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Trust evolution, institutional constraints, and land trusteeship decisions among Chinese farmers

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Abstract: Land trusteeship involves farmers entrusting the farming and managing of their land to trustees, who manage the land on their behalf in exchange for a commission fee. Land trusteeship has been an important approach to bridging the gap between smallholder farmers and modern agriculture in China. Because of the information asymmetry in land trusteeship, farmers have higher uncertainty and perceived risk, so social trust and institutional constraints are particularly important in promoting farmers' participation in trusteeship. The objective of this study was to examine the impact of trust evolution and institutional constraints on smallholder farmers' decision-making in green prevention and pest control trusteeship. Our research was conducted in Shandong, China, utilising factor analysis and binary regression. The results revealed that trusteeship decision-making combines trust governance and institutional governance, with significant roles played by institutional trust, institutional supervision, institutional regulation, and interpersonal trust. As part-time farming became more prevalent, the importance of institutional trust and institutional supervision increased, indicating a shift in trusteeship governance from social relations to institutional contracts and the maturation of land trusteeship models. In addition, we also tested the interaction effect of social trust and institutional constraints and the heterogeneity effect of different trusteeship contracts. To improve the land trust system, we must enhance farmers' institutional trust and leverage the active role of intermediary supervision organisations such as village collectives.

Keywords: households; institutional regulation; institutional supervision; institutional trust; land trust; relational trust

China's fundamental national conditions entail a population increase and limited land resources (Zhang et al. 2011). Consequently, decentralised and small-scale agricultural operations have become prevalent in China, hindering resource allocation optimisation and labour productivity improvement and impeding the progress of agricultural modernisation to some extent. Multiple forms of agricultural scale operations have been recognised as the core approach to transforming the agricultural development mode and meeting China's agricultural needs (Key 2019; Zhang et al. 2019). Initially, land transfer was considered an inevitable choice for small farmers to transition to modern agriculture as a means to achieve land scale. However, land fragmentation has led to high transfer costs and reduced returns for farmers. Furthermore, a considerable portion of transferred land has become 'non-food land' and 'non-farm land', thereby weakening the effec-

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tiveness of the land transfer model. Through practical exploration, land trusteeship has emerged as a superior alternative to land transfer, offering a new path for achieving 'service moderate scale operation' and efficient land management (Zhou et al. 2023). Specifically, land trusteeship involves farmers entrusting the cultivation, planting, prevention, and harvesting of their land to trustees, who manage the land on their behalf in exchange for a commission fee.

Land trusteeship represents specialised social division, allowing farmers to participate in productive services, expanding the external division of the labour economy, and endogenising the 'service scale economy'. Compared to land transfer, land trusteeship offers flexible service forms while preserving farmers' land contracting rights without transferring land management rights (Su et al. 2023), making it the primary mode of agricultural scale management. Land trust enables large-scale land management, enhances comprehensive agricultural production capacity, and promotes the organisation and intensification of small farmers' agricultural production (Xiao et al. 2020). As of the end of 2020, the area covered by land trusteeship services in China exceeded 1.6 billion acres, with over 70 million households participating in land trusteeship.

However, land trusteeship encounters challenges associated with cyclical and seasonal crop production, leading to significant information asymmetry and potential moral hazard and opportunistic behaviour, which diminishes the quality of service provision by trustees (Meinzen-Dick et al. 2004). In such incomplete contracts (Hart and Moore 1990), farmers face high uncertainty and perceived risk (Sheng et al. 2018), reducing their willingness to participate in trusteeship. Therefore, it is crucial to investigate how to enhance small farmers' willingness to engage in land trusteeship, with the aim of optimising the trusteeship model and establishing more effective connections between small farmers and modern agriculture.

Currently, theoretical research on land trusteeship primarily focuses on conceptual analysis, articulation mechanisms, and specific theoretical explorations. Few studies have examined the decision-making behaviour of farmers regarding land trusteeship at the micro level. For instance, Chen et al. (2022) argue that risk perception significantly influences farmers' land trusteeship decisions, with natural and market risk perceptions exhibiting positive effects, while policy and contract risk perceptions have negative effects. Zhang et al. (2023) contend that social capital positively impacts the participation behaviour of rural households in trusteeship services, with its effect varying among farmers of different production scales. Xiao et al. (2020) find that farmers' behavioural attitudes, subjective norms, and perceived behavioural control variables directly influence their willingness to participate in land trusteeship, which indirectly affects their participation behaviour.

