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The Impact of Participatory Projects on Social Capital: Evidence from Farmland Consolidation Projects in Japan

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Farmland fragmentation can lead to low agricultural productivity. In Japan, one solution is Farmland Consolidation Projects (FCPs), participatory public projects that physically merge and reshape several small plots into one large plot. This paper examines the impact of FCPs on community-level social capital by using propensity score matching. We find that FCPs have a positive impact on agriculture-related bonding social capital and a negative impact on non-agriculture-related bridging social capital. Focusing on the constituent elements of bonding social capital, FCPs have a positive effect on the number of community meetings held, non-agriculture-related organizations for women, and management of common-pool resources. On the other hand, focusing on the constituent elements of bridging social capital, FCPs have a negative effect on holding direct sales of agricultural products and rural experience programs for city residents.

Keywords: Farmland Consolidation Projects; Participatory Projects; Social Capital; Impact Evaluation; Japan

JEL codes: O13, Q15

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1. Introduction

Promoting beneficiary participation through community development projects and local decentralization has become a central tenet of development policy (Mansuri and Rao 2012). Participation is expected to lead to better outcomes through better targeting of the poor, reduced project costs, improved project maintenance, and allocative efficiency (Labonne and Chase 2011). In addition, it is also expected that the projects themselves will enhance social capital [1] (SC) in beneficiary communities, and a lack of social capital is considered a major obstacle to economic development[2]. While there is ample literature on the effects of social capital in development projects, only a few studies analyze the impact of participatory development on social capital. The determinants of social capital thus remain poorly understood (Gugerty and Kremer 2002, Miguel et al. 2006). In particular, it is challenging to generalize about the institutional impact, as the projects vary widely in their contexts, objectives, design, and the nature and scale of activities (World Bank 2002, Casey et al. 2012). In each project area, the effects of participatory development on social capital have been mixed (Gugerty and Kremer 2002, World Bank 2002, Vajja and White 2008, Labonne and Chase 2011, Casey et al. 2012, Feigenberg et al. 2013).

In order to add to these previous studies, this paper explores the impact of Farmland Consolidation Projects (FCPs), a type of participatory project in Japan[3], on community-level bonding and bridging social capital. Bonding social capital is the ease with which farmers within a community act collectively, and bridging social capital is the ease with which these farmers act collectively with other community farmers or stakeholders.The main goals of FCPs include improving labor and land productivity by physically merging and reshaping several small plots of farmland into one large-scale plot. In most cases, irrigation canals and farm roads are improved as part of FCP implementation. FCPs are based on proposals from farmers in a rural community and implemented as a public project by the central or prefectural government, with the farmers' agreement[4]. FCPs not only improve agricultural productivity[5] but also encourage the holding of meetings about the future use of rural farmland within the project area during implementation. Therefore, FCPs are expected to cause the accumulation of bonding social capital through the process of landowners agreeing to project

[1] Although social capital has various definitions (Durlauf and Fafchamps 2005), we define social capital as the ease with which community farmers act collectively.

[2] See, for example, Woolcock (1998), Dasgupta and Serageldin (2000), and Grootaert and van Bastelear (2002).

[3] FCPs are one type of Farmland Improvement Projects, which have the purpose of developing agricultural production conditions.

[4] If more than two-thirds of landowners in the project area agree to project implementation, the project is implemented. Projects are funded mainly by the central government, with the remainder provided by prefectures, municipalities, and farm households.

[5] Existing studies have found that Farmland Consolidation Projects reduce production costs and working hours by increasing the size of agricultural machinery and facilitating farmland rental and outsourcing (Arimoto 2011, Kondo 1998, Kunimitsu 2008).

implementation and holding meetings regarding future land use. However, it is also possible for FCP implementation to deteriorate bonding social capital because the opportunities for collective action for irrigation maintenance and water allocation are reduced when irrigation canal maintenance schemes are simplified as part of the process. As such, FCPs might have positive or negative effects on bonding social capital. It is possible that FCPs also affect the accumulation of bridging social capital because they require cooperation with other communities and administrative bodies.

This paper explores the impacts of FCPs on rural community-level bonding and bridging social capital in Japan. We use community-level data drawn from the *Rural Community Card, World Census of Agriculture and Forestry*. This survey contains information on a broad range of community-level agricultural and social capital measures. To explore the impacts of FCPs on bonding and bridging social capital, we employ propensity score matching estimates. We craft proxy variables for bonding social capital and bridging social capital from variables representing interactions within communities, between communities, and with other organizations. Our findings show that FCPs have a positive impact on agriculture-related bonding social capital and a negative impact on non-agriculture-related bridging social capital. Considering the constituent elements of bonding social capital, FCPs have a positive effect on the number of community meetings held and the management of common-pool resources, such as irrigation canals and common facilities in the project area. Thus, FCPs are not only improving agricultural productivity, as pointed out by existing research, but also revitalizing community activities through the accumulation of bonding social capital. On the other hand, FCPs have a negative effect on some constituent elements of bridging social capital, namely holding direct sales of agricultural products and festivals for city residents.

The rest of this paper is organized as follows. In Section 2, we offer an overview of the relationships between FCPs and social capital in rural areas of Japan. Section 3 describes the evaluation strategy and the data used. Section 4 then presents empirical results, while the final section summarizes, offering concluding remarks.

