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Title: Social Capital and the Effectiveness of Land Use Policies: Evidence from Rural China

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Social Capital and the Effectiveness of Land Use Policies: Evidence from Rural China

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Abstract:

This paper investigates the relationship between the three forms of social capital, i.e., social norms, social network, and trust, on the effectiveness of land use policies. Both long-term and short-term policy outcomes are considered in the proposed analytical framework. Benefiting from a comprehensive household survey dataset from 17 provinces in China, we adopt multiple measurements for each of the social capital forms and policy outcomes in the empirical investigation. We use a specific land use policy (i.e., reform to confirm, register, and certify rural land rights) as a natural experiment to estimate the effect of social capital. By revealing the complex relationship between various forms of social capital and a wide range of policy outcome measurements, our empirical findings confirm the validity, reliability, and tractability of the proposed analytical framework. Policy implications are also derived regarding how to utilise social capital to improve the effectiveness of land use policies.

1. Introduction

Property rights formalization is an important way of converting assets to capital to fuel development (De Soto, 2000). The land market reform in China is a good example to support this thesis. The 1986 Constitution sets the stage for land-use rights transactions, and local governments promptly responded by leasing out land-use rights to the private sectors. Throughout the 1990s, the proportion of land-use rights income in local governments' fiscal revenue climbed steadily, and has been around 50% since 2003 (Xu, 2019, Figure 4, Page 5). Leveraging land finance[4], local government was able to provide necessary infrastructure for economic development and urban expansion. As a result, China's economy has been growing at near double-digit rate for almost two decades, and the country has been urbanizing at an unprecedented pace.

This impressive achievement did not come without a price though. The land market reform in China also introduced a wide range of legal, social, and environmental issues, and land use policies are often at the centre of these problems. For example, although grassland use right leasing improves the technical efficiency of livestock grazing in Tibet (Huang et al., 2017), it causes serious degradation in ecosystem services in Inner Mongolia, China (Li et al., 2018; Li and Huntsinger, 2011); full scale land relocation practices have a significant negative impact on organic fertilizer usage in six provinces

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[4] Land finance in China is a much-debated topic that beyond the scope of this paper. For a good discussion on this subject, see Xu (2019).

in China (Bai et al., 2014); the redevelopment of brown fields in rural China is often complicated by land ownership of many stakeholders (Liu et al., 2014), and rural land tenure plays a crucial role in determining land-related investment, land rental market participation, and productivity and efficiency in agriculture (Ma et al., 2015b; Ma et al., 2020). Thus, the effectiveness of land use policies in China has attracted much scholarly interests.

Early studies on this topic shed insights on the role of local and central governments (see, for example, Feng et al., 2014; Jin et al., 2016; Yan et al., 2015; Zhao and Zhang, 2017). In the last decade, the focus has been switched to the most important stakeholder in land reforms in China, i.e., rural residents. This is because the belief, values, and attitudes of individuals at the receiving end of regulations and policies are pivotal for the effective implementation of land use policies. In particular, social capital, which is shaped by personal attributes and experience, is found to play a significantly positive role in encouraging farmers or herders to adopt environmental restoration or climate change adaptation schemes both in China (Ding et al., 2021) as well as in many other parts of the world, such as Australia (Moore et al., 2018), Indonesia (Saptutyningsih et al., 2020), Tanzania (Owusu et al., 2021), Ethiopia (Zeweld et al., 2020), and the U.S. (Yoder and Chowdhury, 2018). This points to a promising research frontier – behavioural land use policies, where interventions are neither monetarily incentivizing nor legally/regulatorily coercive, and hence tend to be more cost-effective with long-lasting effects (Bao and Robinson, 2022). A fast-growing body of literature in the environmental studies area has already demonstrated that behavioural interventions based on social capital are among the most effective (see the mata-analysis in Nisa et al., 2019). Both researchers and policymakers are interested in exploring the potential of leveraging social capital to enhance the effectiveness of land use policies.

This paper endeavours to move land use policy research in this direction. A review of the literature shows that most of the existing studies either cover a single form of social capital or adopt narrow measurements of policy outcomes. Although collectively these findings shed insights on the role of social capital on the effectiveness of land use policies, this is a lack of systematic investigation of all three forms of social capital (i.e., trust, social networks, and social norms, as defined in Putnam, 1993) on a comprehensive set of land use policy outcome measurements. We propose a conceptual framework to bridge this gap in the literature, and test our models by using a comprehensive data set obtained from a nationwide rural household survey in China. Our empirical strategy consists of several innovations, such as the use of multiple-item measurements for both social capital and policy outcome variables and the inclusion of a control group to isolate the net effect of social capital. Multiple instrumental variables are used to address endogeneity issues.

We draw to conclusions from the empirical investigation. First, the proposed analytical framework is capable of capture the complex relationship between social capital and land use policy outcomes. It is necessary to consider all dimensions of both construct in one unified framework. Failing to do so, researchers and policymakers are likely to be misled by findings affected by omitted variable bias and confounding effects. Our analytical framework is an important step to move this line of research forward. Second, the effects of social capital on land use policies are highly contextual; they vary greatly among different policy objectives and at different stages of policy evaluations. Our analytical framework can be used to obtain further empirical evidence

on other land use policies, and from other parts of the world. Collectively these studies will improve our understanding of the role of social capital in the public policy domain, and help promote sustainable urbanization and rural development through improving the effectiveness of land use policies.

The rest of the paper is organised as follows. The next section provides a systematic and critical review of related literature. Section 3 presents the conceptual framework and testable hypotheses. The design and implementation of empirical analysis are given in Section 4. Findings are discussed in Section 5, followed by conclusions and policy implications in Section 6.

2. Literature review

2.1 Social capital: definitions, forms, and measurements

According to the seminal work by Coleman (1988), social capital is created through changes in the relations among person that facilitate action. It is a collection of different entities that consist of some aspects of social structures, and facilitate actions of actors within the structure. There are three forms of social capital: 1) obligations, expectations and trustworthiness of structures, 2) information channels, and 3) norms and effective sanctions (Coleman, 1988). Putnam's version of this definition, which defines social capital as "features of social organization, such as networks, norms, and trust, that facilitate coordination and cooperation for mutual benefit" (Putnam, 1993, page 35), has been widely used in land use policy studies. We surveyed leading journals in the land and environmental studies areas, and identified 16 papers published between 2018 and 2021. Details of these papers are summarised in Appendix 1. We found that fourteen, or nearly 90%, of these 16 papers used Putman's framework. Therefore, the discussion in this section is organized around the three forms of social capital as defined in Putnam (1993) too.

Social network refers to social relations embedded in various types of social organisations and informal networks. They serve as communications routes to acquire and share important resources such as information or financial assistance. As a result, researchers often adopt two types of approaches to quantify social network. The first category uses the number of nodes and links of the network. For example, Saptutyningsih et al. (2020) asked respondents to report the number of relatives they have outside of their villages, and Tschopp et al. (2020) used farmers' affiliation with a producer organization as the social network variable in their studies. Alternatively, the amount of information/resources obtained from the network is also used as the measurement of social network. For instance, Gao et al. (2019) quantified the strength of social network by the total amount of money farmers spent annually on relatives, neighbours, and friends, Yoder and Chowdhury (2018) used farmer-to-farmer information sharing as the social network indicator in their studies. Among the paper surveyed in Appendix 1, twelve of them included social network, and the adoption of the two approaches among these papers is fairly even (i.e., 7 and 6, respectively).

Social norms govern people's behaviours through social sanction, peer pressure, among other 'unwritten social rules.' In Appendix 1, nine out of the 16 papers considered social norm as one form of social capital in their studies. As social norm is probably the most context specific dimension of social capital, it is not surprising to see a rather

wide range of social norm indicators in these studies, such as farmer's awareness of common goals (Zhou et al., 2018), peer pressure (Yoder and Chowdhury, 2018), participation in collective affairs (Tong et al., 2021), and social and media influence (Zeweld et al., 2020). The most commonly used approach is to measure the level of compliance to social norm, such as participating in activities expected by other community members and the willingness to accept punishment if one violates village rules or regulations (Moore et al., 2018; Saptutyningsih et al., 2020; Tong et al., 2021; Wang et al., 2021).

