Drivers of farmers’ behavior toward compensation scheme for cultivated land protection in chengdu pilot area, China

Haipeng Niu\textsuperscript{a,b}, Dongyang Xiao\textsuperscript{a} and Suxia Zhao\textsuperscript{a,b}

\textsuperscript{a}Department of Land Resources Management, School of Surveying and Land Information Engineering of Henan Polytechnic University, Jiaozuo, China; \textsuperscript{b}Department of Arable Land Protection and Land Spatial Planning in the Yellow River Basin, Research Centre of Arable Land Protection and Urban-Rural HighQuality Development of Yellow River Basin, Henan Polytechnic University, Jiaozuo, China

**ABSTRACT**

Studying farmers’ behavior affected by economic incentive is necessary to promote positive behavior among farmers toward protecting the quantity, quality, and ecological environment of cultivated land. In this study, we investigated the current situation regarding economic incentive policies for cultivated land protection, which has attracted the attention of Chinese government. Then, we focused on the earliest pilot scheme (i.e., Cultivated Land Protection Fund, CLPF) implemented in the west of China since 2008 to empirically analyze farmers’ behavior. Statistical analysis and path analysis methods were applied, with data collected from 296 questionnaires. Our results showed that positive actions, including the enhancement of initiatives to protect cultivated land, the improvement of ecological environment of cultivated land, and the investment in agricultural infrastructure, have been adopted by farmers since the implementation of the CLPF. Furthermore, gender, education level, labor force size, cultivated land area, migration out of traditional farming areas, average annual household income, and farmers’ knowledge of the policy impacted significantly on farmers’ behavior. On the premise of comprehensive consideration of the diversity of farmers’ livelihoods, new communication technologies and sufficient funds, we suggested that a long-term and sustainable project should be established at the national level to effectively compensate farmers.

**Introduction**

There has been a rapid worldwide decrease in the area of cultivated land per capita area from 0.41 to 0.21 ha since the 1960s (Linnér and Messing 2012). To control the conversion of cultivated land to alternative uses and reduce the abandonment of agricultural land, cultivated land protection policies have been widely adopted worldwide (Liu, Zhao, and Song 2017). Economic incentives for farmers are one type of policy adopted by many countries. In the European Union, agri-environment programs (AEP) have been operated, in which society pays for farmers to protect and enhance cultivated land (Van Herzele et al. 2013). In 2007–2013, approximately 22% of the total farmland area was supported by 34 billion Euros of agricultural environmental subsidies among the 27 Member States of the European Union (Van Herzele et al. 2013). Because of the limitations of cultivated land, pesticides, chemicals, water, and other inputs have been widely overused to improve food production, which has resulted in great damage to the quality and ecological environment of cultivated land (Altieri 2002; Barbier 2000; Boz 2016; Lasanta et al. 2000). Therefore, specific economic incentives have been offered to prevent farmland soil erosion, improve soil texture, and protect wildlife habitats. One remarkably successful financial incentive is the Conservation Reserve Program (CRP), which was created in 1985 and peaked in 2007, safeguarding approximately 15 million ha of cultivated land in the United States (Johnson et al. 2016). There is evidence that the CRP has had a significant positive effect on soil quality (Sullivan et al. 2004), groundwater levels (Gelfand et al. 2011; Gleason et al. 2011; Rao and Yang 2010), and the biodiversity of cultivated land (Drum et al. 2015). This successful program has been replicated and widely promoted in countries such as Australia and Japan (Liu et al. 2018). Overall, it has been demonstrated that the incentives of the economic compensation policy can mobilize the enthusiasm of farmers to some extent, and help to promote the protection of cultivated land (Liu et al. 2018).

There is a view that short-term financial compensation can be considered “temporary bribes, shallow in operation, and transitory in effect” (Morris and Potter 1995), and previous studies (Burton, Kuczera, and Schwarz 2008; Dayer et al. 2018) have shown that lasting changes in farmers’ attitudes and behavior should be a goal of conservation incentive programs (Cahyono, Fairuzzana, and Williandoet al. 2020). Therefore, farmers’ behavior toward protecting cultivated land, as an important indicator of the...
implementation effectiveness of economic incentive measures for cultivated land protection, have received extensive attention (Liu et al. 2018; Liao, Gu, and Wang et al. 2020). It has been shown that there are significant differences in farmers’ attitudes and behavior with regard to farming practices, such as maintaining farmland landscapes, protecting biodiversity, restricting farming intensity and methods (e.g., reducing or prohibiting the use of pesticides and fertilizers, and limiting crop planting), and long- or short-term cultivated land protection (Polman and Slagen 2008; Ruto and Garrod 2009; Wilson 1997; Wossink and van Wenum 2003). In addition, factors influencing farmers’ behavior toward the protection of cultivated land are complex (Wilson 1997). For example, Mishra and Khanal (2013) found that farmer’s educational attainment, availability of the Internet, age, and farm scale were positively correlated with farmers’ behavior. Sutherland et al. (2013) reported that institutional credibility and personal trust were important in the adoption of cultivated land protection practices. However, Barreiro-Hurlé, Espinosa-Goded, and Dupraz (2010), and Mathijs (2003) showed that there was a negative impact on farmers’ behavior toward cultivated land protection in situations where agricultural income accounted for a high proportion of total household income. Capitanio, Adinolfi, and Malorgio (2011) also suggested that an increase in the extent of family labor on a farm would have an adverse effect on a peasant farmers participation in cultivated land protection programs. Furthermore, farmers’ attitudes (Barreiro-Hurlé, Espinosa-Goded, and Dupraz 2010; Ruto and Garrod 2009), information available regarding the policy (Wilson and Hart 2000), and farmers’ satisfaction (Xiao et al. 2019) might affect farmers’ overall participation. Hence, it is of great significance to discuss farmers’ behavior and its driving factors, which may have a direct impact on the extent of farmers’ participation in cultivated land protection (Liu et al. 2018).