2. Farmland Consolidation Projects and Social Capital

2.1 Farmland Consolidation Projects

Two key causes of low productivity in Japanese agriculture are farmland fragmentation and the smallness of plots[6]. Economies of scale are not achieved on operationally smaller farms, and farmland

[6] From 1990 to 2011, the average farm size has only increased from 1.1 to 2.2 ha.

fragmentation increases both labor and travel costs due to the need to move among the plots[7]. Major obstacles to increasing operational farm size are the agricultural economic conditions, farmland fragmentation in itself[8], and the expectation that farmland will be converted into residential properties and industrial sites. In addition, farmland fragmentation induces increased production costs even if farmland accumulation and increases in operational farm sizes are promoted. It is thus important to resolve farmland fragmentation and increase farm sizes at the same time (MAFF 2007)[9]. Therefore, the Japanese government has been implementing FCPs, as explained in the introduction. As also noted above, the implementation of FCPs may influence both bonding and bridging SC at the community level, as discussed below.

2.2 Effects on Bonding Social Capital

An FCP is implemented as a public project under a landowner's agreement in a project area, such as a rural village. This is done because if farmland owned by certain farmer is reshaped as part of an FCP, one cannot avoid reshaping adjacent farmland owned by other farmers. In addition, if a parcel of farmland is being expanded by merging small plots in a project area, coordination among a large number of landowners is required (Syogenji 1998). As a result, bonding social capital may be accumulated through consensus-building in the project area in the process of project implementation. While the primary objective of FCPs is to improve productivity, nurturing the development of the core farmers in the project area and concentration of farmland among these core farmers have been major objectives since 1992. As a part of this, the program obligates communities to hold community meetings to obtain consensus on future farmland use and the resolution of fragmentation in the project area. These may also strengthen links within a community, leading to accumulation of bonding social capital.

On the other hand, the impact of FCPs on bonding social capital may be negative. In Japan, irrigation systems generally supply water to a parcel of paddy fields, one by one. Many farmers are beneficiaries of a given irrigation system, and because paddy fields are small and fragmented, it is difficult to adjust water allocations (i.e., timing and amount) without interaction between the farmers owning the farmland. As such, direct and indirect networks are formed between the farmers who own paddy

[7] Note, however, that Blarel et al. (1992) found that land fragmentation could help farmers manage risk, overcome seasonal labor bottlenecks, and better match soil types with necessary food crops.

[8] For research on the problem of farmland fragmentation in Japan, see Arimotno (2011) and Kawasaki (2010, 2011). Farmland fragmentation also afflicts many other countries.

[9] It has been argued that economies of scale disappear when farm size exceeds 5 ha in Japan, but Kawasaki (2010) found that economies of scale operate when farm size increases without farmland fragmentation.

fields in the paddy field area. If FCPs are implemented, the size of the average parcel of farmland is expanded, and fragmentation is resolved, it is no longer necessary to build consensus among neighboring farmers in a project area when adjusting water allocations. After FCP implementation, coordination of water allocation involves only one farmer's paddy fields (Shogenji 1998). It is thus also possible that bonding social capital could deteriorate. It is not known whether the positive or negative effects of FCPs on bonding social capital are greater.

2.3 Effects on Bridging Social Capital

In most cases, an FCP is implemented as a joint project in an entire district, covering more than one community. In that case, consensus-building must take place between communities in the project area. In addition to obtaining a consensus between communities, close relationships with relevant organizations, such as municipalities and governments, are essential to FCP implementation. These community activities enhance bridging social capital—i.e., the building of horizontal and vertical networks between organizations in different regions.

The effects of FCPs on these diverse types of social capital will be investigated in this paper using the data and approach detailed in the next section.

3. Data and Identification Strategy

3.1 Data

The data used in this analysis is the *Rural Community Card, World Census of Agriculture and Forestry 2000*. This is a census that has been conducted every five years since 1950 and includes information on agriculture and forestry at the prefecture, municipality, old municipality[10], and rural community levels[11]. FCPs are targeted at the rural community level, and their effects are thus strongly reflected in the rural community-level agricultural data. We hence use this as the unit of observation. We use the data from 1990 and 2000 that has information concerning FCPs[12].

The indicator of FCP implementation in a rural community is a dummy variable for whether an FCP was implemented between 1990 and 2000, enabling us to compare the treated and untreated

[10] "Old municipality" refers to the area of the municipality in 1950.
[11] "Rural community" is the smallest unit of regional society in rural villages.
[12] We constructed the data for analysis by matching the data for each year based on rural community codes.

communities. Following Arimoto (2011), the dummy variable is set to 1 if the area of readjusted farmland increased *and* the ratio of readjusted farmland increased by more than a specific number of percentage points from 1990 to 2000; otherwise, the variable is set to 0. As a robustness check, we created indicators for FCP implementation by assessing the increase rate (percentage points) and the ratio of readjusted farmland in the following four ways[13]:

① The variable is set to 1 if the area of readjusted farmland increased *and* the ratio of readjusted farmland increased between 1990 and 2000; otherwise, the variable is set to 0.

