How Does the Stability of Land Management Right (SLMR) Affect Family Farms’ Cultivated Land Protection and Quality Improvement Behavior (CLPQIB) in China?

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Abstract: Protecting and improving cultivated land quality is a key way to the realization of agricultural modernization. The Chinese government advocates agricultural producers to implement cultivated land protection and quality improvement behavior (CLPQIB). However, the cultivated land management rights of family farms are not so stable. In order to study how stability of land management rights (SLMR) affects family farms’ CLPQIB, promoting family farms in adopting technologies to protect cultivated land, this study investigated 117 family farms in Anhui and Hubei provinces by stratified sampling and analyzed data through the logistic regression model and marginal effects model. The results showed that transferred land ratio, contract types, and contract duration affected family farms’ CLPQIB significantly. The probability of family farms applying organic fertilizer decreased by 0.9% for every 1% increase of the transferred land ratio. Family farms’ rented land through formal contracts have a 21.4% higher probability of adopting planting-breeding technology than family farms’ rented land through informal contracts. For every additional year of the rental contract duration, the possibility for family farms to replace chemical fertilizer with organic fertilizer, pesticides reduction, and integrated planting-breeding increase by 2.1%, 2.2%, and 1.3%, respectively. The results of this study can guide policy makers with further regulating land transfer behavior, guide family farms with signing formal lease contracts, and extending the duration of lease contracts, improving the cultivated land protection behavior of family farms.

Keywords: land rights; cultivated land protection; technology adoption; land transfer contracts

1. Introduction

Cultivated land is an important resource that human beings depend on all the time and plays an extremely significant role in national food security, rural economic development, and ecological environment [1]. China’s urban area has grown exponentially over the past two decades and there has been ongoing urbanization. Limited, high-quality, and fertile cultivated land has been converted to urban land [2]. While controlling the area of arable land areas not less than 12 million ha, more attention should be paid to improve the quality of cultivated land, and ensure the trinity of “quantity, quality and ecology” of cultivated land [3]. Cultivated land protection and quality improvement have become a hot spot of global concern in recent years considering national food security, social security, and environmental conservation. Many countries are committed to protecting cultivated land, curbing various increasing pollution of arable land and maintaining sustainable development of agriculture. Soil Health Institute in America compiled a series of policies and programs such as Environmental Quality Incentives Program and Conservation Stewardship Program [4]. The European Commission published the European Green Deal in order to reduce the use of chemical fertilizers and pesticides. The Mexican government promulgated the General Law of Ecological Balance and Environmental Protection which
indicates protecting lands of high ecological value to ensure environmental services and sustainable use of natural resources [5]. As a major agricultural country in the world, the Chinese government attaches great importance to the protection and quality improvement of cultivated land. As early as 2015, the Chinese government put forward the strategy of “storing grain in the land and storing grain in the technology” and proposed to build 53 million hectares of high standard farmland by 2020 to ensure national food security [6]. In 2017, the Ministry of Agriculture issued the Action Plan for the Protection and Improvement of Cultivated Land Quality [3], which put forward measures such as cultivated land quality improvement and soil fertility cultivation and carried out pilot projects in different regions. In China, high-quality agricultural development has become a future direction of agricultural development, and Cultivated land protection and quality improvement is an important objective of agricultural modernization. CLPQIB is a production behavior which is conducive to protecting or improving the quality of cultivated land. Specifically, it refers to the adoption of technologies that are conducive to protecting and improving the quality of cultivated land (cultivated land protection and quality improvement techniques (CLPQIT). For example, application of organic fertilizers, pesticides reduction, integrated planting-breeding, green control technology, deep tillage and rotations, planting green manure, straw return, rational use of agricultural film, etc. [7,8].

Chinese farmer groups mainly include smallholders, family farms, and large farms. Smallholders are traditional farmers who farm on a small scale of cultivated land (their own plots) and scattered plots with backward production methods [9]. Family farms define that farms are established and registered by family, part of whose arable land is transferred from other farmers (transferred land), characterized as organization, specialization, integration, and socialization generally. Large-scale farms in different regions differ greatly in the definition criteria because of China’s vast territory [10]. Large-scale farms are mainly distributed in areas where the land is flat, and talented with strong capital and ability to start them. However, family farms are operated by families, have a moderate scale, require moderate capital, and are easier to develop in large quantities. Chinese farm households are increasingly classified either as traditional smallholders or family farms, and this situation will coexist for a long period of time [11,12]. In recent years, the number of family farms has grown rapidly, reaching 600,000 by the end of 2018, which is four times in 2013, and the government plan to develop family farms to reach 1 million by 2022 [13]. As direct investors and operators of cultivated land, family farms are the key actors of cultivated land protection, their CLPQIB makes an immediate impact on the quality of cultivated land [7].

In order to expand the scale of planting and obtain scale benefits, family farms often need to transfer in land. Data from Special investigation by the Ministry of Agriculture and Rural Affairs admitted that 73.9% of the cultivated land in family farms is transferred from others [14]. The “Separation of Three Rights” policy stipulates that the property rights of rural land, namely ownership, contract rights, and management rights are separated. Land ownership rights belong to the state and collectives, the contract rights belong to farmers, and the management rights can be freely transferred among farmers [15]. When a family farm transfers in land, it means that the family farm obtains the management rights of land. The land management rights means the right for the farmer to occupy and cultivate the agricultural land and obtain the corresponding benefits within a certain period of time [16]. Stability of land management rights (SLMR) refers to the degree of land management rights guaranteed or the risk of losing the land management rights [17]. The contract of land management right transfer becomes an important basis for family farm operation and management of land. Then, the form of contract such as oral or formal, contract duration and so on directly affect the stability of land management right.

