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Relationship between rural land titling and land transfer in China: a systematic literature review and meta-analysis

Lin Xie[1], Juan Zhang[1], Wenyi Huang[1], Doudou Ke[1] and Linna Li[2]*

[1]College of Economics and Management, South China Agricultural University, Guangzhou, China,
[2]School of Economics, Central University of Finance and Economics, Beijing, China

The traditional land system of rural communities in China has been an obstacle to the sustainable development of land transfer. To facilitate a more efficient allocation of resources, the Chinese government has implemented the largest rural land titling action in the world. However, there has been much debate in scholarly circles regarding the correlation between rural land titling and rural land transactions. By employing meta-analysis technology, this paper evaluates the relationship between rural land titling and rural land transactions. According to the meta-analysis results, rural land titling is only a minor contributor to rural land transfer; it only contributes to rural land transfer-out, with no effect on rural land transfer-in. Furthermore, education, age, labor force, agricultural fixed assets owned, area of contracted rural land, and publication time were identified as situational variables that affect the relationship between rural land titling and rural land transfer-out. This research provides insight into how to promote the sustainable development of agricultural land economy by promoting land transfer, as well as further topics for future study.

KEYWORDS

rural land titling, land transfer, China, meta-analysis, sustainable development

Introduction

Agricultural production in China is dominated by smallholder farms because of the Household Contract Responsibility System (HCRS), which allocates the use rights of collectively owned farmland to rural households based on long-term contracts between households and local village collectives (Ye, 2015). Under the HCRS, members of the community collective have the right to acquire the right to contract land, resulting in China becoming a country dominated by small farmers. Data from China's Third Agricultural Census show that the number of small farmers nationwide accounts for more than 98% of agricultural operators, and the area of small farmers accounts for 70% of the total cultivated land. There are 230 million households in China's current farmers, with an average operating scale of 0.52 hectares and 210 million households operating <0.67 hectares (Xinhua News Agency, 2019). The excessively small scale of operations in China's agricultural sector has hindered the application of modern agricultural technologies, and therefore, through land transfer to expand the scale of individual operators, it is helpful to reduce production costs (Xu et al., 2011); The land transfer also has promoted agricultural intensive, industrialization and standardization, as well as the improvement of production efficiency (Zhang, 2010). Therefore, as early as 1984, the Chinese government put forward the idea of encouraging the gradual concentration of land to those who are capable of farming, and taking the path

of large-scale operations. Subsequently, the concept of land transfer emerged. Land transfer denotes the process through which farmers exchange their rural land use rights, enabling those who seek to enlarge their agricultural scope to lease the rural land held by others. Land transfer-in pertains to farmers who desire to augment their agricultural scale by renting rural land from fellow farmers, whereas land transfer-out refers to farmers who lease out their own rural land holdings (Gao et al., 2020). By 2014, the State Council of China issued the "Opinions on Guiding the Orderly Transfer and Development of Rural Land Use Rights for Moderately-sized Agricultural Operations", requiring all levels of government to guide the orderly transfer of land use rights to expand the scale of agricultural operations (Xinhua News Agency, 2014).

However, as a country in transition, China has long adhered to the collective rural land ownership, with rural land owned by village collectives. Farmers have contract rights but village collectives retain the right to adjust land allocations (Zhang and Donaldson, 2013). This special property structure leads to unclear ownership of agricultural land in China and numerous rural land-related disputes, which hinders rural land transfer transactions and optimal rural land allocation (Bu and Liao, 2022). Under the influence of urbanization, there has been a rapid decrease in China's rural population as it migrates to urban areas. Additionally, under China's existing rural land system, land ownership is held by the collective of peasant communities, with the peasants merely contracted to use the land for production. As a result, ownership disputes often arise during the process of land transfer (Xie and Luo, 2013). The land system that restricts transactions leads to land abandonment and inefficient use, which determines the sustainable development of rural China (Li et al., 2018; Wang et al., 2018; Guo et al., 2019). In 2009–2018, China completed the world's largest rural land titling action at a cost of RMB60 billion. Land titling refers to the process wherein each rural household enters into a written agreement with the collective entity possessing the land, subsequently obtaining a land certificate. This certificate delineates the specific land parcel, its boundaries, and the encompassing area, with the intent of formalizing pre-existing land contracts and land use rights. Furthermore, it permits the utilization of land use rights as collateral (Cheng et al., 2019). Secure the collective and non-exclusive land rights of multiple types of land to individual farmers in an exclusive manner. Through the process of titling, the right of long-term use and transfer of land was granted to the farmers (Yan, 2010). The action clarified farmers' contract and management rights over rural land and prohibited further adjustments, greatly enhancing farmers' rural land property rights (Zhang L. et al., 2020).

In general, as indicated by Figure 1. The collective ownership of agricultural land in China has resulted in an equitable distribution of land per household. However, the country's vast population has led to a pattern of small-scale farming, wherein each household can only manage a diminutive plot of farmland. This practice has hindered the adoption of modern agricultural technologies, thereby limiting agricultural productivity. To address this issue, the Chinese government and researchers have advocated for enlarging the scale of individual households through the transfer of rural land. Nevertheless, the collective ownership of rural land poses significant legal and practical challenges to the transfer of

land. To overcome these challenges, the Chinese government has implemented a land titling effort that grants farmers the right to freely transfer land. This policy weakens the rights of rural communities over the land, but it is necessary to facilitate the transfer of rural land and enhance overall agricultural productivity.

A clear definition of property rights is an important prerequisite for transactions and optimally allocated resources (Coase, 1960). Studies from various countries have shown that clear definitions of property rights promote rural land transfer by reducing transaction asymmetry, improving the perception of property rights security, and increasing credit availability for farmers (Carter and Olinto, 2003; Boucher et al., 2005; Gould et al., 2006; Holden et al., 2007; Chamberlin and Ricker-Gilbert, 2016). Some studies from China suggest that China's rural land titling action has contributed to rural land transfer (Ma et al., 2015; Cheng et al., 2016, 2019; Liu et al., 2017; Xu et al., 2017; Ye et al., 2018; Wang, 2019).

Conversely, some argue that China's land titling action hinders rural land transfer. That argument is based on the special importance of land in Chinese culture (Fei, 1998) as the personified property of farmers. Farmers' special feelings toward the farmland are further bolstered by land titling (Luo, 2019). The endowment effect is the tendency for people who own a good to value it more than people who do not (Knetsch, 1989; Kahneman et al., 1990; Morewedge and Giblin, 2015). In this case, farmers show an endowment effect when transferring rural land, that is, willingness to accept is higher than willingness to pay, which ultimately hinders rural land transfer (Zhong, 2013; Luo, 2017). This view is also supported by empirical studies (Fu et al., 2016; Cai and Xia, 2017; Lin et al., 2017).

The endowment effect has shown that the transaction of property rights for rural land is not as simple as Coase's analytical framework suggests. At the same time, the process of land titling and registration involves more complex interactions with rural communities. For example, research indicates that land titling can alter farmers' interest goals and thus affect mutual aid mechanisms in village society (Hong and Luo, 2023). Consequently, behind land titling lies not only farmers' economic calculations, but also some social issues. For instance, in the context of land titling, the number of lawsuits related to rural land property rights has not decreased, but has increased annually (Sun, 2021). Therefore, the relationship between land titling and land transfer should not only be analyzed from an efficiency perspective, but also from the perspective of equity during the titling process and afterwards (Feng et al., 2020). These factors may obfuscate the relationship between land titling and land transfer.