Trust is the confidence in others when facing risks and uncertainties. It is found to be indispensable for effective governance for both democratic and autocratic institutions (see, for example, Huhe et al., 2015; Lewis-Beck et al., 2014; Pesque-Cela et al., 2009). The trust question used in the World Values Survey (WTS), i.e., "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?" has been widely used for the purpose of measuring and comparing trust level. As much as an efficient way to compare trust level across countries, this question does not capture the context-specific and multi-faceted nature of trust (see the discussions in Tu et al., 2011). Even for studies of trust within a culturally homogeneous community, such as a city or a country, the convention is to break 'people' down into several categories, and measure the level of trust within these categories separately. A commonly used approach is to classify trust as generalized trust and particularized trust (Uslaner, 2002; Whiteley, 2000), where the former is found among people in general such as strangers and the latter in close social proximity such as relatives and friends. In the papers reviewed in Appendix 1, eleven papers included trust in their studies, the majority of which focused on particularised trust. There are only two papers considered both types of trust (Wang et al., 2021; Wu and Liu, 2020), and one paper used a simple 'trust in people' question for generalised trust only (Saptutyningsih et al., 2020).

Our literature review also shows that political trust, which the trust placed on institutions or political leaders, received significant attention in the land use policy literature, and especially in studies using data from China. Among the papers reviewed in Appendix 1, six studies considered political trust (Rao et al., 2020; Tong et al., 2021; Wang et al., 2021; Wu and Liu, 2020; Yoder and Chowdhury, 2018; Zhou et al., 2018). Most of these studies measured political trust at the local level, i.e., based on the trust in village cadres either individually (Rao et al., 2020; Wang et al., 2021) or collectively (Tong et al., 2021; Zhou et al., 2018). The general consensus is that high political trust will improve the effectiveness of land use policies by engaging individuals in the design and implementation of public policies. The findings are consistent with existing literature in more general fields, where evidences show that political trust has a significant impact on rural residents' participation in local governance (Huhe, 2014; Huhe et al., 2015; Pesque-Cela et al., 2009; Tao et al., 2011), support to government policies (Lewis-Beck et al., 2014), and the contribution to public goods (Tu et al., 2011).

2.2 The role of social capital in land and environmental policies

Our literature review reveals overwhelming evidence on the positive role social capital plays in the effective implementation of land and environmental policies.

The effectiveness of land and environmental policies are often assessed based on their outcomes, with either subjective or objective measurements. Subjective measurements are usually obtained from self-reported willingness to contribute to certain land or environment protection schemes (Saptutyningsih et al., 2020) or perceptions about land security (Gao et al., 2019; Rao et al., 2020). Objective measurements look at the intended outcome of land and environmental policies directly, such as whether farmers adopt organic manure (Yang et al., 2020), landowners keep their stock from grazing riverbanks (Moore et al., 2018), and villagers participate in land transfer scheme as promoted by the government (Ma et al., 2020; Wu and Liu, 2020).

Although the measurements of policy outcomes vary greatly among these papers, the conclusions all point in one direction: social capital affects both the implementation and the outcomes of land and environment policies. For example, Tong et al. (2021) found that social capital helped to save significant transaction costs in both the negotiation and developing process of land conversion in rural China; Owusu et al. (2021) showed that social capital has a positively impact on villagers' participation in a community-based forest landscape restoration scheme in Tanzania.

The effect of social capital, albeit significant, also vary greatly across study areas and within the three forms of social capitals. For example, Wang et al. (2021) identified significant differences in adopting climate change adaptation strategies between Chinese farmers with different types of social capitals; they even noted that a specific type of social network has a negative effect on the adoption. Similarly, Ma et al. (2020) found that kinship trust promotes land transfers, but non-kinship trust has the opposite effect. There is some evidence that trust has stronger effect than the other two forms of social capital (Saptutyningsih et al., 2020; Yang et al., 2020). However, because most of these studies did not include all three forms of social capital in one unified framework, it is not possible to know whether the difference is a result of omitted variable biases or the underlying relationship between social capital and policy outcomes. This is clearly a direction for future research.

In conclusion, our focused literature review shows that social capital is an integral part of land use policy studies. If leveraged correctly, social capital can be used by policymakers to implement land use policies efficiently, and to encourage and support sustainable land uses effectively. Although existing studies are helpful to understand the role of a specific form of social capital on narrowly defined policy outcomes, there is a need for a unified framework that captures both social capital and policy outcomes in their most general and comprehensive forms. To bridge this gap in the literature, we outline a conceptual framework in the following section, and conducted empirical investigation by using a large-scale survey data from 17 provinces in China.

3. Conceptual framework

We start with a general expression of the relationship between social capital and the effectiveness of land use policy as follows.

$$E = f(SC, X) , \tag{1}$$

where E and SC denote the effectiveness of land use policy and social capital, respectively, X is a matrix of control variables that affect E as well. Our literature

review suggests that the effect of social capital on the effective implementation of land use policy is non-negligible. Hence, we expect that $\partial E / \partial SC \neq 0$.

In order to estimate $\partial E / \partial SC$ reliably, we take stock from the literature, and adopt multi-dimensional measurements for both E and SC. First, our analytical framework includes all three forms of social capital, i.e., social network, social norms, and trust, by following the framework in Coleman (1988) and Putnam (1993). This is also in line with recent empirical investigations of environmental issues in rural China (see, for example, Gao et al., 2019; Tong et al., 2021; Wang et al., 2021). Moreover, we further divide trust into three categories: generalised social trust, particularised social trust, and political trust. Political trust can be classified as a type of particularised social trust or non-kinship trust, because it is often defined as the trust in local government official or village cadres in land use policy studies. Evidence shows that trust towards local cadres plays an important role in local governance in general (Cai et al., 2020; Tao et al., 2011; Tao et al., 2014) and in land use policies in particular (Rao et al., 2020; Tong et al., 2021). It is necessary to treat it as a separate category in order to isolate its net effect.

The effectiveness of land use policy is a rather complex construct. We take policy-takers' (e.g., farmers or landowners) perspective, and examine both short-term and long-term policy outcomes as the measurements of policy effectiveness. Short-term policy outcomes are directly linked to specific policy, such as whether farmers are satisfied with the implementation of a rural land protection scheme. We include both subjective and objective measurements for this type of policy outcomes. Specifically, policy-takers' satisfaction level towards the policy is used as the subjective assessment, and dis-satisfaction of policy-takers are measured by the actual number of disputes and complaints raised about the policy (i.e., objective measurement).

Long-term policy outcomes often cannot be directly linked to a specific land use policy, although they are the ultimate goal of these policies. For example, a government subsidy programme may encourage farmers to use organic fertilisers, which is the direct and immediate effect of the policy. If participating farmers keep the practice, they will experience an increase of productivity of their land, ceteris paribus. This will encourage them to make further long-term investment in their land, and likely to enhance their ability to invest in side-line businesses as well. In other words, effective land use policies can increase the confidence of farmers in their land and business, and ultimately encourage sustainable land uses and management. However, existing literature largely focus on immediate policy outcomes, such as the participation in environment or land reservation schemes. Long-term policy outcomes are rarely considered. We include two factors, i.e., investment in rural land investment in other agricultural businesses (side-line businesses) as the objective measurement of long-term policy outcomes.

Figure 1: Conceptual framework
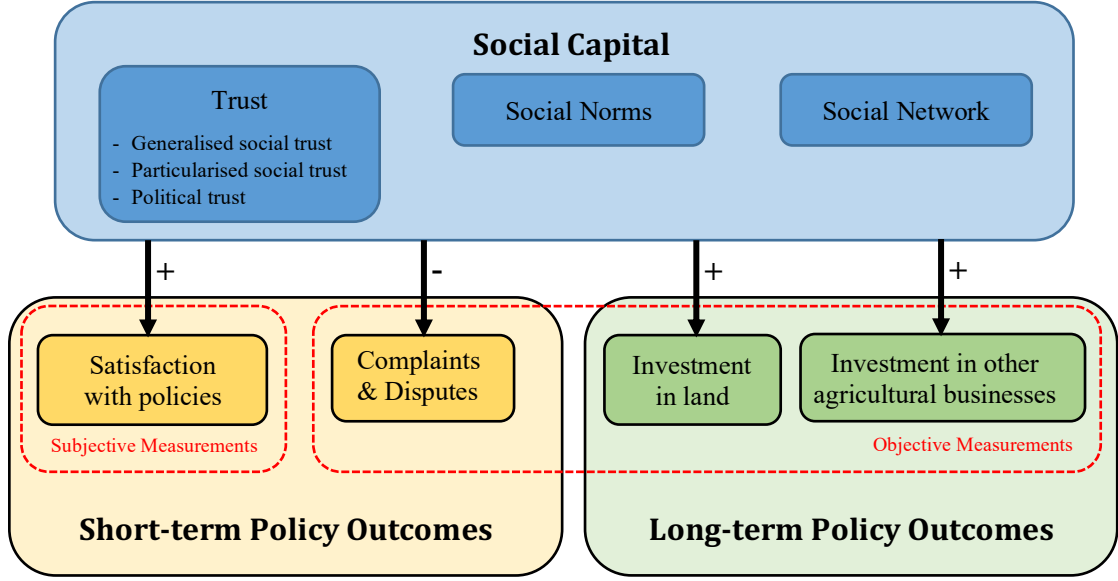
Our extension to the existing literature leads to an augmented version of equation (2) as follows.