Some scholars (e.g., Petrescu-Mag et al.; Ji et al.; Nkonya et al.) [18–20] have studied the relationships between SLMR and farmers’ long-term investment via econometric models, and mainly focus on three parts. Firstly, SLMR is an important determinant of income and food security in rural areas [18]. Secondly, SLMR stimulates the land invest-
ment through three paths including assurance effect, collateral effect, and realizable effect (transaction effect) [19]. Thirdly, instability of land management rights is a critical factor to restrain farmers’ sustainable land management behavior and increase environmental degradation [20]. However, little quantitative literature analyzed the relationship between family farms’ CLPQIB and the stability of land management rights. Does SLMR affects family farms’ cultivated land protection behavior? How does it affect? This study attempts to reveal the interrelationship between SLMR and family farms’ CLPQIB and find out the key factors.

Compared with previous studies, this paper has two main contributions. First, unlike most of the existing literature on CLPQIB of farmers, this paper taking family farms, a major micro-agricultural production subject as a research object which has emerged in recent years and is more likely to adopt CLPQIT than traditional farmers, enriches the research on CLPQIB with family farms as adopters. Second, previous literature studied SLMR from the perspective of land certificates, taking a special situation into account that Chinese family farms need to rent in land to farming, and this study discusses the influence of transferred land proportion, a written rent contract, and rent contract duration on the family farms’ adoption of CLPQIT.

The remainder of the study is organized into five parts. Section 2 constructs the theoretical framework and provides research hypotheses of this study. Section 3 introduces the methodology of this article including study sites, data sources, econometric model, variable selection, and statistical analysis. Section 4 presents the estimated results. Section 5 is a deep discussion of the results. Section 6 summarizes conclusions and puts forward recommendations and limitations.

2. Theoretical Framework

Family farms possess more resources like land and, more typical than smallholders, may pay more attention to the quality of cultivated land. However, most of their arable land is rented from other farmers, so the SLMR is uncertain. According to Schultz’s Farmer Behavior Theory, farmers are “Rational Man” who are self-motivated, can configure resources appropriately, and make decisions due to profit maximization [21]. Family farm is a large-scale, market-oriented and modern business entity, which is more “Rational” than traditional farmers and focus more on economic interests. When the SLMR is uncertain or unstable, whether family farms will sacrifice their short-term economic benefits to do the long-term invest to protect quality of the land rented from others will validate the relationship between SLMR and family farms’ CLPQIB, which is depicted in Figure 1.

![Figure 1. The logical framework of this study.](image-url)
Land management rights stipulate who can use what land when and how. Accessing arable land is a key to influencing how farmers use the land and whether they are willing to invest in cultivated land protection and quality improvement [22]. SLMR is mainly composed of the rights’ certainty, intensity, and duration, which refer to the certainty of land use rights (during the holding period), the completeness of rights, and the length of time a landowner can use the land [23–25]. SLMR is reflected on two levels. The first is the formalization of land transfer contracts, such as written contracts or oral contracts. The second is the length of the period of agricultural land transfer contract [25]. This paper measures SLMR by analyzing the aspects of ratio of transferred land, types of land transfer contract, and land transfer contract duration.

The ratio of transferred land represents the ratio of the transferred land area in the total area of family farms’ management land, which directly reflects compositions of family farms’ own-contracted land and transferred land. After implementing the “separation of three rights” policy, the land used by family farms consists of own-contracted land (which is contracted from the collective authoritatively with a 30-year contract management rights) and transferred land (which is transferred from individual farmers privately) [15]. Land management rights of own-contracted land are confirmed by land certificates from government and guaranteed by legal documents [26]. Transferred land is rented from individual farmers and only limited by private leasing agreements or contracts, which is not as secure as own-contract land [27]. According to Farmer Behavior Theory, family farms produce based on the goal of maximum profit, when they cannot get the ecologic benefits of CLPQIB on transferred land in the short term, they may not be willing to protect the quality of transferred land. Therefore, we assume that family farms own the higher ratio of transferred land, and there is less willingness to adopt CLPQIT.

Land transaction is achieved by signing contracts through leasing, hiring, or mortgaging to transfer entire or partial property rights among individual contracting parties [28]. For tenants, the bundle value of property rights to land is determined by the type of lease contract [29]. Currently, land transfer contracts classify as prevailing informal (verbal) contracts and formal (written) contracts. Farmers’ spontaneous farmland transaction is mostly based on verbal agreements not formally written with a short period or even without common deadline [30]. Scholars from Bulgaria investigated 1108 farmers and concluded that only 5.7% of households rents in land and 15.3% rents out land with written contracts, respectively [31]. Data from Henan province in China reflected that 95% of households who rented land from others build the relationship on oral land leases without legal validity, only four households signed formal written contracts, and about 82% of households’ leases signed a one-year tenure [27]. A survey from Yang Ziyan [32] showed that around 50% of land rental contracts remained informal and 30% lacked fixed duration. The contractual relationship of oral agreement is uncertain and has the risks of breach of contract, which causes unstable land management rights. Under Rational Man assumption, family farms make decisions due to benefits and unwilling to make long-term investment in land with unstable land management rights. Therefore, we suppose that family farms who rent in land by formal transfer contracts seem more motivated to protect cultivated land.