The foregoing implies that existing studies on the relationship between China's rural land titling and rural land transfer are ambiguous. On the one hand, this is partly because of existing studies that have referred to rural land transfer-in and transfer-out as "transfer", whereas farmers might have inconsistent behavior patterns when carrying out rural land transfer-in and transfer-out. Studies have demonstrated that land transfer-in behavior is mainly observed among farmers with higher initial income levels and better economic conditions, whereas land transfer-out behavior is mainly observed among farmers with lower initial income levels and poorer economic conditions. Moreover, land transfer-in has increased farmers' income, while land transfer-out has decreased

FIGURE 1
The relationship between collective ownership of agricultural land and land transfer.
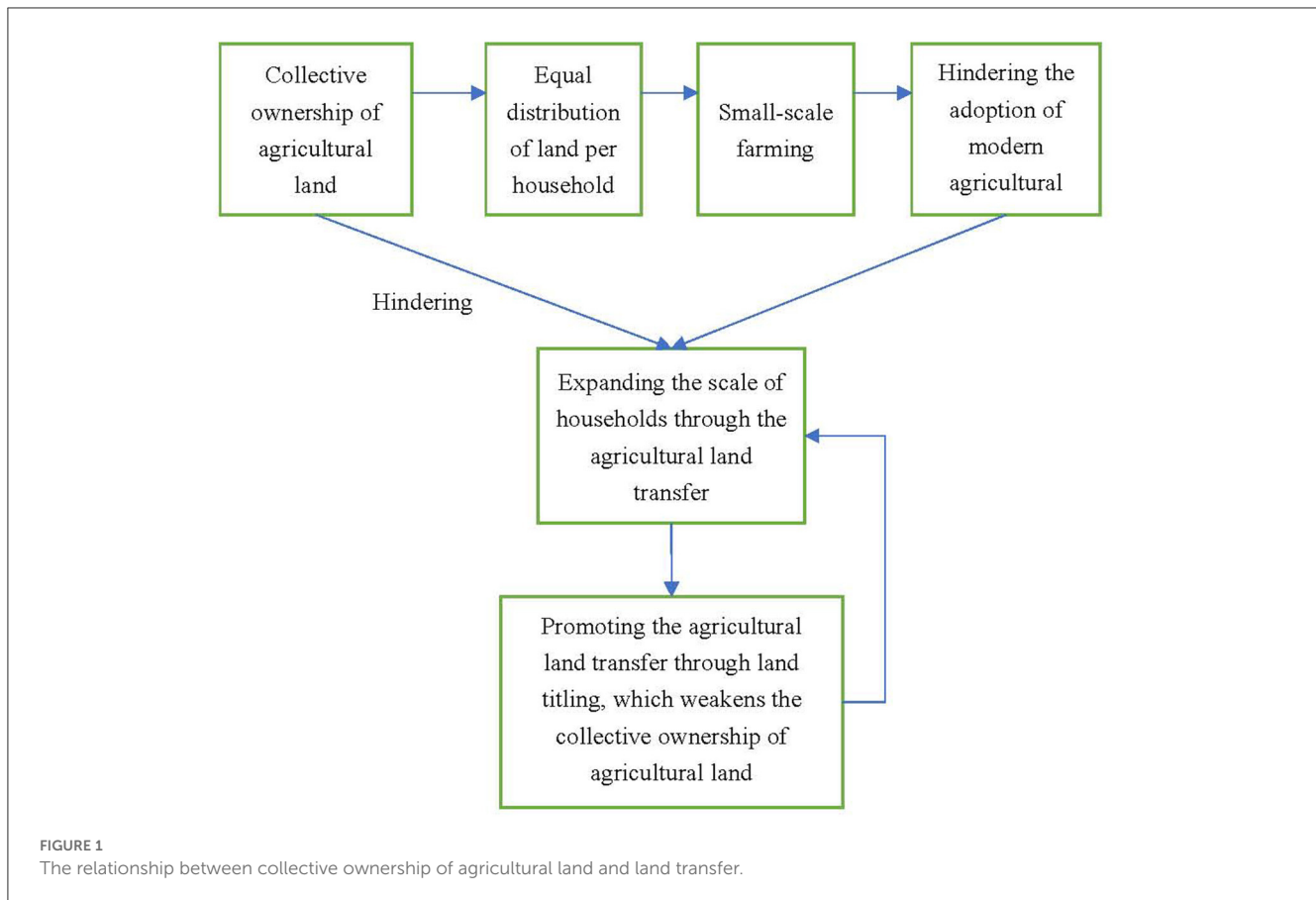
farmers' income, thereby widening the income gap among rural residents in China (Du and Zhang, 2022). On the other hand, there is a moderator variable in the relationship between the variables used in different studies (Hunter and Schmidt, 2004). Most study sample data in the existing literature are limited to a certain region, so study results often apply only to a specific region. China's vast territory and wide regional disparities have led to heterogeneity of previous studies on rural areas in different regions and contexts, greatly weakening the universality of study conclusions (Xie et al., 2020). To this end, two questions remain to be clarified: (1) Has China's rural land titling action really contributed to rural land transfer? (2) What situational factors influence the relationship between the two?

As a comprehensive effect size assessment method, meta-analysis method has been widely applied in agricultural economics (Baumgart-Getz et al., 2012). As a quantitative method, meta-analysis and its derivative, meta-regression analysis method, not only assess the type and strength of the relationship between variables but also explore the moderator variable in that relationship (Miller and Toulouse, 1986). If the relationship between land titling and rural land transfer differs from one sample to another, and the samples have differing traits, those traits can be moderator variables in the relationship. In addition, meta-analysis can further explore the influence of situational factors by analyzing relevant moderating variables such as country and time based on the vast existing secondary database. Using meta-analysis technology, this study assesses the relationship between land titling and rural land transfer, transfer-in, and transfer-out in

China and explores the roles of a range of moderator variables. These moderator variables include those at individual, household, and study timing levels.

(1) Individuals. Farmers' ages, education levels, and other factors significantly influence the rural land transactions in which they engage (Su et al., 2018a; Chikuni and Kilima, 2019; Peng et al., 2020). Studies have also shown that farmers of older age and lower cultural level have a deeper emotional attachment to their land, and land titling can help to further strengthen this endowment effect derived from emotion and further influence the farmers' land transfer behaviors (Zhong, 2013; Luo, 2017). However, some individual-level variables may contribute to the heterogeneity of the relevant conclusions. Therefore, this study first discusses the moderating effect of householder age and education level.

(2) Households play a critical role in China's agricultural production, based on various household-level variables such as labor force size, agricultural fixed asset value, and contracted land area (Zhang Y. et al., 2020; Ji et al., 2021). After land titling, farmers with different economic levels have various choices and the interaction between land titling and economic level has a significant impact on land transfer (Su et al., 2018b). Therefore, this study discusses the moderating effects of fixed asset value, total income, and agricultural income.

(3) Study timing. Land titling is a process of defining and confirming rights; it lasts for 10 years. During the land titling action, government behavior is "unstable" and thus affects farmers' expectations and behaviors (Ji et al., 2021), indicating