$$E_k = f(Trust_m, Norm, Network, X) , \qquad (2)$$

where E_k (k = 1, 2, 3, and 4) represents the four types of policy effectiveness measurements, and $Trust_m$ (m = 1, 2 and 3) represent the three types of trust considered in the analytical framework. $Norm$ and $Network$ represent social norms and social network, respectively. According to the papers summarised in Appendix 1, we expect that the three forms of social capital have a positive impact on satisfaction with policies, investment in land, and investment in other agricultural businesses, and a negative relationship with land-related complaints and disputes. In other words, we predict that $\partial E_k / \partial Trust_m$, $\partial E_k / \partial Norm$ and $\partial E_k / \partial Network$ are positive when k = 1, 3, and 4, and negative when k = 2 (i.e., land-related complaints and disputes). The relationships between these variables are outlined in Figure 1. Empirical investigations of the analytical framework are discussed in the following sections.

4. Empirical Implementation

3.1 Survey design and implementations

We collect data by including a special module in the 17 Provinces Rural Land Survey administrated by Renmin University of China. The survey is a joint research project between the Renmin University of China (RUC) and the Rural Development Institute (RDI) in the US since 1999. A total of seven rounds of survey had been conducted since then, and our data are obtained from the latest round completed in 2016. A combination of multi-stage random sampling and convenience sampling was used in the survey. Villagers were interviewed in home visits without being noticed or the presence of village leaders. A total of 1,809 valid observations were collected in the last round of survey. The distribution of sample points is shown in Figure 2. On average, there are about 100 observations in each of the 17 provinces covered.

Figure 2 Distribution of sample points
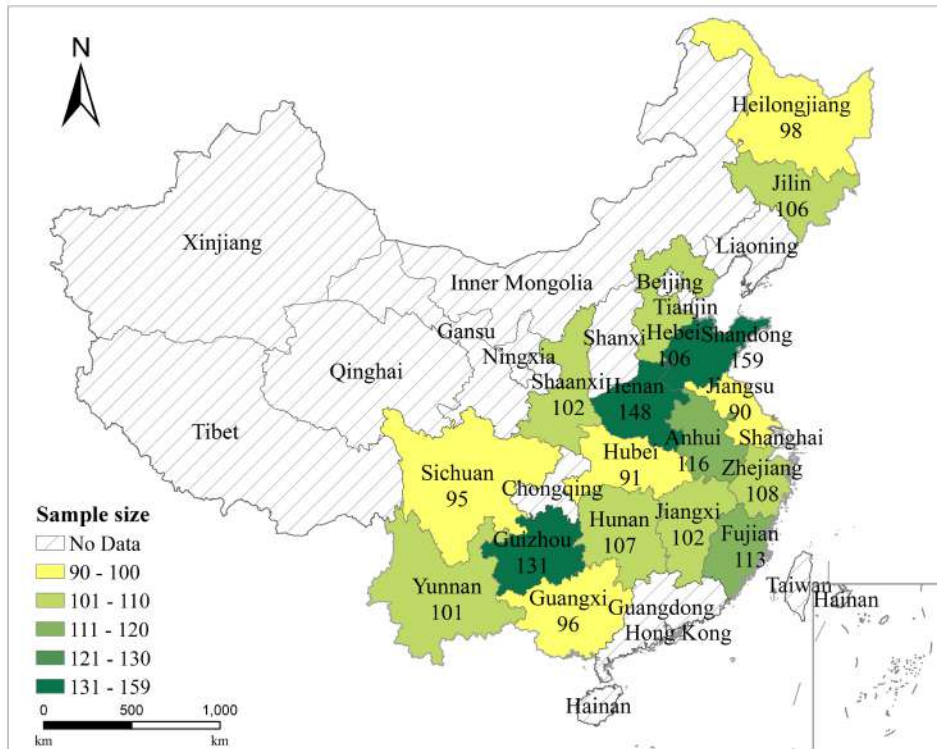
In Table 1 we present evidence of the representativeness of our sample. Specifically, the 17 provinces included in the survey covered 77% of the rural population and 72% of the arable farmland in China. There are also sufficient variations among the provinces included in terms of natural endowment, economic development, and human capital (i.e., education). Therefore, the survey data is reliable sample to investigate the relationship between social capital and the effectiveness of land use polices in rural China.

Table 1: Sample representativeness

Province	Land area in km²		Population in 10,000 (2019)		GDP in billion RMB (2020)	Number of students in higher education in 10,000 (2019)
	Arable Farming Land (2016)	Urban Land (2017)	Rural	Urban		
Included in the survey						
1. Heilongjiang	158,501	2,528	1,467	2,284	1,370	78
2. Henan	81,110	5,364	4,511	5,129	5,500	232
3. Shandong	76,069	23,206	3,876	6,194	7,313	218
4. Jilin	69,934	6,483	1,123	1,568	1,231	70
5. Sichuan	67,329	8,610	3,870	4,505	4,860	166
6. Hebei	65,205	6,309	3,218	4,374	3,621	147
7. Yunnan	62,078	3,204	2,482	2,376	2,452	86
8. Anhui	58,675	6,355	2,813	3,553	3,868	124
9. Hubei	52,453	8,186	2,312	3,615	4,344	150
10. Jiangsu	45,711	15,536	2,372	5,698	10,272	187
11. Guizhou	45,302	3,651	1,847	1,776	1,783	77
12. Guangxi	43,951	5,814	2,426	2,534	2,216	108
13. Hunan	41,487	5,103	2,959	3,959	4,178	141
14. Shaanxi	39,895	2,431	1,572	2,304	2,618	112
15. Jiangxi	30,822	2,941	1,987	2,679	2,569	113
16. Zhejiang	19,747	12,422	1,755	4,095	6,461	107
17. Fujian	13,363	4,138	1,331	2,642	4,390	86
Subtotal (% of national total in parentheses)	971,633 (72%)	122,282 (61%)	41,921 (77%)	59,285 (69%)	69,046 (68%)	2,204 (73%)
Not included in the survey						
1. Inner Mongolia	92,579	5,082	931	1,609	1,736	47
2. Gansu	53,724	1,978	1,363	1,284	902	53
3. Xinjiang	52,165	2,281	1,214	1,309	1,380	43
4. Liaoning	49,745	12,895	1,388	2,964	2,512	104
5. Shanxi	40,568	3,164	1,508	2,221	1,765	80
6. Guangdong	26,076	16,079	3,295	8,226	11,076	205
7. Chongqing	23,825	7,660	1,037	2,087	2,500	83
8. Ningxia	12,888	952	279	416	392	14
9. Hainan	7,227	1,479	385	560	553	21
10. Qinghai	5,894	696	271	337	301	7
11. Tibet	4,446	632	240	111	190	4
12. Tianjin	4,369	2,640	258	1,304	1,408	54
13. Beijing	2,163	16,410	289	1,865	3,610	60
14. Shanghai	1,907	6,341	284	2,144	3,870	53
Subtotal	**377,577**	**78,288**	**12,742**	**26,437**	**32,195**	**828**

3.2 Measurement of Policy Outcomes

We focus our survey questions on one specific land use policy, i.e., the reform to confirm, register, and certify rural land rights (CRC policy hereafter), to reliably isolate the effect of social capital. In China rural land is jointly owned by collectives; farmers have the rights to use and profit from their contracted land from their collectives. While cities have been expanding both in size and in density since its economic reform in the 1980s, significant number of rural residents migrated to cities for jobs and other opportunities that are not available in their hometowns. This supply of low-cost and mobile labour force is one of the most important drivers of China's impressive economic development in the last decades. Nevertheless, while farmers worked and lived in cities, their contracted land was often neglected, resulting many under-utilised,

under-invested, or even abandoned farmland scatter across the country. The central government recognised that this challenge is also an opportunity to encourage the consolidation of segmented land parcels, a problem that is particularly pronounced in villages with high population density and smaller contracted land parcels. For example, if migrant farmers could lease out their unused or under-used contracted land to either individuals or companies, economy of scale could be achieved by consolidating scattered land into larger plots and subsequently by adopting modern agriculture machineries.