② The variable is set to 1 if the area of readjusted farmland increased *and* the ratio of readjusted farmland increased by more than 50 percentage points between 1990 and 2000; otherwise, the variable is set to 0.

③ The variable is set to 1 if the area of readjusted farmland increased *and* the ratio of readjusted farmland increased by more than 75 percentage points between 1990 and 2000; otherwise, the variable is set to 0.

④ The variable is set to 1 if the area of readjusted farmland increased *and* the ratio of readjusted farmland increased by 100 percentage points between 1990 and 2000; otherwise, the variable is set to 0.

The outcomes of interest of FCPs are bonding and bridging social capital. These concepts, however, are intangible and thus difficult to quantify. In this paper, we obtained proxy variables for bonding and bridging social capital by applying principal component analysis (PCA) (Fujiie et al. 2005). In the PCA, we use variables that represent interaction within the community and interaction between communities and with other organizations. Further, we divide social capital into agriculture-related and non-agriculture-related social capital. Because the rural community is the smallest unit of society in rural villages, which form various groups and social relationships, it is possible that FCPs implemented in a community have an effect on non-agriculture-related activities as well as agriculture-related activities.

Our measures of agriculture-related bonding social capital in a community are the number of meetings held by farmers or agriculture-related organizations for youth, women, and the elderly[14] and the persons responsible for managing the irrigation canals and farm roads (coded as follows: All villagers=4, only farmers=3, employees=2, not implemented=1, nonexistent=0). The non-agriculture-related bonding social capital in a community is measured using the number of non-agriculture-

[13] The reason for selecting the 50-percentage-point threshold is that it is necessary for the ratio of readjusted paddy to be a certain degree larger in the treated communities in order to observe the effects.

[14] Agriculture-related organizations are organizations that supply agricultural products, produce or process agricultural products, and sell agricultural products.

related organizations for youth, women, and the elderly as well as the method for managing common facilities (coded as above). These variables are used because more bonding social capital in a community is accumulated when there are many organizations involving farmers. In addition, a community has a high ability to obtain a consensus if common-pool resources, such as irrigation canals, farm roads, and common community facilities, are maintained through high-level collective action including both farmers and non-farmers.

Our measure of agriculture-related bridging social capital in a given community is a binary variable for whether the community provides a program to allow urban residents to experience agriculture, forestry, and fisheries, undertakes direct sale of agricultural products to urban residents, or provides study-away opportunities for urban residents in the community. The non-agriculture-related bridging social capital in a community is measured using a binary variable for whether the community provides an exchange program for urban residents focusing on traditional arts and crafts or traditional festivals. Bridging social capital, which represents connections between different stakeholders, should be more deeply accumulated when there are exchange programs for urban residents. The definitions and descriptive statistics for these variables are presented in Table A-1 and Table 1.

〔Table1〕

The principal component scores are calculated after normalizing each variable by subtracting the average from each individual observation and dividing these differences by the standard deviation. We use the first component score as a composite measure of agriculture-related bonding social capital, non-agriculture-related bonding social capital, agriculture-related bridging social capital, and non-agriculture-related bridging social capital (Table A-2 to Table A-5). We thus use the principal component score, which captures the eigenvalues from one or more components within each category, as measure of social capital.

In the analysis, we exclude rural communities in Hokkaido and Okinawa prefectures, which are very different from other prefectures in terms of agricultural conditions, and Tokyo, Kanagawa, and Osaka, which are mainly urbanized. In addition, we exclude rural communities in which upland farming without paddy fields is the mainstay of agricultural production in 1990 because the origins of the rural community and the environment of agricultural production are very different from those in rural communities with paddy fields. Following Arimoto (2011), we only include rural communities for which the ratio of readjusted farmland in 1990 is 0%. This is done for two reasons. First, it takes time for the impact of FCPs on social capital to appear. Hence, if the treated communities had complemented their FDPs before 1990, we cannot separately identify the effects of

the FCPs complemented before 1990 and those complemented after 1990. Second, if the untreated communities had complemented FCPs before 1990, their effects might appear after 1990. In this case, the communities are no longer suitable to be considered "untreated." As a result, rural communities are limited to those that had not yet complemented FCPs in 1990. We can then measure the impact of FCPs on social capital by comparing the rural communities without FCPs to those that have complemented FCPs after 1990. The sample size (treated and untreated communities) is presented in Table 2.

〔Table2〕

3.2 Identification Strategy

The goal of this paper is to explore the impacts of FCPs on social capital in Japan. We thus estimate the average treatment effect on the treated (ATT), defined as:

$$ATT = E\left(Y_i(1) - Y_i(0) \middle| D_i = 1\right) = E\left(Y_i(1) \middle| D_i = 1\right) - E\left(Y_i(0) \middle| D_i = 1\right) \quad (1)$$

where $Y_i(D_i)$ denotes the outcome variables, the indicator of social capital, in community i, and D_i is a dummy variable equal to one if community i implements an FCP and zero otherwise.

