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## Research Report

# Can Indian Farmers Form Efficient Information-Sharing Networks in the Lab?

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## Can Indian Farmers Form Efficient Information-Sharing Networks in the Lab? \*

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### Abstract

A large literature in development economics argues that information about agricultural innovations diffuses through farmers' social networks. The structure of these network influences the extent and speed of information diffusion. In an artefactual field experiment in rural India we find that subjects form inefficient information-sharing networks and lose 35 percent of payoffs as a result. The game is designed so that the efficient network can be reached if all players choose strategies consistent with self-interest. These strategies are played frequently, but not often enough. Participants also often target the 'most popular' player in the network and this causes large efficiency losses in this experiment. Further, in randomly chosen sessions we disclose information about group membership. The networks formed in these sessions have more connections between subjects of the same group, but are not significantly less efficient.

\* This policy brief reports preliminary results, which are also discussed in Caria and Fafchamps (2015).

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.../... The networks formed in these sessions have more connections between subjects of the same group, but are not significantly less efficient. Networks play an important role in the diffusion of information. If they are inefficiently structured, policies that affect how individuals interact with each other have the potential to increase welfare.

### ► Policy context

Imperfect knowledge about new technologies is a commonly cited cause for the low levels of adoption of many profitable agricultural innovations in developing countries. In many cases, the perceived returns of these innovations may not be aligned with the actual returns and incorrect beliefs about their optimal use may be widespread. Further, imperfect knowledge increases the perception of risk associated with technology adoption.

To help farmers learn about new technologies, governments in many developing countries subsidize a variety of agricultural information services. According to some estimates, there are nearly 1 million workers employed in the dissemination of agricultural information services worldwide and development agencies have spent in the region of 10 billions US\$ to support these activities (Feder 2005).

### ► Experiment design

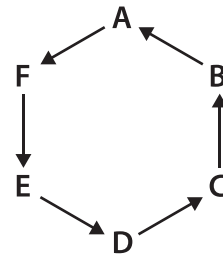
Our experimental game is played by groups of six male, adult farmers, selected through random door-to-door sampling. We select farmers from randomly selected villages in four “talukas” (provinces) in the vicinity of Pune, in the Indian state of Maharashtra.

In the experiment, each farmer can create one link to another farmer in the group. Players identities are anonymous and players are identified by simple IDs. At the beginning of the experiment, there are no links in the network. Farmers create links sequentially, after observing the

choices of those who have already played. At the end of the game, one player in the group is randomly selected to receive a monetary prize. Farmers who are connected directly or indirectly to the winner of the random draw receive a monetary prize of the same value. The prize is thus non-rival.

In this simple game, a farmer maximizes his chances of winning the prize by securing the highest possible number of indirect connections. He achieves this if he links to the player with the highest number of indirect connections at that point in the game. If farmers follow this simple link formation rule, the network structure converges to the cycle within two turns of the game. In the cycle, as Figure 1 illustrates, every farmer is connected to every other farmer and hence all farmers win the monetary prize with certainty. In our experiment, the cycle is the efficient network structure, which maximizes social welfare.

**Figure 1.** The cycle network



To investigate whether social identity affects network structure and efficiency, we assign players to arbitrary groups at the beginning of each experimental session. Then, in randomly selected sessions, we disclose information about the group membership of players at the beginning of the network formation experiment.

### ► Findings

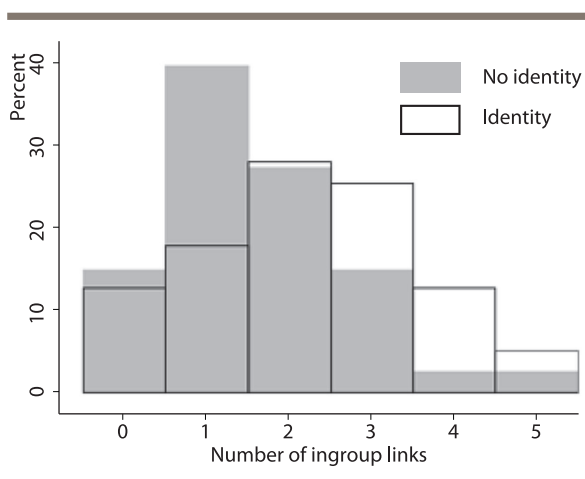
We find that players systematically form inefficient networks. On average, a player is connected with only 3.2 of the 5 other players in the game and payoffs are about 35 percent lower

than those in the efficient network.