FIGURE 2
The PRISMA framework.
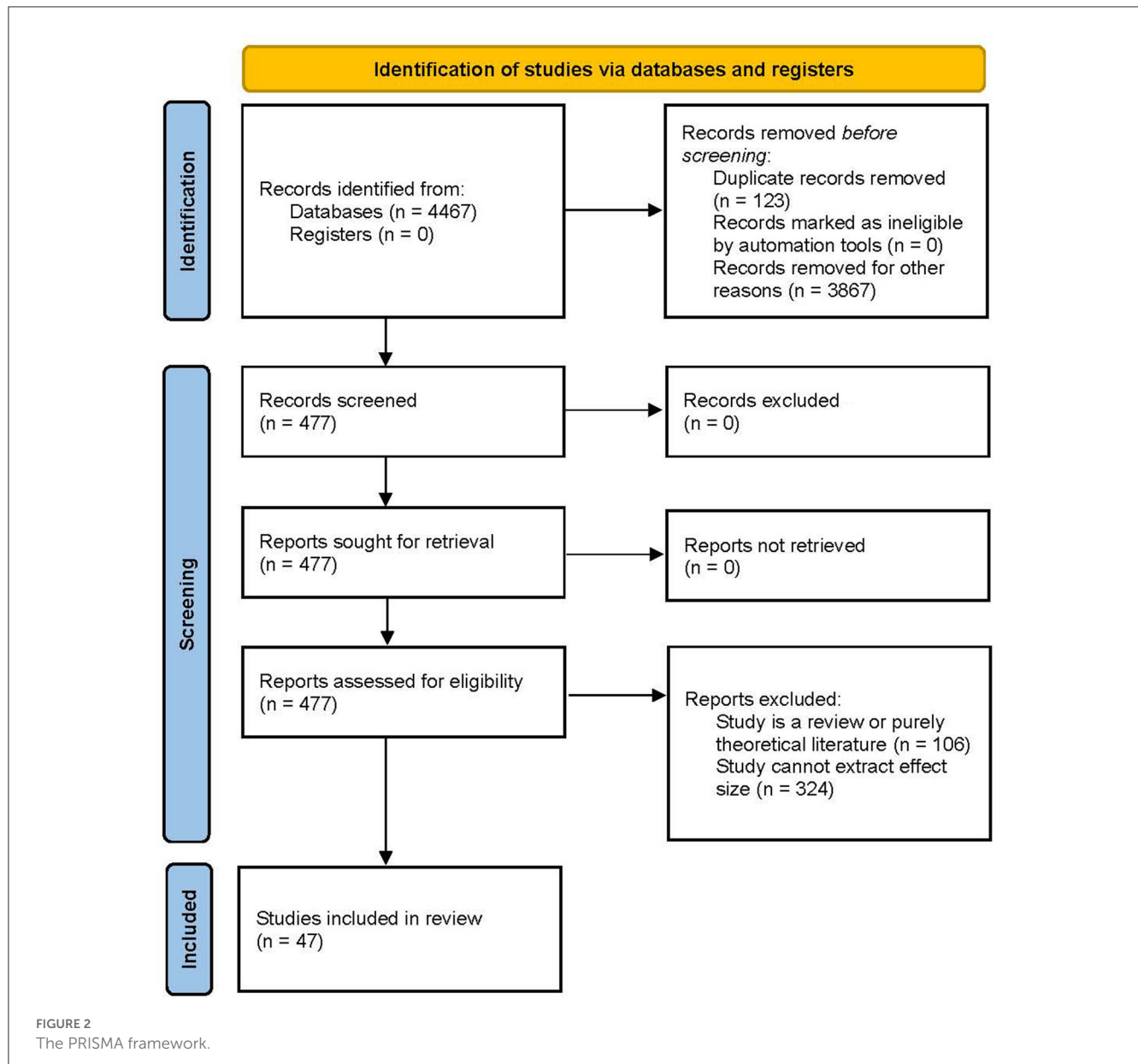
that the impact of a land titling varies with study timing, so the moderating effect of study timing is also discussed.

Materials and methods

Data collection

To ensure the accuracy and completeness of data, we comprehensively search both Chinese and English literature. Chinese literature is searched in CNKI's China Academic Journals Full-text Database, China Masters' Theses Full-text Database, and China Doctoral Dissertations Full-text Database, as well as the CQVIP and Wanfang databases, using the keywords "rural land titling" and "rural land transfer". English literature is mainly searched in several databases—Springer Link, Elsevier Science,

EBSCO-ASP general subject full-text study literature, Emerald full-text journal, Wiley–Blackwell, ProQuest full-text journal, and ProQuest full-text master's and doctoral thesis databases—and Google Scholar using the keywords "land transaction," "land transfer," and "land titling". In order to avoid omissions in the literature, we conducted a second search on the reference literature of the searched related literature, i.e., manually searching all the Chinese and English reference literature related to the research topic in the sample literature, to ensure the comprehensiveness of the sample literature.

In combination with the requirements of the study topic and the meta-analysis method, studies included in the meta-analysis must meet the following conditions: (1) the target literature must contain keywords such as rural land titling, rural land transfer, and whether farmers have rural land titling subject to farmers' certificates of rural land titling and registration; (2) the studies must

TABLE 1 List of original studies included in the meta-analysis 1.

No.	References	Outcome variable	Sample size (N)	Effect size (K)
1	Wang (2018)	Transfer	315	−0.214
2	Liu and Luo (2018)	Transfer	1,240	0.778
		Transfer-out	1,240	0.709
		Transfer-in	1,240	0.374
3	Li (2020)**	Transfer	5,967	−0.008
		Transfer-out	5,967	0.058
		Transfer-in	5,967	−0.084
4	Ding and Zhong (2017)	Transfer	405	0.32
		Transfer-out	405	0.195
		Transfer-in	405	0.427
5	Feng et al. (2021)	Transfer	9,596	0.081
		Transfer-out	9,596	0.028
		Transfer-in	9,596	0.129
6	Zhu and Yang (2019)	Transfer-out	9,165	0.08
7	Liu and Luo (2018)	Transfer	2,738	0.036
8	Lin et al. (2016)	Transfer-out	1,444	0.05
9	He et al. (2016)	Transfer-out	9,723	0.037
10	Yu (2016)	Transfer	287	0.232
11	Li (2018)	Transfer	8,670	0.025
12	Zhou (2019)	Transfer	275	0.215
13	Li et al. (2018)	Transfer-out	5,701	0.043
		Transfer-in	5,701	−0.011
14	Xu (2019)	Transfer-out	14,260	0.014
		Transfer-in	14,260	0.014
15	Han et al. (2019)	Transfer-out	299	1.505
		Transfer-in	299	−2.161
16	Cheng et al. (2016)	Transfer-out	5,920	0.06
		Transfer-in	5,920	−0.014
17	Shi et al. (2017)	Transfer-out	612	0.006
		Transfer-in	612	0
18	Zhan and Zhang (2009)	Transfer-out	142	0.146
		Transfer-in	142	−0.014
19	Xu et al. (2017)	Transfer-out	434	0.141
		Transfer-in	420	0.059
20	Xie et al. (2017)	Transfer	231	0.031
21	Liu et al. (2020)	Transfer	1,030	0.387
22	Wang (2019)	Transfer-out	5,792	−0.061
		Transfer-in	5,792	0.029
23	Shen (2021)	Transfer	280	0.183
24	Luo et al. (2017)	Transfer	645	−0.029

(Continued)

TABLE 1 (Continued)

No.	References	Outcome variable	Sample size (N)	Effect size (K)
25	Li (2020)**	Transfer	5,967	−0.036
		Transfer-out	5,967	−0.012
		Transfer-in	5,967	−0.048
26	Huang et al. (2018)	Transfer	14,321	0.06
		Transfer-out	14,321	0.098
		Transfer-in	14,321	0
27	Fu et al. (2016)	Transfer-out	305	0.297
		Transfer-in	305	−0.026
28	Cai (2018)	Transfer	397	0.221
29	Feng et al. (2020)	Transfer	8,199	0.936
		Transfer-out	8,199	0.879
		Transfer-in	8,199	0.965
30	Xu and Niu (2020)	Transfer-out	9,377	0.013
		Transfer-in	9,377	−0.012
31	Huang et al. (2018)	Transfer	105	0.219
32	Cai and Xia (2017)	Transfer	622	−0.285
33	Klaus et al. (2011)**	Transfer-in	1,302	−0.047
		Transfer-out	1,302	0.055
34	Ji and Qian (2018)	Transfer	7,168	0.124
35	Lin et al. (2017)	Transfer-out	5,481	−0.003
		Transfer-in	5,481	−0.026
36	Luo and Wan (2019)	Transfer-out	2,795	−0.034
37	Xu et al. (2017)	Transfer-out	4,411	0.052
38	Yang and Li (2020)	Transfer-in	4,363	0.028
39	Han and Liu (2019)	Transfer-out	294	0.15
		Transfer-in	294	−0.014
40	Feng and Zhong (2018)	Transfer-in	1,336	−0.083
41	Liu and Xu (2016)	Transfer	200	0.749
42	Chen (2006)	Transfer-out	1,001	−0.034
		Transfer-in	1,001	−0.049
43	Linxiu et al. (2019)	Transfer-out	640	−0.042
		Transfer-in	640	0.092
44	Klaus et al. (2011)**	Transfer-out	1,302	1.984
		Transfer-in	1,302	−1.7
45	Yang (2016)	Transfer	291	0.407
46	Cheng et al. (2019)	Transfer-out	10,287	0.0111
47	Yang and Wang (2022)	Transfer-out	26,397	0.01

**One literature contains two different studies.

be empirical, excluding purely theoretical and literature reviews; in addition, sample size, correlation, and other data indicators that can be converted into effect size must be reported in the articles; (3)

samples for different studies must be independent of each other. If the samples for two studies are the same or overlap, the study with more detailed reports or a larger sample size is included in the analysis. We retrieved 4,467 relevant papers. After paper screening, we had finally acquired a total of 47 papers, of which 39 were in Chinese, and 8 were in English. Based on this data collection process, we drew the PRISMA framework (Figure 2).

