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Drivers of organic farming: Lab-in-the-field evidence of the role of social comparison and information nudge in networks in Vietnam

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Abstract

This study examines farmers' investments in organic farming using the data from a contextualized lab-in-the-field experiment in Northern Vietnam. We analyze how network structures, information nudge and social comparison between farmers impact their decisions. Results show that networks play a key role in encouraging the adoption of organic farming. However, this effect differs depending on the type of network (circle, star or complete), indicating that the role of individuals and the number of individual connections matter. We find that the cooperation incentivized by social comparison can be more easily achieved in decentralized networks like circle networks than in star networks or complete networks. Our results suggest that policymakers can rely on social interaction and social comparison between farmers as well as on information nudge to encourage farmers to make decisions that support sustainable agriculture in Vietnam.

Keywords: Lab-in-the-field; Network; Nudge; Organic agriculture; Social comparison.
JEL codes: C91, C93, O13, Q12.

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1 Introduction

Conventional farming is a widely used method worldwide to produce the majority of the food we eat. However, this type of farming technique is currently facing several issues that may threaten its future. It is well known that pesticides and fertilizers lead to serious health problems for consumers and farmers. For example, cancer, one of the most deadly diseases in the world today, is directly linked to pesticide adulteration of the food we eat (Rodgers et al., 2018; Horrigan et al., 2002). From an economic perspective, it is increasingly difficult for conventional farmers to make a living because they have to purchase expensive hybrid seeds, fertilizers and pesticides from outside sources. As a result, organic farming, a type of farming that does not rely on chemicals has been developed as a solution to limit these negative consequences (Huang et al., 2002; Horrigan et al., 2002). Organic farming, which uses locally available natural inputs, avoids chemicals and stays close to nature, produces healthier foods and contributes to consumer well-being. Self-dependency in terms of inputs can increase the profitability of farms. If farming becomes a profitable activity, the migration of populations to cities will decrease. Organic farming can therefore provide many solutions to prevent the destruction of the environment, pollution and social imbalances (Liu et al., 2016; Cui et al., 2018). However, organic farming is slow to be adopted today and it may take decades to reach widespread adoption, especially in many developing countries.

In recent years, we have observed a relative increase in the adoption of organic farming in several developed countries due to the heightened awareness of health problems caused by the consumption of contaminated foods and the negative effects of environmental degradation, and, in particular, because of the support from governments and international organizations like the European Union and International Federation of Organic Agriculture Movements (IFOAM)[1] (Reisch et al., 2013). However, in many developing countries, conventional farming is still widely accepted since it helps to provide sufficient food for the population and to generate a surplus for exports, even though this practice is becoming increasingly unsustainable, as revealed by declining crop productivity, environmental degradation, chemical contamination, etc. In certain developing countries like Vietnam, the situation is even worse: farmers use pesticides overtly and without restraint.

According to the report of the Vietnamese Ministry of Agriculture and Rural Development (MARD) (August, 2018), Vietnam imported 79 million USD worth of pesticides and raw materials (about 1,800 billion VND), raising the import value of pesticides and raw materials in the first eight months of 2017 to over 660 million USD (over 15,000 billion VND), an increase of almost 47% over the same period in 2016. Statistics show that Vietnam is importing more and more pesticides and raw materials. The import of pesticides and plant protection chemicals has continuously increased over the last few decades due to the expansion of cultivated areas and the intensive cultivation of many crops. However, excessive use of chemicals in agriculture

[1]IFOAM was founded in France in 1972. It has 600 member organizations spread over some 120 countries. IFOAM is involved in a wide range of activities related to organic farming such as the exchange of information, knowledge and reflections among its members.

has caused severe consequences for both the soil and the water, as well as for the quality of agricultural products (Savci, 2012). It is therefore essential to encourage farmers to limit the use of pesticides and to move toward a more sustainable agriculture.

Several studies have shown that the low rate of adoption of organic agriculture is due in part to the lack of information on the part of farmers about the risks of chemical products, as well as to the lack of methods and benefits (Conley and Udry, 2010; Vandercasteelen et al., 2020). Nevertheless, other research has shown that even if farmers personally know that applying more chemicals to their plants is harmful, they are still willing to use pesticides over time to ensure a high level of productivity (Aktar et al., 2009). Government and social media have provided information about the negative effects of chemical inputs, environmental degradation and contaminated food, not only to farmers but to consumers as well, but, unfortunately, these interventions have not yet had a significant impact on farmers' decisions (FAO, 2017).

This paper aims to examine the factors that influence farmers' decisions in relation to organic farming, focusing on the role of their social network and information nudge, as well as on the role of social comparison between farmers. The first objective of our experiment is to examine whether the social connections among farmers could lead to connections in their behaviors. There is a growing literature on both theoretical and empirical studies that focuses on the impact of networks on individuals' behaviors (Ferguson, 2007; Hogset and Barrett, 2010; Santos and Pacheco, 2011). According to the theory of social and economic networks, individuals link together in a network such as a network of friendship or neighborhood in which they can interact and exchange information with others (Granovetter, 1983; Golub and Jackson, 2010). In agriculture, farmers are often linked to farmers' networks such as neighborhood farmers, friends or agriculture organizations in which they can share information, ideas and reflections on new farming methods. Consequently, social networks could be an effective way to diffuse information related to organic farming (Fafchamps et al., 2020).

Second, we introduce social comparison treatment into the experiment to test how social comparison (i.e., information about the average group investment in organic farming) would impact individual farmers' investment decisions. Some studies have indicated that social concern (e.g., revealing an environmental commitment to the others in the network) can be used as a factor to influence farmers' decisions to adopt organic farming (Dessart et al., 2019; Mzoughi, 2011). In our study, we consider an intra-group comparison in which each farmer observes his or her group's average level of investment. It is assumed that when farmers receive information about the average investment of their groups, a social comparison exists such that an investment that is lower than the average would have a negative impact on farmers' outcomes; inversely, a positive impact is the result of an investment that is higher than the average.

We finally introduce information nudge treatment into the experiment. The idea of using information nudges to shape individual behavior has been aggressively studied in the literature (Hotard et al., 2019; Brandon et al., 2019; Sudarshan, 2017). In our study, we theoretically observe that all farmers would be better off at social optimum, but this optimum is difficult to achieve because every farmer has the incentive to deviate and free-ride on other investments. We thus provide the information nudge about the socially optimal investment of each farmer and the optimal investment of his/her direct neighbor to the other farmers to determine whether or not it would help to encourage farmers to adopt a positive attitude toward organic agriculture.

We tested these ideas via *a contextualized lab-in-the-field* experiment in 2019 with 220 farmers in eight different villages in four different provinces in Northern Vietnam. The context was established on the basis of the definition of organic farming and the fact that we only had farmers not involved in organic farming in our sample. Our experiment was conducted with farmers involved in four different types of networks: circle, star, complete, and not in connection (i.e., empty network). Farmers had to indicate how much they would invest in organic farming in different experimental scenarios (see the 11 scenarios in Figure 2). Our main results can be summarized as follows: first, we show that interconnection among farmers affects their decisions in the way that it helps to encourage the investment in organic agriculture. In particular, this impact varies according to the network structure: farmers have a higher incentive to invest in organic farming in a network with more connections than in a network with less connections. Second, the effect of social comparison on the farmer's organic investment also depends on the network structure: we only observe the positive and significant effect of the social comparison treatment in a circle network. Our results suggest that the social comparison treatment performs better in a decentralized network with fewer connections (e.g., a circle network) than the centralized one (e.g., a star network). Finally, our analyses show that social comparison concerns combined with information nudge seem to be a good way to encourage farmers to move toward a more environmentally-friendly agriculture since the information nudge treatment has a positive and significant effect on the organic investment in all network structures.

The remainder of this study is organized as follows. In Section 2, we discuss the theoretical framework and present theoretical predictions. Section 3 describes the *lab-in-the-field* experiment, including treatment, experimental procedure, the sample, and additional experimental questionnaires. Results are presented in Sections 4 and 5. Section 6 is devoted to a discussion and conclusion.

2 A network game

2.1 Model

Let us consider that there are N agents; a typical agent is denoted by i. Let $\mathbf{D}$ be an $N \times N$ adjacency matrix; its element d_{ij} represents the relationship between i and j. Each agent i has a set of neighbors, denoted $N_i(d)$ (i.e., network of i). In the network of i, $d_{ij} = 1$ if $j \in N_i(d)$ and $d_{ij} = 0$ if $j \notin N_i(d)$. We also assume that the network is *undirected*, which requires that $d_{ij} = d_{ji}$. Thus, a set of neighbors such that i is linked to is referred to neighbors of i: $N_i(d) = \{j \setminus i : d_{ij} = 1\}$ or $N_i(d) = \{j | ij \in g\}$.

Each agent will face a decision problem of how to optimally allocate his or her investment in conventional and organic farming. Let c_i and x_i be the agent i's investment in conventional and organic agriculture, respectively. We assume that the investment is the percentage of lands that an agent can allocate to either conventional or organic agriculture. Thus, each agent's amount of investment is bounded: $c_i \in [0,1]$ and $x_i \in [0,1]$. Since the total investment for each agent is $x_i + c_i = 1$, we can rewrite the investment for conventional farming c_i with a given x_i as $c_i = 1 - x_i$.

Let us consider the case that an agent i invests both in conventional farming (c_i) and organic farming (x_i) so that his/her total gross revenue is the sum of both revenues: $f(c_i) + f(x_i)$. For the sake of simplicity, we can assume that $f(c_i) = \beta f(x_i)$ where $f(.)$ is an increasing and concave function, $f^{'} > 0$, $f^{''} < 0$ and $f(0) = 0$. We can also assume that the gross revenue in organic farming is higher than the gross revenue in conventional farming, so that $\beta \in (0,1)$. However, to obtain a higher gross revenue in organic farming, farmers have to pay an extra amount γx_i. By substituting c_i with $1 - x_i$, we can write the agent i's total payoff function as follows:

$$\pi_i(x_i) = \beta f(1 - x_i) + f(x_i) - \gamma x_i$$

Social network

In the next step, we extend our model by taking the role of the social network into account. In particular, we consider that social connections exist among farmers and that each farmer cares about the actions of his/her direct neighbors (i.e., peer effect). We assume that the peer effect is positive such that $\delta \sum_j^N d_{ij} x_j x_i$ where $\delta > 0$. This captures the fact that an organic farmer i would benefit from the total organic investment of his or her direct neighbors $\sum_j^N d_{ij} x_j$. Parameter δ, which represents the magnitude of this effect, is assumed to be positive and homogeneous across agents. We can, for instance, imagine that an organic farmer who has good market information might inform his organic peers about when and where to market their crops to receive high profit. The benefits would not only come from the market information but also from experience and greater labor-sharing opportunities in their networks (e.g., farmers in a network can help each other to cultivate organic products) (Munasib et al., 2011). The peer effect can also be interpreted as the descriptive norm in that farmers who adopt sustainable agriculture may motivate their neighborhood farmers to adopt it as well because most individuals are "conditionally cooperative", i.e., people contribute to public goods only if others do so as well (Dessart et al., 2019).

