Social activity and collective action for agricultural innovation: a case study of New Rural Reconstruction in China

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Résumé / Abstract

Since 2003, a grass-roots movement of New Rural Reconstruction (NRR) has emerged to promote sustainable agricultural development in China. The NRR is regarded as an alternative development model for its distinct initiative based on rural social and cultural reconstruction. To provide profound understanding about its social mechanism, we examine an original NRR case where organic farming is promoted by basketball game. With an in-depth rural household survey, we qualitatively study this case and derive hypothesis of social networking by basketball game. We then empirically test this hypothesis by identifying causal social network effect on organic farming development. Our identification stems from exploiting the endogeneity of social network formation and provides robust micro evidence for a large social multiplier effect on diffusion of organic farming. Also, our result highlights the role of women, education and labor in organic farming development. Based on the result, we conclude that social activities are cost-effective means of social networking, which is essential for diffusion of sustainable agricultural innovation in small village.

Mots clés / Key words : New rural reconstruction; Social network; Organic farming; China.
Codes JEL / JEL codes : D71, O33, Q55

1 Introduction

For many countries in development and transition, the need for sustainable agricultural development is acknowledged as a common consensus. However, how to achieve the goal remains questionable. In China, the critical "Three Dimensional Agrarian Problems" (*San-nong wenti*) [1] make the question relevant and open to various attempts for adequate solution. In contrast to mainstream voice of industrialization and marketization of agriculture, alternative development thinking stresses on smallholder peasants' collective action and cooperation for agricultural innovations (Ostrom, 2000; Berkes et al., 2002; Wen, 2007). In practice, a grass-roots social movement of "New Rural Reconstruction (*xin xiangcun chongjian*)" (Henceforth NRR) has emerged since 2003 to promote community-based and peasant-participatory agricultural development in China.

The NRR is an ongoing rural development movement involving hundreds of thousands of scholars, students, social activists and organizations in China. Being distinguished from the broad campaign of "New Socialist Countryside Construction" announced by the Chinese government[2], the NRR addresses the term of "sustainability" from another perspective. Across the country, most NRR initiatives consist of constructing social and cultural organization (e.g., women association and senior association) in first place, then developing comprehensive co-operatives for the sake of economic and agricultural development[3]. The practitioners of NRR advocate that social and cultural reconstruction is the first urgency in atomized Chinese rural society. In order to achieve sustainable rural development, one should firstly construct a solid social basis for peasants' cooperation. To this end, social and cultural activities are appropriate and cost-effective means to unite peasants and to empower them the esprit of cooperation. (See more detailed discussion about NRR in (Day, 2008; Pan and Du, 2011a))

After ten years' development, the NRR experience begins to attract academic interests.

[1] It is a summary of peasants, rural society, and agriculture problems, e.g., exodus of rural labor, ageing rural population, grabbing of arable land and deterioration of agricultural environment.

[2] It is supported by the rural development policy appeared in the 11th five-years development plan of the Chinese government in 2005.

[3] One can refer to Lishu county co-op in Jilin, Lankao county co-op in Henan and Jiangzhuang co-op in Shandong for example (Day, 2008).

Some scholars have recently studied the economic aspect of NRR and regard it as the emergence of social economy in China (Pan and Du, 2011a,b). However, the effectiveness and efficiency of NRR have never been tested in economics and little is known about its social mechanism. This paper thus attempts to fill this blank of literature and to provide a more profound understanding about the NRR. Beyond the empirical test of the relationship between social activities and sustainable agricultural innovation, the aim of the paper is to investigate the social mechanism underlying the relationship. Our study is essentially inspired and guided by the literature of social network economics, a thriving literature emerged in economics to understand the influence of complex social interaction on economic achievement (Manski, 1993; Brock and Durlauf, 2000; Moffitt and Valente, 2001; Durlauf and Fafchamps, 2003; Lee, 2007; Bramoullé et al., 2009; De Giorgi et al., 2010). Our study will also make a contribution to this literature by providing micro evidence in the domain of agricultural development.

Being lack of macro data, an in-depth case study is appropriate to derive profound understanding about the NRR. We have thus identified an original NRR example in a village of southern China where basketball game is put forward to unite smallholder farmers for sustainable agricultural innovation, i.e., organic farming. With a rural household survey, we investigate farmers' motivation for organic farming and the influence of basketball game on their social network. This qualitative study provides a key hypothesis of social network extension by basketball game in the village. We model the social network according to this hypothesis and then identify the social network effect on farmers' adoption of organic farming using micro data collected by the survey. In terms of methodology, we follow the discussion of Moffitt and Valente (2001) about policy intervention and identification of social network effect. Our identification stems from the exogenous change of social network due to policy intervention (i.e., basketball game). In practice, we make use of Heckman correction for the endogenous formation of social network, and rely on the exclusion restriction of Inverse Mills Ratio to construct valid instruments for estimation of endogenous social network effect. Application of this novel Heckman-IV approach can also be found in recent studies of other domains (Zeitlin, 2009; Patnam, 2011).

For the result, we have identified a significant and robust social multiplier effect on

the diffusion of organic farming which confirms the effectiveness and efficiency of NRR. However, the social network effect seems to be negative for organic experts. Besides, we identify women, education and labor as determinant factors for organic farming development. Finally, our result highlights the constraints of social activity in big village and provides guidance for rural project design in similar circumstance. Taken together, we conclude that social network is crucial for farmers' collective action of agricultural innovation. The networking by means of social and cultural activities is thus an economic and efficient way to promote sustainable agricultural development in small village.

For the rest of the paper: Section 2 presents the case of NRR; Section 3 provides details of our fieldwork; Section 4 describes the dataset; Section 5 explains the methodological and econometric issues; Section 6 discusses the main results and policy implications; Section 7 concludes.

2 An example of New Rural Reconstruction

In China, the Rural Reconstruction (RR) movement can be traced back to the 1920's-30's (Pan and Du, 2011a). A new wave of RR in contemporary China grew out of a shift of debate on "Three Dimensional Agrarian Problems" from the promotion of market-led agricultural economy to the focus on peasantry. The advocates of NRR argue that given the large population and atomized structure of Chinese rural society, the agrarian problems cannot be solved if they are simply treated as one agricultural economic issue in free market economy. The real solution relies on the peasantry side other than the market side, i.e., one should rely on peasants' cooperation for economic, social and agricultural innovation to achieve sustainable rural development (Wen, 2007). This new thinking was rapidly developed and attracted social activists and students to translate it into action. Since 2003, students and social activists are trained at "Liangshuming center" and "James yen institute" to implement NRR experiments (e.g., Comprehensive Co-operatives, Peasant Participatory Agroecology and Community Supported Agriculture) in poor villages across the country (Day, 2008).

Among others, we are interested in an original example in southern China. Sancha

village (109.01E/22.73N) is a small village (i.e., 120 permanent households) under the administration of Pingma town[4] in Guangxi Zhuang autonomous region[5]. With an annual revenue of about 1700 yuan/habitant, the village is classified as a provincial "Poor Village" in Guangxi. Traditionally, the social life and agricultural production in the village are organized on basis of four families (i.e., families Xu, Li, Huang and Lu, also labeled as production groups 1, 2, 3 and 4). Since 1980's, the implementation of Household Responsibility System (HRS) has broken the collective system into individual production (Lin, 1997).