Existing studies haven't investigated the significance of trust evolution and institutional constraints as primary governance mechanisms under incomplete trusteeship contracts, let al.ne analysed their interaction and influence mechanisms. As traditional societies transform into modern societies characterised by 'temporal separation' and 'de-embedding' (Luhmann 1968), the weakening of traditional trust rooted in social relationships is inevitable. Simultaneously, institutional trust has evolved during the process of institutionalising state governance (Tao et al. 2014) and has gradually become an effective mechanism for establishing shared value norms in rural society. Social trust is expected to play new roles in trusteeship decision-making mechanisms during this evolutionary process. Additionally, as land trusteeship practices shift from exploratory operations to modern socialised service models, institutional constraints that gradually evolved during this process will influence service providers' performance and interact with trust mechanisms, consequently influencing farmers' trusteeship decisions.

Green prevention and pest control processes, characterised by fragmented operations, high labour intensity, and technical requirements, significantly impact final yields and food security, making them critical in promoting the trustee model (Gao et al. 2017). Consequently, this study constructed a theoretical framework incorporating trust evolution and institutional constraints to examine smallholder participation in trusteeship decision-making regarding green prevention and pest control. Empirical testing was conducted in Shandong Province, China. Our aim was not only to increase the participation rate in the land trusteeship model and promote modern agriculture in China but also to disseminate trusteeship experiences that can provide valuable references to countries and regions seeking agricultural transformation with small-scale and decentralised smallholder operations.

Theoretical framework and hypotheses

With the rapid progress of industrialisation and urbanisation, the agricultural labour force is accelerating its move from rural areas, leading to an increase in part-

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time employment. The expansion of living circles and non-farm employment disrupts the traditional foundations of trust, causing the social trust to evolve in terms of its level and structure. Additionally, land trusteeship has evolved from informal verbal agreements among friends and relatives to standardised contract models, accompanied by the emergence of formal institutional constraints. Consequently, social trust and institutional constraints have a bearing on farmers' participation in trusteeship contracts, especially when faced with incomplete contracts. We construct an analytical framework (Figure 1) within this context to examine the influence of trust evolution and institutional constraints on smallholder farmers' decisions regarding green prevention and pest control trusteeship.

Trust evolution and land trusteeship decision-making. For farmers, the decision to engage in land trusteeship involves dealing with uncertainty and information asymmetry, resulting in perceived high risks. According to Luhmann (1968), trust is an internal assessment of external conditions that generate risk, indicating confidence in the counterparty's non-opportunistic behaviour. Social systems theory distinguishes between two models of social trust: interpersonal trust and institutional trust (Luhmann 1968). Interpersonal trust is based on interpersonal communication and emotional connections developed through interactions involving blood ties, geographic proximity, and shared karma (Portes and Sesenbrenner 1993). Farmers with high interpersonal trust believe that trustees will act in their best interests, as speculative actions would harm trustees' social credit and reputation, thereby ensuring the successful fulfilment of trustee contracts. Institutional trust pertains to trust in formal norms, conditions, and rules established by authorities, organisations, and actors responsible for enforcing them (Daskalopoulou 2019). Farmers with sufficient institutional trust expect government agencies to bind service providers to trusteeship through effective rules and regulations, ensuring the adherence to contractual requirements and the realisation of expected trusteeship benefits.

Trust is a functional social mechanism embedded in the social structure. As the social structure undergoes changes, trust functions also transform accordingly (Guiso et al. 2004). In the transition from traditional to modern Chinese society, marketisation deepens, and farmers experience increasing social mobility (Zhou and Xie 2019). The cohesive nature of the acquaintance society begins to disintegrate, challenging the foundations of interpersonal trust (Du et al. 2020). In the context of urbanisation and off-farm labour migration, the level of part-time employment among farmers has generally increased. Farmers with high levels of part-time employment psychologically and physically distance themselves from their farming circles, leading to a diminished control of individual trust through relational networks. Furthermore, the absence of interaction between farmers and trustees limits interpersonal trust (De Vries et al. 2019), as farmers can no longer assess trustees' trustworthiness solely based on past experiences and word of mouth. On the contrary, the impor-