Social comparison

In our model, we also take the social comparison mechanism in which an organic farmer receives information about the average level of organic investment in the network into account (from both direct and indirect neighbors). We assume that farmer i, who invests more in organic farming than the average of his or her group, would earn an amount $\eta(x_i - \frac{1}{N}\sum_j^N x_j)$ where $\eta > 0$, otherwise he or she would lose an amount $\eta(\frac{1}{N}\sum_j^N x_j - x_i)$. From a social perspective, the social comparison could be interpreted as the social factors such as social signaling or social norm, that affect farmers' behaviors. Regarding social signaling, improving public image and status help motivate farmers to adopt more sustainable practices such as organic and integrated farming (Dessart et al., 2019; White et al., 2019). The group's average investment could be seen as a norm or an expected amount of investment. Those who invest more than this level would benefit from social signaling. On the contrary, farmers who invest less than the expected amount of investment would suffer from public punishment (e.g., public shaming).

Considering social network and social comparison concerns, the payoff for agent i is as follows:

$$\pi_i(x_i) = \beta f(1-x_i) + f(x_i) - \gamma x_i + \delta \sum_j^N d_{ij} x_j x_i + \eta(x_i - \frac{1}{N}\sum_j^N x_j) \tag{1}$$

where, $f(x) = ax - bx^2$, $a, b > 0$, $a > 2bx$ and $\delta, \eta > 0$.

If each agent chooses x_i by maximizing his or her payoff, from the first order condition (F.O.C), we then have the Nash equilibrium x^* such that

$$x_i^* = \frac{(1-\beta)a + 2\beta b - \gamma + \eta}{2(1+\beta)b} + \delta \frac{\sum_{j=1}^n d_{ij}}{2(1+\beta)b} x_j^*$$

It should be noted that the game is strategy complementary $\frac{\partial x_i^*}{\partial x_j^*} = \delta \frac{\sum_{j=1}^n d_{ij}}{2(1+\beta)b} > 0$ for $\delta > 0$.

Let $\mathbf{x}^* = (x_1^*, x_2^*, ...x_n^*)$. In the matrix formula, we have

$$\mathbf{x}^* = \frac{\alpha}{2(1+\beta)b}\iota + \frac{\delta}{2(1+\beta)b}\mathbf{D}\mathbf{x}^*$$

where, $\alpha = (1-\beta)a + 2\beta b - \gamma + \eta$ and ι is the $n \times 1$ column matrix of one.
Let $\mathbf{\Phi} = \frac{\delta}{2(1+\beta)b}\mathbf{D}$. If the $\mathbf{\Phi}$ is invertible, we then have the equilibrium that is equal to:

$$\mathbf{x}^* = \frac{\alpha}{2(1+\beta)b}(I - \mathbf{\Phi})^{-1}\iota. \tag{2}$$

Thanks to this closed form solution, we can calculate the equilibrium of each agent based on the information of the given network structure $\mathbf{\Phi}$. In other words, the equilibrium solution varies across different networks, the different positions of the agents inside the network and the number of direct links. Note that the condition of the convertibility of matrix $(I - \mathbf{\Phi})$ can be achieved if the determinant of $(I - \mathbf{\Phi})$ is non-singular. This condition always holds for the circle and complete network because these networks are regular graphs, and according to Hall's theorem, every d-regular graph is invertible (West et al., 2001; Aharoni and Haxell, 2000). Moreover, we can also prove that the determinants of $(I - \mathbf{\Phi})$ for all three network structures (circle, star and complete) are non-zero.[2]

Consider that there is a utilitarian social planner who maximizes the total individual payoffs

[2] In particular, $det(I - \mathbf{\Phi}) = 0.9389$ for the circle network, $det(I - \mathbf{\Phi}) = 0.9506$ for the star network and $det(I - \mathbf{\Phi}) = 0.8467$ for the complete network with parameter assumptions in the Appendix (see Table A.1).

(considered as social welfare). His or her maximization problem is as follows:

$$\max_x W(g,d) = \max_{x_1,x_2,\ldots,x_N} \sum_{i=1}^{N} \pi_i(x_i,d)$$
$$= \max_{x_1,x_2,\ldots,x_N} \sum_{i=1}^{N} \{\beta(a-b) + [(1+\beta)a + 2\beta b - \gamma]x_i$$
$$+ \delta \sum_{j=1}^{N} d_{ij}x_ix_j - (1+\beta)bx_i^2 + \eta(x_i - \frac{1}{N}\sum_{j}^{N} x_j)\}$$

Consequently, according to the F.O.C, the socially optimal investment in organic farming is equal to

$$\hat{\mathbf{x}} = \frac{\hat{\alpha}}{2(1+\beta)b}(I - 2\mathbf{\Phi})^{-1}\iota \tag{3}$$

where, $\hat{\alpha} = (1-\beta)a + 2\beta b - \gamma + \eta\frac{N-1}{N}$.

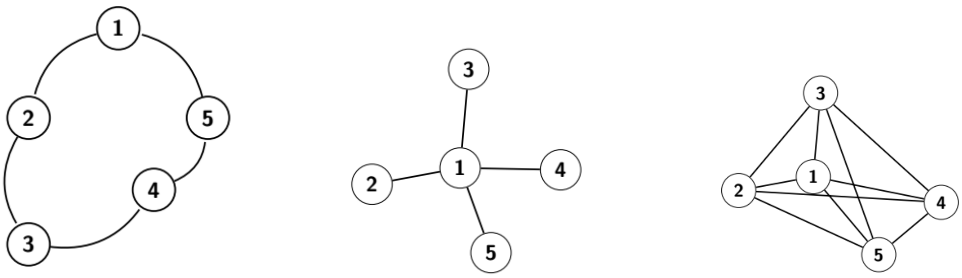
We can observe that for a sufficiently large value of N, $\hat{\alpha} \to \alpha$. Thus, the socially optimal investment $\hat{\mathbf{x}}$ is then higher than the investment at the Nash equilibrium $\mathbf{x}^*$, $\hat{\mathbf{x}} > \mathbf{x}^*$. Since we have $\mathbf{\Phi} = \frac{\delta}{2(1+\beta)b}\mathbf{D}$, a higher value of δ leads to a larger difference between $\hat{\mathbf{x}}$ and $\mathbf{x}^*$. Therefore, in the experiment, we need to impose a sufficiently high value of δ in order to clearly observe the difference between farmers' decisions at the social optimum and at the Nash equilibrium. Note that a higher value of δ also means a stronger impact of the peer effect on individual behavior. A numerical illustration of our theoretical model is discussed in Appendix A.

2.2 Theoretical predictions

According to Equation (2), the equilibrium of organic investment depends on two terms: the fraction $\frac{\alpha}{2(1+\beta)b}$ and the network structure $\mathbf{\Phi} = \frac{\delta}{2(1+\beta)b}\mathbf{D}$. This suggests that the interconnections among farmers (adjacent matrix $\mathbf{D}$) would have a positive impact on farmers' organic investment decisions since $\delta > 0$, which means that an agent who is connected to more organic neighbors (i.e., a neighbor who invests in organic farming) is more likely to invest in organic farming. In addition, the farmers' organic investment would also vary across different types of network structures, which are represented by the matrix $\mathbf{D}$. We therefore establish our first prediction as follows:

Prediction 1 (role of networks): Interconnection among agents via their social networks positively impacts their investment in organic farming. This impact varies across three different types of networks: star, circle, and complete.

In the experiment, we test our results with three different types of networks: a star, circle and complete network (see Figure 1). The complete network is a decentralized network, which is the simplest situation in real life, where farmers care about the behaviors of all other farmers in their groups/communities. The circle network is also a decentralized one but with fewer connections, in which each farmer cares only about his/her two closest neighbors (i.e., two most important neighbors/friends). Concerning the star network, it is a centralized network in which farmers care about the most important farmer in the network, the central farmer (i.e., the center). According to the theoretical model, we expect that network connections would have a positive impact on individual behavior and that the strongest impact on farmers' organic investments would come from the complete network since it is the most connected network in this study.



(a) Circle (b) Star (c) Complete

Figure 1: The three different network structures for $N = 5$.

Remark that the effect of social comparison on the equilibrium is captured by the parameter η. A higher value of η results in a higher equilibrium level of investment x^* (see Equation 2). Thus, we would expect that social comparison has a positive impact on farmers' organic investments. Since the effect of social comparison is independent of the network structure at the equilibrium (Equation (2)), we would expect no significant difference in the effect of social comparison on individual behavior across networks. Our second prediction is as follows:

Prediction 2 (role of social comparison): Social comparison has a positive impact on farmers' investments in organic farming. This impact is independent of network structure.

We observe that when optimal investment is higher than its equilibrium level, i.e. $\hat{x} > x^*$, then the farmers' payoffs at the social optimum are also higher than their payoffs at the Nash equilibrium. This means that all farmers would be better off if they coordinated at the social optimum. However, this Pareto optimum will not be easily achieved because farmers have incentives to deviate from the social optimum and earn higher payoffs if they know that others are coordinating at the social optimum (see Table A.1 in Appendix A for a numerical illustration). Thus, it is necessary to verify whether introducing the nudge information would increase the coordination among farmers. In our experiment, the nudge information (i.e., information about the socially optimal investment) is introduced in the case where farmers receive the social comparison treatment since we want to compare the effectiveness of social comparison and the combination effect (with both social comparison and information nudge) in promoting organic agriculture. This leads us to the following prediction:

Prediction 3 (role of social comparison combined with information nudge): Combining social comparison and information nudge has a positive impact on farmer's organic investments. This impact varies across different network structures: star, circle and complete.

3 The lab-in-the-field experiment

3.1 Treatments

There are two treatments in our experiment: social comparison (Sc) and the combination of social comparison and nudge (ScNd). The control is the *no treatment*, i.e., neither social comparison nor the combination of social comparison and nudge. We test these two treatments and the control in four different types of network structures (empty network, circle, star and complete network).

Treatment variables	Empty network (B)	Network		
		Complete (Cp)	Circle (Cr)	Star (St)
No treatment (N)	-	Cp	Cr	St
Social comparison (Sc)	BSc	CpSc	CrSc	StSc
Social comparison and Nudge (ScNd)	BScNd	CpScNd	CrScNd	StScNd

Figure 2: Two treatments and control in four different types of networks (11 scenarios).