This is essentially a land titling policy to enhance land tenure security. The rural land use rights confirmation, registration, and certification policy was designed with this objective in mind. The policy was rolled out between 2013 and 2018 in five phases, primarily targeting contracted farming land. Our survey covers 17 out of the 22 provinces included in the first three stages (i.e., between 2013 and 2016). We assess the effectiveness of this land use policy in both the subjective and the objective aspects.

For subjective measurements, we elicited rural residents' general satisfaction on the scheme. To improve the validity of the questions, we used different wordings, i.e., 'satisfaction' and 'dissatisfaction', in multiple questions. Specifically, we have one questions asking the respondents how satisfied they are in general about the scheme (*sat*) and several questions about whether they are unhappy about any of the important aspects of the scheme, such as whether farmers' inputs were sought and valued. The list of questions can be found in the first panel of Table 3. We then used factor analysis to group answers to these questions into two categories, i.e., dissatisfaction about communication (*dissat1*) or procedures (*dissat2*) of the scheme. The factor loadings of these two variables can be found in Table 2.

Although public sectors and sociologists use satisfaction routinely in evaluating public services and policies, this subjective measurement may not reflect actual performance of public services or policies, and the difficulty in conceptualisation of problems can complicate the use of subjective assessment in evaluation as well. Objective measurements, on the other hand, reflect established facts and helps in isolating the net effect of trust on policy effectiveness. To overcome the limitations of subjective measurements, we supplemented subjective measurements with three sets of objective measurements as described below.

We firstly focus on villagers' investment in their contracted land. In the face of long lag and irreversibility of investment in land, rural households need secure property rights to protect their investments (Tu et al., 2011). Theories and practices suggest that villagers would invest in farming and land capability if their perceived land tenure security has been improved. As the land policy under study is designed to improve land tenure security, one of the tangible outcomes of this policy should be an increase of rural land investment. Therefore, our first objective measurement of policy outcomes is the level of investment in their contracted land. A multiple choices question asks farmers whether they have made investments in their contract land in seven areas, such as irrigation system or machineries. We use factor analysis to group answers to these questions into two categories: traditional (*Inv_land1*) and risky (*Inv_land2*) land investment. This classification helps to determine whether social capital plays different roles in conservative (i.e., traditional) and risky (i.e., risky) investments.

We then turn our attention to rural residents' rural subsidiary farming business (such as greenhouse and poultry). We included seven sub-categories for rural subsidiary businesses as shown in Table 2. Farmers were asked if they have made investments in any of these seven sub-categories in the last three years. The answers to these questions were classified into two groups by factor analysis: fixtures (such as trellis or plastic-covered tunnels) and cash crops/livestock (such as fruits trees and poultry). Similar to the classification of land investment, this approach helps to determine the roles of trust in conservative (i.e., fixtures) and risky (i.e., cash crops/livestock) investments. We name these two variables as *Inv_sub1* and *Inv_sub2*, respectively.

The last objective measurement deals with disputes about the decisions made by local village cadres. If local government implemented the policy effectively and efficiently, villagers' concerns should have been addressed sufficiently, and the incidence of disputes should have been reduced to minimal. To quantify this policy outcome, we have one question to ask respondents whether they disputed about the preliminary decisions and the final decisions regarding the determination and certification of their contracted land rights (*disp1*), and another question to ask respondents whether any other members of their villages have the same problems (*disp2*).

In summary, there are a total of nine dependent variables in our analysis, of which six are derived from multiple survey questions through factor analysis. This combination of both subjective and objective dependent variables enables us to capture the multiple dimensions of policy outcomes effectively and reliably. Descriptive statistics of these variables are given in Table 3.

Table 2: Variables generated by factor analysis

Dissatisfaction about land use policies	Communication (*Dis_comm*)	Procedure (*Dis_proc*)
What are the complaints about?		
The reasons to implement the policies are not clear	**0.646**	-0.408
Farmers' options were not heard	**0.588**	0.267
Lack of transparency	**0.752**	0.194
The process is not fair	**0.594**	0.448
The work was not professionally done	0.140	**0.739**
Disputes were not handled properly	0.074	**0.721**

Investment in land	Traditional (*Inv_land1*)	Risky (*Inv_land2*)
Have you made any investments in any of the followings in the last three years?		
Irrigation and drainage system	**0.653**	0.347
Land levelling	**0.683**	0.326
Farming machineries	**0.762**	0.269
Imported or composite fertilisers	**0.801**	0.023
Imported seeds	**0.614**	0.172
Farmyard manure	**0.807**	0.247
Organic farming	0.222	**0.839**
Implement new production standards (technology innovations)	0.126	**0.887**

Investment in subsidiary farming	Fixtures (*Inv_sub1*)	Cash crops/livestock (*Inv_sub2*)
Have you made any investments in any of the followings in the last three years?		
Greenhouse	**0.329**	0.297
Plastic-covered tunnel	**0.842**	0.002
Trellis for grapes and similar corps	**0.804**	-0.011
Fishery	-0.078	**0.707**
Cash crops (e.g., fruits, tea trees, and flowers)	-0.009	**0.483**
Livestock (e.g., poultry)	0.083	**0.65**

	Particularised trust (*T_particularised*)	Political trust (*T_political*)	Generalised trust (*T_generalised*)
Social trusts			
Trust in relatives	**0.725**	0.092	-0.042
Trust in neighbouring villagers	**0.824**	0.169	0.071
Trust in non-neighbouring villagers	**0.823**	0.104	0.286
Trust in villagers of the same surnames	**0.833**	0.136	0.234
Trust in villagers of different surnames	**0.774**	0.152	0.356
Trust in strangers	0.143	-0.006	**0.948**
Trust in Village Cadres in general	0.246	**0.809**	0.119
Respect in Village Cadres	0.114	**0.87**	0.033

Note: Varimax method is adopted for orthogonal factor rotation

Table 3: Variable Definitions and Descriptive Statistics

Variable	Description	Mean	Std. Dev.	Min	Max
Dependent variables					
Satisfaction					
sat	Are the villagers in the village satisfied with the recent registration of rights? Strongly support=5, Strongly disagree=1	3.648	0.935	1	5
dissat1*	Complaints about the communication with farmers during the reform	0	1	-1.156	9.384
dissat2*	Complaints about the procedures of the reform	0	1	-4.56	7.513
Dispute					
disp1	Has your family confirmed the results of the survey on the right of contracted land? = 1 if denied, and 0 otherwise	0.016	0.125	0	1
disp2	Do any villagers in the village have disagreement on the results of the land ownership confirmation survey? None=1, a few =2, and many =3.	1.242	0.600	1	3
Investment					
inv_land1*	Investment in land - conventional	0	1	-2.229	5.591
inv_land2*	Investment in land - risky	0	1	-1.390	9.267
inv_sub1*	Subsidiary investment - conventional	0	1	-1.044	10.022
inv_sub2*	Subsidiary investment - risky	0	1	-0.778	9.506
Social capital variables					
Trust					
trust_p*	Particularised trust	0	1	-3.661	2.791
trust_vc*	Political trust	0	1	-2.271	2.044
trust_g	Generalised trust	0	1	-1.447	3.845
Social Network					
network	Did you borrow from friends, relatives, or private lenders to finance any of your investment in either land or subsidiary investments? (Counts of choices from two multiple choice questions)	0.098	0.490	0	4
network_land	Did you borrow from friends, relatives, or private lenders to finance any of your investment in land investments? (Counts of choices from a multiple-choice question)	0.039	0.247	0	3
network_sub	Did you borrow from friends, relatives, or private lenders to finance any of your investment in subsidiary investments? (Counts of choices from a multiple-choice question)	0.059	0.298	0	2
Social Norm					
norm_sub	The ratio of people who have subsidiary investments in the same city	0.156	0.176	0	1
norm_sub1	The ratio of people who have subsidiary investments (conventional) in the same city	0.049	0.117	0	1
norm_sub2	The ratio of people who have subsidiary investments (risky) in the same city	0.114	0.152	0	1
norm_land	The ratio of people who have made land investments in the same city	0.142	0.172	0	1
norm_land1	The ratio of people who have made land investments (conventional) in the same city	0.142	0.172	0	1
norm_land2	The ratio of people who have made land investments (risky) in the same city	0.024	0.051	0	0.333
Control variables					
Policy implementations indicators					
Prioritisation	Do people in your village know that the state now is running the registration and issuance of rural land rights? most =3, some =2, few =1	2.409	0.899	1	3
Communication	When land registration is confirmed, has the village held a publicity meeting? twice = 3, once =2, no =1	1.912	0.884	1	3
Procedure	How were land area and location measured when the rights were confirmed? Aerial photography =3, survey =2, no measure =1	2.203	0.691	1	3
Demographic factors					
female	=1 if female, and 0 otherwise	0.228	0.420	0	1
age	Age in years	53.734	12.285	5	88
edu	Education attainment in years	7.048	3.468	0	25
hhn	Household size	4.105	1.692	0	9
Economic factors					
lgar	Area of arable land in mu, 1 mu = 667 m2 (natural log transformed)	1.667	0.808	0	8.987
lginc	Household income in thousands RMB (natural log transformed)	9.537	2.385	0	15.607
hhinf	Proportion of farming income in household income	2.386	1.693	1	5
jobf1	Blue collar workers	0.357	0.479	0	1
jobf2	Village cadres/Manager	0.050	0.219	0	1
jobf3	Teacher/Doctor/veterinarian	0.020	0.141	0	1
jobf4	White collar workers	0.016	0.126	0	1
Regional factors					
sub	= 1 if suburban village (closer to cities), and 0 otherwise	0.088	0.283	0	1
province dummies	dummy variables for the 17 provinces covered in the survey	NA	NA	0	1
Instrumental Variables					
avg_ttp	IV for trust_p, the mean of the other respondents' particularised trust scores in the same city	0.0004	0.466	-1.08	1.523
avg_ttvc	IV for trust_vc, the mean of the other respondents' political trust scores in the same city	0.0002	0.422	-1.391	1.134
avg_ttg	IV for trust_g, the mean of the other respondents' generalised trust scores in the same city	0.0001	0.455	-1.230	1.720

