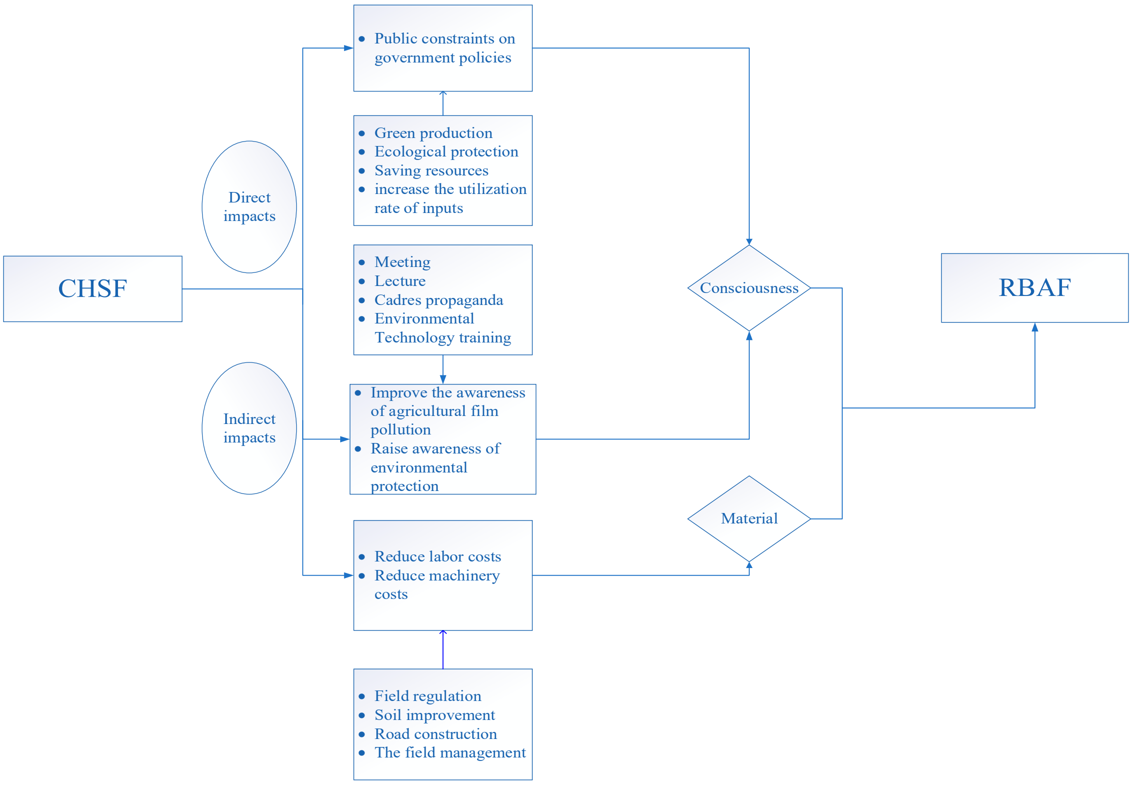

Figure 1. Theoretical analysis framework of the impact of CHSF on RBAF.

3. Data, Variables, and Method

3.1. Data

The data of this study are from the survey data of rural areas in Sichuan Province, China in 2018. This survey conforms to and follows the standard of international survey and research, adopts the method of multi-stage probability stratified sampling. According to the degree of economic development, five counties were selected first, and then one village was selected in the direction of east, west, north, and south of each county. Twenty households were selected from each village. A total of 400 questionnaires were obtained. The interviewer asked each farmer in detail, for example, their age, gender, education level, number of family population, number of family in the agricultural labor force, total household income, non-farm household income, village terrain, etc. The survey covered basic family characteristics, agricultural production and operation, village characteristics, socio-economic characteristics, participation in CHSF, and the adoption of green production technologies such as RBAF and organic fertilizer application. Finally, after removing the questionnaires with missing data and abnormal values, 397 complete and consistent questionnaire samples were obtained.