The control is the *no treatment* where subjects were invited to participate in a land management game without social comparison and nudge but, even then, a network effect exists that influenced the subjects' payoffs depending on the network structure (star, circle or complete network). We tested a total of 11 different scenarios in the experiment (see Figure 2). These 11 scenarios were tested during 22 different experimental sessions, which means that each scenario was tested twice and only one scenario was tested in each session. In the treatment "social comparison" (Sc), information about the average group investment was given. Hypothetically, subjects' payoffs are negatively (or positively) affected by the average group investment if their organic investments are lower (or higher) than the average. In the treatment "social comparison and nudge" (ScNd), subjects receive both information about the average group investment and the information nudge, where the nudge for subjects is provided through information about the socially optimal investment for them and for their direct neighbors.

3.2 Experimental procedure

The experiment was initially run with a pilot in June 2019, followed by the field experiment in August 2019. The pilot was run with two groups of farmers (five subjects per group). In the pilot, farmers were assigned to a complete network and the "ScNd" treatment. The objective of the pilot was to test some outcomes of the theoretical predictions, our parameter assumptions, as well as the experimental instructions. The experiment was conducted using an IPad for each participant.[3]

The experiment consisted of four parts. The first part, identical for all sessions, aimed at capturing the subjects' sensitivity to risk. The second part, also identical for all sessions, concerned the case of the empty network (B), no social comparison and no nudge (N) (i.e., no treatment) (see Figure 2). The third part of the experiment differed from one scenario to another (see Figure 2). In the last part of the experiment, qualitative and quantitative information was collected from the subjects using survey questions. This part was identical for all sessions. More details will be discussed in Section 3.4.

At the beginning of the experiment, subjects were invited to read the experimental instructions and the experimenters explained the different parts as well as the monetary incentives. The experimenters and assistants helped the subjects to understand the instructions after they read them. They then had to answer a quiz to test their understanding of the instructions. All instructions are available in the Supplementary Materials.

In the first part of the experiment, we ran a lottery-choice task to capture the subjects' sensitivity to risk. Each farmer was given 50,000 VND (Vietnam Dong)[4] to invest in a lottery. Subjects made their decisions on the IPad screen (see an example in Figure 7 in Appendix B). At the end of the experiment, subjects were invited to individually make a draw (by tossing a coin), and the lottery winner was the one who had chosen heads. Subjects were told at the beginning of the first part that lottery winners would receive a triple amount of their investment; otherwise, they would lose the investment and keep the amount that was not invested. The amount of money not invested is used as a relative indicator of risk aversion.

In the second part, subjects were invited to participate in a simple organic investment game. In particular, each farmer was given a similar amount of agricultural land (denoted L). They were invited to allot a proportion of their land to organic farming (denoted as X and ranging from 0% to 100%), and the rest of the land that was not allotted to organic farming was devoted to conventional farming ($L - X$). For each unit of X, the farmer's payoff was calculated using Equation (1) and the parameter assumptions in Table A.1. Note that farmers earned 500 VND for each unit of payoff. Thus, individual payoffs (in terms of VND) are given by the following function:

$$\pi = 40,000 + 75,000X - 90,000X^2$$

In this part, there was no peer influence, no social comparison and no information nudge. Depending on their level of investment (X), farmers could receive a payoff ranging from 40,000[5] (for $X = 0$) to 55,625[6] (for the Nash or optimal investment $X = 41.67\%$). Subjects did not receive any information about the optimal decision and payoff nor about the payoff range. Sub-

[3] There were ten assistants during the experiment to help farmers use the IPad and to understand the experimental instructions.

[4] equivalent to almost 2 USD.

[5] equivalent to 1.7 USD.

[6] equivalent to 2.4 USD.

jects were told that their outcomes depended only on their personal decisions. The experiment was repeated over five periods and subjects could observe their payoffs in each round (for an example, see Figure 8 in the Appendix).

The third part of the experiment concerns one of the 11 scenarios mentioned in Figure 2. There was a total of 22 experimental sessions since each scenario was tested twice in two different villages. In each session, there were two groups of subjects (five subjects per group) and all of them were assigned to the same scenario.

In the presence of a network, experimenters informed subjects that organic farmers would benefit from their direct peers organic investment and that the benefit gains depended on the network structure (star: "St", circle: "Cr" and complete: "Cp"). For example, in the star network, the payoff function of farmer 2 (see the network structure in Figure 1) is written as follows:

$$\pi_2 = 40,000 + 75,000X_2 - 90,000{X_2}^2 + 20,000X_2X_1, \tag{4}$$

where, X_1 is the investment in organic farming of farmer 1. Farmer 1, central farmer in the star network, is farmer 2's direct neighbor.

For the treatment "Social comparison" (Sc), each subject received the information about the average investment of their group. As previously mentioned, we assumed that for an investment lower than the average, there is a negative impact of social comparison on the outcome, and for an investment higher than the average, the effect of social comparison on the outcome is positive. For farmer 2 concerned by social comparison in the star network, his or her previous payoff function (Equation (4)) becomes:

$$\begin{aligned} \pi_2 =& 40,000 + 75,000X_2 - 90,000{X_2}^2 + 20,000X_2X_1 \\ &+ 10,000(X_2 - (X2 + X_1 + X_3 + X_4 + X_5)/5). \end{aligned} \tag{5}$$

If we consider the circle network, π_2 is written as follows:

$$\begin{aligned} \pi_2 =& 40,000 + 75,000X_2 - 90,000{X_2}^2 + 20,000X_2(X_1 + X_3) \\ &+ 10,000(X_2 - (X2 + X_1 + X_3 + X_4 + X_5)/5), \end{aligned} \tag{6}$$

where, X_1 and X_3 are the investment in organic farming of farmers 1 and 3 (farmer 2's direct neighbors in the circle network).

For the treatment "social comparison and information nudge" (ScNd), subjects received their peers' benefits depending on the network structure, as well as the information about the average group investment. The presence of an additional information nudge means that nudged farmers receive information about themselves and their direct neighbors' socially optimal level of investment. Each farmer then decides to follow or not this information given that if everyone follows this suggestion, every farmer in the group will receive the highest payoff. Similar to the second part, each participant can make a simulation of their decision and see their expected payoff (for an example, see Figure 9 in the Appendix).

Note that in the second and third part of the experiment, we chose a repeated game design in which subjects make repeated decisions in a single treatment, with earning feedback provided between rounds. The game was repeated five times for the second part and ten times for the third part. After each round, depending on the different network structures, subjects who were assigned to a particular network structure received the feedback of their direct neighbors' decisions. For instance, subjects in the circle network can observe the investment decision of their two direct neighbors, while those in the complete network have four direct neighbors and consequently receive the feedback of four other farmers' decisions. In the presence of treatments, subjects who were assigned to the "Sc" and "ScNd" treatments received the information about the average group's investment after each round. Subjects who were assigned to the "ScNd" treatment received additional information about the socially optimal investment of all members in their group at the beginning of each round. Primary experimental instructions are described in Appendix B.

3.3 Additional experimental questionnaires

In addition to the primary experiments, we collected information from participants on a variety of socio-demographic characteristics. In particular, we collected information on age, gender, farm size, household size, type of residence, individual and household income, health, highest level of education, marital status, number of children in the household, and individual attitudes toward risks, etc.

We also elicited information on a number of questions related to environmental concerns via 15 New Ecological Paradigm (NEP) questions to help us to identify the individual perceptions toward the environment (details of the NEP questions in Table C.3 in the Appendix) (Dunlap et al., 2000). The total NEP score is the aggregate score of these NEP questions, in which Cronbach's alpha is equal to 65.45%[7] and questions number 2, 4, 6, 8, 10, 12, 14 (even number questions) are reversely coded (Cronbach, 1951). There were also several other questions related to environmental concerns in order to capture participants' opinions and concerns toward the environment. All questionnaires are available in the Supplementary Materials.

3.4 Sample

In total, 220 farmers took part in the lab-in-the-field experiment. The 22 experimental sessions were divided equally across geographic locations, with ten farmers (five farmers per group) in each experimental session. The participants were all farmers living in rural areas, aged from 16 to 78 years, across eight villages of four different provinces (Vinh Phuc, Hung Yen, Hai Duong, Ha Noi) in Northern Vietnam (see Figure 6 in the Appendix for the area of the experiment). These provinces around Hanoi were chosen because they produced most of the agricultural

[7] Cronbach's alpha is equal to 65.45% in the reliability test, which suggests that 65.45% of the variance in the score is reliable.

products (vegetables, rice and fruits) for Northern Vietnam. The experiments were conducted in the village where the participants lived.

Farmers were 52-years-old on average. A total of 67% were women and 39.1% of them were heads of households. They produced mainly vegetables (74.5%) and rice (52.7%). Only 33.2% and 27.7% of the farmers produced fruits and corn, respectively.[8] Most of the farmers in our sample was small household farmers with an average farm size of 2466 m^2. In the next two sections, we will present the descriptive statistics and analyze the average as well as the individual decisions for the 11 scenarios mentioned above.

4 An analysis of average investment decisions

In this session, we undertook an analysis of the average investment per network and per treatment. It should be recalled that the decision variable is the proportion of land investment in organic farming, ranging from 0% to 100%. The rest, which is not invested, is devoted to conventional farming. The distribution of the percentage of land invested in organic farming per network and per treatment is shown in Table C.1 (in the Appendix) and in Figure 3.

We examine the differences across treatments and networks using the non-parametric test. The Wilcoxon Rank Sum test (or Mann-Whiney U test) was used to compare the choice of participants in two treatments and no treatment across four different networks (Mann and Whitney, 1947). The non-parametric test is presented in Tables 1 and 2.

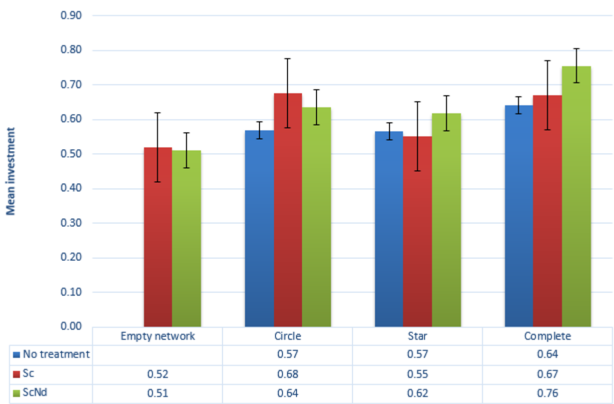


Figure 3: Histogram of mean investment per network and per treatment.[9]

Role of networks

In the situation of no treatment, which means that there is no social comparison or information nudge treatment, we observe that farmers invest more in organic farming in the presence of more network connections: on average, 64.1% of the land is invested in organic farming in the

[8]Note that the sum of these percentages is greater than 100% since each farmer may produce more than one crop.

[9]Sc stands for “social comparison” treatment. ScNd stands for “social comparison and information nudge” treatment.

complete network in which each farmer is connected to all of the others, while only about 57% of the land is invested in the circle and star network in which there are less connections between farmers (Figure 3 and Table C.1 in the Appendix). This result is confirmed by the Wilcoxon Rank Sum test (Table 1). In particular, farmers in the complete network invested an average of 7% more in organic farming compared to the circle and star networks.