Given its underdevelopment state and well preserved agricultural environment, Sancha village was targeted by an NGO, called PCD[6], as a NRR experimental site for sustainable agricultural development in 2005. Initially, a project of organic paddy rice production was introduced to family Li of the village for experimentation. During this early stage, PCD, in collaboration with Guangxi Maize Research Institute (GMRI)[7], had provided environmental education, technical guidance and marketing support (Community Supported Agriculture) to encourage farmers' conversion from conventional farming to organic farming. After three years' experimentation, diverse organic technologies (e.g., substitution of chemical fertilizers by organic compost, rice-duck integrated system and insect control by medicinal plants) were successfully adapted to local condition and judged as successful. The adoption rate had reached 90% within family Li in 2008.

The project's ambition was beyond one family. PCD aimed to promote successful organic farming to the whole village and influence nearby villages. Nevertheless, it was not a simple task. According to PCD's investigation, farmers of other families doubted the yield of organic farming due to lack of information. With few resource, the effect of environmental education seemed limited to convince new farmers. After one year's promotion, the adoption rate was only 29% for the whole village in 2008.

[4]There are five levels of administration in China from high to low: province, city, county, town and village. Governments present at each level except for the village level.

[5]Guangxi Zhuang autonomous region is a "Zhuang" minority dominated region where the economic development is low at the national level. See map9.1 in appendix for the location of Sancha village.

[6]PCD (Partnerships for Community Development) is a NGO based in Hong Kong. More information about this NGO can be found on their site: http://www.pcd.org.hk/eng/index.html.

[7]GMRI is an agronomic research institute sponsored by local government.

Fortunately, the situation was changed by policy intervention of local government. For sake of urban-rural integration, local government decided to incorporate Sancha village into the Pingma community[8]. As a result, Sancha village received a government grant for its community building. With the grant, an old elementary school playground were renovated and transformed to a floodlit basketball court at the end of 2008.

For most farmers, the new court represents modernity and evokes a basketball enthusiasm. By realizing this basketball mode, the village committee decided to organize basketball game regularly with support from PCD. Particularly, a basketball league match was organized by inviting neighbor village teams to play on the new court. For pragmatic consideration, the basketball game was generally programmed in the evening. Because farmers would have more spare time in the evening so that more audience could present. Moreover, the need of children in school was considered as well. However, the mountainous environment condition and lack of road light might constrain some farmers to join the game in the evening[9]. According to the committee, thanks to the basketball league, the social life in Sancha village was substantially enriched. More importantly, the barrier of four families was broken down and more intensified social interactions encouraged farmers' cohesion. For instance, in 2009, the village had won the league match against seven neighbor villages. The prize of a black pig was equally shared by four families.

At the end of story, PCD found that the project of organic farming also moved forward along with the basketball game. Farmers' knowledge about organic technologies increased considerably. At the end of 2009, the adoption rate reported by farmers reached 71% for the whole village. To confirm this story and explore the social mechanism of basketball game in promotion of organic farming, we decide to investigate more closely in the village.

[8]The term of community is employed to conform the rural village with urban district in the rural community construction movement (See reports of Ministry of Civil Affairs for more details).

[9]This particular condition is important for our identification strategy, we will discuss it in details in the section of methodology.

3 The survey and research intuition

The aim of our fieldwork is to investigate: 1) the motivation of smallholder farmers to adopt organic farming; 2) the role of basketball game in the promotion of organic farming; 3) the evolution of social networks in the village. A semi-structured questionnaire is designed according to information gathered via internet and by telephone interview with project field coordinator. To make our questionnaire relevant to the context and gather more background information, we begin with a preliminary interview with key informants (i.e., head of village and party secretary) as well as a sample of 15 households randomly selected in the village (i.e., 10 organic farmers and 5 non-organic farmers, which represent about 10% of the population).

All interviews take place at farmer' home at dinner so that the conversation is unrolled in a friendly atmosphere. According to these interviews, three main motivations for organic farming are identified: 1) health consideration 2) economic profit and 3) information. Firstly, the health consideration is put forward by most farmers who practice organic farming (9 of 10 respondents). Six of them confirm that the syndromes due to chemical pesticide spray are general and significant, which push them to adopt organic farming. Secondly, the price premium of organic rice is attractive for poor farmers (7 of 10 respondents). Although organic food is still a niche market in China, the organic price is about two times the conventional price[10]. Thirdly, the knowledge of organic farming is strongly correlated with farmers' adoption. For instance, organic experts of family Li, who have engaged in PCD's experimentation, have comprehensive information about organic farming and are familiar with all organic technologies. They are thus confident about the productivity of organic farming and support it firmly. For new organic farmers, most regard organic farming as agriculture without chemical fertilizer and pesticide. But their understandings about comprehensive organic technologies are fuzzy. For non-organic farmers, they have heard about organic farming but with no comprehensive knowledge. Most of them are worried about yield reduction due to conversion.

We then investigate the source of information about organic farming by asking the

[10]The price of organic rice is 7 yuan/kg through the CSA marketing, whereas the price for conventional rice is only 4 yuan/kg on local market.

question *"where do you learn organic farming?"* For farmers of family Li, all of them mention PCD as information provider. However, this is not the case for farmers from other families. Five of them report that they learn organic farming from their relatives, neighbors and friends. The answers is confirmed by the coordinator of PCD, stating that they have tried to promote organic farming to all farmers, but many of them are out of reach given the limited human resource. Curiously, three farmers mention that they learn about organic farming on the occasion of basketball game. As one reports: *"I get to understand organic farming for the first time after the conversation with LB*[11] *in the basketball game."*

We get the hint and continue to explore the role of basketball game. According to our filed observation, most farmers of family Li live close to the basketball court. In fact, given their proximity, farmers of family Li get used to play basketball game and love this sport. Therefore, participation in the basketball game will certainly induce more contacts with farmers of family Li. This observation explains why farmers get information about organic farming from the basketball court.

"So what is the biggest change with basketball game?" To this question, we get different answers. In general, 13 of 15 respondents confirm that basketball game has induced more communication with other farmers. Not surprisingly, when asked to count the friends of other family, farmers who report to frequently participate in the game generally count more than 15 names. In contrast, those who report to participate rarely count less than 5 names. Intuitively, our interview reveals that farmers' social networks are indeed intensified due to the basketball game. This understanding leads to a hypothesis for empirical test: the basketball game promotes organic farming in Sancha village through the mechanism of social networking.

To test this hypothesis, we revise our questionnaire with the feedback from the interviews and use it for collection of data from all households in Sancha village. In practice, the formal survey is implemented in form of face-to-face interview with household head at home. The formal survey lasts for about one hour. Key questions of *"On average, have you or your family participated in the basketball game as player or audience more than*

[11] LB is a farmer of family Li.

3 times per month?[12]*"* is asked to measure farmers' participation in the basketball game, *"Do you practice organic farming on at least one plot of your paddy land?"* and '*"Can you tell the difference between organic farming and conventional farming?*[13]" are asked to measure farmers' organic adoption. Besides, a number of household's socio-economic characteristics (e.g., age, gender and education level) and living condition are also recorded during our home visiting. Respondents are asked to recall information for 2007, 2008 and 2009. It should note that the data we collected is a retrospective panel data using a single survey. To ensure the accuracy, we check the answers with available records provided by the village head[14] and drop information from any non-relevant interview[15]. After the data cleaning, information of 108 households for 2008 and 2009 are retained for the empirical analysis. The response rate of our survey is 90%[16].

4 Data

In this section, we describe the dataset derived from the formal survey and used for our empirical analysis. It contains information about farmers' report of participation in the basketball game and organic farming adoption as well as a number of socio-economic characteristics for 108 households during 2008 and 2009[17]. Table 1 presents the descriptive statistics of mains variables by organic status of household. A summary for the definitions of these variables can be found in the appendix 9.2.

[12] According to village head, the game is organized weekly. So we regard households who report to participate at least three times per month as frequent participants that are able to make effective social connection with others.