*: variables generated by factor analysis based on multiple responses.

3.3 Measurement of Social Capital

We include the three dimensions of social capital, i.e., social network, social norms, and social trusts, in our analytical framework. To measure social network, we use questions that asked respondents whether they borrowed money from their personal network (i.e., relatives, friends, or other informal lenders) to finance their investments in land or subsidiary businesses. This is similar to the approach to measure social network in (Gao et al., 2019). In rural China, these informal borrowings have been positively related to the size and quality of personal network (Lin et al., 2019; Sun et al., 2018), and hence a good measurement of social network. Although this approach restricted our sample size (i.e., only 17% of the respondents in our survey had invested in land or subsidiary businesses), it is a 'revealed' strength of social network instead of a 'stated' one, as commonly used in the literature. Therefore, overall, it is a reliable measurement of social network.

For social norm, we calculate the proportion of farmers who invested in either their contracted land or subsidiary farming businesses in the same municipal area. These variables are used as proxies of social norm in terms of farming practice. Similar to the approach of measuring social network, this measurement has the limitation of focusing on the subsample with land or subsidiary farming businesses only. However, the relatively objective and quantitative information can reduce measurement error. It also has the benefit of being specific to the type of policy outcomes under study (i.e., investments in contract land and subsidiary businesses). Hence, it facilitates the isolation of the net effect of social norm reliably.

We developed multiple questions to measure social trust by following the framework in Huhe et al. (2015). We ask each respondent "Generally speaking, you have a full trust in the people of the following categories?" There are seven groups of people included in these questions: relatives, neighbouring villagers, non-neighbouring villagers, villagers of the same surnames, villagers of different surnames, strangers, and village cadres. The 'strangers' subgroup is used to gauge generalised trust; the 'village cadres' group is used to measure political trust; whilst the rest of the groups are used to measure particularised trust. Given the important role of political trust in our analysis, and the sensitivity of the question, we also included an alternative, indirect measurement of political trust: 'how much respect do you have toward the village cadres in your village?'. We then used factor analysis to generate three variables for generalised, particularised, and political trust, respectively.

Table 4 reports the descriptive statistics of trust measurements. Overall, rural residents are more likely to trust acquaintances than strangers. The level of generalized trust is considerably low as indicated by the average score of 1.70 for the trust of strangers. These implications derived from the distribution of the level of social trust in rural China echo those in Huhe et al. (2015). Meanwhile, there are considerable variations in all three dimensions of social capital among the 17 provinces, as shown in Figure 3. Therefore, it is important to understand how social capital affect the effectiveness of land use policies.

Table 4: Trust in rural China: Descriptive Statistics

| Questions	Strongly disagree (=1)	Disagree (=2)	Neutral (=3)	Agree (=4)	Strongly agree (=5)	Mean score	Standard deviation
1.Trust in relatives	16	89	398	674	692	3.80	1.15
2.Trust in neighbouring villagers	23	150	626	717	353	3.32	1.14
3.Trust in non-neighbouring villagers	48	274	940	496	111	2.73	1.06
4.Trust in villagers of the same surnames	43	203	903	549	171	2.90	1.09
5.Trust in villagers of different surnames	71	321	948	415	114	2.62	1.10
6.Trust in strangers	766	759	267	66	11	1.03	1.06
7.Trust in Village Cadres in general	231	368	563	465	242	2.58	1.51
8.Respect in Village Cadres	259	285	511	543	271	2.69	1.56

Figure 3 Regional variations of trust
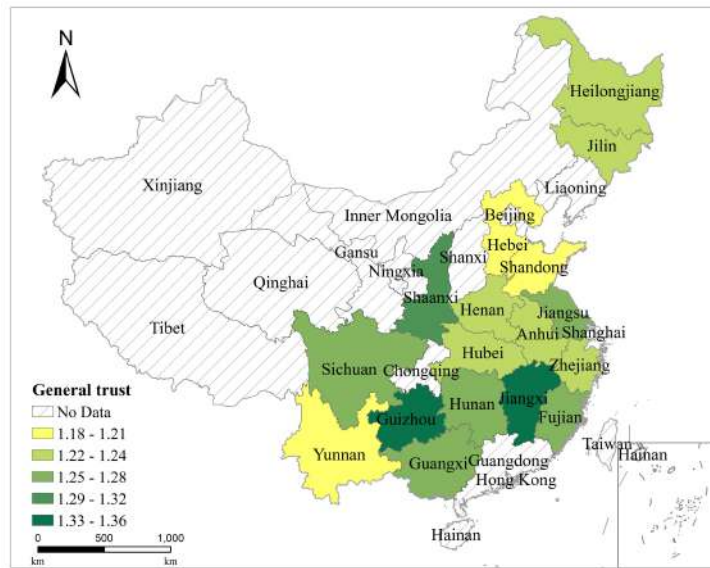
Panel A: Average value of general trust by province
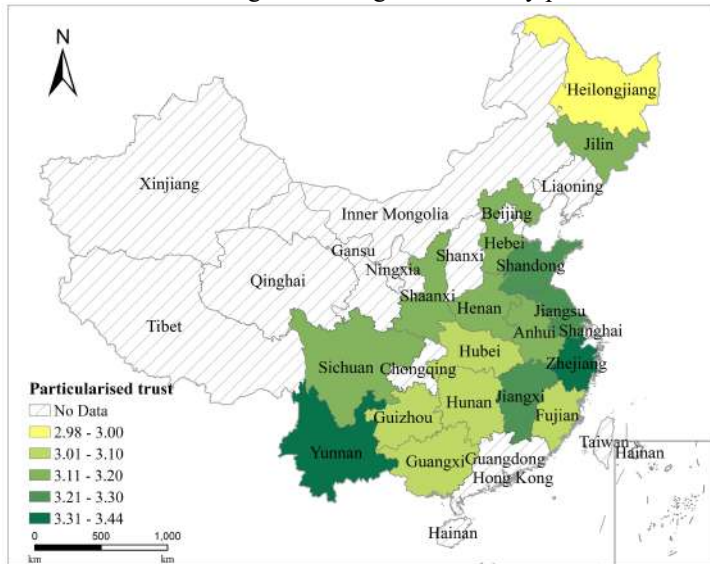
Panel B: Average value of particularised trust by province
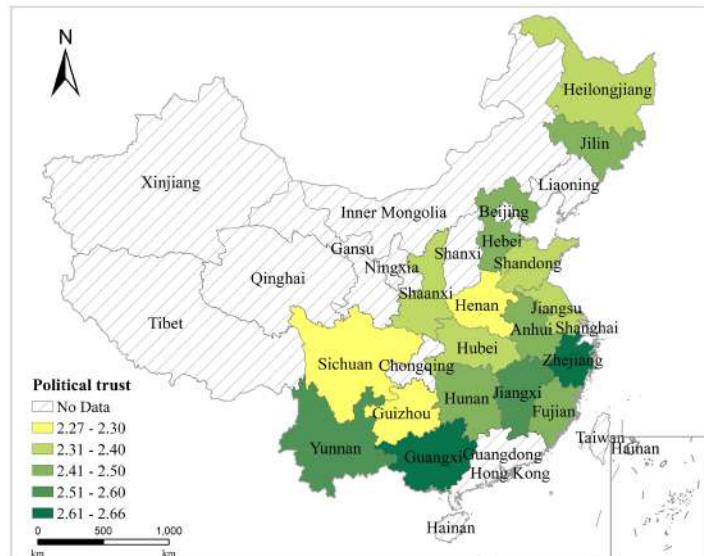
Panel C: Average values of political trust by province