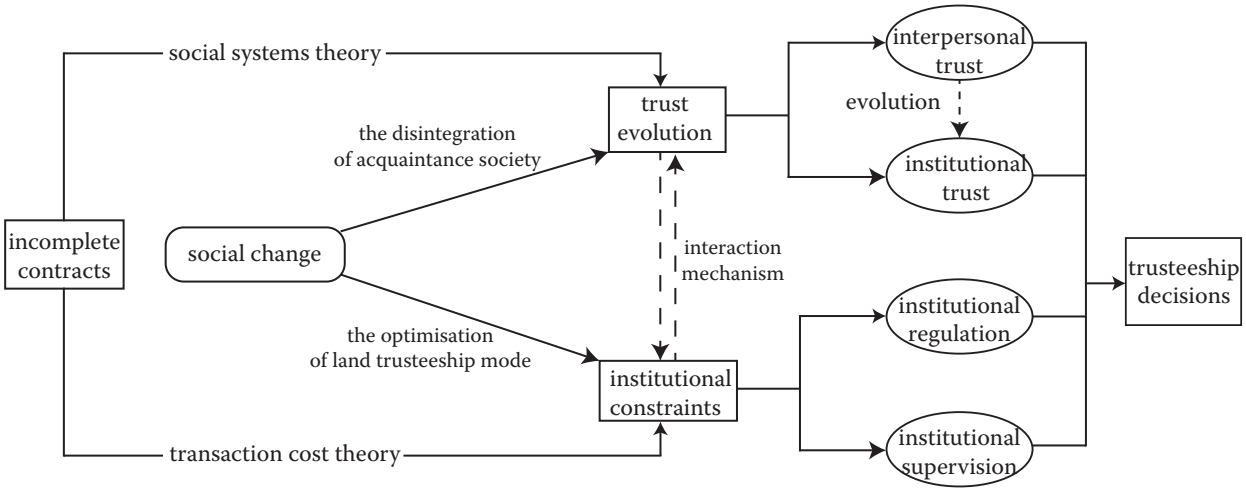

Figure 1. The influence mechanism of trust evolution and institutional constraints on farmers' participation in land trusteeship decision-making under incomplete contracts

Source: Authors' own processing

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tance of institutional trust is magnified, as trust in the institution can dispel the suspicion of trustees among farmers working outside. Considering these dynamics, we propose the following hypotheses:

H_1: Both enhanced interpersonal trust and institutional trust facilitate farmers' decisions regarding green prevention and pest control trusteeship. Institutional trust has become more significant than interpersonal trust.

H_2: With an improvement in farmers' part-time employment levels, the impact of interpersonal trust on green prevention and pest control trusteeship decisions decreases, while the impact of institutional trust increases.

Institutional constraints and land trusteeship decision-making. According to transaction cost theory, institutional constraints involve the use of detailed and explicit contracts between cooperating parties to define their respective rights and responsibilities. These constraints serve as essential tools to overcome contractual incompleteness (Williamson 2007). Traditional contract farming operates based on gentleman's agreements, often without formal contracts. However, as the socialised service system develops, farmers and socialised service providers gradually establish a principal-agent relationship in a standardised service model (Luo 2002).

Based on Coleman's theory of rational behaviour (Coleman 1990), institutional constraints can be categorised into two main forms. Institutional regulation: achieved through the signing of uniform contracts, this form explicitly outlines the rights and obligations of trustees and is protected by the law. Institutional supervision: tripartite organisations, such as village collectives, intervene during green prevention and pest control trusteeship, offering mutual supervision, enabling punishment for opportunistic behaviour and disputing coordination services to farmers and service providers. Consequently, we propose the following hypothesis:

H_3: Both institutional regulations, represented by uniform contracts, and institutional supervision, represented by third-party involvement, facilitate farmers' decisions regarding green prevention and pest control trusteeship.

Both social trust and institutional constraints contribute to maintaining the stability of trusteeship contracts. Farmers' willingness to participate can be influenced by both internal social trust and external institutional design, indicating a potential mutual influence. Since institutional regulation provides a formal framework for informal relational governance, a complementary relationship exists between social trust and institutional regulation. Farmers with high social trust tend to believe that institutional regulations can be consciously implemented during the trusteeship process. However, farmers with low levels of trust require external coercive supervision to dispel doubts about the implementation of institutions, indicating a substitution relationship exists between social trust and institutional supervision. Therefore, we propose the following hypothesis:

H_4: An interaction exists between the influence of social trust and institutional constraints on farmers' decisions regarding green prevention and pest control trusteeship. Specifically, a complementary relationship exists between the influence of institutional regulation and social trust, while institutional supervision and social trust have a substitution relationship.

MATERIAL AND METHODS

Data sources

The sample data were collected through a household survey conducted in Shandong Province between 2021 and 2022. Shandong Province, located in the coastal area of East China, is bordered by the Bohai Sea and the Yellow Sea (34°22.9'–38°24.01'N, 114°47.5'–122°42.3'E) and has a warm temperate monsoon climate. As the first province to implement nationwide 'land trusteeship', Shandong provides valuable insights into the investigation of agricultural trusteeship service mechanisms and offers realistic conditions for data collection. The sample areas consisted of four cities and counties (districts): Qingyun County in northwestern Dezhou City, Linshu County in southwestern Linyi City, Zhaoyuan City in northeastern Yantai City, and Laixi City in southeastern Qingdao City. The sample was selected using a stratified sampling method, dividing sample townships into high, medium, and low wheat cultivation areas. One city or county (district) was randomly chosen from each group, and 3–4 administrative villages were randomly selected within each city or county (district). Finally, 25–30 households were randomly selected in each village, resulting in a total of 1 311 questionnaires collected, of which 1 203 were valid.

