



A project among Cornell University, the Kenya Agricultural Research Institute and the World Agroforestry Centre, funded by the USAID BASIS Collaborative Research Support Program.

P O L I C Y B R I E F

No. 6 January 2005

SOCIAL NETWORKS AND TECHNOLOGY ADOPTION

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Introduction

Technologies that can improve the performance of African agriculture exist and new innovations are constantly under development. The problem is that diffusion of new technologies to producers is slow and incomplete. Farm-level technology adoption may be hampered by poorly understood socioeconomic and institutional constraints, some of which may be located in the mechanisms that sustain economically important functions of social networks. Social networks may influence technology adoption through their function as a source of informal finance (both credit and insurance), as channels of information and thus vehicles of learning, as a means for resolving externalities and collective action problems, or through enforcement of social norms. Moreover, these functions of social networks may interact with gender to produce different outcomes for decision-makers of different gender. Different members of the same household may also participate in different social networks due to gender or generational differences.

This brief describes work in progress from a study of the relationship between technology adoption and social networks, with the objective to determine how informal institutions may be improved or complemented in order to relax constraints to beneficial technology adoption. This research is based on data collected in two separate sites in Kenya, characterized by similar agro-ecological environments, but with ethno-linguistically different populations.

The main research question is whether, or how, social networks influence the technology adoption decisions of poor farmers of either sex, and to what extent this influence is positive or negative for adoption of higher-yielding and more agroecologically sustainable technologies, with a special emphasis on soil and water conservation and soil nutrient management technologies. The empirical analysis for

this study has not yet been completed, so there are no results to report. Instead, the following sections summarize the questions the study addresses, the data and methods used, and the policy questions to which such analysis can speak.

Informal Finance

The search for binding constraints on farm-level technology adoption has focused on weak market incentives for improved productivity of agriculture, and market imperfections, in particular missing financial markets (Feder, *et al.*, 1985). In general, African farmers have poor access to formal financial markets. Instead, they rely on informal financial markets. The most important sources of informal finance in rural Africa have been (i) interlinked contracts, where input purchases and output sales are made through the same marketing channels, (ii) private money lenders, and (iii) transfers within social networks.

Rotating savings- and credit associations (ROSCA's), commonly known in Kenya as "merry-go-rounds", offer a well-known form of transfers within social networks that are popular as a means to save money for larger investments. While ROSCA's have been extensively studied before, a major contribution of this study is detailed information about bilateral transfers between individual members of social networks. Unlike in groups, where all members are subject to the same rules, bilateral transfers are non-anonymous in the sense that the participants' identities and the relationship between them influence the terms, and therefore the quantities of transfers between them. The terms of bilateral financial transactions therefore typically vary more across individuals than do the terms of group-mediated transactions based on clear rules, such as commonly prevail in ROSCAs and formal microfinance groups. Part of this study uses

primary data to characterize the individuals who contribute to transfers within networks, those who receive such transfers, and therefore the complementary group: those who fail to get needed assistance through social networks where other sources of formal or informal finance fail.

The study then compares the effect on technology adoption of finance from both formal and informal sources, including banks and savings- and credit cooperatives (SACCO's), marketing cooperatives, ROSCA's, and bilateral lending through networks. In general, access to credit and insurance facilitates technology adoption. But both formal and informal lenders may influence adoption choices through the conditions placed on loans. Such conditions may be more complex and unpredictable for social networks than for the relatively more formal sources of finance, since interaction between social network members may be influenced by information about individual behavior that is not available to formal institutions, or by other ways of judging behavior than formal institutions do, perhaps guided by traditions and norms rather than economic rationality. An important difference may be associated with how risk is shared between lenders and borrowers in social networks.

Coordination Problems

Technological spillover effects occur when one farmer's management practices have consequences for another's farm operation, which may happen if, for example, one farmer's terrace protects a neighbor's field against damaging water run-off (a positive spillover), or when one farmer's poorly constructed terrace is leading damaging run-off onto a neighbor's field (a negative spillover). When it matters what others do, a farmer may choose to make his or her own management decisions depend on the observed behavior of others, coordinating own activities with those of others. But beneficial coordination may fail, especially if it is difficult to identify whose behavior matters most. Such effects represent additional sources of market failures that may hamper technology adoption.

There are several reasons why technology adoption may require some coordination. First, the benefits from adoption may depend on *how many* other agents adopt the same technology. In one scenario, adoption is individually rational only if a sufficient number of others also adopt. At a macroeconomic level, this effect has been characterized as a 'big push' problem (Murphy, *et al.*, 1989). Few studies look at this problem in the context of village-level economies. Second, the individual farmer's benefits from adoption may depend on whether she is an early or late adopter,

so the *sequencing* of adoption matters. One version of this problem is the 'technological treadmill' problem in agriculture, whereby technological progress is driven by farmers who try to capture benefits from being early adopters, but as new technologies become widely adopted, increased productivity combined with the low price elasticity of demand for agricultural outputs drives down output prices, leading to an evaporation of benefits to the producers. One can also imagine other scenarios, where benefits may accrue mostly to late adopters rather than early adopters.

