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Can Market-Oriented Allocation of Land Factors Promote the Adoption of Cropland Quality Protection Behaviors by Farmers: Evidence from Rural China

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Abstract: Protecting cropland quality is a fundamental national policy that China must adhere to for the long term. This study examines the impact of market-oriented allocation of land factors on farmers' cropland quality protection behaviors and its mechanism of action, based on survey data from 3804 farm households in the 2020 China Rural Revitalization Survey (CRRS). The study employs the Ordered Probit (O-probit) model, the mediated effect model, and other econometric tools to analyze the data. The study found that the market-oriented allocation of land factors can significantly promote farmers' adoption of cropland quality protection behaviors. The robustness test supports this conclusion. The market-oriented allocation of land factors indirectly promotes the adoption of cropland quality protection by expanding the plot size and improving agricultural income. The analysis of heterogeneity indicates that farmers are more likely to adopt cropland quality protection behaviors in the plains, suburban areas, or areas with better developed labor markets. Therefore, it is essential to continue promoting market-oriented reforms of rural land factors, actively promoting land transfer policies, and guiding the development of agricultural operations towards scaling, specialization, and modernization. This will achieve the rational allocation of land resources. It is important to consider geographical variations in each area when implementing policies to guarantee effective utilization and protection of cropland.

Keywords: land transfer; cropland quality protection behaviors; factor market-oriented allocation; O-probit model; mediation effect

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1. Introduction

Safeguarding cropland is crucial for both the national economy and the well-being of the population. The rational use of cropland and the effective safeguarding of agriculture are fundamental long-term national policies that our country must consistently adhere to. The report of the 20th CPC National Congress highlighted the need to comprehensively enhance food security and protect the 1.8 billion mu of cropland as a critical measure to ensure the Chinese people's self-sufficiency in food production. The 2024 No. 1 Document of the Central Committee suggested the strict implementation of the cropland protection system, which should consider the quantity, quality, and ecological aspects of cropland as a whole entity. For too long, governments have paid special attention to the protection of cropland quality, and have implemented a series of initiatives such as reducing the amounts of chemical fertilizers and increasing their efficiency, the comprehensive utilization of straw, rotational fallow cultivation, and high-standard cropland construction.

However, in recent years, facing many risks and challenges such as climate change, a geopolitical crisis, and economic slowdown, the task of cropland protection in China has not been alleviated, but has become even more arduous. China has experienced repeated alterations in the utilization of cropland, a decrease in the amount of cropland, and a deterioration in cropland quality [1,2]. The state of cropland protection in China is not promising. The 2021 data from the third national land survey reveals that China's cropland areas are 127,861,900 hectares, representing 9% of the global cropland total. Furthermore, the cropland area has fallen by 7,523,100 hectares compared to the second national land survey conducted in 2007. Meanwhile, the deterioration of black soil in the northeast, the acidity of cropland in the south, and the salinization of cropland in the north are very grave issues [3]. To guarantee food security, it is imperative to prioritize cropland protection, adhere closely to the designated boundaries of cropland, and enhance cropland quality [4]. As the ultimate participants and most direct beneficiaries of cropland utilization, the greening and intensification of farmers' production behaviors will directly affect whether arable land can be effectively protected and utilized.

The Ministry of Agriculture issued the Action Program for Protection and Enhancement of Cultivated Cropland Quality in 2015. This program emphasizes four key measures for protecting cultivated cropland quality: soil improvement, fertility cultivation, preservation of water and fertilizer, and pollution control and repair. The existing academic study on the farmers' behaviors in protecting the quality of cropland can be categorized into two groups: internal variables and external factors. On the one hand, factors such as the farmers' individual qualities, household characteristics, and production characteristics might influence the extent to which farmers engage in cropland quality protection behaviors. At the level of individual farmers' characteristics, age, gender, education level, socio-economic status, risk preference, and behavioral perception are important factors influencing the adoption of cropland quality protection behaviors [5–10]. At the level of household characteristics, the adoption of cropland quality protection behaviors is affected by income level, the number of laborers, and part-time jobs in the household [11–14]. At the level of production and operation characteristics, crop varieties, production investment, agricultural insurance, degree of land fragmentation, scale of operation, and the duration of transfer will all affect the behaviors of cropland quality protection [15–21]. On the other hand, from the perspective of external influences, government subsidies, the farmland property rights system, rural infrastructure, technology promotion, policy propaganda, and climatic environment also have a certain relationship with the adoption of cropland quality protection behaviors [22–26].

According to the theory of farmers' behaviors, farmers' behavioral decisions depend on their consideration of expected costs and benefits. The ongoing migration of workers from rural areas has alleviated the conflict between people and land, leading to a robust growth in the rural land transfer market [27]. Recently, China has consistently followed a market-oriented reform approach. To guide the development of the land factor market, China has implemented various policies. According to the Ministry of Agriculture and Rural Affairs, the transferred area accounted for 37% of the operating cropland area nationally at the end of 2017. In the early days, problems such as land fragmentation and land resource mismatch made farmers less capable and motivated in adopting new technologies, which in turn led to the abandonment of intensive farming and over-cultivation of land. A standardized and efficient land transfer market can alleviate the mismatch between the size of farmers' land and their management capacity, and reduce the negative impacts of fragmentation and resource mismatch [28]. The active supply and demand relationship offers more ways for farmers to dispose of idle land. Certain farmers who possess exceptional farming skills and are highly motivated have the capacity to make transfer decisions based on their own managerial capabilities and the current state of their operations. This enables them to achieve a moderate scale of operation while avoiding any inefficiencies or wastage of production resources [29].