Variables

We follow the methodology proposed by Stanley et al. to generate high-quality study data (Stanley et al., 2013). We use effect size to indicate the strength of the relationship between land titling and rural land transactions. The larger the effect size, the stronger the association between land titling and rural land transactions. Effect size in meta-analysis usually consists of a correlation coefficient between continuous variables or the mean difference between two groups of subjects in an experimental study. The calculation and coding of effect values adhere to the principle of "one sample, one effect value". If a single literature reports multiple independent and non-redundant samples, the corresponding effect values are separately calculated and coded for each sample. After coding is completed, different researchers re-calculate and code the data to ensure the accuracy of the data. Of course, some studies do not report these values but rather report t-test, F-test, or χ^2-test values—we use the tools provided by Wilson to convert them. Our meta-analysis study used Comprehensive Meta Analysis (CMA) software for statistical analysis. Table 1 lists the literature included in this study and the effect sizes obtained from it. In Table 1, columns 1 and 6 display the study numbers, while columns 2 and 7 list the authors of the studies and their respective publication years. Columns 3 and 8 present the types of land transfer analysis for each study, and columns 4 and 9 indicate the sample sizes included in the studies. Finally, columns 5 and 10 show the corresponding effect sizes of each study, as analyzed by CMA software.

In addition, Table 2 provides the moderator variable definition. "Householder" encompasses both "Age" and "Level of education;" "Household" comprises "Household labor force," "Present value of agricultural fixed assets," and "Area of household contracted land;" "Timing" refers to "Publication time".

Publication selection bias

Journals usually exhibit a preference for publishing articles with statistically significant results, while those with non-significant results are often more difficult to publish. As the majority of the literature included in this meta-analysis consists of journal articles, a potential publication bias should be taken into consideration. First, we check for serious publication selection bias by referencing the funnel plot proposed by Light and Pillemer (1984). Most studies on the effect of rural land titling on rural land transfer (Figure 3, the funnel plot for the effect of rural land titling on rural land transfer) and rural land transfer-in (Figure 4) have concentrated on the middle and upper parts of the funnel plot with left–right

symmetry, indicating only a small possibility of publication bias in the studies on the effects of rural land titling on rural land transfer and rural land transfer-in. In the meta-analysis of the effect of rural land titling on rural land transfer-out (Figure 5), some studies are concentrated on the left side of the funnel plot, and the effect size of individual studies is far from the central axis of the funnel plot, indicating that some publication bias may exist in the studies on the effect of rural land titling on rural land transfer-out.

Further testing for publication bias in the studies is conducted using a classic fail-safe N. The classic fail-safe N-test refers to the number of missing papers required to reduce the cumulative effect size to an insignificant level-i.e., the greater the classic fail-safe N, the less likely it is that publication bias exists (Jiang et al., 2012; Xie et al., 2016). The classic fail-safe Ns for the relationships between rural land titling and rural land transfer, rural land transfer-out, and rural land transfer-in are 21,154, 3,908, and 268, respectively—i.e., the number of additional papers for the sample needed to disprove the important relationships between rural land titling and rural land transfer, rural land transfer-out, and rural land transfer-in. The three corresponding classic fail-safe Ns are much larger than the 5K + 10 standard (K is the total effect size included in the literature; K = 48) (Jin et al., 2016; Wang et al., 2016) and much different from the study sample. This result suggests that there is little possibility of publication bias in our research conclusions.

Heterogeneity test and model selection

Heterogeneity test

In a meta-analysis, to determine whether there is a moderator variable between main effects, a heterogeneity test is usually used to see how much the effect size has changed. The heterogeneity test is carried out using an I^2-test and Q-test in this study. An I^2-test is the effect size variation as a percentage of the total variation: $0 \leq I^2 < 25\%$ indicates the absence of heterogeneity; $25\% \leq I^2 < 50\%$ indicates low heterogeneity; $50\% \leq I^2 < 75\%$ indicates moderate heterogeneity; and $75\% \leq I^2 < 100\%$ indicates high heterogeneity (Higgins and Thompson, 2002). Q-test is a test based on the total variation test, that is, Q-value obeys the chi-square distribution. If $P < 0.05$, there is heterogeneity in effect size.

The results of the heterogeneity test are set out in Table 3. The I^2 value of land titling on transfer, transfer-out, and transfer-in is 99.663, 98.552, and 99.193%, respectively, and the effect size Q-test is significant ($p < 0.05$), indicating high heterogeneity between rural land titling and rural land transfer, rural land transfer-out, and rural land transfer-in in the meta-analysis. There is a potential moderator variable between the effects of rural land titling on rural land transfer, rural land transfer-out, and rural land transfer-in.

Model selection

The heterogeneity test can also be used to select a meta-analysis model. The difference between the fixed-effect and random-effect models lies in their different hypotheses for reasons for the difference between conclusions: the fixed-effect model believes that there is only one real effect size in all studies, and the difference

TABLE 2 Definition of moderator variable.

Variable		Variable coding
Householder	Age	0 = Young, age < 53.14; 1 = senior, age ≥ 53.14
	Level of education	0 = Low, primary school or below or years of education <7; 1 = high, junior high school or above or years of education ≥ 7
Household	Household labor force (aged 16–65)	0 = Less, household labor force < 1.70; 1 = more, household labor force ≥ 1.70
	Present value of agricultural fixed assets (RMB) (original value of fixed assets such as household farm vehicles, tractors, threshing machines, and harvesters)	0 = Low, present value of agricultural fixed assets <14,718.54; 1 = high, present value of agricultural fixed assets ≥ 14,718.54
	Area of household contracted land (mu) (per capita household area * household size)	0 = Small, area of contracted land < 21.47; 1 = large, area of contracted land ≥ 21.47
Timing	Publication time (year) (difference from 2022)	0 = Far, publication time <4.23; 1 = near, publication time ≥ 4.23