Facing the double pressure of protecting cultivated land (Jiang et al. 2017) and economic development, the Chinese government have proposed economic instruments for encouraging farmers to protect cultivated land (Liu, Zhao, and Song 2017). Agricultural Subsidy Policies (ASP) have been implemented nationwide to subsidize farmers since 2004 and promote food production in China. In 2015, the Agricultural Support and Protection Subsidy (ASPS) was proposed by the Chinese government, which was an integration of the sub-policies of the ASP, such as the Seed Subsidy, Direct Grain Subsidy, and Agricultural Comprehensive Subsidy. Anhui, Shandong, Hunan, Sichuan, and Zhejiang were selected as the pilot provinces for this scheme. The main purpose of the ASPS was to strengthen the awareness of farmers toward the protection of agricultural ecological resources and maintain their enthusiasm for planting crops. After receiving money, farmers were expected to take measures to maintain cultivated land and soil fertility. This was achieved by measures such as returning straw to the field, loosening soil, reducing or prohibiting the use of pesticides and fertilizers, and strengthening the protection of agricultural ecological resources (Zhou and Zeng 2019). In 2016, the Chinese government promoted this policy nationwide. The subsidies (the ASP/ASPS) implemented in China are inclusive, i.e., every farmer who owns the same scale of cultivated land can receive equal compensation from the government, regardless of the quality of their cultivated land or the exact measures adopted by farmers that benefit the cultivated land. Therefore, despite the positive effects of the ASP/ASPS it has been viewed as a controversial policy by some researchers (Huang, Guo, and Wu 2019; Wang and Yang 2014; Zhou, Tan, and Zhong 2014). In 2008, an economic incentive (i.e., the Cultivated Land Protection Fund, CLPF) was proposed by the Chengdu government, with the aim of more effectively motivating farmers to protect cultivated land. Under this scheme, after a formal contract is signed between the farmer and government, 854 USD/ha is paid to farmers who own high-quality cultivated land (prime farmland) every year, and 641 USD/ha is paid to farmers who own general quality cultivated land every year. It should be noted that the management options available to farmers participating in this scheme are restricted, including the reduction of fertilizer use and the prohibition of straw burning in the fields. Furthermore, the contract also provides for penalties to be imposed. For example, funding will be suspended if farmers illegally change the use or damage the productivity of cultivated land. Farmers will also face legal sanctions if their practices cause serious damage to cultivated land. Other regions in China have subsequently adopted similar economic compensation measures. Since 2010, farmers with high-quality cultivated land (prime farmland) in Suzhou can receive at least 854 USD/ha each year. From 2012, the government of Guangdong Province has paid economic compensation to farmers with high-quality cultivated land (prime farmland). From 2016, farmers in Zhejiang Province have been paid different rates of compensation based on the quality of their cultivated land. All these incentive schemes have a common feature in that the money paid to farmers per ha of cultivated land is no longer equal, and the funding received by farmers will be reduced or canceled if they break the agreement. Consequently, this differential and the competitive economic compensation model is an innovation in China, and is conducive to motivating farmers to protect the quality and ecological environment of cultivated land. Recently, 17 provincial governments in China expressed an interest in operating such schemes (Zhu, Zhang, and Cai 2018). Through the analysis of
satisfaction, Xiao et al. (2019) found that farmers’ satisfaction with the cultivated land protection fund was not very high on the whole. Based on the comparison of the three compensation models in Chengdu, Wuhan and Suzhou, Zhu, Zhang, and Cai (2018) proved that the implementation effect of the Chengdu model with pension insurance as the highlight was the best. Cai and Yu (2018) indicated that the performance of compensation schemes became increasingly significant over time. Meanwhile, the performance of the Chengdu model was stronger than that of the Suzhou model and the Shanghai model. Niu and Xiao (2019) found that the CLPF has a stronger influence on farmers’ willingness to protect cultivated land than agricultural subsidies. Yu and Cai (2016) argued that farmers who transferred outward their cultivated land have higher satisfaction with the CLPF. In general, different compensation schemes for cultivated land protection have diverse policy effects. As the longest running incentive scheme in China, the Cultivated Land Protection Fund has clearly attracted the attention of more scholars.

There have been only a few studies of the relationship between farmers’ behavior toward the protection of cultivated land and economic incentives because the existing economic incentive schemes have only been implemented in a limited number of regions in China. The first aim of this study was therefore to comprehensively analyze the current situation regarding economic incentive policies for cultivated land protection used by the Chinese government in recent years. The second aim was to analyze data from a questionnaire survey of 296 farmers in pilot regions to evaluate their participation in the earliest incentive scheme (i.e., CLPF) implemented in western China in 2008. Three specific actions were evaluated: i) taking the initiative to stop and report any damage to cultivated land; ii) taking measures to improve the ecological environment of cultivated land (e.g., use of organic fertilizers; use of high-efficiency, low-toxicity, and low-residue pesticides; and use of biological pesticides); and iii) increasing the investment in the construction of agricultural facilities and soil improvement. Finally, we explored the key factors that affect farmers’ behavior by taking the farmers’ own characteristics and understanding of the CLPF into consideration.