The holding duration of land is an important component of SLMR [28], which significantly affects farmers’ perception of property rights security and is also important to encourage farmers to invest in arable land [33]. The Land Contract Law provisioned that the duration of a land transfer contract should be less than 30 years in China [34]. According to the “Rational Man” hypothesis of Farmer Behavior Theory, when the term of the land transfer contract is short (such as 1–3 years), there is not enough time for family farms to implement long-term investment behavior; moreover, family farms need to maximize the effectiveness of the rented land in a short time; they possibly carry out agricultural production regardless of the depletion of land fertility and the decline in the quality of cultivated land. Thus, we presume that the longer duration of land transfer contracts, the more possible for family farms to adopt CLPQIT.
Except for considering SLMR, the characteristics in the socio-economic level of head of family farms (HFFs) and family farms are basic factors to their CLPQIB such as age, education, crop types, family fund status, policy cognition, etc. Farmers’ behavior is different visibly due to their diverse individual endowments and family characteristics [35]. Some studies showed that younger, better educated farmers with better finance status were more conscious to agricultural conservation and were more likely to adopt CLPQIT [12,36]. Policy cognition is also a relevant factor for farmers’ CLPQIB. Sufficient information and related regulation encourage farmers to conduct conservation practices [37]. For the complicated CLPQIB of farmers, we presume that family farms’ CLPQIB are affected by the characteristics of HFFs and farms. Based on the backgrounds, the following hypotheses are formulated:

Hypothesis 1 (H1). Ratio of transferred land has a negative impact on CLPQIB of family farms.
Hypothesis 2 (H2). Formal transfer contract has a positive effect on CLPQIB of family farms.
Hypothesis 3 (H3). The land transfer contract duration positively impacts family farms’ CLPQIB.
Hypothesis 4 (H4). Family farms’ characteristics and policies’ cognition influence their CLPQIB.

3. Methodology
3.1. Study Area

This study selected two provinces, Hubei and Anhui, in the middle and lower reaches of the Yangtze Economic Belt. In 2016, the national leader proposed that “Promoting the development of the Yangtze River Economic Zone must put the restoration of ecological environment in an overwhelming position, and must protect the Yangtze River and avoid large-scale development” [38]. In addition, it must issue the Plan for Ecological Environmental Protection in the Yangtze River Economic Zone [39]. Anhui and Hubei provinces have made efforts on cultivated land protection, and family farms in two provinces have diversified characteristics in industrial types, moderate business scale, and continuous improvement in business efficiency. Moreover, the Anhui Province ranking first in China in total for many years and had 143,000 family farms registered with the market supervision department in 2020 [40]. Hubei Province registered 33,700 family farms in 2018 [41]. Therefore, the sustainable production and CLPQIB of family farms in these two provinces need more concerns. This research sorted and numbered the counties in Hubei Province and Anhui Province according to their economic levels, and randomly selected four numbers as the research sites. The four selected counties are Gongan County, Jianli County, and Songzi County in Hubei Province; and Yingshang County in Anhui Province (Figure 2). The Yingshang County of Anhui is a national pilot demonstration zone for green agricultural development and is a large integrated planting-breeding county that positively develops crop-livestock integration to protect cultivated land.
Figure 2. Location of study areas.

3.2. Data Sources

Data are collected by this research group in Hubei in July 2019 and Anhui in January 2020. The survey is divided into two stages. The first stage was pre-investigation. The initial questionnaire surveyed in July 2019 was aimed to sample family farms in Hubei province randomly. The results estimate the reliability and validity of questionnaire and then we modify the questionnaire to improve accuracy. The final questionnaire consists of five sections: (1) personal characteristics of farmers; (2) social and economic characteristics of family farms; (3) family farms’ CLPQIB; and (4) recommendation of CLPQIB. The second stage was carrying out a formal survey in Jingzhou of Hubei province and Fuyang in Anhui province. By using stratified sampling, three typical districts in Jingzhou and one classic district in Fuyang were determined as survey sites. Several towns were chosen randomly in each district and selected family farms in each town were investigated face-to-face. The investigators were graduate students. In addition, the respondents were HFFs who owned the farm and knew the farms’ situation and CLPQIB best. The average interview was 30 min (±10 min). We collected 120 questionnaires with 117 valid questionnaires, and the validity rate is 98.3%.

3.3. Econometric Model and Variable Selection

A bivariate logistic model followed by Eriksson [42] and Yang et al. [43] is used in this study, and the CLPQIB of family farms is measured by three dichotomous variables. The Logit model is defined as follows:

$$Y = \ln \left( \frac{P_i}{1 - P_i} \right) = \beta_0 + \sum_{j=1}^{n} \beta_j X_j + \mu \tag{1}$$
\[ Y = \begin{cases} 
1, & \text{the family farm conducts CLPB} \\
0, & \text{the family farm not conducts CLPB} 
\end{cases} \] \hspace{1cm} (2)

where \( Y \) is binary dependent variable, \( P_i \) is the probability of \( i \)th family farms conducting CLPQB, \( \beta_0 \) is the constant term, \( \beta_j \) is the coefficient of \( j \)th independent variable to be estimated, \( X_j \) is the \( j \)th independent variable of the model, and \( \mu \) is the error term.

The standard interpretation of marginal effect in linear statistical models generally refers to the change of dependent variable when the independent variable is increased by one unit and the other variables remain constant [44]. The relationship between the regression coefficients of the nonlinear Logit model and the marginal effect is briefly described as follows [45]:

\[
\beta_j = \varepsilon = \frac{\Delta Y / Y}{\Delta X / X} = \frac{\Delta Y}{\Delta X} \cdot \frac{X}{Y} = \frac{\partial Y}{\partial X} \cdot \frac{X}{Y} = ME \cdot \frac{X}{Y} \hspace{1cm} (3)
\]

where \( \varepsilon \) is the elasticity, \( \Delta \) is the delta symbol, and \( ME \) means marginal effects (Mar. Efct).