Currently, studies have found that the mismatch of resources caused by the incomplete nature of the land factor market has a significant detrimental effect on total factor productivity, industrial structure upgrading, innovation capacity, the natural environment, food security, and overall economic development [30–40]. To achieve the high-quality development of agriculture and rural areas, the key is to promote the market-oriented allocation of land factors and optimize the rational allocation of agricultural land resources. This can not only effectively reduce transaction costs, but also enable land transfer to the hands of planting professionals who are truly engaged in agricultural production, significantly reducing the phenomenon of abandonment of arable land, thereby enhancing the land use efficiency, curbing the loss of agricultural productivity, and promoting the enhancement of agricultural labor productivity, and further realizing the industrialization of agriculture and large-scale operation [41–45]. A scale effect and an agricultural mechanization level of efficiency brought about by the increase in the level of transfer to the land of farmers can improve business income, transfer out of farmers through labor transfer to improve wage income, help rural poverty reduction, and increase social welfare [46–49]. At the same time, the market-oriented allocation of land factors can also significantly reduce the gap between urban and rural areas and promote the level of urban–rural integration and development [50–52]. In addition, it also provides an effective solution to the problem of agricultural pollution in China [53].

In the context of China's current factor marketization reform, land is the most basic production factor. Therefore, it is crucial to examine the effects of market-oriented allocation of land factors on the cropland quality protection behaviors, to excavate the important mechanisms existing therein, to promote the application and development of market-oriented reform in agricultural production, to guarantee the stable supply of food, and to achieve the modernization and development of China's agriculture, which are of great theoretical and practical importance. In rural areas of China, farmers make decisions about how to allocate resources based on both the available resources and the specific agricultural production environment in their local area. These decisions are influenced by the social interactions within the farming community. In the existing research, most of the studies on land factor allocation and cropland quality protection focus on the land transfer decisions and market-oriented transfer behaviors of individual farmers, ignoring the impact of the market-oriented degree of land allocation. It can be seen that the impact of the market-oriented allocation of land factors on the behaviors of cropland quality protection has not been fully discussed in this research area. According to the analysis provided above, we use the data of CRRS to construct the O-probit model and the mediated effect model to explore the role mechanism and influence the difference of the market-oriented allocation of land factors on the behaviors of cropland quality protection, in order to offer pertinent recommendations for advancing the sustainable growth of agriculture and ensuring food security in China. The following are the main contributions of this study: firstly, from the perspective of micro-level farmers, analyzing the impact of the market-oriented allocation of land factors on the behaviors of cropland quality protection, expanding the analysis scale of the level of market-oriented allocation of land factors, and making up for the lack of relevant research on the market-oriented allocation of land factors in the area of agriculture; secondly, from the perspective of the degree of fragmentation and the function of land security, we further analyze the mechanism of the role of the market-oriented allocation of land factors on the behaviors of cropland quality protection; thirdly, it explores the different effects of market-oriented allocation of land effects on the protection of cropland quality under differences in terrain, location, and labor market development, in order to better tailor policies to local conditions.

2. Theoretical Analysis

During the initial stages of the introduction of China's family contract responsibility system, due to clear property rights incentives, agricultural production incentives for farmers can be improved. However, as time goes by, the problems of fragmentation of cropland operated by farmers and uneven allocation of production factors have limited the expansion of agricultural marginal output and impeded the progress of agriculture [54]. Land transfer facilitates the transfer of land use rights between different entities, hence reducing land fragmentation to some extent and enabling moderate-scale operations [55]. The enhancement and standardization of the land transfer market are crucial prerequisites for optimizing reasonable land resource allocation and facilitating farmers' efforts to safeguard the quality of cropland. Currently, many areas are still facing the issue of an underdeveloped land factors market, and there are noticeable expenses associated with transactions in the rural land transfer market. Once the transaction costs are so high as to impede the trading of resources and rights, the value of resources can only be measured by non-monetary measures, and the trading of rights will most likely be characterized by non-marketization. The phenomena of rent-free transfers, verbalization of contracts, and short-termination of transfers that prevail in the rural land transfer procedure in China are in fact specific manifestations of the high transaction costs [43,56].

In the context of incomplete factor markets, if the scale of land exceeds the operating capacity of farmers, it is difficult to smoothly adjust the scale of land through market transactions, and farmers may give up the intensive farming model under the constraint of family labor. Similarly, if the size of the land operation is insufficient to align with the farmer's operating capacity, the farmer may resort to over-cultivating the land to enhance the marginal output of the land. This is carried out to achieve a return that is at least on par with the returns from other non-farming activities. Whether it is large-scale farmers or small farmers, if the management capacity of farmers is decoupled from land management scale, the phenomenon of not adopting the behaviors of protecting the quality of cropland is likely to occur. It is evident that in the process of changing the rural land system, it is crucial to prioritize the significant role of the land transfer market in allocating land factor resources [57]. The market's "invisible hand" can offer farmers additional options for managing unused cropland and adjusting their operational scale. This facilitates the achievement of optimal allocation of operational capacity and scale, as well as the promotion of various forms of moderate-scale operations. Consequently, it reduces challenges faced by farmers in adopting cropland protection practices and enhances their motivation to safeguard cropland quality. The implementation of diverse and suitable scale management strategies can alleviate the challenges associated with implementing cropland quality protection practices and enhance the motivation for cropland quality preservation [58].

Compared with the incomplete factor market scenario, farmers in the complete factor market scenario may be more inclined to adopt cropland quality protection measures to maximize their own interests [21]. On the one hand, market-oriented transfers allow farmers to be more flexible in choosing management methods that suit their conditions and land quality. According to the theory of farmers' behaviors, by spending money on leasing land, farmers will improve their expectation of land operation, stimulate the willingness of rational production and long-term investment, and thus be more inclined to protect the quality of cropland to ensure long-term sustainable operation [59]. On the other hand, due to the existence of transfer costs, the transferring party, as the actual land operator, needs to make transfer decisions based on the costs and outputs of production inputs, so it will not blindly transfer cropland, reducing the waste of cropland resources. Simultaneously, the improvement of the land factor market can also promote the land transfer procedure to improve the transparency of information, where farmers can better understand the transfer of differing land quality in the market; so in this context, farmers are more likely to prioritize the preservation of land quality in their choice of agricultural methods, rather than over-development of the land quality decline to ensure that the land can be successfully transferred out or transferred in [60]. In addition, the market-oriented transfer of land is usually accompanied by more legal and institutional support, with clearer delineation of land rights and interests and more standardized contract performance. This helps farmers to reduce inappropriate development and misuse of land, thus prompting them to adopt cropland quality protection behaviors.

