Spatial Coordination in Agglomeration Bonus Schemes with Transaction Costs and Communication: An Experiment Study

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Abstract

Agglomeration Bonus (AB) schemes reward private landowners to spatially coordinate land use decisions to enhance the supply of ecosystem services. The AB mechanism creates a coordination game with multiple Pareto ranked Nash equilibria, which correspond to different spatially-coordinated land use patterns. This paper experimentally analyses subjects' participation decisions, land use choices and AB performance in the presence of transaction costs, with and without the option to communicate with neighboring subjects in a local network setting. The experiment varies transaction costs at two levels (high and low), which affects the risks and payoffs of coordinating on the different equilibria. Results indicate a significant difference in participation under high and low transaction costs in the early stages of the experiment. Increased experience reduces participation rates and AB performance. Costless pre-play communication induces full participation and land use choice pertaining to the efficient Nash equilibrium. If communication is costly, the level of transaction costs affects participation levels, the degree of spatial coordination, and the ecosystem services benefits produced. Our study suggests that performance of Payment for Ecosystem Services schemes in general and the AB scheme in particular can be improved through mechanisms intended to reduce the costs associated with participation and communication.

Keywords: *Coordination Games, Lab Experiments, Local Networks, Payment for Ecosystem Services*

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1. Introduction

Payment for Ecosystem Services (PES) schemes are a common element of agricultural and environmental policy in many countries, offering landowners financial incentives for contracted actions designed to increase the supply of ecosystem services from privately owned land (Hanley et al., 2012; Hanley and White, 2014). In many instances, spatial coordination is a desirable feature of such schemes, enabling the delivery of greater ecosystem service or biodiversity conservation benefits compared to a situation where the uptake of contracts is spatially uncoordinated. Examples of higher environmental benefits from coordination include greater biodiversity conservation benefits on farmland (Merckx et al., 2009; Dallimer et al., 2010; Wätzold et al., 2010), enhanced water quality improvements (Lane et al., 2004, 2006), native vegetation restoration (Windle et al., 2009), and species reintroduction programmes or meta-population management on private land where corridors permit wildlife movements, or where a certain minimum size of contiguous habitat is needed (Williams, ReVelle, and Levin 2005; Önal and Briers, 2006).

Since participation in PES schemes is voluntary, economists have looked for means of incentivising spatial coordination. One such idea is the Agglomeration Bonus (Parkhurst and Shogren, 2002, 2007). The Agglomeration Bonus is a two-part payment scheme in which landowners receive compensation for participating or enrolling in the PES scheme, plus a bonus if their neighbor(s) participates and enrols as well. In this format, the Agglomeration Bonus produces a strategic environment which is a coordination game with multiple Nash equilibria. The Nash equilibria can be Pareto ranked by their payoffs. Laboratory experiments have indicated that such a payment structure can produce a range of desired spatial patterns of enrolled land on a landscape. However, Banerjee et al. (2012, 2014) have shown that the Agglomeration Bonus can often fail to produce the desired spatial pattern owing to coordination failure when agents play a risk-dominant rather than a Pareto-dominant equilibrium (Harsanyi and Selten, 1986).

Focusing on implementation of the Agglomeration Bonus and other PES schemes we consider the fact that participation is associated with substantial landowner transaction costs (Shortle, Abler, and Horan 1998; Kampas and White, 2004). Examples of such costs include landowners' travel time to meetings, the time and cognitive effort of determining the relative payoffs of signing or not signing a contract, and time spent meeting with advisors and government officials. These transaction costs have been shown to reduce participation in agri-environment schemes (Falconer and Saunders, 2002; McCann et al., 2005; Mettepenningen, Verspecht and Van Huylenbroeck, 2009). More complex designs of incentive schemes, such as an Agglomeration Bonus, are likely to result in greater transaction costs relative to simpler schemes because of the costs associated with negotiating with neighbors. It seems likely, then, that the success of such schemes will be influenced by the size of transaction costs relative to the payoffs of enrolling.

In view of these important policy aspects our paper addresses the following two questions. First, what is the degree of participation and nature of spatial coordination realized in Agglomeration Bonus schemes under different levels of transaction costs? Second, to what extent can communication between neighboring landowners, impact participation, land use decisions and policy performance?

We answer these questions with the help of a controlled laboratory experiment that systematically varies transaction costs values and the communication format. Lab experiments are useful since they bypass the fact that it is not practical, and often even impossible, to exogenously manipulate the size of transaction costs for PES schemes in the field; and because few PES schemes in practice today include payments for spatial coordination.

Our experiment comprises groups of eight subjects who decide whether to participate in an Agglomeration Bonus scheme. The transaction cost treatment is implemented as a within-subject treatment. The subjects are arranged on a circular local network with every individual connected to two direct neighbors (one to their left and one to their right) and indirectly to the others (Jackson 2010).

This network structure serves two purposes. First, it attaches location-specific identities to decision-makers providing a spatial structure for the strategic environment. Second, it allows us to draw on and contribute to the experimental literature on equilibrium selection and individual behavior in network coordination games (Berninghaus, Ehrhart, and Keser, 2002; Cassar, 2007). The network is also useful in implementing our communication treatment (as a between-subject treatment) in a format representative of social interactions in agricultural communities where landowner communications may often only or most frequently be between neighbors. We implemented communication in two formats: in one format players have to pay a fee to communicate with their neighbors; and in the second one communication is free.

Our results indicate that participation is significantly higher when transactions costs are low relative to when they are high in the early periods of the experiment. However, over time, subjects' strategic uncertainty in the coordination game is resolved in favor of the less risky strategy so that no significant transaction cost treatment effect is observed in the latter experimental periods. Yet, even though transaction costs deter participation in the event that they do participate, we observe both localized spatial coordination where a subject chose the same strategy as her adjacent neighbors and global coordination where everyone chooses the same strategy. These results indicate that even if there are challenges to spatial coordination, the Agglomeration Bonus is able to deliver on its ecological objectives, albeit more frequently at the local than global network level. Communication further improves upon this environmental outcome. When communication is costless, everyone participates and coordinates perfectly on the Pareto efficient choice. However, in the more realistic costly communication, the impact of messaging depends upon the transaction cost value. Costly messaging improves performance relative to no-communication situations only when costs are high.

2. The Strategic Environment

There are $i = 1, ..., N$ landowners who face two simultaneous decision opportunities related to their land use. The first decision entails whether or not to participate in the Agglomeration Bonus scheme. If a landowner decides to participate, he or she can use their land for two types of conservation uses: $\sigma_i = X, Y$. These types of land uses provide different levels of ecosystem services. We assume that land use type X delivers higher ecosystem service benefits than land use type Y and the Agglomeration Bonus payments reflect this ranking. Let NP denote the case of non-participation by landowner i. This represents a situation where the landowner devotes land to profit-based conventional agriculture and hence receives only agricultural returns and no ecosystem service payments.[1]

Since we are interested in the spatial coordination of similar land use practices, we assume that the regulatory agency implements an Agglomeration Bonus scheme. This scheme consists of two payoff components. The base component is a simple participation subsidy, $s(\sigma_i)$, the standard agri-environment payment intended to compensate for any opportunity cost of conservation land uses relative to profit-maximising agriculture. Landowner i receives an additional bonus, $b(\sigma_i)$, if a neighboring landowner implements a *similar* land use practice as landowner i. It is assumed that the bonus is proportional to the number of neighbors choosing the same land use strategy, denoted by $n_{i\sigma}$. We assume that the agency provides Agglomeration Bonus payments for adoption of pro-conservation land use of one type only, i.e., the landowner cannot choose both X and Y. We make this assumption because (*i*) PES schemes typically involve a menu of land use practices from which landowners usually pick a few suitable ones, and (*ii*) paying some landowners for undertaking all listed actions may exhaust the limited PES budget (Cooper, Hart, and Baldock, 2009; Armsworth et al., 2012), creating

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[1] Traditional agricultural land use practices (*NP*, in our model) can also deliver ecosystem services such as reduction in soil erosion and biodiversity benefits by providing nesting and foraging habitats. These benefits are, however, not additional as they are associated with business-as-usual land use practices. Since one of the criteria for receiving ecosystem services payments is additionality (Wunder, 2007; Engel, Pagiola, and Wunder, 2008), such benefits should not be rewarded by the conservation agency. We therefore do not consider them in our model.

high participation clusters in some areas at the expense of low participation rates elsewhere.[2] Let $r(\sigma_i)$ denote the agricultural revenue under land use σ_i.

If landowner i chooses to participate in the scheme he or she incurs transaction costs, T_i. For simplicity, we assume that the transaction costs across landowners are homogeneous, i.e., $T_i = T$.[3] The size of these transaction costs can vary substantially and may affect the participation decision. The magnitude of the transaction costs is our treatment variable and we distinguish between two levels of T: *High* or *Low*. The payoff of landowner i under the Agglomeration Bonus scheme, $u_i(\sigma_i)$, is now as follows:

$$u_i(\sigma_i) = \begin{cases} r(\sigma_i) + s(\sigma_i) + n_{i\sigma}b(\sigma_i) - T & if \ \sigma_i = X, Y \\ r(\sigma_i) & if \ \sigma_i = NP \end{cases} \qquad (1)$$

Eq. (1) shows that given a landowner's decision to participate, the bonus payment $n_{i\sigma}b(\sigma_i)$ depends on the number of neighbors choosing similar land use practice, $n_{i\sigma}$. This feature makes the current game similar to critical mass coordination games where the payoff from choosing an action is positive only if a critical mass of players also choose that action (Devetag, 2003). In our case, to receive the bonus a player has to coordinate actions with at least one neighbor. The number of neighbors is contingent on the specific structure of the landscape. Since we are interested in analyzing the effects of varying transaction costs on participation and spatial coordination, we imposed a simple circular network structure to represent neighborhood interactions following Banerjee, Kwasnica and Shortle (2012) and Banerjee et al. (2014). On this circular local network $n_{i\sigma}$ can either take the value 0, 1 or 2.