ATT is defined in such a way that, given the participation of community i in an FCP, the difference in the expected values of social capital that community i would have achieved with or without the FCP. Therefore, the first term on the right-hand side of equation (1), $E\left(Y_i(1) \middle| D_i = 1\right)$, is observable, whereas the second term, $E\left(Y_i(0) \middle| D_i = 1\right)$, is not. If FCPs were randomly assigned to communities, we could replace the second term on the right-hand side of equation (1) with the outcome for a community not implementing an FCP. As described above, however, FCPs have not been randomly implemented. To address this problem, we use propensity score matching (PSM) (Rosenbaum and Rubin 1983). PSM is a method that involves matching each project participant with a non-participant that is similar to the participant by calculating the probability of participation based on observable pre-project characteristics. In this way, we can match a treated community with an untreated community that had a similar probability of implementing an FCP. The probability of implementing an FCP, $P(X_i)$, is the propensity score and is estimated via a probit or logit model. If X_i denotes community characteristics, the PSM estimator of the ATT is defined as:

$$ATT = E\left(Y_i(1) \middle| D_i = 1, P(X_i)\right) - E\left(Y_i(0) \middle| D_i = 0, P(X_i)\right) \quad (2)$$

In addition, given common support condition[15], equation (2) can be rewritten as:

$$ATT = \frac{1}{N}\sum_{i \in T}\left[Y_i(1) - \sum_{j \in C} w(i, j) Y_j(0) \right] \qquad (3)$$

where N is the number of observations for treated communities, T and C denote the treated and the matched untreated communities, respectively. $w(i, j)$ is a weight determined based on the propensity score. Various matching techniques have been proposed using this weight. We apply one-to-one nearest neighbor matching, radius matching, and kernel matching as our matching algorithms.

4. Empirical Results

4.1 Propensity Score Matching

Table 3 provides marginal effects of the determinants of FCP implementation. The results of the probit regression can be summarized as follows[16]. First, communities in mountainous, urban, and city planning areas have a lower probability of implementing FCPs, while communities with flat slopes or located far from a densely inhabited district (DID) in an agriculture promotion area have higher probability of hosting a project. Communities without favorable agricultural conditions do not tend to implement FCPs. Second, communities with many elderly farmers have lower probability of having a project, while communities where there are many farmers and part-time farm households have higher probability of a project.

〔Table3〕

We match treated communities with the untreated communities that have similar probabilities of implementing FCPs by using the propensity score derived from the probit regression. When matching, we apply one-to-one nearest neighbor, radius, and kernel matching, imposing the common support condition. We use the distribution as the kernel function and set the bandwidth to 0.06. When applying radius matching, if the difference between the treatment and control groups in terms of propensity score is within a radius of 0.01, we match it. After matching, we carry out the balancing test to check whether the treated and untreated communities matched are similar in terms of their distributions of

[15] In the estimation of ATT, common support or overlap condition can be relaxed to $P(D_i = 1 | X_i) < 1$ (Khandker et al. 2009). This condition indicates that the control group is represented in the distribution of propensity scores for the treatment group.

[16] Independent variables include a measure of social capital in 1990. This measure is a PC score made by using the number of meetings held by farmers and the method for management of irrigation canals and farm roads.

community characteristics. Table 4 reports the results of the balancing test proposed by Sianesi (2004). First, a t test is used to check whether the mean of the independent variable appeared in the probit regression differs between the treated and untreated communities after matching. Second, we compare the pseudo-R^2 obtained from the probit regression after matching with that before matching. Third, a likelihood-ratio test examines whether all estimated coefficients obtained from the probit regression are zero. The results of these tests indicate that no difference between the treated and untreated communities after matching is observed, meaning that our matching strategy is successful.

〔Table4〕

4.2 Aggregate Indices

Table 5 and Table 6 provide PSM estimates of the ATT from equation (3). Standard errors are obtained from bootstrapping with 100 replications. The results can be summarized as follows. First, regardless of the matching methods, FCPs have a positive impact on agriculture-related bonding social capital. However, it should be noted that this result captures the overall effect of FCPs. Because the effect of FCPs on bonding social capital has both positive and negative aspects, this result implies that the positive effects are larger than the negative effects. In the case that FCPs are implemented on all paddy areas (readjustment dummy 100%), this results in a reduction of bonding social capital that is larger than the other indicator: the positive effect is reduced because irrigation maintenance and water allocation are simplified in the treated community.

Second, FCPs have a negative impact on non-agricultural bridging social capital. Accumulation of bonding and bridging social capital is negatively correlated (Dasgupta 2005). Therefore, as bonding social capital is built through the implementation of FCPs, bridging social capital deteriorates.

〔Table5〕 〔Table6〕

4.3 Specific Outcomes

We turn our attention to specific outcomes regarding bonding social capital (Table 7) and bridging social capital (Table 8). We only report the results for the readjustment dummy[17]. Regardless of the matching methods, FCPs have a positive effect on the number of meetings and the management of irrigation and common facilities, while FCPs have a negative effect on the number of non-agriculture-related organizations for women.

[17] Regardless of indicator of treatment, the estimates are similar in sign and size.

〔Table7〕 〔Table8〕

When FCPs are implemented through a process of agreement among landowners in the project area, communities have the opportunity to meet and gain consensus on implementing FCPs and to determine the nature of future farmland use in the project area. Communities select the management methods for common-pool resources that require cooperative management, and bonding social capital in the project area is accumulated. Focusing on elements included in bridging social capital, FCPs have a negative effect on holding direct sales of agricultural products and festival experience programs for city residents. It is possible that low agricultural productivity is ameliorated by the FCPs, and farmers can concentrate more on agriculture production, making it unnecessary to engage in cooperation with outside communities.