However, surprisingly, there is no significant difference in organic investment between the circle and the star network (second column of Table 1). If we break down the farmers in the star network into two groups - farmers in the center and the corner of the star - we then observe that farmers in the center seem to invest more than the corner ones in organic farming, according to the Wilcoxon test statistic reported in Table C.2 (in the Appendix). The results indicate that farmers in the center invested an average of 10% and 13% more in organic farming compared to the circle and farmers in the corner, respectively. However, there is only one central farmer in the star network. This leads to the fact that the corners have only one direct neighbor (i.e., the network connection is weak) and thus a weaker network (i.e., with fewer connections) results in a lower level of organic investment.

Therefore, in the case without any treatment, we could observe a positive impact of the network on farmers' investment decisions in organic farming. This suggests that farmers seem to be influenced by their direct neighborhood farmers' decisions, and the greater number of direct links/connections means a higher level of organic investment. Prediction 1 is therefore validated.

Table 1: Difference-in-mean across the different network structures (Wilcoxon Rank Sum test).

	No treatment			SC			SC & Nudge		
	Circle	Star	Complete	Circle	Star	Complete	Circle	Star	Complete
Empty network	-	-	-	-0.16***	-0.03**	-0.15***	-0.13***	-0.11***	-0.25***
				(0.000)	(0.026)	(0.000)	(0.000)	(0.000)	(0.000)
Circle	-	0.00	-0.07***	-	0.13***	0.01	-	0.02	-0.12***
		(0.858)	(0.000)		(0.000)	(0.778)		(0.179)	(0.000)
Star	-	-	-0.07***	-	-	-0.12***	-	-	-0.14***
			(0.000)			(0.000)			(0.000)

Notes: The table reports the difference-in-mean and the p-value of the Wilcoxon Rank Sum test in parentheses. SC stands for the social comparison.
** $p < 0.05$; *** $p < 0.01$.

Role of social comparison

In the presence of social comparison where farmers received information about their average group investment after each round, the circle and complete networks result in a sufficiently high level of organic investment (about 68% for the circle network and 67% for the complete network compared to 57% and 64% in the case without social comparison) (Figure 3). Figure 5 suggests that the social comparison treatment works effectively in the circle and complete networks (decentralized network) but that it is less effective in the star network (centralized network). Farmers in the star network invest just a little in organic agriculture (only 55.1% on average). Our theoretical prediction indicated that the effect of social comparison on farmers' decisions does not depend on the network structure. However, we observe that this is not the case in the experiment, even when every farmer in the same network received the same information about his or her group's average investment. One interpretation could be that in the experiment, in addition to the information about the average group investment, farmers who were assigned to the "Sc" treatment received different types of feedback about their direct neighborhood investment depending on the network structure. For instance, farmers in the complete network could observe all of the others' decisions, while those in the circle network could only observe the decisions of two direct neighbors. Thus, the social comparison treatment could play an important role in a network with fewer connections.

Table 2: Difference-in-mean (Wilcoxon Rank Sum test).

	No network		Circle		Star		Complete	
	SC	SC & Nudge	SC	SC & Nudge	SC	SC & Nudge	SC	SC & Nudge
No policy	-	-	-0.11***	-0.07***	0.02	-0.05***	-0.03	-0.11***
			(0.000)	(0.000)	(0.156)	(0.000)	(0.105)	(0.000)
SC	-	0.01**	-	0.04**	-	-0.07***	-	-0.08***
		(0.013)		(0.043)		(0.000)		(0.000)

Notes: The table reports difference-in-mean and the p-value of the Wilcoxon Rank Sum test in parentheses. SC stands for the social comparison.
** $p < 0.05$; *** $p < 0.01$.

In a star network, after each round, both farmers in the center and corner received information about the average organic investment of their group (i.e., the same information). The difference is that the center had information about the decisions of all the other farmers in the network, while the corners observe only the center's decision. Figure 5 (in the Appendix) suggests that because of the asymmetric information, both the centers and corners followed the average group investment. During the last period, the decisions of the corners seemed to converge to the Nash equilibrium (about 55% at the Nash equilibrium), while the centers followed the average group decision instead of choosing the Nash equilibrium strategy, i.e. about 71% of land invested in organic farming (Table A.1 in the Appendix). This also suggests that the center seems to be more influenced by the average group decision than what was expected from the theoretical prediction.

We can therefore observe that the social comparison treatment works more effectively in a decentralized network with fewer connections (like a circle network) but performs worse in a centralized network (like a star). Therefore, Prediction 2 is only partially validated.

Role of social comparison combined with information nudge

In the case of an empty network, according to the results in Table 2, the value 0.01 in the second column suggests that the farmers in the "Sc" treatment invest 1% more in organic farming than the ones in the "ScNd" treatment. This difference is statistically significant at the 5% level, which is suggested by the Wilcoxon Rank Sum test with the $p - value = 0.013$. This means that in the case of an empty network, the additional information nudge, which is about the socially optimal investment in organic farming, results in a small reduction in investment compared to the social comparison. This observation is in line with our theoretical result that the social optimum (46.11%) is lower than the Nash equilibrium (47.22%) (see Table A.2 in the Appendix).

While the "Sc" treatment performs more efficiently only in the decentralized network (like a circle network), the nudge implementation performs well in encouraging farmers' coordination in all three networks (circle, star and complete network), especially in the complete network with an increase in organic investment up to 76% (see Figure 3). This is because farmers are more likely to coordinate with the nudge information in a more strongly connected network (like a complete network) than a weaker connected network (like a circle network). One interpretation could be that in a complete network, each farmer receives nudge information and observes the decisions of all the others (because they are all connected to each other), while in a circle network, each farmer receives nudge information about the optimal decision of two other farmers (who are the two direct neighbors) and also observes only the decisions of these two farmers. Thus, farmers in a complete network are more likely to cooperate with the nudge information when their action is observed by all other farmers in the network (Brick et al., 2017). Consequently, these observations confirm Prediction 3.

5 Analysis of individual decisions

In this section, we analyze the impact of different treatments on the individual decisions, x_i. We adopt the fractional regression model to deal with dependent variable, which is defined on the closed interval $x_i \in [0, 1]$ (Papke and Wooldridge, 1996; Ramalho et al., 2011). Figure 4 presents the distribution of individual investment decisions across different network structures.

The fractional model with the dependent variable x_i as a fraction bounded between zero and one, i.e., $x_i \in [0, 1]$, has the following structure:

$$E(x_i|Z_i) = H(Z_i\beta), \tag{7}$$

where Z_i represents a set of regressors including explanatory variables (Exp_i), socio-economic control variables ($Socio_i$) and psychological control variables (Psy_i). For the logistic link-function $H(.)$ satisfying $0 < H(.) = \frac{exp(.)}{1+exp(.)} < 1$ (Wooldridge, 2009), the fractional logistic model can be written as follows :

$$E(x_i|Z_i) = \frac{e^{Z_i\beta}}{1 + e^{Z_i\beta}}. \tag{8}$$

The proposed estimator for β is the Quasi Maximum Likelihood Estimator (QMLE), which maximizes the following Bernoulli log-likelihood function (McCullagh, 1989):

$$l_i(\beta) = x_i log[H(Z_i^{'}\beta)] + (1 - x_i)log[1 - H(Z_i^{'}\beta)]. \tag{9}$$

Since there is the non-linear estimation of the conditional mean, the fractional logit model perform well if there are not many observations at the boundary levels; otherwise, two-part models are often a better solution (Ramalho et al., 2011). We observe that the majority of individual investments fall inside the interval $(0, 1)$ and only some small proportion of organic investment is left censored at 0% and right censored at 100% (see Figure 4). Additionally, the estimation results with the Tobit regression model are also reported in Table C.5 (in the Appendix).

5.1 Descriptive statistics

The dependent variable is the individual decision, or the percentage of individual organic investment ranging from 0 (0%) to 1 (100%). In the fractional logit model, we specify the set of regressors as $Z_i = (Exp_i, Socio_i, Psy_i)$. The descriptive statistics of our variables are reported in Table 3.

Table 3: Descriptive statistics.

	Mean	Std.Dev	Min	Max
Dependent variables				
Individual decision	0.57	0.19	0	1
Explanatory variables				
Neighbor (t-1)	0.45	0.63	-2.30	1.38
Sc	0.30	0.46	0	1
ScNd	0.24	0.43	0	1
Center	0.04	0.19	0	1
Control variables				
Period	5.5	2.87	1	10
Female	0.67	0.47	0	1
Age (in log)	3.94	0.21	2.77	4.36
Age (in years)	52.40	9.92	16	78
Education				
High school	0.30	0.46	0	1
College/university	0.11	0.31	0	1
Health				
Good	0.40	0.49	0	1
Very good	0.22	0.41	0	1
Individual income				
Medium	0.33	0.47	0	1
High	0.04	0.20	0	1
Farm size (in log)	7.45	0.81	4.99	10.0
Farm size (in m^2)	2466.17	2903.83	147	23,040
Communist	0.18	0.38	0	1
Farmer association	0.88	0.32	0	1
Cooperative	0.68	0.47	0	1
NEP	46.87	4.45	36	63
Risk investment (in log)	10.1	0.82	0	10.8
Organic approval				
Unsure	0.30	0.46	0	1
Agree	0.11	0.31	0	1

The explanatory variables Exp_i include: $Neighbor(t-1)$, the log of total direct neighborhood investment in the previous period; Sc, the social comparison treatment; $ScNd$, the combination of social comparison and information nudge treatment; and $Period$, introduced to capture the time trend (or learning effect).

The socio-economic control variables $Socio_i$ include: $Female$, a dummy that takes a value of 1 if the farmer is female; Age, the log of individual age; $Health$, a category variable that takes the value of 1, 2 or 3 if the individual has bad health, good health or very good health, respectively; $Education$, category variable that takes the value of 1, 2 or 3 if the individual level of education is below secondary school (grade 6 to grade 9), or below vocational school

(1 to 2 years after high school), or college and university; *Income*, a category variable that takes a value 1 if the individual is in the low income group (monthly earnings $<$ 4 millions VND), a value of 2 if the individual is in the middle income group (monthly earnings from 4 to 8 millions VND) and a value of 3 if the individual is in the high income group (monthly earnings $>$ 8 million VND); *Farmsize*, the log of household farmer's farming land (in m^2); and *Communist*, *Farmer association* and *Cooperative*, three dummy variables that take the value of 1 if the individual is a member of the communist party, a farmer's association or a farmer's cooperative, respectively.