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[2] Such localized clustering may be interpreted as geographical targeting of conservation funds which has been prohibited by U.S. Congress (Shortle et al., 2012), although targeting is a feature of some European Union schemes.

[3] We make this assumption in order to isolate the intrinsic impact of our experimental treatments without having to consider potential confounding issues arising from subjects behaving differently while facing varying levels of transaction costs.

Given the specification of the payoff function in Eq. (1), the Agglomeration Bonus scheme is a coordination game with multiple Nash equilibria. When the transaction costs are sufficiently high, the scheme features two Nash equilibria: one corresponding to all agents choosing land use option *X* and the other featuring non-participation *NP*. Land use practice *Y* is strictly dominated by the outside option, *NP*. In contrast, when transaction costs are sufficiently low, then there is an additional Nash equilibrium which corresponds to land use practice *Y*. Tables 1a and 1b represent the Agglomeration Bonus coordination game under the two transaction cost conditions implemented in the experimental parameterization.

3. Experimental Design and Procedures

We report data from 32 sessions with 8 subjects per session, producing a data set with 256 subjects. During a session, subjects adopted the role of private landowners who had to pay a fee – the transaction cost to participate in the Agglomeration Bonus scheme. Subjects received a reservation agricultural income in case they chose the *NP* option.

The experiment was divided into two phases – Phases I and II, consisting of 15 periods each. In Phase I of 16 sessions termed HLTC (abbreviating *High-Low Transaction Cost*), subjects faced a high transaction cost of 40, followed by a low transaction cost of 15 in Phase II. In the remaining 16 sessions termed LHTC (abbreviating *Low-High Transaction Cost*), the transaction cost ordering was reversed. This within-subject treatment format permitted us to (*i*) minimize within-subject variation across the two treatments, (*ii*) capture the fact that transaction costs associated with the same economic decision may change over time and (*iii*) allowed us to study behavior of completely inexperienced subjects and subjects with some prior experience.

Non-binding pre-play communication was implemented in 16 of 32 sessions. We implemented anonymous costly online "chat" communication in 8 sessions, denoted by Costly-Comm. Each subject

could communicate privately in chat windows with adjacent neighbors at a cost of 5 experimental francs per neighbor. Subjects could receive messages from their adjacent neighbors for free despite having chosen not to communicate. The costly communication protocol is similar to the one implemented in Cooper et al. (1989) and represents the reality that communication is almost always costly for the sender (be it in terms of time, cognitive effort or money) whereas receiving messages (an email, voicemail or written communication) incurs minimal to no cost. In the remaining 8 other sessions, denoted by Free-Comm, messaging was free. This experimental design is summarized in Table 2.

On this network, every subject's payoffs are determined by their own and by their two direct neighbors' choices. However, the remaining five indirect neighbors' actions influence subjects' choices via their links to the subjects' direct neighbors. Given this symmetric strategic setup, every subject faces the same degree of strategic uncertainty in this coordination game.[4]

At the beginning of the experiment, every subject received a randomly-assigned ID that determined their location and their networked neighbors' identities. This ID remained the same during all the periods of Phase I. We implemented this fixed-matching protocol because private land ownership is usually unchanged for long periods and also because repeated interactions with the same set of subjects can build subjects' reputation for playing a particular strategy amongst their direct neighbors, fostering coordination. At the beginning of Phase II the neighborhood structure was shuffled and every subject received a new ID and a new set of neighbors which remained unchanged until the end of the experiment. We implemented this ID switch in order to break any possible path dependence that is often present in coordination game experiments (Van Huyck, Battalio, and Beil 1991). This path dependence can confound the transaction cost variation treatment when transitioning from Phase I to Phase II.

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[4] We selected a symmetric circular network over others where subjects have different numbers of direct and indirect links. This is because on asymmetric networks subjects would have varying degrees of strategic uncertainty and could respond to the transaction cost variation and communication treatments differently, potentially confounding our results.

During each phase of the experiment, subjects received hand-outs (included in the Appendix) containing information on the payoffs, the transaction cost of participation associated with that phase (15 or 40), the reservation (non-participation) income of 175, and a figure representing the circular spatial grid. The high transaction cost value (40) ensured that strategy *Y* would be dominated by the *NP* strategy. Thus, if a subject chose to participate in the Agglomeration Bonus scheme, he or she would be likely to choose *X* and not *Y*. This strategic setting afforded us the opportunity to analyse whether subjects follow the forward induction principle (Van Huyck, Battalio, and Beil, 1993; Cooper et al., 1994; Cachon and Camerer, 1996; Plott and Williamson, 2000) while making choices in coordination games on local networks.

In the Costly-Comm treatment, at the beginning of a period subjects first decided whether they wanted to communicate with their neighbors. If players chose to communicate, chat rooms opened up for 60 seconds and then closed, after which subjects made participation decisions. In the no-communication sessions, subjects proceeded to the participation stage directly. At this point, each subject had to decide whether to participate in the Agglomeration Bonus scheme by incurring the transaction cost. While they were making this decision, subjects were unaware of their neighbors' participation decisions.[5] Subjects who chose to participate moved on to the next stage of the experimental period in which they selected land use *X* or *Y*.

Once all choices were made, subjects received information about their own and their neighbors' communication decisions, participation, land use choices and payoffs for the current period. Additionally, a History table on screen provided this information for all past periods within a phase. In the Costly-Comm sessions, this History table also included subjects' own and neighbors' current and past communication decisions as well as the total fees paid to communicate.

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[5] By following this approach, we were able to retain the simultaneous move feature of the coordination game although it comprised of two stages of decision-making.

The experiment was implemented in z-Tree (Fischbacher, 2007) and subjects were recruited from the broad undergraduate Purdue University population using ORSEE (Greiner, 2004) during August 2013 and November 2014. All instructions (included in the Appendix) were made available on subjects' computer screens. No contextual terminology relevant to ecosystem services provision other than land use was included in the instructions, because we wanted to study how financial incentives impact experimental outcomes and also because pro-environmental terminology can potentially trigger various subject behaviors and confound the treatment effect (Cason and Raymond, 2011).

Instructions indicated that all subjects would be facing the same payoff table, that all Agglomeration Bonus scheme payoffs were net of transaction costs of participation and that the experiment would repeat for 30 periods.[6] At the end of Period 15, when the experiment proceeded to Phase II, subjects were instructed that they would henceforth face a new payoff table. To ensure that everyone clearly understood this treatment change, we provided subjects with a second handout containing a new payoff table, transaction cost value, and a new ID to indicate the subjects' network location and neighbor identity switch.

Before starting the experiment, subjects participated in a quiz to verify their understanding of the strategic environment, the game choices, and payoffs. The sessions lasted between 60 and 90 minutes. Subjects were paid a $6 show-up fee and any money made during the experiment. An exchange rate of US$1 for 350 experimental francs was used to convert all earnings, and average subject earnings (including the show-up fee) were $26.82.

4. Experimental Results

Our results are organized into sections focusing on the role of transaction costs and communication format on participation levels and rates of spatial coordination on the efficient land use

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[6] To ensure that subjects knew that all payoffs were net of transaction costs, we clearly indicated their total payoff for each outcome in the experimental handout provided to them during Phases I and II.

choice. The analysis focuses on the treatments without communication and with costly communication, because participation and performance is nearly perfect with costless communication.

4.1. Participation

The top panel of Figure 1 presents the participation rates in the two phases of the experiment for both the high-cost and low-cost treatments pooled across the 16 No-Comm sessions. Participation rates are always higher under low transaction costs in both Phases of the experiment. These rates fall steadily from 70% in Period 1 to 20% in Period 15 in the HLTC-No-Comm cohorts. By contrast, subjects in LHTC-No-Comm sessions are able to maintain relatively higher levels of participation with only a weak negative trend in Phase I. A non-parametric Wilcoxon Mann-Whitney test based on session-level average rates of participation in Phase I indicates a statistically significant transaction cost treatment effect at the 5% level (*p-value* = 0.015).[7] Thus, transaction costs can have a significant impact on participation rates in PES schemes with spatial targeting.