5. Concluding Remarks

In this paper, we examined the impact of Farmland Consolidation Programs (FCPs) on social capital in Japan by applying propensity score matching estimation to a community-level dataset. We found that these participatory projects, which involve merging several small plots into larger plots, have a positive impact on agriculture-related bonding social capital and a negative impact on non-agriculture-related bridging social capital. Focusing on the constituent elements of bonding social capital, FCPs have a positive effect on the number of community meetings held and the management of common-pool resources, such as irrigation canals and common facilities in the project area, but they have a negative effect on non-agriculture-related organizations for women. Thus, FCPs not only improve agricultural productivity, as pointed out in the existing literature, but also revitalize community activities through the accumulation of bonding social capital. On the other hand, focusing on the elements included in bridging social capital, FCPs have a negative effect on holding direct sales of agricultural products and programs for city residents to experience festivals.

There are two caveats to the results of this study. First, our study is limited to a sample for which the ratio of readjusted paddy was 0 in 1990. However, FCPs were implemented before 1990, and the results obtained do not contain the effect of these FCPs. Second, treated communities have different exposure periods between the completion of their FCP and the evaluation in 2000, but we are unable to identify this in the analysis due to data limitations. Despite this, our results offer useful insight for the future design of participatory agricultural development programs.

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Table 1 Descriptive statistics of variables

Variable	Obs	year	Mean	S.D.
Characteristics				
Agricultural area (urban)	48,197	1990	0.26	
Agricultural area (intermediate)	48,197	1990	0.36	
Agricultural area (mountainous)	48,197	1990	0.20	
Distance to DID (0.5 to 1hr)	48,197	1990	0.25	
Distance to DID (more than 1hr)	48,197	1990	0.06	
Ratio of elderly farmers	48,197	1990	39.98	15.20
Ratio of part-time farm households	48,197	1990	71.59	21.21
Number of farm households	48,197	1990	18.33	15.04
Gradient (flat)	48,197	1990	0.54	
Gradient (gentle)	48,197	1990	0.32	
Agricultural promotion area	48,197	1990	0.88	
Agricultural promotion area (farmland)	48,197	1990	0.74	
City planning area (Urbanization promotion area)	48,197	1990	0.16	
City planning area (Urbanization control area)	48,197	1990	0.25	
City planning area (not designated)	48,197	1990	0.26	
Social capital ('90)	48,197	1990	0.03	1.23
Readjustment dummy	48,197	1990, 2000	0.29	
Specific outcomes (agriculture-related bonding social capital)				
Irrigation management	36,492	2000	2.74	1.22
Farm road management	36,492	2000	2.81	1.34
Number of meetings	36,492	2000	7.98	6.24
Number of agriculture-related organizations for youth	36,492	2000	0.02	0.17
Number of agriculture-related organizations for women	36,492	2000	0.13	0.44
Number of agriculture-related organizations for the elderly	36,492	2000	0.03	0.22
Specific outcomes (non-agriculture-related bonding social capital)				
Common facilities management	33,984	2000	3.23	0.97
Number of non-agriculture-related organizations for youth	36,492	2000	0.27	0.56
Number of non-agriculture-related organizations for women	36,492	2000	0.49	0.68
Number of non-agriculture-related organizations for the elderly	36,492	2000	0.59	0.65
Specific outcomes (agriculture-related bridging social capital)				
Experience program for agriculture, forestry, and fisheries	36,492	2000	0.02	
Direct sale of agricultural products	36,492	2000	0.05	
Program for temporary transfer to rural community	36,492	2000	0.00	
Specific outcomes (non-agriculture-related bridging social capital)				
Program for experience of traditional arts and crafts	36,492	2000	0.04	
Program for experience of events	36,492	2000	0.12	

Table 2 Sample size (treated and untreated communities)

	Readjustment dummy	Readjustment dummy (more than 50%)	Readjustment dummy (more than 75%)	Readjustment dummy (100%)
treated	14,007	10,998	8,691	5,803
untreated	34,190	34,190	34,190	34,190
Total	48,197	45,188	42,881	39,993

Table 3 Probit estimates of project placement

	Marginal effects
Agricultural area (urban)	-0.108 ***
	(0.006)
Agricultural area (intermediate)	-0.052 ***
	(0.006)
Agricultural area (mountainous)	-0.047 ***
	(0.007)
Distance to DID (0.5 to 1hr)	0.047 ***
	(0.006)
Distance to DID (more than 1hr)	0.031 ***
	(0.010)
Gradient (flat)	0.129 ***
	(0.007)
Gradient (gentle)	0.066 ***
	(0.007)
Agricultural promotion area	0.054 ***
	(0.009)
Agricultural promotion area (farmland)	0.110 ***
	(0.006)
City planning area (Urbanization promotion area)	-0.025 ***
	(0.008)
City planning area (Urbanization control area)	-0.038 ***
	(0.006)
City planning area (not designated)	-0.028 ***
	(0.005)
Ratio of elderly farmers	-0.001 ***
	(0.000)
Ratio of part-time farm households	0.001 ***
	(0.000)
Number of farm households	0.004 ***
	(0.000)
Social capital ('90)	0.002
	(0.002)
Observations	48,197
LR $chi^2(16)$	3,233.65
Log likelihood	-27,431.78
Pseudo R^2	0.056

Note: *** denotes significance at the 1%. Standard error reported in parenthesis.