FIGURE 3
The funnel plot for the effect of rural land titling on rural land transfer.
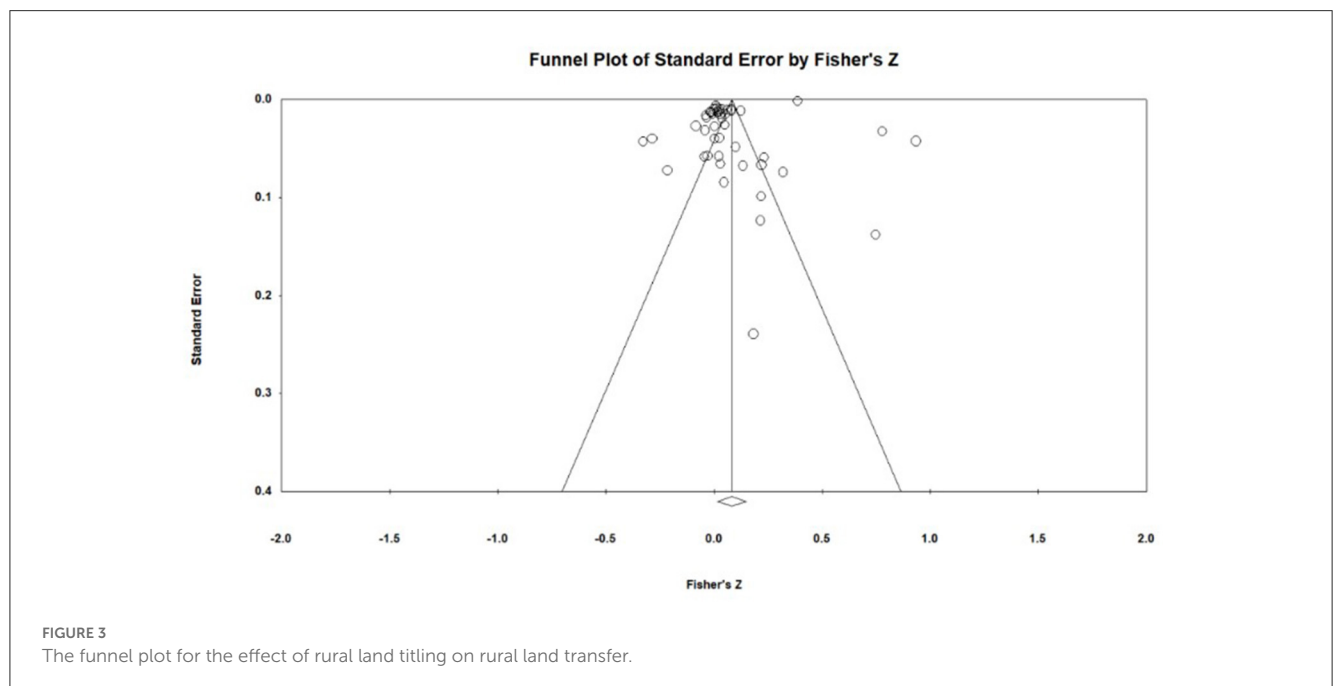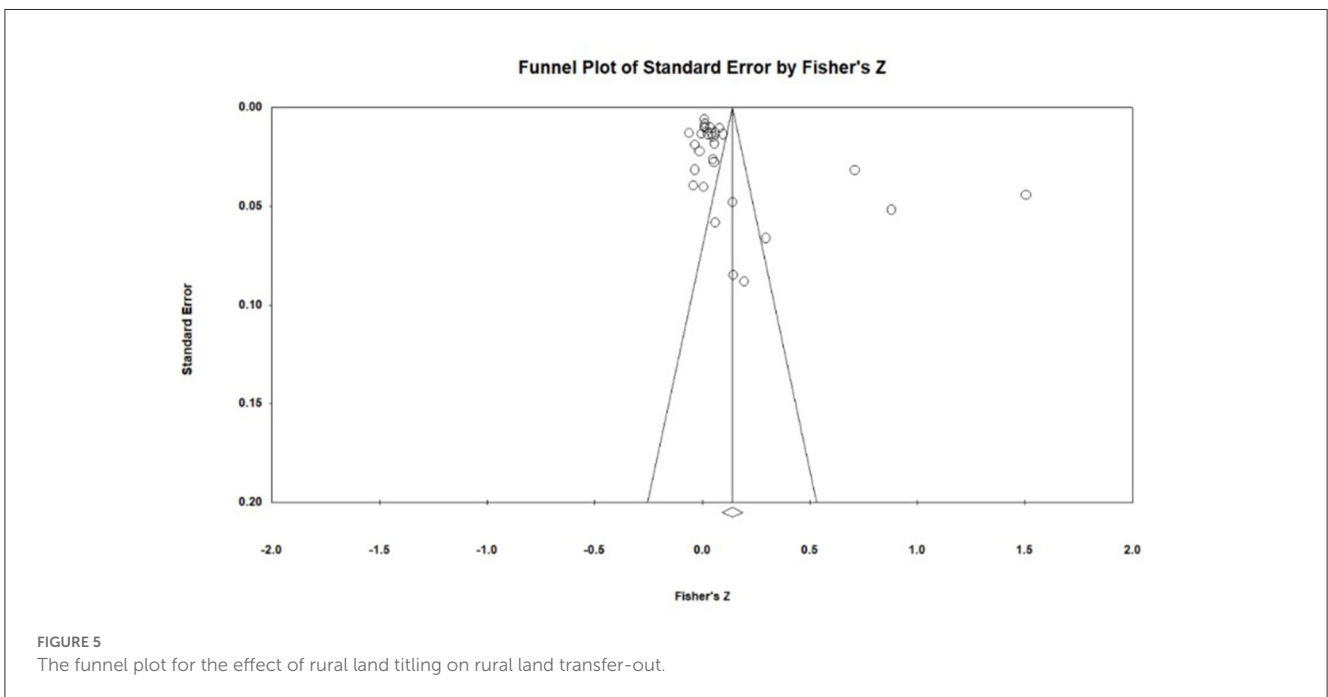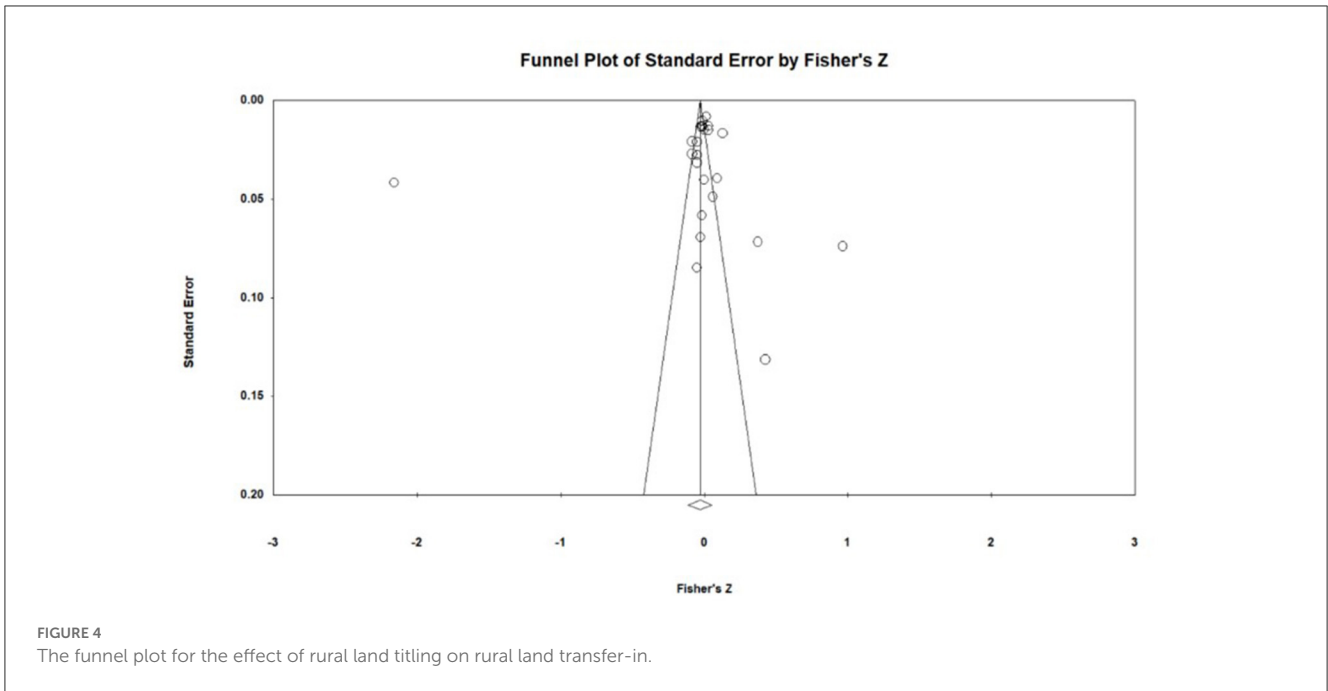
between conclusions is solely due to sampling error; the random-effect model assumes that every study has its own real effect size and that the difference between conclusions is not solely due to sampling error (Borenstein et al., 2009). In general, if the p-value of the Q-test in the heterogeneity test is <0.01 and $I^2 > 50\%$, the random-effect model is more appropriate, and conversely, the fixed-effect model should be used (Hedges and Vevea, 1998).

Results

Main effect analysis

The results of the meta-analysis are shown in Table 4. According to the standards provided by Cohen (Cohen, 1992), a combined effect size <0.2 indicates a weak correlation between the two variables; a combined effect size between 0.2 and 0.5 indicates a moderate correlation; and a combined effect size >0.5 indicates a high correlation (Lipsey and Wilson, 2001). According

to the results of the random-effect model, the combined effect sizes of rural land titling on rural land transfer and rural land transfer-out are 0.082 and 0.138, respectively, indicating that rural land titling has a slightly positive effect on rural land transfer and rural land transfer-out and is statistically significant (combined effect size < 0.2, $P < 0.05$). The results are consistent with earlier empirical study (Ye et al., 2018)—that is, there is a positive but weak correlation between rural land titling and rural land transfer and rural land transfer-out. The result is consistent with research that supports the rural land titling, which can facilitate the transfer of farmlands (Ma et al., 2015; Cheng et al., 2016, 2019; Liu et al., 2017; Xu et al., 2017; Ye et al., 2018; Wang, 2019). In addition, the combined effect size of rural land titling on rural land transfer-in is −0.03 and not statistically significant ($P > 0.1$), indicating that rural land titling has no significant effect on rural land transfer-in. The result neither supports the view that land titling promotes agricultural land transfer, nor supports the view that land titling suppresses agricultural land transfer. This might be because previous studies

FIGURE 4
The funnel plot for the effect of rural land titling on rural land transfer-in.