[13] The definition of organic farming follows that of International Federation of Organic Agriculture Movements.

[14] Especially for the adoption of organic farming.

[15] The rejected cases include farmers who were too old to answer the question, farmers who refused to be interviewed and farmers who don't practice agricultural production.

[16] The response rate is reported according to the definition and calculation of the American Association for Public Opinion Research (AAPOR, 2011)

[17] All interviewed households have actively participated in paddy rice production, using conventional or organic methods. Some in a hybrid way, which means both conventional and organic farming.

Table 1: Descriptive statistics by organic adoption status

	Total (216)		Organic Adopter (108)		Non-Adopter (108)		t-test
	mean	Sd	mean	sd	mean	sd	p-value
Individual characteristics:							
BASKET(1=Participated)	0.55	(0.50)	0.94	(0.25)	0.17	(0.37)	0.00
AGE(in years)	53.62	(12.82)	54.00	(12.19)	53.24	(13.46)	0.66
SEX(1=woman)	0.61	(0.49)	0.67	(0.47)	0.56	(0.50)	0.09
EDUCATION(in years)	3.63	(3.31)	3.8	(3.52)	3.46	(3.10)	0.46
HOUSEHOLDSIZE(in no.)	3.42	(1.61)	3.49	(1.67)	3.34	(1.56)	0.50
FARMSIZE(in mu)	2.13	(0.95)	2.22	(0.96)	2.05	(0.93)	0.18
INCOME(in Yuan)	1946.00	(5919.65)	2331.02	(7067.62)	1560.97	(4490.14)	0.34
REMOTENESS(walk time)	1.86	(0.70)	1.56	(0.65)	2.16	(0.63)	0.00
KID(in no.)	0.34	(0.61)	0.35	(0.60)	0.32	(0.62)	0.74
Peers' characteristics:							
GORGANIC	0.54	(0.34)	0.79	(0.10)	0.28	(0.30)	0.00
GAGE	53.75	(1.13)	54.18	(0.59)	53.31	(1.34)	0.00
GSEX	0.61	(0.05)	0.63	(0.02)	0.59	(0.06)	0.00
GEDUCATION	3.56	(0.49)	3.57	(0.18)	3.55	(0.67)	0.82
GHOUSEHOLDSIZE	3.45	(0.25)	3.40	(0.14)	3.50	(0.31)	0.00
GFARMSIZE	2.14	(0.08)	2.10	(0.06)	2.18	(0.08)	0.00
GINCOME	2035.24	(879.85)	2109.30	(669.60)	1961.17	(1046.92)	0.22

Note: For all tests of means, the null hypothesis is that the means are equal against a two-sided alternative. The confidence level is at 5%.

Table1 provides a brief picture of Sancha village. As one can note, the arable land resource is scarce in the village, the average area of paddy field is only 2.13 mu (0.14 ha) per household. The labor force seems abundant (3.4 persons per household), but most of which are aged people (54 years old) and female farmer (61%). Their average education level is hardly four years of primary school. This is not surprising in rural China. Along with the development of manufacturing sector, more and more rural household rely their livelihood on off-farm activities. Since there is few off-farm employment in the countryside (e.g., in Sancha village, the average annual off-farm income is only 1946 yuan (311 US dollar)), rural households intend to migrate and work in the city to improve their life.

However, under the Hukou system and rigid land tenure regime, rural household with Rural Hukou can not sell their land and easily integrate in the city[18]. Consequently, man work in the city and woman work at home is the best strategy for most poor rural households. As reported by Cai and Wang (2008), more than 150 million Chinese farmers worked out in the city in 2011.

When we compare the organic adopters with non-adopters in Sancha village, some preliminary evidences should be noted. Firstly, there is significant difference in terms of basketball game participation. 94% organic adopter have reported to frequently participate in the basketball game in comparison to 17% non-adopter. Secondly, the difference in peers' adoption rate is also significant. For adopters, 83% of their peers also adopt. While for non-adopters, only 28% of their peers adopt. Thirdly, most peers' characteristics are also significantly different, e.g., adopters have more aged and female peers with large household size and big farm land. To sort out all these correlations and determine the role of each, we need turn to a more rigorous empirical analysis.

5 Methodological framework

5.1 Literature review

In this section, we firstly make a brief literature review to guide our empirical analysis. The social network effect (also known as peers effect) is often studied in diffusion of innovation in economics (Young, 2000; Rogers, 1995). Specifically in the domain of agricultural economics, the social network has attracted keen interests to explain the diffusion of agricultural technologies in developing countries (Foster and Rosenzweig, 1996; Conley and Udry, 2001; Bandiera and Rasul, 2006; Munshi, 2004; Miguel and Kremer, 2003). In spite of its solid theoretic foundation, the empirical estimation of social network effect is not easy. In summary, one needs to address three fundamental problems when estimating

[18]In China, the population is administrated by Urban Hukou and Rural Hukou according to the permanent residence. In accordance, the schemes of social security and medical care are distinct for two types of Hukou. People with Rural Hukou are thus not covered by the urban social safety nets even they work in the city. For compensation, they have the use right of arable land for agricultural exploitation but without property right, i.e., they can not sell the land under their exploitation.

social network effect. The first one is discussed by Manski (1993) and commonly known as the *"reflection problem"*. Basically, it refers to the difficulty to disentangle the endogenous social network effect from the exogenous contextual effect when using a *"linear-in-means"* model to estimate social network effect[19]. It could be regarded as a simultaneity problem in econometrics. The second is the endogenous formation of social network. For instance, in our case, farmer's participation in the basketball game and his adoption of organic farming could be jointly determined by his intrinsic attributes (e.g., sociability and health state) which are non-observable to econometrician. The formation of basketball network is thus endogenous. Third, the effect of social network could be spuriously estimated if some correlated environmental effects are omitted by econometrician. In our case, the socio-economic endowments may be family specific (e.g., culture and expertise). These endowments may probably confound with the social network effect.

To overcome these problems and achieve consistent estimation of social network effect, varied methods have been proposed. For instance, one could rely on the nonlinearity between individual and group response which is imposed by a discrete choice model as discussed by Brock and Durlauf (2000). One could also explore the exogenous variation in group size to achieve the identification (Lee, 2007; Boucher et al., 2012). Moreover, the overlapping structure of social networks could be explored to derive spatial instruments for the identification of social network effect (Bramoullé et al., 2009). Finally, as discussed by Moffitt and Valente (2001), the change of social network by policy intervention could be an exogenous source of identification. In our case, the policy intervention of basketball game is destined to all farmers in the village, whereas some are hindered by their remote location (given the evening condition of basketball game) and family situation(kids). Therefore, the specificity of basketball game provides a possibility of identification. We will discuss more in details about our identification strategy in the section of econometric issues. Before that, we firstly turn to the definition of social network in our study.

[19]In the linear-in-means model, the outcome of each individual depends linearly on his own characteristics, on the mean outcome of his reference group and on its mean characteristics.

5.2 Model the social network in Sancha village

In literature, egocentric data is usually collected to measure specific social networks, e.g., kinship network and friendship network (Wasserman and Faust, 1994). In this study, we aim to explore the social interactions in a broader scope, i.e., social activity. In the case of basketball game, it is difficult to distinguish all kinds of interactions. For instance, one may interact with more people besides his family members and close friends, or get information just from conversations between others. To this effect, we decide to take account of all potential social links to define the social network. One may argue that it is unrealistic for a farmer to interact with all peers in the group. It is indeed true. However, the risk of precise measurement of social links is the potential measurement errors and information omission. Alternatively, if one can justify the efficiency of an extensive network involving all participants, it is convincing to infer the efficiency of more intensive social network. Therefore, we adopt here the loose definition of social network for the identification of social network effect.

