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GENDER, SOCIAL CAPITAL AND INFORMATION EXCHANGE IN RURAL UGANDA

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Abstract: Changing agricultural research and extension systems mean that informal mechanisms of information diffusion are often the primary source of information about improved seed and practices for farmers in sub-Saharan Africa. This paper investigates the interactions between gender, social capital and information exchange in rural Uganda. Within the framework of farmer-to-farmer models, we conceptualise the informal information diffusion process to comprise social capital accumulation and information exchange. We assume that each agent participates in information exchange with a fixed (predetermined) level of social capital and examine how endowments of social capital influence information exchange, paying close attention to gender differences. A multinomial logit model is used to analyse multiple participation choices of information exchange facing the farmer. Findings demonstrate that social capital is an important factor in information exchange, with men generally having better access to social capital than women. We also find strong evidence in support of group-based technology dissemination systems. Copyright © 2008 John Wiley & Sons, Ltd.

Keywords: gender; social capital; information exchange; informal mechanisms; Uganda

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1 INTRODUCTION

In light of growing challenges of population pressure, land degradation and declining agricultural productivity, farming in sub-Saharan Africa is increasingly knowledge intensive. Agricultural households deal with different biotic pressures simultaneously (e.g. pest and disease infestations, drought, soil fertility) while trying to compete in the global market for their produce. Given the limited scope of formal extension programs in sub-Saharan Africa, small-scale producers often rely on informal mechanisms of information exchange and knowledge sharing to address these challenges. The increasing role of informal mechanisms for information sharing has been recognised in the literature through farmer-to-farmer models of agricultural development (Eveleens *et al.*, 1996). Unlike the traditional extension model, which treats farmers as passive recipients of information, the farmer-to-farmer model recognises that farmers actively gather information from fellow farmers to enhance their knowledge. This process of information gathering, also known as social learning, is characterised by pooling of information or observing the behaviour of others and imitating it.

Although the role of social learning in technology adoption is well recognised in the literature (Foster and Rosenzweig, 1995; Conley and Udry, 2001; Munshi, 2004), factors that intervene in the process are less known. A common assumption in previous research has been that information from early adopters is freely available in the village and all potential adopters can access it equally (Conley and Udry, 2001). Differences in social learning have typically been attributed to endogenous factors, such as risk preferences, human capital and attitudes (Kislev and Shchori-Bachrach, 1973; Hiebert, 1974; Feder and Slade, 1984). Social capital is increasingly recognised as an intervening factor in the process of social learning and information exchange. Social capital depicts the features of social organisations, such as social institutions, networks or associations, less institutionalised networks of friends, relatives and acquaintances (or private social networks) and civic engagement, that enable knowledge gathering and information exchange.

Social capital may influence social learning and information diffusion in a number of ways. First, social capital reduces the cost of information acquisition since it can be acquired passively during social interactions or actively from people who already know each other. Second, social capital reduces the uncertainty about the reliability of information. Information is likely to be given a higher value if it comes from trusted people. Third, social capital facilitates the willingness and cooperation to share information, thereby revealing the tacit information that would be difficult to exchange otherwise (Yli Renko *et al.*, 2002).

Though research on the role of social capital in information flows in developing economies has been growing, limited attention has been given to gender aspects that may influence both social learning and accumulation of social capital. Emerging empirical evidence provides support for the role of gender in information exchange through different, gender-related stocks of information and usage of social capital (Maluccio *et al.*, 2003). In many rural areas, where small-scale agriculture takes place, gender differences have been found to have a significant impact on resource allocation and productivity in agriculture (Alderman *et al.*, 2003).

This paper contributes to the literature by providing evidence of gender disparities in the access and exchange of information in rural Uganda. We hypothesise that there are gender differences in information exchange that can be attributed to gender differences in the

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formation and use of social capital among agricultural households. Information exchanged pertains to different agricultural technologies for improving the productivity of bananas, the staple crop of Uganda. In recent years, the Ugandan government has intensified its effort to develop and disseminate banana productivity enhancing technologies (e.g. new banana varieties, management practices) in the country with the goal to improve food security.

2 GENDER, SOCIAL CAPITAL, INFORMATION EXCHANGE

Development programs are often criticised for failing to account for gender inequalities in decision making, task allocation and resource ownership and management, which has implications for policy recommendations (Quisumbing, 2003). Gender inequalities almost always favour men, with women often being disadvantaged both in the control over household assets (Fafchamps and Quisumbing, 2003) and in the division of responsibilities in the household and in the community. Even when a woman heads the household and is in charge of household resources, gender differences emerge across female-headed households and their male-headed counterparts. Female-headed and male-headed households also have different resource endowments when pursuing livelihood strategies (Peters, 1983), which could have far-reaching consequences on social capital formation and information exchange.