3.4 Control variables

To isolate the net effects of social capital on the scheme's performance, we incorporate four sets of control variables to reduce omitted variable biases. The first set of control variable are policy implementation indicators, quantifying how the scheme was administrated in three questions. The first question checks whether the respondent knows that the scheme is a national policy, which is always treated as a priority by both villagers and local governments. The second question measures the number of public meetings that were held to provide villagers with information about the scheme. The last question focuses on an important technical aspect of the scheme, i.e., how the size and the location of contracted land parcels were determined (aerial photograph, survey, or without field verification). Generally speaking, field verification with modern technology such as aerial photography is considered to be fair and reliable by villagers and consequently could reduce the possibility of disputes significantly. The answers to these three questions inform us about whether local governments emphasised the importance of the policy, provided sufficient information about the scheme, and adopted reliable methods to implement the policy, all of which could enhance the effectiveness of the policy. We derive three variables, namely, *Prioritisation*, *Communication*, and *Procedure* based on these three questions, respectively.

The second set of control variables are demographic factors. This includes gender (*female*), age in years (*age*), education attainment in years (*edu*), and household size (*hhn*). We also considered socio-economic factors that can potentially affect policy outcomes. For example, the size of contracted farmland in each household (*lgar*), annual household income (*lginc*), the proportion of household income coming from main farming business (*hhinf*), and the nature of any part-ime off-farm occupations such as blue-collar jobs (*jobf1*), village cadre/manager (*jobf2*), teacher/doctor/veterinarian (*jobf3*), or white-collar jobs (*jobf4*).

Finally, we include control variables to account for regional variations among the large number of provinces considered in our study. Specifically, we include a dummy variable *sub* that equals one if the village is located within 5 km of the town or city centre. We also added province dummies to control for unobserved regional variations among the provinces. The definition and descriptive statistics of these control variables can be found in 'Control variable' panel in Table 3.

3.5 Econometric models

We estimated regression models separately with each of the nine policy outcome variables as the dependent variable. The general model specification is as follows.

$$Y_k = \beta_0 + \beta_1 trust_g + \beta_2 trust_p + \beta_3 trust_{vc} + \boldsymbol{S\delta} + \boldsymbol{N\varphi} + \boldsymbol{X\theta} + \varepsilon \qquad (2)$$

In Equation (2), Y_k is one of the dependent variables listed in the first panel of Table 3. $\boldsymbol{X}$ is a matrix of the control variables as discussed in the previous section. $trust_g$, $trust_p$, and $trust_{vc}$ are the measurement of generalised, particularised, and political trust, respectively. $\boldsymbol{S}$ and $\boldsymbol{N}$ consists of one or several measurements of social norm or social network, respectively. The specification of $\boldsymbol{S}$ and $\boldsymbol{N}$ is determined by the dependent variable of the regression model. For example, when risky investment in contracted land (*inv_land2*) is the dependent variable, the variables included in $\boldsymbol{S}$ and $\boldsymbol{N}$ are *network_land*, and *norm_land1* and *norm_land2*, respectively.

There might be a reverse causality relationship between policy outcomes and social trust, because households with positive experience with the scheme are likely to report a higher level of social trust. In other words, trust is likely to be endogenous, as suggested in other similar studies on social trust (see, for example, Zhai, 2021). Following the practice in the literature, we adopted the two-stage instrumental variable (2SIV) approach and used proxies of land tenure securities as IVs. Specifically, Rao et al. (2020) introduce the average level of trust in the same area (jurisdiction) as an instrument for measuring social trusts at the individual level. As the aggregate level of social trust is associated with the individual level trust but not directly related to individuals' experience of policy implementation, such IV strategy is proved to be valid in the study of social trust in land policies (Ma et al., 2015a; Rao et al., 2020). The three proxies are defined as the mean of the other respondents' trust in the same city. For example, for generalised trust (*trust_g*), the *avg_ttg* is defined as $avg\_ttg_i = \frac{\Sigma_{j \neq i}^{n} ttg_j}{n-1}$, where $i, j \in N^k$ and N^k denotes all the samples in the *k*-th city.

5. Empirical findings and discussions

The coefficient estimates from the first stage of the 2SIV is reported in Table 5. We found significant relationship between the three trust variables and their IVs. The results of the second stage of the 2SIV estimation are given in Tables 6 and 7. The White heteroskedasticity-robust standard errors are used to address heteroskedasticity issues.

5.1 Social capital and short-term land use policy outcomes

In Table 6 we reported results for models with five short-term measurements (i.e., *sat*, *dissat1*, *dissat2, disp1*, and *disp2*) land use policy outcomes as the dependent variables. The R-squared of these models is between 0.078 and 0.241. This is largely in line with the literature, and consistent with the notion that satisfaction is complex and difficult to model. For example, in Mouratidis (2020)'s investigation of neighbourhood satisfaction, the linear regression models returned R-squares between 0.048 and 0.161. Similar results are found in studies of both specific aspect of satisfaction (i.e., residential satisfaction in Ren and Folmer, 2017) and general subjective wellbeing (Tauseef, 2021).

Because the measurements of short-term policy outcomes capture the effect of the policy directly, the potential influence of confounding factors is reduced significantly. The results in Table 6 suggest that political trust, i.e., the trust towards village cadres, this the most important type of social capital determining the effectiveness of the rural land confirmation, registration, and certification scheme. Higher levels of *trust_vc* can significantly improve the general satisfaction of the scheme (*sat*), and reduce the occurrence of disputes (*disp1* and *disp2*) and complaints (*dissat1* and *dissat2*). The coefficient estimates of the generalised trust and particularised trust do not show clear patterns: most of them are statistically insignificant from zero except for the effect of generalised trust in the model for complaints about communications (i.e., the fourth model in Table 6). These findings support our decision to separate the trust towards village cadres from particularised trust, because it clearly carries special weight in the context of land use policies in China. We conclude that political trust is a very important dimension of social capital in the study of land use policy outcomes in China.

The effect of social network and social norm is less clear than that of political trust. Specifically, there is evidence that both social network and social norm can reduce

disputes and complaints in some areas but not in others. For example, stronger social network can reduce complaints about the communications of the scheme, but has no impact on complaints about the procedural aspects of the scheme. On the other hand, a stronger social norm on subsidiary business seems to dampen complaints about procedural aspect of the scheme, but not those about communications. Our conclusion is that the effect of social norm and social network is weak, but consistent with theory and the literature.

5.2 Social capital and long-term land use policy outcomes

Our second set of policy outcome variables measure some long-term outcomes of the rural land CRC policy. specifically, the dependent variables in the second group of regression models are farmers' investment in their contracted land and subsidiary businesses. As these group of questions were asked to farmers from areas that have implemented the scheme as well as areas that have not, our sample can be divided into a control group (i.e., villages that were not affected by the scheme) and a treatment group (i.e., villages that have implemented the policy at the time of the survey). Chow test analysis indicates that regression models should be constructed separately for the two sub-samples. Hence, we estimated a total of 12 models as shown in Table 7.

First, we estimated four models by using the full sample (labelled as models 1, 4, 7, and 10 in Table 7). The dependent variables in these four models are farmers investment in land and subsidiary business (i.e., their main and side businesses, respectively). For each type of investment, we also classify investments into conventional and risky categories as outlined in section 3.2. Overall, social trusts do not have an impact on farmers' decision to invest in their contract land or farming business in both categories considered. The coefficient estimates are all small and insignificant among the three types of social trusts. Meanwhile, the effects of social network and social norm are strong and consistent. The coefficient estimates of *network* range between 0.489 and 0.924, most of which are significant at the 1% level. Thus, social network encourages investments in both contracted land and subsidiary businesses.

The strongest impact of social capital comes from social norm. The more farmers in the same town engaging in conventional/risky investments in their contracted land, the more likely the respondent will make the same type of investments on their own. The opposite effect is observed on different type of investment. For example, if the proportion of farmers from the same city who had made conventional investments in their contract land increases by 1%, a respondent's conventional investment in his/her own land will increase by 2.535 (as measured by the score generated from factor analysis), whilst the risky investments in his/her contracted land will decrease by 0.658 (again, as measured by the score generated from factor analysis).