According to the analysis provided above, H1 is proposed as follows:

H1. *Market-oriented allocation of land factors can promote the adoption of cropland quality protection behaviors by farmers.*

The market-oriented allocation of land factors not only directly affects the famers' cropland quality protection behaviors, but also may indirectly affect the famers' cropland quality protection behaviors through some characteristic variables (e.g., plot size and farm income).

The rural production model in China is characterized by small-scale and dispersed operations. To realize the moderate scale of agricultural development and reduce the fragmentation, the key lies in the simultaneous expansion of the operating area of farmers and the size of plots, the integration of adjacent plots, and the realization of land concentration and contiguity. By promoting the development and improvement of the land transaction market, it will be more conducive for farmers with agricultural production advantages to transfer to adjacent land, at the same time expanding the scale of operation and plot size, so as to realize the economy of scale in agriculture, and to fundamentally change China's decentralized and fragmented family operation pattern [61,62]. When the land is concentrated and contiguous, the plot size can be expanded, avoiding the waste of time and cost caused by labor and agricultural machinery operation between plots, reducing the difficulty of substituting agricultural machinery for human labor, and facilitating the large-scale batch operation of agricultural machinery to improve the farming conditions of farmers [63]. In addition, the continuous expansion of the scale of operation is also conducive to the transformation of the previous decentralized and diversified crop cultivation mode into a single, specialized cultivation mode, which reduces the difficulty and cost of management, thus increasing the enthusiasm of farmers to carry out cropland quality protection [64].

In addition, within the framework of China's ongoing factor marketization reform, the discrepancy between the size of farmers' land operations and their marginal production capacity has been reduced for agricultural management subjects. This has increased the agricultural production efficiency and incomes [65]. And cropland quality protection often requires investment in capital, labor, and technology, whereby the increase in agricultural income can improve the ability of farmers to pay for cropland quality protection [66]. Simultaneously, farmers with higher incomes, who do not face issues regarding food and clothing, are more likely to receive greater policy attention and possess better information acquisition capabilities. Consequently, they find it easier to comply with relevant government policies and engage in actions that protect the quality of cropland. Furthermore, with the increase in income, the survival security function of land such as employment and old age is also strengthened [67]. The growing demand for land by farmers highlights the crucial need for adequate protection and rational utilization of cropland resources to support agricultural development [68]. Long-term sustainable utilization of land can guarantee the long-term stability of farmers' future income; so as farmers' agricultural income rises, they prefer to invest in the protection of cropland quality to ensure long-term economic benefits.

According to the analysis provided above, H2 and H3 are proposed as follows:

H2. *The market-oriented allocation of land factors indirectly influences the adoption of cropland quality protection behaviors by farmers through the expansion of plot size.*

H3. *The market-oriented allocation of land factors indirectly influences the adoption of cropland quality protection behaviors by farmers through increasing agricultural income.*

This study presents a logical framework diagram based on the theoretical analysis and research assumptions mentioned above (Figure 1).

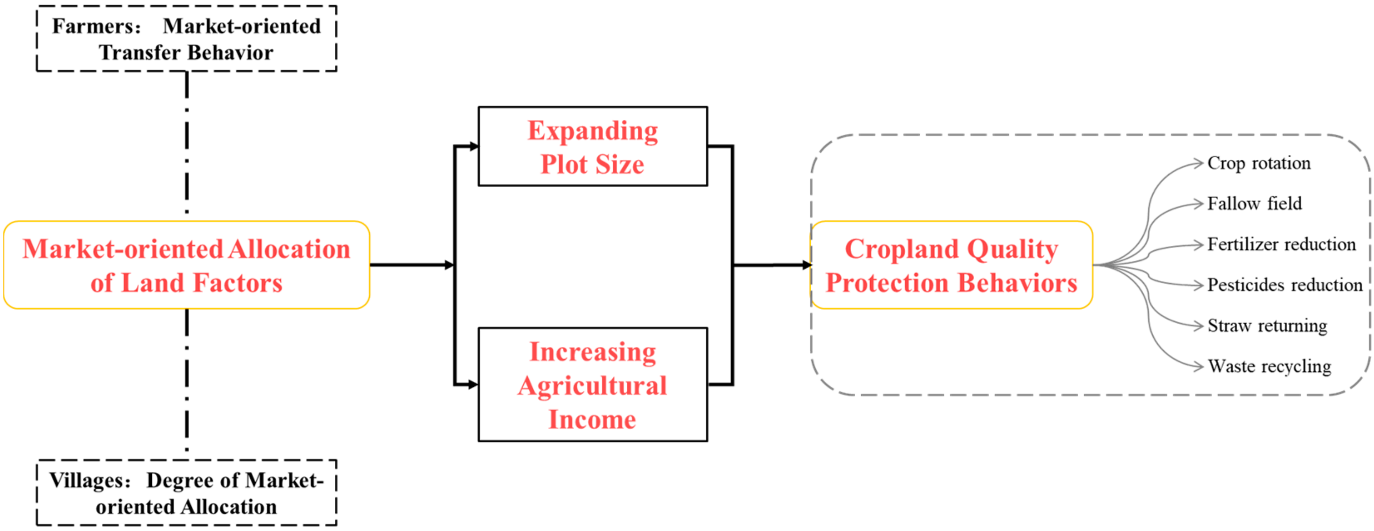

Figure 1. Theoretical framework diagram.

