Neighborhood Effects on Social Behavior: The Case of Irrigated and Rainfed Farmers in Bohol, the Philippines

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Abstract

Behavioral game experiments, spatial econometrics, and household survey are blended in a single study to investigate the neighborhood effects of social behaviors. In the context of rural development and institutional change, revelation of neighborhood effects is expected to contribute toward a better understanding of the emergence of social norm and community mechanism. Dictator game and public goods game experiments are conducted by the International Rice Research Institute (IRRI) to quantitatively elicit altruistic behavior and contributory behavior, respectively, of rice farmers in Bohol, the Philippines. Subsequently, the neighborhood dependence of such social behaviors is tested using spatial econometric technique, while socioeconomic factors are duly controlled for. Extra attention is paid to the difference in neighborhood effects between irrigated and non-irrigated areas. It is found that (i) altruistic behavior and contributory behavior to public work are significantly influenced by those of the neighbors in the irrigated areas alone where collective actions are required for water resource management in their real life; (ii) among irrigated farmers, those under volumetric water pricing system (as opposed to are-based flat-rate system) contribute slightly more to public work; (iii) the spillover of contributory behavior to public work is stronger among farm plot neighbors than among residential neighbors in the irrigated areas, possibly reflecting their interactions for irrigation management; (iv) a warning message effectively reduces free riding in public goods game in the irrigated areas.

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1. Introduction

An increasing number of economists now recognize that social behavior of individuals within their community plays a crucial role in rural development. In particular, a large body of literature on social capital has provided evidences as to how social behavior can affect poverty reduction and economic growth of the community.[1] The underlying mechanism is considered to be the ability of social capital to induce effective collective actions and reduce transaction costs in a variety of ways (Hayami 2009, Arrow 1999, Solow 1999). Different facets of social capital have been demonstrated to have a profound impact on economic development. Studies by Zack and Knack (2001) and Knack and Keefer (1997) revealed that a survey-based measure of trusting behavior has a positive effect on economic growth. Chou (2006) takes one step further and indicates that social norms and collective trust promote economic growth through accumulation of human and financial capitals. Further evidence of the impact of social capital on development through case studies in Africa, Central America, and Asia are reported by Grootaert Christiaan and van-Bastelaer (2008), Krishna (2007), and Isham et al. (2002).

Despite the marked importance of social behavior, their spatial spillovers and externalities had not received much attention in socioeconomic literature. Over the past decade, the interest in this type of study had begun to grow. Anselin (2003) addresses the significance of neighbors'

[1] Terms such as social behavior, social interaction, social norms, social relationship, and collective trust are often used as synonyms and are considered to be forms of social capital, although they may carry different connotations (Ionnides and Topa 2010; Hayami 2009).

influence on economic decision making. Through neighborhood interactions, individuals (or households) affect each other's personal decisions, preferences, information sets, and behavioral outcomes, directly rather than indirectly through markets. Hence, decisions of individuals who share spatial and social milieus are likely to be interdependent. In the setting of development economics, this kind of mutual influence may be interpreted as the behavior shaped by informal social norms or by community mechanisms. Since social interaction of agents contains a spatial aspect, it is desirable to explicitly model the spillover of social behavior across neighbors.[2]

This study aims to examine the influence of neighborhood effects on individual-level social behaviors of rice farmers in Bohol, the Philippines. Following this introduction, section 2 outlines the idea of neighborhood effects in more depth, while contrasting our study with preceding literature. Section 3 assembles our main hypotheses, followed by section 4 to introduce the econometric methodology to estimate the neighborhood spillover effects. Section 5 explains our survey data by illustrating the game experiments to elicit quantitative measures of farmers' social behaviors, as well as describing the characteristics of possible determinants and control variables to be included in regressions. Section 6 presents the results of the regression analysis. Finally, section 7 offers concluding remarks.

2. Neighborhood Effects

[2] Moreover, Anselin and Griffith (1988) point out that omission of spatial interdependence in a regression model would result in spatially autocorrelated error terms which affect the interpretation of often used diagnostics such as model fit and misspecification tests. Case (1992) also indicates that failure to control for neighbors' influence may bias estimation of parameters of interest, using an example of new technology adoption among farmers in Indonesia.

Aside from social behaviors, neighborhood effects on socioeconomic outcomes in general have been studied to a great extent.[3] According to Raudenbush and Sampson (1999), the most common approach in neighborhood effect studies is to estimate the impact of current characteristics of residential neighborhood, alongside a host of controls such as individual, familial, workplace, and school variables. Such studies typically treat neighborhood processes by tagging a variable or two that represent neighborhood characteristics of some kind (e.g. ethnicity, income level). This methodology may be appropriate when the study site is relatively extensive and comprises a substantial number of different neighborhoods to be analyzed. In contrast, our study site is a relatively concentrated rice farming environment without a considerable degree of neighborhood variation (e.g. ethnical). In this setting, interpersonal level spillover is expected to be significant, and person-to-person interaction should pose a measureable impact on individual behavioral pattern formation (Hypothesis 1). This, in fact, is somewhat consistent with the view of Cook et al. (1997) that each neighborhood is internally more heterogeneous and less monolithic than is often believed. Our analysis takes into account neighbors' individual level behaviors and characteristics, rather than variables aggregated to neighborhood level.

Ioannides and Topa (2010) delineate three sources of neighborhood effects. First, the direct effects of neighbors' outcome on the individual's outcome are known as *endogenous social effects*. The propensity of an individual to behave in some way varies together with the prevalence of that behavior in some reference group containing that individual. For instance, individuals care about their friends' altruism, which then affects their own altruism. That is, own decisions and decisions of those in the same neighborhood are, in some sense, mutually

[3] Depending on the context, neighborhood effects can be called, "peer influences", "conformity", "imitation", "contagion", "epidemics", "bandwagons", "spatial externalities", "herd behavior", "neighborhood spillover", or "interdependent preferences" (Manski, 1993).

influential.[4] Second, individuals also care about personal characteristics of others, i.e., whether their neighbors are young or old, male or female, rich or poor, black or white, trendy or traditional, so on so forth. Such effects are known as *exogenous social effects*.[5] Third, individuals in the same social settings may act similarly because they share common unobservable factors or face similar institutional environments. Such an interaction pattern is known as *correlated social effects*. A precursor to the concept is Manski (1993), who emphasized the difficulty in separately identifying endogenous effect from exogenous effect in linear models, as well as identifying the two effects from correlated effect. Drawing on this argument, we attempt to explicitly distinguish the three sources of social effects in our econometric model (section 3), while referring to all the three as "neighborhood effects." This demarcation is important because the three channels of neighborhood effects should lead to differing policy implications.

One general note on the identification of neighborhood effects is that it may suffer a self-selection problem. Interdependence among individuals' decisions and behaviors within a spatial or social milieu can be complicated by the fact that in some circumstances individuals can choose their own neighborhood. In other words, individuals may choose their neighborhood effects by choosing their residence and/or workplace. Such choices involve information that is unobservable to the researcher, and thus require inferences about possible factors which contribute to their choices (Blume et al. 2010, Bandiera and Rasul 2006, Brock and Durlauf 2001, Moffitt 2001). In our analysis, however, the self-selection problem is assumed to be negligible since farmers, particularly farm household heads, are less likely to relocate and choose their community as compared with residents in urban areas who are subject to moving much more

[4] Examples are nicely presented by Bandiera and Rasul (2006) who conducted a household survey on sunflower adoption in Mozambique, Case (1992) who did a research on new technology adoption among rice farmers in Indonesia, and Conley and Udry (2003) who analyzed social learning of new technology in pineapple farming in Ghana.

[5] In sociology literature, exogenous social effects are often referred to as "contextual effects."

frequently. Sampson et al. (1999) also back up this point by indicating that the most reliable conditions in favor of neighborhood effects are residential stability and low population density, among other things.[6]

3. Hypotheses

Based on the previous discussions, our main hypotheses to be tested are related with whether, in what cases, and in what ways farmers' social behaviors are influenced by neighbors' behaviors and characteristics. To rephrase our first hypothesis developed in section 2,

H1) *Social behaviors of individual farmers are influenced by their neighbors' social behaviors and personal attributes.*

Second, social interdependencies emerge if individuals share a common public resource and social space which may generate constraints on individual actions (Ioannides and Topa 2010). Since irrigation schemes mandate farmers to cooperate over conservation and management of public water resources (Fujiie et al. 2005; Ostrom 2000), our second hypothesis is,

H2) *Neighborhood effects on social behaviors, particularly contribution to public goods, augment in the irrigated area vis-à-vis in the rain-fed area.*

Third, by the same token, volumetric pricing of irrigation water should induce incentive for better collective action toward saving water resources, than does area-based pricing in which marginal cost of using water is zero. Hence, our third hypothesis is,

[6] To be more specific, they found that the most reliable conditions are low population density, residential stability, and concentrated affluence rather than concentrated poverty, racial/ethnic composition, and individual-level covariates.