To build and maintain a social network is costly in terms of both time and other resources (Dasgupta, 2005), imposing a barrier to social capital accumulation (Ioannides and Loury, 2004). Women typically have a high opportunity cost of time that reduces their incentives to participate in certain social networks (Meinzen-Dick and Zwarteveen, 2003). Women have been found to join groups that mobilise fewer resources than men because they are resource-constrained (Maluccio *et al.*, 2003). Gender norms in the community may also exclude women from social capital enhancing activities, such as drinking clubs. Meinzen-Dick and Zwarteveen (2003) demonstrate how barriers facing women's participation in water management user groups in South Asia may stimulate women's use of alternative forms of social capital such as a network of friends and relatives.

If women and men have different types and qualities of social capital, they may participate differently in the exchange of agricultural-related information. Men may be inclined to acquire and provide more information to their social network (i.e. pooling of information) than women. Women are often more dependent on informal networks based on everyday forms of collaboration, such as collecting water, fetching fuel wood and rearing children. These services, together with the fact that women have a high opportunity cost of time, may motivate women to form networks with individuals who are geographically close to reduce the length of time required for travel for social interaction. However, geographically close networks tend to be limited in their scope of information transmission (Granovetter, 1973). In contrast, men may be engaged in more geographically dispersed social networks, such as community projects, and may participate more in civic engagement (Maluccio *et al.*, 2003). Such participation provides them with greater access to information about agricultural innovations and stimulates information exchange with others (Granovetter, 1973).

If women and men belong to the same social networks, but men take on brokerage positions (i.e. bridge otherwise disconnected social groups), then new information obtained by men from distant social networks may quickly diffuse to women. Though provided with access to social information, women become net information receivers and

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disproportionately under-participate as information providers. Therefore, gender differences may emerge in the extent of reciprocity of information exchange.

3 CONCEPTUAL FRAMEWORK

It is now increasingly recognised that information on agricultural innovations diffuses through social networks rather than being freely available in the village. We adhere to this view in studying the role that social capital may play in facilitating the exchange of agricultural information among farmers in Uganda. We further differentiate the social networks by gender in order to gain greater insight into how gender inequalities influence the effectiveness of social capital in facilitating information exchange.

Information from other farmers diffuses through pooling and copying mechanisms (Collier, 1998). Pooling of information is a two-way mechanism where the individual involved in direct interpersonal interactions gives some information and/or obtains some from others in return. Copying is a one-way mechanism that takes place by physical observation of the others' experiments without a direct interaction between agents. In this paper we focus on information pooling through face-to-face interpersonal interactions; copying is viewed as being nested in the pooling mechanism.

By information exchange, we mean any form of interpersonal information sharing among farmers about agricultural technologies, whether as recipient, provider or both. Unlike formal sources where information is transferred from providers to the consumers in a unidirectional manner, information diffusion through informal mechanisms is multidirectional. In other words, farmers simultaneously receive and provide information related to agricultural technologies to each other. Although information exchange through informal means generally tends to be less costly compared to that from formal sources, it is not cost free. We attach a cost to information acquisition and provision to account for the time and effort it takes to exchange information.

Each individual decides whether to exchange agricultural-related information with others, and if so, whether to provide or acquire information, or both. Social capital plays an important role in those decisions, by facilitating the flow of resources between agents in an economy (Putman, 1993). For individuals to engage in gainful information exchange, a degree of interpersonal connections between them is required (Granovetter, 1973; Coleman, 2000). Information and knowledge about new agricultural technologies and markets have been found to diffuse through social networks of friends, relatives and acquaintances (Collier, 1998; Conley and Udry, 2001; Fafchamps and Minten, 2001; Barr, 2002). We assume that each agent participates in information exchange with a fixed (predetermined) level of social capital and examines how endowments of social capital influence information exchange, paying close attention to gender differences.

3.1 Modelling Household Participation in Information Exchange

The theoretical model draws from the literature on information diffusion within social networks (Barr, 2000; Conley and Udry, 2001) and information acquisition (Feder and Slade, 1984; Just *et al.*, 2002). While Barr (2000) assumes homogeneity among members in a network who engage in reciprocal exchange of information, we consider members in a social network to be heterogeneous and argue that for some network members, information exchange can be a one-way exchange while for others it can be a two-way exchange.

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Agents choose the sources of information that maximise their expected utility (Feder and Slade, 1984; Just *et al.*, 2002).