The falling rates of participation under both cost conditions may be attributed to factors that increase subjects' strategic uncertainty and impact likelihood of participation. First, unlike in a non-network coordination game, both direct and indirect neighbors influence payoffs but only past choices of direct neighbors are visible. Second, as mentioned earlier, the Agglomeration Bonus setting is similar to a critical mass game (Devetag, 2003) in which coordination depends on number of people making the same choice; as opposed to the value of the choice itself such as in the case of a minimum effort coordination game. Third, the structure of the payoffs is such that participation and subsequent coordination on choice *X* is profitable only when both direct neighbors participate. This is true for both

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[7] All nonparametric tests reported in the paper employ independent 8-person groups as the unit of observation.

high and low transaction cost values, but losses induced by coordination-failure are greater when costs are high and a subject chooses to participate and direct neighbors do not.[8]

The experiment's two treatment phases are useful for evaluating how the order in which the transaction cost treatment is implemented and subjects' experience with a particular transaction cost regime, affects participation. After the transaction cost treatment switchover participation rates jump substantially (from 20% to nearly 86%) in the HLTC-No-Comm sessions between Periods 15 and 16 (in the top panel of Figure 1). This increase is statistically significant (Wilcoxon matched-pairs signed-rank test *p-value* = 0.013). The small change in the participation rate from 78% to 80% at the treatment switchover point for the LHTC-No-Comm group is, however, not statistically significant (Wilcoxon matched-pairs signed-rank test *p-value* = 0.943). This result suggests a path dependence in outcomes, which has been observed in coordination games without a spatial structure (Van Huyck, Battalio, and Beil, 1991; Romero, 2015). Owing to path dependence, groups who have experienced favorable participation conditions because of low transaction cost are less likely to change their behavior immediately when their participation circumstances deteriorate. Such sluggish behavior has been termed strategy inertia (Blume, 1993).

Focusing on overall trends in Phase II, we observe only a small decrease in participation in the low transaction costs groups in HLTC-No-Comm from 85% in Period 16 to 78% in Period 30. For the high transaction costs groups in LHTC-No-Comm, a deterioration in participation circumstances leads to a fall in program uptake from 79% in Period 16 to 36% in Period 30. However, there is no significant difference in participation rates between the HLTC-No-Comm and LHTC-No-Comm groups in Phase II (Wilcoxon Mann-Whitney test *p-value* = 0.14). Thus, prior experience with

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[8] We adopted this feature to evaluate the performance of the Agglomeration Bonus scheme in a payoff adverse setting with the expectation that if the incentive scheme performs well in the current environment, it will perform even better in scenarios where efficient coordination is profitable even if only one or a few neighbors choose *X*, post-participation. Moreover, this adverse payoff situation also reflects recent reductions in PES scheme budgets which now have to be spread thinly over the numerous existing programs (Shortle et al., 2012).

favorable transaction costs circumstances can reduce the negative impact of a transaction cost increase on subsequent participation rates.

The bottom panel of Figure 1 graphs participation rates pooled across the 8 Costly-Comm sessions for the two transaction cost ordering treatments for both phases. Similar to the no-communication setting, participation is higher in all periods of the experiment when transaction costs are lower. Additionally, for both high and low cost groups participation is higher with communication than without it. Also, there seems to be no discernable time trend. For an explanation, we first focus on the nature and pattern of costly communication. Since every player has two neighbors, in each session, a maximum of 16 communication channels can be opened up if everyone pays the fee to communicate with both neighbors in a period. Thus for every period, there are a total of 64 unique communication possibilities. Figure 2 presents information about the timing and fraction of instances in which subjects paid the fee to communicate with one or both neighbors under each transaction cost condition. Clearly, subjects do communicate under both cost settings but the fraction of instances is low (the highest value is about 30% in Period 1 and 40% in Period 16). Most subjects rely on receiving messages from neighbors or on feedback about the outcomes at the end of the decision period when making future choices. For those individuals who do communicate, messaging is frequent in the early periods for both transaction costs and is centered on convincing neighbors to participate and choose *X*.

The greater messaging frequency in the early periods relative to the later ones, reflects substantial variability in subject behavior. However, messaging often resolves subjects' strategic uncertainty in favor of a particular strategy within a few periods, beyond which there is no need for additional communication to change behavior and hence participation rates. Positive instances of communication are observed again in the first part of Phase II. Since neighbor identities have changed, some subjects incur communication costs to assure new neighbors about their own commitment to participate and choose *X*, and try to convince them to do the same. However, such communication ends

quickly since groups overall are familiar with the experiment. Costly communication effectively ceases within three periods in Phase II with only some very isolated instances later.

For a systematic analysis of the influence of transaction costs in the Costly-Comm sessions, we use two probit regressions (owing to the smaller sample size for the Costly-Comm groups) for Phases I and II. These results are presented in the left two columns of Table 3. The dependent variable is the likelihood of participation in the Agglomeration Bonus scheme in any experimental period. The control variables include a dummy variable taking a value of 1 for the high cost sessions and the reciprocal of the Period variable to capture non-linear rates of participant learning. Owing to subject unfamiliarity and variability of responses in the initial periods of a phase, we use data from the second half of both phases beyond the 7th period for Phase I and beyond the 22nd period for Phase II to make transaction cost treatment comparisons. All standard errors are clustered at the subject level. The regressions reveal a significant and negative treatment effect for Participation in both Phase I (at 10% level of significance) and Phase II (at 1% level of significance). Thus, relative to situations where transaction costs are low, high transaction costs lead to a negative impact on participation with costly communication in both phases of the experiment.

Comparing both top and bottom panels in Figure 1, we also observe that participation on average is higher with costly-communication under both cost conditions that without communication. In order to assess whether this between-subject communication treatment is statistically significant, we use 4 probit regressions (for each Phase and transaction cost condition) to make comparisons between the No-Comm and Costly-Comm sessions. These results are presented in the four left columns of Table 4. The dependent variable is again the likelihood of participation which is now regressed on a dummy variable taking a value of 1 for the Costly-Comm sessions, the reciprocal of the Period variable to capture time trends and an interaction term between these two variables to control for differences in

learning rates under different communication formats. All standard errors are clustered at the subject level and data are used from all periods of a Phase.

A significant (at the 1% level) and positive estimate is obtained for the costly communication treatment dummy variable in both phase regressions for the high transaction cost condition only. Thus, when costs are high, subjects use costly messaging as a tool to signal their commitment to participation, to reduce strategic uncertainty in their local neighborhood (comprising of the two direct neighbors of any player) and to influence neighbors to participate. This is, however, not the case when costs are low suggesting, that costly communication maybe a useful mechanism to improve participation rates only when circumstances strongly deter participation. When transaction costs are low, subjects largely rely on information feedback at the end of decision periods to exchange information and make participation decisions, similar to the no communication condition.

4.2 Spatial Coordination

The purpose of the Agglomeration Bonus scheme is spatial targeting of land uses. In this regard, we present an analysis of location-specific land use choices of all participants to assess the mechanism's performance. We developed a performance metric counting every instance where a player and their two direct neighbors within their local neighborhood are able to *locally coordinate* on the same land use strategy. This metric can take a maximum value of 8 signifying that all 8 group members are perfectly or *globally coordinated* on either strategy *X* or *Y*. Any other lower non-zero value indicates only localized clustering of similar choices on the network. In this format, the same metric captures instances of both local and global coordination that are routinely observed in all groups during the experiment. Coordination on the *X* strategy is Pareto efficient, so we refer to this as locally *efficient* coordination.

Figure 3 presents the average levels of localized efficient coordination of *X* choices by a player and his or her two neighbors in the No-Comm (top panel) and the Costly-Comm (bottom panel) groups for all periods of Phases I and II. Conditional on participation, a majority of individuals (and many of them neighbors) select *X* and not *Y* (see Figure A in the Appendix for overall levels of *X* and *Y* choices.) The many *X* choices is of special interest for the high cost condition under which strategy *NP* strictly dominates option *Y*. Thus, post-participation in this network coordination game, the selection principle of forward induction can guide many adjacent subjects' choices to the Pareto efficient *X* equilibrium. While forward induction may not explain the many adjacent *X* choices in the low-cost groups, we can still conclude that upfront payment of the 15 franc fee focuses many neighboring subjects' choices on *X* which pays more than *Y* at least for the subject who chooses *X* and is flanked by two neighbors choosing *X*.

Figure 4 displays the fraction of instances for all treatments in which the entire group was able to coordinate on the efficient strategy. We observe global and local efficient coordination in all sessions but the values are lowest for the No-Comm condition. This suggests that if mechanisms to reduce strategic uncertainty such as localized costly communication are facilitated with an Agglomeration Bonus scheme, unanimous participation and contiguous selection of the land use choice generating greater ecosystem services benefits may be possible even if transaction costs hinder participation. Higher levels of efficient coordination on average in Costly-Comm sessions relative to No-Comm sessions for both phases (from Figure 3) support this conclusion.[9]

Turning to within-subject treatment induced performance differences, a Wilcoxon Mann-Whitney test using session-level average values of efficient localized coordination in low and high cost groups without communication detects a significant treatment effect (*p-value* = 0.05) in Phase I after Period 8. Thus, in the initial periods when subjects are less familiar with the strategic environment,

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[9] Appendix Figure B presents average levels of *X* choices by Period and Phase under No-Comm and Costly-Comm sessions as additional supporting evidence.

most *X* choices are either non-adjacent or involve only two adjacent subjects selecting *X*. In Phase II there is no significant difference between these two groups which is similar to our previous result about no significant difference in participation rates. In Phase II most subjects who participate, choose *X* (and not *Y*) in both transaction cost treatments.

Since the rate of global efficient coordination is low in No-Comm groups, Wilcoxon Mann-Whitney tests indicate no significant within-subject cost treatment effect in either Phase. Surprisingly, the HLTC-No-Comm and LHTC-No-Comm groups are more often able to globally coordinate in Phase II than in Phase I. This increase is weakly statistically significant for the HLTC-No-Comm groups (Wilcoxon matched-pairs signed-ranks test *p-value* = 0.08) and suggests that game experience plays a positive role in promoting efficient global coordination when transaction costs are lowered.