Theoretical basis

Economic compensation policies for cultivated land protection in China

In this section, the current situation regarding economic incentive policies for protecting cultivated land in China (Figure 1) is analyzed. In 2004, the Agricultural Subsidy policies (ASP), which were implemented nationwide, paid an equal amount to farmers having an equal scale of cultivated land. Several sub-policies were included in the ASP, including the Seed Subsidy, Direct Grain Subsidy, and Agricultural Comprehensive Subsidy. A low standard subsidy (about 235 USD/ha per year) was paid to farmers regardless of the differences in cultivated land quality and farmers’ behavior. In 2016, the Agricultural Support and Protection Subsidy (ASPS), which was an integration of the ASP sub-policies, was proposed by the Chinese government to be implemented nationwide. The objectives of the ASPS were to improve the fertility of cultivated land and promote large-scale cultivated land management. Although there were no significant differences in the compensation standards of the ASP and the ASPS, the objectives of the ASPS

![Figure 1. The development of economic compensation policies for cultivated land protection in China.](image-url)
were more specific than those of the ASP. Neither of these policies established corresponding monitoring and punishment measures. The CLPF, an innovative incentive scheme focusing on the protection of cultivated land (Li et al. 2014), was implemented in Chengdu in 2008. Compared with the ASP and ASPS, there were three significant differences in the CLPF: i) the level of the compensation standard, ii) restrictions on the usage of compensation funds, and iii) punishment measures. For the CLPF, different subsidy standards are provided based on the quality of cultivated land. Under this scheme, farmers with high-quality cultivated land (prime farmland) receive more compensation than those with general quality cultivated land. The subsidies received by farmers can be used in three ways. First, 10% of the funds can be used for agricultural insurance and other guarantees. Second, the remaining 90% of the subsidy funds can be used to purchase farmers’ pension insurance. Finally, farmers who have paid their own pension insurance in full will receive cash subsidies from the government. Subsidy funds will be suspended or confiscated (i.e., where funds have already been paid to farmers) if farmers illegally change the use of cultivated land or damage the productivity of cultivated land. In addition, farmers will also face legal sanctions if their practices cause serious damage to cultivated land. Other similar schemes aimed at protecting cultivated land through the economic compensation of farmers have been conducted in other regions (Table 1). In 2010, an economic incentive scheme to protect the ecological functioning of cultivated land was introduced in Suzhou. Farmers who own cultivated land can receive a subsidy (854 USD/ha) from the government each year. Additional funds (427 USD/ha and 854 USD/ha each year) are offered to farmers who grow rice. These rice fields need to reach a size of 66.7–666.7 ha or more. In 2012, an economic compensation scheme to protect high-quality cultivated land (prime farmland) was established in Guangdong Province. A subsidy of 64 USD/ha is paid to farmers who own prime farmland. The compensation standard of this scheme is adjusted by the government every 3–5 years according to the level of economic development. This scheme is only offered to village collectives, with individual farmers not eligible for economic compensation. Therefore, the scheme in Guangdong mainly operates to incentivize the organization of grassroots management in an attempt to protect prime farmland. In 2016, to ensure the enthusiasm and initiative of farmers to protect cultivated land, an economic incentive scheme for subsidizing farmers who own cultivated land was promoted in Zhejiang Province.

To summarize, compared with the ASP and ASPS, the objectives of the four pilot economic incentive schemes listed in Table 1 are more specific, i.e., to protect the quality of cultivated land or the farmland ecological environment. Another typical feature of these schemes is that the more high-quality cultivated land farmers have, the larger the subsidy they receive. However, standardized management and punishment measures, which can effectively encourage farmers to protect the quantity and quality of cultivated land, are only established in the CLPF. These schemes have only been tested in limited regions, and it is unclear whether they can be extended nationwide. Nevertheless, there is an urgent need to implement economic incentive schemes for the protection of cultivated land nationwide (Zhu, Zhang, and Cai 2018). In this study, the CLPF which has been implemented for a long period and has been studied by many researchers was used as a case study in our empirical analysis.

**Research framework of this study**

In the present study, farmers’ behavior toward compensation scheme for cultivated land protection is argued to be influenced by the following two factors: farmers’ objective factors, and farmers’ subjective factors.

Based on the previous literatures, the research framework of this study is proposed (Figure 2). The behavior of farmers’ cultivated land protection is usually reflected through quantitative protection, quality protection, and ecological environment protection of cultivated land (Yu and Cai 2014). Relevant case studies suggested that farmers’ behavior toward compensation scheme for cultivated land protection was usually driven by some potential factors, including farmers’ gender, age, education level, family economic level, farm scale, and farmers’ attitude (Polman and Slangen 2008; Van Dijken et al. 2015; Wilson 1996; Yu and Cai 2014; Yu and Cai 2015; Zhou, Tan, and Zhong 2014). In this study, these factors are described as the following two categories: objective factors, and subjective factors. Complex interactions are present in these factors and farmers’ behavior. Farmers’ objective factors, including individual characteristics (e.g., gender and age), family characteristics (e.g., family size and labor force), economic characteristics (e.g., agricultural income and total annual income) and cultivated land characteristics (e.g., area and quality), have direct impact on farmers’ behavior. Subjective factors refer to farmers’ attitudes, that is, farmers’ recognition of policies. The previous results demonstrated that farmers’ recognition significantly affects farmers’ behavior (Van Dijken et al. 2015). In addition, objective factors also affect farmers’ subjective consciousness, which indirectly affects farmers’ behavior.