Consider a village composed of m farmers, who are household heads, each linked to n individuals directly. The links among the individuals can be in the form of clubs (associations) and/or private social networks. Associations describe finite closed groups with a common interest while private networks refer to a set of bilateral links the individual is directly connected to. The linkages between these individuals are used in the exchange of resources based on norms of reciprocity. Let information be one of those resources that farmers exchange among themselves through their links. This allows us to model the social network as exogenous to information exchange related to agricultural technologies. Each individual can engage in information exchange with others he/she has a direct link with, whether through associations or private networks. Thus, information from other people, indirectly linked to the individual, is only accessed from direct contacts through the n established links.

An individual can participate in information exchange as an information receiver, information provider (sender) or both. If each alternative of participation is thought of as a possible choice, the decision maker's problem is to choose from the available options the one that maximises his/her expected utility of the net benefits from participation. Benefits can be derived from knowledge gained from receiving information or from expected future resources acquired from providing information, or both.

The utility of receiving information is constrained by the cost of information acquisition, which depends on the amount of information received, the number of established bilateral links and the personal ability to acquire information. The utility of providing information is constrained by the cost of information provision, which is defined by the individual's ability to communicate his knowledge and by the size of the social network. The decision maker also faces a social norm constraint. An individual who deliberately withholds information from another member of the social network faces a punishment, the magnitude of which depends on the size of the social network. Non-participation in a network entails zero punishment, while participation is associated with some positive level of punishment when non-compliance of norms is observed. Information about the cooperation of a network member is assumed to be freely available and observable by all other members in the same network. Finally, the utility obtained from both receiving and sending information is constrained by the cost of information acquisition and information provision, as well as by the punishment for deviating from a social norm.

4 ECONOMETRIC METHOD

The decision maker is faced with a choice of whether to participate in information exchange and which form of participation to engage in. There are four feasible alternatives: (1) do not participate in information exchange, $j = 0$; (2) participate in information exchange as a net receiver, $j = 1$; (3) participate in information exchange as a net provider, $j = 2$; and (4) participate in information exchange both as receiver and provider, $j = 3$. Let y be a random variable taking of the values $\{0,1,2,3\}$ denoting the participation choice given a set of conditioning variables $\mathbf{x}$ (household and community characteristics, as well as the size of the social network). Each choice is associated with a different level of utility and decision makers will select alternatives that maximise their utility, as defined above. Changes in the elements of $\mathbf{x}$ affect the probabilities of choosing one alternative out of the set of available alternatives, $P(y = j|x)$ for $j = 0,1,2,3$.

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The multinomial logit model is used to estimate the response probabilities associated with each outcome. A multinomial model is a conceptual extension of the standard univariate model to a system of equations with latent dependent variables. The utility derived from choice j for each individual i is depicted by:

$$u_j = x_i\beta_j + \varepsilon_j \quad j = 0, 1 \ldots J$$

where μ_j is the average utility associated with choice j, $\mathbf{x}$ is a vector of explanatory variables, β_j are coefficients to be estimated and $\boldsymbol{\varepsilon}_j$ is a vector of stochastic terms assumed to be jointly distributed as multivariate normal (Maddala, 1983). The probability of choosing alternative h is the probability that utility from alternative h exceeds the utility from alternative j:

$$\mathrm{P}(y = h) = \mathrm{P}(u_h > u_j \quad \text{for all} \quad j \neq h)$$

Participation in information exchange related to new agricultural technologies is estimated for the full sample, while controlling for gender, as well as for two sub-samples (male- and female-headed households) in order to capture gender differences in the reciprocity of information exchange.

5 DATA AND SAMPLE DESIGN

The data are drawn from a survey of randomly selected banana-growing households in rural Uganda, conducted between December 2003 and October 2004. The sample domain was selected to represent major banana producing areas in eastern, central and southwestern Uganda. The sample was stratified according to low and high elevation (with a threshold of 1200 m above sea level). Prior biophysical information suggests that elevation is correlated with soil fertility and the incidence and severity of pests and diseases, large sources of variation in banana productivity. Primary sampling units were defined at the sub-county level, allocated proportionately with respect to elevation strata. Rural villages were the secondary sampling units. One village was randomly selected per primary sampling unit. A total of 20 households with access to land were selected randomly in each village. The total sample comprises 400 households in 20 villages. The household head was identified as a representative household member and was interviewed about his/her participation in the exchange of agricultural information with other people.

5.1 Variable Definition and Hypotheses

5.1.1 Dependent variable

Our focus is on differences between female and male heads of households in their formation of social capital and participation in information exchange about agricultural technologies. We define female-headed households as those led by women who are either widowed, never married or divorced.[1] Household heads were asked to recall whether they

[1]Households headed by women due to absenteeism of their husbands were treated as male-headed households. In Uganda, most men in the study area rarely reside away from their households for extended periods of time. Based on the data collected by IFPRI and NBRP, only seven male heads of households had a total of 6 or less months of residence with their household members in 2002.