Table 3 includes results of two probit regressions (in the right two columns) analyzing the effect of the transaction costs treatment and game experience on localized efficient coordination for Costly-Comm groups after Period 7 (for Phase I) and beyond Period 22 (for Phase II). There are more instances of localized efficient coordination in the high cost groups in Phase I (left figure of bottom panel of Figure 3) than in the low cost ones but this difference is not significant. In Phase II however, the difference is significant at 1% level reiterating the positive role of experience in ensuring overall improved outcomes in the Agglomeration Bonus games.

To compare localized coordination rates with and without costly communication, we present results of four probit regressions (for each Phase, transaction cost condition and including all periods) in the four right columns of Table 4. The dependent variable is an indicator taking a value of one when players within a local neighborhood are able to coordinate on the efficient strategy *X*. Similar to the previous models, the control variables include a dummy variable taking a value of 1 for the Costly-Comm sessions, a time trend and an interaction term.

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A significant (at the 1% level) and positive estimate is obtained for the Costly-Comm dummy variable in both phase regressions for the high transaction cost condition. Thus, relative to no-communication, costly messaging can guide behavior to significantly improve the likelihood that a subject and his or her neighbors can locally coordinate on the efficient strategy. For groups facing low transaction costs, the Costly-Comm dummy variable is not significant in Phase I. In Phase II, coordination rates increase and then remain stable at an average of 75% in all periods of the experiment for the HLTC-Costly-Comm groups (for which participation circumstances have improved) but their values are falling (from 45% to 28%) in the HLTC-No-Comm groups. Hence, we obtain a significant and positive estimate for the Costly-Comm dummy in Phase II. This result confirms the positive role of communication in guiding the selection of the efficient Nash equilibrium outcome in coordination games with a Pareto dominant and risk dominant Nash equilibria when played on local networks.

5. Discussion

The goal of this paper was to study the role of transaction costs in influencing participation rates and spatial coordination patterns under the Agglomeration Bonus scheme. Obviously, our results are strongly predicated on the nature of the strategic environment and payoff function under high or low transaction costs, circular local network size and the degree of information feedback. Using a spatial set-up different from the circular network (such as a two-dimensional lattice grid, where each player has more than 2 direct neighbors) would also likely produce different results. We could have chosen a transaction cost value less than 40, which would not have made *Y* strictly dominated by *NP*. In this setting, we conjecture that there would be much greater participation and many more *Y* choices than is currently observed in high cost groups. While this is interesting, this finding is similar to results obtained in Banerjee et al. (2014) and would have (*i*) most likely eliminated any within-subject

treatment effect we observe in Phase I and (*ii*) prevented us from studying whether subjects use the forward induction principle to select the efficient equilibrium strategy in coordination games when arranged on a social network. Moreover, the transaction cost treatment is more interesting if it generates differences in the strategic situation than if it just induces a difference in payoff magnitudes.

The size of the circular network and nature of information feedback also play key roles in impacting choices. More information and smaller groups usually generate greater rates of efficient choices in coordination games. However, the group size of 8 is small enough for many individuals to choose *X* and large enough for many to select *NP* (owing to high strategic uncertainty). With this group size we are able to assess the extent to which the Agglomeration Bonus mechanism can still deliver on its environmental goal when the effect of each individual is relatively small compared to the total group size. Finally, we could have provided information to subjects beyond their local neighborhoods. However that would be inconsistent with our localized costly-communication format and our goal to maintain consistency between our treatments and the strategic setting. Greater observability, communication with all group members and varying groups sizes are all interesting treatments to consider in future research. It is also possible that coordination failure would have implications for what participants consider to be a "fair" outcome, and that this would influence the likelihood of coordination onto the Pareto-superior outcome, especially if outcomes are observable (Reeson et al (2011).

6. Conclusions

The Agglomeration Bonus has appeal as a conservation policy instrument for several reasons. First, the predominant property rights regime in many countries such as the UK, USA, New Zealand and Australia requires that landowners be financially compensated to encourage the supply of ecosystem services, rather than being compelled to do so by regulation: the "provider gets" principle

(Hanley et al., 1998). Second, for many environmental outcomes, spatial coordination increases the size of environmental benefits for a given level of enrollment in voluntary conservation programs. The policy design challenge is then to find systems of incentives which spatially coordinate a voluntary sign-up program. A novel incentive mechanism that fosters spatial coordination is the Agglomeration Bonus (Parkhurst et al., 2002, 2007). However, the Agglomeration Bonus faces a number of problems, including the tendency over time for participants to converge on risk-dominant outcomes, lack of cost-effectiveness, and, like many incentive programs, the size and nature of transaction costs. Such transaction costs are likely to vary with the number of potential participants and with the complexity of the coordination arrangements that the regulator is trying to induce. That, in turn, depends on the environmental objectives of the scheme, and the actual landscape in which the contracts are offered. Previous empirical work shows that transactions costs can deter enrollment in PES-type schemes to a significant degree.

In this paper we use a laboratory experiment to investigate how private transaction costs affect the degree of participation in an Agglomeration Bonus scheme, its efficiency and the patterns of spatial coordination in the presence and absence of communication. Results show that higher transaction costs lead to greater non-participation, whilst lower transaction costs are conducive to producing a greater degree of coordination on the most preferred environmental outcome. Localized coordination also improves under lower transaction costs. However, due to strategic uncertainty, enhanced experience leads to a fall in the instances of coordination on the environmentally-preferred outcome, although the rate of decline is lower when transaction costs are low. Full coordination on the most efficient outcome is rarely achieved, but localized clusters of coordinated conservation actions emerge in most cases. Communication improves outcomes generating economic and ecological win-wins.

The policy implications are clear: if the regulator can design an Agglomeration Bonus scheme in a way which keeps transaction costs low relative to the payoffs of coordination, then it will be easier

to achieve both local and global spatial coordination which produces the most desired environmental outcome. However, the degree of coordination on this desirable outcome is likely to fall over time. Indeed, if achieving a given environmental objective requires writing (complicated) rules for potential participants (e.g., with regard to which actions need to be monitored, or how monitored, or if targeting is also required rather than simply coordination), then there is a trade-off between improving environmental effectiveness and increasing coordination. Set against this, facilitating low-cost communication between landowners would seem likely to improve the likelihood of successful coordination towards socially-desirable land use patterns. Providing subsidies to lower transaction costs initially could foster early coordination, and our results across the two phases suggest that improved performance could persist even after such subsidies are removed.

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Table 1a: Payoff Table for High TC condition

<p style="text-align:center">Payoff Table</p>

<p style="text-align:center">Actions Chosen by Neighbors</p>

Your Action	Both Participate Choose X	Both Participate and one Chooses X & other Y	Both Participate and Choose Y	Only one Participates & Chooses X	Only one Participates & Chooses Y	No Neighbor Participates
X	210	125	40	125	40	40
Y	145	155	165	145	155	145
NP (Non-Participation)	175	175	175	175	175	175

Table 1b: Payoff Table for Low TC condition

<p style="text-align:center">Payoff Table</p>

<p style="text-align:center">Actions Chosen by Neighbors</p>

Your Action	Both Participate Choose X	Both Participate & one Chooses X & other Y	Both Participate & Choose Y	Only one Participates & Chooses X	Only one Participates & Chooses Y	No Neighbor Participates
X	235	150	65	150	65	65
Y	170	180	190	170	180	170
NP (Non-Participation)	175	175	175	175	175	175

Table 2: Summary of Experimental Design

Transaction Cost Ordering Treatment	Communication Treatment		
	No-Comm	Costly-Comm	Free-Comm
High-Low	HLTC-No-Comm (8 sessions)	HLTC-Costly-Comm (4 sessions)	HLTC-Free-Comm (4 sessions)
Low-High	LHTC-No-Comm (8 sessions)	LHTC-Costly-Comm (4 sessions)	LHTC-Free-Comm (4 sessions)