According to Technical Guidelines for Agricultural Green Development (2018–2030), replace chemical fertilizer with organic fertilizer, pesticides reduction, and integrated planting and breeding are efficacious technologies to improve the quality of cultivated land (see in Table 1) [46]. These three CLPQIT protect and improve the quality of cultivated land by reducing pollution and increasing soil fertility. This study chooses three aspects including the organic-replace-chemical-fertilizer (Organic-RCF), pesticides reduction (R-Pesticides) and integrated planting-breeding (Planting-Breeding) to explain family farms’ CLPQB. If the family farm adopted one or more of these three technologies, the family farm has CLPQB. According to theoretical framework, this study chooses three key variables of Transferred Land Ratio, Contract Types, and Contract Duration to represent SLMR. To control as much as possible all variables that can cause the dependent variable to change, this study also selected nine control variables, which include characteristics of HFFs (Age, Education, Entrepreneur, Cognition) and characteristics of family farms (Crop Types, Income, Debt Cooperation, Region). The chosen of nine variables meet the standard of minimum variables approach [47]: to select the fewest variables which explain the majority of variation in the survey data; and these variables are easy to collect. All the dependent and independent variables are presented in Table 2.

| CLPQIT                                      | Explanation                                                                                       | Function                                                                                      |
|---------------------------------------------|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Replace Chemical Fertilizer with Organic Fertilizer | Use commercial organic fertilizers or farmyard manures such as livestock and poultry manure to replace chemical fertilizers. | Organic fertilizer contains trace elements and other minerals which can promote the growth of crop healthily, maintain soil structure, boost grain yields, and improve quality of farmland particularly lasting for the long term [23]. |
| Pesticides Reduction                        | Reduce the use of chemical pesticides through applying pest prevention and control technology or replacing highly toxic and high-residue chemical pesticides to biological pesticides [48]. | Reduce the spreading plethoric harmful chemical pesticides to the farmland and causing cultivated land pollution. |
| Integrated Planting-breeding                 | A production model that ferments the manure and organic matter produced by livestock breeding to provide the source of organic fertilizer for the planting industry and the crops can provide food for livestock and poultry breeding, in which all the components have synergism at different time scales [49]. | Without any chemical product pollution, the production method is green, and it has the characteristics of improving the quality of arable land, recycling resources, and being environmentally friendly. |
### Table 2. Definition and assignment of variables.

| Variables (Abbreviation) | Definition and Assignment                                                                 | Minimum | Max  | Mean   | Standard Deviation |
|-------------------------|------------------------------------------------------------------------------------------|---------|------|--------|--------------------|
| **Dependent variables** |                                                                                         |         |      |        |                    |
| Organic-Replace-Chemical-Fertilizer (Organic-RCF) | Whether family farm replaces chemical fertilizer with organic fertilizer (1 = yes; 0 = no) | 0       | 1    | 0.51   | 0.502              |
| Reduce Pesticides (R-Pesticides) | Whether the average amount of chemical pesticides per ha decreased compared with previous years (1 = yes; 0 = no) | 0       | 1    | 0.29   | 0.456              |
| Integrated Planting and Breeding (Planting-Breeding) | Whether the family farms applied integrated planting and breeding (1 = yes; 0 = no) | 0       | 1    | 0.21   | 0.406              |
| **Independent variables** |                                                                                         |         |      |        |                    |
| Transferred Land Ratio | The ratio of transferred land in total farmland area of family farms (%) | 33.21   | 100  | 83.02  | 16.066             |
| Contract Types | Whether the land transfer contract a formal contract or informal contract? (0 = informal contract; 1 = formal contract) | 0       | 1    | 0.58   | 0.495              |
| Contract Duration | The duration of land transfer contract (years) | 1       | 30   | 5.36   | 5.667              |
| Age | Age of HFF (years) | 24      | 70   | 49.01  | 8.413              |
| Education | Education level of HFF (years) | 6       | 15   | 9      | 2.297              |
| Entrepreneur | Whether HFF is entrepreneur returning hometown from urban (1 = yes; 0 = no) | 0       | 1    | 0.21   | 0.406              |
| Cognition | HFF’s cognition to policies of organic-replace-chemical-fertilizer (1 = understand; 0 = not understand) | 0       | 1    | 0.50   | 0.502              |
| Cognition | HFF’s cognition to policies of pesticides reduction (1 = understand; 0 = not understand) | 0       | 1    | 0.38   | 0.489              |
| Cognition | HFF’s cognition to policies of integrated planting and breeding system (1 = understand; 0 = not understand) | 0       | 1    | 0.38   | 0.489              |
| Crop Types | Family farm growing alimentary crops or economy crops (1 = food crops; 0 = cash crops) | 0       | 1    | 0.64   | 0.482              |
| Income | Annual agricultural net income of family farm (thousand CNY) | 14      | 3150 | 245.50 | 447.412            |
| Debt | Whether family farm in debt (1 = yes; 0 = no) | 0       | 1    | 0.15   | 0.362              |
| Cooperation | Whether family farm has cooperation with other agricultural organization (1 = yes; 0 = no) | 0       | 1    | 0.23   | 0.423              |
| Region | Region of family farm (1 = Anhui; 0 = Hubei) | 0       | 1    | 0.56   | 0.499              |