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Table 1. Forms of information exchange among rural households, by gender

Information exchange	% of households		
	Pooled sample ($N = 352$)	Male-headed households ($N = 279$)	Female-headed households ($N = 73$)
Not participate at all	21.11	14.70	32.88
Receive information only	11.06	12.54	8.22
Provide information only	6.78	7.53	6.85
Both receive and provide	61.06	65.23	52.05

had participated in information exchange 6 months prior to the interview. Responses were disaggregated according to whether the household head received information from people other than household members and supplied information to non-household members. For each form of participation, the relationship of the respondent to the person(s) with whom information was exchanged was also recorded. Table 1 provides a summary of information exchange according to the form of participation and sex of the respondent.

The majority of surveyed households (about 60 per cent) simultaneously received and provided information to others. Only one fifth of the household heads did not participate in any form of information exchange related to agricultural technologies, with the proportion being much higher for female heads of households (33 per cent) than for male heads of households (15 per cent). A measure of association (Pearson's chi-square, significant at 0.005) suggests that the exchange of information on new agriculture technologies is higher among male heads of households than among female heads of households.

5.1.2 Explanatory variables

Explanatory variables and their hypothesised effects are summarised in Table 2 by gender.

Participation in information exchange related to agricultural technologies is expected to be determined by personal characteristics, social capital and the overall production environment. Education of the household head, measured as years of schooling, is expected to influence information exchange both directly and indirectly. However, the direction of the effect cannot be established *a priori*. Education enhances the individual's ability to recognise, acquire and process information (Schultz, 1975). Ability to express one's self also improves with education. Education may also increase participation in associations (Haddad and Maluccio, 2003) or in other forms of social capital (i.e. civic engagement and/or the size of private social network). However, education also increases the likelihood of acquiring information from formal sources, and it can lower the likelihood of relying on informal mechanisms for exchange of information on agricultural technologies.

The age of the household head is also hypothesised to influence the probability of participating in information exchange on agricultural technologies. The sign of the effect is, however, ambiguous, depending on the direction of information exchange. Age is inversely related with labour productivity, reducing incentives for information search, implying that older people may hold less information about a new technology to provide to others. Yet, their long standing experience makes older people custodians of traditional knowledge that may provide an incentive to others to engage in information exchange with

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Table 2. Summary of explanatory variables, by gender, and hypothesised effects

Variable	Variable description	Expected effect	Male-headed		Female-headed	
			Mean	SD	Mean	SD
Age	Age of the household head	±	43.41	15.075	53.07	15.665
Education	Years of schooling of the household head	±	5.78	4.091	2.90	3.749
Extension	Number of contacts with extension agents within a village in the year prior the date of interview	±	2.03	4.993	1.13	2.206
Distance	Farm location from paved roads in (km)	±	10.91	7.076	8.93	6.958
Elevation	Elevation at which the farm is located (1 = high; 0 = low)	−	0.27	0.444	0.26	0.442
Social capital variables						
Social network	Number of people the household head closely talks to and can approach in case of a problem	+	25.55	19.371	18.29	15.056
Weak ties	Number people residing outside the sub-county the household head gave money to or any other material goods during the year prior to data of interview	+	0.52	2.187	0.20	0.844
Civic engagement	An index of the frequency of reading newspaper, listening to radios and watching television for household head	+	8.53	2.725	6.78	3.181
Number associations	Number of associations a household belongs to	+	1.561	1.378	1.307	1.389
Social institutions	An index of the number of times the household head participates in market places, festivals, drinking clubs, school open days, village activities and attends prayers in a year	+	21.42	27.656	13.19	16.604

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them. In other words, older people may be in a position of receiving rather than providing new information.

Gender is hypothesised to indirectly influence how the individual participates in the information exchange but a direct effect can also be present. Female compared to male heads of households are likely to be disadvantaged in their access to social capital that facilitates information flow. Because women have a high opportunity cost of time, they may derive less incentive from information giving. Generally, female heads of households are expected to participate less in information exchange on agricultural technologies.

The level of extension activity in the village is used as a measure of the formal institutional factors in the individual's production environment. The role of the formal information institutions is not clear. When formal information providers are less accessible, as is the case in most developing economies, the cost of acquiring information from them becomes high. This high cost of information acquisition implies that formal mechanisms will be substituted with informal mechanisms. However, the absence of formal information institutions may imply that the rate at which new information flows into the community is low. Without new information, the community may remain in equilibrium with common knowledge as the existing knowledge. Since there is no incentive for individuals to search for common knowledge, information exchange will be minimal.