The explanatory variables were farmers' decisions regarding participation in green prevention and pest control trusteeship. 411 sample farmers participated in trusteeship, accounting for 34.11% of the total. One of the core explanatory variables was social trust, which

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was divided into interpersonal trust and institutional trust according to social systems theory and measured using factor analysis. The second variable was institutional constraints, which were divided into institutional supervision and institutional regulation according to rational behaviour theory. Institutional supervision was measured by the presence of three parties involved in trusteeship, while institutional regulation was measured by the existence of a unified local trust contract. 803 sample farmers had a unified contract, accounting for 71.01%, and 848 farmers had tripartite supervision, accounting for 74.98%. The sample farmers generally exhibited characteristics such as old age, low education, risk aversion, and part-time work, and their land showed characteristics of small scale and fragmentation (Table 1).

Methods

The binary probit model. A binary probit model was applied to determine the factors influencing farmers' decision-making in green prevention and pest control trusteeship. Here, the dependent variable was binary in nature and took the numeric value 1 if a household participated in green prevention and pest control trusteeship; 0 was assigned otherwise. The general form of the probit model was as follows:

$$Pr\,(y = 1|x) = \Phi(x\beta) \quad (1)$$

where: Pr – probability; y – dependent binary variable; x – set of all the explanatory variables; $\Phi(x\beta)$ – cumulative distribution function.

The extended regression models (ERM) based on multivariate normal distribution and maximum likelihood estimation were utilised to determine whether there is endogeneity between social trust and trusteeship decisions in the probit model. This model allows for different types of values for endogenous variables and addresses non-random assignment of decision variables and sample selection problems associated with endogeneity. The instrumental variables chosen for the extended regression models were the average interpersonal trust of other farmers in the

Table 1. Basic characteristics of sample farm households

Variable name		Variable definition	Mean value	SD
Land trusteeship	whether to participate in green prevention and pest control trusteeship	yes = 1; no = 0	0.39	0.49
Social trust	interpersonal trust	calculated through factor analysis	$1.15e^{-9}$	1.00
	institutional trust		$-2.34e^{-10}$	1.00
Institutional constraints	institutional regulation	availability of local unified contract: yes = 1; no = 0	0.71	0.46
	institutional supervision	availability of third-party supervision: yes = 1; no = 0	0.75	0.43
Individual endowment	age of the household head	age of head of household (years)	51.93	9.63
	education level of the household head	elementary school education and below = 1; middle school education = 2; high school education = 3; high school education and above = 4	1.95	0.81
	labor quantity	number of household laborers (pcs)	3.20	0.73
	whether have an executive position	yes = 1; no = 0	0.13	0.34
	part-time employment level	non-farm income/gross household income (%)	0.41	0.31
	social network scale	number of friends and relatives who keep in touch with the family (pcs)	21.04	16.02
Production characteristics	planting area	cultivated area (hm^2)	0.66	1.03
	degree of land fragmentation	average plot area (hm^2)	0.08	0.03
	soil quality	very poor = 1; poor = 2; fair = 3; good = 4; very good = 5	2.53	1.20

Source: Authors' own processing

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Table 2. Social trust measurement indicators

Interpersonal trust indicators	Blood group	Geographical groups	Occupational groups	Stranger groups
Average	4.01	3.95	2.41	1.97
Variance	0.86	0.92	1.37	0.88
Institutional trust indicators	agriculture-related systems are complete	the law is valid	the local government is efficient	agricultural production organizations are professional
Average	2.71	3.56	3.07	3.36
Variance	0.95	0.98	1.42	0.94

Source: Authors' own processing

Table 3. Results of factor analysis of social trust variables

Indicators	Common factor 1	Common factor 2
Agricultural production organizations are professional	–0.0244	0.7671
Geographical groups	0.7038	–0.0547
The local government is efficient	–0.6670	–0.0356
The law is valid	–0.0147	0.7128
Agriculture-related systems are complete	0.0854	0.7863
Stranger groups	0.6916	0.0888

Source: Authors' own processing

village and the average institutional trust of other farmers in the village. The average here refers to the average factor value of interpersonal trust and institutional trust among other farmers in the village. These variables were selected due to the significant influence of surrounding individuals' trust levels on individual farmers' trust levels (Robbins 2016). Moreover, the instrumental variables were exogenous and did not impact farmers' trusteeship decisions.

Factor analysis for social trust variables. Since the measurement of social trust included multiple indicators, factor analysis was adopted to reduce dimensionality. We used 5-point Likert-type scales to measure the variables representing social trust. Interpersonal trust was operationalised as trust in people within the social interaction circle, including blood groups consisting of relatives, geographic groups consisting of neighbours, occupational groups consisting of colleagues and classmates, and general trust in groups of strangers (Glanville et al. 2013). The measure was based on the question 'How much do you trust the following people?', with response options ranging from not at all, not very, moderately, somewhat, and very. Institutional trust was measured across two dimensions: the institution itself (including norms and laws) and those who implement it (including government and organisations). The measure is based on the question 'How much do you approve of the following descriptions?' (Table 2), with response options ranging from not at all, not very, moderately, somewhat, and very.