Following previous discussions, the social network of Sancha village is composed of two parts, i.e., family network and basketball game extension. First of all, to represent the family network in a matrix way, we construct a matrix $F = [f1_i f2_i f3_i f4_i]$ where the row i represent the household i, the columns $f1 - f4$ represent four family dummies. This can be transformed to a symmetric matrix $W1$ that represents family specific social links between household i and household j within the village.

$$W1 = [w1_{ij}] = F \times F' \tag{1}$$

Next, participation in the basketball game is assumed to extend family network $W1$. Similarly, the extension induced by participation in basketball game can be represented by a one column matrix $C = [c_i]$ where c_i is a dummy variable measuring household i's participation in the game. It can also be transformed into a symmetric matrix $W2$:

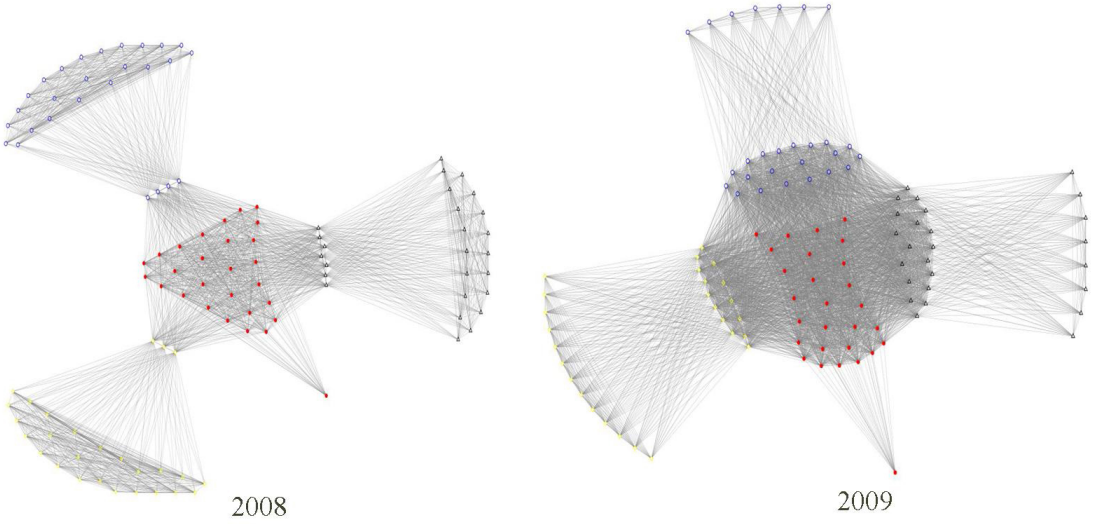
$$W2 = [w2_{ij}] = C \times C' \tag{2}$$

By combining $W1$ and $W2$, we construct a symmetric matrix G to represent the extended social network taking account both family relationship and basketball game:

$$G \equiv W1 + W2 \tag{3}$$

With this definition, we implicitly suppose that the social interactions within network $W1$ and $W2$ are of the same effect. Regardless of any particular nature, e.g., family or friend, the social network effect that we are going to identify is the mean effect within the social network G. By convention, one is NOT considered as peer of himself. The matrix G is then normalized for subsequent use. With this modeling, we can visualize the social network G in Figure 1.

Fig 1. The dynamic of social network in Sancha village



Notes: Social networks are drawn according to author's survey and total community social network definition. The dark triangle, red point, yellow diamond and blue circle represent villagers in families 1, 2, 3 and 4 respectively. Villagers in the central zone are those who have reported to participate in the basketball match frequently.

Figure 1 is produced with NodeXL using data collected by our survey. The nodes of different forms (i.e., dark triangle, red point, yellow diamond and blue circle) correspond to households of four families (i.e., Xu, Li, Huang and Lu) respectively. The edges represent the social links between households according to our definition of social network (i.e., both

in the same family or in the basketball game). To make it more intuitive, households who participate in the basketball game are placed in the center of the graph. One can note that in 2008 (i.e., before the renovation of court), a few households (majorally of family Li) participate in the game and the social network is relatively sparse. While in 2009, more households are attracted by the game and thus intensified the social network. This change of social network could be explored for the identification of social network effect.

5.3 Econometric issues

5.3.1 Baseline study

As a benchmark of our empirical analysis, we would firstly conduct a baseline study to test the relevance of basketball game on organic farming adoption using a simple model as follows:

$$ORGANIC_{i,t} = \alpha_0 + \alpha_1 BASKET_{i,t} + \alpha_2 X_{i,t} + F_s + T_t + \varepsilon_{i,t} \tag{4}$$

Here the dependent variable $ORGANIC_{i,t}$ is household i's organic farming adoption, $BASKET_{i,t}$ is household i's participation in basketball game at time t, $X_{i,t}$ control for a number of household socio-economic endowments such as age, gender, education level, household size, farm size and off-farm income. These endowments are expected to capture the human capital and physical capital of household. F_s are family dummies to control for unobservable family specific characteristics. T_t denotes a year dummy to capture common shocks related to the year.

With this specification, $BASKET_{i,t}$ could be endogenous due to unobservable characteristics of farmer (e.g., health state and sociability). To address this problem, an IV estimation is applied. Two instruments are available in our specific setting: the remoteness from the basketball court and the number of kids of household. As discussed earlier, the mountainous environment and the evening condition make household's participation in the basketball sensible to a small geographical distance (i.e., 5 to 15 minutes walk at

means). Nevertheless, such small distance seems less possible to determine important agricultural decision such as organic farming adoption. To make sure, this exclusion restriction will be checked by Sargan over-identification test. This baseline regression is useful to confirm our intuition of research on one hand. On the other hand, it serve to check the validity of our instruments for identification purpose.

5.3.2 Identification of social network effect

Next, we would like to identify the social network effect to validate the mechanism underlying the relationship. To do so, we estimate a model that describe the interdependent relationship between individual adoption decision and his peers' adoption decision within the predefined social network (Case, 1992; Manski, 1993; Durlauf and Young, 2001; Moffitt and Valente, 2001).

$$ORGANIC_{i,t} = \beta_0 + \beta_1 \frac{\sum_{j \in P_i} ORGANIC_{j,t}}{n_i} + \beta_2 \frac{\sum_{j \in P_i} X_{j,t}}{n_i} + \beta_2 X_{i,t} + \tau_t + \epsilon_{i,t}, \quad (5)$$

In the model, household i's organic adoption depends on the mean adoption rate of his peers in his group P_i. This social network effect is captured by coefficient β_1. In the connotation of Manski (1993) we call it the *endogenous social effect*. Meanwhile, household i's decision also depends on the characteristics of his peers, which represent the *contextual effect* and is captured by β_2. Also, a number of socio-economic endowments of household are controlled for by X. Finally, τ_t is a year dummy to capture the year shock and the error term $\epsilon_{i,t}$ is i.i.d. disturbances with zero mean and an unknown variance associated with i.

We then write the structural model in matrix notation:

$$ORGANIC_{i,t} = \beta_0 + \beta_1 GORGANIC_{i,t} + \beta_2 GX_{i,t} + \beta_3 X_{i,t} + \tau_t + \epsilon_{i,t} \quad (6)$$

where G is the social network matrix as predefined earlier. $G_{ij} = 1/n_i$ if i and j share the same family or both participate in the basketball game, and 0 otherwise. The

objective of our identification is to disentangle the *endogenous social effect* (i.e, social network effect) from *contextual effect* and possible *correlated effects* in the error. We will address the problems as discussed in the literature one by one.