Two conclusions can be drawn from this set of results. First, the social norm of conventional and risky investments in either land or subsidiary rural businesses are not complements. They often compete for the same, limited resources, and are likely affected by different risk and time preferences. For example, farmers who are risk averse are less likely to engage in risky investments in their contracted land such as experimenting organic farming. Hence the opposite signs of coefficient estimate for conventional and risky investment social norm in each model. Second, and more importantly, the social norm of conventional and risky investments in land and subsidiary businesses are not complete substitute of each other either. This can be seen

from the absolute value of the social norm coefficient estimates in each model, i.e., the offsetting effect from the competing social norm is much smaller. For example, the social norm of conventional investments in subsidiary business has a positive and significant loading of 5.293 on the same type of investment, whilst the social norm of risky investment in subsidiary business is 0.407 (see model 7 in Table 7). This suggests there is ample room for improving both types of investments at the same time.

Next, we contrast the coefficient estimates of social capital variables in the 'control' and 'treatment' subsamples. As defined in section 3, these two subsamples were collected from villages that have not and have already implemented the CRC policy at the time of the survey. Therefore, the difference of social capital effects between the two groups is an indirect measurement of the effectiveness of the policy. To facilitate the discussions, we construct Table 8 to illustrate the absolute and relative differences of coefficient estimates between the two subsample models. In the first row of Table 8 we give the estimated direct effect of the CRC policy based on the intercept terms from subsample models. For example, farmers' conventional investments increased by 0.727 (i.e., [-0.354] – [-1.081] = 0.727 from models 2 and 3), or 67.25% (i.e., 0.727 / [-1.081] = 0.6725). The CRC policy led farmers to increase their investments in land (conventional only) and subsidiary investment (both conventional and risky). Given that the types of investment included in the risky investments category are "organic farming" and "implement new production standards (technology innovations)", it seems that the policy somehow discouraged investment in innovative methods of farming. We do not have enough data in our sample to further explore along this direction, and shall leave this interesting question to future studies.

We then turn our attention to the moderating effect of social network and social norm on the effectiveness of CRC policy. As show in Table 8, social network will further enhance CRC policy's positive effect on conventional investments in both land and subsidiary businesses, and aggravate its negative impact on risky investments in land. The moderating effect of social network on (risky) subsidiary investments is negligible. The results suggest that good social network or local support (particularly financial support) is helpful to achieve the policy's goal to increase farmers' investments in their contracted land through conventional means.

Finally, social norm helps to strike a balance in land investments. The offsetting effect of alternative investments is reduced by 61.35% and 46.45% in conventional and risky land investments, respectively. Meanwhile, the effect of social norm of the same type of investment remains largely the same between the treatment and the control group (i.e., a difference of 4.10% and 2.97%, respectively). During the implementation of the CRC policy, there were information dissemination meetings where possible alternative uses of land were discussed as policy outcomes of the reform. Therefore, it could help farmers to overcome the pressure of social norms (e.g., nobody has poultry, and I probably should not do so either). However, when it comes to subsidiary investments, the effect of social norm is more pronounced in the treatment group. Farmers are more likely to feel the push/pressure from the social norm of the same/alternative type of investments in subsidiary businesses. The conclusion is that the effect of social norm is to encourage farmers to do both conventional and risky investment in their contracted land at the same time, while choosing between conventional and risky investments in subsidiary businesses.

Table 5: 2SIV regression – first stage

	Dependent variable		
	trust_p	*trust_vc*	*trust_g*
avg_ttp	-106.232***	-0.088	0.674
avg_ttvc	-0.075	-106.688***	-0.342**
avg_ttg	0.503	-0.469**	-106.295***
network	-0.005	0	-0.02
norm_sub	0.01	0.016	-0.042
norm_land	-0.027	-0.034	-0.041
female	0.002	0.023	-0.013
age	0	0	0
edu	-0.002	0.003**	0
hhn	-0.001	-0.004	0.003
lgar	0.004	0.005	-0.002
lginc	-0.003**	-0.002	-0.001
hhinf	0.002	0.001	0.001
sub	-0.005	-0.033*	-0.015
jobf1	0.007	0	-0.008
jobf2	0.021	-0.013	0.005
jobf3	0.037	0.04	0.018
jobf4	0.016	0.004	0.024
Province dummies	Y	Y	Y
Intercept	8.002***	22.239***	-32.635***
N	1809	1809	1809
R^2	0.978	0.976	0.979

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 6: Social capital and satisfaction about land use policy

	Satisfaction (*sat*)	Complaints – communication (*dissat1*)	Complaints – procedures (*dissat2*)	Dispute – self (*disp1*)	Dispute – others (*disp2*)
trust_p (particularised trust)	0.019	**-0.013**	**-0.017**	-0.003	-0.012
trust_vc (political trust)	0.270***	**-0.141***	**-0.182***	-0.007*	-0.125***
trust_g (generalised trust)	0.004	**0.047***	**-0.024**	0.005	-0.004
network (social network)	0.082	**-0.149***	**0.199**	-0.009**	0.089
norm_sub	0.876	**-0.577**	**-1.068****	0.136	0.167
norm_land	-0.540	**0.457**	**0.843**	-0.135	-0.289
Prioritisation	0.198**	**-0.086**	**-0.248***	-0.015	-0.081*
Communication	0.190***	**-0.134***	**0.008**	-0.006	-0.047*
Procedure	0.070*	**-0.1**	**-0.109***	-0.016*	-0.037
female	0.095	**0.05**	**-0.094**	-0.018**	-0.074
age	0.004	**-0.004**	**0**	0.001	-0.001
edu	0.013	**0.018**	**-0.023**	-0.001	-0.007
hhn	-0.006	**0.03**	**-0.042**	0	0.032**
lgar	0.080**	**-0.032**	**-0.024**	0	-0.088**
lginc	-0.02	**0.014**	**0.008**	0	0.019
hhinf	-0.025	**-0.023**	**0.011**	-0.006	0.032
jobf1	0.025	**-0.073**	**0.106**	-0.006	-0.046
jobf2	-0.104	**-0.152***	**0.352***	-0.001	-0.027
jobf3	0.113	**-0.283***	**0.029**	-0.016	0.108
jobf4	0.112	**-0.321**	**0.045**	-0.008	-0.004
sub	-0.051	**0.115**	**-0.314***	0.03	-0.071
Province dummies	Y	**Y**	**Y**	Y	Y
Intercept	2.218***	**0.767**	**1.225***	0.094	1.497***
N	656	**656**	**656**	687	648
R²	0.241	**0.118**	**0.114**	0.078	0.139

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 7: Social trust and overall evaluation of the performance of the scheme

	Land Investment (conventional)			Land Investment (risky)			Subsidiary Investment (conventional)			Subsidiary Investment (risky)		
	Full sample	Before reform	After reform	Full sample	Before reform	After reform	Full sample	Before reform	After reform	Full sample	Before reform	After reform
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
trust_p (particularised trust)	-0.023	0.006	-0.051*	-0.011	0.017	-0.038	0.003	0.029	-0.033	0.022	0.042	-0.001
trust_vc (political trust)	0.004	-0.002	-0.003	0.004	0.007	0.011	-0.008	-0.023	0.010	0.047**	0.044	0.038
trust_g (generalised trust)	0.002	0.009	0.003	0.024	0.021	0.040	0.007	0.013	<0.001	-0.007	0.001	-0.018
network	0.984***	0.884***	1.183***	0.489*	0.658*	0.141	0.520***	0.392***	0.662**	0.866***	0.924***	0.914***
Social norm (conventional)[1]	2.535***	2.609***	2.502***	-0.658***	-0.788***	-0.422	5.293***	4.084***	5.386***	-1.262***	-0.838***	-1.416***
Social norm (risky)[2]	-0.808**	-1.110*	-0.429	6.150***	5.961***	6.138***	-0.407***	-0.302***	-0.727***	1.840***	1.705***	2.387***
female	0.029	0.102	-0.031	-0.019	-0.023	0.002	-0.074	-0.047	-0.086*	0.078	0.100	0.101
age	-0.001	0.001	-0.004	0.001	-0.001	0.003	0.001	0.002	-0.001	<0.001	0.002	-0.001
edu	0.011*	0.018**	0.004	0.012	0.024**	-0.004	0.006	0.013*	0.003	0.006	0.015	-0.006
hhn	0.026**	0.033*	0.024*	0.005	-0.005	0.018	0.003	-0.004	0.003	0.009	0.017	0.006
lgar	0.003	0.026	-0.027	0.001	-0.005	0.022	-0.02	-0.044	0.018	0.024	0.044	0.002
lginc	0.012	0.011	0.009	0.003	<0.001	0.010	0.012	0.018**	0.008	0.015**	0.007	0.024**
hhinf	0.054***	0.070***	0.031**	-0.009	-0.013	-0.008	0.020*	0.024	0.026*	0.012	0.013	0.005
jobf1	0.030	0.023	0.04	0.009	-0.024	0.063	-0.043	-0.027	-0.082	0.016	0.045	-0.006
jobf2	0.062	0.509	-0.066	0.060	-0.09	0.186	-0.059	-0.198*	0.01	0.140	0.301	0.133
jobf3	-0.217	-0.221***	-0.289	-0.117*	-0.212***	0.074	-0.155*	-0.361***	0.083	0.001	-0.125	0.065
jobf4	-0.234	-0.385***	-0.126	0.034	-0.061	0.136	-0.191**	-0.04	-0.447***	-0.042	-0.169*	0.143
sub	0.074	-0.067	0.239	0.007	0.029	-0.008	0.079	0.006	0.226	0.031	0.072	0.068
Province dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Intercept	-0.738***	-1.081***	-0.354*	-0.264*	-0.082	-0.531*	-0.396*	-0.433*	-0.319	-0.487***	-0.622**	-0.401*
N	1809	956	853	1809	956	853	1809	956	853	1809	956	853
R^2	0.332	0.265	0.429	0.125	0.167	0.113	0.468	0.174	0.672	0.2	0.212	0.24