3. Data and Methods

3.1. Data Source

This paper is based on the 2020 CRRS database to assess the impact of the market-oriented allocation of land factors on the protection of cropland quality and the mechanism. The survey is a comprehensive survey initiated by the Institute of Rural Development of the Chinese Academy of Social Sciences, which includes agricultural production, rural development, and farmers' life, and the data are representative to a certain extent. The survey mainly referred to the level of economic development, agricultural production, spatial layout, and other related factors of each province in China, and adopted an equidistant random sampling method to conduct the survey in several regions of China (Figure 2). In the selection of sample provinces, one-third of the provinces were randomly selected from the eastern, northeastern, western, and central regions of China, and eventually traveled to a total of 10 provinces (autonomous regions), including Shandong, Zhejiang, Guangdong, Henan, Anhui, Ningxia Hui Autonomous Region, Shaanxi, Sichuan, and Guizhou, to conduct a large-scale area research study. In the selection of sample counties, the group in each province (autonomous region) of all counties (cities, districts) was allocated according to the per capita gross domestic product sorting, and according to the level, was evenly divided into five groups, and respectively, randomly selected from each group of counties (municipalities, districts); with such a method in each province in the selection of five counties (municipalities, districts) for the survey, a total of 50 counties (municipalities, districts) were chosen. In the selection of sample townships and sample villages, the methodology used is similar to that of sample counties, i.e., sorted according to GDP per capita and then randomly sampled at equal intervals from among them, with 3 townships randomly selected in each county and 2 villages randomly selected in each township, making a total of 156 townships in the end, including 300 villages. In the selection of sample households, the group screened out farm households living at home in the roster of farm households in each village, and the same method of random equidistant sampling was used to select 14 households (of which two were selected as alternatives), and a total of more than 3800 questionnaire data on farm households were collected through the farm household questionnaire. After collation, missing and abnormal data involving the main and control variables were excluded, resulting in a final sample of 3804 farm households.

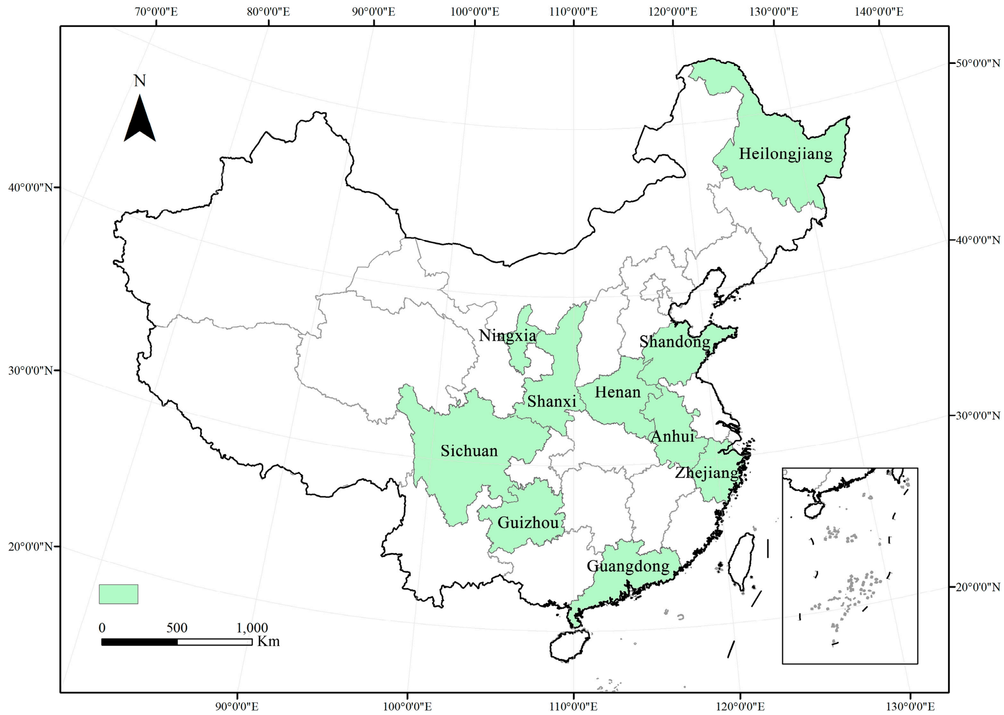

Figure 2. Map of research aera.

3.2. *Variables Definition and Descriptive Statistical Analysis*

The dependent variable is cropland quality protection behaviors. According to the production stage of crops, from the perspective of technology adoption, the farmers' measures for cropland quality protection are classified into three segments and six subcategories, which are crop rotation and fallow behaviors in the pre-production segment, fertilizer and pesticide reduction in the mid-production segment, and straw resource utilization and waste recycling behaviors in the post-production segment, which are related to the above six measures and have a representative of the above six measures [69]. Meanwhile, in order to scientifically quantify farmers' cropland quality protection behaviors, the number of farmers' adoption of these six cropland quality protection behaviors is used as an indicator of cropland quality protection behaviors [70]. Table 1 displays the precise adoption scenario.

Table 1. Adoption of cropland quality protection behavior by farmers.

Type of Adoption	N	Percentage	Level of Adoption	N	Percentage
Crop rotation	634	16.67%	Adoption of 0 behavior	1659	43.61%
Fallow field	240	6.30%	Adoption of 1 behavior	1112	29.23%
Fertilizer reduction	154	4.04%	Adoption of 2 behaviors	1142	30.02%
Pesticides reduction	279	7.33%	Adoption of 3 behaviors	100	2.63%
Straw resource utilization	1166	30.65%	Adoption of 4 behaviors	25	0.66%
Waste recycling	1127	29.62%	Adoption of 5 behaviors	5	0.13%
Adoption of any behaviors	2145	56.39%	Adoption of 6 behaviors	0	0.00%

As shown in Table 1, the most common cropland quality protection behaviors adopted by farmers was straw resource utilization, with an adoption rate of 30.65%, followed by waste recycling and crop rotation, with an adoption rate of 29.62% and 16.67%, respectively, while the lowest adoption rate was the reduction of chemical fertilizer application, with a rate of only 4.04%. Although 56.39% of the farmers adopted at least one of the cropland quality protection behaviors, most of them adopted only one (29.23%) or two (30.02%) behaviors, and a small number of them adopted three (2.63%) behaviors, and there are no farmers who adopted all six cropland quality protection behaviors at the same time. It can be seen that farmers in the sample area are not highly motivated to engage in cropland quality protection, and measures are urgently needed to promote their response to cropland quality protection.

The independent variable is the market-oriented allocation of land factors. At the present stage, the phenomenon of rural land transfer in China widely exists without charging physical and monetary land rent, instead of production help, care for the elderly and weak and other forms of human rent, usually considered as a manifestation of the imperfect development of the land transfer market. This paper uses the degree of market-oriented land transfer to measure the level of the market-oriented allocation of land factors, the percentage of marketized land transfer in villages, which is characterized by the proportion of the number of farmers using money rent to transfer land in villages other than the farmers themselves to the total number of farmers in the sample of land transfer [54], which is calculated by the following formula:

$$Land\_market_i = \frac{1}{m-1}\sum_{j \neq i}^{m-1} trans_j \quad (1)$$

In Formula (1), m indicates the number of sample farmers who transferred land in the village; $trans_j$ indicates whether the sample farmer j who transferred land in the village adopts the form of monetary land rent. If the farmer chooses this option, the variable is assigned a value of 1; otherwise, it is assigned a value of 0.