Table 4 Balancing test

	Sample Before matching			Sample After one-to-one NN matching			Sample After Radius matching			Sample After Kernel matching		
	mean		t test	mean		t test	mean		t test	mean		t test
	treated	untreated	(p alue)	treated	untreated	(p alue)	treated	untreated	(p alue)	treated	untreated	(p alue)
Agricultural area (urban)	0.18	0.30	0.00	0.18	0.18	0.61	0.18	0.18	0.80	0.18	0.19	0.69
Agricultural area (intermediate)	0.37	0.36	0.00	0.37	0.38	0.20	0.37	0.38	0.18	0.37	0.38	0.12
Agricultural area (mountainous)	0.20	0.20	0.89	0.20	0.20	0.95	0.20	0.20	0.70	0.20	0.20	0.98
Distance to DID (0.5 to 1hr)	0.28	0.24	0.00	0.28	0.29	0.32	0.28	0.29	0.35	0.28	0.29	0.47
Distance to DID (more than 1hr)	0.06	0.06	0.91	0.06	0.07	0.23	0.06	0.06	0.64	0.06	0.06	0.80
Ratio of elderly farmers	38.56	40.56	0.00	38.56	38.73	0.34	38.56	38.56	0.97	38.56	38.67	0.54
Ratio of part-time farm households	71.19	71.75	0.01	71.19	71.22	0.90	71.19	71.04	0.56	71.19	71.07	0.64
Number of farm households	22.04	16.82	0.00	22.04	21.67	0.08	22.01	21.75	0.22	22.04	21.36	0.00
Gradient (flat)	0.57	0.52	0.00	0.57	0.57	0.35	0.57	0.57	0.70	0.57	0.57	0.21
Gradient (gentle)	0.31	0.32	0.01	0.31	0.32	0.68	0.31	0.31	0.73	0.31	0.32	0.35
Agricultural promotion area	0.94	0.85	0.00	0.94	0.94	0.24	0.94	0.95	0.19	0.94	0.94	0.41
Agricultural promotion area (farmland)	0.85	0.70	0.00	0.85	0.86	0.01	0.85	0.86	0.11	0.85	0.86	0.33
City planning area (Urbanization promotion area)	0.11	0.18	0.00	0.11	0.11	0.26	0.11	0.11	0.44	0.11	0.11	0.68
City planning area (Urbanization control area)	0.23	0.26	0.00	0.23	0.22	0.02	0.23	0.23	0.33	0.23	0.23	0.41
City planning area (not designated)	0.26	0.25	0.40	0.26	0.26	0.39	0.26	0.26	0.44	0.26	0.26	0.50
Social capital ('90)	0.01	0.04	0.02	0.01	-0.01	0.07	0.01	0.00	0.51	0.01	0.01	0.61
Pseudo R^2	0.056			0.001			0.000			0.001		
LR Test(p value)	0.000			0.132			0.913			0.233		

Table 5 Project effects on bonding social capital - propensity score matching estimates

	Before matching		One-to-one NN matching		Radius matching		Kernel matching		Obs
agriculture-related bonding social capital									
Readjustment dummy	0.177	***	0.125	***	0.138	***	0.141	***	36492
	(0.014)		(0.023)		(0.013)		(0.014)		
Readjustment dummy (more than 50%)	0.179	***	0.115	***	0.137	***	0.140	***	33874
	(0.014)		(0.022)		(0.016)		(0.014)		
Readjustment dummy (more than 75%)	0.173	***	0.104	***	0.127	***	0.131	***	31887
	(0.014)		(0.026)		(0.018)		(0.015)		
Readjustment dummy (100%)	0.138	***	0.099	***	0.095	***	0.098	***	29305
	(0.018)		(0.026)		(0.021)		(0.019)		
non-agriculture-related bonding social capital									
Readjustment dummy	0.053	***	0.020		0.026		0.029		36492
	(0.014)		(0.023)		(0.014)		(0.015)		
Readjustment dummy (more than 50%)	0.045	***	0.005		0.016		0.019		33874
	(0.016)		(0.023)		(0.016)		(0.017)		
Readjustment dummy (more than 75%)	0.038	**	0.000		0.006		0.009		31887
	(0.016)		(0.023)		(0.019)		(0.017)		
Readjustment dummy (100%)	0.030		-0.008		-0.001		0.003		29305
	(0.019)		(0.033)		(0.021)		(0.019)		

Note:**denotes significance at the 5%, and, *** at the 1% level. The standard errors (in parenthes) are obtained from bootstrapping with 100 repetitions.