H3) *In irrigated areas, farmers are more contributory to public goods when they are engaged in volumetric water pricing system than in area-based flat rate system.*

Fourth, H2 and H3 imply that neighborhood effects on public goods contribution may be greater when we consider farm field neighbors than residential neighbors, as collective actions must be intensively required in the field work rather than in the residential life. Sampson et al. (2002) also emphasize the need of looking into social interactions at school or workplace, despite the common practice in neighborhood-effects research of looking solely at the place of residence. Accordingly, our fourth hypothesis is,

H4) *The endogenous social effects on public goods contribution are more salient among farm plot neighbors than among residential neighbors.*

4. Spatial Econometric Model

Econometrically, it had not been so straightforward to capture spatial spillover until the recent development of spatial econometric techniques as well as the surge in the availability of geo-coded economic information collected at a range of spatial scales. These advancements began serving the need of accounting for neighborhood dependence explicitly and systematically (Anselin 2010).[7] Therefore, our empirical strategy is to capture the influence of neighbors on individuals' measured social behaviors through spatial econometric estimations.

From the geographical coordinates of the farmers of sample size N, an N x N weight matrix W is constructed to define the interdependence among observations. In this paper, the weight

[7] Since our study site is a rural farm area, there are no such issues as raised by Grannis (1998, 2001) for cases of urban areas, where residents interact more with those living within their extended communities than with those who live nearby but across major thoroughfares.

matrix is based on the arc distance between observations. The weight matrix is a binary matrix with elements coded 1 when two observations (spatial units) are neighbors, and 0 when they are not. Hence, by definition, orthogonal elements of the matrix, which describe the seof-relationship, are all zeros. The neighborhood is defined based on a threshold distance which enforces all observations (spatial units) to have at least one neighbor. In order to test H4, two forms of neighborhood structures are considered: residential neighborhood W_r and farm plot neighborhood W_p, so that we can investigate which form of neighbors is more influential on farmers' social behaviors.

Our estimation procedure starts with a general a-spatial model where a farmer's social behavior depends on his/her own socioeconomic characteristics:

$$Y_i = \alpha_{1i} X + \varepsilon_{1i} \quad (1)$$

where Y_i represents an *N* x 1 series measurement of social behavior *i* of individual individual farmers (spatial units), *X* represents an *N* x *K* matrix containing vectors of *K* variables which measure the individual agricultural and socioeconomic characteristics; and the last term ε_{1i} represents the residual or error term. Recently, the exogenous social effects as discussed in section 2 are also systematically modeled by Autant-Bernard and LeSage (2011) into spatial econometrics framework. Mathematically, Eq. (1) can be modified to include the influence of neighbors' characteristics as:

$$Y_i = \alpha_{2i} X + \beta_{2i} W_s X + \varepsilon_{2i} \quad (2)$$

where the spatial lag of *X*, denoted $W_s X$ ($s = r, p$), represents the weighted average of *X* over individuals' neighbors when the *N* x *N* weight matrix W_s is row standardized. This specification is referred to as cross-regression model.

Spatial diagnostic tests are then performed on the residual ε_{2i} to determine the appropriate spatial process (see Anselin et. al 1996). Performing a set of Lagrange multiplier tests and following the procedure outlined in Anselin (2005), the candidates specification can be (a) spatial lag model[8] (with cross or spatially lagged independent variables), (b) spatial error model (with cross or spatially lagged independent variables), (c) the combination of the two (ARAR model with cross or spatially lagged independent variables), and (d) cross or spatially lagged independent variable model (i.e., Eq. (2)). These specifications are expressed as follows:

$$\text{(a) } Y_i = \rho_{3i} W_s Y_i + \alpha_{3i} X + \beta_{3i} W_s X + \varepsilon_{3i} \tag{3}$$

$$\text{(b) } Y_i = \alpha_{4i} X + \beta_{4i} W_s X + \varepsilon_{4i}, \quad \varepsilon_{4i} = \lambda_{4i} W_s \varepsilon_{4i} + \mu_{4i} \tag{4}$$

$$\text{(c) } Y_i = \rho_{5i} W_s Y_i + \alpha_{5i} X + \beta_{5i} W_s X + \varepsilon_{5i}, \; \varepsilon_{5i} = \lambda_{5i} W_s \varepsilon_{5i} + \mu_{5i} \tag{5}$$

where the coefficients ρ_i, β_i, and λ_i capture the endogenous social effects, exogenous social effects, and correlated social effected, respectively, for social behavior *i*, along the lines of the discussion in section 2.

5. Survey Data

5.1 Agricultural and Socioeconomic Variables

Agricultural and socioeconomic variables constitute the vector of variables X described in section 4. The International Rice Research Institute (IRRI) conducted a set of surveys on 243 randomly selected rice farmers in three municipalities (San Miguel, Trinidad, Ubay) in Bohol, the Philippines for four agricultural seasons from 2009 to 2010, to construct the individual-level

[8] It is also often referred to as spatial autoregressive model.

primary dataset consisting of agricultural and socioeconomic profile. The survey covers both irrigated areas, where $N = 132$, and rain-fed areas, where $N = 111$. For the sake of other research projects, a half of the irrigated farmers randomly selected are charged the irrigation water fee by consumed volume while the other half by area size (i.e., zero marginal cost). This feature of the dataset is utilized for testing H3.

Among the collected variables, this paper employs farmer's age, gender*, years of schooling, field size, asset[9], household size[10], and female ratio of the household as well as access to irrigation*, pricing system for irrigation water*, to see whether any of these variables of themselves and their neighbors can explain the social behavior.[11] The asterisked variables are converted into dummy format. Logarithm is considered for the asset variable to exhibit a distribution that is much closer to normal distribution. For most of the variables, the average over four crop seasons is calculated.[12] The sample mean and standard error of these variables are summarized by irrigation status in Table 1.

To validate the comparison of neighborhood effects between the irrigated and rainfed samples, it is required that the difference in social behavior arises from the difference in the way farmers interact due to their ecosystem, but not as much from the difference in intrinsic demographical factors. The rightmost column of Table 1 presents the t-test diagnostics for the mean difference in the mentioned variables between the two ecosystems. The only highly significant difference is found for the field size variable. Attention is paid to this variable when discussing the regression results in section 6. For all other variables, however, the mean

[9] Asset is included as an indicator of farmers' general wealth level. It consists of agricultural, non-agricultural, and livestock assets.
[10] Household size is defined as the number of household members.
[11] To circumvent a multicollinearity problem, the coefficient of correlation was checked for all the combinations of variables included together in any regression, and was confirmed to be at most 0.35 on the absolute term.
[12] In most parts of the Philippines, rice is cultivated twice a year: i.e., in rainy season and dry season.

difference is neither statistically significant nor large in magnitude. We therefore assume that there is little intrinsic difference between the irrigated and rainfed samples, except the ecosystem itself.

5.2 Geographical Coordinates

The geographical coordinates are recorded for both the farm plots and residences of the sample farmers, which allows us to define two types of neighborhood, plot neighborhood and residential neighborhood, for each individual farmer.[13] To show the geographical coverage of the sample, Table 2 presents the range of the latitude and longitude of the plots and residences, separately for irrigated and rainfed farmers.[14] The rainfed areas are located to the north of the irrigated areas as indicated by the coordinates.

5.3 Game Experiment Design

Our dependent variables are the indicators of social behaviors which are the results of our behavioral game experiments. To elicit farmers' social behaviors, at the end of the last survey season, IRRI conducted two types of game experiment that are commonly practiced in the field of behavioral and experimental economics: (1) dictator game for measuring altruistic behavior and (2) repeated public goods game for measuring contributory behavior to public work.

The general conditions in the experiments are as follows: Participants are paid a show-up fee of 50 Philippines pesos (P50) before the game, plus additional P100 after the game. Whatever money participants acquire through the games also becomes their property to take home. Participants are instructed to take the games seriously and are not allowed to chat with other

[13] For farmers with multiple plots, the geo-coordinates of the most important plot self-claimed by the respondents are considered.
[14] Those farmers who have plots in both irrigated and rainfed areas are categorized as irrigated farmers.

participants throughout the event. If the rules are violated along the way, they do not receive the rest of the show up fee (P100).