FIGURE 5
The funnel plot for the effect of rural land titling on rural land transfer-out.

have conflated land outflows and inflows without differentiating their heterogeneity.

Moderating effect analysis

The main effect in Table 4 shows a very weak correlation ($K < 0.2$) between rural land titling and rural land transfer, rural land transfer-out, and rural land transfer-in, which may be due to a potential moderator variable that affects the correlation among the three. To explore the moderating effect and sources of

heterogeneity of moderator variables, we use the methods proposed by Stanley and Jarrell (2005) and Zhang and Hu (2013) to carry out a meta-regression of the relationship between rural land titling and rural land transfer, rural land transfer-out, and rural land transfer-in, respectively. The moderating variables are grouped and categorized by mean, and the moderating effects are analyzed at three levels—householders, households, and publication time—with the results shown in Table 5.

In studies concerning the effect of rural land titling on rural land transfer, the effect size (K) of all moderator variables other than the present value of agricultural fixed assets ($K = 0.184$) is

<0.1. All variables other than the area of household contracted land are significant, indicating five moderator variables with a significantly weak positive effect on the relationship between rural land titling and rural land transfer. Only the moderator variable "area of household contracted land" has no significant effect, indicating that it is the only variable that does not play a role in regulating the relationship between rural land titling and rural land transfer. This may be due to the small area of farmers' household contracted land in some study samples, resulting in a less significant moderating effect.

In the study of the relationship between rural land titling and rural land transfer-out, all moderator variables have a significant moderate positive effect on the relationship between rural land titling and rural land transfer-out ($p < 0.1$), indicating that all moderator variables have a modulating effect on the study. At the householder level, the positive correlation between rural land titling and rural land transfer-out increases with senior aging and higher education levels of farmers. The specific magnitude of effects and the number of other moderating variables remain to be tested by subgroups. In addition, we can see that the moderator variables for rural land transfer-in are not significant. This suggests that rural land titling makes no contribution to rural land transfer-in, with the relationship unaffected by other situational factors.

Robustness test: subgroup test

A subgroup test is used to study sources of heterogeneity and examine the robustness of the outcome of moderator variables to solve the problem of combined effect size in homogeneous heterogeneity and is typically used to handle heterogeneity in meta-analyses (Ding and Zhao, 2018). The operating principle of a subgroup test is to stratify each variable and establish subgroups for moderating variables. The moderating variables are generally grouped and classified by mean. At the same time, the effect sizes of all subgroups are combined, and statistical tests are conducted to verify the accuracy of the analysis of moderating variables by examining whether the combined effect sizes of all groups are significant and consistent in direction (Zhang, 2016). The subgroup

test results of the effect of rural land titling on rural land transfer are shown in Table 6.

At the householder level, the effect size (K) of the senior age group $= 0.036$ and the effect size (K) of the low age group $= 0.066$ ($Q = 7.577$, $p < 0.01$), indicating that the age of farmers plays a significant role in moderating the relationship between rural land titling and rural land transfer, and the younger the householder is, the more he/she prefers to transfer rural land. The cause is that, as rural population increasingly moves into urban areas, the younger generation of farmers no longer have the same deep attachment to land as their fathers. Therefore, compared to the elderly farmers, the younger ones are more likely to transfer agricultural land after the land rights are secured.

At the household level, the present value of agricultural fixed assets ($Q = 2.877$, $p > 0.1$) indicate that the present value of agricultural fixed assets do not play a role in moderating the relationship between rural land titling and rural land transfer, and the reason may be that the farming size of sample farmers in some studies is small, there are few agricultural fixed assets, farmers mainly engage in household operations, and the quantity and use of agricultural assets tend to be consistent, leading to an insignificant moderating effect.

The area of household contracted land ($Q = 6.501$, $0.05 < p < 0.1$), the effect size (K) for farmers with more contracted land and less contracted land is 0.11 and 0.067, indicating that the more contracted farmland has a stronger positive relationship between rural land titling and rural land transfer, and a greater preference for transferring more farmland. The cause of this result might be that farmers operating on a larger scale of farmland have more incentives to further expand their operations through land transfer and thus gain more economic benefits. On the contrary, for small-scale farmers, there is no significant effect on the economic benefit either from entering or leaving after their rights are confirmed.

The household labor force ($Q = 10.485$, $p < 0.01$), and the effect size (K) of more household and less household labor forces is 0.138 and -0.045, respectively, and the significant difference between the two shows that household labor force plays a significant role in moderating the relationship between rural land titling and rural land transfer, and the more household labor force a household has, the stronger the positive relationship between rural land titling and rural land transfer is, and the more likely it is for the household to transfer rural land; however, households with less labor force play an inhibitory role in the relationship between rural land titling and rural land transfer, and are not willing to transfer rural land; and (3) publication time ($Q = 1.489$, $p > 0.1$) does not play a role in moderating the relationship between rural land titling and rural land transfer. This result implies that,

TABLE 3 Results of heterogeneity test for land titling on land transfer.

Outcome variable	Effect size	I^2	Q	df	P-value
Land titling to transfer	47	99.669	13,884.589	46	0.000
Land titling to transfer-out	30	98.552	2,003.279	29	0.000
Land titling to transfer-in	25	99.193	2,973.432	24	0.000

TABLE 4 Results of main effect analysis for land titling on land transfer.

Main effect	Effect size	Combined effect size (K)	Ll	Ul	z-statistical value	p-value
Land titling to transfer	47	0.082	0.015	0.148	2.387	0.017
Land titling to transfer-out	30	0.138	0.091	0.184	5.783	<0.01
Land titling to transfer-in	25	−0.03	−0.115	0.055	−0.695	0.487

In the main effects, the mean value of the combined multiple effects of rural land titling on rural land transfer, rural land transfer-out, and rural land transfer-in is taken.

TABLE 5 Moderating effect analysis for land transfer.

Moderator variable		Transfer					Transfer-out					Transfer-in				
		Combined effect size (K)	se	z	P	N	Combined effect size (K)	se	z	P	N	Combined effect size (K)	se	z	P	N
Householder	Age of householder	0.044	0.006	1.786	0.074	22	0.2	0.018	4.427	<0.01	14	−0.204	0.262	−0.958	0.338	9
	Education level of householder	0.062	0.006	2.445	0.014	24	0.188	0.018	4.145	<0.01	16	−0.113	0.091	−1.05	0.294	12
Household	Household labor force	0.082	0.006	2.929	<0.01	15	0.233	0.018	4.911	<0.01	12	−0.188	0.118	−1.504	0.133	9
	Present value of agricultural fixed assets (RMB)	0.184	0.02	2.725	<0.01	6	0.187	0.03	2.154	0.031	4	0.062	0.005	1.559	0.119	3
	Area of household contracted land (mu)	0.071	0.042	1.197	0.231	16	0.203	0.023	3.566	<0.01	11	−0.196	0.13	−1.423	0.155	9
Timing	Publication time	0.082	0.032	2.387	0.017	47	0.138	0.007	5.783	<0.01	30	−0.03	0.02	−0.695	0.487	25

in terms of the research on land transfer in relation to land titling, the publication time of the research has not changed the relationship between the two. The reason may be that the existing research has not distinguished well between land inflow and outflow. Such a conflating approach is not conducive to clearly reflecting the relationship between the two variables of our concern.

Therefore, householder age and household labor force are significant in moderating rural land titling and rural land transfer, consistent with the moderating effect analysis results.

The subgroup test results of the relationship between rural land titling and rural land transfer-out are shown in Table 7.