Table 6 Project effects on bridging social capital - propensity score matching estimates

	Before matching	One-to-one NN matching	Radius matching	Kernel matching	Obs
agriculture-related bridging social capital					
Readjustment dummy	-0.005	0.011	-0.001	-0.002	36492
	(0.011)	(0.018)	(0.012)	(0.014)	
Readjustment dummy (more than 50%)	-0.017	-0.001	-0.012	-0.014	33874
	(0.013)	(0.021)	(0.013)	(0.013)	
Readjustment dummy (more than 75%)	-0.030 **	-0.010	-0.023	-0.025	31887
	(0.015)	(0.021)	(0.014)	(0.015)	
Readjustment dummy (100%)	-0.027	-0.003	-0.021	-0.022	29305
	(0.018)	(0.029)	(0.020)	(0.018)	
non-agriculture-related bridging social capital					
Readjustment dummy	-0.042 ***	-0.036	-0.026 **	-0.029	36492
	(0.015)	(0.021)	(0.013)	(0.015)	
Readjustment dummy (more than 50%)	-0.061 ***	-0.047 **	-0.044 ***	-0.047 ***	33874
	(0.014)	(0.022)	(0.016)	(0.014)	
Readjustment dummy (more than 75%)	-0.079 ***	-0.072 ***	-0.059 ***	-0.062 ***	31887
	(0.015)	(0.022)	(0.017)	(0.016)	
Readjustment dummy (100%)	-0.091 ***	-0.087 ***	-0.072 ***	-0.075 ***	29305
	(0.016)	(0.027)	(0.020)	(0.016)	

Note:**denotes significance at the 5%, and, *** at the 1% level. The standard errors (in parenthes) are obtained from bootstrapping with 100 repetitions.

Table 7 Project effects on bonding social capital (specific outcomes) - propensity score matching estimates

	Before matching	One-to-one NN matching	Radius matching	Kernel matching
agriculture-related bonding social capital				
Irrigation management	0.147 ***	0.093 ***	0.106 ***	0.110 ***
	(0.014)	(0.019)	(0.014)	(0.015)
Farm road management	-0.017	-0.053 **	-0.027	-0.027
	(0.018)	(0.024)	(0.014)	(0.019)
Number of meetings	1.162 ***	0.858 ***	0.908 ***	0.928 ***
	(0.072)	(0.108)	(0.081)	(0.074)
Number of agriculture-related organizations for youth	0.003	0.004	0.001	0.001
	(0.002)	(0.003)	(0.002)	(0.002)
Number of agriculture-related organizations for women	-0.004	-0.008	-0.005	-0.005
	(0.005)	(0.007)	(0.005)	(0.005)
Number of agriculture-related organizations for the elderly	-0.005 ***	-0.003	-0.003	-0.004
	(0.002)	(0.003)	(0.002)	(0.002)
non-agriculture-related bonding social capital				
Common facilities management	0.110 ***	0.074 ***	0.083 ***	0.086 ***
	(0.010)	(0.015)	(0.010)	(0.011)
Number of non-agriculture-related organizations for youth	0.026 ***	0.009	0.009	0.010
	(0.006)	(0.010)	(0.007)	(0.007)
Number of non-agriculture-related organizations for women	-0.013	-0.027 **	-0.017 **	-0.016 **
	(0.007)	(0.013)	(0.007)	(0.007)
Number of non-agriculture-related organizations for the elderly	0.022 ***	0.022	0.019 **	0.019 **
	(0.007)	(0.012)	(0.007)	(0.007)

Note:**denotes significance at the 5%, and, *** at the 1% level. The standard errors (in parenthes) are obtained from bootstrapping with 100 repetitions.

Table 8 Project effects on bridging social capital (specific outcomes) - propensity score matching estimates

	Before matching	One-to-one NN matching	Radius matching	Kernel matching
agriculture-related bridging social capital				
Experience program for agriculture, forestry, and fisheries	0.001	0.004	0.002	0.002
	(0.001)	(0.002)	(0.002)	(0.001)
Direct sale of agricultural products	-0.006 **	-0.002	-0.008 ***	-0.008 ***
	(0.002)	(0.004)	(0.003)	(0.003)
Program for temporary transfer to rural community	0.001	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
non-agriculture-related bridging social capital				
Program for experience of traditional arts and crafts	-0.003	-0.003	-0.002	-0.002
	(0.002)	(0.004)	(0.002)	(0.002)
Program for experience of events	-0.014 ***	-0.011 **	-0.008 **	-0.009 **
	(0.003)	(0.005)	(0.004)	(0.004)

Note:**denotes significance at the 5%, and, *** at the 1% level. The standard errors (in parenthes) are obtained from bootstrapping with 100 repetitions.