5.3.1 Dictator Game

This game is played by an arbitrary pair of individuals. Participants are not informed of who their partner is, and vice versa. The partner is given no money in the beginning, and the participant does not receive any money from his/her partner. Then, the participant is given P100 (five P20 banknotes) and is asked to determine how much to transfer to the partner if the partner is someone anonymous in the same barangay who has no initial endowment of P100.[15] This value is recorded as the result of the game, and is regarded as an indicator of each participant's altruistic behavior within the barangay community.[16] The game ends in one-shot interaction.

5.3.2 Tow-round Repeated Public Goods Game with Monitoring and Message

In the repeated public goods game experiment, participants form groups of four persons within the same barangay, but are not informed of who their group members are.[17] Then, each consisting member is given P100 (five P20 banknotes) and is asked to contribute some amount to the group the one belongs to. The key feature is that the amounts contributed by all the members are collectively doubled and then shared evenly among the members, regardless of whether each member contributes more/less than the others. This feature provides an incentive of free riding, which is typically observed in the provision of public goods. After the first round of the game, participants can, in secret, observe the contribution from each partner by paying P1 of cost. Then,

[15] Barangay is the smallest official administrative unit corresponding to the concept of village in general.
[16] Though not reported as it goes beyond the scope of this paper, the same experiments are conducted in terms of different levels of community as well: purok (unofficial small village), TSA (turn-out service area of irrigation) of the same barangay, TSA of a different barangay (nonspecific), and municipality.
[17] Though not reported in this paper, a non-repeated public goods game experiment is also executed, in which different levels of community are considered.

the one can send an anonymous unhappy signal to particular partners to manifest his/her peeve, with the cost of P1 per message sent.[18] The second round of the game is played immediately after the first round, within the same groups. The data as to whether the participant checked the other members' contribution in the first round, how many complaints he/she received, and how much the other members contributed in total, are also recorded for controlling purposes. The amount of contribution provides a measure of the player's contributory behavior to public work or anti-free riding behavior.

5.4 Control Variables in Public Goods Game Analysis

5.4.1 Risk Preference

One critical control variable in the estimation of the public goods game results may be farmers' individual risk-taking behavior. Some theoretical researches on game experiments and social capital suggest that the propensity to transfer money in games like trust game and public goods game, in which the subject receives some amount back from the partner(s), should be closely associated with the willingness to take risk (Cook and Cooper 2003, Ben-Ner and Putterman 2001). On the empirical side, Eckel and Wilson (2003) found that subjects' self-reported risk attitudes influence the trust decision.[19] These reports indicate that individuals' propensity to bet in return-expected games is at least partly accounted for by their bet in a risk game. Hence, we also conducted a risk game experiment as follows: the game is played by one person only. The participant receives P100 (five P20 banknotes) and is given an opportunity to bet a share. The bet is multiplied by either 0, 0.5, 1, 1.5, 2, or 2.5, which is determined by

[18] We used a so-called unhappy face icon card to express the message of dissatisfaction. The cards are secretly given to the designated persons at the beginning of the second round of the game.

[19] On the other hand, Bohnet & Zeckhauser (2003) found that individuals are more willing to take risks when the outcome is purely due to chance (as in risk game), than in an equivalent-odds situation where the outcome depends on how trustworthy the receiver is (as in trust game).

drawing one of six cards bearing those numbers, with equal probabilities of being selected. The betted amount is recorded as an indicator of individuals' risk preference.

5.4.2 Message Receipt Dummy

The message receipt dummy (MRD) takes the value of 1 if the individual received at least one complaining message from the group members after the first round of public goods game, and 0 otherwise. The MRD variable is included in the regressions for the second round, and a positive coefficient is expected, on the ground that the presence of peer pressure discourages free riding behavior.[20]

5.4.3 Free Riding Index

The free riding index (FRI) is defined as a product of two variables: (a) the average of the group members' contribution minus one's own contribution, which indicates the relative degree of free riding within the group, and (b) the dummy of whether the one checked the other group members' contribution explicitly. The FRI therefore is intended to express the recognition of one's own free riding level relative to the group members.[21]

5.4.4 The Interaction Term between the MRD and FRI

It is assumed that the effect of receiving messages augments when the one is free riding and is aware of it. To control for this impact, the interaction term between the MRD and FRI is created and included in the regressions.

5.4.5 The Contribution in the First Round

[20] We also performed regressions using the number of complaints received instead of the MRD. In that case, the coefficients were smaller and less significant.
[21] We also tried including the variable (b) alone instead of the FRI, since one's degree of free riding can be indirectly recognized through the return on the contribution. The regression results were not as clear as with the FRI.

The most essential control in the second round is the one's own contribution in the first round. Onesa & Putterman (2007) point out that those individuals who contribute highly in the first round tend to contribute largely in the second round as well. They conclude that public goods contribution is a somewhat persistent behavior even in the presence of sanction. Thus, without controlling for this tendency, variables such as the MRD would suffer a severe estimation bias.[22]

To wrap up the section, the descriptive statistics of the variables from the game experiments are summarized in Table 3, with a view to comparing the two samples. There is no significant mean difference in these variables except that the dictator game result is slightly higher in the irrigated areas than in the rainfed areas. Tables 1 and 3 together suggest that the farmers in the two ecosystems are not intrinsically different. However, the mechanism of the determination, particularly regarding neighborhood effects, could be different. We investigate this issue with spatial econometric technique in the following sections.

6 Neighborhood Structure

Four different weight matrices are constructed, corresponding to the four types of neighborhood considered: (a) plot neighborhood for irrigated farmers, (b) plot neighborhood for rainfed farmers, (c) residential neighborhood for irrigated farmers, and (d) residential neighborhood for rainfed farmers. A threshold distance criterion is employed to determine who

[22] We did the check and confirmed that the absence of this control variable inverts the sign of the coefficient on the MRD, due to a selection bias.

the neighbors are for every individual farmer, which is the most common way of creating distance weight matrices.[23]

In view of the boundary bias issue (see e.g. Griffith (1983)), our basic strategy is to set a threshold distance as short as possible. First, we created weight matrices by imposing the shortest possible threshold distance in each of the four neighborhoods.[24] The threshold distance (in kilometers) for each matrix turned out to be 0.959, 1.302, 0.956, and 1.376 for neighborhood (a), (b), (c), and (d), respectively. Then, since our purpose is to undertake a fair comparison among the neighborhoods, we attempt to impose a uniform threshold distance for all the matrices, for which we choose the shortest of the four. Hence, the uniform threshold distance of 0.965 km is applied. Accordingly, one, two, and one observations are dropped from neighborhood (a), (b), and (d), respectively.[25]

Table 4 summarizes the characteristics of the four weight matrices. The imposition of the uniform threshold distance seems to be reflected in the insignificant mean difference in average distance of links between the two ecosystems. The average number of links and the average distance of links are in a trade-off relationship. The t-test suggests that neighbors are relatively densely located in the rainfed areas. The frequency distribution of the number of neighbor links per farmer (Figure 1) illustrates that the variance of the number of neighbors is also larger in the rainfed areas. Finally, graphical representations of the neighbor links are provided in Figures 2a-d.

[23] In general, distance weight matrices are used for individual level spatial analysis, while contiguity weight matrices are considered for administrative unit level spatial analysis in which the neighbors are the adjacent administrative units. Another common way of creating distance weight matrices is to use the k-nearest neighbor criterion.

[24] The shortest possible threshold distance is the distance that barely ensures that every observation in the neighborhood has at least one neighbor. Note that observations with no neighbor have to be dropped from the weight matrix, and thus, disappear from the entire regression.

[25] The two observations dropped from neighborhood (b) and the one from (d) are mutually exclusive. Therefore, the comprehensive observations in the rainfed sample that should be considered in the earlier descriptive statistics are 111.

7 Spatial Regression Results

7.1 Spatial Model Selection

To identify which spatial model should be adopted, the Lagrange multiplier tests on the cross regression residuals are performed for each of the twelve cases (three games times four weights). The test statistics and our corresponding model choice are summarized in Table 5. In the cases of dictator game and public goods game round 2 for weight (c), the diagnostics are somewhat ambiguous, so that the secondary model is also examined for robustness check.

7.2 Estimation Results

Tables 6, 7, and 8 present the estimation results for dictator game, public goods game round 1, public goods game round 2, respectively.

7.2.1 Dictator Game

In the irrigated areas, the coefficient ρ is found to be positive and significant, according to the results for neighborhoods (a) and (c) (with the first model). This finding indicates that neighbors' altruistic behavior directly and positively affects farmers' altruism. In other words, farmers' altruistic tendencies are prone to be aligned with their neighbors', so that such kinds of actions tend to be homogeneous within the community. It is thus inferred that the introduction and availability of irrigation that requires collective management promoted social interactions and behavioral spillovers, which led to the emergence of the kind of social norm. In comparing the magnitude of ρ between (a) and (c), we may claim that the endogenous social effect is larger and more significant among the residential neighbors than among plot neighbors. It may be the case that altruistic actions are associated more with daily life activities around their residences than with farming activities on the fields.