(1) At the senior age group level, the age of a householder will significantly influence the effect of rural land transfer; the effect size (K) of senior age group = 0.217, effect size (K) of young age group = 0.089 ($Q = 6.93$, $p < 0.01$), which indicates that the more senior the householder becomes, the more he is inclined to transfer-out rural land. The effect size (K) of high education group = 0.251, and the effect size (K) of low education group = 0.05 ($Q = 6.584$, $p < 0.01$), which indicates that the educational years have a significant role in moderating the relationship between rural land titling and rural land transfer-out, and the more years of education, the stronger the positive relationship between rural land titling and rural land transfer-out is, and the more likely it is for the household to transfer-out rural land. The aforementioned results can be attributed to the fact that younger generations of farmers have a higher level of education, are more willing, and have easier access to employment outside of the agricultural sector, thus having a weaker emotional connection to the land. After land titling, new generations of farmers are more likely to exit their agricultural land compared to their elder counterparts.

(2) At the household level, the area of household contracted land ($Q = 3.671$, $p > 0.1$), indicating that the area of household contracted land is not significant; household labor force ($Q = 7.223$, $p < 0.1$) has a significant moderating effect, with more household labor force $K = 0.16$ and less household labor force $K = 0.372$, indicating that the less household labor force a household has, the stronger the positive relationship between rural land titling and rural land transfer-out is, and the more likely it is for the household to transfer-out rural land. The result is attributed to the fact that, in China where the level of agricultural mechanization is comparatively low, farming requires more labor input. Hence, for those households with a lower labor force, it is more advantageous to seek employment in the non-agricultural sector instead of possessing more rights in agricultural land. Consequently, after the land rights were secured, these households with a lower labor force were more inclined to transfer their agricultural land.

(3) In terms of article publication time, 66% of the effect sizes are derived after 2018—i.e., the vast majority of articles on rural land titling and rural land transfer-out were published after 2018, and the effect sizes of articles published before and after 2018 are 0.047 and 0.076 ($Q = 10.58$, $p < 0.1$),

TABLE 6 Subgroup test of the relationship between rural land titling and rural land transfer 2.

Outcome variable	Moderator variable		Class	Sample size	Effect size (K)	LL	UL	Q	p
Transfer	Householder	Age	Senior (≥53.14)	13	0.036	−0.031	0.103	7.577	0.056
			Young (<53.14)	8	0.066	−0.013	0.144		
		Level of education	High	14	0.09	0.005	0.174	4.481	0.214
			Low	8	−0.003	−0.069	0.063		
	Household	Household labor force	More (≥1.70)	11	0.138	0.061	0.213	10.485	<0.01
			Less (<1.70)	4	−0.045	−0.126	0.037		
		Present value of agricultural fixed assets (RMB)	High (≥14,718.54)	2	0.123	0.101	0.146	2.877	0.237
			Low (<14,718.54)	4	0.201	0.02	0.369		
		Area of household contracted land (mu)	Large (≥21.47)	3	0.11	−0.07	0.283	6.501	0.09
			Small (<21.47)	12	0.067	−0.064	0.196		
	Timing	From 2018	Far	13	0.03	−0.003	0.064	1.489	0.222
			Near	35	0.076	−0.004	0.154		

TABLE 7 Subgroup test of the effect of rural land titling on rural land transfer-out 3.

Outcome variable	Moderator variable		Class	Sample size	Effect size (K)	LL	UL	Q	p
Transfer-out	Householder	Age	Senior (≥53.14)	12	0.217	0.121	0.309	6.93	0.031
			Young (<53.14)	2	0.089	0.006	0.17		
		Level of education	High	11	0.251	0.098	0.392	6.584	0.037
			Low	5	0.05	0.016	0.085		
	Household	Household labor force	More (≥1.70)	8	0.16	0.078	0.239	7.223	0.027
			Less (<1.70)	4	0.372	0.056	0.62		
		Present value of agricultural fixed assets (RMB)	High (≥14,718.54)	0	—	—	—	0.415	0.519
			Low (<14,718.54)	4	0.187	0.017	0.347		
		Area of household contracted land (mu)	Large (≥21.47)	2	0.084	−0.099	0.261	3.671	0.16
			Small (<21.47)	9	0.225	0.103	0.341		
	Timing	From 2018	Far	10	0.047	0.021	0.074	13.305	<0.01
			Near	20	0.076	0.112	0.237		

respectively, indicating that article publication time has a significant role in moderating the relationship between rural land titling and rural land transfer-out, and compared with early studies, articles published after 2018 show that farmers are more willing to transfer-out rural land, which is in line with the moderating effect acquired previously. The emergence of this outcome is attributable to the lagged effect of institutional influence on behavior. As a result, the effect of rights formalization on land transfer-out is more pronounced in recent studies. Therefore, the impact of land titling on land transfer-out is more significant in recent studies.

The subgroup test results of the effect of rural land titling on rural land transfer-in are shown in Table 8. The results show that education level and area of household contracted land are marginally significant ($0.05 < P < 0.1$), while all other moderator variables are marginally insignificant. The results are consistent with those shown in Table 8, indicating that the relationship between rural land titling and rural land transfer-in is not affected

TABLE 8 Subgroup test of the effect of rural land titling on rural land transfer-in 4.

Outcome variable	Moderator variable		Class	Sample size	Effect size (K)	LL	UL	Q	p
Transfer-in	Householder	Age	Senior (≥53.14)	7	0.217	−0.683	0.292	1.548	0.461
			Young (<53.14)	2	−0.002	−0.104	0.101		
		Level of education	High	10	−0.128	−0.356	0.113	5.399	0.067
			Low	2	−0.041	−0.09	0.008		
	Household	Household labor force	More (≥1.70)	5	0.053	−0.037	0.142	4.193	0.123
			Less (<1.70)	4	−0.472	−0.78	0.021		
		Present value of agricultural fixed assets (RMB)	High (≥14,718.54)	0	—	—	—	2.683	0.101
			Low (<14,718.54)	3	0.062	−0.016	0.139		
		Area of household contracted land (mu)	Large (≥21.47)	2	0.193	−0.218	0.545	5.278	0.071
			Small (<21.47)	7	−0.299	−0.555	0.008		
	Timing	From 2018	Far	8	−0.043	−0.063	−0.023	0.136	0.712
			Near	17	−0.021	−0.138	0.097		

by other situational factors. The result is attributed to the fact that land conversion is, in itself, an entrepreneurial behavior requiring higher capability, which is facilitated by higher education after the land titling. Meanwhile, the incentive for further land expansion is more salient for those with larger landholdings than those with smaller ones, leading to more positive land conversion after titling. Thus, concerning the impact of land titling on rural land transfer, we only need to focus on rural land transfer-in rather than rural land transfer-out.

To visualize the impact of each potential moderator variable on the relationship between rural land titling and rural land transfer, the results of the subgroup test have been visualized (Figure 6). Some obvious moderator variables are selected for analysis in the moderating effect illustrations. Specifically, the slope in the grouping illustration of each moderating variable represents the combined effect size of that moderating variable. Figure 6, which uses data from studies on the effect of rural land titling on rural land transfer, shows that farmer age, household labor force, and other moderator variables have a significant modulating effect on the main effect. Slopes in the various groups differ greatly, and the slopes of the household labor groups are opposites. This may offset the effect of rural land titling on rural land transfer and may be the main reason for only a weak positive correlation between rural land titling and rural land transfer-in the main effect analysis.

Discussion

In China's traditional rural land property rights system, land transfer is not smooth, resulting in land abandonment and hindering the sustainable development of the rural economy. The Chinese government has completed the world's largest exercise in land titling to facilitate rural land transfers. However, the impact of China's land titling action, a costly project, on rural land transfer remains controversial in academia. To clarify the above debate, we have used the meta-analysis technology to explore the relationship between rural land titling and rural land transfer: (1) Rural land titling contributes to rural land transfer with a weak effect ($K = 0.082$, $P < 0.05$). (2) Rural land titling only contributes to rural land transfer-out with no effect on rural land transfer-in. Therefore, the so-called effect of land titling on rural land transfer is limited to rural land transfer-out. (3) The higher the educational level of farmers, the more senior the age of farmers, the more labor force in a household, the more agricultural fixed assets in a household, and the larger the area of contracted rural land, the stronger the effect that land titling has on rural land transfer-out. (4) Compared with early studies, land titling has a stronger effect on rural land transfer-out, according to recent studies.