The psychological control variables Psy_i include: *NEP*, the aggregate score of individual 15 New Environmental Paradigm questions (Table C.3 in the Appendix); *Risk investment*, the log of individual investment in the lottery choice task (in the first part of the experiment); and *Organic approval*, a category variable that takes the value of 1, 2 or 3 if the individual disagrees/is unsure/agrees, respectively, when the adoption of organic farming is approved by most of the other villagers.

5.2 Results

Role of networks

The results in Table 4 suggest that in the case of no treatment, $Complete * NoTreat$ has a positive and significant impact on individual decisions compared to the circle network (i.e., $Circle * NoTreat$ is a base category) across the three models in Table 4. This result is in line with the results on the average decisions reported in Table 1. The results also suggest that the $Star * NoTreat$ is not significantly different compared to the $Circle * NoTreat$, while $Circle * NoTreat$ is positive and statistically significant compared to the empty network. This suggests that farmers are positively influenced by their direct neighborhood's organic investment, even in the case of no treatment. Thus, the network could play an important role in promoting investment in organic farming.

Since the $Neigbor(t-1)$ have different impacts on individual behavior depending on the different network structures (i.e., farmers in different networks and different locations in a particular network have different numbers of direct neighbors), we break down our estimation into four different network structures presented in Table 5. We observe that $Neigbor(t-1)$ is statistically significant in all network structures, except for the star network. In the star network, we observe the statistically significant coefficient of $Center * Neighbor(t-1)$. This also suggests that a stronger network connection helps to promote the investment in organic farming.

The variable $Neighbor(t-1)$ is not significant in the star network, which indicates that farmers in the corner of the star seem less likely to care about the behaviors of the center, as was expected in our theoretical prediction. Additionally, the variable *Center* is not significant at the 5% level, which means that the center in our sample does not seem to invest more in organic farming compared to the corner farmers. This could be the reason why the star network performs worse than the other networks (e.g., circle and complete network) in encouraging organic farming.

Therefore, Prediction 1 is validated since the results show that a network with more connections (i.e., complete network) is more effective in encouraging organic investment than one with fewer connections.

Table 4: Individual decision in organic farming and network structures.

	Fractional regression		
Variables	(1)	(2)	(3)
Empty network*Sc	-0.193***	-0.195***	-0.221***
	(0.067)	(0.066)	(0.068)
Empty network*ScNd	-0.236***	-0.238***	-0.134**
	(0.067)	(0.064)	(0.068)
Circle*Sc	0.463***	0.468***	0.535***
	(0.083)	(0.079)	(0.081)
Circle*ScNd	0.282***	0.284***	0.406***
	(0.079)	(0.075)	(0.073)
Star*NoTreat	-0.007	-0.007	0.007
	(0.071)	(0.066)	(0.071)
Star*Sc	-0.072	-0.072	-0.041
	(0.068)	(0.065)	(0.072)
Star*ScNd	0.207***	0.209***	0.236***
	(0.077)	(0.075)	(0.081)
Complete*NoTreat	0.304***	0.307***	0.289***
	(0.081)	(0.077)	(0.076)
Complete*Sc	0.437***	0.441***	0.380***
	(0.088)	(0.082)	(0.088)
Complete*ScNd	0.853***	0.861***	0.800***
	(0.096)	(0.092)	(0.095)
Period		0.070***	0.070***
		(0.005)	(0.005)
Control variables			
Age (in log)			0.366***
			(0.087)
Education (below secondary as a base category)			
High school			-0.048
			(0.037)
College			-0.163***
			(0.060)
Health (bad health as a base category)			
Good			-0.073*
			(0.039)
Very good			0.185***
			(0.050)
Farm size (in log)			-0.063***
			(0.022)
Cooperative			-0.084**
			(0.040)
Intercept	0.277***	-0.106	-0.724
	(0.060)	(0.066)	(0.522)
Observations	2200	2200	2200
Number of farmers	220	220	220
Log pseudo-likelihood	-1446.20	-1435.84	-1430.95
Wald $\chi^2(q)$	421.05***, q=10	594.86***, q=11	670.53***, q=27
Pseudo R^2	0.016	0.023	0.026

Note: The dependent variable is the individual investment. Regressions with Circle*NoTreat which is circle network with no treatment, is a base category. NoTreat is no treatment. Sc and ScNd stand for the social comparison and social comparison & nudge treatment, respectively. Insignificant control variables are not reported including NEP, Female, Individual income, Risk investment, Communist, Farmer association and Organic approval, which are not statistically significant.
Bootstrapped standard errors in parentheses with 500 bootstrap replications.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Role of social comparison

In the presence of the "Sc" treatment, the results in Table 4 show that the $Circle * Sc$ and $Complete*Sc$ are positive and significant, while $Star*Sc$ is not significant and $EmptyNetwork*Sc$ is negative and significant. This suggests that the "Sc" treatment plays a role in promoting organic farming but the effects of "Sc" are different in different network structures. This result is also confirmed by the non-parametric test in Table 2.

Table 5: Summary estimation results.

	Fractional regressions			
Variables	**Empty network**	**Circle**	**Star**	**Complete**
Neighbor (t-1)		0.637***	0.080	0.667**
		(0.147)	(0.109)	(0.333)
Center			-0.568*	
			(0.325)	
Center*Neighbor (t-1)			0.996**	
			(0.409)	
Sc		0.289***	-0.084	0.166
		(0.106)	(0.053)	(0.107)
ScNd	0.008	0.210***	0.143*	0.349***
	(0.051)	(0.092)	(0.080)	(0.101)
Period	0.006	0.054***	0.030***	0.098***
	(0.008)	(0.013)	(0.009)	(0.021)
Control variables				
NEP	0.006	0.014*	-0.017***	-0.016*
	(0.006)	(0.007)	(0.006)	(0.010)
Female	-0.051	-0.144*	-0.494***	0.364***
	(0.058)	(0.082)	(0.089)	(0.101)
Age (in log)	0.346**	0.158	-0.294	1.666***
	(0.141)	(0.207)	(0.216)	(0.292)
Health (bad health as a base category)				
Good	-0.060	-0.099	-0.213***	0.279**
	(0.059)	(0.087)	(0.062)	(0.111)
Very good	0.074	-0.081	-0.108	0.677***
	(0.084)	(0.094)	(0.102)	(0.127)
Risk investment (in log)	0.005	-0.083	0.042	0.394***
	(0.018)	(0.081)	(0.064)	(0.117)
Organic approval (disagree as a base category)				
Unsure	-0.233*	0.209	-0.763***	0.377**
	(0.136)	(0.180)	(0.156)	(0.174)
Agree	0.103*	0.736***	-0.017	-0.478***
	(0.075)	(0.175)	(0.075)	(0.120)
Intercept	-2.101**	-0.744	2.203*	-9.460***
	(0.875)	(1.500)	(1.157)	(1.856)
Observations	400	540	540	540
Number of farmers	40	60	60	60
Log pseudo-likelihood	-276.19	-341.72	-359.45	-311.09
Wald $\chi^2(q)$	104.93***	200.51***	228.51***	248.77***
q	18	20	20	20
Pseudo R^2	0.003	0.029	0.017	0.053

Note: The dependent variable is the individual investment. Regressions with no treatment as a base category.
Bootstrapped standard errors in parentheses with 500 bootstrap replications.
Control variables are not reported, including Individual income, Education, Farm size, Communist, Farmer association and Cooperative which are not statistically significant at the 5% level. The detailed estimation results are reported in the Appendix.
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

According to the estimation results in Table 5, we find that the social comparison treatment is positive and significant only in the circle network. Figure 5 shows that social comparison also has a positive impact on individual decisions in both circle and complete networks. This suggests that the social comparison treatment has a positive impact on farmers' investments in organic farming in the complete network, but its impact is not statistically different compared to the case of complete network without treatment.

Our results confirm that in the case of the circle network, farmers who received the social comparison treatment allocated a higher percentage of lands to organic farming than farmers in other types of network structures. It should be noted that the circle and complete network are both decentralized networks, but each agent in the complete network has more connections compared to the circle. While the circle and complete networks are decentralized, the star is representative of the centralized network in which all agents are connected to the center and there is no link between individuals in the corner. In our experiment, each farmer in the circle network only had two direct neighbors and he or she could therefore only observe the investment decisions of two direct neighbors after each round. However, in the complete network, each farmer is linked to all others and he or she could thus observe all the others' investment decisions even without social comparison. In the star network, only the centers could observe all the other farmers' decisions. Thus, this implies that the social comparison does not have a significant impact on the individual investment in organic farming in the star and complete networks. Consequently, Prediction 2 is partially validated: the "Sc" treatment performs better in the decentralized network with fewer connections (like the circle network).

Role of social comparison combined with information nudge

We observe that the "ScNd" (social comparison combined with information nudge) treatment does not seem to perform well in the empty network, but provides a positive and significant impact on farmers' investments in organic farming in the presence of a network (Table 4). Table 4 shows that there is a negative impact of $EmptyNetwork * ScNd$ on individual behavior compared to the baseline which is $Circle * NoTreat$. Moreover, the first column of Table 5 confirms this result by indicating that the impact of "ScNd" on individual organic investment in the empty network is negligible. This result is in line with the theoretical prediction that there is no significant difference between the socially optimal investment and the Nash equilibrium in the case of the empty network (Table A.2 in the Appendix).

The results in both Tables 4 and 5 indicate that in the presence of network connections, the treatment "ScNd" has positive and significant impacts on farmers' investments in organic farming in all the three networks (circle, star and complete network). This suggests that the "ScNd" treatment performs more efficiently in the presence of network connections than in the empty network. By comparing different networks (e.g., circle, star and complete networks), we observe that the "ScNd" performs extremely well in the complete network compared to the star and circle networks (Table 4). This is also in line with our theoretical prediction since the information nudge provided to farmers is the information about the socially optimal investment, and the social optimum in the complete network is higher than the one in the star and circle networks (Table A.1 in the Appendix). This suggests that it would be more efficient to provide the combination treatment to a strongly connected network (i.e., complete network) than a weakly connected one (i.e., circle network) and to a decentralized network (i.e., complete and circle networks) rather than a centralized one (i.e., star network). Additionally, because of the network connection, farmers in the complete network can observe the decisions of all the others after each period of the game, while farmers in the circle and star networks can observe only the decision of their direct neighbors, except for the center in the star network. Thus, it is easier for farmers in complete networks to coordinate in terms of organic investment than others in other networks. Prediction 3 is therefore validated.

For the control variables, some of the control variables (age, education, health, farmer size, belonging to a farmers' cooperative) can significantly explain the individual decision to invest in organic farming. In particular, older farmers seem to invest more in organic farming than younger ones. Surprisingly, farmers who have college and university degrees in our sample are less likely to care about organic farming than others. Farmers in very good health have a higher incentive to invest in organic farming than other farmers. However, a large farm size, which is a proxy for farming scale, has a negative and significant impact on the individual investment in organic farming. This is perhaps because it is more costly for larger-scale household farmers to convert their lands to organic farming than small-scale ones. Being a member of a farmer's cooperative does not seem to help farmers to become more aware of organic agriculture. Other variables like NEP, female, risk investment, individual monthly income or belonging to the communist party do not have any significant impact on farmers' decisions.