As for the exogenous social effects, the only highly significant effect is found in field size for plot neighbors. It is shown that farmers who interact with largeholders are more altruistic, regardless of their own landholding. In comparing (a) and (c), the field size effect is weaker among residential neighbors than among plot neighbors, probably because the land size is less visible to residential neighbors.

Among the own characteristics, the effect of household female ratio is positive and significant. Dufwenberg & Muren (2006) report a similar finding that people from certain groups are more generous and equalitarian when women are in majority of the group, which may suggest that members of a female-dominant family tend to be more altruistic.

In the rainfed areas, on the other hand, no endogenous social effect, ρ, is detected. It seems clear that, unlike in irrigated areas, farmers' altruistic behavior is not directly influenced by that of their neighbors, whether plot or residential. Farmers' own land size, however, might have a positive effect on their altruism. In the absence of intensive collective actions, individual farmers' altruistic behavior is, at least partially, determined by the abundance of his/her land resource. At any rate, rainfed farmers' altruistic behavior seems to be rather individually than mutually influenced.

7.2.2 Public Goods Game, Round 1

In the first round of public goods game, no endogenous social effect is found in any of the four types of neighborhood. This result may indicate that before individuals are exposed to the result of monitoring actions exercised by community members, they do not align their contributory behavior with that of their neighbors. The exogenous social effect is generally weak as well. By no means, farmers' contributory behavior is clearly influenced by the community members, provided that no peer effect is in operation.

Turning to the own characteristics, the most decisive factor is found to be age, of which the coefficients are negative and highly significant.[26] Since public goods contribution has an aspect of investment, the decision must be associated with individual time preference. According to Read & Read (2004), older people discount time more than younger ones, which appears to explain our estimated coefficients.[27] In comparing the two ecosystems, a positive effect of field size is found in the irrigated areas, whereas the coefficient is negative and insignificant in the rainfed areas.[28] Although this result seems somewhat puzzling, one possible interpretation is that largeholders of irrigated land depend on collective actions for irrigation maintenance, while in the rainfed areas largeholders are relatively self-sufficient. In other words, for largeholders, the incentive for community investment is relatively high (low) in the irrigated areas (rainfed areas). Volumetric water pricing has no effect before observing the result of monitoring. As expected, risk preference is positively linked with public goods contribution, particularly in the irrigated areas, which may be because investment mindset is more established in the irrigated areas and is decisive in the pre-monitoring environment.

7.2.3 Dictator Game, Round 2

[26] Quadratic function of age was also examined. However, the coefficients on the quadratic terms were always insignificant, indicating that the inclusion of quadratic age does not add to the results. We have thus removed that term.

[27] Some studies present contrasting findings. Chao et al. (2009) find an insignificant age effect on time preference while Aldy & Viscusi (2007) report an inverted U relation. Nevertheless, the downward sloping part of the inverted U may correspond to our result, since a majority of our sample famers are middle-aged or elderly.

[28] A simple X-Y scatter plot of land size and public goods game contribution also shows a negative slope.

In the second round of public goods game, farmers' contributory behavior with the influence of monitoring and message is expected to manifest. The game setting is designed to correspond to a community consisting of individuals with experience in collective actions.

In the irrigated areas, the coefficient ρ is found to be positive and highly significant, in particular for plot neighbors. This is a remarkable result indicating a spillover effect of contributory behavior from neighbor to neighbor, i.e., farmers who are experienced in collective actions are inclined to align their contribution level with that of the community members. Hence, it is inferred that contributory behavior tends to become incrementally homogeneous within the neighborhood, inducing an emergence of social norm. In comparing the magnitude of ρ between (a) and (c), this endogenous social effect is greater and more significant for plot neighbors than for residential neighbors, which must be attributed to the collective irrigation management conducted primarily in cooperation with plot neighbors, but not as much with residential neighbors. As in the first round of the game, the exogenous social effects are generally weak. Among the own characteristics, age effect became much less significant compared with the first round. It may be the case that older farmers are more loyal to the evolving social norm. Under the monitoring pressure, the volumetric pricing dummy has positive coefficients, though the statistical significance is not considerably high.

In the rainfed areas, on the other hand, no endogenous social effect is detected. It seems clear that, unlike in irrigated areas, farmers' contributory behavior is not directly influenced by that of their neighbors, whether plot or residential. Anyhow, rainfed farmers' contributory behavior seems to be largely independent of others.

The estimation as to the monitoring-related control variables deserves close attention. The coefficients on MRD are positive and significant all over, indicating that farmers increase their contribution when they explicitly receive an unhappy message from the community members.[29] The result supports the effectiveness of the monitoring mechanism. FRI shows a positive impact in the irrigated areas alone. Since this index represents farmers' awareness of own free-riding behavior, it is indicated that irrigated farmers are willing to adjust their contribution voluntarily when they notice their own over-contribution or under-contribution. This result provides another evidence of irrigated farmers' tendency to emulate others or emergence of social norms. The MRD-FRI interaction term exhibits a positive impact in the irrigated areas, which means that receipt of complaints is even more effective when combined with the awareness of own free-riding behavior. In other words, in the irrigated areas, free-riders are more responsive to messages of dissatisfaction, while in the rainfed areas, farmers respond to messages more or less uniformly regardless of free riding. This result may indicate the emergence of a community mechanism in the irrigated areas, which facilitates to socially circumvent the free riding problem. Lastly, as mentioned in section 5.4.5, contribution in the first round of the game plays a crucial role as a control variable.

7.3 Summary of the Findings

In view of our hypotheses, the findings are summarized as follows. First, neighborhood effects on farmers' social behavior are identified in this study. The endogenous social effects among irrigated farmers are found in the estimations of dictator game and monitored public goods game. The exogenous social effects are minor on the whole, whereas no correlated social

[29] The coefficients appear to be smaller in the irrigated areas. However, the total effect of MRD must incorporate the cross effect of MRD-FRI interaction as well. Since the interaction term is significant only in the irrigated areas, the total effect of MRD is not considerably different between the two ecosystems.

effects are found. Hypothesis 1 is accepted to the extent that it depends on the irrigation availability and the type of social behavior. Second, there exists a clear contrast in the result between the two ecosystems. The endogenous social effects and the impact of FRI are found only in the irrigated areas, which definitely supports Hypothesis 2. Third, volumetric water pricing makes no difference in the outcome of dictator game and pre-monitoring public goods game, though it has a minimal positive effect in monitored public goods game. Thus, Hypothesis 3 is only weakly supported. Fourth, in comparing between plot neighborhood and residential neighborhood, the spillover of public goods contribution under monitoring is stronger among plot neighbors. Hence, Hypothesis 4 is clearly accepted.

8 Concluding Remarks

The study has provided insights into the emergence of social norms and community mechanisms that are induced through the experience of community based natural resource management. Combining the methodologies from experimental and behavioral economics, spatial econometrics, and farm household survey, we have empirically explored whether and to what extent farmers' social behaviors are affected by their neighbors' behaviors and characteristics. The most remarkable finding is that only in the irrigated areas, farmers' altruistic behavior and contributory behavior spill over to their neighbors. Assuming no intrinsic difference in behavioral traits between irrigated farmers and rainfed farmers, which is partially supported by the descriptive tables, our result indicates that collective actions required in irrigation water management induce the emergence of social norm, in which farmers decide on their social behavior more or less by following the way their neighbors behave socially. Besides, farmers' positive corrective response to their own free riding behavior in the irrigated areas may be also regarded as the emergence of social norms. Moreover, the message of dissatisfaction effectively increases the contribution by free riders. It is thus inferred that cooperative resource management also promotes a community mechanism, through which individuals' free riding acts are corrected. An important note is that the irrigation systems in the study site were introduced rather recently, in 2008. Therefore, it is implied that, by intervention schemes such as the construction of gravity irrigation, changes in social norm and community mechanism can take place rather shortly than slowly.

There are a couple of important areas in which extensions would be of interest. First, the contrasting result between the two ecosystems may be partially attributed to the relative concentration of neighbors in the rainfed areas, in addition to the relatively independent agricultural practices pointed out in this study. Although our hypothesis 2 is proposed in relation to the latter rationale, the result would be more convincing if we could separate out the former factor. Second, as mentioned in section 6, the number of neighbors per person and the average distance to neighbors are conflicting criteria commonly used in creating weight matrices. We have assumed the fairness of imposing the same threshold distance across the four types of neighborhood. Nonetheless, it may be interesting to use the k-nearest neighbor criterion, though the choice of criterion number has to be justified somehow. Finally, to understand the process of behavioral spillover in more depth, the next step of this research may be to estimate social behaviors using social distance instead of geographical distance. Such a study will explore how personal relationship affects the spillover of social behavior, and can also be applicable to situations in which geographical distance is not a hard constraint.