Table 3: Probit Regressions for Performance Analysis in the Second part of each Phase for
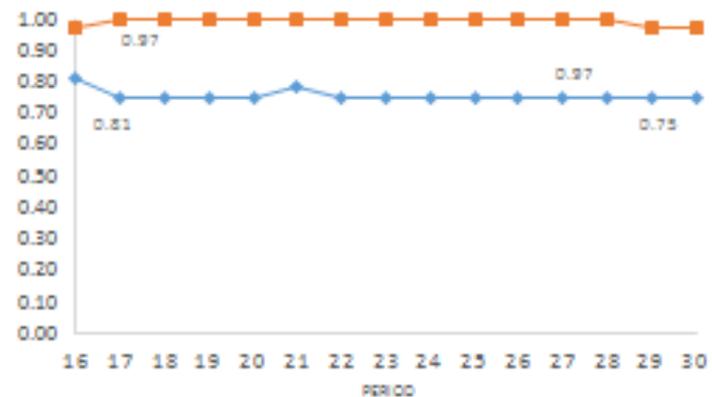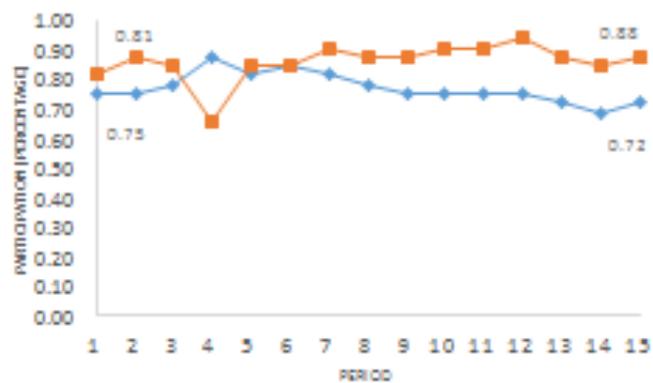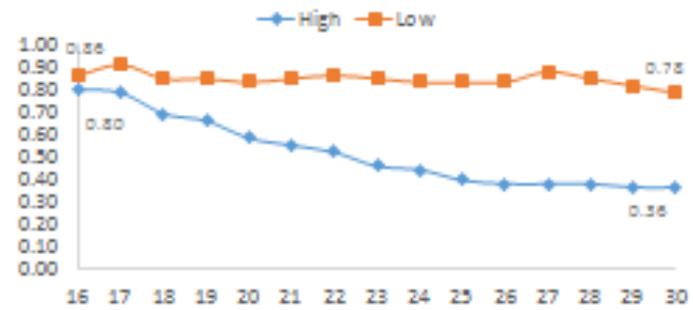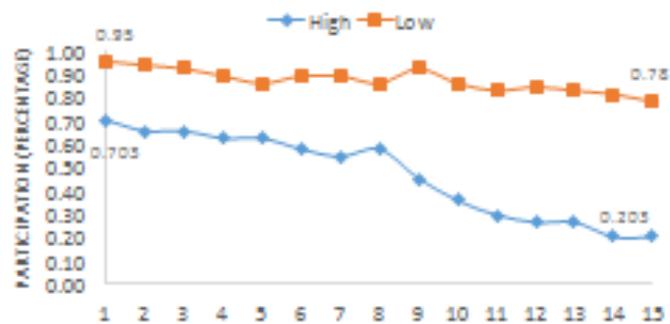
Costly Communication Groups

Dependent Variables	Participation		Localized Efficient Coordination	
Independent Variables	**Phase I**	**Phase II**	**Phase I**	**Phase II**
High Cost	-0.023* (0.013)	-0.070*** (0.017)	0.018 (0.01)	-0.046*** (0.01)
$\dfrac{1}{Period^+}$	2.537 (2.43)	2.189 (1.85)	4.197** (1.96)	6.116*** (2.36)
Constant	1.323*** (0.46)	3.276*** (0.75)	-0.552 (0.41)	1.975*** (0.49)
Number of observations	512			
Number of Clusters	64			

*** Represents statistical significance at 1% level, ** at 5% level & * at 10% level
\+ Period value recoded to range from 8 to 15

Table 4: Probit Regressions for Performance comparison of Costly Communication and No
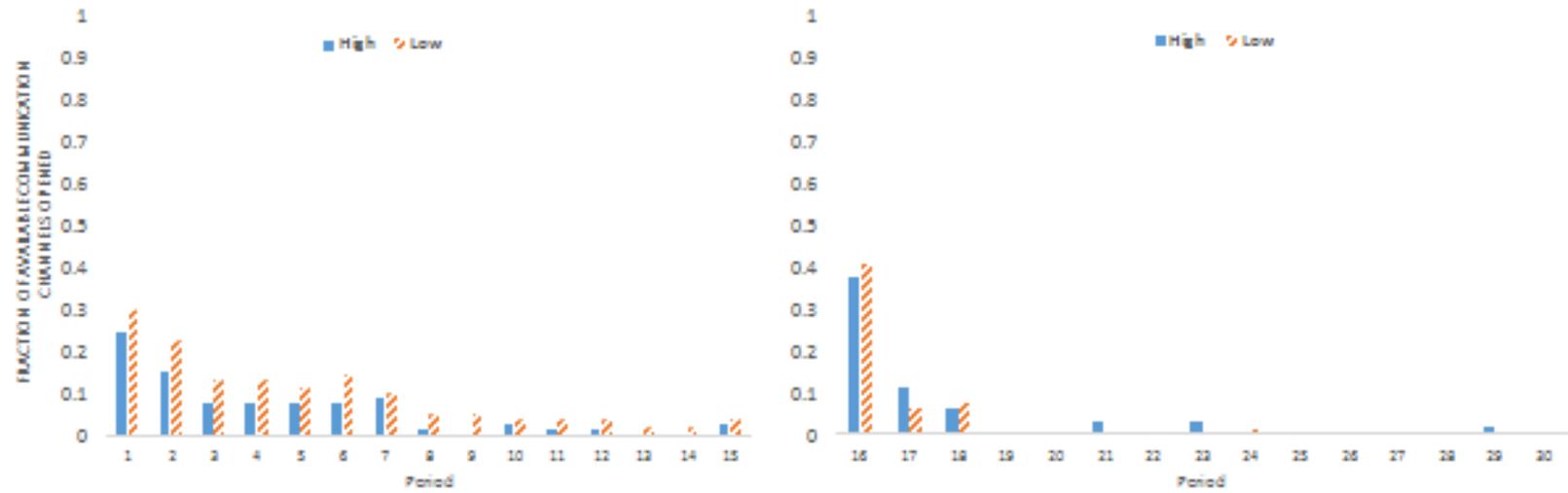
Communication Treatments by Phase and Transaction Cost

Independent variables	Participation				Localized Efficient Coordination			
	Phase I (HC)	**Phase II (HC)**	**Phase I (LC)**	**Phase II (LC)**	**Phase I (HC)**	**Phase II (HC)**	**Phase I (LC)**	**Phase II (LC)**
Costly-Comm	1.089*** (0.276)	0.945*** (0.3)	0.198 (0.272)	1.715 (.468)	1.311*** (0.27)	1.066*** (0.297)	0.037 (0.252)	2.124*** (0.276)
$\dfrac{1}{Period^+}$	1.298*** (0.239)	1.527*** (0.265)	0.935** (0.373)	0.228*** (0.279)	0.016 (0.215)	0.381** (0.155)	-0.706*** (0.225)	-0.229 (0.21)
$\dfrac{1}{Period^+}$ x **Costly-Comm**	-1.254** (0.508)	-1.342*** (0.373)	-1.279*** (0.444)	-0.843 (0.899)	-1.04** (0.444)	-0.8*** (0.254)	0.083 (0.407)	-0.212 (0.6)
Constant	-0.364*** (0.129)	-0.291* (.150)	0.953*** (0.163)	0.952*** (0.1505)	-0.668*** (0.159)	-0.341** (0.156)	0.104 (0.138)	-0.54 (0.157)
Number of Observations	1440							
Number of Clusters	96							

*** Represents statistical significance at 1% level, ** at 5% level & *at 10% level
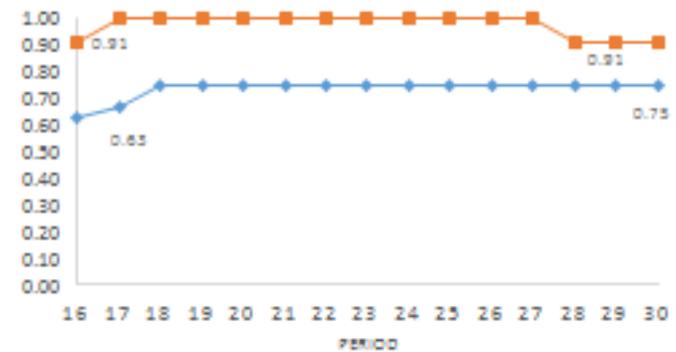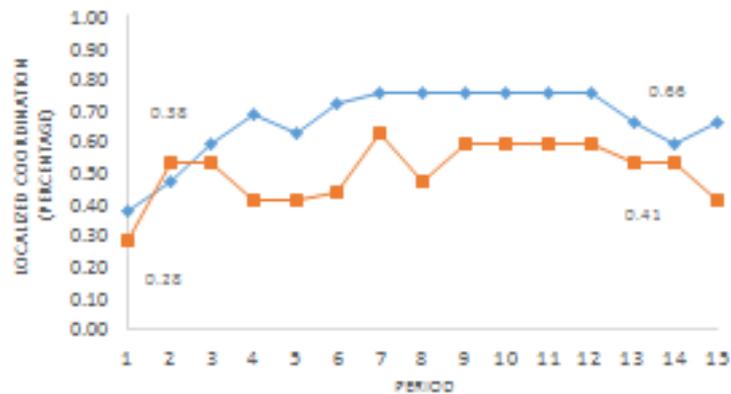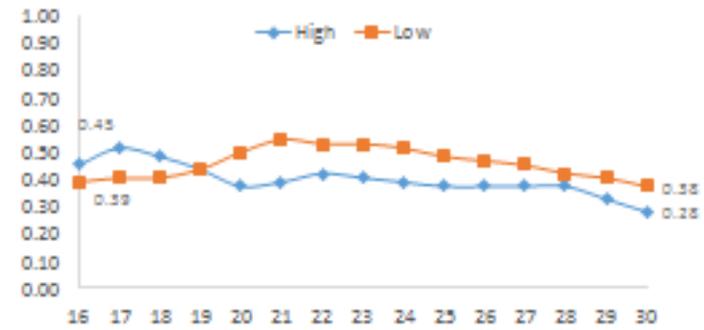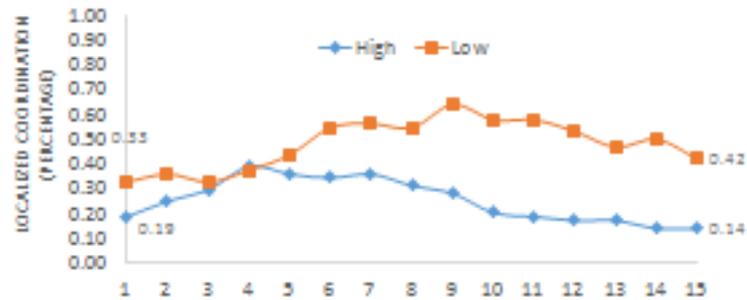\+ Period takes a value between 1 and 15