To enhance the cumulative variance contribution, the anomalous indicators with uniqueness greater than 0.600 were removed from the factor loading matrix. The Kaiser-Meyer-Olkin (KMO) sampling fitness measure was 0.668, and Bartlett's spherical test indicated a rejection of the original hypothesis at the 1% level, validating the use of factor analysis. Principal component analysis was employed to extract the first two common factors with eigenvalues greater than 1, and the component matrix was rotated using the Kaiser normalised maximum variance method (Table 3). Common factor 1 was named 'interpersonal trust', and common factor 2 was named 'institutional trust'.

RESULTS AND DISCUSSION

Trust evolution, institutional constraints, and land trusteeship decision-making

The probit model's goodness-of-fit was assessed through a modified Pearson χ^2 test (Hosmer-Lemeshow test) and a class goodness-of-fit test (count R^2).

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The Pearson χ^2 test yielded a χ^2 value of 1 215.81 with a *P*-value of 0.2671, indicating no significant difference between predicted and observed values. The count R^2 value was 0.717, indicating that the model could predict over 70% of trusteeship decisions.

The results (Table 4) indicated that both interpersonal trust and institutional trust had positive and significant effects on farmers' decisions to participate in green prevention and pest control trusteeship at the 5% and 1% levels, respectively, validating H_1. Institutional supervision had a positive and significant effect at the 5% level, while the significance of institutional regulation was observed at the 10% level, validating H_3. Marginal effects (Table 5) revealed that institutional trust and institutional supervision had the greatest influence on trusteeship decisions, followed by institutional regulation, while interpersonal trust had the least impact.

Among the control variables, the age of the household head had a significantly negative effect. Older farmers tended to be less comfortable with others' involvement in their production and preferred to bear the burden themselves rather than pay additional service costs, making them less willing to participate in trusteeship. The education level of the household head had a positive effect, indicating that farmers with higher education were more willing to participate. The labour quantity had a significantly negative effect, as households lacking labour resources were motivated to participate in trusteeship to alleviate production constraints. The planting area had a significantly positive effect, with larger areas leading to a greater willingness to participate in land trusteeship to save labour and energy. The soil quality also had a significantly positive effect, with better soil quality increasing the willingness to participate in trusteeship.

Farmers were divided into high and low part-time employment level groups based on the average level of part-time employment for heterogeneity analysis.

Table 4. Regression results for trust evolution, institutional constraints, and land trusteeship decision

Variables	Main model		High part-time employment level farmers		Low part-time employment level farmers	
	coefficient	SE	coefficient	SE	coefficient	SE
Interpersonal trust	0.1016**	0.0442	–0.0771	0.0686	0.1436**	0.0721
Institutional trust	0.1968***	0.0501	0.2052**	0.0831	–0.0222	0.0742
Institutional regulation	0.1577*	0.0882	0.2848*	0.1463	0.0069	0.1380
Institutional supervision	0.1949**	0.0910	0.3045**	0.1445	–0.0082	0.1312
Age of the household head	–0.0180***	0.0042	–0.0232***	0.0070	–0.0113*	0.0064
Education level of the household head	0.1268***	0.0491	0.1517*	0.0818	0.0980	0.0740
Labor quantity	–0.1931***	0.0567	–0.1108	0.0938	–0.1504*	0.0844
Whether have an executive position	0.1441	0.1153	0.0877	0.1862	0.2486	0.1729
Part-time employment level	0.1206	0.1330	–	–	–	–
Social network scale	–0.0002	0.0025	–0.0021	0.0039	0.0032	0.0037
Planting area	0.0056**	0.0023	0.0062	0.0039	0.0019	0.0035
Degree of land fragmentation	0.1196	0.0855	0.0928	0.1391	–0.0216	0.1317
Soil quality	0.1108***	0.0330	0.1828***	0.0536	0.0207	0.0510
Dezhou area	0.1319	0.1139	1.0781***	0.1996	–0.4905***	0.1628
Linyi area	–0.1673	0.1246	0.8316***	0.2135	–0.9739***	0.2004
Yantai area	0.6838***	0.1175	1.1343***	0.1826	0.1306	0.1646
Intercept term	–0.0969	0.3578	–0.2854	0.5778	0.0641	0.5238

*, **, ***significant at the 10%, 5%, and 1% levels, respectively

Source: Authors' own processing

Table 5. Marginal effect results of social trust and institutional constrains variables

Variables	Interpersonal trust	Institutional trust	Institutional regulation	Institutional supervision
Marginal effect	0.0333	0.0644	0.0516	0.0638

Source: Authors' own processing

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The results (Table 4) showed that interpersonal trust was significant for farmers with high part-time employment levels, indicating that agriculture-based farmers primarily rely on traditional interpersonal communication and supervision to enhance trusteeship effectiveness. In contrast, for farmers with low part-time employment levels, interpersonal trust lost significance, and the role of institutional trust and tripartite supervision became prominent. This suggests that as more farmers engaged in non-farm industries, they increasingly relied on formalised control and external constraints related to institutional contract governance to uphold the trusteeship contract. H_2 was confirmed.