### 4. Results

#### 4.1. Statistic Results

Data were analyzed by Stata 16.0 software (Stata Corporation, College Station, TX, USA). Table 3 shows that 51.3% of respondents uses organic fertilizer, while 29.1% and 20.5% of family farms respectively use pesticides’ reduction and integrated planting-breeding. With the maturity of organic fertilizer production technology, its price has been increasingly accepted by farmers. However, the adoption rate of Planting-Breeding is not as high as Organic-RCF because it is more complicated for ordinary farmers to learn, and its cost is higher than that of Organic-RCF. Table 4 presents the SLMR of family farms, of which 50.4% possesses 85–100% of transferred land, 41.9% signed oral transfer contracts, 53.0% signs 1–3 years’ lease agreements. The research objective of this paper is mostly family farms which have transferred a large amount of arable land and signed written contracts. The evident shows that family farms are one of the new agricultural actors in the aspects of scale and standardization, and also embodies the importance of transferred land for family farms. The situation of land transfer contracts is similar to China’s land circulation market...
for which most interviewees signed 1–3-year short-term contracts. From Tables 2 and 4, the descriptive statistical analysis makes it evident that the sample data can represent the actual situation. HFFs surveyed mainly 45–54 year olds (51.3%), whose education level is junior high school and below (81.2%), but few (20.5%) entrepreneurs returning home from urban centers. In addition, 50.4% of farmers understand the policies of Organic-RCF, and 38.5% know the policies about R-Pesticides and Planting-Breeding. It implies that HFFs are mainly middle-age people with some education knowing some related policies and have been farming for many years. In the sample, 64.1% of farm land grow cash crops, with an average farm income of 245,500 CNY, 15.4% is in arrears, and 23.1% cooperated with agricultural organizations.

Table 3. Family farms’ adoption of CLPQIT \( (n = 117) \).

| Organic-RCF | R-Pesticides | Planting-Breeding |
|-------------|--------------|-------------------|
| **Adopters** | Frequency | Percentage (%) | Frequency | Percentage (%) | Frequency | Percentage (%) |
| 60          | 51.3        | 34               | 29.1      | 24              | 20.5      |
| **Non-adopters** | 57 | 48.7 | 83 | 70.9 | 93 | 79.5 |

Table 4. Demographic profile of the sample \( (n = 117) \).

| Variables                        | Classification        | Frequency | Percentage (%) |
|----------------------------------|-----------------------|-----------|----------------|
| Transferred Land Ratio           | 0–50%                 | 6         | 5.1            |
|                                  | 50–70%                | 19        | 16.3           |
|                                  | 70–85%                | 33        | 28.2           |
|                                  | 85–100%               | 59        | 50.4           |
| Contract Types                   | Informal Contracts    | 49        | 41.9           |
|                                  | Formal Contracts      | 68        | 58.1           |
|                                  | 1.0–3.0               | 62        | 53.0           |
| Contract Duration                | 3.1–5.0               | 16        | 13.7           |
|                                  | 5.1–10.0              | 26        | 22.2           |
|                                  | 10.1–30.0             | 13        | 11.1           |
|                                  | <30                   | 3         | 2.5            |
|                                  | 30–45                 | 32        | 27.3           |
| Age                              | 45–55                 | 60        | 51.3           |
|                                  | 55–65                 | 20        | 17.2           |
|                                  | >65                   | 2         | 1.7            |
|                                  | 0–6                   | 28        | 23.9           |
|                                  | 7–9                   | 67        | 57.2           |
| Education                        | 10–12                 | 16        | 13.6           |
|                                  | above 12              | 6         | 5.1            |
|                                  | Entrepreneur returning home | 24 | 20.5 |
|                                  | Not an entrepreneur    | 93        | 79.49          |
|                                  | Understand            | 59        | 50.43          |
|                                  | Not understand        | 58        | 49.57          |
| Cognition of Organic-RCF         | Not understand        | 45        | 38.46          |
|                                  | Not understand        | 72        | 61.54          |
| Cognition of R-Pesticides       | Not understand        | 45        | 38.46          |
|                                  | Not understand        | 72        | 61.54          |
| Cognition of Planting-Breeding  | Not understand        | 45        | 38.46          |
|                                  | Food crops            | 75        | 64.10          |
| Crop Types                       | Cash crops            | 42        | 35.90          |
|                                  | 0–200                 | 85        | 72.60          |
|                                  | 200–500               | 22        | 18.90          |
|                                  | >500                  | 10        | 8.50           |
| Income                           | In debt               | 18        | 15.38          |
|                                  | Not in debt           | 99        | 84.62          |
| Cooperation                      | Yes                   | 27        | 23.08          |
|                                  | No                    | 90        | 76.92          |
| Region                           | Anhui                 | 65        | 55.56          |
|                                  | Hubei                 | 52        | 44.44          |

4.2. Estimate Results

The results are shown in Table 5. The omnibus test is conducted for which chi-squares of three models are 125.49, 67.387, and 71.898, respectively, and the significance is less than 0.05. It reveals that at least one variable’s OR value in each model is statistically significant, i.e., every model is statistically sense. Log likelihood (–2 time) values of three Logit models are 36.970, 73.642, and 46.841, respectively, which proves that models performed well. The significance of a three H-L test value is more than 0.05, indicating that three models maximize the fit of the model by existing information and explains the variation. Overall,
models fit well. Results in column Mar. Efct display the marginal effect of variables, which is mutually confirmed with the results of logistic regression.