6 Discussion and conclusion

Our results suggest that more connections (or links) in the network could result in a higher investment in organic farming. This is in line with the literature that reports that participants are more likely to coordinate in the presence of a network structure: a network with more connections is better than one with fewer connections in facilitating coordination (McCubbins et al., 2009). This result suggests that the network-based approach could be considered as a cost-effective method for policymaker to incentivize the adoption of organic agriculture or new environmentally-friendly agricultural practices (Beaman et al., 2018).

As suggested in the existing literature, the intra-group comparison can lead to stronger cooperation in the public good provision (Böhm and Rockenbach, 2013). In our study, we also investigate the effect of intra-group comparison (i.e., social comparison treatment), but in the context of organic farming and in the presence of the network (i.e., connections exist among individuals). We find that the social comparison treatment has a significant impact on farmers' organic investment decisions in organic farming in a circle network. In a complete network, when every farmer can fully observe all other farmers' decisions, providing social comparison treatment cannot sufficiently help to promote the organic investment since the comparison effect among individuals in the network dominates the comparison effect of the social comparison treatment. The results therefore suggest that social comparison can be used to incentivize farmers to cooperate by investing in organic farming more effectively in a decentralized network with fewer connections (like a circle network).

In a network where only one farmer has the advantage of fully observing the others' decisions (i.e., farmers in the center of the star network), social comparison makes those in the center to perform worse than what was expected in our theoretical prediction. In the last period of the game, we observe that the farmers in the center do not seem to play the Nash equilibrium as expected in the theoretical prediction, but that they instead follow the average investment decision of the whole group (i.e., their direct neighbors) (see Figure 5). Thus, it would be more interesting for future studies to investigate this issue in greater detail, perhaps with two or more farmers in the center of the network (e.g., a bridge network). In our model, we have only one farmer in the center and this could therefore make them less likely to sustain their behaviors when they observe that all the other farmers in the network have chosen a low level of organic investment.

While social comparison can encourage farmers' pro-environmental decisions only in a decentralized network with fewer connections (i.e., a circle network), social comparison combined with information nudge treatment seems to be a more effective way to encourage farmers to move toward a more environmentally-friendly agriculture. This suggests that the complementarity of social comparison and information nudge (i.e., combination effect) could exceed the effect of social comparison. We also observe a positive and strongly significant impact of the social comparison combined with the information nudge on individual farmers' decisions in the presence of a complete network. This means that farmers in a network with more connections perform better with the combination effect than the one with fewer connections in promoting organic farming.

In order to capture the causal effect of networks on farmers' behaviors, we consider the organic investment game with the given network structures (exogenous network) and allow the network to vary. Future studies should also take the endogenous structure of the network into account in order to capture which network pattern could result in a higher level of adoption of organic agriculture. Our results suggest that there is a possibility of a *crowd in* effect since the effect of both social comparison and information nudge exceeds the effect of social comparison (Brandon et al., 2019). The mechanism of *crowding in and out* in social nudges (social comparison and information nudge) deserves our attention since it may have important implications in promoting sustainable agriculture.

One major issue concerns the recommendations that could be adopted to design public policies. They would be based not only on subsidies but more essentially on information given to farmers (Van Campenhout et al., 2017). Firstly, it is crucial for farmers to understand the importance of their social links. In many instances, neighborhood farmers or local agricultural organizations are valuable sources of knowledge, information and advice for farmers and, consequently, policymakers and/or individuals themselves should always try to establish a channel for local farmers to promote farmer-to-farmer links. Secondly, in reality, it is always very difficult to observe the actual network structure, and farmers cannot normally fully observe the behaviors, actions or decisions of their neighbors. In this situation, providing social comparison treatment like information about the average organic investment of the local groups or communities to farmers could stimulate self-evaluation as well as competition, and could thus help to incentivize farmers to behave positively towards organic farming. Finally, timely reminders about not only the importance of organic agriculture but also the socially optimal organic investment (i.e., information nudge) can help to increase farmers' awareness about organic agriculture and to help them to maintain commitments and schedules (Fabregas et al., 2019). As a result, it helps to nudge them towards bridging the gap between their intentions and their actions.

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Appendix A: Theoretical predictions - A numerical illustration.

To illustrate the theoretical model, let us consider a numerical example with the parameter assumption reported in Table A.1. We consider that each farmer will decide to invest the percentage of his or her farming land in organic agriculture, $x \in [0, 1]$ (i.e., from 0% to 100%). We also consider that $\beta = 0.8$, which means that the benefit of organic farming is 20% higher than that of conventional farming. "Cost and benefit analysis" literature suggests that income from organic farming varies from 20-30% higher than conventional farming at a low level of subsidy, and 50% at the highest subsidy level (Urfi et al., 2011). We assume that the parameter of the revenue function $a = 2$ and, thus, given the assumption that $f^{'}(x) \geq 0$, b must be ≤ 1 for $x = 1$. In order to make the game more interesting, we consider that in the absence of a network and social comparison, it is optimal to invest less than 50% of the land in organic farming (i.e., $x^* < 0.5$) and thus it is therefore necessary that $\gamma = 0.5$ since this assumption holds for $\gamma > 0.45$. For the social comparison parameter, we chose $\eta = 0.2$ since the existing literature suggests that the impact of social comparison on individual behavior varies from 20% to 30% (Vogel et al., 2015; Jiang and Ngien, 2020). The peer parameter is equal to 0.4 since δ must be ≥ 0.4 in order to obtain a difference of at least 0.2 in the Nash equilibrium and social optimum in the circle network (Table A.1), which is required for the information nudge treatment, as discussed in our theoretical model in Section 2. Table A.1 (in the presence of social comparison), Table A.3 (in the case of no social comparison) and Table A.2 (in the empty network) present the equilibrium and payoffs associated with two different organic land investment decisions (Nash equilibrium and social optimum) in a five-player game.

Table A.1: Nash equilibrium and social optimum in the presence of social comparison.

Parameter values

Difference in revenue between conventional and organic farming: $\beta = 0.8$.

Parameters of the revenue function $f(x) = ax - bx^2$: $a = 2$ and $b = 1$.

Extra cost for organic investment: $\gamma = 0.5$.

Peer parameter: $\delta = 0.4$.

Comparison parameter: $\eta = 0.2$.

Number of agents per network: $N = 5$.

Equilibrium in the presence of social comparison

	Circle	Star: Center	Star: Corner	Complete
Nash equilibrium	0.6071	0.7175	0.5519	0.85
Social optimum	0.83	1.00	0.7023	1.00

Farmer i's payoff

Farmer i's choice/ Other farmers' choices	Circle: Nash	Circle: Social	Star Center: Nash	Star Center: Social	Star Corner: Nash	Star Corner: Social	Complete: Nash	Complete: Social
Nash	**134.2***	141.4	**160.9***	175.8	**123.1***	126.4	**193.1***	211.1
Social	124.3	**135.6**^{e}	145.4	**167.1**^{e}	118.4	**123.4**^{e}	188.4	**210**^{e}

Notes: * and ^{e} stand for farmer i's payoff at the Nash equilibrium and the social optimum, respectively.

The results of the Nash equilibrium, social optimum and payoffs are calculated using Equations (1), (2) and (3), respectively. Our results in Table A.1 indicate that this five-player game has a unique Nash equilibrium. In the complete network, the payoff for each farmer at the Nash equilibrium is 193.1. However, the Nash equilibrium is not Pareto optimal. By coordinating at the social optimum, each farmer would earn an amount equal to 210, whereas, this optimum is difficult to achieve because each farmer has the incentive to deviate if he or she knows that the other farmers will choose the optimal strategy. Specifically, farmer i would deviate in order to play at the Nash equilibrium and earn a slightly higher payoff of 211.1. The other farmers would then suffer a loss equal to $210 - 188.4 = 21.6$. Therefore, the dominant strategy is that every farmer coordinates at the Nash equilibrium and earns a payoff equals to 193.1. Similarly, the same logic is applied to the circle and the star networks. However, in the case of the empty network, we observe that the Nash equilibrium is higher than the social optimum in the presence of social comparison. This is because there is a negative externality of the social comparison.

Table A.2: Nash equilibrium and social optimum in the empty network.

Equilibrium in the empty network				
	No social comparison		Social comparison	
Nash equilibrium	0.4167		0.4722	
Social optimum	0.4167		0.4611	
Farmer i's payoff				
Farmer i's choice/	No social comparison		Social comparison	
Other farmers' choices	Nash	Social	Nash	Social
Nash	**111.3***	111.3	**110.7***	110.9
Social	111.3	**111.3**^{e}	110.7	**110.9**^{e}

Notes: Equilibrium and payoffs are calculated with the same parameter as in the case of presence of social comparison.
* and ^{e} stand for farmer i's payoff at the Nash equilibrium and the social optimum, respectively.

Because of the sub-optimality of the Nash equilibrium, our objective is to introduce the information nudge about the socially optimal level of investment to the farmers in the experiment in order to examine whether the nudge treatment could help to encourage farmers to move toward a more sustainable agriculture.

Table A.3: Nash equilibrium and social optimum in the case of no social comparison.

Equilibrium in the case of no social comparison								
			Star					
	Circle		Center		Corner		Complete	
Nash equilibrium	0.5357		0.6331		0.4870		0.75	
Social optimum	0.75		0.9807		0.6346		1.00	
Farmer i's payoff								
			Star					
Farmer i's choice/	Circle		Center		Corner		Complete	
Other farmers' choices	Nash	Social	Nash	Social	Nash	Social	Nash	Social
Nash	**131.7***	140.8	**152.2***	167.1	**122.7***	129.5	**181.3***	211.3
Social	123.4	**136.3**^{e}	130.4	**153.6**^{e}	118.8	**127.6**^{e}	170	**210**^{e}

Notes: Equilibrium and payoffs are calculated with the same parameter as in the case of the presence of social comparison.
* and ^{e} stand for farmer i's payoff at the Nash equilibrium and the social optimum, respectively.

It should be noted that in Tables A.1-A.2, in order to facilitate the computation as well as the theoretical analysis, we assume that all agents are identical. In this case, all of the agents' direct and indirect neighbors (four other agents) play the same strategies at the equilibrium. Indeed, the real situation would be more complicated if all of the agents' strategies were different. However, this assumption still makes sense in reality because when making their decisions, agents usually take what both direct and indirect neighbors would do into account. In the experiment, agents participate in a ten-period repeated game. In the case of no social comparison, agents can observe the previous decision of their direct neighbors after each round. For instance, agents in the circle observe the decisions of two direct neighbors, while those in the complete network observe the decisions of four direct neighbors. In the presence of social comparison, agents will receive additional information about the average group organic investment. The information nudge provides agents with information about the optimal investment strategy at the beginning of each round. In this way, we can explore the impact of information about their neighbors' previous choices on their likelihood of choosing the Nash equilibrium strategy and coordinating on the socially optimal outcome.