First of all, to rule out the *correlated effects* specific to family, we compare household's organic adoption within each family by adding family dummies ς_s $s \in 1...4$ in equation 6. The second concern is the endogenous formation of social network. As discussed earlier, it is possible that household will *self-select* into the basketball game due to unobservable characteristics (e.g., health state and sociability). To address this concern, we will make use of Heckman correction for the *self-selection* problem (Heckman, 1979). For a demonstration, we model the adoption processus and participation processus with two separate equations:

$$ORGANIC_{i,t} = \beta_0 + \beta_1 GORGANIC_{i,t} + \beta_2 GX_{i,t} + \beta_3 X_{i,t} + \varsigma_s + \tau_t + \mu_{i,t} + \epsilon_{i,t} \quad (7)$$

$$PR(BASKET_{i,t} = 1) = \delta_0 + \delta_1 GX_{i,t} + \delta_2 X_{i,t} + \delta_3 Z_{i,t} + \varsigma_s + \tau_t + \xi_{i,t} \quad (8)$$

The presence of unobservable characteristics in both $\mu_{i,t}$ and $\xi_{i,t}$ is the origin of *self-selection* problem. Using two exogenous variables $Z_{i,t}$ (i.e.,remoteness and number of kids) and making strict assumption (i.e., $\mu_{i,t}$ and $\xi_{i,t}$ are mean zero, jointly and normally distributed with the variance-covariance matrix), the expectation of $\mu_{i,t}$ conditional on participation can be calculated using the formula below:

$$E[\mu_{i,t}|BASKET_{i,t} = 1] = \iota\sigma_\mu\lambda_{i,t} \quad (9)$$

Of which, $\lambda_{i,t}$ is the *Inverse Mills Ratio* calculated from the residues predicted from the participation equation 8.

$$\lambda(\xi_{i,t}) = \phi(\xi_{i,t})/\Phi(\xi_{i,t}) \quad (10)$$

Therefore, to get rid of *self-selection* problem, one can calculate $\lambda_{i,t}$ and explicitly

control for it in the adoption equation as follows:

$$ORGANIC_{i,t} = \beta_0 + \beta_1 GORGANIC_{i,t} + \beta_2 GX_{i,t} + \beta_3 X_{i,t} + \beta_4 \lambda_{i,t} + \varsigma_s + \tau_t + \epsilon_{i,t} \quad (11)$$

The third is the *reflection problem*. One of the solutions proposed in literature is to find appropriate instruments for $GORGANIC_{i,t}$ (Bramoullé et al., 2009; Moffitt and Valente, 2001). Here, the key observation we make is that $G\lambda_{i,t}$ and $G^2\lambda_{i,t}$ are two candidates under two conditions: 1) $\lambda_{i,t}$ is significant 2) $G\lambda_{i,t}$ and $G^2\lambda_{i,t}$ are *excludable* from equation11. The first condition relies on the assumption of endogenous formation of social network. The second condition of *exclusion restriction* is ensured by the assumption that farmer's participation in the basketball game should not be driven by his strategic behavior based on his observation of peers' organic adoption. This crucial assumption is strong but seems hold given the timing of our survey (i.e., one year around the court renovation). During such a short period, any strategic behaviour is unlikely which is based on complete observation of the entire social network.

To ensure the *exclusion restriction*, we also need control for both observable and non-observable characteristics (i.e., $\lambda_{i,t}$) of household in the adoption equation 11. As suggested by other studies (Arcand and Fafchamps, 2011; Fafchamps and Lund, 2003; Conley and Topa, 2002), the *assortative matching* is common in social network formation, i.e., farmers' characteristics are similar within their group. It means $G\lambda_{i,t}$ and $G^2\lambda_{i,t}$ may correlate with $\lambda_{i,t}$ in the model.

In summary, under the reasonable assumption of *exclusion restriction*, our identification of social network effect is achieved in three steps:

1. The participation equation 8 is estimated with two $Z_{i,t}$ (i.e., remoteness from the court and number of kids) to calculate the *Inverse Mills Ratio* $\lambda_{i,t}$ (Maddala, 1983).

2. The assumption of endogenous formation of social network (i.e., $\lambda_{i,t} \neq 0$) is checked. If it holds, we construct two instruments $G\lambda_{i,t}$ and $G^2\lambda_{i,t}$ for subsequent use.

3. The adoption equation 11 is estimated by applying the IV estimation using $G\lambda_{i,t}$ and $G^2\lambda_{i,t}$ as instruments for $GORGANIC_{i,t}$.

6 Result and discussion

6.1 Basketball game and organic farming

As a starting point, we firstly regress our baseline model to test the relationship between farmers' participation in basketball game and their organic farming adoption. The result is reported in table 3, which serves as a benchmark result and a check of our two instruments.

Table 3: Results of baseline regression

Dependant Variable: ORGANIC(1/0)						
Estimator	PROBIT		XTPROBIT		IV-PROBIT	
BASKET	0.28***	(0.00)	0.28***	(0.00)	0.26***	(0.00)
AGE	1.98e-03	(0.13)	1.96e-03	(0.14)	2.15e-03	(0.15)
SEX	0.12***	(0.00)	0.12***	(0.00)	0.13***	(0.00)
EDUCATION	0.01**	(0.02)	0.01**	(0.02)	0.01**	(0.03)
HOUSEHOLDSIZE	0.01	(0.26)	0.01	(0.26)	0.01	(0.29)
FARMSIZE	0.09***	(0.00)	0.09***	(0.00)	0.09***	(0.00)
INCOME	1.42e-07	(0.95)	1.96e-07	(0.93)	1.76e-07	(0.95)
FAMILY2	0.30***	(0.00)	0.30***	(0.00)	0.34***	(0.00)
FAMILY3	-0.04	(0.43)	-0.04	(0.46)	-0.04	(0.44)
FAMILY4	0.07	(0.12)	0.07	(0.15)	0.07	(0.12)
YEAR	0.19***	(0.00)	0.19***	(0.00)	0.21***	(0.00)
Observations	216		216		216	
Log pseudolikelihood	-39.79				-124.46	
P-value Wald chi2	0.00		0.00		0.00	
Sargan test					0.98	

Notes: Average Marginal Effects are calculated for the coefficient and robust p-value reported in parentheses, with ***, ** and * denoting significance at the 1, 5 and 10 percent level respectively. P-value of Wald chi2 is presented. P-value of Sargan test is presented for the IV-probit estimator. First stage result is presented in Appendix 3.

For the sake of comparison, we employ different estimators (i.e., probit and xtprobit) and yield consistent result. The result indicates, all else equal, farmer's participation in the basketball game will increase his probability to adopt organic farming by 28%. The effect of basketball game is positive and significant, which confirms the effectiveness and efficiency of social activity for farmers' agricultural innovation. To address the concern of endogeneity problem of participation, we apply an IV estimation using household's remoteness from the court and the numbers of kids as instruments. One can note that the statistics of Sargan test doesn't reject the validity of our instruments, and the effect of basketball game remains significant with a magnitude of 0.26.

Regarding other determinants of organic farming, the result highlights the role of women and education. It is plausible that female and more educated farmers are more sensible to the health issue. Since the health concerns is the first motivation for organic farming as revealed by our fieldwork, the result just confirms this motivation. This result is in line with other studies which also find education indispensable in promotion of new technology (Foster and Rosenzweig, 1996; Huffman, 2001). Farm size is found a positive effect for organic adoption. A conceivable explanation is that organic farming is associated with high risk (i.e., yield lost) as other new technologies. Household with big farm could alleviate the risk by allocating a small portion of its farm for experimentation. Finally, family Li (FAMILY2) is significantly related to organic farming. The result confirms the finding of our fieldwork that household of family Li has accumulated rich experience of organic farming during the early stage of experimentation. Their expertise sustains their choice of organic farming.