**Materials and methods**

**Study area**

The study area of Chengdu (102°54'E-104°53'E, 30°05'N-31°26'N) is located in western China (Figure 3(a)). The total land area of Chengdu is $1.4 \times 10^4$ km$^2$. There is
Table 1. Four pilot economic incentive schemes for cultivated land protection in China.

| Regions | Time  | Scheme                                | Subsidy recipient                  | Types of cultivated land to be subsidized | Compensation standard                          | Objective of the subsidy                                      | Punishment measures |
|---------|-------|---------------------------------------|-----------------------------------|-------------------------------------------|-----------------------------------------------|-------------------------------------------------------------|--------------------|
| Chengdu | 2008  | Cultivated land protection fund (CLPF) | Farmers and village collectives   | Prime farmland, general quality cultivated land | Prime farmland: 854 USD/ha per year. General quality cultivated land: 641 USD/ha per year. | Improve farmers’ enthusiasm and initiative to protect cultivated land (quantity, quality, and ecology) protect the ecological functions of cultivated land | Yes                 |
| Suzhou  | 2010  | Ecological compensation                | Farmers and village collectives   | Cultivated land                           | Cultivated land: 854 USD/ha per year; rice fields (66.7–666.7 ha): (854 + 427) USD/ha per year; rice fields (more than 666.7 ha): (854 + 854) USD/ha per year. about 64 USD/ha per year; the standard should be adjusted every 3–5 years in combination with economic development. | Fully motivate the organizations of grassroots management to protect basic farmland | No                  |
| Guangdong | 2012 | Economic compensation for prime farmland protection | Village collectives | Prime farmland                           | Grassroot governments make their own decisions based on local economic levels and make adjustments every year. | Improve farmers’ enthusiasm and initiative toward protecting cultivated land | No                  |
| Zhejiang | 2016 | Compensation for cultivated land protection | Farmers and village collectives   | Prime farmland, general quality cultivated land |                                  |                                              |                    |

A sloping terrain from northwest to southeast in Chengdu, with mountains in the west, and plains and hills in the east. Therefore, forest land and grassland are distributed in the northwest, and cultivated land and built-up land are concentrated in the central and eastern regions (Figure 3(b)). Paddy fields are mostly distributed in the central region, while other dry land areas are scattered throughout the study area (Figure 3(b)). There is a large concentration of developed land in the built-up areas of Chengdu, whereas there is a very fragmented pattern of developed land in other areas (Figure 3(b)).

Chengdu is a district with some of the strongest economic strength in western China, with excellent natural, social, and economic land use conditions (She 2016). To improve farmers’ enthusiasm and strengthen their responsibility and awareness toward protecting cultivated land, the local government of Chengdu established the CLPF in 2008. Under this policy, farmers are entitled to financial compensation from the CLPF. According to local statistics, 2.28 billion USD were raised from 2009 to 2014 in Chengdu and 1.71 billion USD of the fund had been used to benefit 1.7 million farmers and 10 million pieces of land (Zhu, Zhang, and Cai 2018).

Data sources

Before the survey, high-resolution Google maps were used to select sample villages because most of the rural settlements in Chengdu are small in scale and have a scattered distribution (Figure 3(b)), the built-up land category shows the distributional characteristics of “small settlements” within the overall urban area. Those villages that were large in scale or close together were selected as our sample villages. There were 35 sample villages used to obtain a total of 296 farmers in Chengdu on May 17–22, 2016. In the actual survey, the sampling was conducted in eight regions of Chengdu (Figure 3(a)). There were obvious regional differences between these sample regions. For example, considering the distance between agricultural production and markets, Wenjiang, Shuangliu, and Xindu have significant advantages due to their relatively close distance to the center of Chengdu. However, because of this, the cultivated land in these three areas was under pressure from urban development. In terms of the topography, Wenjiang, Shuangliu, and Xindu have a relatively flat terrain, high quality cultivated land, and are convenient for agricultural production; while Pengzhou, Chongzhou, and Qionglai are closer to mountainous areas, and agricultural production is more difficult. (Figure 3(a)) shows the spatial distribution of sample villages. To meet the statistical requirements for an appropriate sample size, we allocated the Xinjin samples (nine samples) as Shuangliu samples. We also allocated the Dayi samples (six samples) as Qionglai samples. The samples from Wenjiang, Shuangliu (including Xinjin), Xindu, Qionglai (including Dayi), Chongzhou, and Pengzhou were then included in the statistical analysis.