The characteristics of the production environment, such as risk factors, also determine the source of information (Just *et al.*, 2002). A more risky production environment is likely to favour consumption of information from other farmers who may have experienced similar situations. We use elevation as a proxy for risk. Banana farmers in low elevation areas are more susceptible to pests and diseases than farmers in highland areas.

Social capital is measured by five indicators, each capturing a different aspect of social interaction: the size of the social network, the frequency of interaction in social institutions and civic engagement. Forms of social institutions in the study area were identified with the help of key informants (i.e. community leaders, elders and development workers) as: places of worship, festivals, markets, drinking clubs, village meetings and school open days.[2] Different forms of social institutions were combined into an index measuring the degree of participation in social institutions by summing up the individual frequencies of participation in the year prior to the interviews. Likewise, an index for civic engagement was computed by summing up variables used to represent civic engagement (e.g. frequency of reading newspapers, listening to radio or watching television within a year).

Geographical distance is commonly used as a measure of spatial diffusion of physical technologies such as seed. Following Granovetter (1973), networks formed within the same village or same sub-county were classified as strong ties because the frequency of interaction is likely to be higher in geographically close networks and lower in geographically distant networks ('weak ties' (Rogers, 1983)) irrespective of social relationship characterising the network. The index for 'weak ties' was defined as the number of people residing outside the sub-county whom the household gave or obtained money/any other materials from, during the year prior to the interview.

The size of the household social network is depicted by (1) the total number of non-household members to whom the household can talk closely and/or approach in case of a problem, and (2) the number of associations the household belongs to. In Uganda, three categories of farmer associations are common: (a) social associations (i.e. burial societies,

[2]As a forum for parents and teachers to discuss matters related with education, school open days facilitate informal sharing of new information among community members.

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religious-based and culture-based associations; (b) revolving credit and savings associations; and (c) agriculture production based associations. These two types of social networks (bilateral links and associations) were included in the analysis separately.

All forms of social capital are hypothesised to increase the probability of information exchange. The extent to which an agent acquires external knowledge from its social network depends on the existence of the external knowledge in the network, the intensity of social interactions and the willingness to share information (Yli Renko *et al.*, 2002). Search for knowledge is preceded by problem awareness and this awareness can be created passively during social interactions (Rogers, 1983). By encouraging awareness of the problem, social capital contributes to information exchange by stimulating the process of information search.

We also expect that social norms underlying the social networks enhance the trust and cooperation of network members, which in turn influence the proportion of individual stock of knowledge exchanged with network members. Increased trust and cooperation reduce uncertainty about other people's willingness to reciprocate and hence encourage individuals with valuable information to share it with others because they expect the reward in terms of future reciprocity (either in the form of information, cooperation or material gains) to be high.

6 RESULTS

6.1 Gender and Social Capital in the Context of Rural Uganda

In Uganda, geographical distance constitutes an important factor in shaping individual interactions and consequent information exchange. Most of the network ties among rural people are formed within the administrative level of a sub-county. Male heads of households tend to build and maintain larger network ties with relatives and friends than female heads of households (Table 3).

The difference in the size of the social network can be attributed to the differences in the structure of the household. Females who head households are generally older and less educated and these households have less wealth assets than male-headed households. Old age, low education and poverty tend to discourage an individual from accumulating social capital (Alesina and La Ferrara, 2002; LaFerrara, 2002; Haddad and Maluccio, 2003; Godquin and Quisumbing, 2006).

While male heads of households build and maintain bigger social networks with relatives and friends in close proximity than female heads of households, no differences were observed in the case of the 'weak ties' form of social capital. The transaction cost of information exchange beyond the sub-county level is high for both male and female heads of households. No significant differences were found in terms of civic engagement, with the exception of reading newspapers, which male-headed households appear to do more than female-headed households. Maluccio *et al.* (2003) observed a similar pattern in South Africa.

Social institutions and the underlying social norms within a village influence the extent to which rural people interact and hence the rate at which information is exchanged. Six social institutions were identified in the context of rural Uganda, where people meet and interact: places of worship, market place, weddings or other related celebrations, school open days, village meetings. Places of worship are the most common social institutions in

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Table 3. Social capital indicators, by gender

	All household heads ($N = 349$)	Male heads of households ($N = 279$)	Female heads of households ($N = 73$)
Social network			
Number of relatives in household social network within sub-county	9.2	9.9**	6.7**
Number of friends in household social network within sub-county	14.9	15.7*	11.8*
Number of associations a household belongs to	1.5	1.5	1.3
Weak ties			
Number of relatives in household social network residing outside the sub-county	1.4	1.5	0.9
Number of the friends in household social network residing outside the sub-county	0.6	0.5	0.2
Civic engagement			
Number of times household head reads a newspaper	6.7	7.5**	4.5**
Number of times household head listens to the radio	4.4	4.5	4.1
Number of times household head listens to an agricultural program on the radio	2.8	3.0	2.2
Number of times household head watches television	1.3	1.4	1.1
Frequency of household participation in social institutions in a year			
Weddings/celebrations	3.0	2.3	2.3
Places of worship (churches, mosques)	37.5	38.1	39.1
Market places	19.5	21.4**	13.2**
Drinking places	56.7	63.5**	36.5**
School open days	3.3	3.7	2.2
General village meetings or *bulungi bwansi*	1.1	1.4	0.4