Appendix B: Primary experimental instructions.

One week before the experiment, the local authorities in each village contacted farmers either directly or by sending letters to invite them to the experiment without knowing its content.

Upon arrival at the experimental session, farmers were given the detailed information about the experiment and the monetary incentives. The farmers were informed that they would be paid after participating in the survey and one farmer would receive at least 120,000 VND[10] depending on their performances.

The first part of the experiment was a lottery choice task described above. In the second part of the experiment, farmers were told that their investment would not affect any of the others' decisions and that their payoffs depended only on their personal level of investment. Before starting the second part in which the simple organic investment game was played, experimenters introduced the definition of organic farming to the farmers. The definition is written as follows:

> "Organic agriculture is a production method that excludes the use of most chemicals (such as pesticides and fertilizers often used in conventional agriculture since the beginning of the 20th century), GMOs (Genetically Modified Organisms) and crop preservation by irradiation. Organic farming contributes to reducing environmental impacts (for example, by reducing water pollution and protecting soil fertility, etc.) and improving food quality."

In the third part, farmers were informed that each individual was assigned to a position in a particular network of five participants (star, circle, complete or empty network). There were two groups per session (since there were ten participants per session). Only the farmers knew their positions and thus nobody had any information about who would be their neighbors (either direct or indirect) or which group they were in. This position would be fixed determined all ten periods of the experiment. Experimenters also explained the particular network structure that they were assigned to, and the direct and indirect neighbors/links. They were also informed that there were peer effects due to the network links. Farmers would benefit from their direct neighborhood investments. They were told that there would be feedback after each round and that each farmer could observe the investment decision of his or her direct neighbors. The explanation of the role of networks is summarized as follows:

> "Organic farmers would benefit from the total organic investment of their direct neighbors. This benefit would be the result of the market information that an organic farmer who has good market information might share with his organic peers about when and where to market their crops to receive high prices. The peer benefits would also come from positive experiences and considerable labor-sharing opportunities in their networks. From a social perspective, farmers who adopt organic agriculture may motivate their neighboring farmers to adopt it as well because most individuals are "conditionally cooperative"."

[10] equivalent to about 5 USD.

In the presence of social comparison (Sc), experimenters informed farmers that there would be the peer effects depending on the network structures (star, circle or complete network) and the social comparison. The peer effect was explained in the same way as previously described. After each round, there was also feedback and each farmer would receive the information about his or her group's average investment decision. Regarding the social comparison, it was explained as follows:

> "Farmers would receive information about the average organic investment of the total group (including themselves and their direct and indirect neighbors) after each round. Organic farmers who invested less would then suffer a negative impact on the payoff. This negative impact would be calculated accordingly by the given payoff function".

In the presence of an information nudge (ScNd), farmers were informed that information would appear on the screen at the beginning of each round: their optimal investment as well as that of all the other farmers in their group. If every farmer followed the instruction to choose the optimal level of investment, then all farmers would earn the optimal profit/payoff. This information would appear every time at the beginning of each round. For example, in the star network, the information was displayed as follows:

> "The optimal decision for the whole group is: player 1 chooses X equal to 100% and four other players choose X equal to 70.23%".

They can decide to follow or not this information. After each round, farmers would receive feedback concerning information about the investment decision of their direct neighbors.

Appendix C: Additional experimental results.

Table C.1: Mean investment per network and per treatment.

	Empty network	Circle	Star	Complete
No treatment	-	0.568	0.567	0.641
		(0.197)	(0.132)	(0.190)
Sc	0.520	0.677	0.551	0.671
	(0.111)	(0.185)	(0.115)	(0.220)
ScNd	0.510	0.636	0.618	0.756
	(0.112)	(0.176)	(0.175)	(0.193)

Notes: The standard deviation is in parentheses. Sc stands for "social comparison" treatment. ScNd stands for "social comparison and information nudge" treatment.

Table C.2: Difference-in-mean across different network structures and the center/corner of the star network (Wilcoxon Rank Sum test).

	No treatment			Sc			ScNd		
	Center	Corner	Complete	Center	Corner	Complete	Center	Corner	Complete
Circle	-0.10***	0.03	-0.07***	0.12***	0.13***	0.01	-0.06**	0.04**	-0.12***
	(0.000)	(0.094)	(0.000)	(0.000)	(0.000)	(0.778)	(0.048)	(0.016)	(0.000)
Center	-	0.13***	0.03	-	0.01	-0.11***	-	0.10***	-0.06
		(0.000)	(0.595)		(0.435)	(0.000)		(0.000)	(0.171)
Corner	-	-	-0.10***	-	-	-0.12***	-	-	-0.16***
			(0.000)			(0.000)			(0.000)

Notes: The table reports the difference-in-mean and the p-value of the Wilcoxon Rank Sum test in parentheses. Sc stands for "social comparison" treatment; ScNd stands for "social comparison and information nudge" treatment. Center and corner are presented for the subset of only center and corner farmers in the star network.
** $p < 0.05$; *** $p < 0.01$.

Table C.3: The 15 NEP scale items and their response distributions (in percentage).

NEP scale items	Strongly disagree	Partly disagree	Unsure	Partly agree	Strongly agree	Corr
1: "We are approaching the limit of the number of people the earth can support".	7.27	39.09	4.55	35.00	14.09	0.441
2: "Humans have the right to modify the natural environment to suit their needs".[a]	6.36	14.55	0.45	55.45	23.18	0.535
3: "When humans interfere with nature, it often leads to disastrous consequences".	6.82	44.09	3.64	33.64	11.82	0.466
4: "Human ingenuity will ensure that we do not make the earth unlivable".[a]	2.73	10.00	3.18	62.27	21.82	0.419
5: "Humans are severely abusing the environment".	6.36	25.91	2.27	41.82	23.64	0.387
6: "The Earth has plenty of natural resources if we just learn how to develop them".[a]	2.73	1.36	1.36	58.18	36.36	0.456
7: "Plants and animals have as much right as humans to exist".	0.91	5.00	1.82	56.82	35.45	0.485
8: "The balance of nature is strong enough to cope with the impacts of modern industrial nations".[a]	14.55	44.55	6.36	26.82	7.73	0.340
9: "Despite our special abilities, humans are still subject to the laws of nature".	0.45	4.09	1.82	53.64	40.00	0.414
10: "The so-called "ecological crisis" facing humankind has been greatly exaggerated".[a]	2.27	45.91	10.00	35.00	6.82	0.356
11: "The Earth is like a spaceship with very limited room and resources".	0.45	12.27	3.64	59.09	24.55	0.375
12: "Humans were meant to rule over the rest of nature".[a]	3.64	24.55	5.91	52.27	13.64	0.380
13: "The balance of nature is very delicate and easily upset".	1.82	19.09	5.91	64.09	9.09	0.390
14: "Humans will eventually learn enough about how nature works to be able to control it".[a]	2.73	15.00	1.82	65.45	15.00	0.399
15: "If things continue on their present course, we will soon experience a major ecological catastrophe".	0.91	8.18	3.18	63.18	24.55	0.485
Total NEP score.		Mean = 46.87 and SD = 4.455.				
Cronbach's alpha			0.6545			

Notes: [a] Reverse coded.
The column Corr represents the item-total correlation, which tells us how much each item correlates with the total NEP score.
Cronbach's alpha is equal to 65.4% in the reliability test, which suggests that 65.4% of the variance in the score is reliable.

Table C.4: Correlation matrix of explanatory variables by different networks (with Pearson's correlation test).

	Empty network	Circle network		Star network			Complete network	
	Sc	Neighbor(t-1)	Sc	Center	Neighbor(t-1)	Sc	Neighbor(t-1)	Sc
Center	-	-	-	1.00	-	-	-	-
Neighbor(t-1)	-	1.00	-	0.83	1.00	-	1.00	-
				(0.00)				
Sc	1.00	0.21	1.00	0.00	0.00	1.00	-0.06	1.00
		(0.00)		(1.00)	(0.93)		(0.150)	
ScNd	-0.15	0.06	-0.50	0.00	0.06	0.5	0.18	-0.50
	(0.00)	(0.166)	(0.00)	(1.00)	(0.117)	(0.00)	(0.00)	(0.00)

Notes: The p-value of the Pearson correlation test statistics are in parentheses.
The Pearson correlation test statistics suggest that there are correlations between the "Sc" and "ScNd" treatments and between direct neighborhood investment $Neighbor(t-1)$ and Center. However, the correlation coefficients of these variables are not too large, except for the correlation between center and $Neighbor(t-1)$ in the star network.

Table C.5: The full estimation results.