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Table 1 Descriptive Statistics for the Agricultural and Socioeconomic Variables, by Irrigation Availability

	(1) Overall (N=243)	(2) Irrigated Areas (N=132)	(3) Rainfed Areas (N=111)	(4) t-test for mean difference (3)-(2) [p-value]	
Volumetric Pricing Dummy		0.561			
		(0.498)			
Age	51.062	49.689	52.694	3.004	*
	(12.019)	(12.248)	(11.585)	[0.052]	
Gender Dummy	0.708	0.758	0.649	0.109	*
	(0.456)	(0.430)	(0.480)	[0.063]	
Years of Schooling	6.395	6.144	6.694	0.550	
	(3.0384)	(2.922)	(3.159)	[0.160]	
Ln Asset	10.578	10.444	10.738	0.295	
	(1.132)	(1.193)	(1.038)	[0.718]	
Field Size (ha)	1.585	1.167	1.754	0.586	***
	(1.058)	(0.682)	(1.228)	[0.000]	
Household Size (head count)	5.936	6.144	5.689	0.455	
	(2.302)	(2.321)	(2.265)	[0.125]	
Household Female Ratio	0.500	0.484	0.519	0.035	*
	(0.162)	(0.148)	(0.176)	[0.092]	

Note: The standard deviations are in the parentheses. *** and * indicate 1 percent and 10 percent statistical significance levels, respectively, for the mean difference between the irrigated and rainfed areas. For the mean difference, the absolute values are presented.
Sources: Authors' calculation with data collected by IRRI.

Table 2 Geographical Coordinates of Sample Rice Farmers in Bohol, Irrigated Areas and Rain-fed Areas

		Residence		Farm Plot	
		Minimum	Maximum	Minimum	Maximum
Irrigated Area (N=132)	Latitude (N°)	9.960	10.052	9.960	10.049
	Longitude (E°)	124.355	124.436	124.355	124.434
Rain-fed Area (N=111)	Latitude (N°)	10.000	10.103	10.001	10.103
	Longitude (E°)	124.349	124.427	124.349	124.427

Source: IRRI

Table 3 Descriptive Statistics for the Game Experiment Results, by Irrigation Availability

	(1) Overall (N=243)	(2) Irrigated Areas (N=132)	(3) Rainfed Areas (N=111)	(4) t-test for mean difference (3)-(2) [p-value]	
Dependent Variables					
Dictator Game	30.041	32.197	27.477	4.719	*
	(20.236)	(21.555)	(18.314)	[0.070]	
PGG Round 1	54.403	53.182	55.856	2.674	
	(23.033)	(22.080)	(24.139)	[0.368]	
PGG Round 2	52.140	51.818	52.523	0.704	
	(24.350)	(23.633)	(25.279)	[0.823]	
Controls					
Risk Preference	53.786	54.470	52.973	1.497	
	(25.898)	(24.380)	(27.686)	[0.655]	
PGG R1 Message Reception Dummy	0.280	0.273	0.288	0.016	
	(0.450)	(0.447)	(0.455)	[0.789]	
PGG R1 Free-riding Index	-0.110	0.455	-0.781	1.235	
	(15.335)	(14.746)	(16.049)	[0.533]	

Note: The standard deviations are in the parentheses. * indicates 10 percent statistical significance level for the mean difference between the irrigated and rainfed areas. For the mean difference, the absolute values are presented.

Sources: Authors' calculation with data collected by IRRI.

Table 4 Neighborhood Structure: Characteristics of the 4 Weight Matrices

	------- Field Plot Neighbor -------			-------- Residential Neighbor --------		
	(1) Irrigated Areas	(2) Rainfed Areas	(3) t-test for mean difference (2)-(3) [p-value]	(4) Irrigated Areas	(5) Rainfed Areas	(6) t-test for mean difference (5)-(4) [p-value]
Weight Code	(a)	(b)		(c)	(d)	
Number of Observations	131	109		132	110	
Total Number of Links	860	1166		866	1292	
Nonzero Weights (%)	5.01	9.81		4.97	10.68	
Average Number of Links	6.565	10.697	4.132	6.561	11.746	5.185
	(2.649)	(4.309)	[0.000]	(3.119)	(5.409)	[0.000]
Average Distance of Links	0.603	0.587	0.016	0.583	0.574	0.009
(kilometers)	(0.236)	(0.239)	[0.293]	(0.243)	(0.252)	[0.564]
<u>Weights Constants Summary</u>						
n	131	109		132	110	
nn	17,161	11,881		17,424	12,100	
S0	131	109		132	110	
S1	48.79	28.30		56.17	28.90	
S2	536.4	447.0		542.6	450.0	

Note:
Threshold Distance = 0.956 (kilometers): the distance that ensures that for any one of the four neighborhood structures, there is at least one neighbor for every observation. The constraining weight matrix is the one for (c). See text for more details.
Weight Style = W. The standard deviations are in the parentheses.

Table 5 Lagrange Multiplier Tests on Cross Regression Residuals for Spatial Dependence Identification

Game Experiment	Dictator Game				Public Goods Game, Round 1				Public Goods Game, Round 2			
Neighborhood	Field Plot		Residential		Field Plot		Residential		Field Plot		Residential	
Ecosystem	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
Weight Code	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
Moran's I	0.042 *	-0.031	0.131 ***	-0.126	-0.087	0.060 ***	0.004	-0.010	0.119 ***	-0.016	0.162 ***	0.014 *
	(0.050)	(0.385)	(0.001)	(0.990)	(0.849)	(0.004)	(0.246)	(0.219)	(0.000)	(0.241)	(0.000)	(0.081)
	↓	↓		↓	↓		↓	↓	↓	↓	↓	↓
LM on Error Correlation	0.616		5.332 **			1.511			5.001 **		8.135 ***	0.083
	(0.433)		(0.021)			(0.219)			(0.025)		(0.004)	(0.773)
LM on Lag Correlation	3.034 *		7.854 ***			1.831			10.961 ***		9.849 ***	0.974
	(0.082)		(0.005)			(0.176)			(0.001)		(0.002)	(0.324)
Robust LM on Error Correlation	12.977 ***		2.540 †			0.623			0.375		0.214	1.165
	(0.000)		(0.111)			(0.430)			(0.540)		(0.644)	(0.281)
Robust LM on Lag Correlation	15.395 ***		5.062 **			0.943			6.335 **		1.928	2.055
	(0.000)		(0.024)			(0.332)			(0.012)		(0.165)	(0.152)
LM on SARMA	16.011 ***		10.394 ***			2.453			11.336 ***		10.062 ***	2.138
	(0.000)		(0.006)			(0.293)			(0.003)		(0.007)	(0.343)
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Spatial Model of Our Choice	Lag and Cross	Cross	Lag and Cross	Cross	Cross	Cross	Cross	Cross	Lag and Cross	Cross	Cross	Cross
For Robustness Check			ARAR and Cross								Lag and Cross	

Note: The p-values are in the parentheses. ***, **, *, and † indicate 1, 5, 10, and 15 percent statistical significance levels, respectively.