6.2 Diffusion of organic farming through social network

The literature and our fieldwork provide a mechanism to explain the relationship between basketball game and organic farming, i.e., the social network effect. We thus attempt to identify the social network effect as discussed earlier. The identification result is presented in table 4, we will follow the three-steps identification for a discussion.

Table 4: Participation and social network effect

	Naive		Step1		Step2		Step3	
Dependant Var	ORGANIC		BASKET		ORGANIC		ORGANIC	
Estimator	OLS		PROBIT		OLS		IV	
GORGANIC	1.31***	(0.00)			0.35	(0.17)	0.67**	(0.01)
AGE	3.20e-03	(0.41)	0.01***	(0.00)	3.36e-03	(0.31)	3.66e-03	(0.34)
SEX	0.15	(0.11)	0.06	(0.29)	0.19***	(0.01)	0.15**	(0.01)
EDUCATION	0.02**	(0.03)	0.02***	(0.00)	0.03***	(0.00)	0.02***	(0.00)
FARMSIZE	0.09***	(0.00)	-0.04*	(0.08)	0.03	(0.26)	0.05*	(0.08)
INCOME	-3.65e-06	(0.49)	1.98e-06	(0.81)	-8.99e-06*	(0.07)	-8.53e-06	(0.17)
HOUSEHOLDSIZE	0.03	(0.15)	0.05**	(0.03)	0.08***	(0.00)	0.07***	(0.00)
GAGE	0.07	(0.54)	0.43***	(0.00)	0.10	(0.35)	0.11	(0.33)
GSEX	1.03	(0.68)	3.42*	(0.05)	4.59**	(0.02)	2.97	(0.14)
GEDUCATION	0.23**	(0.03)	0.82***	(0.00)	0.86***	(0.00)	0.71***	(0.00)
GFARMSIZE	0.17	(0.84)	-1.87***	(0.00)	-1.79**	(0.04)	-0.99	(0.28)
GINCOME	-2.28e-04	(0.32)	1.20e-05	(0.97)	-5.38e-04***	(0.00)	-5.17e-04**	(0.02)
GHOUSEHOLDSIZE	0.93	(0.18)	1.61**	(0.04)	2.76***	(0.00)	2.43***	(0.00)
REMOTENESS			-0.14***	(0.00)				
KID			0.05*	(0.09)				
IMR					0.28***	(0.00)	0.26***	(0.00)
Observations	216		216		216		216	
R2/Log likelihood	0.64		-51.07		0.73		0.73	
F-test	0.00				0.00		0.00	
Sargan test							0.71	

Notes: Average Marginal Effects are calculated for probit estimation in col2; Robust p-value is represented in parentheses, with ***, ** and * denoting significance at the 1, 5 and 10 percent level respectively. R2 value is reported for OLS and IV estimation, log pseudolikelihood value is reported for probit estimation. The p-value of Sargan test is reported for IV estimation. The family and year dummies are controlled except for naive estimation in col1.

6.2.1 Social activity and its constraints

In the first column of table 4, we present the result of a "naive" estimation of social network effect. One can note that the coefficient of social network effect is significant and quite large (i.e., 1.31), which seems too good to be true. On the other hand, most contextual effects are non-significant. It raises doubts about the spurious identification of social network effect as discussed by Manski (1993). We will compare this result with our three-steps identification result and find that the "naive" result is indeed not robust.

In first step, column two reports the estimation result of the participation equation 8 using a probit estimator. The result is instructive to understand the advantages and constraints of social activity in rural areas and guide other fieldwork. Firstly, we find that education and household size are positively correlated with household's participation in the basketball game. Besides, senior people are also more interested by the basketball game. It is not surprising since senior people have generally more spare time and less life pressure. This result is in line with Putnam (2001)'s finding of cohort effect where senior people belong to more organizations than younger people. In rural China, the role of senior people is recognized to guide other NRR project. For instance, Wang and Hale (2009) report that a number of successful NRR cooperatives are founded on basis of senior association.

On the other hand, farm size is found to impede household's participation. In our analysis, the farm size may capture the activity of agricultural production. Big farm probably implicates more agricultural work and less spare time. This result suggests a potential constraint of social activity in big villages, which is supported by Wang and Hale (2009)'s finding stating that NRR has encountered more difficulties in big villages. The feasibility of social activity remains thus questionable in big villages where agricultural burden is heavy. Moreover, we find the remoteness from the court significantly hinders household's participation in the basketball game. It also questions the efficiency of social activity in big villages where households are sparsely located.

For peers' influence, the signs and significance are similar with one's own charac-

teristics. For instance, more senior, educated, female and big household peers will encourage one's participation, while peers' farm size play the opposite effect. The result suggests an *assortative matching* in the formation of social network in our case (Arcand and Fafchamps, 2011; Fafchamps and Lund, 2003; Conley and Topa, 2002). Consequently, the problem of endogenous formation of social network should be taken into account in our following analysis.

6.2.2 Effect of social network on organic farming development

We continue with the identification of social network effect. In column three, the *Inverse Mills Ratio* (λ) of Heckman is calculated and controlled in the model. One can note that the coefficient of IMR is significant, which suggests the presence of *self-selection* problem. A likelihood ratio test is thus performed. The rejection of null hypothesis has confirmed this assumption and supports the necessity of Heckman correction. Moreover, the significant IMR enables us to construct instruments $G\lambda_{i,t}$ and $G^2\lambda_{i,t}$ for subsequent identification use.

In column four, we address the *reflection problem* by applying the IV estimation. The model we estimate is a Linear Probit Model (LPM), which is simple and intuitive for estimation and interpretation. Another advantage of the LPM model is the comprehensive statistical tests that enable us to check assumptions such as *exclusion restriction* of our instruments. Finally, given the survey nature of our data, it is possible that the errors of respondents are correlated. To eliminate this concern, a bootstrap approach is applied to the estimation. For the result, we firstly note that the magnitude of social network effect is reduced by 50% comparing to the naive estimation. However, it remains positive and statistically significant at the 5% level. The result indicates that, all else equal, 10% growth in the fraction of peers who adopt organic farming will increase 6.7% of the probability that a household also adopt organic farming. This is a large social multiplier effect in comparison with other studies in the literature (Conley and Udry, 2001; Bandiera and Rasul, 2006). With this result, we can explain the social mechanism of basketball game by a strong social network effect. This understanding is crucial for government or development agency with aim to promote sustainable agriculture innovation in poor rural

area. Apart from conventional promotion such as advertising campaign and subsidy, they could also rely on the social network effect for technology diffusion. To do so, social or cultural activities are cost-effective means for networking as suggested by our result.

For the contextual effects, we identify more significant coefficients comparing to the naive estimation. These contextual effects provide a more comprehensive understanding of the social network effect. For instance, peers' education level and household size significantly influence household's adoption decision whereas peers' off-farm income plays the opposite role. Given the knowledge and labor intensity of organic farming, one plausible explanation is that farmers share knowledge as well as labor within their social network. In contrary, peers' off-farm income may capture off-farm employment opportunity provided by peers. These opportunities will certainly raise a competition of labor for organic farming thus discourage the adoption.

Finally, apart from the social network effect, the effects of household's characteristics are meaningful and useful to understand the advantages and constraints for organic farming development in rural China. We note here women, education and labor as three key factors to promote organic farming. As explained earlier, the Chinese rural society is characterized by a massive exodus of male rural labor. This phenomenon represent both constraints and opportunity for organic farming development. On one hand, government should recognize the critical role of women in rural society and rely on them for a change to sustainable agriculture. On the other hand, more educational service (i.e., environmental education and technical formation) is needed to reinforce farmers' capacity for sustainable development.