Previous studies both in China and abroad have pointed out that trust plays an important role in promoting farmers' participation in various types of cooperation or contracts (Luo et al. 2018; Wang et al. 2021; Mao et al. 2022). For example, the trust level of farmers in the eastern region of Rwanda significantly affected the choice of contract attributes for high-value agricultural products such as fruits (Ihli et al. 2022). The role of trust also had important effects on contract attribute choices among Ghanaian pineapple farmers (Fischer and Wollni 2018). Consistent with the results of previous studies, we also found that social trust, including interpersonal trust and institutional trust, had positive and significant effects on farmers' decisions to participate in land trusteeship.

It is worth noting that in studies on the role of trust in farmers' land transfer or land lease decisions, interpersonal trust, rather than institutional trust, plays a more crucial role. Wenjun et al. (2023) claim that farmers' decision-making regarding continuing the land transfer contract in West China was significantly affected by their levels of interpersonal trust because interpersonal trust fostered a sense of confidence and security in the ongoing relationship. Shi et al. (2018) reveal that farmers' lack of trust in the village committee in East China probably weakened their participation in farmland transfer. However, when comparing our results to those of older studies, we noted that the impact of institutional trust on trusteeship behaviour surpasses that of interpersonal trust, playing a decisive role in farmers' decisions to engage in trusteeship. As farmers gradually transition from an agrarian lifestyle, the significance of institutional trust becomes more pronounced. Our study revealed the importance of institutional trust by comparing it with interpersonal trust and analysing the influence of changes in farmers' part-time employment levels. The result aligns with Luhmann's observation of a transition from intimate emotional relationships to contractual relationships in an integrated order (Luhmann 1968). The importance of a formal contract has surpassed that of personal acquaintances, representing the development of the Chinese land trusteeship model toward formalisation and standardisation. At the same time, it reflects an important shift in farmers' preference for the governance structure of trusteeship services from an emotional model to a contractual control model, which means that institutional trust based on contracts and property rights is urgently needed for the construction of land trusteeship in China. Farmers can actively participate in trusteeship decisions only when they trust the trusteeship contract system and trustees and believe that their trusteeship rights will be well protected even in incomplete contracts.

Endogeneity test

The regression results of the endogeneity test (Table 6) demonstrated the validity of the instrumental variables. Furthermore, the correlation coefficient of the residual term in the regression was insignificant, indicating the absence of endogeneity issues with the social trust variables, enabling further analysis using the probit model.

The interaction of social trust and institutional constraints

To examine the interplay between social trust and institutional constraints in influencing farmers' deci-

Table 6. Results of endogeneity test of social trust variables

Variables	Coefficient	SE
Correlation between interpersonal trust instrument variables and relational trust variables	0.9403***	0.0295
Correlation between institutional trust instrument variables and institutional trust variables	0.9672***	0.0147
Error term correlation coefficient between the regression equation of the endogenous variables of the interpersonal trust and the basic regression equation	–0.0918	0.0604
Error term correlation coefficient of the regression equation of the endogenous variables of institutional trust and the basic regression equation	0.0001	0.0460

***significant at 1% level

Source: Authors' own processing

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sion-making regarding green prevention and control of pest trusteeship, the social trust factor was incorporated as an interaction term with two separate institutional constraint approaches. All interaction terms were centralised and included in the probit model for examination (Table 7). The results revealed that among the interaction terms involving social trust and institutional regulation, the interaction term of institutional trust and institutional regulation had a positive and significant effect at the 1% level. This suggests that strengthening the regulation of green prevention and control of pest trusteeship contracts can effectively enhance the impact of farmers' institutional trust, and increased institutional trust can also amplify the effect of institutional regulation. Therefore, institutional trust and institutional regulation act as complementary facilitators in influencing trust decisions. For farmers, signing a uniform contract serves as an important complementary means of institutional trust, providing a form of 'double insurance' for green prevention and control of pest trusteeship services.

Regarding the interaction terms involving social trust and institutional supervision, the interaction term of institutional trust and institutional supervision exhibited a negative effect at the 5% level, indicating that institutional trust and institutional supervision serve as substitutes for each other. A third-party intervention, such as village committees, can effectively alleviate farmers' concerns about trusteeship subjects' behaviour, substituting for farmers' own trust in the trusteeship system. These findings support H_4.