Mediating variables include two variables, plot size and agricultural income, where plot size is characterized by the ratio of the total area operated by the farmer to the number of plots [71]. Agricultural income is characterized by the proportion of the agricultural income of the farmer to the overall household income [67].

To mitigate the potential bias in the model estimate resulting from omitted variables, this work makes reference to prior research and incorporates three specific types of control variables [72,73]: firstly, household head characteristics, such as the sex, age, and education level of the head of the household; secondly, household characteristics, including the overall number of members in the household, household support percentage, and per capita annual income of the household; thirdly, production characteristics, including the number of parcels of land, the proportion that can be irrigated, and whether or not to purchase agricultural insurance. Meanwhile, regional dummy variables are generated to control for regional differences. Table 2 displays the definition, assignment, and descriptive statistics for each variable.

Table 2. Definition of main variables and descriptive statistics results.

	Variables	**Definitions**	**Mean**	**Standard Deviation**
Dependent variable	Cropland protection	Number of cropland quality protection measures adopted by farmers in the course of production (nos.)	0.95	1.05
Independent variable	LMA [a]	Number of farmers in villages using money rent for land transfers, excluding the farmers themselves, as a proportion of the total number of farmers in the sample of land transfers	0.54	0.44

Table 2. *Cont.*

	Variables	Definitions	Mean	Standard Deviation
Control variables	Sex	Sex of head of household (1 = male; 0 = female)	0.93	0.25
	Age	Age of head of household (years)	55.95	11.28
	Edu	Years of education of head of household (years)	2.76	1.08
	Labor	Number of persons in household (persons)	4.06	1.58
	Older	Ratio of the number of elderly persons in households to the number of persons in the labor force	0.18	0.38
	Income	Logarithm of annual per capita household income (yuan)	9.28	1.42
	Irrigable	Proportion of irrigable cropland area to total cropland area	0.61	0.43
	Plots	Current number of operating plots (blocks)	5.89	8.43
	Insurance	Whether agricultural insurance is purchased (0 = no; 1 = yes)	0.23	0.42
Intermediary variables	Agricultural income	Agricultural income of farm households as a proportion of total household income	0.26	0.33
	Plot size	Total area of farm operation divided by number of parcels (acres/parcel)	3.60	14.96

Note: [a] LMA = market-oriented allocation of land factors (the following tables are identical).

3.3. Model Setup

3.3.1. Regression Model

In general, for the estimation model of ordered discrete variables, the standard O-probit model is usually used for fitting estimation, and the model is set as follows:

$$Behavior_{i*} = \beta_0 + \beta_1 Land\_market_i + \beta_2 Controls_i + \varepsilon_i \quad (2)$$

In Formula (2), $Behavior_i$ denotes the unobservable latent variable, $Land\_market_i$ denotes the status of the market allocation level of land factors of farmers, $Controls_i$ is a string of control variables, β_1 and β_2 are the coefficients to be estimated, β_0 is the constant term, ε_i is the random perturbation term. The relationship between the observable behavioral variable of famers adopting cropland quality protection $Behavior_i$ and the unobservable latent variable $Behavior_{i^*}$ is as follows:

$$Behavior_i = \begin{cases} 0, \text{ if } Behavior_{i*} \leq r_0 \\ 1, \text{ if } r_0 < Behavior_{i*} \leq r_1 \\ 2, \text{ if } r_1 < Behavior_{i*} \leq r_2 \\ 3, \text{ if } r_2 < Behavior_{i*} \leq r_3 \\ 4, \text{ if } r_3 < Behavior_{i*} \leq r_4 \\ 5, \text{ if } r_4 < Behavior_{i*} \leq r_5 \end{cases} \quad (3)$$

In Formula (3), r_0, r_1, r_2, r_3, r_4, and r_5 are the unknown split points of the farmers' adoption of cropland quality protection behaviors, and $r_0 < r_1 < r_2 < r_3 < r_4 < r_5$. From this, we obtain the probabilities of the farmers' non-adoption, adoption of 1, adoption of 2, adoption of 3, adoption of 4, and adoption of 5 types of cropland quality protection behaviors, respectively:

$$
\begin{aligned}
&P(Behavior_i = 0|x) = \varphi(r_0 - \beta_1 Land\_market_i - \beta_2 Controls_i) \\
&P(Behavior_i = 1|x) = \varphi(r_1 - \beta_1 Land\_market_i - \beta_2 Controls_i) - \varphi(r_0 - \beta_1 Land\_market_i - \beta_2 Controls_i) \\
&P(Behavior_i = 2|x) = \varphi(r_2 - \beta_1 Land\_market_i - \beta_2 Controls_i) - \varphi(r_1 - \beta_1 Land\_market_i - \beta_2 Controls_i) \\
&P(Behavior_i = 3|x) = \varphi(r_3 - \beta_1 Land\_market_i - \beta_2 Controls_i) - \varphi(r_2 - \beta_1 Land\_market_i - \beta_2 Controls_i) \\
&P(Behavior_i = 4|x) = \varphi(r_4 - \beta_1 Land\_market_i - \beta_2 Controls_i) - \varphi(r_3 - \beta_1 Land\_market_i - \beta_2 Controls_i) \\
&P(Behavior_i = 5|x) = 1 - \varphi(r_4 - \beta_1 Land\_market_i - \beta_2 Controls_i)
\end{aligned} \quad (4)
$$

In Formula (4), φ is the cumulative density function of the standard normal allocation.