*Significant at 5%.
**Mean differences significant at 1%.

rural areas for both men and women. As a forum for the exchange of goods, markets are organised weekly, biweekly or monthly and constitute an important place where agricultural information is exchanged. Unlike places of worship, gender differences exist in the frequency of market participation. Male heads of households go to markets more often (on average, 21 times a year) than their female counterparts (on average, 13 times a year). Gender differences were also observed regarding participation in drinking clubs. In rural areas of Uganda, gender norms restrict women from attending drinking clubs. Both men and women participate in weddings and celebrations and in school open days; hence, no significant differences are found between male and female heads of households with respect to these types of social institutions. Village meetings, or *bulungi bwansi*, are activities held by village residents related to collective action such as providing free labour for local public goods (e.g. roads, water). Mainly men participate in them as women are exempted from community work and hence they rarely attend these meetings.

6.2 Information Exchange in the Context of Rural Uganda

Three types of mechanisms are used in the dissemination of agricultural information in Ugandan villages: (1) formal sources (e.g. government extension services, NGOs and

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on-farm research); (2) informal sources (e.g. relatives, friends, other farmers); and (3) mass media. The dissemination of new agricultural technologies in Uganda was traditionally the role of the government extension service, which was joined by several NGOs in the 1990s as part of an economic recovery program implemented in 1986. On-farm research, though not a new mechanism of disseminating information about agricultural innovations, has recently received greater attention by policy makers in response to a shift from a traditional top-down approach to a more farmer-to-farmer model of agricultural development in Uganda. Mass media has also recently gained importance in Uganda as a channel of diffusing information related to agricultural technologies because of the shrinking government budget for extension services.

Although the scope of formal sources may be wide, the rate of contact with extension educators, estimated at about two times a year, is too low to be effective in circumstances when agriculture is knowledge intensive. Among banana-growing farmers, about 35 per cent do not have a direct contact with formal sources while 56 per cent access information from both farmers and formal sources (Katungi, 2006). Hence informal mechanisms are the most common sources of information for farmers in Uganda.

An important aspect of informal mechanisms of information diffusion is with whom information is exchanged. The nature of the social relationships that characterise the interaction between the individuals exchanging information is presented in Table 4. Social relationships are described by the direction of information diffusion (received or sent) and are disaggregated by gender.

Information networks appear to be formed around social and geographical proximity. Networks built around friendship are the most common channels of information. Local associations are an additional mechanism of information exchange for rural people. About 20 per cent of the sampled household heads reported having exchanged information with individuals identified only as group members after accounting for friends, relatives and neighbours. This rate of direct information exchange facilitated by farmer associations is impressive given that members of these associations are not directly related outside of the association.

Table 4. Nature of relationships characterising information diffusion among rural household heads (%)

Type of relationship	All household heads ($N = 377$)		Male heads of households ($N = 283$)		Female heads of households ($N = 73$)	
	Receive	Send	Receive	Send	Receive	Send
Informal mechanisms						
Relative	36.34	40.32	38.52	43.46	32.88	32.88
Friend	60.48	57.83	65.72	61.18	49.32	49.32
Employer/employee	4.51	1.86	5.65	2.12	1.37	1.37
Neighbour	41.65	43.23	44.52	45.94	35.62	36.99
Group member	21.22	20.16	22.62	22.26	16.44	13.70
Formal mechanisms						
Extension	7.16	—	7.78	—	4.11	—
Radio	0.27	—	0.35	—	0.00	—

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Table 5. Accuracy of the model's predictions

Choice of participation	Pooled sample		Men sub-sample		Women sub-sample	
	Observed	% correctly predicted	Observed	% correctly predicted	Observed	% correctly predicted
Neither	80	28.75	42	33.33	27	51.85
Receiver only	43	16.28	37	21.62	6	66.67
Provider only	27	0.00	21	0.00	5	40.00
Both receiver and provider	227	89.86	183	94.54	38	86.84
Total	377	62.07	283	68.9	76	69.74

6.3 Estimation Results

A multinomial logit model was used to study household participation in information exchange in rural Uganda. The independence of the irrelevant alternatives assumption was tested, and the null hypothesis that the odds of the outcome *j* versus outcome *h* are independent of other categories is accepted (*p*-values of 0.640 and 0.894). In terms of predicting the information exchange decisions, the model performs reasonably well (Table 5).