Robustness test

Replacement of the regression model. The model was re-estimated using the Logit model. The results (Table 8) demonstrated substantial consistency in the social trust, institutional constraints variables, and their interaction effects compared to the probit regression model.

Replacement of the sample. To account for demographic characteristics, older farmers over 65 years old were excluded from the sample, and the estimation was conducted again. The results (Table 9) showed that the social trust, institutional constraints variables, and their interaction effects generally remained consistent with the main regression results. The estimation results can be considered robust.

Heterogeneity analysis

With the increasing prevalence of land trusteeship practices, diverse characteristics of trusteeship models have emerged. The trusteeship contracts were further divided based on trustee object and trusteeship duration to examine the effects of these governance types on heterogeneous green prevention and control of pest trusteeship models.

The trustee object was represented as a binary variable: organisational trustee (assigned as 1) and acquaintance trustee (assigned as 0), reflecting the influence of different trustee objects on farmers' participation decisions. The results (Table 10) indicated a negative effect of interpersonal trust at the 5% level. Given that interpersonal relational transactions are typically associated with acquaintances in the

Table 7. Regression results for the interaction effect of social trust and institutional constraints on land trusteeship decision

Variables	Social trust and institutional regulation		Social trust and institutional supervision	
	coefficient	SE	coefficient	SE
Interpersonal trust	–0.0241	0.0885	0.1717**	0.0696
Institutional trust	0.0505	0.0765	0.3273***	0.0794
Institutional regulation	0.2038**	0.0934	–	–
Interpersonal trust × institutional regulation	0.1284	0.0990	–	–
Institutional trust × institutional regulation	0.2251***	0.0870	–	–
Institutional supervision	–	–	0.2190**	0.0925
Interpersonal trust × institutional supervision	–	–	–0.0628	0.0833
Institutional trust × institutional supervision	–	–	–0.1835**	0.0882
Control variables	controlled	controlled	controlled	controlled

**, ***significant at the 5%, and 1% levels, respectively

Source: Authors' own processing

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Table 8. Regression results for trust evolution, institutional constraints, and land trusteeship decision using logit models

Variables	Basic model		High part-time employment level farmers		Low part-time employment level farmers	
	coefficient	SE	coefficient	SE	coefficient	SE
Interpersonal trust	0.1746**	0.0737	–0.0211	0.1494	0.2824**	0.1170
Institutional trust	0.3349***	0.0845	0.1070	0.1284	0.5364***	0.1321
Institutional regulation	0.2731*	0.1480	0.3345**	0.1569	–	–
Interpersonal trust × institutional regulation	–	–	0.1966	0.1664	–	–
Institutional trust × institutional regulation	–	–	0.3497**	0.1443	–	–
Institutional supervision	0.3149**	0.1525	–	–	0.3672**	0.1566
Interpersonal trust × institutional supervision	–	–	–	–	–0.0916	0.1393
Interpersonal trust × institutional supervision	–	–	–	–	–0.2899**	0.1456
Control variables	controlled	controlled	controlled	controlled	controlled	controlled

*, **, ***significant at the 10%, 5%, and 1% levels, respectively

Source: Authors' own processing

Chinese farmland service market, farmers often opt for informal means of governance through interpersonal communication. In contrast, institutional trust exhibited a significant positive effect at the 5% level, while institutional regulation and institutional supervision showed significant positive effects at the 5% and 1% levels, respectively. Trust lands to organisations outside the interpersonal circle for green prevention and control of pest trusteeship reduced reliance on interpersonal trust for communication and problem-solving. Farmers required higher levels of institutional trust and a favourable contractual environment, leading to a greater reliance on formal institutional trust.

The effect of escrow time frame on the governance structure was examined by using a binary variable: more than one year escrow (assigned a value of 1) and one year escrow (assigned a value of 0). The results (Table 10) demonstrated a significant positive effect of institutional trust at the 1% level, while institutional regulation and institutional supervision exhibited a significant positive effect at the 5% level. Since the number of transactions between the principal and trustee also influenced farmers' decisions, those who choose long-term contracts require higher levels of institutional trust and a more favourable institutional constraint environment for green prevention and control of pest trusteeship compared to those with short-

Table 9. Regression results for trust evolution, institutional constraints, and land trusteeship decision excluding the elderly population