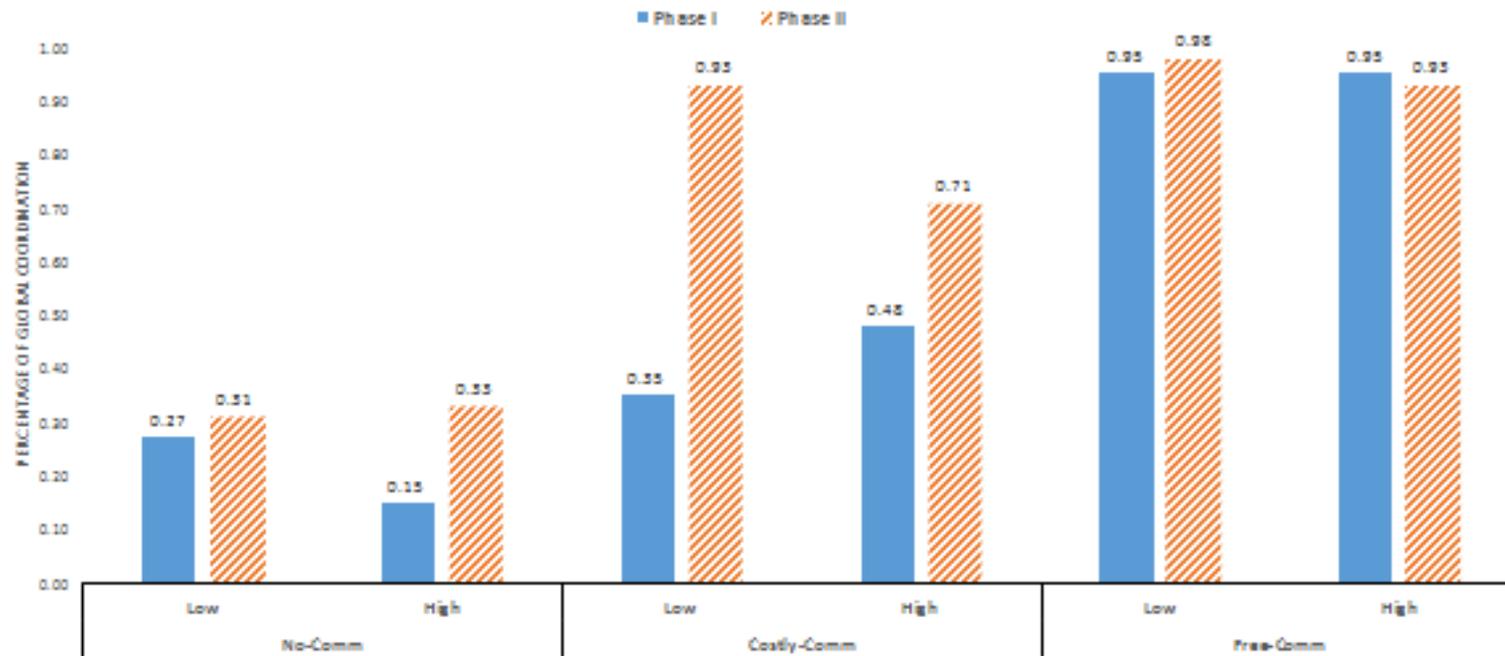Figure 1: Percentage of Participation in Phase I & Phase II of No-Comm (top panel) and Costly-Comm (bottom panel)
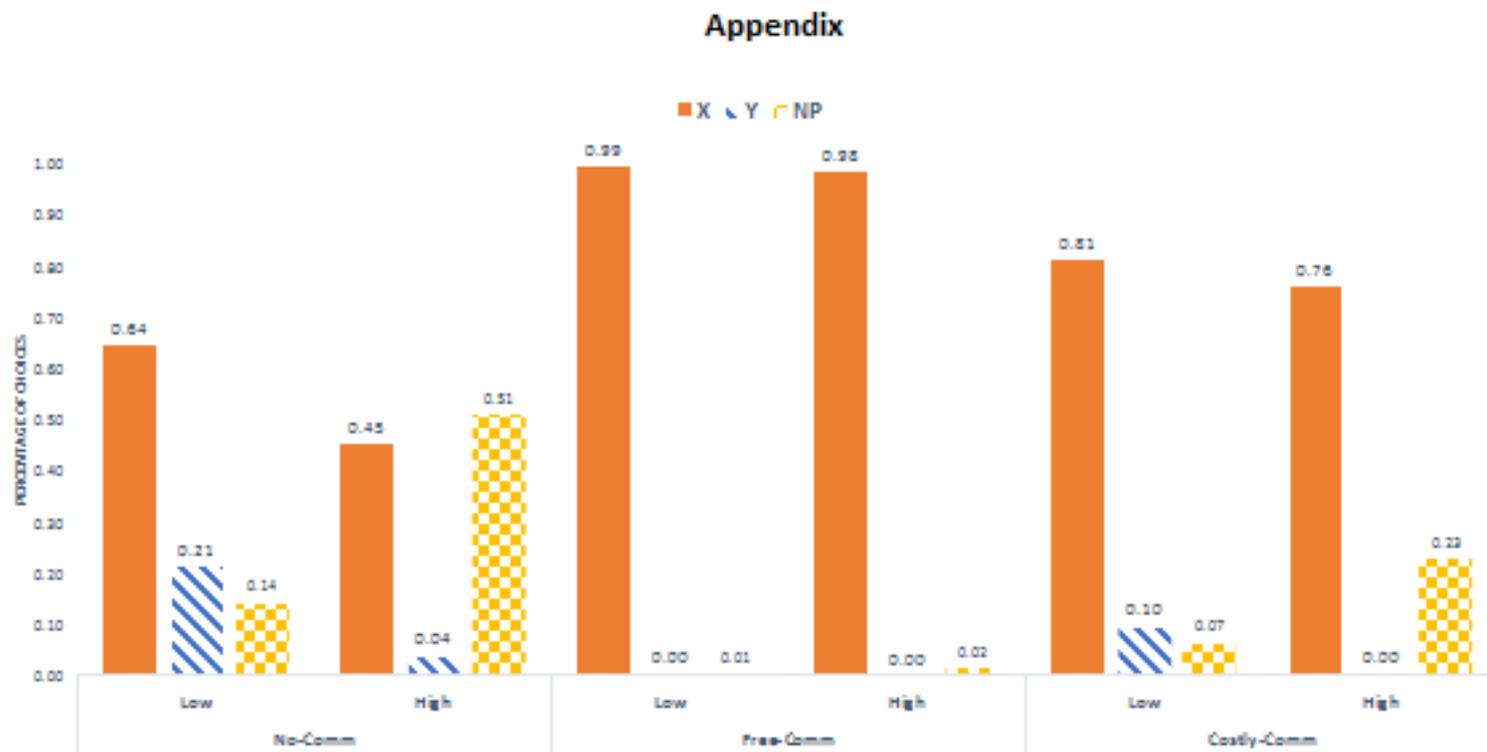
Sessions by Transaction Costs Treatment