3.2. Variables

3.2.1. Dependent Variable

The purpose of this study is to discuss the impact of farmers' participation in CHSF on their RBAF. Therefore, referring to the research of Li et al. [56] and Yang et al. [63], 1 means that farmers have the RBAF, and 0 means that farmers do not have the RBAF. It can be seen from Table 1 that only 30% of the farmers in the survey sample have the RBAF, which indicates that the recovery rate of agricultural film is low.

Table 1. Definition of variables and descriptive statistical results.

Variables	Definition	Mean	S.D.
Agricultural film	Whether farmers recycle agricultural films (1 = yes; 0 = no)	0.300	0.459
High-standard farmland	Whether farmers participate in high-standard farmland construction projects (1 = yes; 0 = no)	0.055	0.229
Age	Age of head of household (years)	60.169	10.391
Gender	Gender of head of household (1 = male; 0 = female)	0.872	0.335
Education	Whether the head of household has a high school diploma or above (1 = yes; 0 = no)	0.010	0.100
Fragmentation	Degree of farmland fragmentation (mu/piece)	0.446	0.430
Family education	Proportion of family members with high school diploma or above (%)	8.928	14.020
Farm employment	Proportion of family members engaged in agricultural production (%)	43.443	30.714
Farm income	Proportion of agricultural income in total household income (%)	13.727	16.800
Smartphone	Whether the family used smartphones before 2018 (1 = yes; 0 = no)	0.655	0.476
Party	Proportion of family members participating in the Communist Party of China (%)	8.464	17.325
Cadre	Whether there are members of the family serving as village cadres (1 = yes; 0 = no)	0.116	0.320
Plain	Whether the family is located on the plain (1 = yes; 0 = no)	0.050	0.219
Hilly	Whether the family is located in the hills (1 = yes; 0 = no)	0.849	0.359
Mountain	Whether the family is located in the mountains (1 = yes; 0 = no)	0.101	0.301

3.2.2. Key Variable

CHSF is the core explanatory variable of this study. Compared with developed countries, the problems of food shortage and low efficiency of cultivated land use in China are more serious, and the need to build and protect high-quality cultivated land is particularly urgent. In this case, China started to build the CHSF project in 2011, and has achieved some results so far [64]. Focusing on the requirements of improving farmland production capacity, irrigation and drainage capacity, field road transportation capacity, farmland protection and ecological environment protection capacity, mechanization level, science and technology application level, post construction management and protection capacity, and in combination with land space, agricultural and rural modernization development, water resources utilization and other planning, the project is committed to building a scientific, unified, well-organized and reasonably structured CHSF standard system. However, due to the differences in natural geographical conditions and resource endowment conditions in various regions, the CHSF project implemented by them show different characteristics. Therefore, the core explanatory variable of this study is defined as to whether the farmer's family has participated in the overall CHSF project.

3.2.3. Control Variables

In order to improve the estimation ability of the model, referring to the research of Li et al. [32], Liu et al. [45], Wang et al. [46], Cai-hong et al. [48], and Feng et al. [49], this study also added some factors affecting farmers' RBAF as control variables. These control variables include the characteristics of the head of household (such as the age, gender, and education level), family characteristics and social capital characteristics (such as the structure of family education level, the proportion of members engaged in agricultural labor, the composition of family economic income, the use of smartphones, the degree of land fragmentation, whether family members serve as village cadres, and whether the family is located in hilly and mountainous terrain), and village characteristics. Table 1 presents the variable definitions and descriptive statistical results of this study.