Table 5. Estimation results of family farms’ CLPQIB.

|                       | Organic-RCF       | R-Pesticides     | Planting-Breeding |
|-----------------------|-------------------|------------------|-------------------|
|                       | Coef.             | Std. Err.        | Mar. Efct.        | Coef.             | Std. Err. | Mar. Efct. | Coef.             | Std. Err. | Mar. Efct. |
| Transferred Land Ratio | $-18.357^{***}$   | 5.716            | $-0.884^{***}$   | $-1.394$         | 2.726      | $-0.135$   | $-5.622^*$        | 3.395      | $-0.355^*$  |
| Contract Types        | $-1.763$          | 1.185            | $-0.085$         | $1.323^*$        | 0.8        | $0.128^*$  | $3.383^{**}$      | 1.641      | $0.214^{**}$ |
| Contract Duration     | 0.429**           | 0.186            | 0.021***         | 0.225**          | 0.103      | 0.022**    | 0.202*           | 0.118      | 0.013*      |
| Age                   | 0.143*            | 0.081            | 0.007*           | $-0.026$         | 0.045      | $-0.003$   | $-0.021$         | 0.057      | $-0.001$    |
| Education             | $-0.485$          | 0.315            | $-0.023$         | $-0.172$         | 0.159      | $-0.017$   | 0.424**          | 0.201      | 0.027**     |
| Entrepreneur          | $-6.38^{**}$      | 2.518            | $-0.307^{***}$   | 0.604            | 0.86       | 0.059      | $-0.999$         | 1.246      | $-0.063$    |
| Cognition             | 4.667***          | 1.394            | 0.225***         | 1.81***          | 0.666      | 0.176***   | 3.97***          | 1.149      | 0.251***    |
| Crop Types            | 4.265***          | 1.634            | 0.206***         | 2.137***         | 0.85       | 0.207***   | $-3.075^{**}$    | 1.47       | $-0.194^{**}$|
| Income                | 0.027***          | 0.009            | 0.001*           | $-0.001$         | 0.001      | $-0.000^*$ | 0.001            | 0.001      | 0.000       |
| Debt                  | 5.367***          | 1.855            | 0.259***         | 2.549***         | 0.959      | 0.247***   | $-1.533$         | 1.321      | $-0.097$    |
| Cooperation           | 5.62**            | 2.232            | 0.271***         | 0.533            | 0.781      | 0.052      | $-2.022$         | 1.39       | $-0.128$    |
| Region                | $-1.352$          | 1.206            | $-0.065$         | $-0.565$         | 0.807      | $-0.055$   | 0.172            | 1.039      | 0.011       |
| Constant              | 2.313             | 5.447            | $-4.277$         | 4.367            | —         | $-4.601$   | 4.427            | —         | —           |
| Omnibus               | 125.149 ($p = 0.00$) | —  | 67.387 ($p = 0.00$) | —  | 71.898 ($p = 0.00$) | —  | —  | —  |
| (-2) Log likelihood   | 36.970            | 73.642           | —                | 46.841           | —         | —         | 36.970            | 73.642     | —           |
| Hosmer-Lemesho        | 10.998 ($p = 0.202$) | —  | 14.714 ($p = 0.065$) | —  | 2.367 ($p = 0.968$) | —  | —  | —  |

Note: ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

Empirical results on family farms’ CLPQIB (Table 5) show that variables of SLMR influenced family farms’ CLPQIB in varying degrees. Transferred Land Ratio negatively influenced Organic-RCF and Planting-Breeding, while Contract Types positively relate to R-Pesticides and Planting-Breeding. All three CLPQIT are influenced by Contract Duration positively. In Table 5, Transferred Land Ratio negatively impacts family farms’ adoption of Organic-RCF, and Planting-Breeding is significant at the 1% and 10% level, respectively, showing that the ratio of transferred land has a negative impact on CLPQIB of family farms, which confirm the first hypothesis. This result indicates that a high proportion of transferred land inhibits the enthusiasm of family farms to implement CLPQIT. Moreover, the results of the marginal effect model show that marginal effects of Transferred Land Ratio to Organic-RCF and Planting-Breeding are $-0.884$ and $-0.335$. This implies that, when increasing every 1% of ratio of transferred land, the probability for family farms to use organic fertilizer and apply Planting-Breeding decreased by $0.89%$ and $0.34%$ respectively. The Contract Types have significantly positive effects on R-Pesticides and Planting-Breeding at the 1% and 10% levels, respectively, and show that a formal transfer contract has a positive effect on CLPQIB of family farms, which supports H2. This reflects that farmers who rented cultivated land by a written contract are more likely to apply CLPQIT. Results in marginal effect analysis demonstrate that family farms who rented land through written contracts have 12.8% and 21.4% more possibility to adopt R-Pesticides and Planting-Breeding than through verbal agreement. In Table 5, Contract Duration influencing Organic-RCF, R-Pesticides, and Planting-Breeding is positively significant in the level of 5%, 5%, and 10%, showing that the land transfer contract duration positively impacts family farms’ CLPQIB, H3 is supported. This result indicates that family farms signing a transfer contract with a longer duration are more likely to have CLPQIT. In addition, the results of the marginal effect model show that, for every additional year of
contract duration, the possibility of using Organic-RCF, R-Pesticides, and Planting-Breeding for family farms is increased by 2.1%, 2.2%, and 1.3%, respectively.