In this study, a survey was designed to measure farmers’ behavior toward participation in the CLPF. This study was carried out from three aspects of farmers’ characteristics, cognitive characteristics, and farmer behavior based on previous studies. Three core questions were used to understand farmers’ behavior after obtaining the subsidy (Table S1). In the first question, farmers were asked “Will you take the initiative to stop damaging or report any damage to cultivated land, or any other violations of the
cultivated land protection system?” (Zhou, Tan, and Zhong 2014). The answers from the interviewed farmers were classified into two categories: i) Yes, I will or ii) No, I will not. In the second question, farmers were asked “Since the implementation of the CLPF, do you take measures to improve the ecological environment of cultivated land (e.g., use of organic fertilizers; use of high-efficiency, low-toxicity, and low-residue pesticides; and use of biological pesticides)?” (Polman and Slangen 2008). The answers from the interviewed farmers were classified into three categories: i) Yes, I always do; ii) Yes, sometimes I do; or iii) No, I will never do that. In the third question, farmers were asked “Have you increased your investment in the construction of agricultural facilities and soil improvement since the implementation of the CLPF?” (Yu and Cai 2014). The answers from the interviewed farmers were classified into two categories: i) Yes, I have or ii) No, I have not. In addition, farmers’ understanding of the CLPF and their own characteristics were taken into account when attempting to evaluate the factors that affect farmers’ behavior in sections 2 and 3 of our questionnaire. Six main questions were designed to assess the level of farmers’ understanding (Table S1). First, we wanted to know if the policy was well-known by most farmers (Van Dijk et al. 2015), and two options were offered to farmers: i) Yes, I know it very well or ii) Yes, I only know a little about it. The
second question on this topic was designed to assess farmers’ satisfaction with the CLPF (Yu and Cai 2015). Farmers could express their satisfaction with the CLPF by selecting one of the following five options: strongly dissatisfied, dissatisfied, undecided, satisfied, or strongly satisfied. In this section, we also introduced the objectives of implementing the CLPF to farmers, and asked them whether these objectives have been achieved at present (Wilson 1996). The following four options were offered to farmers: fully achieved, partly achieved, undecided, or unachieved. The three remaining questions in this section investigated the impact of the CLPF on farmers’ household income, living standards, and pension security. The third section of the survey asked questions regarding socioeconomic and demographic variables (gender, age, education level, village cadres, labor force size, cultivated land area, migration out of traditional farming areas, average annual household income, total annual agricultural income) (Polman and Slangen 2008; Van Dijk et al. 2015; Wilson 1996; Yu and Cai 2014; Yu and Cai 2015; Zhou, Tan, and Zhong 2014). These variables in the second and third sections of the questionnaire were used to analyze the factors affecting farmers’ participation in the CLPF. Table S1 presents a definition of all the variables considered in our study.

Methods

Descriptive statistics
To compare the characteristics of the 296 survey samples, we calculated the frequency, mean score, and standard deviation (SD) with the SPSS 22.0 software. Thereafter, vertical bar plots, error bar plots, and mosaic plot were applied to visualize the characteristics of the basic information and behavior of the farmers interviewed.

Correlation analysis
A Pearson correlation analysis was performed to test the interrelationship between farmers’ behavior toward participating in the CLPF and their characteristics if the variables were approximately normally distributed. For non-normally distributed variables, A Spearman’s rank-order correlation was used to analyze the correlation between variables (Burton 2006; Greiner, Patterson, and Miller 2009).

Path analysis
A path analysis (Fan et al. 2015) was applied to determine the explanatory power of the key impact factors in the multi-factor systems that controlled farmers’ behavior. The contribution ratios (the direct and indirect effects) of the related impact factors obtained from the results of the correlation analyses of farmers’ behavior were calculated using DPS 7.05 software. The influencing factors in the regression equations were selected by the default methods of the DPS 7.05 software system.

Results

Analysis of farmers’ characteristics
This section reports the descriptive statistics of the individual and household characteristics of the farmers interviewed (Figure 4). As Figure 4(a) shows, there was no significant difference in the total sample size of male and female farmers interviewed (frequency: male = 147, female = 146). As seen in (Figure 4(b)), a few village cadres were interviewed (frequency: yes = 27, no = 269). Figure 4(c) depicted the mean and standard deviation (SD) of other farmers’ characteristics. Most of the farmers interviewed were 51–60 years old on average (Age: mean = 3.834, SD = 1.490), which was mainly due to the fact that most young laborers in rural China have migrated to work in cities, while the elderly have remained in the countryside (Li et al. 2013). Respondents’ education levels were generally low with the average education level being primary school (EL: mean = 2.389, SD = 0.816). The average labor force size in the households surveyed was 3 (LFS: mean = 2.878, SD = 1.034), with an average cultivated land area of 0.133 to 0.2 ha (CLA: mean = 3.318, SD = 1.448). Among the samples of migrants leaving the cultivated area, the average size of the cultivated land was less than 0.133 ha (FCLA: mean = 1.976, SD = 1.263). The average level of the average annual household income of the surveyed households was 4274–7124 USD (AAHI: mean = 3.139, SD = 0.994), which was significantly higher than the average annual agricultural income of 1425 USD (TAAI: mean = 1.213, SD = 0.449).

Farmers’ understanding of the CLPF
The descriptive statistics of farmers’ understanding of the CLPF were presented as shown in Figure 5. For the farmers’ knowledge of the CLPF (Figure 5(a)), there were 157 farmers interviewed (53.04%) believing that they knew about the CLPF very well, whereas 139 farmers interviewed (46.96%) believing that they knew a little about the CLPF. It is likely therefore that farmers’ familiarity with the CLPF needs to be further strengthened even though the CLPF has been implemented for nine years (2008–2016). For their satisfaction with the CLPF (Figure 5(b)), most farmers were “satisfied” with the CLPF (179 farmers). Meanwhile, farmers generally confirmed that the expected purpose of the CLPF has been “partly achieved” (173 farmers in Figure 5(c)). It’s obvious that there are still many imperfections in the CLPF, although it has been
generally approved by farmers. In terms of the economic effects of the CLPF, 227 farmers stated that the CLPF had increased their family income (Figure 5(d)); the living standard of farmers had been improved with 210 “increased” samples (Figure 5(e)); 187 farmers believed that the CLPF had promoted their pension security (Figure 5(f)). In general, the economic impact of the CLPF on farmers is not strong enough due to the policy’s lower subsidy standard.

Farmers’ behavior toward participating in the CLPF

Figure 6 depicted the survey results of farmers’ behaviors toward participating in the CLPF with the bar plots (Figure 6(a-c)).