6.3 Robustness check

For the robustness check, we firstly explore the panel structure of our data to estimate a within model which relies on the variation of social network due to policy intervention (i.e., renovation of basket court and organization of basketball league match). The advantage of within model is to get rid of any time-invariant correlated effects. To address the concerns of time-variant factors, we control for the IMR of Heckman under the assumption

of *exclusion restriction*. Also, we can combine the advantages of within model and the IV approach to run an Within-2SLS estimation. These exercises are useful to serve as a comparison with previous Heckman-IV approach.

Secondly, as discussed by Bramoullé et al. (2009), we can take advantage of the overlapping structure of social network for the identification of social network effect. In practice, one could construct spatial instruments G^2X which consist of characteristics of peer's peers to identify the social network effect. In our case, the basketball game turns the social network overlap among four families (see figure 1 in section 5). This network structure makes it possible to apply the estimator of Bramoullé et al. (2009) (BDF henceforth). For concerns of endogenous formation of social network (i.e., farmers' *self-selection* into the basketball game) and correlated effects, we will control for IMR in the model and estimate a within model.

Finally, the social network effect may be heterogeneous. The intuition is that if the social network effect is due to information spillover, farmers who have precise information about organic farming should be less sensible to the social network effect. In presence of heterogeneous expertise, social network effect is expected to be non significant for organic experts of family Li. It could even be negative if the social network becomes too large (see explanation of Bandiera and Rasul (2006)). To check this hypothesis, we conduct a difference-in-difference type analysis based on the timing of organic adoption. We note here new adopters and organic experts have the same incentive for organic farming, they are comparable to determine the heterogenous social network effect. In practice, we construct a dummy variable C which indicates "0" for organic experts (i.e., households who participated in experimentation of PCD) and "1" for new adopters(i.e., households who adopt organic farming since 2009). The dummy is then crossed with the variable $GORGANIC$ to construct a new variable $C * GORGANIC$ and included in the model. Finally the estimation is made by within and within-2SLS estimators for comparison. Intuitively, we expect significant and positive sign for $C * GORGANIC$, whereas the $GORGANIC$ could be nonsignificant or negative.

Table 5: Robustness check(I)

Dependant variable: ORGANIC(1/0)								
Estimator	WITHIN		WITHIN-2SLS		BDF		BDF-WITHIN	
GORGANIC	0.60**	(0.04)	0.76***	(0.01)	0.60***	(0.01)	0.79***	(0.00)
AGE	0.65**	(0.01)	0.56**	(0.01)	3.60e-03	(0.26)	0.54**	(0.02)
SEX					0.16**	(0.01)		
EDUCATION					0.02***	(0.00)		
FARMSIZE	-0.03	(0.53)	-0.02	(0.73)	0.05*	(0.06)	-0.01	(0.76)
INCOME	6.67e-06	(0.44)	6.78e-06	(0.42)	-8.62e-06*	(0.07)	6.81e-06	(0.42)
HOUSEHOLDSIZE	0.09	(0.17)	0.10	(0.13)	0.07***	(0.00)	0.10	(0.13)
GAGE	-0.09	(0.51)	-0.07	(0.56)	0.11	(0.28)	-0.07	(0.58)
GSEX	6.58***	(0.00)	5.96***	(0.00)	3.31*	(0.06)	5.83***	(0.01)
GEDUCATION	0.61***	(0.00)	0.56***	(0.00)	0.74***	(0.00)	0.55***	(0.00)
GFARMSIZE	-0.87	(0.32)	-0.44	(0.63)	-1.16	(0.15)	-0.36	(0.67)
GINCOME	-5.36e-04***	(0.00)	-5.31e-04***	(0.00)	-5.22e-04***	(0.00)	-5.30e-04***	(0.00)
GHOUSEHOLDSIZE	2.31***	(0.00)	2.19***	(0.00)	2.50***	(0.00)	2.17***	(0.00)
IMR	0.24***	(0.01)	0.22**	(0.01)	0.27***	(0.00)	0.22**	(0.02)
Observations	216		216		216		216	
R-squared	0.74		0.74		0.73		0.74	
F-test	0.00		0.00		0.00		0.00	
Sargan test			0.13		0.45		0.15	

Notes: Robust p-value in parentheses with ***, ** and * denoting significance at the 1, 5 and 10 percent level respectively. The P-value of Sargan test is presented for IV estimations in col 2, 3 and 4; The family and year dummies are controlled in all estimations; BDF refers to the estimator of spatial instrumentation as discussed by Bramoullé et al. (2009).

Let's first check out the results of within and BDF estimations in table 5. In all these estimations, the social network effect is significant and positive. The magnitude of coefficient varies from 0.60 to 0.79. Our conclusion of large social multiplier effect is thus not rejected by the robustness check. Besides, the role of women, education and labor force favor organic adoption while off-farm activity is the major competitor for organic farming development. All these results are consistent in the robustness check.

Table 6: Robustness check(II)

Dependant variable: ORGANIC(1/0)				
Estimator	WITHIN		WITHIN-2SLS	
GORGANIC	-1.55***	(0.00)	-2.44***	(0.00)
C*GORGANIC	1.57***	(0.00)	2.43***	(0.00)

AGE	0.96***	(0.00)	0.99***	(0.00)
FARMSIZE	0.01	(0.12)	-1.25e-03	(0.90)
INCOME	1.26e-07	(0.42)	3.63e-07	(0.20)
HOUSEHOLDSIZE	-0.01*	(0.07)	-0.02	(0.20)
GAGE	-0.16***	(0.00)	-0.10**	(0.02)
GSEX	-0.23	(0.80)	1.11	(0.52)
GEDUCATION	0.13	(0.32)	0.58**	(0.02)
GFARMSIZE	1.14***	(0.00)	0.64	(1.18)
GINCOME	-4.33e-04***	(0.00)	-2.60e-04*	(0.08)
GHOUSEHOLDSIZE	-1.31***	(0.00)	-2.06***	(0.00)
C*GAGE	0.17***	(0.00)	0.10**	(0.02)
C*GSEX	0.04	(0.96)	-1.11	(0.51)
C*GEDUCATION	-0.15	(0.23)	-0.58**	(0.02)
C*GFARMSIZE	-1.10***	(0.00)	-0.70	(0.13)
C*GINCOME	4.59e-04***	(0.00)	2.78e-04*	(0.05)
C*GHOUSEHOLDSIZE	1.21***	(0.00)	2.03***	(0.00)
IMR	4.06e-04	(0.87)	2.18e-03	(0.41)
Observations	154		154	
R-squared	0.99		0.99	
F-test	0.00		0.00	
Sargan test			0.93	

Notes: Robust p-value in parentheses; With ***, ** and * denoting significance at the 1, 5 and 10 percent level respectively. The family and year dummies are controlled for in both estimations. The P-value of Sargan test is presented for IV estimation.

Next, let's check out the heterogeneous effect of social network with the difference-in-difference analysis in table 6. Not surprisingly, $GORGANIC$ becomes negative whereas the cross term $C * GORGANIC$ is significantly positive. The result indicates that the probability of organic experts' adoption is indeed decreasing along with the increasing number of participants in the social network. This could be due to their strategic behaviour given their comprehensive information about the niche market for organic produce. In contrast, the social network effect is much stronger for new adopters, who have no comprehensive information about organic farming. Taken together, this result suggests information spillover as a credible explanation to the large social multiplier effect identi-

fied in our case. However, the result doesn't eliminate other mechanisms such as altruism and social pressure which may also explain the social network effect. More specific data setting is needed to disentangle these mechanisms and we will leave it for the future study.