The decision equation shows that variables of Age, Cooperation have a positive impact on Organic-RCF, and Entrepreneur has a negative impact. The marginal effect model shows that, for each increase year of age, the probability of family farms’ use of organic fertilizer heights by 0.7%. Family farms cooperated with other agricultural organizations are 27.1% more possible to use organic fertilizer than those who do not cooperate. The returned entrepreneurs are 30.7% less likely to use organic fertilizer than HFFs who have engaged in agriculture for years. Education is negatively associated with family farms using integrated planting-breeding, whose possibility will increase by 2.7% when education improved by each level. Debt influences Organic-RCF and R-Pesticides positively at a 1% level. The farms in debt are respectively 25.9% and 24.7% more possible to adopt Organic-RCF and pesticides’ reduction than family farms did not borrow any money. Income plays a positive effect on Organic-RCF and a negative effect on R-Pesticides. For every thousand CNY improvement of Income, the possibility for family farms to adopt Organic-RCF will increase 0.1%. Cognition has positive effects on all three CLPQITs. HFFs who understand corresponding policies are 22.5%, 17.6%, and 25.1% more probable to adopt Organic-RCF, R-Pesticides, and Planting-Breeding than those who cannot tell them apart. In contrast to family farms who grow food crops, farms planting cash crops are 20.6% and 20.7% more willing to resort to organic fertilizer and pesticides reduction as well as 19.4% less possible to take integrated planting-breeding. Region is not significant, and it is evident that the CLPQIB of family farms in Hubei and Anhui province is similar. In addition to regional variable Location, all variables of characteristics about HFFs and family farms influence family farms’ CLPQIB, which shows that family farms’ characteristics and policies’ cognition influence their CLPQIB. H4 is proven.

5. Discussion

This study analyzes the influence of SLMR on family farms’ CLPQIB from the perspectives of ratio of transferred land, transfer contract types, and duration. Transferred Land Ratio negatively impacts family farms’ CLPQIB, which indicates that the high ratio of transferred land inhibits the enthusiasm of family farms to implement CLPQIB. This result is similar to the research from Andreas et al. [50] that the ratio of transferred land was negatively associated with soil conservation efficiency and eco-efficiency. Tenants pursued short-term economic benefits, which caused the over-exploitation of soil. The 30-year land contract and land certificated program policies have stabilized the family farms’ land management right on own-contracted land. Farmers can improve the quality of their own-contracted land by sacrificing immediate benefits. China’s land transfer market is immature with irregular contract form, unclear content, insufficient time limit, and even no contract [32,51]. The management rights of transferred land are not stable compared to own-contracted land. Family farms must make a trade-off between short-run economic yield and long-term sustainable produce behavior due to the unstable management rights. Farmers have a large area of transferred land easily leading to make short-sighted decisions. Thence, it is necessary to improve the quality of cultivated land.

The results show that the formal land transfer contracts promote family farms’ CLPQIB, which is consistent with the result of Zhang et al. [30] that renting land via formal contracts would facilitate farmers with protecting the land quality. Family farms’ CLPQIB can be influenced by written land leasing contracts in two ways theoretically. First, the formal contract regulates the duration and content of rights for family farms. Specifically, it includes the legal significance and detailed regulations on the time limit, price, and even behavior [25]. The lease contract defines what is transferred to family farms, what is left for transferors, and which actions can be conduct in the rented land [29]. Family farms have an express expectation of their investment and can control the gain of their CLPQIB owned by themselves rather than landowner within the agreed time, which is realized by clarified rights and time limits. Second, guaranteeing the legality to land management rights of
family farms who rent in arable land in order to reduce breaches of contract. Written land contract is a key to securing the land transactions to make land transfer transparent and protect legally, which can cut back potential land conflicts, and family farms will use CLPQIT in rented arable land with ease [36]. Comparatively, verbal land transfer agreement lacks authoritative land use rights and legal evidence, whose contractual relationship is not stable. Once the transferors suffer unexpected shocks like fail of off-farm employment, they will probably terminate the leasing contract and take back cultivated land, their only valuable asset, to resume agricultural production [52]. Furthermore, oral agreements lack regulations, and it is difficult to clearly define the responsibilities of each party when breach of contract happens. However, in reality, local governments neglect the unilateral breach of a contract that happened in farmers due to the large income gap between smallholders and family farms, which may prevent farmers losing their livelihoods [31,32]. Therefore, it is difficult for family farms to invest more money to improve the quality of cultivated land because of the uncertain behavior of the transferor under the oral rent agreement [30].

The results show that family farms signing a rental contract with longer duration are more willing to apply CLPQIT, which is similar to the findings of Vu et al. [53] that perceive with regard to the addition in duration of agricultural land management rights that can stimulate farmers to invest in organic fertilizer and soil and water conservation. Early discovery showed that land lease term may promote land degradation, which traced back to Adam Smith, John Stuart Mill, and Alfred Marshall [50], who believed that farmers have no interest in maintaining the productivity of land beyond the expected time span of the contract. Regulations on the duration of transfer contracts prevent farmers from short sight making decisions, which include some rules about minimum duration of transfer contracts, renewal of contracts, and a priority for tenants to buy when the landowner wants to sell the land.

Farmers especially a younger generation leave home to search jobs in towns and cities. They tend to rent out farmland instead of farming by themselves [54]. Thus, rental shares in China are increasing due to a structural change of land system and tight agricultural land rents markets. The National Bureau of Statistics estimated that the area of transferred cultivated land was 353.33 million ha, accounting for 38.4% of the total contracted land area in 2018 [55]. The transferred land area continues to increase, but a high area of transferred land has a negative impact on family farms’ CLPQIB; this is a contradiction. The key to resolving contradictions lies in SLMR.