	Empty network		Circle		Star		Complete	
Variables	Tobit	Fractional	Tobit	Fractional	Tobit	Fractional	Tobit	Fractional
Neighbor (t-1)			0.149***	0.637***	0.019	0.080	0.176**	0.667**
			(0.034)	(0.147)	(0.026)	(0.109)	(0.070)	(0.333)
Center					-0.113	-0.568*		
					(0.073)	(0.325)		
Center*Neighbor (t-1)					0.206**	0.996**		
					(0.090)	(0.409)		
Sc			0.067***	0.289***	-0.020	-0.084	0.038*	0.166
			(0.021)	(0.106)	(0.012)	(0.053)	(0.022)	(0.107)
ScNd	0.002	0.008	0.048**	0.210***	0.033*	0.143*	0.090***	0.349***
	(0.012)	(0.051)	(0.019)	(0.092)	(0.018)	(0.080)	(0.020)	(0.101)
Period	0.001	0.006	0.012***	0.054***	0.007***	0.030***	0.020***	0.098***
	(0.002)	(0.008)	(0.003)	(0.013)	(0.002)	(0.009)	(0.004)	(0.021)
Control variables								
NEP	0.001	0.006	0.003*	0.014*	-0.004***	-0.017***	-0.003*	-0.016*
	(0.001)	(0.006)	(0.001)	(0.007)	(0.001)	(0.006)	(0.002)	(0.010)
Female	-0.012	-0.051	-0.030*	-0.144*	-0.105***	-0.494***	0.077***	0.364***
	(0.014)	(0.058)	(0.017)	(0.082)	(0.023)	(0.089)	(0.022)	(0.101)
Age (in log)	0.085**	0.346**	0.036	0.158	-0.062	-0.294	0.378***	1.666***
	(0.035)	(0.141)	(0.043)	(0.207)	(0.051)	(0.216)	(0.056)	(0.292)
Education (below secondary as a base category)								
High school	0.026*	0.107**	0.048*	0.202*	-0.001	0.004	-0.023	-0.120
	(0.013)	(0.054)	(0.024)	(0.120)	(0.016)	(0.065)	(0.021)	(0.111)
College	0.058**	0.235**	-0.035	-0.121	-	-	-0.112***	-0.492**
	(0.026)	(0.104)	(0.035)	(0.163)			(0.039)	(0.193)
Health (bad health as a base category)								
Good	-0.014	-0.060	-0.037*	-0.148*	-0.051***	-0.215***	0.066***	0.331***
	(0.014)	(0.059)	(0.019)	(0.089)	(0.015)	(0.066)	(0.024)	(0.120)
Very good	0.018	0.074	-0.021	-0.085	-0.027	-0.100	0.157***	0.712***
	(0.021)	(0.084)	(0.021)	(0.098)	(0.024)	(0.102)	(0.027)	(0.136)
Individual income (low income as base category)								
Medium	0.004	0.020	-0.014	-0.069	0.0004	-0.100	0.035*	0.138*
	(0.015)	(0.060)	(0.014)	(0.070)	(0.021)	(0.091)	(0.020)	(0.100)
High	-0.053*	-0.213*	0.059	0.231	-	-	0.025	0.134
	(0.027)	(0.109)	(0.049)	(0.274)			(0.028)	(0.143)
Risk investment (in log)	0.001	0.005	-0.006	-0.035	0.010	0.019	0.082***	0.394***
	(0.004)	(0.018)	(0.018)	(0.084)	(0.015)	(0.061)	(0.025)	(0.130)
Farm size (in log)	0.019**	0.079**	-0.023*	-0.107*	0.0001	0.004	-0.021	-0.139*
	(0.009)	(0.036)	(0.013)	(0.065)	(0.009)	(0.040)	(0.013)	(0.076)
Communist	-0.019	-0.082	0.055***	0.251***	-0.028	-0.110	-0.032	-0.072
	(0.034)	(0.136)	(0.018)	(0.080)	(0.019)	(0.079)	(0.033)	(0.164)
Farmer association	-0.009	-0.036	0.003	0.010	0.115***	0.476***	-0.049	-0.117
	(0.016)	(0.067)	(0.022)	(0.100)	(0.035)	(0.145)	(0.036)	(0.172)
Cooperative	-0.082***	-0.331***	0.007	0.034	-0.051**	-0.218*	-0.008	-0.094
	(0.019)	(0.077)	(0.018)	(0.080)	(0.023)	(0.109)	(0.021)	(0.105)
Organic approval (disagree as base category)								
Unsure	-0.057*	-0.233*	0.058	0.209	-0.188***	-0.763***	0.083**	0.377**
	(0.034)	(0.136)	(0.042)	(0.180)	(0.037)	(0.156)	(0.033)	(0.174)
Agree	0.026	0.103*	0.169***	0.736***	-0.005	-0.017	-0.102***	-0.478***
	(0.018)	(0.075)	(0.038)	(0.175)	(0.016)	(0.075)	(0.024)	(0.120)
Intercept	0.094	-2.101**	0.308	-0.744	1.022***	2.203*	-1.610***	-9.460***
	(0.222)	(0.875)	(0.315)	(1.500)	(0.278)	(1.157)	(0.394)	(1.856)
Observations	400	400	540	540	540	540	540	540
Log (pseudo)-likelihood	315.05	-276.19	185.60	-341.72	373.29	-359.45	66.94	-311.09
Wald $\chi^2(q)$	106.67***	104.93***	217.62***	200.51***	251.93***	228.51***	289.36***	248.77***
q	18	18	20	20	20	20	20	20
Pseudo R^2	-0.059	0.003	-0.742	0.029	-0.325	0.017	2.570	0.053

Note: The dependent variable is the individual investment. No treatment is a base category.
Bootstrapped standard errors are in parentheses with 500 bootstrap replications.
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Figures

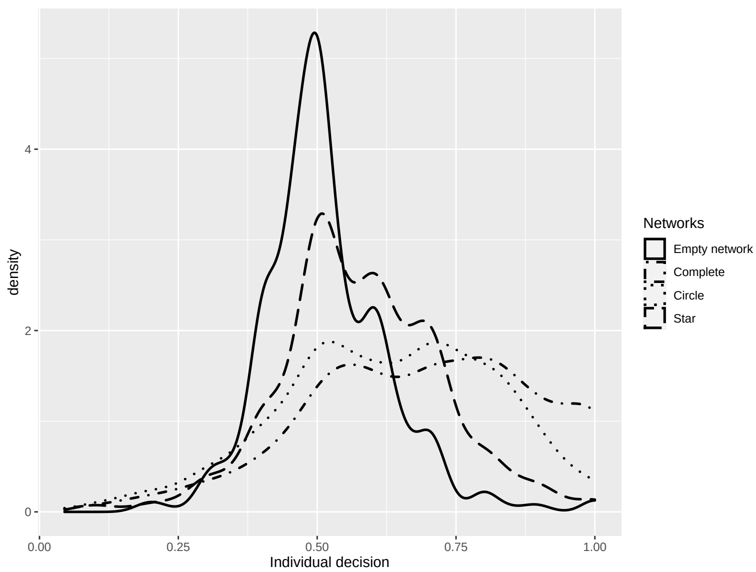

Figure 4: Density plot of individual decisions by different networks.

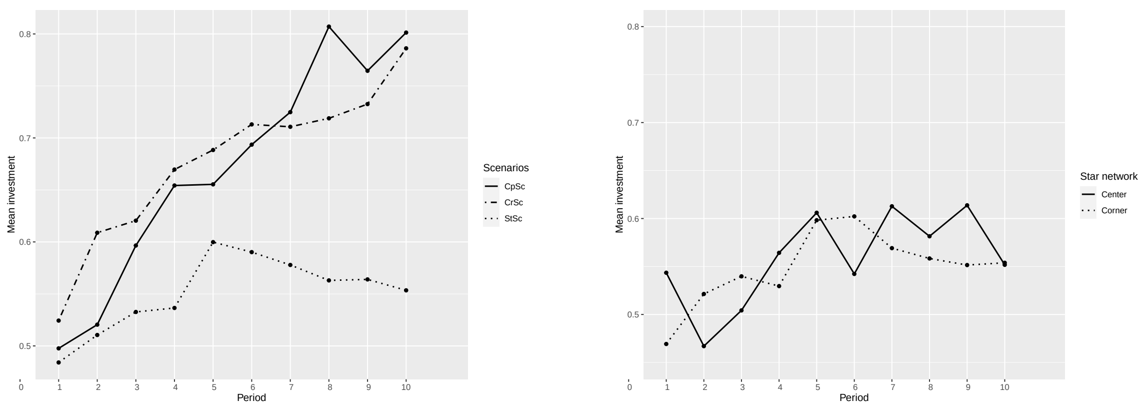

Figure 5: Mean investment over time (with social comparison treatments).

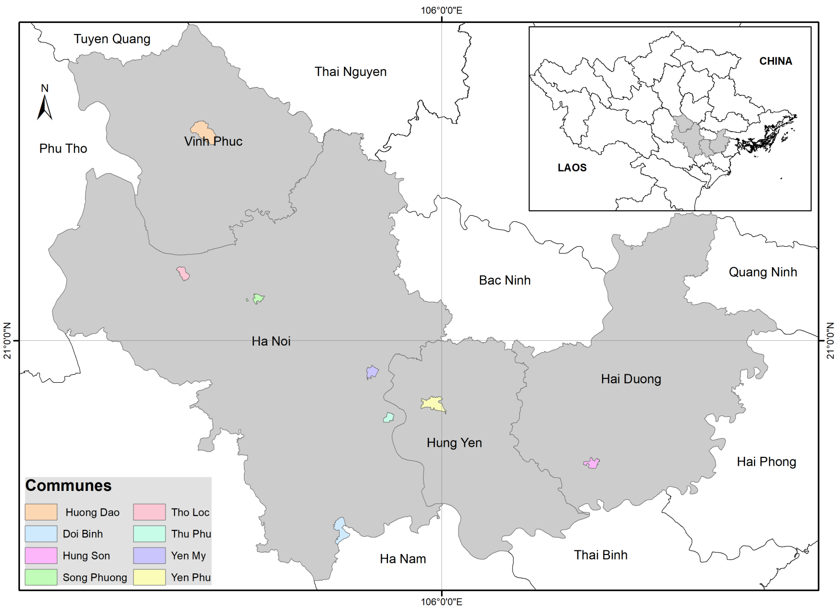

Figure 6: The experimental map.

Figure 7: The first part of the experiment (lottery-choice task).

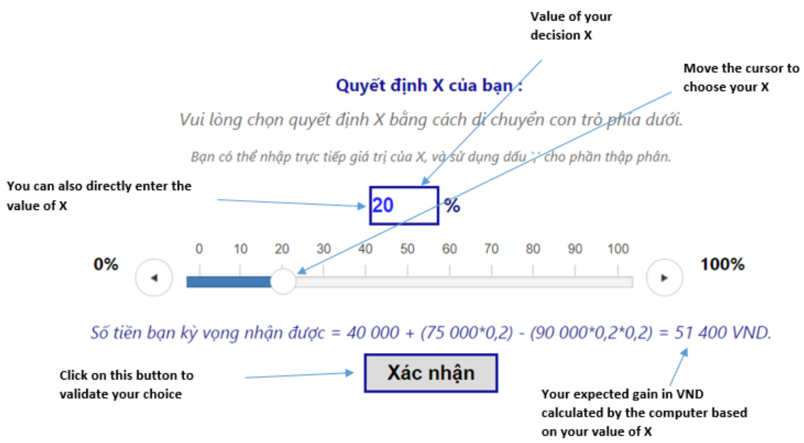

Figure 8: The second part of the experiment (simple organic investment game).

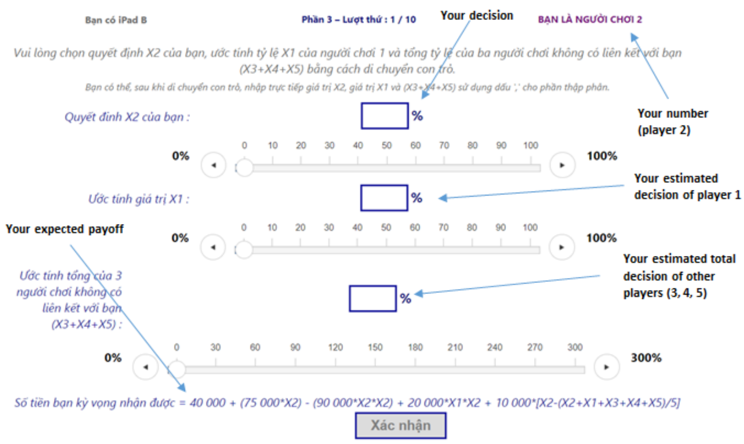

Figure 9: The third part of the experiment (an example of the StSc scenario).