Pooling all decisions together, we find that players choose links consistent with pay-off maximisation about half of the times. They also often connect to the least well-off player in the network. Lastly, in about two thirds of the remaining cases, links target the ‘most popular’ player – the player with the largest number of direct connections at that point in the game. Simulation analysis shows that this strategy is responsible for the largest efficiency losses. The efficiency loss would be reduced to 5 percent if links to the most popular player were re-wired according to the strategy that maximises payoffs.

We find some evidence that players are more likely to target the most popular player when it is more cognitively demanding to identify the efficient. Also, we find that links to the most popular player are more common in the second round of the experiment, when complexity is higher and mental resources are depleted. These findings are consistent with models of thinking in complex environments where individuals minimize cognitive costs.

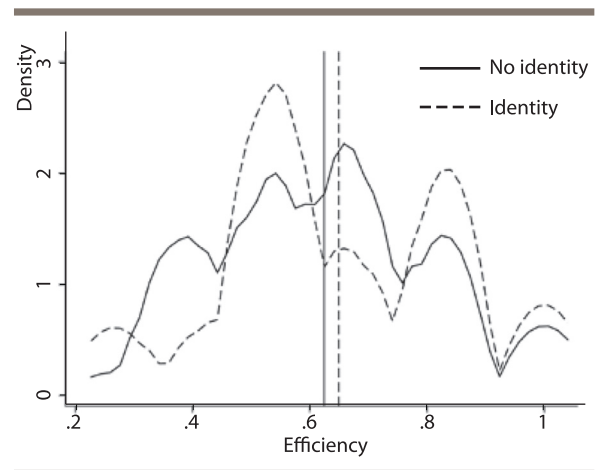
**Figure 2.** In-group links in sessions with and without disclosure of group identity



Finally, we have two main results on the effect of disclosing information about group identity. First, the frequency of in-group links

increases. Figure 2 shows a histogram of the number of in-group links in the final network for sessions where group identity is disclosed and session where it is not. The distribution clearly shifts to the right. A Wilcoxon rank-sum test confirms this difference is significant at the 5 percent level ( $Z = 2.23$ ,  $p = .02$ ).

**Figure 3.** Network efficiency in sessions with and without disclosure of group identity



Second, we cannot detect a systematic effect of disclosing players’ group identity on network efficiency. This is documented graphically in figure 3, which shows kernel density estimates of the distribution of network efficiency in sessions where group membership is disclosed and sessions where it is not.

### ► Policy implications

Our findings on network inefficiency lend support for interventions that change the structure of social networks (Feigenberg et al., 2013; Vasylaky and Leonard, 2013; Fafchamps and Quinn, 2015; Cai and Szeidl, 2016). In these studies, researchers have often focused on creating more connections. Our results suggest that creating incentives for individuals to create different connections – in particular, connections with less popular nodes – may be particularly effective at improving information diffusion.

Our results are also consistent with the ex-

istence of deeply held social norms restricting social interaction across groups. This suggests that diffusion of information among farmers in communities with diverse social identities will be challenging. In such communities, programs that promote the adoption of innovations can choose to bypass social structures altogether and rely instead on modern technologies. Recent trials show that agronomic information transmitted via SMS, phone lines, and voice messages can be effective at increasing yields, and discouraging the use of inefficient pesticides (Cole and Fernando, 2012, Casaburi et al., 2014). Alternatively, interventions should ensure that information is disseminated across social groups.

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