The results demonstrated that family farms already had awareness of the importance of cultivated land protection and environmental conservation in the progress of greenization and modernization agricultural production. HFFs are mostly middle-aged people who have received some education and are familiar with some relevant policies, and part of them have left the city to start a family farm. A large proportion of family farms planting cash crops gain less than 200,000 of annual net income; part of the family farms are in debt and part have cooperation with other agricultural organizations. Family farms that grow food crops, keep low incomes, do not have loans, have little contact with other agricultural tissues, and have a principal who is young, is an entrepreneur, and do not understand the CLPQIT policy are more reluctant to apply Organic-RCF. Family farms that grow cash crops, borrow money, and understand CLPQIT policies are more willing to reduce the use of pesticides. Family farms that grow food crops, understand related policies, have a head with high education, and are more pleased to adopt integrated planting-breeding.

Age has a positive impact on family farms’ CLPQIB. Bowei et al. [23] had a different result in that old HFFs have recognized the negative effect of land degradation and the positive of CLPQIT for their long working experience on agricultural production, and they are willing to conduct CLPQIB. The higher education is more rational to balance the relationship between economic benefits and environmental protection. In addition, education is positively related to use knowledge-intensive conservation agricultural techniques. People that got more educated have a stronger ability in information access and decision-making [56], greater understanding about CLPQIT, and more opportunities to obtain
off-farm employment, which will reduce the obstacles to implement CLPQIB [37]. Entrepreneur has negative effects on family farms’ CLPQIB. This reveals that HFF who rooted in rural areas for years have more enthusiasm to adopt Organic-RCF than entrepreneurs who returned from urban areas and have sufficient off-farm business experience. Family farms’ cognition about policies of CLPQIT has a positive impact on family farms’ CLPQIB, which is in line with the conclusions from Cao et al. [58]. The understanding of arable land protection policies displays a direct impact on farmers’ CLPQIB, and also indirectly affects CLPQIB through other economic factors. Since policy cognition can form family farms’ subjective norms and lead them to adjust CLPQIB. If farmers have little cognition of arable land protection policies, it is difficult for them to abandon their conventional agricultural produce practices [58]. Family farms who plant food crops have a greater reluctance to adopt Organic-RCF and reduce the use of pesticides, which has a similar conclusion to Gao et al. [26]. Planting cash crops bring about higher expected returns and stricter quality requirements, while farmers planting food crops have less motivations to adopt Planting-Breeding. The reason is that Planting-Breeding is based on food crops are more prevalent in the middle and lower reaches of the Yangtze River, such as rice-fish model, rice-shrimp model, rice-turtle model, etc. In addition, debt is positively significant to family farms’ use of organic fertilizer and pesticides reduction. When family farms are in debt, it indicates that they have the ability to loan from institutions like banks and had already borrowed a lot of money to invest in farming.

This research has two limitations. First, this study assumes that one or more CLPQIT are regarded as CLPQIB and for this paper focuses more on the impact of SLMR on CLPQIB. The difference between different CLPQIT is not discussed in depth. This is and will be studied in the next step of exploring the impact of SLMR on family farms’ adoption of different CLPQIT. Second, this study only considers whether the family farm adopted CLPQIT or not, and did not consider the intensity of adoption. This study measures whether CLPQIB is carried out by adopting CLPQIT, that is, CLPQIT with a degree of 1 and CLPQIT with a degree of 99 are both regarded as having CLPQIB in this article. For example, the application of 10 kg/ha of organic fertilizer instead of chemical fertilizer and the application of 10,000 kg/ha of organic fertilizer are both regarded as organic-RCF adopted, and CLFQIB exists. Future research will further explore the intensity of CLPQIT adopted by family farms.

6. Conclusions

China is in an important period of rapid development of land circulation, increasing importance of cultivated land protection, and vigorous implementation of rural revitalization strategies. The CLPQIB of family farms in the process of agricultural production is vital to improve the quality of country’s cultivated land and protect the ecological environment. This paper investigated family farms in Hubei and Anhui provinces by using a binary logistic regression model in order to explore the realization of how SLMR influences family farms’ CLPQIB. Results show that SLMR have influences on family farms’ CLPQIB. The lower the ratio of transferred land, the more formal the signed rent contract, the longer the land transfer duration, and the more possible family farms are to adopt CLPQIT. Family farms already had the awareness of the importance of cultivated land protection and environmental conservation in the progress of greenization and modernization agricultural production.

This study provides useful information for policy makers to formulate the policy of improving quality of cultivated land. SLMR can be protected by establishing land transfer management service centers with the help of village collectives and other grassroots organizations, regulating the procedures when farmers transfer cultivated land with others and witnessing the land transfer transaction as a third-party, in addition to increasing the intensity of publicity work about standard land transfer, increasing family farms’ awareness of the benefits of signing written contracts and long-term contracts, and encouraging parties to the lease transaction to sign formal and long-term contracts.
Based on the limitations of this paper, the next step of this research is to explore the impact of SLMR on family farms’ adoption of different CLPQIT and adoption intensity of CLPQIT.

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Abbreviations

| Concepts/Terms                                      | Abbreviation          |
|----------------------------------------------------|-----------------------|
| cultivated land protection and quality improvement behavior | CLPQIB                |
| cultivated land protection and quality improvement techniques | CLPQIT                |
| stability of land management right                 | SLMR                  |
| head of family farms                                | HFFs                  |
| Organic-Replace-Chemical-Fertilizer                | Organic-RCF           |
| Reduce Pesticides                                  | R-Pesticides          |
| Integrated Planting and Breeding                    | Planting-Breeding     |

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