A Chow test was also used to determine the validity of estimating two sub-samples versus using the pooled data. The null hypothesis of equal coefficients in the two groups defined by gender is rejected (*F*-statistic of 2.46, which exceeds the critical value at the 1 per cent level), justifying the statistical validity of inferences done by sub-groups versus those for the full sample. Marginal effects of factors that influence how male and female heads of households participate in informal information exchange are computed at the mean values and are presented in Table 6.

The model was estimated first using the whole sample, while controlling for gender, and then using sub-samples defined by male and female-headed households. In each case, the chi-square value is significant at the 1 per cent, implying that the explanatory variables taken together influence the information exchange decisions.

As expected, social capital significantly influences the informal information exchange among rural households in Uganda. However it has a differential effect on the type of information exchange, with most social capital variables having a significant positive effect on the multidirectional exchange of information, that is for those who both receive and provide information from and to others. In the pooled sample, gender appears to play a role only in information acquisition, with male-headed households being more likely to receive information than female-headed households. Differences in the direction of information exchange emerge across sub-samples.

Belonging to more associations appears to have a strong effect on two-way informal information exchange, increasing the likelihood that both male and female-headed households will engage in information pooling with others. The effect of associations is larger for female than for male-headed households. This could be attributed to the characteristics of associations to which female heads of households belong as compared to those of male heads of households. Qualitative information from the survey shows that female heads of households belong to associations that are relatively homogenous in terms of gender and religious beliefs compared to male heads of households. The degree of homogeneity between two people communicating is believed to enhance the effectiveness of communication (Rogers, 1983). Associations increase the likelihood of interacting with

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Table 6. Marginal effects of multinomial estimates of the choice of participation in information exchange among farmers in rural Uganda (standard errors in parentheses)[1]

Variable	Pooled sample ($N=351$)			Men sub-sample ($N=280$)			Women sub-sample[2] ($N=71$)	
	Receive	Send	Both	Receive	Send	Both	Send	Both
Gender (1 = men)	0.079** (0.029)	0.001 (0.034)	−0.036 (0.065)					
Elevation	−0.037 (0.036)	0.111*** (0.062)	−0.110 (0.079)	−0.02514 (0.042)	0.059 (0.054)	−0.088 (0.083)	0.002 (0.010)	0.007 (0.158)
Age	0.003* (0.001)	0.001 (0.001)	−0.004** (0.002)	0.004** (0.001)	0.001 (0.001)	−0.005** (0.002)	1.6E-07 (0.000)	−0.001 (0.004)
Education	−0.009* (0.005)	0.005 (0.003)	0.004 (0.007)	−0.00814*** (0.005)	0.005 (0.003)	−0.002 (0.007)	2.0E-06 (0.0001)	0.090* (0.040)
Extension	−0.055** (0.019)	0.010 (0.015)	0.114** (0.030)	−0.057** (0.020)	0.010 (0.014)	0.092** (0.030)	-1.0E-5 (0.0001)	0.254*** (0.139)
Distance	−0.002 (0.003)	−0.006** (0.002)	0.010** (0.004)	−0.0004 (0.003)	−0.007** (0.003)	0.007*** (0.004)	5.2E-07 (0.000)	0.020 (0.014)
Number of associations	−0.027*** (0.016)	0.002 (0.009)	0.075** (0.023)	−0.024 (0.018)	0.009 (0.009)	0.059* (0.026)	−0.00001 (0.0008)	0.154*** (0.084)
Social institutions	0.000 (4E-04)	0.0001 (0.0001)	0.001* (0.001)	−0.0004 (0.00010)	-9E-05 (0.000)	0.001*** (0.001)	2.0E-08 (0.0001)	0.004 (0.003)
Civic engagement	−0.001 (0.006)	0.001 (0.005)	0.020* (0.010)	−0.003 (0.007)	0.002 (0.006)	0.024* (0.011)	-1.3E-06 (0.0001)	0.009 (0.020)
Weak ties	0.003 (0.003)	0.000 (0.002)	0.000 (0.006)	0.003 (0.003)	0.000 (0.003)	0.000 (0.006)	4.3E-06 (0.0003)	0.039 (0.042)
Social networks	0.000 (0.001)	0.000 (0.001)	−0.001 (0.002)	0.001 (0.001)	-1E-04 (0.001)	−0.002 (0.002)	8.0E-08 (0.000)	−0.001 (0.005)

[1]These marginal effects show the effect of one unit change in the explanatory variable on the probability of choosing the participation alternative, where each alternative indicated in the column is compared with none participation alternative.
[2]Estimates of the marginal effects of the probability of choosing receiver only alternative were not generated for the women sub-sample, which could be due to the small sample size.
*Significant at 5%.
**Significant at 1%.
***Significant at 10%.

other people holding different pieces of information and hence the incentive for information exchange. Higher participation in civic engagement and in social institutions also increases the probability of information exchange, with male-headed households being more likely to participate as both receivers and providers of information about agriculture than female-headed households. These two forms of social capital enable decision makers to obtain new information, which could stimulate them to search for more information from others and hence catalyse the information pooling process.