Figure 2: Fraction and Timing of Communication Channels opened with One or Both Neighbors by Phase and Transaction Cost
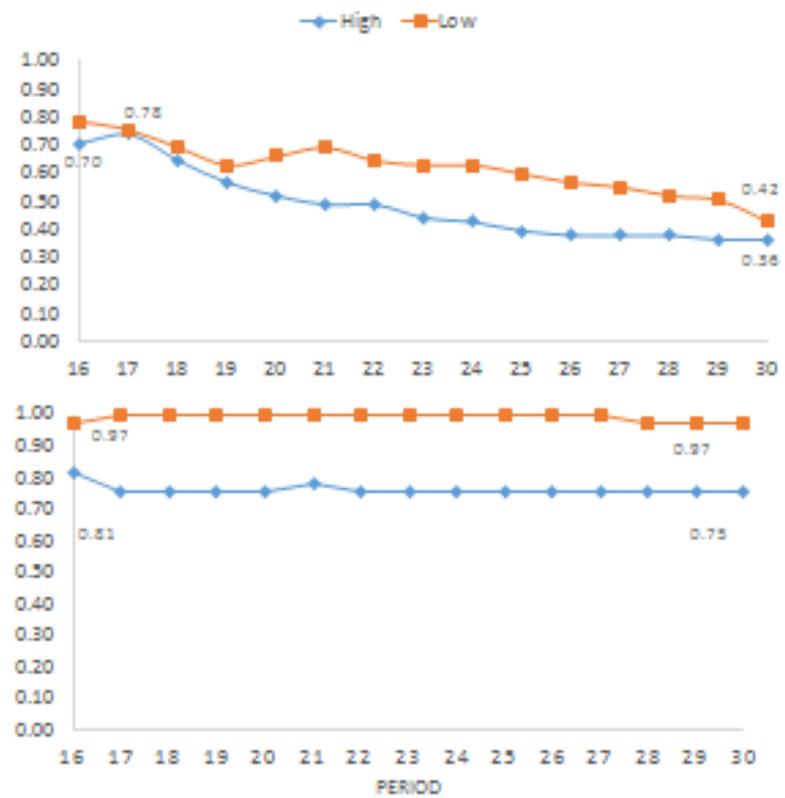
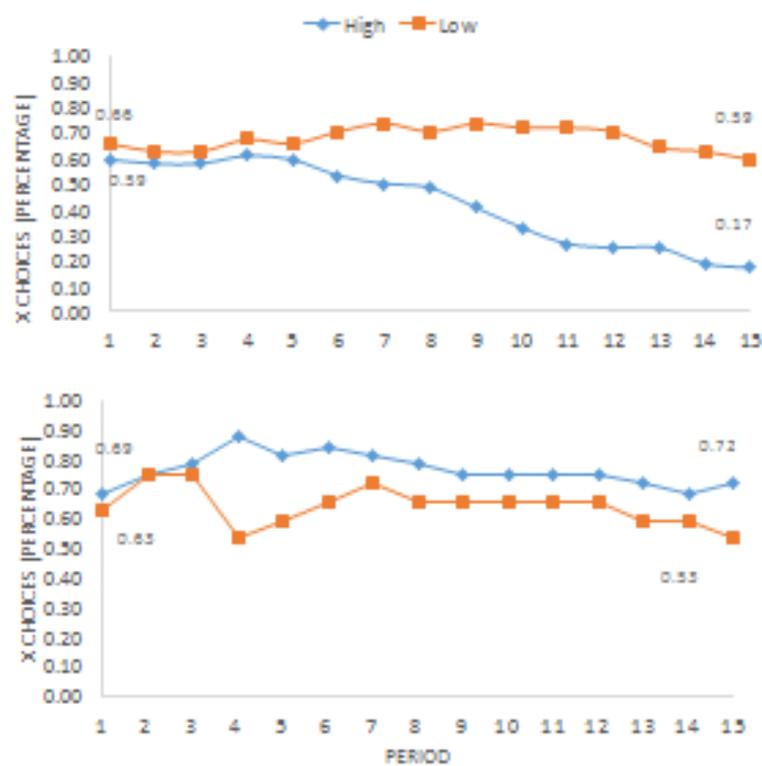Figure 3: Percentage of Localized Efficient Coordination (player and direct neighbors choose *X*) in Phase I & Phase II of No-Comm (top panel) and Costly-Comm (bottom panel) Sessions by Transaction Costs Treatment

Figure 4: Perfect/Global Efficient Coordination (the whole group chooses *X*) in all treatments for both Phases

Appendix

Figure A: Frequency of Choices Pooled over Time for All Treatments

Figure B: Percentage of *X* Choices in Phase I & Phase II of No-Comm (top panel) and Costly-Comm (bottom panel) Sessions by Transaction Costs Treatment

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*(**Text in italics represents instructions for Costly-Comm Sessions. Note that the X and Y strategies referred to in the paper correspond to the strategy labels A and B in the instructions.**)*

Thank you for participating in today's experiment

Your unique Identification number - ID for this experiment is **1**. This number is private and should not be shared with anyone. You will have this ID for the next 15 periods of the experiment.

Please click "OK" when you are ready.

General Information:

This is an experiment in decision making. In today's experiment you will participate in a group decision task. In addition to a $6 participation fee, you will be paid the money you accumulate from your choices which will be described to you in a moment. Upon the completion of the experiment, your earnings will be added up and you will be paid privately, in cash. The exact amount you will receive will be determined during the experiment and will depend on your decisions and the decisions of others. **From this point forward all units of account will be in experimental francs. At the end of the experiment, experimental francs will be converted to U.S. dollars at the rate of 1 U.S. dollar for every 250 experimental francs.**

If you have any questions during the experiment, please raise your hand and wait for the experimenter to come to you. **Please do not talk, exclaim, and look at the computer screens of other participants during the experiment**. Participants intentionally violating the rules may be asked to leave the experiment and may not be paid.

Please click "Continue" when you are ready.

Today's Decision Making Task:

The experiment will have **thirty periods**. In each period you will be in a group with **7** other participants. You and all the other players are arranged around a circle. The diagram of this circle is included in the handout that has been provided to you. The black dots on the circle represent your location. On this circle, you have two neighbors - **a right or anti-clockwise** neighbor and **a left or clockwise** neighbor. You will never know the identity of your neighbors. Your ID will determine who your neighbors are. Please keep in mind that every player has **a different** set of neighbors. Thus if you are **Player 8** then your right or anti-clockwise neighbor is **Player 7** and left or clockwise neighbor is **Player 1**. Similarly **Player 7** has **you** as their left or clockwise neighbor and **Player 6** as their right or anti-clockwise neighbor. Your ID and your neighbors will be the **same** for the first 15 periods of the experiment. At the beginning of Period 16, everyone will be provided with a different ID. As a result of this ID change, your neighbors between Periods 16 and 30 will be different from those between Periods 1 and 15. Also please remember that the person sitting at the computer terminal beside you is not your neighbor in the experiment.

During this experiment each of you will assume the role of a landowner who can participate in a land management program or opt out of it. In both cases, you will receive money for your actions. You will first be given the option to participate in this program. If you choose not to participate, you will receive a payment. **Participation is costly and so you have to incur a cost to do so.** Once you have incurred the cost, you will be able to take part in a group decision task which is part of the land management program. In this task, you will make a choice between two types of land use actions denoted by **A** and **B**. You will

receive a payment based on your choice of **A** or **B**. Since this is a group decision task, your payment will depend on the choices made by your neighbors as well. In a moment we will give you a detailed description of how your payment will be determined.

Please note that you may decide to participate in the task but one or both of your neighbors may choose not to. Also while you decide to participate, you will not know what choices your neighbors' are making.

Please raise your hand if there are any questions otherwise click "Continue".

Your Payment from Group Decision Task:

If you choose to participate in the land management program, then in each period of the experiment, the computer will display a table such as the one shown below. This Payoff Table will be the **same for everyone during a period. However the values in the cells will be different in different periods of the experiment.** You will be provided with a handout containing the Payoff Table. Each number in the table corresponds to a payment (**in experimental francs**) resulting from a possible combination of your choice of A or B (in the row) and your neighbors' choices (in the column). **Please note that all figures in the table are net of the participation cost, i.e., the participation cost has already been deducted from the payoffs.** For example, suppose the participation cost is 40 and your payoff from choosing A and both your neighbors participating and choosing A is 250. Then your final payoff is (250 - 40) = 210. This is listed in the first cell of the first row of the Payoff Table. Similarly if you select B after participation and only one of your neighbors participates and chooses B, the payoff is 195. Then your final payoff is (195 - 40) = 155. The last column in the table indicates your payoffs if you participate and none of your neighbors participate.

Please note that when you will be asked to participate or not, you will know the value of the cost you have to incur. In general, your payoff from the group decision task increases when you choose the same action as your participating neighbors.

Also your payoffs are the same if 1) one or both neighbors participate and choose a different strategy than you or 2) they don't participate at all. For example, the payment to you from choosing B and both of your neighbors choosing A is the same as you choosing B and none of your neighbors participating.

Costly Communication stage:

*Before making a choice in a period about participating in the land management program, you will have the option to communicate with one or both of your neighbors. For every person you choose to communicate with, you have to pay a fee of **5** experimental francs per person. Thus if you choose to communicate with both neighbors, you have to pay a fee of **10** francs. If you choose not to communicate, you don't have to pay the fee. Please note that it is possible that you pay the fee and choose to communicate with your neighbors but they choose not to pay the fee and communicate with you. **If that is the case, you will be able to send messages to the neighbors with whom you have paid to chat and they will be able to view these messages. Similarly, you may have chosen not to chat with your neighbors but one or both of them paid a fee to chat with you. They will be able to send messages to you which you will be able to view.***

*Your communication with the neighbor(s) will consist of messages exchanged in "chat boxes" to the left and/or right of your computer screen depending upon which neighbor you chat with. Messages sent in this chat will only be viewed by you and the neighbor you send it to. For example, if you are **Player 8** and you and both your neighbors have paid the fee to communicate, the chat box on your left will contain messages you send to and receive from Player 1 and that to the right will contain messages you send to*

*and receive from **Player 7**. You will be able to send and receive chats for 60 seconds each period. In order to send a chat to your neighbors, please type in the blue panel at the bottom of your chat box and press Enter. To send a message to your left neighbor, type your chat in the left blue panel at the base of the left chat box. Similarly use the blue panel at the base of the right chat box to send chats to your right neighbor.*

*Although the messages you send to each other will be recorded, your ID remains anonymous and hence all communication is anonymous to the experimenter and cannot be traced back to any subject. In sending messages, you should follow two basic rules: (1) **be civil to one another and do not use profanities,** (2) **only use your ID to identify yourself in any manner**. After the chat period is over you will be able to see the chats you have exchanged with your neighbors for 10 seconds. After these 10 seconds are over, everyone will make their participation and land management decisions. **Please note that you do not learn the land management decisions of your neighbors while making your own decision.***

Making a choice in a period: (No-Comm)

Once the period starts, each of you will first choose whether to participate or not. If you decide not to participate, then you will receive a fixed payoff. This payoff **does not depend** upon your neighbors' participation decisions. If you decide to participate, then in the next stage, you will choose strategy **A or B** by clicking on one of the buttons that will appear on the right of your screen. You may change your choice as often as you like, but once you click on **OK** your choice for that period is final.