3.3. Method

This study refers to the available articles of Wooldridge [65], Mikhaylov [66], and Li et al. [67], adopts econometric methods, and uses the probit model in the research of agricultural film pollution control. The purpose of this study is to explore the quantitative impact of CHSF on farmers' RBAF. Based on the method of regression analysis, the probit regression model is used to analyze the quantitative relationship between CHSF policies and farmers' RBAF. The econometric model is set as follows:

$$Y_{iv} = \beta_0 + \beta_{1i} \times HF_{iv} + \beta_{2i} \times Control_{iv} + \delta_v + \varepsilon_i$$

The subscripts i and v represent the household i and the sample village v, respectively; Y_{iv} is the dependent variable, representing the RBAF of farmers; HF_i is the core independent variable, which indicates whether farmers participate in the CHSF project; $Control_{iv}$ represent control variables (such as household characteristics, householder characteristics, and village characteristics); β_0 represents a constant term; β_{1i} represents the estimated coefficient of participating in the CHSF; β_{2i} represents the estimation coefficient of the control variable; δ_v represents the dummy variable, which is the village effect of each village; ε_i is the random disturbance term.

4. Results

4.1. Empirical Results

4.1.1. Impacts of High-Standard Construction on Farmer Agriculture Film Recycling

Table 2 reports the regression estimation results of the impact of CHSF on farmers' RBAF. Since the farmers' RBAF is a binary discrete variable, models (1)–(4) in Table 2 are estimated by probit model. At the same time, considering that the probit model is a nonlinear model, in order to facilitate the interpretation of the estimation results, the marginal effect estimation is carried out on the basis of model (4), and the results are shown in model (5). In addition, in order to improve the accuracy of research estimation results as much as possible, this study adopts the strategy of gradually adding variables. On the basis of the core explanatory variables of model (1), the control variables of head of household characteristics, family characteristics and village characteristics are gradually added to model (2)–(4).

Table 2. Probit regression results of CHSF for RBAF.

	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**
High-standard farmland	0.597 *	0.598 **	0.536 *	0.536 *	0.160 *
	(0.307)	(0.302)	(0.305)	(0.305)	(0.090)
Age		0.011	0.010	0.010	0.003
		(0.007)	(0.008)	(0.008)	(0.002)
Gender		0.237	0.217	0.217	0.065
		(0.235)	(0.245)	(0.245)	(0.073)
Education		−0.084	−0.007	−0.007	−0.002
		(0.675)	(0.785)	(0.785)	(0.235)
Fragmentation			−0.278	−0.278	−0.083
			(0.324)	(0.324)	(0.096)
Family education			−0.002	−0.002	−0.000
			(0.006)	(0.006)	(0.002)
Farm employment			0.006 **	0.006 **	0.002 **
			(0.003)	(0.003)	(0.001)
Farm income			0.005	0.005	0.001
			(0.006)	(0.006)	(0.002)
Smartphone			−0.062	−0.062	−0.018
			(0.167)	(0.167)	(0.050)
Party			−0.007	−0.007	−0.002
			(0.004)	(0.004)	(0.001)
Cadre			0.273	0.273	0.082
			(0.222)	(0.222)	(0.066)
Hilly				0.419	0.125
				(0.483)	(0.144)
Mountain				−0.109	−0.033
				(0.474)	(0.141)
Constant	−0.230	−1.078 *	−1.306 *	−1.725 ***	
	(0.288)	(0.574)	(0.713)	(0.655)	
Village dummies	Yes	Yes	Yes	Yes	
chi2	44.158 ***	47.070 ***	53.288 ***	53.288 ***	53.288 ***
R2	0.105	0.111	0.138	0.138	0.138
N	397	397	397	397	397

Note: *, ** and *** are significant at the level of 10%, 5%, and 1%, respectively; Standard errors in parentheses.

According to the regression results in Table 2, the core explanatory variables of CHSF in model (1), model (3), model (4), and model (5) are significant at the level of 10%. Additionally, the core explanatory variables in model (2) are significant at the level of 5%. These show that CHSF can indeed promote farmers' participation in RBAF. From the results of marginal effect analysis, compared with farmers who did not participate in the CHSF, farmers who participated in the CHSF were 16% more likely to recycle agricultural film. In addition, the estimated results in Table 2 also show that the proportion of members engaged in agricultural labor in the family characteristics is significant at the level of 5%. It indicates that the higher the proportion of members engaged in agricultural labor in the family, the stronger their willingness to adopt RBAF.