The size of the private social networks and the weak ties do not seem to influence the probability of information exchange. Those with membership in a wider private social network are as likely to exchange information as people who belong to smaller social networks. However, the density of institutional social networks is an important determinant of participation in information exchange.

Personal characteristics also influence information exchange. Older male heads of households are more likely to participate as information receivers only, but less likely to engage in simultaneous receiving and providing of information, perhaps due to limited knowledge of new agricultural technologies held by older people. Lack of statistical significance of age among female heads of households may be associated with low variability in this sub-sample since most of the women that head households were likely to be older in age. Relatively more educated male heads of households are less likely to obtain information from others, which could be related to the ability to acquire information from formal sources among people with more formal education. The effect is different among women; more educated women that head households are more likely to engage in two-way information sharing. This could be related to the differences in the general education attainment between gender groups. Although the education attainment of rural people is generally low, it is much lower among women.

Extension activity in the village is another important determinant of information exchange related to agricultural technologies among rural people. This suggests that formal and informal sources of information exchange are complementary in the provision of different pieces of knowledge. Generally, individuals in villages with higher extension activity are more likely to engage in a two-way information exchange compared to those in villages with less frequent extension activity. This is true for both male and female heads of households, though the effect is much higher for female heads of households. Thus, more frequent formal information diffusion mechanisms may stimulate the informal mechanisms of information exchange in villages in Uganda, particularly among female heads of households.

Distance to available road infrastructure also appears to be an important factor in information exchange, though with opposing effects across the sub-samples defined by gender of household head. Households located in villages far from paved roads, with implicitly poor physical market access and communication infrastructure, are more likely to participate as both information receivers and providers, but less likely to participate in the exchange of information on agricultural technologies as information providers only. The transaction cost of information exchange is higher for isolated households, which stimulates a two-way exchange of information when engaging in social interactions. This is particularly true for male heads of households, as distance does not appear to have significant effect on information exchange of female heads of households.

7 CONCLUSIONS AND POLICY IMPLICATIONS

Established social structures, such as grassroots associations, have undoubtedly contributed to efforts at agricultural development in rural areas. These structures facilitate

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information diffusion among farmers and transactions within the economy, thus improving the efficiency of outreach programs by complementing government and market-based approaches.

This paper provides an insight into the linkages between social capital and informal exchange of information on agricultural technologies among rural households in Uganda. By disaggregating the analysis by the gender of the household head, the study also provides a more detailed assessment of how differences among male and female heads of households influence information diffusion in rural areas. Results support our initial premise that social capital significantly influences information exchange among rural households, with evidence of gender disparities in the process. Consistent with existing literature, female heads of households appear to be disadvantaged in their access to information related to agricultural technologies. Male and female heads of households also diverge in their access to different types of social capital.

While social capital enhances the exchange of information related to agricultural technologies for both male and female heads of households, the significance and magnitude of the effect is gender specific. Local associations have a higher effect among female heads of households while social institutions have a higher effect among male heads of households. An important implication from this result for outreach programs is that different forms of social capital may need to be accounted for in development programs to avoid exacerbating gender inequalities in rural areas.

The results also provide support for group-based approaches in technology dissemination. Since both male and female heads of household have the same propensity to join associations, this type of social capital should be encouraged for enhanced information diffusion in rural communities. Furthermore, gender differences in social capital and the propensity for men and women to exchange information with others suggest that strategies that promote gender heterogeneous groups may have a greater impact on information diffusion.

The econometric analysis also reveals that formal extension activity in the village stimulates information exchange, particularly among women that head households. Hence, greater support to extension programs that target farmer groups would have more impact on information diffusion in the community. Though important, articulating the relationship between road infrastructure development and information exchange requires further analysis.

Finally, the direction of information exchange is also of policy relevance. Both informal and formal mechanisms for information dissemination appear to have a significant impact on a two-way information sharing. If those more likely to receive information are also more likely to provide it, the extent of information dissemination will be larger (both in terms of geographical coverage and in terms of the number of farmers receiving and providing information). This warrants support for formal extension programs and community associations as two complementary mechanisms for information diffusion in rural areas.

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