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

[1] *norm_land1* is used in Model (1-6) while *norm_sub1* is used in Model (7-12). [2] *norm_land2* is used in Model (1-6) while *norm_sub2* is used in Model (7-12).

Table 8: Differences of coefficient estimates between control and treatment groups

	Land Investment (Conventional)		Land Investment (Risky)		Subsidiary Investment (Conventional)		Subsidiary Investment (Risky)	
	Absolute	**Relative**	**Absolute**	**Relative**	**Absolute**	**Relative**	**Absolute**	**Relative**
Direct policy effect	0.727	67.25%	-0.449	-547.56%	0.114	26.33%	0.221	35.53%
Moderating effects								
Social network	0.299	33.82%	-0.517	-78.57%	0.270	68.88%	-0.010	-1.08%
Social norm (conventional)	-0.107	-4.10%	0.366	-46.45%	1.302	31.88%	-0.578	68.97%
Social norm (risky)	0.681	-61.35%	0.177	2.97%	-0.425	140.73%	0.682	40.00%

Note: The formula to calculate the absolute and relative difference are $\beta_{Control} - \beta_{Treatment}$ and $(\beta_{Control} - \beta_{Treatment})/\beta_{Control}$, respectively. In these formulas, $\beta_{Control}$ and $\beta_{Treatment}$ are the coefficient estimates from the control and treatment group models in Table 7, respectively. The direct policy effect is calculated based on the intercept terms from the control and the treatment group models.

6. Conclusions

Social capital affects people's ability and willingness to adopt sustainable practices and to comply with environmental policies by reducing the costs of collecting information, mobilising financial resources, and overcoming psychological barriers. Although there are multiple case studies showing that all three forms of social capital, i.e., social norms, social network, and trust, helped the effective implementation of a wide range of land and environmental policies across the world, our literature review reveals that most of existing studies did not consider all three forms of social capital under one unified framework, and the empirical evidence was obtained from small samples and study regions. Our research design and empirical implementation address these issues in the literature, and our findings provide reliable estimation of the relationship between social capital and the effectiveness of land use policies.

From a methodological perspective, our analytical framework includes all three forms of social capital, breaks down trust into generalised, particularised, and political trust, and considers both short-term and long-term policy outcomes. Such a wholistic and comprehensive design could effectively reduce omitted variable bias and ameliorate confounding effects, both of which are challenging issues in land use policy studies. The model can be used to identify the effect of social capital on the effectiveness of land use policies in both developing and developed countries. It also has the potential to be modified to investigate the effectiveness of other types of environment policies, by adjusting the short-term and long-term policy outcomes accordingly.

On the empirical front, we push the frontier of this important research area in multiple ways. First, we adopted multiple measurements for each of the social capital forms and policy outcomes. In contrast, single-item measurement of social capital is common in the literature, and policy outcomes was almost always measured by one variable. Second, our sample size is nearly 2,000 and the sample covers 17 provinces in China. As shown in Appendix 1, all nine Chinese studies used data from one or two provinces in China. Hence, our findings are more likely to be applied to other parts of China and beyond. Third, we use a nation-wide land use policy as a natural experience to isolate the net effect of social capital on policy effectiveness. Previous studies rarely make

comparison between regions that are affected and unaffected by the policy under study. Consequently, it is possible that the effect of social capital is over-estimated. Our research design helps identify the moderating effect of social capital in this context. In conclusion, our empirical approach is a significant improvement over the existing literature, because such a systematic and comprehensive empirical strategy allows the reliable identification of social capital effects.

Our empirical findings have significant policy implications as well. We found that the effects of social capital are different on short-term and long-term policy outcomes. Therefore, policymakers should mobilise different types of social capital accordingly, such as focusing on political trust to improve the satisfaction about the policies, and provide additional support to villages with weaker social network to achieve better long-term outcomes. Nevertheless, the effects of social capital are highly context specific. Both existing literature and our findings show that social capital works differently as the characteristics of policy-takers, the measurement of policy outcomes, and the nature of the policies vary. Our findings about the complex relationship between social capital and conventional and risky land investments is a good example. Therefore, it is important to apply the analytical framework in this paper to other land use policies implemented in other parts of China and beyond. The collective knowledge from these studies will help to inform policymakers to design and implement land and environment policies effectively.

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Appendix 1: Summary of social capital studies in the land and environment policy area

No	Paper	Dependent variable	Social network	Social norm	Trust			Sample size	Study area	Study period
					Generalized	Particularized	Political			
1	Ding et al. (2021)	The effectiveness of Rangeland Ecological Protection Subsidy and Reward scheme	Yes					288	Qinghai. China	2019
2	Gao et al. (2019)	Family farms' adoption of green control techniques and land tenure security	Yes	Yes		Yes		433	Shandong and Henan Province, China	2018
3	Ma et al. (2020)	Participation in land transfer				Yes		787	Gansu and Jiangxi Province, China	2010-2011
4	Moore et al. (2018)	Compliance to government policies that encourage landholders to adopt environmental practices, such as excluding stock from grazing riverbanks.		Yes				93	Victoria, Australia	2013 - 2014
5	Owusu et al. (2021)	Participation in Community-based Forest Landscape Restoration	Yes					98	Babati District, Tanzania	2019-2020
6	Rao et al. (2020)	Perception of Land Tenure Security				Yes	Yes	352	Xinjiang, China	2008
7	Razafimahatratra et al. (2021)	Adoption of conservation agriculture	Yes					240	Madagascar	2015
8	Saptutyningsih et al. (2020)	Support for climate change adaptation: WTP for a monthly payment.	Yes	Yes	Yes			22	Yogyakarta, Indonesia	
9	Tong et al. (2021)	Land conversion and community development	Yes	Yes		Yes	Yes	9	Huanggang, Shenzhen, China	2018
10	Tschopp et al. (2020)	Adoption of sustainable silvopastoral practices	Yes					392	Dry Chaco in the Province of Salta, Argentina	2018
11	Wang et al. (2021)	Choice of climate change adaptation strategies for farmers	Yes	Yes	Yes	Yes	Yes	539	Qinghai-Tibetan Plateau, China	2017
12	Wu and Liu (2020)	Participation of farmland transfer			Yes	Yes	Yes	71	Chengdu, China	2015
13	Yang et al. (2020)	Adoption of organic manure	Yes	Yes		Yes		1116	Hubei Province, China	2018
14	Yoder and Chowdhury (2018)	Adoption of on-farm best management practices designed to reduce the total phosphorus loads.	Yes	Yes			Yes	34	Florida Everglades, USA	2014 - 2016
15	Zeweld et al. (2020)	Sustainable agricultural practices to enhance soil fertility, water retention capacity and agricultural productivity	Yes	Yes		Yes		350	Tigray region, Northern Ethiopia	2015
16	Zhou et al. (2018)	The way to use pesticides and fertilisers (chemical input) in vegetation production	Yes	Yes		Yes	Yes	192	Hebei and Zhejiang Province, China	2015

Note: Sample size is either the number of observations or the number of survey/interview units (e.g., households or farms) included.