Although the results of this study seem to support the idea that land titling promotes rural land transfer, the literature defines both transfer-in and transfer-out as transfer-in general terms. However, the empirical results indicate that rural land titling only contributes to rural land transfer-out, with no significant effect on rural land transfer-in. Thus, our conclusion will help clarify future studies on land titling and rural land transfer can focus on rural land transfer-out. This study also shows that the effect of land titling on rural land transfer is affected by situational factors such as education, age, labor force, agricultural fixed assets, and area of contracted rural land. We identify the sources of heterogeneity in the conclusions of existing literature and explore the hidden mechanisms that affect the relationship between rural land titling and rural land transfer.

The conclusion of this study helps us understand the reasons for the contradictory conclusions in the existing literature. On this basis, this study's conclusion helps us identify the possibility of improving rural land transfer by changing heterogeneity factors.
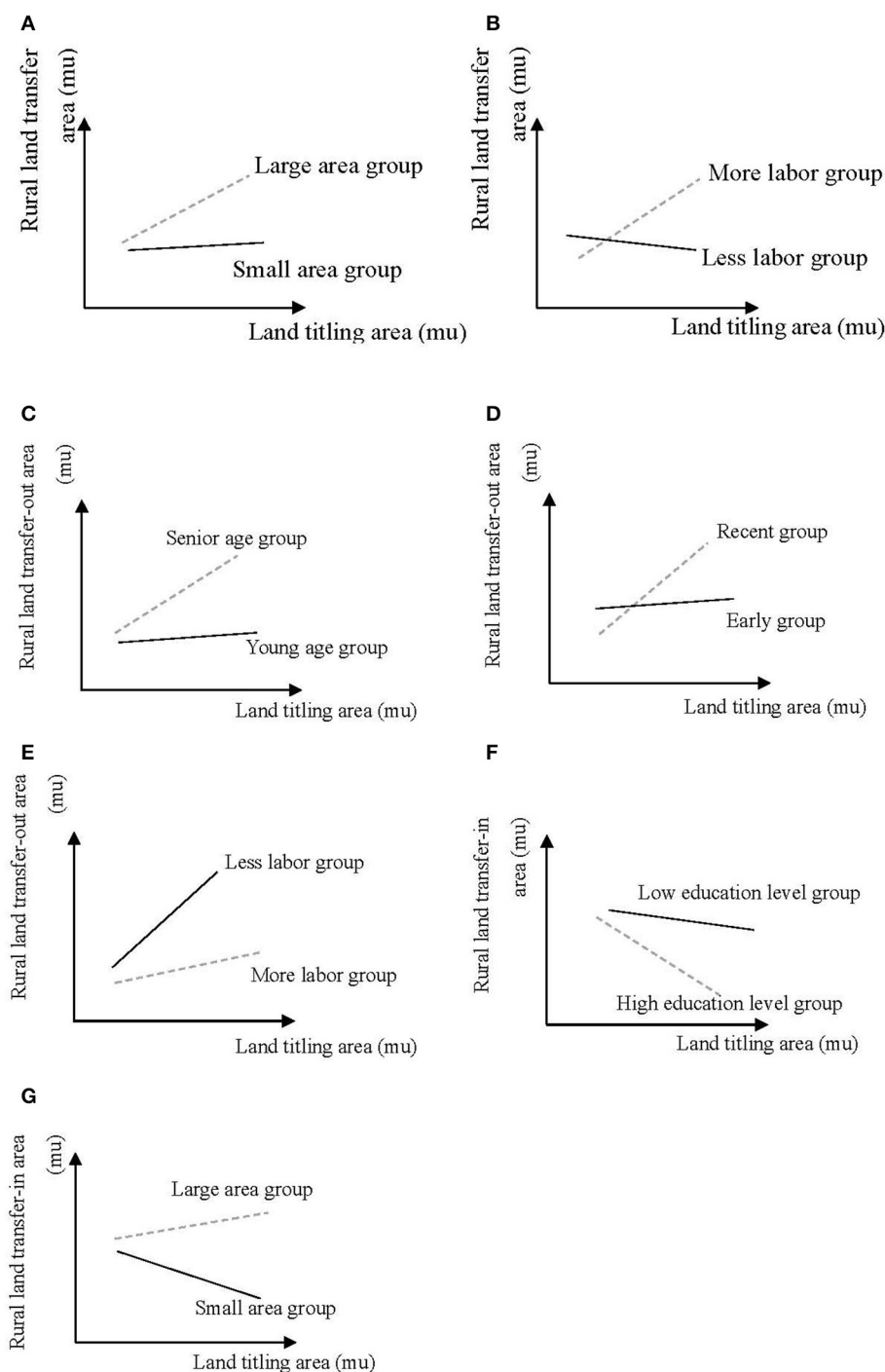
FIGURE 6
The moderating effect of rural land ownership confirmation on rural land transfer. **(A)** Area of contracted land (mu). **(B)** Household labor force. **(C)** Age. **(D)** Time of study. **(E)** Household labor force. **(F)** Level of education. **(G)** Area of contracted land (mu).

Therefore, from the perspective of policymakers, different strategies can be implemented for different groups to improve the land transfer rate and thus promote the sustainable development of the rural economy. The conclusion of this study also helps us identify topics for future studies to empirically test the effect of these situational variables by collecting data. This study also helps us treat rural land transfer dynamically—the role of land titling becomes

more apparent over time, reflecting the long-term accumulation required for the definition of land titling and its implications.

Attention should be paid to the fact that both Chinese policy orientation and existing literature follow Coase's assumption, which states that the welfare growth could be achieved through the transfer of land rights among farmers. However, the literature has shown that property rights are much more complex than

the framework proposed by Coase, thus Ostrom's Bundle of Rights provides a more comprehensive framework to tackle the complexity of land rights (Ostrom, 1990; Schlager and Ostrom, 1992). Chinese rural communities are a collective, thus a diverse range of policies and a multi-level bundle of rights should be developed to satisfy the different needs of community in managing resources and land. The greatest significance of this bundle of rights lies in the fact that it takes into account aspects such as social, cultural, and environmental aspects and combines traditional laws and policies with the realities of local communities to construct a more inclusive and diversified bundle of land rights. This bundle may be beneficial to policy makers, local community members and resource managers, providing a more effective resource management system for local communities and thus helping to resolve the complexities of land rights. Therefore, when it comes to the process of land transfer in Chinese rural areas, policies that are in line with the interests of the local community should be formulated to improve the land transfer rate, taking into consideration traditional culture and social requirements, and a multi-level bundle of rights should be perfected to realize social equity and environmental sustainability.

Although this study further proves that rural land titling has a weak effect on rural land transfer, it has the following limitations. First, there is a trade-off in the selection of moderator variables. Many situational variables are discarded to obtain a greater sample size and achieve data-based manipulability. Second, most of the literature included in the meta-analysis is journal literature, with less unpublished and degree literature at home and abroad, so the unbalanced distribution of literature may affect the results of the main effect analysis.

Conclusions

This paper explored the relationship between rural land titling and rural land transactions using meta-analysis technology and identified and discussed the potential situational variables affecting the relationship. The results show that (1) rural land titling has a weak promoting effect on rural land transactions; (2) rural land titling only facilitates rural land transfer-out, with no effect on rural land transfer-in; (3) educational level, age, labor force, agricultural fixed assets owned, and area of contracted rural land are all situational variables that affect the relationship between land titling and rural land transfer; and (4) the relationship between rural land titling and rural land transfer is dynamic, and the longer that land titling takes, the more obvious the relationship between them becomes. Overall, this study contributes not only to our clarification of the true relationship between rural land titling and rural land transactions but also to our identification of topics for future studies. For example, this study has identified the moderating variables that influence the relationship between land titling and land transfer, guiding us to focus on the research of these moderating variables in the future. In addition, the conclusions of this study will help policymakers develop and implement appropriate policies to promote sustainable rural economic development by increasing land transfer rates.

This research suggests that simplifying agricultural land property rights may not support a sustainable rural agricultural production system. Instead, policies should align with local communities' interests, consider traditional cultures and social needs, and refine multi-level rights combinations. Further research on rural land rights combinations in China is still necessary.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

Conceptualization, validation, writing—review and editing, and funding acquisition: LX and LL. Methodology: LX, JZ, and DK. Software: DK, WH, and JZ. Formal analysis: JZ. Writing—original draft preparation: LX and DK. Supervision and project administration: LL. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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