Where farm practices generate spillover effects on neighboring farms, as is true of erosion, pest and weed control measures, then divergent technology choices between neighbors may become a source of conflict. The existence of such conflicts can be used as an indicator of the presence of technological spillover effects that may hamper adoption of agricultural innovations. The data in this study include information about such conflicts, in order to establish whether the possibility or actuality of such spillovers affect farm-level adoption patterns.

Individual and Collective Learning

Finally, the role of social networks for dissemination of knowledge is well documented in the technology adoption literature (Feder, *et al.*, 1985; Foster and Rosenzweig, 1995). Social learning is deliberately exploited when the agricultural extension service establishes partnerships with groups and directs teaching and training efforts to group members collectively. Such group activities generate learning externalities, since knowledge disseminated through groups eventually become available to a larger community that observes the outcomes of group members' experimentation with new technologies. Moreover, changes in collective behavior typically require a critical mass of pioneers, who not only carry the risks involved in experimentation, but also serve as advisers to later adopters, and ensure a sufficient market for associated inputs and services (the "big push" problem).

Collective learning may also occur in the absence of groups, sometimes led by influential role models, or by commercial or other outside interests that may use mass media to get out their message. But social networks influence how people evaluate the information they receive through broadcast channels and may still play a decisive role in determining the collective response to such information. A more atomistic learning process occurs when people actively seek out information through their networks, to locate specific information they need to make important decisions. Such individual information seeking may

benefit from mobilization of what is known in the social networks literature as “weak ties”, i.e., people with whom one has only sporadic contact at best, but with whom one can establish contact when needed.

This study has the necessary data to compare the effects on technology adoption of all the following components of a learning environment: (i) having regular contact with extension officers, (ii) membership in groups, (iii) observation of what adoption choices social network members make, and (iv) the ability to mobilize weak ties in order to obtain accurate and timely information.

Methodology

Economic studies of the interaction between social networks and technology adoption generally narrow in on the mechanisms associated with one particular function of social networks, and do not consider the social mechanisms that underpin their operation. Economic studies of social network effects rarely use data on the social networks as such. On the other hand, sociological studies of such effects tend to be predominantly qualitative, with little quantitative data to support their arguments in a statistically rigorous fashion. Studies of social networks and technology adoption that integrate sociological and economic approaches are rare. I know of no such studies undertaken in Kenya to date.

It is my ambition to summarize this research with a joint analysis of all sources of social network effects on technology adoption. A joint econometric evaluation of informal finance, coordination problems and social learning, mediated through group membership, and both strong and weak social network ties has never been done, to my knowledge. Such an analysis – supplemented by qualitative analysis based on extensive discussions with farmers and key informants – promises to shed important light on the constraints and incentives that condition small farmers’ agricultural technology adoption decisions, and thereby their productivity dynamics, within the actual social systems within which they operate.

Data

Data for this study come from two sources. First, survey data collected specifically for this study in two research sites in Kenya during 2003-2004, and second, panel data on the same households collected as part of the BASIS CRSP project’s broader study of poverty dynamics in those same sites. The study sites are two divisions in the Kenyan highlands, each a high-potential area for agriculture. One site is located in upper Embu District in Eastern Province, and the other

in the former Madzui Division within Vihiga District in Western Province. The sites are agro-ecologically similar, but the Embu site has better market access due to its proximity to Nairobi. The sites also differ ethnoculturally, with their populations dominated by different tribes.

Policy Implications

The importance of giving the poor access to appropriate financial services is well known, and already informs government policies aimed at poverty alleviation. This research can contribute information about some specific beneficial technologies whose adoption may be hampered by problems related to the terms under which informal finance is made available to small farmers, and the individuals who are most likely to encounter these problems. Such analysis can enable better targeting of policy interventions, and also inform institutional innovation in the finance sector serving the poor.

Where technology adoption is slowed down by coordination failures, the government can play a positive role by encouraging and supporting the formation of groups able to resolve such problems effectively and fairly. This study can contribute some information about important sources of conflicts related to farm management practices, some of which are being promoted by the extension service. Unless these problems are addressed, adoption of the associated practices will continue to be slow.

A better understanding of learning effects on technology adoption can help the government expand its portfolio of policies aimed at dissemination of knowledge to subsistence farmers. In particular, the interaction between extension officers and farmers’ groups versus individual farmers can inform resource allocation within the extension service. The importance of access to information through so-called weak ties can be used as an indicator of the need for new ways of making more specific information available to the poor.

About The Author

Heidi Hogset is a Ph.D. candidate in the Department of Applied Economics and Management at Cornell University. This brief is based on a draft paper entitled “Social Networks and Technology Adoption”.

Further Reading

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Publication made possible by support in part from the US Agency for International Development (USAID) Grant No. LAG-A-00-96-90016-00 through BASIS CRSP. All views, interpretations, recommendations, and conclusions expressed in this paper are those of the authors and not necessarily those of the supporting or cooperating organizations.



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