Table 6 Spatial Regression Results for Dictator Game

Neighborhood	Field Plot		Residential		
Ecosystem	Irrigated	Rainfed	Irrigated		Rainfed
Spatial Model	Lag & Cross	Cross	Lag & Cross	ARAR & Cross	Cross
Weight Code	(a)	(b)	(c)	(c)	(d)
Endogenous Social Effect					
ρ	0.239 *		0.352 ***	0.331	
□	(0.078)		(0.004)	(0.430)	
Correlated Social Effect					
λ				0.034	
□				(0.948)	
Neighbors' Characteristics					
Volumetric Pricing Dummy	-13.630 *		-11.492 †	-11.601 †	
	(0.089)		(0.109)	(0.150)	
Age	0.123	0.060	-0.105	-0.128	0.445
	(0.740)	(0.923)	(0.763)	(0.763)	(0.505)
Gender Dummy	4.382	-24.624 *	11.062	11.584	8.701
	(0.589)	(0.077)	(0.195)	(0.258)	(0.514)
Years of Schooling	-0.750	-4.222 *	-1.288	-1.322	1.294
	(0.609)	(0.062)	(0.391)	(0.383)	(0.617)
Ln Asset	-0.887	10.944 *	5.075	5.230	-1.344
	(0.827)	(0.051)	(0.200)	(0.218)	(0.735)
Field Area (ha)	16.206 ***	3.016	8.419 †	8.361	4.183
	(0.008)	(0.587)	(0.135)	(0.194)	(0.426)
Household Size	-2.513 †	-2.327	-1.876	-1.895	-2.070
	(0.140)	(0.545)	(0.275)	(0.317)	(0.525)
Household Female Ratio	-2.364	-2.837	21.705	23.196	-5.491
	(0.942)	(0.934)	(0.440)	(0.500)	(0.893)
Own Characteristics					
Volumetric Pricing Dummy	-2.131		-0.327	-0.371	
	(0.543)		(0.922)	(0.915)	
Age	-0.201	-0.091	-0.263 *	-0.266 *	-0.121
	(0.186)	(0.607)	(0.077)	(0.077)	(0.487)
Gender Dummy	2.914	3.098	3.526	3.605	5.631 †

	(0.484)	(0.433)	(0.385)	(0.407)	(0.143)
Years of Schooling	0.610	0.282	0.221	0.213	0.334
	(0.341)	(0.663)	(0.734)	(0.748)	(0.615)
Ln Asset	-0.374	0.854	-0.308	-0.290	-0.347
	(0.820)	(0.653)	(0.849)	(0.863)	(0.859)
Field Area (ha)	-0.118	2.322 †	-0.956	-0.920	2.324 †
	(0.967)	(0.135)	(0.723)	(0.745)	(0.127)
Household Size	-0.323	0.261	-0.377	-0.387	0.462
	(0.664)	(0.759)	(0.613)	(0.610)	(0.613)
Household Female Ratio	29.147 **	3.188	30.608 **	30.845 **	-4.975
	(0.013)	(0.905)	(0.011)	(0.012)	(0.629)
Intercept	31.840	-52.679	-29.964	-30.609 †	10.964
	(0.470)	(0.441)	(0.494)	(0.150)	(0.846)
Sample Size	131	109	132	132	110
Fit of the Model					
Multiple R-squared		0.206			0.136
Adjusted R-squared		0.088			0.009
F Statistic		1.746 *			1.071
		(0.059)			(0.394)
Wald Statistic	3.865 **		11.480 ***		
	(0.049)		(0.001)		
LR Test				8.159 **	
				(0.017)	

Note: The p-values are in the parentheses. ***, **, *, and † indicate 1, 5, 10, and 15 percent statistical significance levels, respectively.

Table 7 Spatial Regression Results for Public Goods Game, Round 1

Neighborhood	Field Plot				Residential			
Ecosystem	Irrigated		Rainfed		Irrigated		Rainfed	
Spatial Model	Cross		Cross		Cross		Cross	
Weight Code	(a)		(b)		(c)		(d)	
Neighbors' Characteristics								
Volumetric Pricing Dummy	-9.637				-11.411	†		
	(0.273)				(0.147)			
Age	-0.623	†	0.548		-0.682	*	-0.520	
	(0.131)		(0.516)		(0.074)		(0.559)	
Gender Dummy	-9.676		19.125		-10.821		35.160	**
	(0.279)		(0.314)		(0.244)		(0.049)	
Years of Schooling	-0.152		-0.088		0.533		-1.508	
	(0.926)		(0.978)		(0.755)		(0.672)	
Ln Asset	0.013		-3.671		3.425		-3.891	
	(0.998)		(0.624)		(0.440)		(0.462)	
Field Area (ha)	8.575		-7.042		2.966		5.672	
	(0.190)		(0.347)		(0.633)		(0.418)	
Household Size	-1.822		-0.502		1.453		0.633	
	(0.328)		(0.924)		(0.440)		(0.884)	
Household Female Ratio	11.186		11.712		-8.118		31.177	
	(0.751)		(0.798)		(0.790)		(0.567)	
Own Characteristics								
Volumetric Pricing Dummy	0.221				0.217			
	(0.955)				(0.954)			
Age	-0.450	***	-0.713	***	-0.441	***	-0.743	***
	(0.008)		(0.004)		(0.008)		(0.002)	
Gender Dummy	-4.709		-3.032		-5.778		-2.514	
	(0.305)		(0.568)		(0.195)		(0.624)	
Years of Schooling	0.112		-0.194		0.236		-0.044	
	(0.876)		(0.824)		(0.744)		(0.960)	
Ln Asset	2.323		2.589		1.307		0.981	
	(0.201)		(0.312)		(0.465)		(0.708)	
Field Area (ha)	5.586	*	-2.125		5.754	*	-1.965	
	(0.069)		(0.315)		(0.054)		(0.334)	
Household Size	-0.742		-0.717		-0.575		-0.889	

	(0.367)		(0.531)		(0.486)		(0.469)	
Household Female Ratio	20.000	†	-18.463		18.812		-14.913	
	(0.125)		(0.191)		(0.155)		(0.286)	
Control								
Risk-Taking Behavior	0.227	***	0.132		0.215	***	0.135	†
	(0.006)		(0.167)		(0.010)		(0.134)	
Intercept	69.559		87.550		39.920		121.884	†
	(0.153)		(0.346)		(0.411)		(0.107)	
Sample Size	131		109		132		110	
Fit of the Model								
Multiple R-squared	0.232		0.185		0.256		0.218	
Adjusted R-squared	0.117		0.054		0.145		0.093	
F Statistic	2.012	**	1.409		2.302	***	1.741	*
	(0.016)		(0.159)		(0.005)		(0.056)	

Note: The p-values are in the parentheses. ***, **, *, and † indicate 1, 5, 10, and 15 percent statistical significance levels, respectively.

Table 8 Spatial Regression Results for Public Goods Game, Round 2

Neighborhood	Field Plot		Residential		
Ecosystem	Irrigated	Rainfed	Irrigated		Rainfed
Spatial Model	Lag & Cross	Cross	Cross	Lag & Cross	Cross
Weight Code	(a)	(b)	(c)	(c)	(d)
Endogenous Social Effect					
ρ	0.332 ***			0.284 ***	
	(0.001)			(0.004)	
Neighbors' Characteristics					
Volumetric Pricing Dummy	1.337		11.436 *	-6.470	
	(0.831)		(0.076)	(0.258)	
Age	-0.317	-0.584	-0.276	-0.221	-0.579
	(0.289)	(0.406)	(0.377)	(0.418)	(0.467)
Gender Dummy	0.439	14.381	-3.750	-1.077	25.875 †
	(0.945)	(0.364)	(0.627)	(0.874)	(0.116)
Years of Schooling	-2.103 *	3.266	1.360	0.428	1.365
	(0.070)	(0.215)	(0.331)	(0.731)	(0.665)
Ln Asset	2.964	-0.095	-1.520	-1.265	-3.677
	(0.354)	(0.988)	(0.680)	(0.694)	(0.437)
Field Area (ha)	0.574	2.848	8.166 †	3.265	4.391
	(0.903)	(0.653)	(0.111)	(0.480)	(0.482)
Household Size	-0.577	3.104	0.798	0.224	4.020
	(0.670)	(0.485)	(0.606)	(0.868)	(0.301)
Household Female Ratio	-8.270	19.684	35.690	-28.779	-19.813
	(0.742)	(0.610)	(0.157)	(0.189)	(0.683)
Own Characteristics					
Volumetric Pricing Dummy	3.199		3.314	4.083 †	
	(0.243)		(0.280)	(0.128)	
Age	0.167	-0.169	0.179	0.187 †	-0.089
	(0.170)	(0.429)	(0.193)	(0.120)	(0.692)
Gender Dummy	2.492	0.145	0.690	2.059	-0.156
	(0.438)	(0.974)	(0.849)	(0.517)	(0.973)
Years of Schooling	0.371	0.214	0.385	0.366	0.322
	(0.466)	(0.769)	(0.516)	(0.481)	(0.682)