Variables	Basic model		High part-time employment level farmers		Low part-time employment level farmers	
	coefficient	SE	coefficient	SE	coefficient	SE
Interpersonal trust	0.1051**	0.0444	–0.0248	0.0891	0.1757**	0.0702
Institutional trust	0.2007***	0.0505	0.0463	0.0774	0.3286***	0.0799
Institutional regulation	0.1521*	0.0890	0.1967**	0.0940	–	–
Interpersonal trust × institutional regulation	–	–	0.1316	0.0997	–	–
Institutional trust × institutional regulation	–	–	0.2359***	0.0878	–	–
Institutional supervision	0.1950**	0.0919	–	–	0.2201**	0.0935
Interpersonal trust × institutional supervision	–	–	–	–	–0.0650	0.0839
Interpersonal trust × institutional supervision	–	–	–	–	–0.1808**	0.0887
Control variables	controlled	controlled	controlled	controlled	controlled	controlled

*, **, ***significant at the 10%, 5%, and 1% levels, respectively

Source: Authors' own processing

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Table 10. Heterogeneity analysis results of the impact of social trust an institutional constrains on different contracts

Variables	Organizational trustee		More than one year escrow	
	coefficient	SE	coefficient	SE
Interpersonal trust	–0.1820**	0.0837	0.1093	0.0751
Institutional trust	0.2016**	0.0977	0.3418***	0.0895
Institutional regulation	0.3843**	0.1833	0.3388**	0.1547
Institutional supervision	0.7812***	0.1982	0.3783**	0.1608
Control variables	controlled	controlled	controlled	controlled

**, ***significant at the 5%, and 1% levels, respectively
Source: Authors' own processing

term contracts. Therefore, establishing institutional standardisation and constraint enhances farmers' willingness to engage in repeated orderly transactions.

CONCLUSION

As land trusteeship gradually becomes an effective scale management approach in the Chinese context, understanding the factors influencing farmers' participation in land trusteeship is crucial for the transformation of smallholder farmers into modern agriculture and can provide valuable insights for areas with fragmented and small-scale agricultural models. Using green prevention and control of pest trusteeship as an example, this study identified the impact of trust evolution and institutional constraints on farmers' land trusteeship decisions using the survey data of 1 203 wheat growers in Shandong Province, China. The main research findings were as follows:

First, the decision-making process for Chinese green prevention and control of pest trusteeship involves a combination of social trust and institutional constraints, with institutional trust, institutional supervision, institutional regulation, and interpersonal trust playing progressively important roles. As farmers gradually transition from an agrarian lifestyle, the significance of institutional trust and institutional supervision becomes more pronounced. It indicates that farmers can actively participate in trusteeship decisions only when they trust the trusteeship contract system and trustees, and believe that their trusteeship rights will be well protected even in incomplete contracts. However, as a new type of socialised service system, building farmers' trust in the land trusteeship system requires time for psychological and emotional cultivation. To strengthen the standardisation and uniformity of regional land trusteeship contracts, it is crucial to emphasise diversified institutional designs for risk prevention in land trusteeship contracts and to promote the meaning, process, and various models of land trust to farmers through multi-dimensional channels such as the internet, agricultural training, and village cadres' awareness campaigns.

Second, institutional trust and institutional regulation complement each other, while institutional trust and institutional supervision serve as alternatives in the decision-making process of green prevention and control of pest trusteeship. The results suggest that improving the governance strategy of trusteeship contracts requires a combination of various governance mechanisms and their interactions. Building a 'double insurance' model of 'institutional trust + unified contract' or implementing a monitoring mechanism involving village committees and other third-party supervision can be effective.

Lastly, as the demand for trust increases and trusteeship contracts become more diversified, promoting the transition from short-term to long-term contracts in green prevention and control of pest trusteeship requires intensified regulation and supervision of institutional constraints. Similarly, advancing from trust in acquaintances to organisational trusteeship necessitates strengthening both institutional trust and institutional regulation and supervision.

To the best of our knowledge, this study contributes to the existing literature in several ways. Firstly, it focuses on the participation issues related to smallholder farmers' land trusteeship models in China, and the dissemination of this experience can serve as a reference for agricultural modernisation in other countries with similar agricultural conditions. Secondly, the study explores the strength, interaction, and heterogeneity of the effects of social trust and institutional constraints on trusteeship decisions in the rapidly changing social structure of rural China. Lastly, methodologically, it addresses the lack of microdata analysis in existing studies on land trusteeship decision-making and provides empirical evidence on how to motivate farmers to participate in land trusteeship.

Besides important contributions to theory and practice, the present study also has some limita-

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tions. First, this study does not fully explore the role of farmer heterogeneity in the impact of trust evolution and institutional constraints on land trusteeship decisions. The stratification of Chinese farmers is not only evident in their levels of part-time employment but also in terms of the cultivation scale and social capital. One important future research direction is the impact of the heterogeneous endowments of farmers beyond part-time employment on the relationship between trust and land trusteeship decisions. Second, the study is based on a cross-sectional design, and the data of farmers are from a single point in time. Future studies may use longitudinal designs to increase the generalizability of the empirical findings.

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