Note that when you are making a choice, you will not know what choices others are making. Also, remember that you will never know the identity of anyone else in your group, meaning that all choices are confidential and that no one will ever know what choices you make.

At the end of each period after you have made your choices, your screen will display your choice and payoff. Information will also be provided about whether your neighbors participated and if they did, what were their choices for that period. Information on your accumulated payment through the current period will also be provided. At the end of the experiment, you will receive the sum of your payments from all thirty periods converted to real dollars. This will be paid to you privately in cash.

Before starting the experiment you will participate in a quiz on the next screen. Please note that you will not earn any money from participating in the quiz i.e. this is a non-paying period. Your answers in this quiz will not influence your final payoffs at the end of the experiment.

Making a choice in a period: (Costly-Comm)

*Once the period starts and after you have made a decision to communicate (or not), each of you will first choose whether to participate or not. If you decide not to participate, then you will receive a fixed payoff. This payoff **does not depend** upon your neighbors' participation decisions. If you decide to participate, then in the next stage, you will choose strategy **A or B** by clicking on one of the buttons that will appear on the right of your screen. You may change your choice as often as you like, but once you click on **OK** your choice for that period is final.*

Note that when you are making a choice, you will not know what choices others are making. Also, remember that you will never know the identity of anyone else in your group, meaning that all choices are confidential and that no one will ever know what choices you make.

At the end of each period after you have made your choices, your screen will display your choice and payoff. Information will also be provided about whether your neighbors participated and if they did, what were their choices for that period. Information on your accumulated payment through the current period will also be provided. You will also receive information about your and your neighbors' communication decisions. At the end of the experiment, you will receive the sum of your payments from all thirty periods converted to real dollars. This will be paid to you privately in cash.

Before starting the experiment you will participate in a quiz on the next screen. Please note that you will not earn any money from participating in the quiz i.e. this is a non-paying period. Your answers in this quiz will not influence your final payoffs at the end of the experiment.

Quiz:

1. Your neighbor has the same neighbors as you. **FALSE**
2. Your ID and your neighbors change in Period 16 **TRUE**
3. What is your payoff when you chose B and both of your neighbors participate and chose A? **145**
4. If you choose not to participate, then your neighbors' actions don't impact your payoff. **TRUE**
5. When you are deciding whether to participate or not, you will know whether your neighbors are participating or not. **FALSE**
6. If you decide to communicate with a neighbor, you have to pay a fee of 5. **TRUE**

The Payoff Table: (Phase I)

The table below represents the Payoff Table for Periods 1 to 15. If you choose to participate in the land management program, your payoffs will be determined on the basis of this table for the next 15 periods. This Payoff Table has been provided to you in the handout. You will be provided a handout with a different Payoff Table at the end of 15 periods.

The cost of participating in the land management program for the first 15 periods is **40**.

If you choose not to participate, then you will receive a payoff of **175**. This payoff is not dependent on the choices of your neighbors and is the **same for all 30 periods**.

As mentioned before, all figures in the Payoff Table are net of the participation cost, i.e., the participation cost has already been deducted from the payoffs.

Your ID for the next 15 periods is **1** and your left neighbor is **Player 2** and right neighbor is **Player 8.**

We are now ready to begin the experiment. You will be paid on the basis of all choices you make henceforth. If you don't have any further questions, please click OK to begin.

Results Table: (No-Comm)

On the next screen you will be able to see two tables. The first table presents your choice (of A, B or NP) and the choices of your right and left neighbors for **the current period**. Your choice is in the cell at the center of the table. Your neighbors' choices are recorded in cells on your left and right. **NP** denotes a non-participation choice. The second table is the **History Table** and records your and your neighbors' choices and your profits for the **current period** and **all periods** of this experiment. Please raise your hand if there are any questions otherwise click "Continue".

*On the next screen you will be able to see three tables. The first table records your and your neighbors' chat decisions for the current period. The second table presents your choice (of A, B or NP) and the choices of your right and left neighbors for **the current period**. Your choice is in the cell at the center of the table. Your neighbors' choices are recorded in cells on your left and right. **NP** denotes a non-participation choice. The third table is the **History Table** and records your and your neighbors' choices and your profits for the **current period** and **all periods** of this experiment. Please raise your hand if there are any questions otherwise click "Continue".*

The Payoff Table: (Phase II)

The table below represents the Payoff Table for Periods 16 to 30. If you choose to participate in the land management program, your payoffs will be determined on the basis of this table for the remaining 15 periods. The handout containing this Payoff Table will now be distributed to you.

The cost of participating in the land management program for the remaining 15 periods is **15**.

If you choose not to participate, then you will receive a payoff of **175**. This payoff is not dependent on the choices of your neighbors and is as mentioned the **same for all 30 periods**.

As mentioned before, all figures in the Payoff Table are net of the participation cost, i.e., the participation cost has already been deducted from the payoffs.

Please remember that your new ID is **4** and your new neighbors are **Player 5** and **Player 3**. Everyone else has a different ID as well. Thus your neighbors between Periods 16 and 30 are **different** from your neighbors between Periods 1 and 15. However your neighbors during the next 15 periods of the experiment will remain the same.
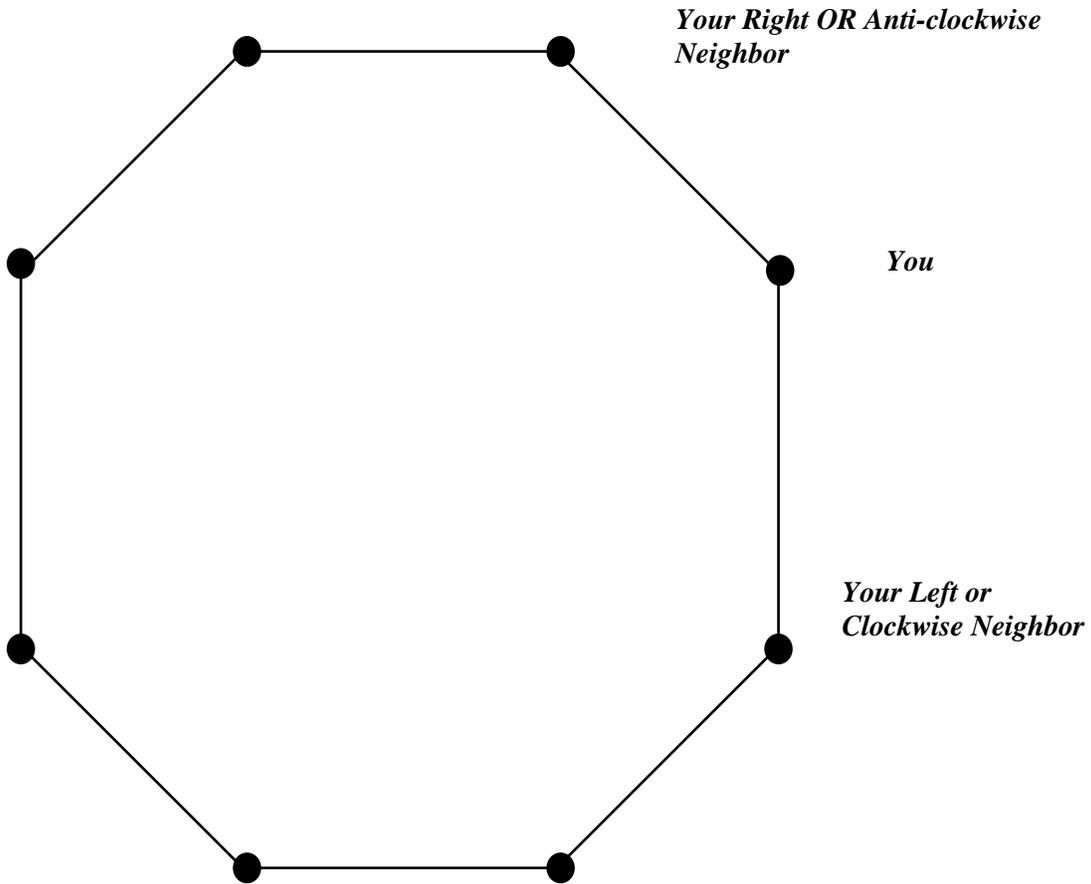
Once you have received the handout, please click OK to continue.

***

Circular Grid with Your Location   **ID Number:**_____

Your Right OR Anti-clockwise Neighbor

You

Your Left or Clockwise Neighbor

Payoff from Non-Participation (NP): 175

Cost of Participating in Land Management Program: 40

Payoff Table

Actions Chosen by Neighbors

Your Action	Both Participate Choose A	Both Participate and one Chooses A & other B	Both Participate and Choose B	Only one Participates & Chooses A	Only one Participates & Chooses B	No Neighbor Participates
A	210	125	40	125	40	40
B	145	155	165	145	155	145
NP (Non-Participation)	175	175	175	175	175	175

All payoffs are net of participation costs