



# The Diffusion of Agricultural Technologies within Social Networks: Evidence from Composting in Mali

Lori Beaman and Andrew Dillon

**I**N THE ABSENCE OF FORMAL INSTITUTIONS, SOCIAL NETWORKS ARE AN IMPORTANT MECHANISM FOR DIFFUSING information. Social networks are of particular importance for agricultural households in the developing regions of the world. A key difficulty in promoting new technologies is the labor-intensive and costly effort required to educate farmers about new technologies. A prominent approach is to use group-based, village-level trainings through agricultural associations or cooperatives. These programs implicitly assume that farmers' social networks reinforce extension messages and increase the uptake of technologies. They may be more cost-effective than direct extension visits to farmers in their fields; however, vulnerable or otherwise less-influential community members may be less likely to benefit due to the impact of social norms or the gender composition of the targeted groups. Little is actually understood about how networks function to disseminate information about agricultural technologies. The policy implications of this issue are critical to understanding whether group-based approaches can promote gender-inclusive adoption of climate-risk-mitigating technologies. This policy note summarizes research on the effect of social network characteristics and gender on the diffusion of information about an agricultural technology.

## CONTEXT OF THE STUDY

The study was designed to test how social network structures affect the diffusion of information on composting among Malian farmers. The adoption of improved soil management practices, such as composting, are important not only for long-term soil fertility and productivity, but also because of their mitigating effects on climate risk and long-term climate change. The benefits of applying compost to soil, like many agricultural practices, are not certain; they require complementary inputs and farmers' knowledge of the practice in question. The benefits of composting are due to increasing the stability of organic material in the soil, which can change soil pH and moisture content, increase biomass, and reduce water run-off. These benefits depend on characteristics of the soil before the application of compost, the materials with which the compost is made, and the compost's quality prior to its application. For example, composts produced from crop

residues release nutrients into the soil over a longer period of time than from animal residues, so the longer term benefits are potentially larger, but they accrue at a slower rate.

To develop a greater understanding of the effect of social network structure on agricultural information diffusion, a calendar providing farmers with information on composting was randomly distributed for the purpose of observing its diffusion across household networks. Calendars were chosen because Malians often display them in their homes for years as decorative conversation pieces. The calendar provided information about how to compost and generate organic fertilizer.

## EXPERIMENTAL METHODOLOGY

The core of the experimental research design was to randomize the probability that a household would receive the information either directly or through a social network; the data facilitated the test of whether more influential nodes (that is, points of contact within the social network) would increase the probability of diffusion.

The first step of the study in 2008 was collecting baseline social network data. Within each village, all households and their members were fully enumerated in an initial visit. Husbands and wives were asked to list their social network links within the village: either people with whom they spoke frequently regarding agriculture, with whom they had financial transactions, or who were their relatives; or organizations with which they were affiliated. In addition, demographic and welfare characteristics of both nodes of each social network link were incorporated.

Villages were randomly assigned one of three treatments. Two treatments used social network characteristics to determine who would receive the calendars, whereas the third treatment randomly distributed the information within the village. The two social network characteristics utilized were *degree*, which measured the number of links to which the node was connected, and *betweenness*, which measured the share of shortest paths from all pairs of nodes in the network that were connected to that household. In short, *degree* measured potential household connectivity, whereas *betweenness* captured potential network influence. In the first treatment, the two women and two men with the highest *degree* measure within the village were chosen as calendar recipients; in the second treatment, the households with the highest *betweenness* measure were chosen, randomizing whether the individual recipient of the calendar within the household was male or female. In the random treatment, half of all calendar recipients were women.

There were 23 random villages, 15 *degree* villages, and 15 *betweenness* villages. The experiment was implemented in 30 villages in 2010 (15 random and 15 *degree*) and 23 villages in 2011 (8 random and 15 *betweenness*). Balancing tests within treatment villages were also conducted to determine whether observable characteristics of the calendar recipients differed by gender—indicating that it

may be only one of the mechanisms influencing information diffusion. The gender balancing tests indicated that assets, household size, and experience with the primary crops grown in these villages were not statistically different by gender, a finding consistent across the random villages, *degree* treatment villages, and *betweenness* treatment villages.

The protocol was standardized across all villages. After the initial random allocation of calendars, initial nodes were provided with three additional calendars to pass onto other villagers after their initial training with the calendar on composting practices. All households within a village were revisited after a month and were tested on their composting knowledge to determine whether accurate information had spread and to track the distribution of the calendars.

## POLICY IMPLICATIONS

While the empirical strategy of using social network targeting may not be identical to the way group-based approaches are implemented in development programs (because they may use smaller groups), the analysis conducted for this study illustrates that links and their gender-related characteristics are significant determinants of knowledge diffusion. Without understanding social network characteristics either at the village level or in a smaller group, knowledge inequality may affect the efficacy of the adaptation strategy or general program intervention.

Results indicate that knowledge diffusion depended on the distance of a household from the initial node, but that women were less likely to receive a calendar than were men. Within the women's subsample, however, the probability of women's receiving a calendar was much more equal across social network distances relative to that of men's. With respect to knowledge of composting, women's social network distance to the initial node had a much larger effect relative to that of men's. Women who were four links away from an initial node had 79 percent less knowledge relative to the counterfactual, whereas men who were four links away from an initial node had only 35 percent less knowledge relative to their counterfactual. Moreover, women in villages who were targeted according to the social network *influence* of members of their village had significantly lower knowledge relative to women

targeted in villages based on the *number* of contacts of villagers.

The results provide important insights into the potential effectiveness of targeting information on the allocative efficiency of public goods and on agricultural technologies. While networks or group-based approaches that rely on networks within groups offer an opportunity to spread information cheaply and efficiently, network-based diffusion of information can exacerbate inequalities within the targeted area or population if the nodes targeted are influential but are connected to only a subset of villagers or if information flows between women and men are unequal. This would occur if information or resources do not equally disperse within a network or if any individuals in the community—in this case women—are socially excluded and hence lack the necessary social links to benefit from the intervention. Further research into the effect of social network structure on technology diffusion will be critical to developing further understanding of climate change adaptation strategies and the design of potential policies, given that potential gender and social inequalities will affect diffusion.



Panos/R. Jones

## FOR FURTHER READING

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**Lori Beaman** ([l-beaman@northwestern.edu](mailto:l-beaman@northwestern.edu)) is an assistant professor in the Department of Economics of Northwestern University, Evanston, IL, US. **Andrew Dillon** ([dillona6@msu.edu](mailto:dillona6@msu.edu)) is an assistant professor in the Agricultural, Food, and Resource Economics Department of Michigan State University, East Lansing, US.

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2033 K Street, NW, Washington, DC 20006-1002 USA | T. +1.202.862.5600 | F. +1.202.467.4439 | Skype: IFPRIhomeoffice | [ifpri@cgiar.org](mailto:ifpri@cgiar.org) | [www.ifpri.org](http://www.ifpri.org)

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