3.3.2. Mediating Effect Model

To analyze the influence path of the market-oriented allocation of land factors on the famers' cropland quality protection behaviors, the mediating effect model is constructed with reference to the existing scholars' research [74,75]:

$$Med_{i*} = \gamma_0 + \gamma_1 Land\_market_i + \gamma_2 Controls_i + \mu_i \quad (5)$$

$$Behavior_{i*} = \delta_0 + \delta_1 Land\_market_i + \delta_2 Med_i + \delta_3 Controls_i + \sigma_i \quad (6)$$

In Formulas (5) and (6), $Behavior_i$ denotes the unobservable latent variable, $Land\_market_i$ denotes the status of the market allocation level of land factors of farmers, $Controls_i$ is a string of control variables, Med_i is the mediating variable, including plot size and agriculture income, γ_1, γ_2, δ_1, δ_2, and δ_3 are the coefficients to be estimated, γ_0 and δ_0 are the constant terms, μ_i and σ_i are the random perturbation terms.

4. Result Analysis

4.1. Baseline Regression Results

In Table 3, Model (1) and (2) were regressed using the O-probit model; the market-oriented allocation of land all positively affects farmers' cropland quality protection behaviors at the 1% level. Model (3) and (4) used the OLS model to estimate the results, and the positive effect of the market-oriented allocation of land factors on farmers' cropland quality protection behaviors was still significant, and H1 was valid. Among the control variables, sex, number of family members, number of plots, percentage of irrigable, and whether or not to purchase agricultural insurance positively affects cropland quality protection behaviors.

Table 3. Baseline regression results.

Variables	(1) Cropland Protection	(2) Cropland Protection	(3) Cropland Protection	(4) Cropland Protection
LMA	0.425 *** (0.069)	0.218 *** (0.071)	0.221 *** (0.038)	0.109 *** (0.038)
Sex		0.500 *** (0.133)		0.221 *** (0.066)
Age		−0.000 (0.003)		−0.000 (0.002)
Edu		0.035 (0.031)		0.027 * (0.016)
Older		−0.101 (0.085)		−0.037 (0.045)
Income		−0.021 (0.022)		−0.015 (0.012)
Labor		0.052 *** (0.020)		0.024 ** (0.011)
Irrigable		0.341 *** (0.073)		0.198 *** (0.039)
Plots		0.025 *** (0.004)		0.010 *** (0.002)

Table 3. *Cont.*

Variables	(1) Cropland Protection	(2) Cropland Protection	(3) Cropland Protection	(4) Cropland Protection
Insurance		1.155 *** (0.073)		0.618 *** (0.039)
_cons			0.897 *** (0.029)	0.434 ** (0.180)
Regional	Yes	Yes	Yes	Yes
N	3804	3804	3804	3804
Pseudo R^2/R^2	0.0065	0.0436	0.0147	0.0976
Wald chi^2/F	64.293	432.306	28.41	37.30

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; robust standard errors in parentheses.

Table 4 further demonstrates the marginal effects of each explanatory variable in Model (2) on farmers' cropland quality protection behaviors. The results show that for every 0.1 increase in the degree of market-oriented allocation of land factors, the probability of farmers not adopting any of the cropland quality protection behaviors decreases by 4.98%, the probability of adopting 1 cropland quality protection behavior increases by 1.04%, the probability of adopting 2 cropland quality protection behaviors increases by 0.23%, the probability of adopting 3 cropland quality protection behaviors increases by 0.11%, the probability of adopting 4 cropland quality protection behaviors increases by 0.04%, and the probability of adopting 5 cropland quality protection behaviors increases by 0.01%. It can be seen that the higher the degree of market-oriented allocation of land factors, the higher the degree of adoption of cropland quality protection behaviors by farmers, and the market-oriented land transfer does significantly promote the implementation of cropland quality protection behaviors by farmers.

Table 4. Marginal effect.

Variables	Number of Cropland Quality Protection Adopted					
	0	1	2	3	4	5
LMA	−0.494 *** (0.016)	0.104 *** (0.016)	0.023 *** (0.003)	0.011 *** (0.007)	0.004 *** (0.001)	0.001 ** (0.0003)
Sex	−0.114 *** (0.030)	0.024 *** (0.006)	0.052 *** (0.014)	0.026 *** (0.007)	0.010 *** (0.003)	0.001 ** (0.001)
Age	0.00007 (0.0007)	−0.00002 (0.0001)	−0.00003 (0.0003)	−0.00002 (0.0002)	-6.07×10^{-6} (0.00006)	-8.78×10^{-7} (8.48e-06)
Edu	−0.008 (0.007)	0.002 (0.001)	0.004 (0.003)	0.002 (0.002)	0.001 (0.001)	0.0001 (0.0001)
Older	0.023 (0.019)	−0.005 (0.004)	−0.011 (0.009)	−0.005 (0.004)	−0.002 (0.002)	−0.0003 (0.0002)
Income	0.005 (0.005)	−0.001 (0.001)	−0.002 (0.002)	−0.001 (0.001)	0.0004 (0.0004)	−0.00006 (0.00006)
Labor	−0.012 *** (0.005)	0.002 ** (0.001)	0.005 *** (0.002)	0.003 ** (0.001)	0.001 ** (0.0004)	0.0001 ** (0.0001)
Irrigable	−0.077 *** (0.016)	0.016 *** (0.004)	0.036 *** (0.008)	0.018 *** (0.004)	0.006 *** (0.002)	0.001 *** (0.0004)
Plots	−0.006 *** (0.001)	0.001 *** (0.0002)	0.003 *** (0.0005)	0.001 *** (0.0002)	0.001 *** (0.0001)	0.00007 *** (0.00003)
Insurance	−0.263 *** (0.0153)	0.055 *** (0.005)	0.121 *** (0.007)	0.061 *** (0.005)	0.022 *** (0.003)	0.003 *** (0.001)

Note: ** $p < 0.05$, *** $p < 0.01$; robust standard errors in parentheses.

4.2. Robustness Tests

In Table 5, this study utilizes three methods of limited subsample, replacement regression model, and replacement variables in order to conduct the robustness test.

Table 5. Robustness test.

Variables	**Restricted Subsample (5)**	**Replacement Regression Model (6)**	**Replacement of Dependent Variable (7)**	**Replacement of Independent Variable (8)**
LMA	0.212 ***	0.131 ***	0.243 ***	0.706 ***
	(0.072)	(0.042)	(0.080)	(0.084)
Control	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
N	3750	3804	3804	3804
Pseudo R^2	0.0429	0.0409	0.0820	0.0498
Wald chi^2	419.499	405.594	427.320	493.310

Note: *** $p < 0.01$; robust standard errors in parentheses.