Table A-1 Definition of Variables

Variable	Definition
Characteristics	
Agricultural area (urban)	Dummy, 1 if the classification of the agricultural area is urban area, 0 otherwise
Agricultural area (intermediate)	Dummy, 1 if the classification of the agricultural area is flat agricultural area, 0 otherwise
Agricultural area (mountainous)	Dummy 1 if the classification of the agricultural area is intermediate agricultural area, 0 otherwise
Distance to DID (0.5 to 1hr)	Dummy, 1 if the time distance to a densely inhibited district (city/town/village) is 0.5 to 1 hour, 0 otherwise
Distance to DID (more than 1hr)	Dummy, 1 if the time distance to a densely inhibited district (city/town/village) is more than 1 hour, 0 otherwise
Ratio of elderly farmers	Denominator = total population engaged in farming
Ratio of part-time farm households	Denominator = total number of farm households
Number of farm households	Total number of farm households
Gradient (flat)	Dummy, 1 if the gradient is smaller than 1/100, 0 otherwise
Gradient (gentle)	Dummy, 1 if the gradient is 1/100 to 1/20, 0 otherwise
Agricultural promotion area	Dummy, 1 if the community is in an agricultural promotion area, 0 otherwise
Agricultural promotion area (farmland)	Dummy, 1 if the community is in an agricultural promotion area and designated as a farmland area, 0 otherwise
City planning area (Urbanization promotion area)	Dummy, 1 if the city planning area is an "urbanization promotion area", 0 otherwise
City planning area (Urbanization control area)	Dummy, 1 if the city planning area is an "urbanization control area", 0 otherwise
City planning area (not designated)	Dummy, 1 if the community is in a city planning area but not designated as either an urbanization promotion area or an urbanization control area, 0 otherwise
Social capital ('90)	Social capital of the community in 1990
Readjustment dummy	Dummy, 1 if the area and ratio of readjusted farmland increased between 1990 and 2000, 0 otherwise
Specific outcomes (agriculture-related bonding social capital)	
Irrigation management	All villagers =4, only farmers =3, employees=2, not implemented=1, nonexistent=0
Farm road management	All villagers =4, only farmers =3, employees=2, not implemented=1, nonexistent=0
Number of meetings	Total number of meetings held by farmers
Number of agriculture-related organizations for youth	Total number of agriculture-related organizations for youth
Number of agriculture-related organizations for women	Total number of agriculture-related organizations for women
Number of agriculture-related organizations for the elderly	Total number of agriculture-related organizations for the elderly
Specific outcomes (non-agriculture-related bonding social capital)	
Common facilities management	All villagers =4, only farmers =3, employees=2, not implemented=1, nonexistent=0
Number of non-agriculture-related organizations for youth	Total number of non-agriculture-related organizations for youth
Number of non-agriculture-related organizations for women	Total number of non-agriculture-related organizations for women
Number of non-agriculture-related organizations for the elderly	Total number of non-agriculture-related organizations for the elderly
Specific outcomes (agriculture-related bridging social capital)	
Experience program for agriculture, forestry, and fisheries	Dummy, 1 if an experience program related to agriculture, forestry, and fisheries is offered, 0 otherwise
Direct sale of agricultural products	Dummy, 1 if direct sale of agricultural products is undertaken, 0 otherwise
Program for temporary transfer to rural community	Dummy, 1 if study trips are offered to the rural community, 0 otherwise
Specific outcomes (non-agriculture-related bridging social capital)	
Program for experience of traditional arts and crafts	Dummy, 1 if an exchange program related to traditional arts and crafts is offered, 0 otherwise
Program for experience of events	Dummy, 1 if an exchange program related to a traditional festival is offered, 0 otherwise

Table A-2 PCA on bonding social capital (agriculture-related)

Component	Eigenvalue	Proportion	Cumulative		Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
Comp1	1.472	0.245	0.245	Irrigation management	0.674	-0.129	-0.103	-0.093	-0.056	-0.712
Comp2	1.167	0.195	0.440	Farm road management	0.664	-0.135	-0.166	-0.138	-0.058	0.701
Comp3	0.993	0.166	0.605	Number of meetings	0.284	0.104	0.653	0.653	0.230	0.052
Comp4	0.933	0.156	0.761	Number of agriculture-related organizations for youth	0.109	0.573	0.245	-0.569	0.526	-0.004
Comp5	0.862	0.144	0.904	Number of agriculture-related organizations for women	0.089	0.659	0.086	0.031	-0.742	0.007
Comp6	0.573	0.096	1.000	Number of agriculture-related organizations for the elderly	0.059	0.439	-0.685	0.470	0.337	-0.013

Table A-3 PCA on bonding social capital (non-agriculture-related)

Component	Eigenvalue	Proportion	Cumulative		Comp1	Comp2	Comp3	Comp4
Comp1	1.691	0.423	0.423	Common facilities management	0.175	0.984	-0.004	-0.013
Comp2	0.978	0.245	0.667	Number of non-agriculture-related organizations for youth	0.511	-0.085	0.843	0.145
Comp3	0.758	0.190	0.857	Number of non-agriculture-related organizations for women	0.606	-0.119	-0.251	-0.746
Comp4	0.572	0.143	1.000	Number of non-agriculture-related organizations for the elderly	0.584	-0.097	-0.477	0.650

Table A-4 PCA on bridging social capital (agriculture-related)

Component	Eigenvalue	Proportion	Cumulative		Comp1	Comp2	Comp3
Comp1	1.214	0.405	0.405	Experience program for agriculture, forestry, and fisheries	0.666	-0.016	-0.746
Comp2	0.956	0.319	0.724	Direct sale of agricultural products	0.539	-0.682	0.495
Comp3	0.830	0.277	1.000	Program for temporary transfer to rural community	0.517	0.731	0.445

TableA-5 PCA on bridging social capital (non-agriculture-related)

Component	Eigenvalue	Proportion	Cumulative		Comp1	Comp2
Comp1	1.303	0.651	0.651	Program for experience of traditional arts and crafts	0.707	0.707
Comp2	0.697	0.349	1.000	Program for experience of events	0.707	-0.707