4.1.2. Robustness Test

Missing variables may affect the estimation results [65]. In order to avoid the influence of missing variables on the estimation results as far as possible, this study uses logit model and IV-probit model to test the estimation results of the impact of CHSF on farmers' RBAF. Table 3 reports the estimation results. Logit estimation results and IV-probit estimation results show that the CHSF is significant at the level of 10%. This indicates that the estimation results of the impact of CHSF on farmers' RBAF are robust.

Table 3. Robustness analysis results of CHSF for RBAF.

	(1)	(2)
	Logit	**IV-Probit**
High-standard farmland	0.930 * (0.521)	0.740 * (0.439)
Control variables	Yes	Yes
Village dummies	Yes	Yes
chi2	46.237 **	60.811 ***
N	397	397

Note: *, ** and *** are significant at the level of 10%, 5%, and 1%, respectively; Standard errors in parentheses.

5. Discussion

In this article, the research approaches are extended, and the reasons for the influence of high-standard farmland construction on the recycling of agricultural film are supplemented. At present, most studies only discuss the harm caused by the long-term use of agricultural film and not timely recycling, and reach a consensus on the importance of agricultural film recycling, while the related research on driving mechanism factors of agricultural film recycling is less. Even though there are researches on driving factors of agricultural film recycling, such as Li et al. [32], Xue et al. [42], Yang et al. [68] etc., they fail to pay attention to the influence of CHSF on RBAF. Different from previous studies, this study finds that CHSF can significantly enhance farmers' willingness to recycle agricultural film. Specifically, compared with farmers who have not participated in CHSF projects, farmers who participate in a CHSF project are 16% more likely to adopt RBAF. This paper speculates that the CHSF project may improve the basic environment of farmland through field remediation, soil improvement, road construction, and farmland management and protection. These measures reduce the economic cost of RBAF. On the one hand, it creates conditions for the service of relevant agricultural film recycling machinery and equipment, and at the same time, it improves the convenience and value of agricultural film recycling, thus promoting the willingness of farmers to RBAF. In addition, CHSF restrains the individual behavior of farmers and improves their cognition of environmental protection through the formal and informal institutions of social norms, thus the possibility of farmers' RBAF increased.

Compared with existing studies, the findings of this study are also different. For example, this study finds that the degree of farmland fragmentation does not significantly affect farmers' RBAF. This is inconsistent with the research conclusions of Xie and Huang [51], Cao and Zhao [69], Cao et al. [70], Zhao and Cai [71], and others. This study speculates the following reason: CHSF may have changed the original land conditions. Even from the perspective of land ownership, land is fragmented and scattered. However, the impact of high-standard farmland on all land is similar. Under the unified CHSF, the fields are more orderly and the roads have been improved. This will be conducive to the unified management and recycling of films on each piece of land. Secondly, this study found that farm employment can significantly affect the RBAF and the impact is positive. The higher the proportion of farm employment, the higher the willingness of farmers to adopt RBAF. Compared with studies on an off-farm labor force, this result is contrary to the conclusion of Issahaku et al. [72], Gedikoglu and McCann [73], and Ju et al. [74], that the higher the proportion of off-farm labor, the higher the possibility of adopting environmental protection behavior. This study speculates the following reason: In addition to mechanical factors, the RBAF needs to rely on more manpower for recycling. The higher the proportion of farm employment, the more labor available for recycling agricultural film in families. On the contrary, the higher the proportion of non-farm labor, even if the farmers have a good cognition of the problem of agricultural film pollution, they will give up taking RBAF because of the lack of relevant farm employment. Finally, this study also found that the factor of using a smartphone did not significantly affect the RBAF, which is different from the research that the use of a smartphone is beneficial to sustainable agricultural production [75–78].

This study speculated that this might be related to the uncertain contents of smartphones used by farmers and the difficulty of clear investigation in a short time.