First of all, taking into account the decline in physical ability of the elderly and their low acceptance of new things, they do not have the representativeness to carry out the behaviors of cropland quality protection; but also taking into account the aging phenomenon of rural farming is serious, so the samples over 80 years old are excluded from the regression [76], the results are shown in Model (5), the market-oriented allocation of land factors still positively affects the behaviors of cropland quality protection at the level of 1 percent.

Secondly, in Model (6), the model replacement method is chosen to replace the O-probit model with the O-logit model, and the results show that the market-oriented allocation of land factors still promotes the famers to protect the quality of cropland.

Finally, Model (7) replaces the dependent variable "cropland quality protection behaviors" with "whether at least one cropland quality protection behaviors is carried out", and the dependent variable is changed to "ordinal variable". Since the dependent variable is changed from "ordered variable" to "dichotomous variable", the Probit model is selected again for estimation, and the test results are not much different from the previous results. Model (8) replaces the independent variable "Degree of market-oriented allocation of land" with "Whether farmers carry out market-oriented transfer", with the farmers themselves to transfer land with the use of monetary land rent to characterize. If the variable has a value of 1, it indicates that the transfer land takes place with money, while a value of 0 indicates the opposite.

The above three methods have verified the market-oriented allocation of land factors on the promotion of farmers' cropland quality protection behaviors, indicating that the results are relatively robust and reliable.

4.3. Mediating Effect

With the help of the Bootstrap method to test the mediating effect, the sampling number was set as 1000 times. In Table 6, the indirect effect of plot size in the influence of the market-oriented allocation of land factors on the behaviors of cropland quality protection is positive and the effect is significant. This indicates that there is a transmission mechanism of "the market-oriented allocation of land factors → expanding plot size → cropland quality protection", which confirms H2.

Similarly, the indirect effect of agricultural income in the influence of the market-oriented allocation of land factors on the behaviors of cropland quality protection is positive and significant. This indicates that there is a transmission mechanism of "the market-oriented allocation of land factors → raising agricultural income → cropland quality protection", which confirms H3.

Table 6. Mediated effects test.

Variables	Agriculture Income	Plot Size	Cropland Protection	
	(9)	(10)	(11)	(12)
LMA	0.092 *** (0.012)	2.247 *** (0.554)	0.142 ** (0.072)	0.203 *** (0.072)
Agriculture income			0.739 *** (0.097)	
Plot size				0.007 *** (0.002)
Control	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
N	3804	3804	3804	3804

Note: ** $p < 0.05$, *** $p < 0.01$; robust standard errors in parentheses.

4.4. Heterogeneity Analysis

4.4.1. Heterogeneity of Terrain Differences

During a specific timeframe, especially in the early stage of agricultural production, scale expansion often promotes the reallocation of production factors, so that agricultural production has a scale effect. As far as terrain is concerned, compared with mountainous terrain, plains are flat, with low fragmentation of land parcels and relatively good farming conditions and supporting facilities [77]. The market-oriented allocation of land factors helps farmers to scale up production, which can bring cost advantages, such as resource utilization and mechanization, thus making farmers more inclined to adopt cropland quality protection behaviors [63]. In addition, the plains are flat and fit to farming and planting of different crops, and the market-oriented allocation of land factors makes farmers more flexible in choosing the land use mode and reasonable farming according to the market demand.

Therefore, the sample is divided into plains and non-plains areas to further explore the heterogeneity of farmers carrying out cropland quality protection under different terrain conditions. In Table 7, Model (13) shows the results in plain areas, and Model (14) is in hilly areas. It shows that farm households in different terrains have different behaviors of cropland quality protection, and that in hilly areas, farmers are less likely to adopt cropland quality protection behaviors because of the large differences in the difficulty of carrying out agricultural production among different plots of land.

Table 7. Heterogeneity analysis.

Variables	Cropland Protection					
	Terrain		Location		Labor Market Development	
	Plains	Non-Plains	Suburban	Non-Suburban	High Level	Low Level
	(13)	(14)	(15)	(16)	(17)	(18)
LMA	0.415 *** (0.117)	0.032 (0.097)	0.641 *** (0.164)	0.095 (0.081)	0.200 * (0.110)	0.400 *** (0.098)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes
N	1672	2132	808	2996	1810	1994

Note: * $p < 0.1$, *** $p < 0.01$; robust standard errors in parentheses.

4.4.2. Heterogeneous Effects of Location Differences

Differences in market resource endowment are also the main factors influencing farmers' cropland quality protection behaviors [78]. As urban fringe areas, the suburbs experience a more serious phenomenon of "non-agriculture" and "non-grain" production of arable land. However, compared with non-suburban areas, suburban areas are usually located in the urban fringe, influenced by the economic radiation of urban areas, the penetration of social ideology and urban ecological effects, farmers are more likely to be close to the market and have access to modernized agricultural technology, production materials, and market information, and at the same time, they face more market competition and pressures. As a result, most suburban farmers who are still engaged in agricultural production tend to take active cropland protection measures to improve the productivity of the land and their own positive benefits, in order to cope with market challenges [79]. The difference in market resources makes the market-oriented allocation of land factors make a difference to the production decisions of groups of farmers. For farmers in resource-rich and market-developed suburbs, the land transfer market is usually more sound and complete, and farmers can more easily access market information on land resources, price information, and related policy support, which will prompt farmers to place greater emphasis on the protection of the quality of cropland because they are more aware of the importance and sustainability of the quality of the land for agricultural production and are more capable to carry out land protection and improvement through market-oriented means. For non-suburban farmers, on the other hand, due to imperfect market mechanisms or poor market information, farmers may face more uncertainty and risk, which will affect their motivation to protect cropland quality.

Therefore, the sample is categorized into suburban and non-suburban areas to further explore the heterogeneity of farm households for cropland quality protection under different resource endowment conditions. In Table 7, Model (15) is the result of suburban area, and Model (16) is the non-suburban area. The regression results indicate that suburban farmers are more active in cropland quality protection than non-suburban farmers for those engaged in agricultural production. It can be seen that the agricultural operation of suburban farmers favors long-term investment and stable operation, and therefore needs to actively maintain the productivity of the land as the basis for sustainable operation.