Ln Asset	1.746		0.954		1.110		1.330		0.387	
	(0.171)		(0.661)		(0.447)		(0.297)		(0.869)	
Field Area (ha)	-0.716		-2.529		1.028		0.302		-2.671	†
	(0.749)		(0.154)		(0.681)		(0.890)		(0.142)	
Household Size	0.613		0.219		0.567		0.517		0.144	
	(0.291)		(0.821)		(0.405)		(0.384)		(0.895)	
Household Female Ratio	7.872		-5.448		2.114		5.034		-6.961	
	(0.393)		(0.663)		(0.846)		(0.598)		(0.586)	
Controls										
Risk-Taking Behavior	0.126	**	0.252	***	0.193	***	0.161	***	0.240	***
	(0.034)		(0.002)		(0.006)		(0.008)		(0.003)	
Round 1 Message D	7.312	**	11.574	**	7.139	*	7.416	**	11.731	**
	(0.039)		(0.041)		(0.080)		(0.036)		(0.050)	
Round 1 Free Riding Index	0.212	*	0.014		0.232	*	0.266	**	0.093	
	(0.090)		(0.940)		(0.090)		(0.026)		(0.624)	
Round 1 Message D x FRI	0.440	**	-0.358		0.471	*	0.419	**	-0.289	
	(0.044)		(0.238)		(0.053)		(0.047)		(0.361)	
Round 1 Result	0.847	***	0.542	***	0.821	***	0.840	***	0.584	***
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Intercept	-56.946	†	-22.235		-2.661		-19.659		34.196	
	(0.117)		(0.774)		(0.949)		(0.587)		(0.620)	
Sample Size	131		109		132		132		110	
Fit of the Model										
Multiple R-squared			0.511		0.591				0.476	
Adjusted R-squared			0.406		0.513				0.365	
F Statistic			4.884	***	7.558	***			4.300	***
			(0.000)		(0.000)				(0.000)	
Wald Statistic	13.042	***					9.141	***		
	(0.000)						(0.002)			

Note: The p-values are in the parentheses. ***, **, *, and † indicate 1, 5, 10, and 15 percent statistical significance levels, respectively.

Figure 1 Neighbor Link Distribution for the Four Weight Matrices

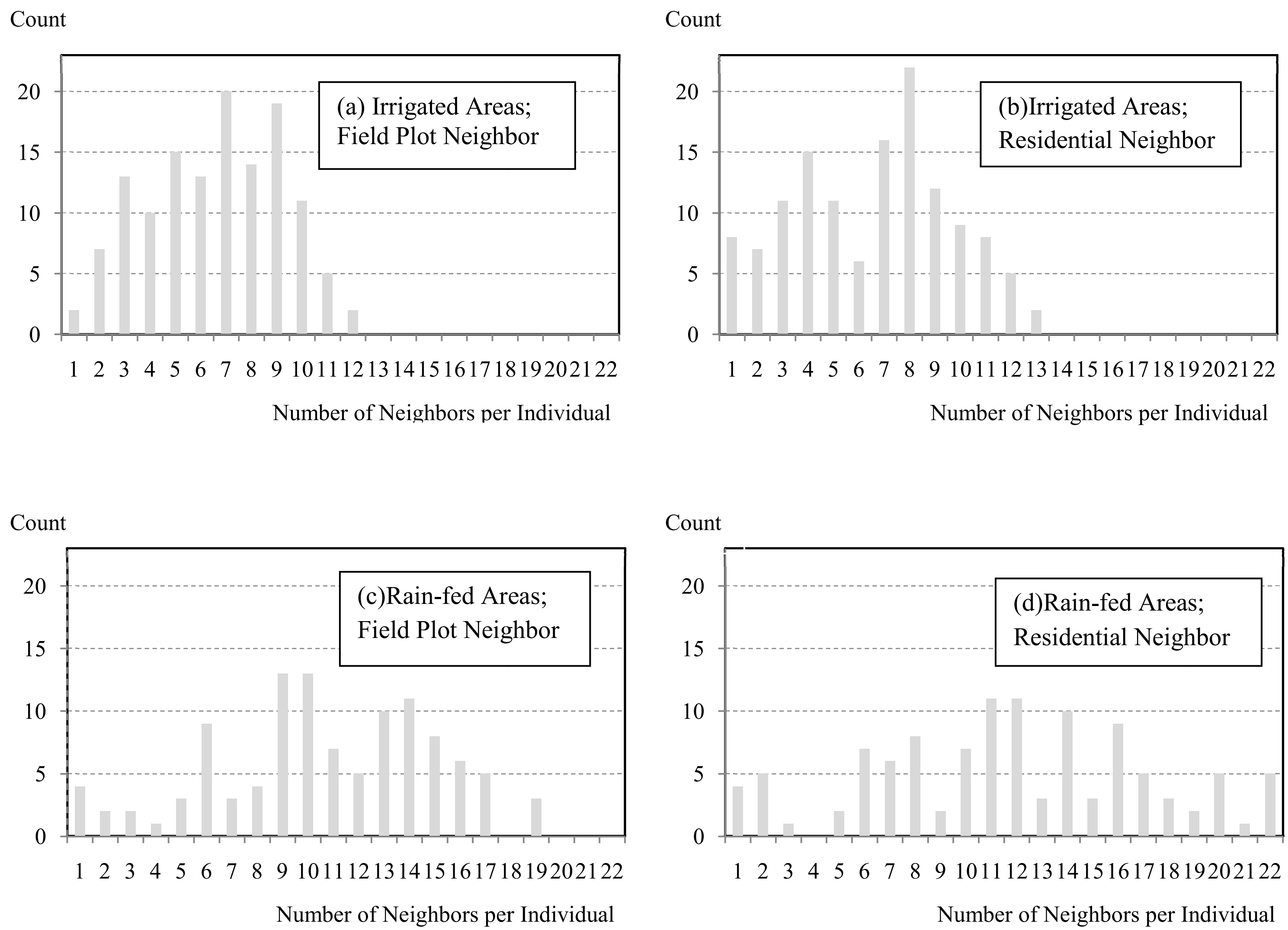

Figure 2a Graphical Representation of the Neighbor Links, Plot Neighborhood in Irrigated Areas

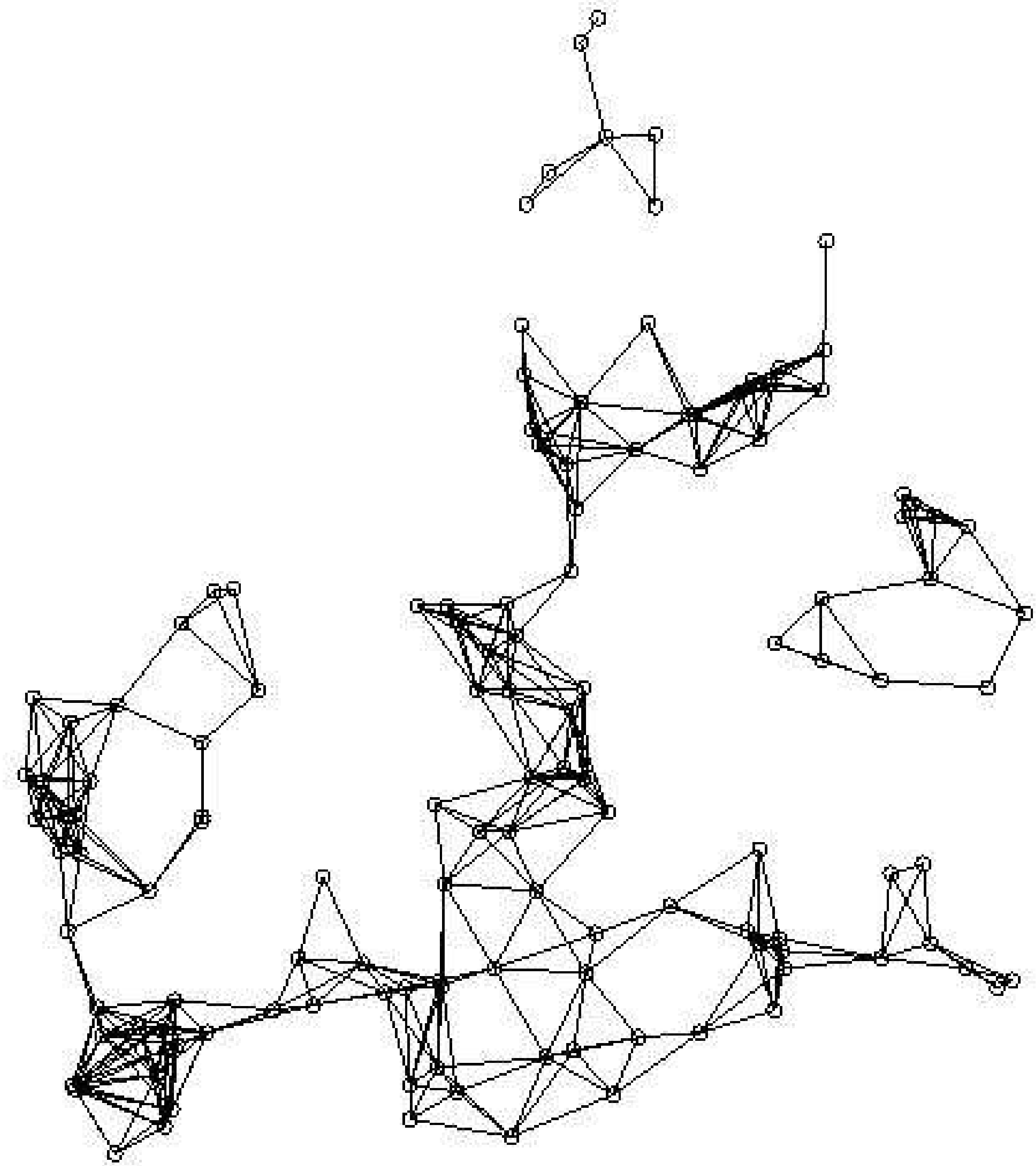

Figure 2b Graphical Representation of the Neighbor Links, Plot Neighborhood in Rainfed Areas