From the farmers’ enthusiasm toward cultivated land protection (Figure 6(a)), 247 farmers would take initiatives to stop damaging land and report damage to the government following the implementation of the CLPF. In terms of protecting the farmland quality (Figure 6(b)), 185 farmers interviewed stated that they had increased their investment in the construction of agricultural facilities and soil improvements. It was worth noting that there were still 111 farmers who behaved differently from these aforementioned farmers, mainly because of the lower subsidies. As for as improving the ecological environment of farmland (Figure 6(c)), some positive measures (e.g., the use of livestock manure and highly-efficient, low-toxicity, and low-residue pesticides, as well as the use of biological pesticides) had been adopted by farmers interviewed. However, according to the responses of 188 farmers interviewed, these behaviors only happened occasionally.

Correlation analysis between farmers’ behavior and their characteristics

This section presents the results of the correlation analysis (Table 2). In terms of the TSIR behavior, the KW and OA factors had the highest significant positive correlations ($p < 0.01$) with the TISR. Furthermore, the AAHI factor had a significant positive correlation with the TISR at the 0.05 level. The age and LFS factors had significant negative correlations with the TISR at the 0.05 and 0.01 levels, respectively.

In terms of the IEECL behavior, the KW, SO, OA, EL, and VC factors had the highest significant positive correlations ($p < 0.01$) with the IEECL. However, the gender and LFS factors had a significant negative impact with the IEECL at the 0.05 and 0.01 levels, respectively.

In terms of the AFCSI behavior, the KW, FLSC, IPS, CLA, and TAAI factors had significant positive correlations ($p < 0.01$) with the AFCSI. The SO and IHI factors had a significant positive impact with the AFCSI at the 0.05 level. In addition, the CLPF factor had a significant negative correlation ($p < 0.01$) with the AFCSI.

Estimation of the direct influence factors of farmers’ behavior

The factors that potentially had a direct effect on farmers’ behaviors are presented in this section.

For the TSIR behavior, the KW, OA, LFS, and AAHI factors were automatically entered into the regression equation by the default methods of the software system (Table 3). The direct path coefficients (DPCs) of...
KW, OA, LFS, and AAHI were 0.124, 0.135, −0.251, and 0.213, respectively. Therefore, LFS had the strongest direct effect on TISR among these four factors, and the effect was negative (DPC = −0.251).

For the IEECL behavior, the KW, OA, gender, VC, and LFS factors were automatically entered into the regression equation by the default methods of the software system (Table 4). The DPCs of KW, OA, gender, VC, and LFS were 0.129, 0.180, −0.113, 0.151, and −0.169, respectively. This indicated a small difference in the direct effect of these five factors on the IEECL. However, the direct effects of gender and LFS on the IEECL were negative (the DPCs were −0.113 and −0.169, respectively), and the direct effects of KW, OA and VC were positive (the DPCs were 0.129, 0.180, and 0.151, respectively).

For the AFCSI behavior, the KW, IPS, CLA, and FCLA factors were automatically entered into the regression equation by the default methods of the software system (Table 5). The DPCs of KW, IPS, CLA, and FCLA were 0.130, 0.140, 0.298, and −0.428, respectively. The FCLA had the strongest direct effect on AFCSI among these four factors, with a DPC of −0.428, and the effect was negative. The CLA had the strongest positive direct effect on AFCSI, with a DPC of 0.298.

**Discussion**

Carrying out economic compensation schemes for farmers at the national level is conducive to the sustainable development of cultivated land protection, especially in countries such as China where cultivated land resources are scarce. This study was conducted in a pilot area in western China with 296 farmers interviewed. The results in this study indicated that farmers’ understanding of the cultivated land protection fund (CLPF) is still very poor for almost half (46.96%) of farmers have little knowledge of the CLPF. Therefore, it will be important in the future to improve the publicity of the CLPF to deepen farmers’ understanding of the scheme. Overall, the CLPF was generally approved by farmers, but the pilot scheme still needs improvement. This outcome was consistent with the results of
previous studies of farmers’ satisfaction with the CLPF (Zhu, Zhang, and Cai 2018). In particular, the local government should strengthen the effects of the CLPF on increasing household income, improving living standards, and enhancing pension security.

From the perspective of farmers’ behavior, positive effects have been achieved since the implementation of the CLPF. First, farmers’ enthusiasm for protecting cultivated land has been improved. Farmers can take the initiative to stop activities that damage cultivated land (e.g., building houses, mining, removing soil, digging fish ponds, and waste disposal without authorization), or they can report such activities to the relevant authorities. As Chinese traditional agriculture has gradually transformed into modern agriculture that relies on chemical fertilizers and pesticides to ensure continuous growth in outputs, agricultural non-point source pollution has intensified, leading to the continuous deterioration of the farmland ecological environment and the frequent occurrence of agricultural product safety incidents (Yu and Cai 2014). To improve the ecological environment of cultivated land and reduce soil pollution, some effective measures (e.g., use of organic fertilizers; use of high-efficiency, low-toxicity, and low-residue pesticides; and use of biological pesticides) have been adopted by farmers in the cultivation process. Similar results have been obtained in studies of rural households’ participation in compensation programs that targeted cultivated land preservation in China (Cai and Yu 2018). In addition, many interviewed farmers expressed their willingness to use the subsidies to increase their investment in the construction of agricultural facilities (e.g., investing in the construction of small agricultural irrigation facilities and repairing field roads). Generally, the CLPF has achieved good results in the short term, but the positive effect is relatively weak. Only the long-term and continuous implementation of the CLPF can change farmers’ behavior toward cultivated land protection from passive incentive to active consciousness.

Farmers’ characteristics play an important role in whether they participate in agri-environmental programs (Dang et al. 2020; Defrancesco et al. 2008; Zhang et al. 2020). The results of the path analysis showed that female farmers were more inclined to take active measures to improve the ecological environment of cultivated land. Therefore, more publicity of the scheme should be targeted toward female farmers.