7 Conclusion

In order to answer the question of how to achieve sustainable agricultural development, we investigate an original New Rural Reconstruction example in Sancha village where basketball game is employed to promote sustainable agricultural innovation, i.e., organic farming. Our fieldwork and empirical analysis reveal a large social multiplier effect within the extended social network in the village, which provide robust micro evidence for the role of social activity in the promotion of sustainable agricultural development.

In developing countries, agricultural development is often constrained by the scarcity and inefficiency of formal institution in rural areas. The achievement of sustainable agricultural development seems to strongly depend on government's colossal investment. Alternatively, NRR proposes a cost-effective solution which relies on informal institution–the social network. Regarded as a major form of social capital, social networks are indeed widespread in rural areas. Smallholder farmers form social networks on basis of kinship, friendship as well as social and cultural activities. These social networks are essential for farmers' social learning, risk sharing, labor and finance cooperation, thus constitute the solid social foundation for farmers' collective action to achieve the sustainable development.

For the perspectives, the experience of NRR in China proposes a new angle to rethink current rural development. Its sustainable development strategy and original social initiative deserve more profound studies to generate comprehensive understanding of this alternative development model.

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9 Appendices

9.1 Location of Sancha village

Source: www.map-of-china.org

9.2 Definition and description of variables

ORGANIC	Farmer's self report of organic farming adoption. It's a binary variable code "1" if at least one plot of paddy field is under organic management. Code "0" otherwise.
BASKET	Farmer's report of basketball game participation. It's a binary variable code "1" if household participates in the basketball game more than 3 times per month during the year. Code "0" otherwise.
AGE	Age of household head.
SEX	Gender of household head. Code "1" for woman, "0" for man.
EDUCATION	Education level of household head. Code "0" for illiteracy, "1" for primary school first grade, "2" for primary school second grade, "3" for primary school third grade, "4" for primary school fourth grade, "5" for primary school fifth grade, "6" for primary school sixth grade, "7" for middle school first grade, "8" for middle school second grade, "9" for middle school third grade, "10" for high school first grade, "11" for high school second grade, "12" for high school third grade.
HOUSEHOLDSIZE	Number of permanent residents of the household.
FARMSIZE	Area of cultivated paddy field during the reference year, the unit is "Mu"(0.067 ha).
INCOME	Off-farm income of off-farm activities, the unit is "Yuan".
REMOTENESS	The distance to the basketball court measured by walk time. Code "1" for less than 5 minutes, "2" for 5 to 15 minutes, "3" for more than 15 minutes.
KID	The number of kids under 5 years old and taken care by the household head.

9.3 First stage regressions

Dependant variable	Baseline study COMMUNITY		Heckman-IV GORGANIC		Heckman-IV(WITHIN) GORGANIC		BDF GORGANIC		BDF(WITHIN) GORGANIC		DIF-DIF C*GORGANIC		DIF-DIF GORGANIC	
REMOTENESS	-0.29***	(0.00)												
KID	0.06	(0.10)												
GIMR			-0.21	(0.39)	-0.32	(0.12)								
G2IMR			1.65***	(0.00)	1.78***	(0.00)								
G2AGE							-1.17***	(0.00)	-1.17***	(0.00)				
G2SEX							19.41***	(0.00)	19.59***	(0.00)				
G2EDUCATION							-0.14***	(0.01)	-0.12*	(0.07)				
G2FARMSIZE							-0.75***	(0.00)	-0.76***	(0.00)				
G2INCOME							-3.86e-04***	(0.00)	-4.40e-04***	(0.00)				
G2HOUSEHOLDSIZE							-0.38**	(0.01)	-0.26	(0.16)				
AGE	1.26e-03	(0.50)	1.81e-03***	(0.00)	0.34***	(0.00)	-2.43e-04	(0.14)			2.46e-03	(0.73)	0.40***	(0.00)
SEX	3.63e-03	(0.95)	0.09***	(0.00)			0.01**	(0.03)						
EDUCATION	1.37e-03	(0.88)	0.01***	(0.00)			3.82e-04	(0.59)						
FARMSIZE	0.01	(0.78)	-0.07***	(0.00)	-0.07***	(0.00)	-2.07e-03	(0.24)	-4.85e-03	(0.25)	1.12e-03	(0.26)	-4.87e-04	(0.93)
INCOME	-1.09e-06	(0.77)	-1.45e-06	(0.39)	-4.87e-06**	(0.01)	-5.06e-08	(0.86)	6.77e-07	(0.13)	1.45e-07	(0.57)	3.16e-07	(0.33)
HOUSEHOLDSIZE	0.01	(0.52)	0.03***	(0.00)	0.02	(0.20)	-0.01***	(0.00)	-2.02e-03	(0.64)	6.06e-04	(0.66)	-5.42e-03	(0.38)
GAGE			0.06***	(0.00)	0.06	(0.10)	-0.05***	(0.00)	-0.05***	(0.00)	-6.94e-03**	(0.02)	-0.04	(0.14)
GSEX			3.72***	(0.00)	3.04***	(0.00)	1.19***	(0.00)	1.04***	(0.00)	-0.04	(0.48)	0.45	(0.49)
GEDUCATION			0.40***	(0.00)	0.29***	(0.00)	0.03	(0.24)	0.01	(0.65)	-0.01	(0.26)	0.24***	(0.00)
GFARMSIZE			-2.56***	(0.00)	-2.51***	(0.00)	-0.08	(0.16)	-0.06	(0.53)	0.04	(0.20)	0.25	(0.39)
GINCOME			-3.84e-05	(0.34)	-1.32e-05	(0.71)	-2.28e-05	(0.13)	-1.76e-05	(0.35)	-7.73e-07	(0.91)	-9.95e-05	(0.31)
GHOUSEHOLDSIZE			1.07***	(0.00)	0.88***	(0.00)	-0.23***	(0.00)	-0.27***	(0.00)	-0.01	(0.46)	-0.84***	(0.00)
IMR			0.03	(0.29)	0.04	(0.19)	0.03***	(0.00)	0.03***	(0.00)	-0.01***	(0.00)	-3.30e-03	(0.40)
C*GAGE											0.02***	(0.00)	0.04	(0.10)
C*GSEX											2.32***	(0.00)	1.65**	(0.01)
C*GEDUCATION											0.12***	(0.00)	-0.15**	(0.01)
C*GFARMSIZE											0.21***	(0.00)	-0.08	(0.77)
C*GINCOME											-6.10e-05***	(0.00)	4.97e-05	(0.62)
C*GHOUSEHOLDSIZE											0.43***	(0.00)	1.16***	(0.00)
C*G2AGE											0.53***	(0.00)	0.24***	(0.01)
C*G2SEX											44.99***	(0.00)	41.26***	(0.00)
C*G2EDUCATION											2.55***	(0.00)	2.14***	(0.00)
C*G2FARMSIZE											5.14***	(0.00)	4.25***	(0.00)
C*G2INCOME											-1.16e-03***	(0.00)	-1.11e-03***	(0.00)
C*G2HOUSEHOLDSIZE											9.98***	(0.00)	8.42***	(0.00)
Observations	216		216		216		216		216		154		154	
R2/Log pseudolikelihood	-80.03		0.88		0.88		0.89		0.89		0.89		0.89	

Notes: Average Marginal Effects are calculated for probit estimation in col1; Robust p-value in parentheses; With ***, ** and * denoting significance at the 1, 5 and 10 percent level respectively; BDF refers to the estimator of spatial instrumentation as discussed by Bramoullé et al(2009); The family and year dummies are controlled for in all equations.