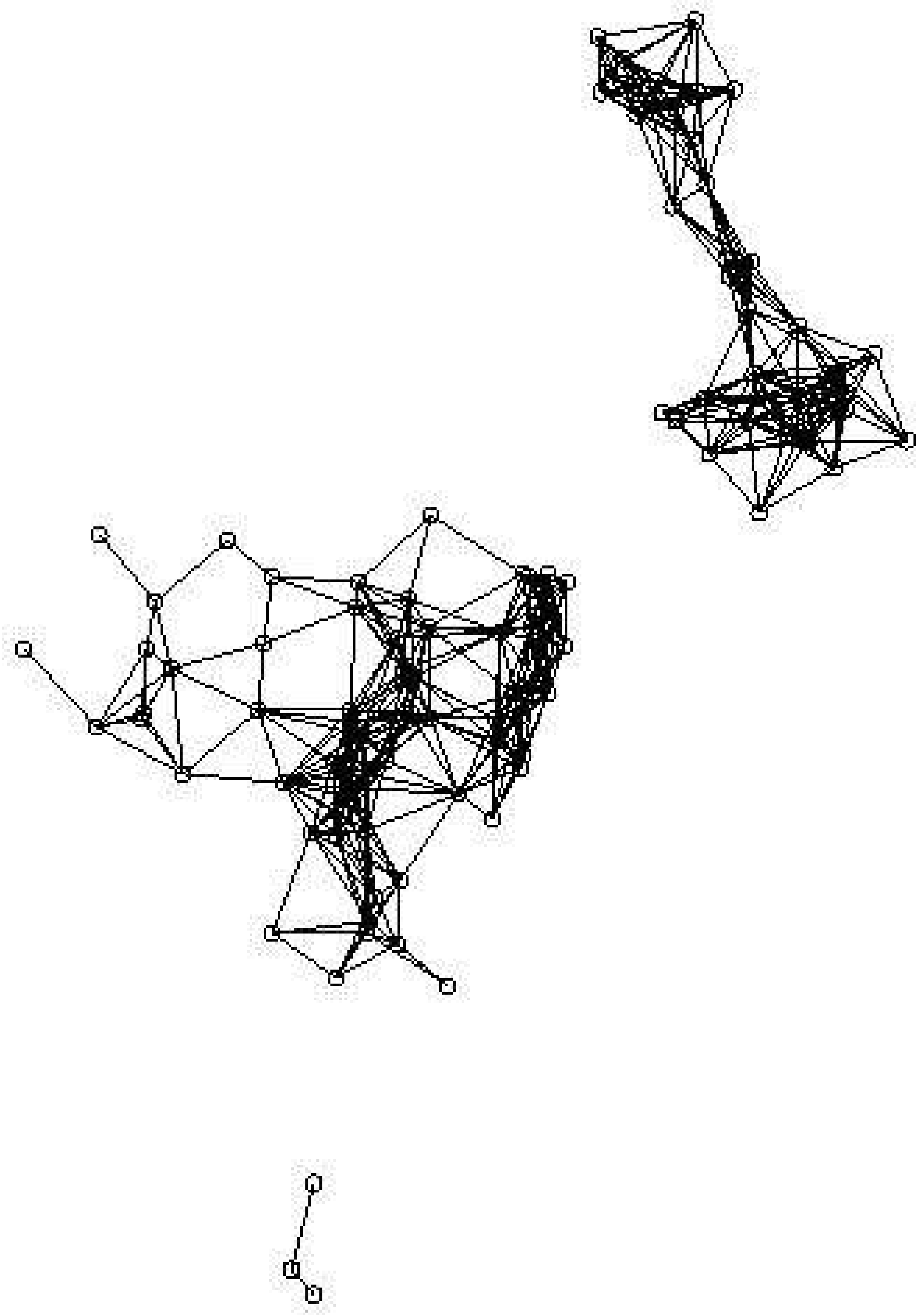

Figure 2c Graphical Representation of the Neighbor Links, Residential Neighborhood in Irrigated Areas

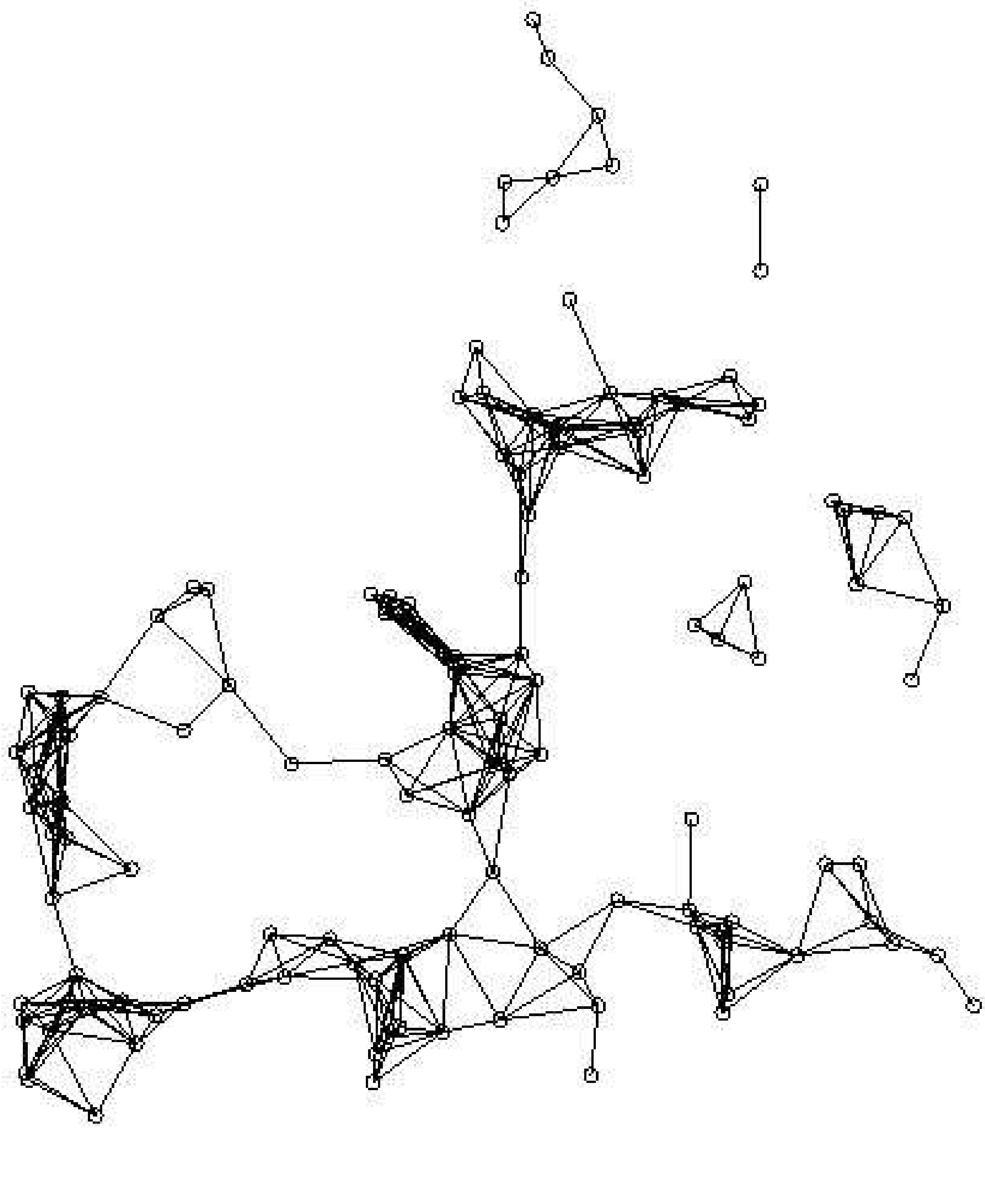

Figure 2d Graphical Representation of the Neighbor Links, Residential Neighborhood in Rainfed Areas