4.4.3. Heterogeneous Effects of Labor Market Differences

In recent years, the non-farm transfer of labor has become increasingly prominent in cracking the social dilemmas associated with rural areas. From the perspective of resource allocation, the non-farm transfer of rural labor can not only meet the labor demand of China's industrialization and urbanization, but also help to promote the transfer of local agricultural land and enhance the specialization of agricultural production [80]. Therefore, the improvement of the labor market has lowered the threshold for rural residents to transfer to secondary and tertiary industries, making it easier for farmers to obtain non-agricultural employment opportunities, and providing opportunities for farmers to increase income levels and improve living conditions. In this context, the group of farmers with more stable non-farm income has more diversified income, and even if the local land factor market operates very efficiently, farmers may still put more energy and resources into non-farm industries rather than agricultural production, with less reliance and less emphasis on land [78]. As a result, they are also less motivated to protect the quality of cropland. And in areas where the labor market is lacking and the labor transfer is restricted, the non-farm employment opportunities of farmers are limited; farmers find it difficult to seek a way out of the land, and pay more attention to agricultural output. As a result, they are eager to improve land quality to increase farm income, and therefore have higher motivation for cropland quality protection.

Therefore, dividing the sample into regions with higher and lower levels of labor market development, we can explore the differences in farmers' cropland quality protection among farmers under different resource endowment conditions. In Table 7, Model (17) shows the results for regions with higher labor market development than the sample mean and Model (18) is with lower labor market than the sample mean. It shows that due to the difference in the degree of land dependence of farm households, farm households in areas with lower labor market development are more active in cropland quality protection compared to areas with higher labor market development.

5. Discussion

Protecting and improving the quality of cropland is a major issue in guaranteeing food security in China. Continuously promoting the market-oriented reform of rural land factors has become an effective tool to promote the behaviors of farm households in cropland quality protection. Most of the existing studies on land factor allocation and cropland quality protection focus on individual farmers' land transfer decisions and market-oriented transfer behaviors, ignoring the impact caused by the market-oriented degree of land factor allocation, and the impact of market-oriented allocation of land factors on the behaviors of cropland quality protection has not yet been fully discussed.

This paper finds that the market-oriented allocation of rural land factors has a beneficial impact on promoting farmers to engage in cropland quality protection, which aligns with H1 and existing research [21,59,60]. Based on the results of previous research, this study proposes and analyzes two pathways (H2 and H3) to illustrate the mechanism of the influence of the market-oriented allocation of land factors on famers' behaviors of cropland quality protection. Consistent with most studies [64], the study shows that market-oriented allocation of land factors can significantly enhance the motivation of farmers to engage in cropland quality protection during agricultural production by expanding the plot size as well as increasing agricultural income. In addition, this study investigated the effects of changes in village terrain and geographical position as well as the level of development of the village labor market on farmers' cropland quality protection behaviors, and the conclusions were consistent with existing studies [77,79]. This paper aims to strengthen and complement previous studies by providing theoretical support for the government to understand the urgency of cropland quality protection, to resolve the conflict between people and land, to assess the effectiveness of the land transfer market development, and to ensure the seamless implementation of the national food security strategy.

However, this study also has limitations in some respects. Firstly, there are various factors influencing farmers' cropland quality protection behaviors; in this paper on the marketization of land transfer, we have not additionally considered the impact of other factors in this paper. Secondly, cropland quality protection behaviors requires long-term investment by farmers, so multi-year tracking data analysis of farmers' cropland quality protection behaviors may be more accurate. Finally, due to the diverse differences in China's rural areas, rural Chinese farmers use and develop land in different ways, and viewing farmers as a unified whole may affect the results of the study. Unfortunately, data limitations prevent the correction of the above problems. In the future, this paper will look for more detailed and comprehensive data to make up for the above shortcomings, so as to explore the influence of different factors on the cropland quality protection behaviors, the dynamic changes in the behaviors of farmers, and the behavioral differences among different groups of farmers, and to provide better theoretical support and data references for policy makers.

6. Conclusions and Policy Recommendations

Using 3804 samples from the 2020 CRRS database, this paper examines how market-oriented land allocation affects village cropland quality protection. The results show the following: Firstly, the market-oriented allocation of land factors significantly and positively affects the cropland quality protection behaviors of farmers. Secondly, the market-oriented allocation of land factors indirectly affects the cropland quality protection behaviors of farmers through expanding the plot size and increasing the farm income; there is a heterogeneity in the influence of the market-oriented allocation of land factors on the cropland quality protection behaviors, and farmers tend to take more measures to protect the quality of the cropland in the plains, suburban areas, and areas with more well-developed labor markets. Thirdly, there is heterogeneity in the influence of the market-oriented allocation of land factors on cropland quality protection behaviors; in the plains, suburbs, and more developed labor market, farmers are more inclined to adopt cropland quality protection behaviors.

The policy insights of this paper are as follows: Firstly, continue to promote the market-oriented reform of rural land factors. Government agencies and other relevant departments need to recognize the importance of the market-oriented allocation of land factors, and should actively promote land transfer policy to achieve a reasonable allocation of land resources, thereby reducing agricultural production costs and increasing the enthusiasm of farmers to protect cropland quality. Secondly, guide agricultural operation in the direction of scale, specialization, and modernization. Encourage farmers to carry out plot integration and serialization, regulate the land transfer market to transform the previous decentralized form of land transfer, reduce the waste of agricultural resources and costs caused by fine fragmentation, improve farmers' income, and maximize benefits. Thirdly, pay attention to regional differences in each area. Non-plains, non-suburban areas, and areas with imperfect labor employment markets will, to a certain extent, reduce the incentives for cropland quality protection among various groups of farmers. Consequently, the government has to customize strategies based on specific regional circumstances and categorize policies that encourage the specialization and expansion of agricultural production by ensuring a consistent supply and equitable allocation of resources, so as to enhance the incentives of farmers to carry out cropland quality protection.

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