6. Conclusions and Implications

6.1. Conclusions

Based on the survey data of 397 farmers in rural areas of Sichuan Province, China, this study uses the probit model to conduct regression analysis to analyze the quantitative impact of construction of high-standard farmland on farmers' recycle behavior of agricultural film. The conclusions of this study are as follows:

(1) Participating in construction of a high-standard farmland project can promote farmers to adopt recycle behavior of agricultural film. That is, compared with farmers who do not participate in construction of a high-standard farmland project, the possibility of participating in farmers to adopt recycle behavior of agricultural film is increased by 16%.

(2) For every 1% increase in the proportion of agricultural labor force in households, the possibility of recycle behavior of agricultural film is increased by 0.2%.

(3) It can be seen from the above that the construction of high-standard farmland affects the recycle behavior of agricultural film in a material and consciousness way, which increases the possibility of this behavior.

6.2. Implications

How to solve the huge harm left by the massive pollution of plastic film in farmland to the ecological environment and human society is an important challenge the world is facing. China's CHSF project provides an effective way to solve this problem. The results of this study show that the CHSF helps to promote farmers in starting to adopt RBAF. Additionally, the higher the proportion of agricultural labor in the family, the higher the willingness of farmers to adopt RBAF. These will help reduce agricultural non-point source pollution and reduce the pressure on the ecological environment. Based on the above findings, this study puts forward the following policy recommendations:

(1) Strengthen the regulation of fields. Due to the differences in specifications between fields in the past, the application and coverage standards of agricultural film are also different. Through reasonable consolidation and leveling of land, and ridge construction of sloping farmland, determine the appropriate farming length and width of the field, so as to realize the appropriate scale of the field block, centralized and continuous, and the leveling of the field surface. These help make agricultural film to be applied to agricultural production with unified standards, so as to facilitate farmers' subsequent unified recycling.

(2) Soil improvement. Through engineering, biological, chemical, and other methods, we can control sandy or sticky soil, saline alkali soil, and acidified soil, and improve the quality of cultivated land. The improvement of soil quality is conducive to reducing the excessive dependence of agricultural production on agricultural film. At the same time, in the process of agricultural film covering, it can also reduce the erosion and damage to it, ensure the recycling integrity of agricultural film, and improve the recycling value of agricultural film.

(3) Construction of field roads. Through the connection construction of field roads and production roads, and the matching of bridges and culverts, the width of the road should be reasonably increased, and the load standard and accessibility of the road should be improved, so as to create conditions for agricultural film recycling-related machinery to enter the farmland.

(4) Strengthen management and protection. Through image warehousing and whole process management, implement the post construction management subjects and responsibilities, establish management funds, and improve the management mechanism. The local government should bring the recycling of agricultural film into the monitoring index system of CHSF, and reduce the pollution of agricultural film in the following ways: Clarify the relevant supervision responsibility subjects, establish a reward and punishment mecha-

nism, increase the capital investment in the recovery and treatment of residual agricultural film in the field, and provide socialized services related to agricultural film recovery, etc.

(5) Promote the use of new materials that can replace plastic films, such as biodegradable plastic films and photodegradable plastic films. Biodegradable plastic coverings are designed to break down into carbon dioxide, water and microbial biomass [23,79,80], and produce no waste after use. Although the use of these new materials is expensive, they can well solve the problem of plastic pollution in agricultural production, which is conducive to sustainable development. The government should vigorously support their promotion and use.

7. Limitations of the Study

This study also has the following deficiencies, which can be solved and improved in future:

(1) The relationship between CHSF and farmers' RBAF may be dynamic, and future research can further build panel data sets to discuss their dynamic relationship;

(2) This study focuses on the quantitative impact of CHSF on farmers' adoption of RBAF. Future research can quantitatively test the mechanism of CHSF affecting farmers' adoption of RBAF;

(3) This study takes rural agricultural production areas in Sichuan, China as the research object. Whether the research conclusion is applicable to rural areas in other countries remains to be further tested.

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