Farmers with higher educational backgrounds performed better in improving the ecological environment of cultivated land. This result differed from that of other studies of farmers’ willingness to undertake agri-environmental measures (Defrancesco et al. 2008). It can be seen from the investigation that a higher level of education was conducive to farmers’ understanding of the ecological functions of cultivated land; thus, raising farmers’ awareness of the need to improve the ecological environment of cultivated land.

With the rapid growth in agricultural productivity in China, a massive surplus of rural labor has been released from the fields and migrated to urban areas, where workers have entered the non-agricultural sector (Liu et al. 2016). The out-migration of rural labor has had a negative effect on the use of cultivated land (Liu et al. 2016; Rudel et al. 2005; Hua et al. 2016). In this study, this was verified by the finding that farmers with more family labor had a more
Table 2. Correlation between farmers' behavior and the influencing factors.

| Influencing Factors                                           | Farmers' behavior in quantity protection (TISR) | Farmers' behavior in ecological environment protection (IEECL) | Farmers' behavior in quality protection (AFCSI) |
|---------------------------------------------------------------|------------------------------------------------|---------------------------------------------------------------|--------------------------------------------------|
| Farmers' knowledge of the CLPF (KW)                           | 0.218**                                        | 0.250**                                                       | 0.166**                                          |
| Farmers' overall satisfaction (SO)                            | 0.040                                          | 0.160**                                                       | 0.122*                                           |
| Degree of objectives achievement (DA)                         | 0.200**                                        | 0.271**                                                       | 0.114                                            |
| Degree of impact on household income (IHI)                    | 0.048                                          | 0.032                                                        | 0.142*                                           |
| Degree of change in family's living standards (FLSC)          | 0.051                                          | 0.004                                                        | 0.217**                                          |
| Degree of impact on pension security (IPS)                    | −0.006                                         | 0.037                                                        | 0.173**                                          |
| Gender                                                        | −0.048                                         | −0.115*                                                       | 0.002                                            |
| Age                                                           | −0.119*                                        | −0.024                                                       | 0.027                                            |
| Education level (EL)                                         | 0.109                                          | 0.150**                                                       | 0.017                                            |
| Village cadres (VC)                                          | 0.046                                          | 0.176**                                                       | 0.076                                            |
| Labor force size (LFS)                                       | −0.188**                                       | −0.176**                                                      | −0.034                                           |
| Cultivated land area (CLA)                                   | 0.095                                          | −0.015                                                       | 0.159**                                          |
| Flowing out of cultivated land area (FCLA)                   | 0.052                                          | 0.046                                                        | −0.363**                                         |
| Average annual household income (AAMI)                        | 0.127*                                         | −0.043                                                       | 0.100                                            |
| Total annual agricultural income (TAAI)                       | −0.095                                         | 0.074                                                        | 0.226**                                          |

* Significant at p < 0.05, ** Significant at p < 0.01. "a:" A Spearman’s rank-order correlation was selected because both TISR and AFCSI were binary variables. "b:" A Pearson correlation analysis was selected because IEECL was approximately normally distributed.
passive participation in the protection of cultivated land and the improvement of its ecological environment. Therefore, specific favorable measures (e.g., increasing subsidies for establishing agricultural support systems and training professional farmers) should be incorporated into the economic compensation policy for cultivated land protection.

Farmers’ investment in cultivated land is greatly affected by farm size (Byiringiro and Reardon 1996; Liu and Zhou 2018). There is evidence that farmers with small farms make more investment in their land to ensure its food production capacity (Ma and Liu 2019). However, evidence also suggests that large farms have better access to capital investment (Rao and Chotigeat 1981). In our study, the more cultivated land farmers had, the stronger their desire to invest in agricultural facilities. We also found that farmers who transferred their cultivated land to others were very reluctant to increase investment in the land. The Chinese government is actively promoting a land reform policy called the “three rights separation system” (Wang and Zhang 2017), which aims to speed up the transfer of rural land management rights to promote large-scale cultivated land management. Therefore, more attention should be given to encouraging farmers who rent/lease land to invest more in cultivated land (Gao, Huang, and Rozelle 2012).

Household income is one of the significant determinants of farmers’ willingness to protect cultivated land (Jianjun et al. 2013). It has been confirmed that household non-agricultural income has a negative effect on farmers’ behavior toward protecting cultivated land (Hua et al. 2016). However, our findings indicated that a higher average annual household income (agricultural income and non-agricultural income) will increase farmers’ willingness to protect cultivated land. We concluded that farmers with higher household incomes might have a deeper understanding of the functions of cultivated land and the importance of its protection.

Farmers’ understanding of a policy directly affects their willingness to participate with it (Liu, Luo, and Zheng 2013). In general, the adequacy of available information and farmers’ familiarity with a policy are considered to play a crucial role, with significant and positive effects on their behavior (Wynn, Crabtree, and Potts 2001). In our study, the behavior of farmers who had a deep understanding of the CLPF were manifested in the three aspects of enhancing their willingness to protect cultivated land, improving the cultivated land ecological environment, and investing in agricultural infrastructure. However, according to the survey results the extent to which farmers felt adequately informed about the CLPF was not sufficient. Therefore, the following four information communication technologies were proposed to disseminate more information about the CLPF to farmers: i) using radios, videos, mobile phones, computers, and the internet to sporadically publicize policy content (Birke, Lemma, and Kierim 2019), ii) providing printed promotional materials to raise awareness of the CLPF; iii) sending more technicians and experts out to the countryside to speak directly to farmers; and iii) strengthening policy training for grassroots managers.

The difficulty in achieving policy objectives plays a decisive role in the participation of farmers (Wilson 1996). Our research confirmed that only a few farmers believed that the objectives of the CLPF have been fully achieved. Although the subsidies could encourage farmers to take some measures to protect the cultivated land, the positive economic effects of these subsidies on farmers were not significant. Therefore, a dynamically adjusted compensation standard should be established, which is based on the local level of economic development, to increase farmers’ income.

Unlike other schemes, for the first time the CLPF provides a subsidy that is specifically used to purchase pension security. Our results indicated that most of the surveyed farmers believed that the CLPF promoted farmers’ pension security. We could also confirm that the greater the impact of the CLPF on farmers’ pension security, the more willing farmers were to increase their investment in the construction of agricultural facilities and soil improvement.

Overall, farmers with different characteristics (farmers’ own characteristics and their cognitive characteristics) indicated a diverse range of behaviors toward participating in the CLPF. It is necessary to discuss the

### Table 3. Path coefficients between farmers’ behavior in farmland quantity protection and the influencing factors.

| Factors | Direct path coefficients | Indirect path coefficients |
|---------|-------------------------|---------------------------|
| KW      | 0.124                   | 0.000 0.056 0.029 0.009 |
| OA      | 0.325                   | 0.051 0.000 -0.003 -0.013 |
| LFS     | -0.251                  | -0.015 0.001 0.000 0.079 |
| AAHI    | 0.213                   | 0.005 -0.008 -0.093 0.000 |

F-value = 10.052, P < 0.01, Adjusted R2 = 0.3306. “→” denotes the influence direction of the factors. TISR denotes farmers’ behavior in quantity protection. KW denotes farmers’ knowledge of the CLPF. OA denotes the degree of objectives achievement. LFS denotes labor force size. AAHI denotes average annual household income.

### Table 4. Path coefficients between farmers’ behavior in farmland ecological environment protection and the influencing factors.

| Factors | Direct path coefficients | Indirect path coefficients |
|---------|-------------------------|---------------------------|
| KW      | 0.129                   | 0.000 0.075 0.003 0.024 0.020 |
| OA      | 0.180                   | 0.053 0.000 0.008 0.031 -0.002 |
| Gender  | -0.113                  | -0.003 -0.013 0.000 0.023 -0.009 |
| VC      | 0.151                   | 0.020 0.037 -0.018 0.000 -0.014 |
| LFS     | -0.169                  | -0.015 0.002 -0.006 0.012 0.000 |

F-value = 10.268, P < 0.01, Adjusted R2 = 0.3685. “→” denotes the influence direction of the factors. EIECL denotes farmers’ behavior in ecological environment protection. KW denotes farmers’ knowledge of the CLPF. OA denotes the degree of objectives achievement. VC denotes village cadres. LFS denotes labor force size.
multidimensionality and complexity of the factors that affect farmers’ behavior toward cultivated land protection in a more extensive and profound discussion in future studies.

Conclusions

This study comprehensively analyzed the current situation of ecological environment compensation for cultivated land protection in China firstly. Then, the earliest pilot scheme implemented in Chengdu of China was used to empirically analyze the drivers of farmers’ behavior toward compensation schemes for cultivated land protection. The results can make a contribution to the design and implementation of the ecological environment compensation schemes at the national level for cultivated land protection in China and other countries. The results suggest that: 1) There has been a slightly positive response from farmers toward cultivated land protection since the implementation of the cultivated land protection fund (CLPF). Those farmers who have received subsidies are now able to take proactive measures to maintain the quantity of cultivated land. In addition, farm manure and less polluting fertilizers and pesticides have been applied to fields to improve the ecological environment of cultivated land. Farmers are also willing to invest more money in the construction of agricultural facilities and soil improvement to improve the quality of cultivated land. However, these positive effects have been relatively weak, and long-term and sustainable economic compensation schemes still need to be incorporated into future cultivated land protection policy. 2) The drivers of farmers’ behavior toward cultivated land protection are multidimensional. This study indicated that farmers’ knowledge of the CLPF has significant and positive effects on their behavior in farmland quantity, quality, and ecological environment protection. However, our survey results demonstrated that farmers’ understanding of the CLPF still needs to be greatly improved. The easier the policy goal is to achieve, the more active farmers will be in farmland quantity and ecological environment protection. The larger the labor force size, the easier it is to transfer labor from rural to urban areas, which is not conducive to protecting the quantity and ecological environment of cultivated land. Average annual household income only significantly promotes the protection of the amount of cultivated land. Female farmers and village cadres are more concerned about the protection of the ecological environment of cultivated land. Pension security and cultivated land area have significant positive effects on farmers’ behavior in farmland quality protection. Farmers who transfer cultivated land to others are very reluctant to increase investment in land quality improvement.

The following recommendations are proposed to further improve the current pilot schemes and encourage farmers to protect cultivated land: (1) Policy propaganda to farmers should be strengthened to increase their understanding of the pilot model, which plays an important role in changing farmers’ behavior toward the cultivated land protection from passive incentives to active consciousness. We believe that new information communication technologies (e.g., mobile phones, Internet, radios, print media, and expert lectures) are conducive to this goal. (2) Short-term, mid-term, and long-term goals should be included in the pilot policy, which is conducive to evaluating the effects of policy implementation in stages and adjusting the policy goals in a timely manner. (3) Given the diverse range of farmers’ characteristics, a differentiated economic incentive scheme should be implemented at the national level. This differentiated scheme should take into account factors such as farmers’ gender, family size, cultivated land area, and family income level, so as to ensure the fairness of farmers’ subsidies.

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